

DRAINAGE REPORT

FOR

**NORTH POINTE SENIOR LIVING  
WICHITA, KANSAS**

FEBRUARY 2009

## Tab 0. Checklist

---



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

Reviewer: _____	Date: _____
Subdivision Name: _____	Location: _____
Total Land Area Of Ownership: _____ Acres	
Type: _____ Residential _____ Commercial _____ Industrial _____ Recreation _____ Municipal _____ Other	
Applicant: _____	Contact: _____ Phone #: _____
Engineer: _____	Contact: _____ Phone #: _____

Please check the appropriate box:

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

<b>Tab 1. Project Narrative</b>	<b>Applicant</b>			<b>Engr</b>	
	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					

<b>Tab 2. Existing Conditions Runoff Calculations</b>	<b>Applicant</b>			<b>Engr</b>	
	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					

<b>Tab 3. Post-Development Hydrologic Analysis</b>	<b>Applicant</b>			<b>Engr</b>	
	<b>I</b>	<b>NA</b>	<b>Explanation / Location in Plan</b>	<b>I</b>	<b>NA</b>
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					



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					

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					

## **Tab 1. Project Narrative**

---

### ***A. Location***

The subject property is in the city of Wichita, Sedgwick County, Kansas. The proposed development is located in the northwest quarter of Section 6, Township 27 South, Range 2 East. Summit Crossing Addition consists of 10.4 acres of property on the east side of Woodlawn Avenue between East 29<sup>th</sup> Street North and East 21<sup>st</sup> Street North. The site is shown on the USGS Map, Figure 1.1.

### ***B. Discussion of Development***

The entire site will be developed as commercial property.

### ***C. Discussion of Offsite***

The site has access to Woodlawn Avenue to the west. Woodlawn North Point Addition borders the site to the west, Galichia Hospital is to the south in Hinkle's Addition, Waterford North Addition is to the east and Pepperwood Village Addition is to the north.

### ***D. Summary of Runoff***

The entire site drains to the north and east into a reserve in the Waterford North Addition. A pond on the Galichia Hospital property outlets near the southeast corner of the property. Runoff from this pond flows to the north and into the reserve in Waterford North. The site was included as developed for commercial uses in earlier drainage reports for Comotara, Figure 1.2, and Pepperwood Village, Figure 1.3

### ***E. Best Management Practices***

The site will be seeded or sodded after construction of grading and utilities are complete. Inlets will be kept clear of debris to ensure proper drainage of the site.

### ***F. Plat***

The plat is included, Figure 1.4.

### ***G. Preliminary Grading Plan***

The preliminary lot grading plan is included, Figure 1.5.

### ***H. Professional Engineer Seal***

The cover of the report will be signed and dated.

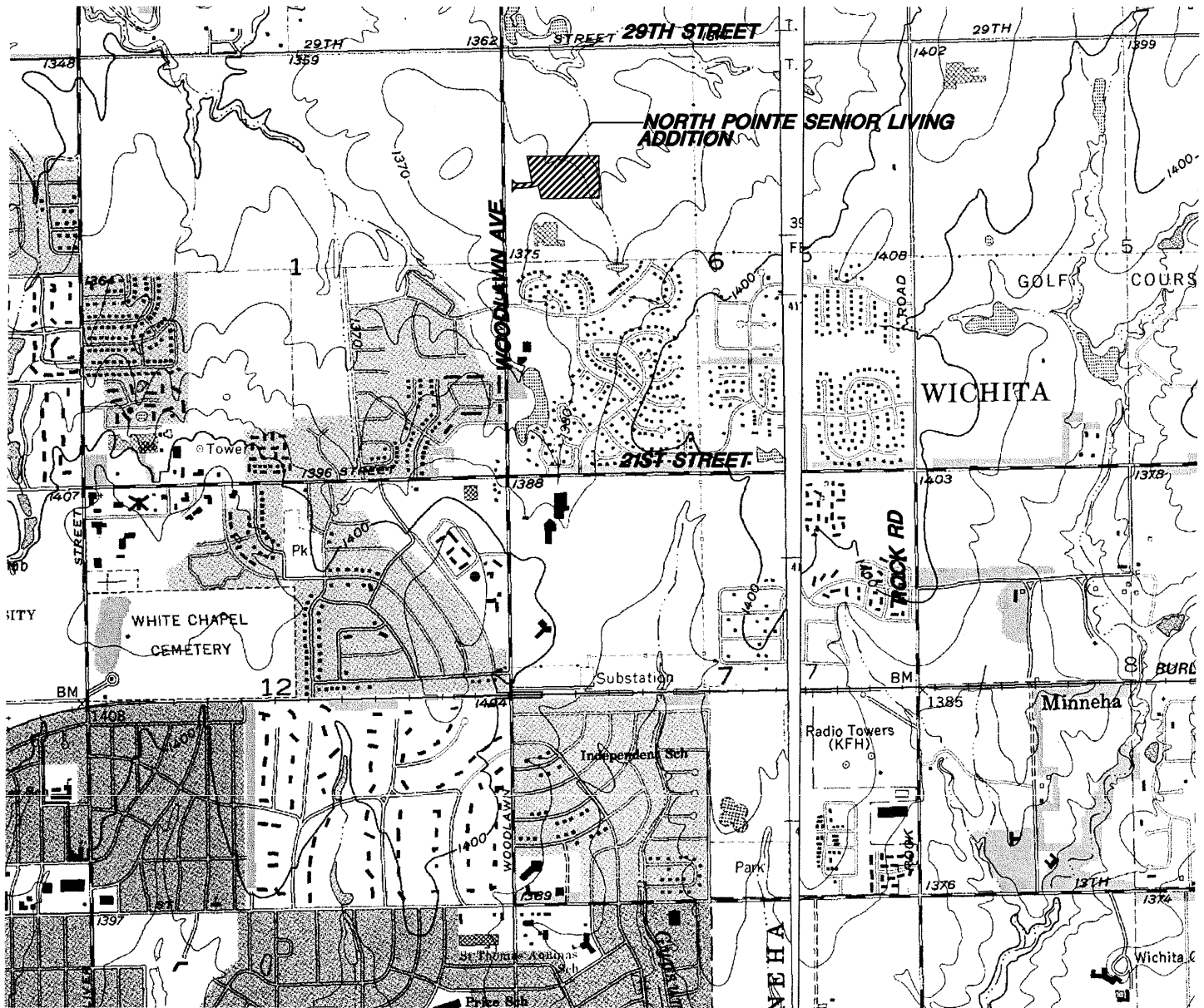
### ***I. CD***

A CD of the drainage report in PDF format is attached to the inside front cover of the bound report.

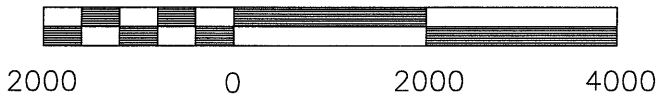
**Figure 1.1**

---

USGS Quadrangle Map



SCALE: 1" = 2000'



J:\Civil\09040 North Pointe Senior Living\dwg\Drng\09040\_QUAD.dwg

<b>MKEC</b> ENGINEERING CONSULTANTS, INC.  411 N. WEBB ROAD WICHITA, KS. 67206 316 - 684 - 9600	<b>NORTH POINTE SENIOR LIVING</b>		
	PROJECT NAME		
	<b>QUAD MAP</b>		
	SHEET TITLE		
<b>KLA</b>	<b>CMJ</b>	<b>GJA</b>	
DESIGN BY.	DRAWN BY.	CHECKED BY.	
<b>FEBRUARY 2009</b>	<b>09040</b>	<b>1 / 1</b>	
DATE	JOB NO.	SHEET/OF	

**Figure 1.2**

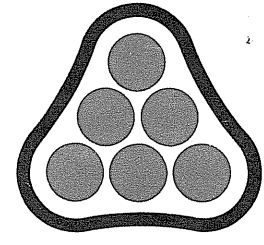
---

Comotara Drainage Report

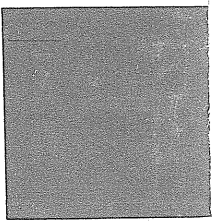
Bill G. Young

1

HYDROLOGY  
AND  
HYDRAULIC ANALYSIS



**P**ROFESSIONAL  
**E**NGINEERING  
**C**ONSULTANTS  
PROFESSIONAL ASSOCIATION



for a  
portion of  
COMOTARA  
in  
WICHITA, KANSAS

**DRAFT**

Prepared By

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.

1440 EAST ENGLISH

WICHITA, KANSAS

MARCH, 1977

**g** BILL G. YUNG  
Design Consultant  
316-264-0678  
1355 North Waco  
Wichita, Kans. 67203

HYDROLOGY  
AND  
HYDRAULIC ANALYSIS

for a  
portion of  
COMOTARA  
in  
WICHITA, KANSAS

**DRAFT**

Prepared By

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.

1440 EAST ENGLISH

WICHITA, KANSAS

MARCH, 1977

# TABLE OF CONTENTS

	<u>PAGE</u>
PART I - INTRODUCTION	
A. Purpose and Scope.....	1
B. Project Area.....	1
PART II - CRITERIA	
A. General.....	2
B. Design Storm Frequency.....	2
C. Method of Computations.....	3
PART III - EVALUATION OF EXISTING DRAINAGE	
A. Hydrology.....	5
B. Existing Structures.....	5
PART IV - HYDROLOGY FOR ULTIMATE DEVELOPMENT	
A. General.....	7
B. Discussion.....	7
PART V - PROPOSED LAKES - STATE STORAGE	
A. General.....	8
B. Discussion.....	8
PART VI - OPEN CHANNELS	
A. General.....	10
PART VII - DISCUSSIONS AND RECOMMENDATIONS.....	11
APPENDIX A: HYDRAULIC CALCULATIONS	

TABLES

		<u>PAGE</u>
TABLE II-1	- Manning's "n" Values.....	2
TABLE II-2	- Coefficient of Runoff Values.....	3
TABLE III-1	- Existing Peak Flows.....	5
TABLE IV-1	- Ultimate Peak Flows Without Stage Storage.....	7
TABLE V-1	- Ultimate Peak Flows With Stage Storage.....	9

FIGURES

FIGURE V-1	- 100-Year Flood Routing Curve for Lake A.....	12
FIGURE V-2	- 100-Year Flood Routing Curve for Lake B.....	13
FIGURE V-3	- 100-Year Flood Routing Curve for Lake C.....	14
FIGURE V-4	- 100-Year Flood Routing Curve for Lake D.....	15
FIGURE V-5	- 100-Year Flood Routing Curve for Lake E.....	16
FIGURE V-6	- 100-Year Drainage Profile A.....	17
FIGURE V-7	- 100-Year Drainage Profile B.....	18
FIGURE V-8	- 100-Year Drainage Profile C.....	19
FIGURE V-9	- 100-Year Drainage Profile D.....	20
FIGURE V-10	- Typical Channel Cross-Section.....	21

MAPS

MAP 1	- Vicinity Map.....	22
MAP 2	- Existing Drainage Patterns.....	23
MAP 3	- Ultimate Land Use.....	24
MAP 4	- Profile Key.....	25

## PART I - INTRODUCTION

### A. PURPOSE AND SCOPE

The purpose of this study is to evaluate storm water flows for the 100-year return period for a portion of the East Fork of the Chisholm Creek Drainage Basin as it affects part of the proposed development known as Comotara.

Comotara is located in northeast Wichita and is comprised of approximately 5 1/2 square miles. The part that this report covers is generally the north half of Section 6, T27S, R2E which has been filed with the Wichita-Sedgwick County Metropolitan Planning Commission as the *Comotara Community Unit Plan*.

The scope of the study is to (1) establish drainage basin and boundaries within the proposed development, (2) determine the magnitude of the discharge for each basin, (3) complete flood routing through the several proposed lakes (4) check backwater affects on habital structure sites, and (5) compare the fully developed 100 year discharge flow rate leaving the site with the undeveloped 100 year discharge flow rate.

### B. PROJECT AREA

The Project Area is located in northeast Wichita as shown on Map 1. The Project Area is defined as the drainage sub-basin that generally lies either side of 29th Street North between Woodlawn Avenue and Rock Road as shown on map 2.

## PART II - CRITERIA

### A. GENERAL

The assumptions utilized in this study were discussed with the Wichita-Valley Center Flood Control office and the City of Wichita Engineering Department. All computations were completed using the following criteria.

### B. DESIGN STORM FREQUENCY

#### 1. Lakes

All proposed and existing lakes in the project area should be developed to adequately pass the 100-year 6-hour storm and maintain a three foot freeboard.

#### 2. Open Channels

All channels in the project area should be designed for the 100-year storm flow plus 2 feet of freeboard. If the channel ways are to be maintained by the local Flood Control Office then a 15 foot access must be provided on either side of the channel. Mannings equation was used to compute backwater elevations using the "n" values presented in Table II-1.

TABLE II-1

MANNINGS'S "n" VALUES

Earthen Channel	0.035
Rock Lined Channel	0.045
Concrete Lined Channel	0.015

C. METHOD OF COMPUTATIONS

1. Hydrology

All hydrology computations or the prediction of the rate of surface water runoff from a drainage basin were estimated using a computer program based on the Rational Formula. Using the Rational Formula the rate of runoff "Q" is dependent on three basic factors:

C - the runoff coefficient which is mainly dependent on surface permeability (1.0 impermeable - 0.2 highly permeable).

I - the intensity of rainfall (in/hr.)

A - the area of land contributing (Ac.)

The equation for the Rational Formula is  $Q = CIA$ .

a. C - values were assigned to the various land uses incorporated into the project and are presented in Table II-2

TABLE II-2

COEFFICIENT OF RUNOFF VALUES

<u>Land Use</u>	<u>C</u>
Single Family	0.50
Multi Family	0.70
Commercial	0.70
Light Commercial	0.60
Open Space	0.30
Lakes	1.00
Institutional	0.80
Streets	0.80

b. I - intensity values were determined by using the data published by the U.S. Weather Bureau for Sedgwick County, Kansas.

2. Stage Storage

Stage storage is defined as the reservoir storage capacity (AC-Ft) which can "store" the difference between the inflow over a selected time period and the outflow over the same time period. After an inflow hydrograph and the reservoir-storage curve is developed, and a spillway selected then stage storage computations can be completed by an arithmetical trial-and-error tabular method. This method is outlined in the "Design of Small Dams" as published by U.S. Department of the Interior, Bureau of Reclamation.

3. Backwater

Backwater is defined as water held back from free flow by an obstruction or a confined channel. The method employed to produce the theoretical backwaterwater profile utilized a computer program, HEC 2, developed by the Hydrologic Engineering Center, USA Corps of Engineers. The affects of hydraulic structures such as bridges, culverts, spillways, and embankments, as well as curves, bends, and changes in hydraulic properties are considered by the HEC 2 program.

## PART III - EVALUATION OF EXISTING DRAINAGE

### A. HYDROLOGY

The boundaries for the existing drainage area (527 acres) is shown on Map 2 and were established by review of a topography map prepared by the Wichita-Valley Center Flood Control Office. This area was further subdivided into five sub-drainage areas to facilitate comparison with various anticipated proposed features for the project area. Utilizing the criteria established, peak flows were determined for the 100-year storm at each point referenced on Map 2 and are shown in Table III-1.

TABLE III-1  
EXISTING PEAK FLOWS

<u>POINT</u>	<u>DRAINAGE AREA (acres)</u>	<u>PEAK FLOW (cfs)</u>	<u>TIME OF CONCENTRATION (min)</u>
A	105	160.9	46.6
B	134	203.0	51.4
C	423	596.3	65.6
D	104	132.9	64.3
E	527	727.1	66.2

### B. EXISTING STRUCTURES

#### 1. Culverts

a. Rock Road - 600'± south of 29th Street North

(1) 2'x2' Wood Box

(2) Flow Line = 209.9'±

b. 29th Street North - 2065'± east of Woodlawn

(1) 6'x4' Reinforced Concrete Box

(2) Flow Line = 176.6±

c. 29th Street North - 980'± east of Woodlawn

(1) Double 5'x3' Reinforced Concrete Box

(2) Flow Line = 171.4±

d. 29th Street North - 150'± east of Woodlawn

(1) Triple - 4'x4' Reinforced Concrete Box

(2) Flow Line = 167.3±

e. Woodlawn - 700'± north of 29th Street North

(1) Double - 7'x5' Reinforced Concrete Box

(2) Flow Line = 165.3±

## 2. Dams

a. Location - NW 1/4 of the NE 1/4 of Section 6, Township 27 South, Range 2 East.

(1) 8 inch cast iron overflow pipe

(2) Static Water Level - 190±

(3) Surface Area - 1.74 acres

b. Location - SW 1/4 of the SW 1/4 of Section 31, Township 26 South, Range 2 East

(1) Natural overflow

(2) Static Water Level - Dry

(3) Surface Area - 2.5 acres

## PART IV - HYDROLOGY FOR ULTIMATE DEVELOPMENT

### A. GENERAL

The ultimate development for the drainage basin under study is shown on Map 3. This area was also subdivided into five subbasins as shown on this Map. The runoff from each subbasin, as shown, will be directed to one of the five proposed lakes.

Utilizing the criteria established in Part II and assuming no stage storage, peak flows were determined for the 100-year storm at the points referenced on Map 3 and are presented in Table IV-1.

TABLE IV-1  
ULTIMATE PEAK FLOWS  
WITHOUT STAGE STORAGE

<u>POINT</u>	<u>DRAINAGE AREA (acres)</u>	<u>PEAK FLOW (cfs)</u>	<u>TIME OF CONCENTRATION (min)</u>
A	118	621.0	32.7
B	169	874.2	35.0
C	426	1618.3	42.1
D	101	402.9	30.9
E	527	1934.4	42.7

### B. DISCUSSION

By comparing Tables III-1 and IV-1 it can easily be seen that the peak flow for the project area would be significantly increased due to projected development (2.5 to 4 times existing). Major reconstruction of culverts along 29th Street North and Woodlawn would be required. In addition, some downstream structures may also need to be redesigned due to the increased peak flow.

## PART V - PROPOSED LAKES - STAGE STORAGE

### A. GENERAL

The project proposes renovation of two existing lakes (A and E) and construction of three new ones (B, C, and D). For the purposes of this study it was assumed that: (1) the general configuration of lakes (A and E) would correspond to those shown on Map 3; (2) The average sideslope around the lake would vary from 3 to 1, to 6 to 1; and (3) The maximum acceptable ponding height above the spillway during flood stage would be five feet. Within this ponding height water would be detained, thus reducing the peak flow from the drainage area.

Using the stage storage method of calculation the 100-year frequency storms were routed through each lake in series (A to B to C to E and D to E). Each flood routing (inflow/outflow) curve for each lake is shown in Figures V-1 through V-5. The results for each lake are shown in Table V-1.

### B. DISCUSSION

It should be noted that approximate elevations were assigned to each dam outlet structure by review of the drainage profile (See Fig. V-6.). By assigning weir elevations and weir lengths at each outlet structure ponding height elevations could be calculated as outlined in Part II. The ponding elevations were then used for beginning water surface elevations to compute the affect of backwater on the project area. The HEC-2 program was utilized to produce a theoretical backwater profile from the box structure at Woodlawn through Lakes E, C, B, and A to Rock Road.

It was found that Lake D would be similar to Lake C in terms of hydraulics and backwater effects. The results of the HEC-2 analysis are shown on Figure V-6 and presented in Appendix A.

TABLE V-1

ULTIMATE PEAK FLOWS  
WITH STAGE STORAGE

	<u>LAKE</u>				
	A	B	C	D	E
Drainage Area (Acres)	118	169	426	101	527
Peak Reservoir Outflow - (CFS)	296.0	142.1	611.2	103.6	715.0
Time of Concentration (Min)	48.0	96.0	96.0	72.0	96.0
Spillway Length (Feet)	10	5	25	5	50
Surface Area-Static Pool (Acres)	3.5	5.7	<u>8.5</u>	<u>5.3</u>	2.5
Spillway Elevation (City Datum)	190.0	181.0	174.0	174.0	165.6
Maximum Ponding Height-(Elev)	194.96	185.83	178.37	178.10	172.92
Surface Area-Flood Stage (Acres)	4.6	7.0	<u>9.9</u>	6.4	3.9
Maximum Storage (Acre-Ft)	3.54	18.27	<u>35.39</u>	27.54	17.65
Minimum Pad Around Lake (Elev)	198	189	181	181	176

## PART VI - OPEN CHANNELS

### A. GENERAL

Open channels should be considered for flow whenever open space is available. Overall right-of-way (R/W) requirements would range from a minimum of 50 feet at the upper end of the subbasins to 100 feet at the lower end of the subbasins and between proposed lakes. These requirements are based on a trapezoidal channel with 6 to 1 sideslopes with a pilot channel.

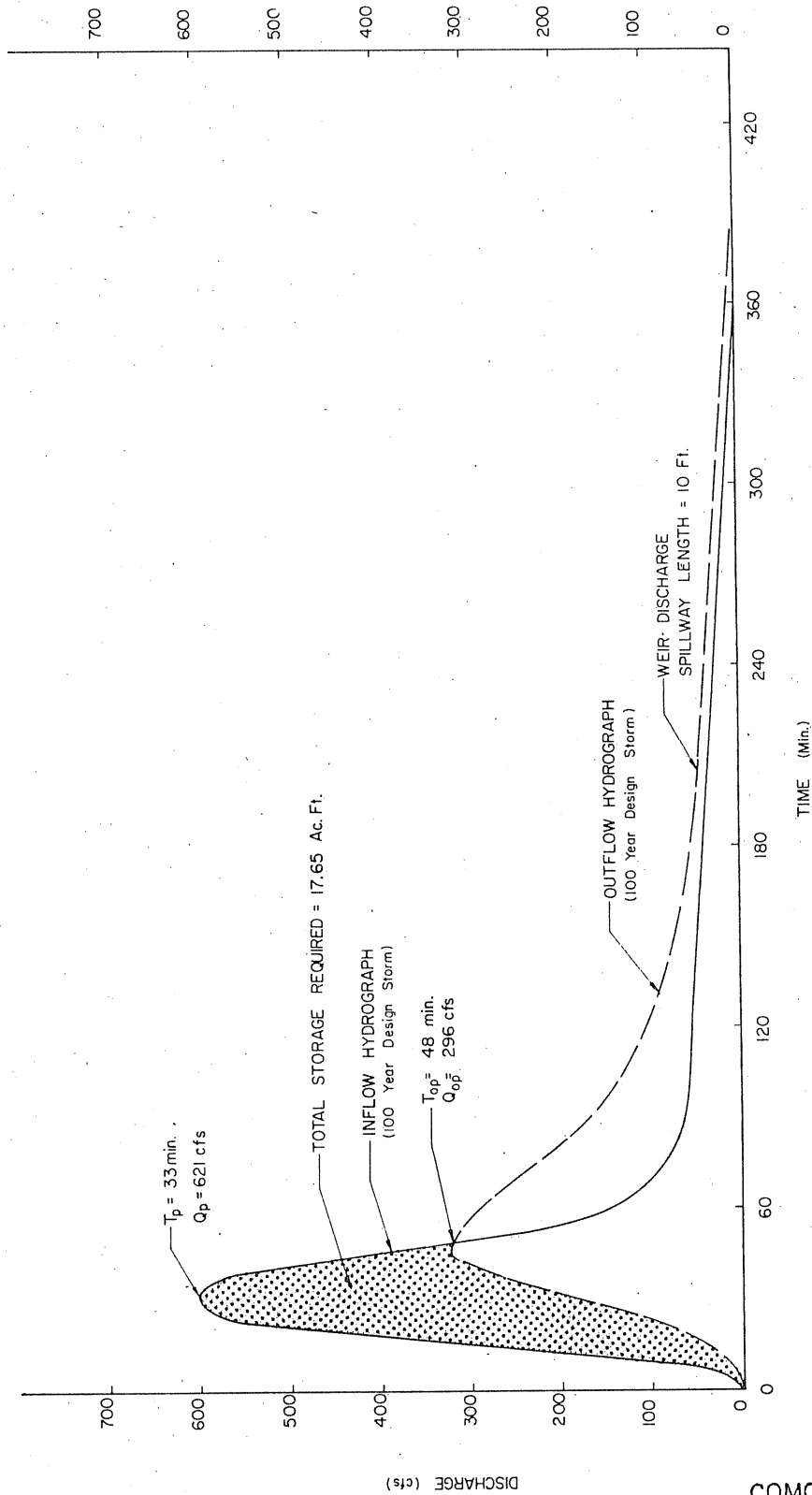
For this report a typical channel cross section as shown in Figure V-20 as assigned for each flow way and backwater calculations were performed to establish flood elevations for each drainage basin. Flood elevations are shown on the profiles presented in Figures V-6 through V-9, as referenced on Map 4. Any major variation between the typical sections and channel slopes shown and the proposed channel cross-sections and slopes should be considered and reevaluated in the early design stages of the project to check minimum pad elevations.

## PART VII - DISCUSSION AND RECOMMENDATIONS

As shown in Part V of this report, the peak flow can be significantly reduced by detaining a portion of the flow through stage storage. By utilizing the existing and proposed lakes for flood routing the size of drainage channels and drainage structures crossing 29th Street, Woodlawn, and the proposed interior streets within the project area, reduced in size.

By comparing Tables III-1, IV-1 and V-I it can be seen that flood routing through the proposed lakes has reduced the ultimate peak flow from the project area from 1,934 cfs to 715 cfs. And 715 cfs is less than the existing discharge of 727 cfs.

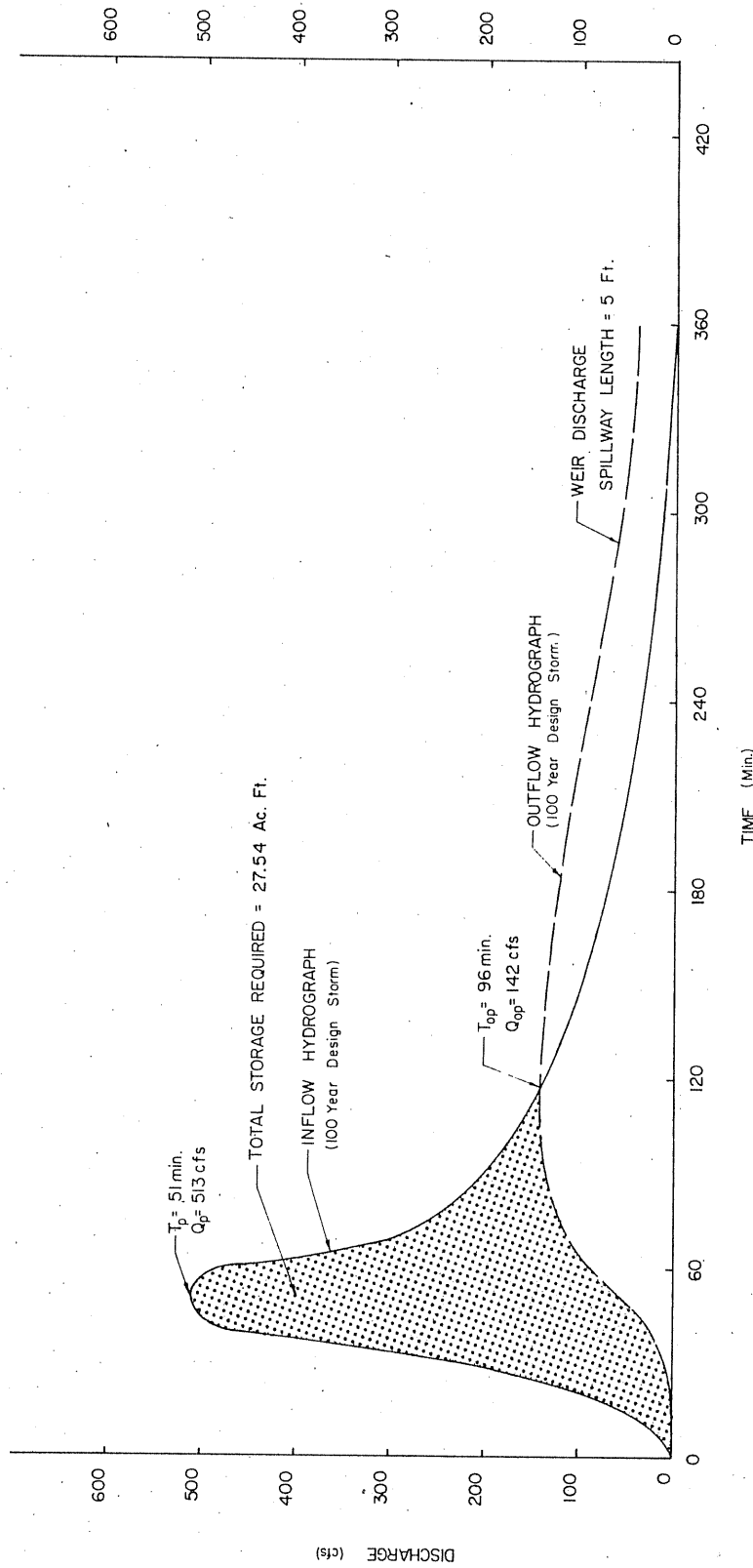
Minimum pad elevations can be established for habital structure sites in the Project Area by review of the Profile Key Map (Map 4) and the Profiles (Figures V-6 and through V-9).



COMOTARA  
 HYDROLOGY AND HYDRAULICS  
 ANALYSIS  
 WICHITA, KANSAS  
 100 YEAR FLOOD ROUTING CURVE  
 FOR  
 LAKE "A"

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.  
 ENGINEERS  
 WICHITA, KANSAS

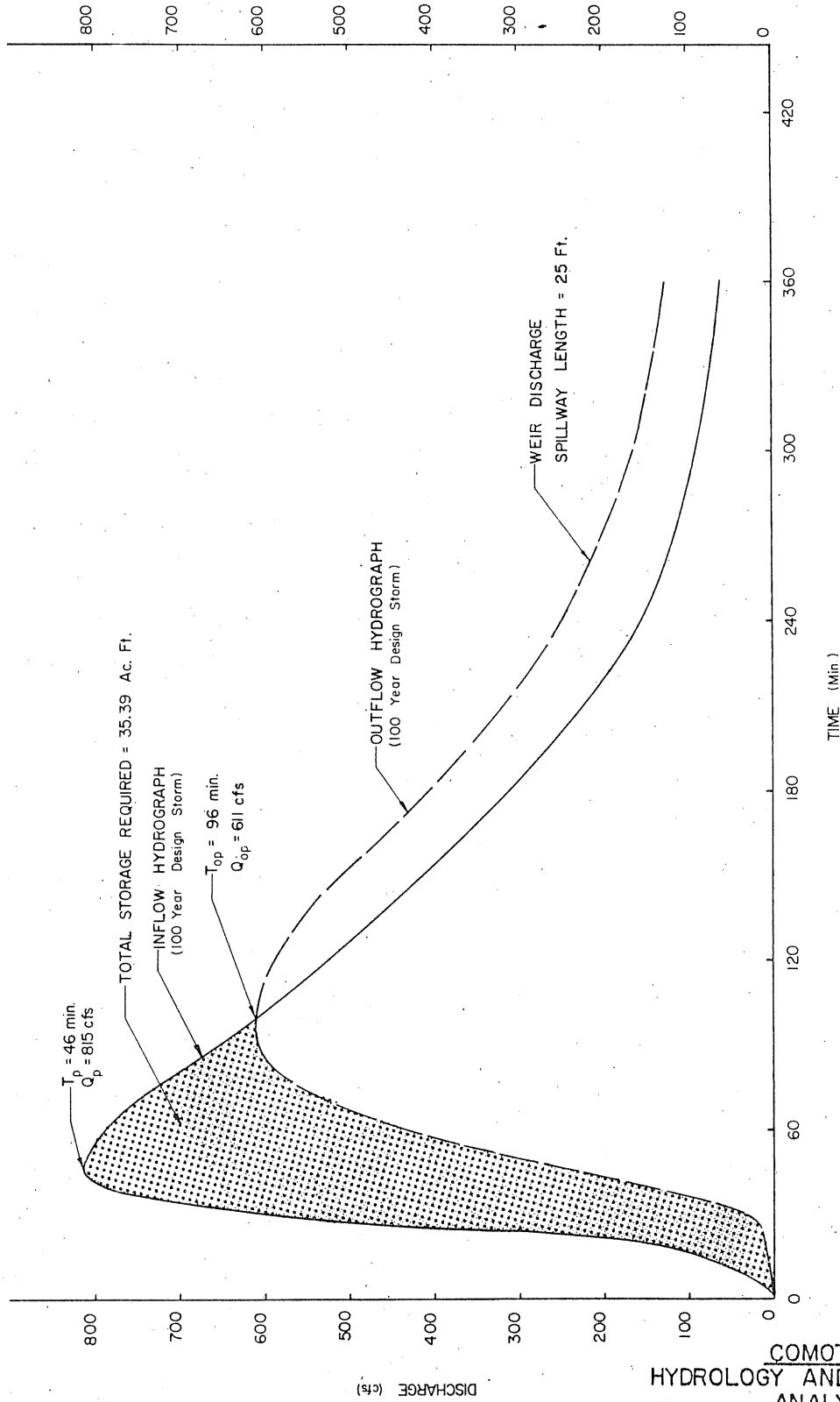
FIG. -V-1.



COMOTARA  
 HYDROLOGY AND HYDRAULICS  
 ANALYSIS  
 WICHITA, KANSAS  
 100 YEAR FLOOD ROUTING CURVE  
 FOR  
 LAKE "B"

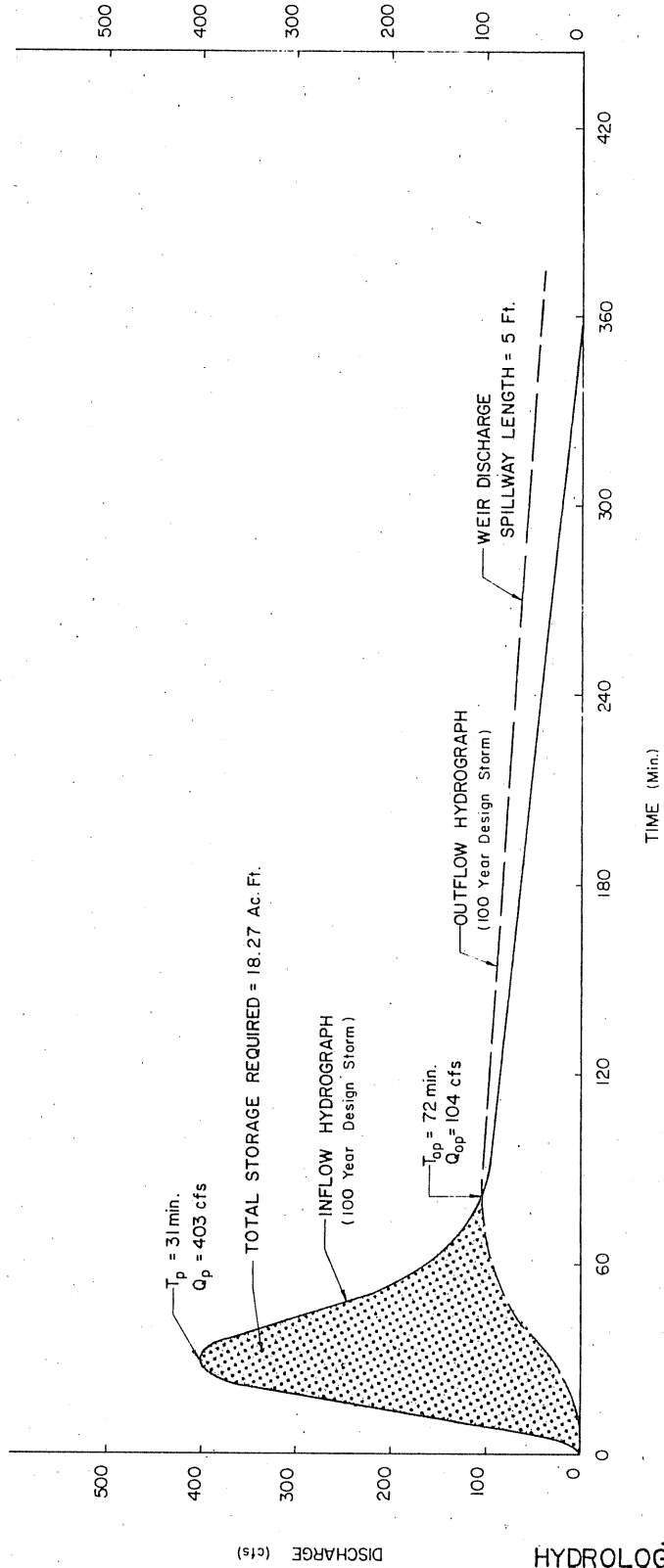
PROFESSIONAL ENGINEERING CONSULTANTS, P.A.  
 ENGINEERS  
 WICHITA, KANSAS

FIG.-V-2



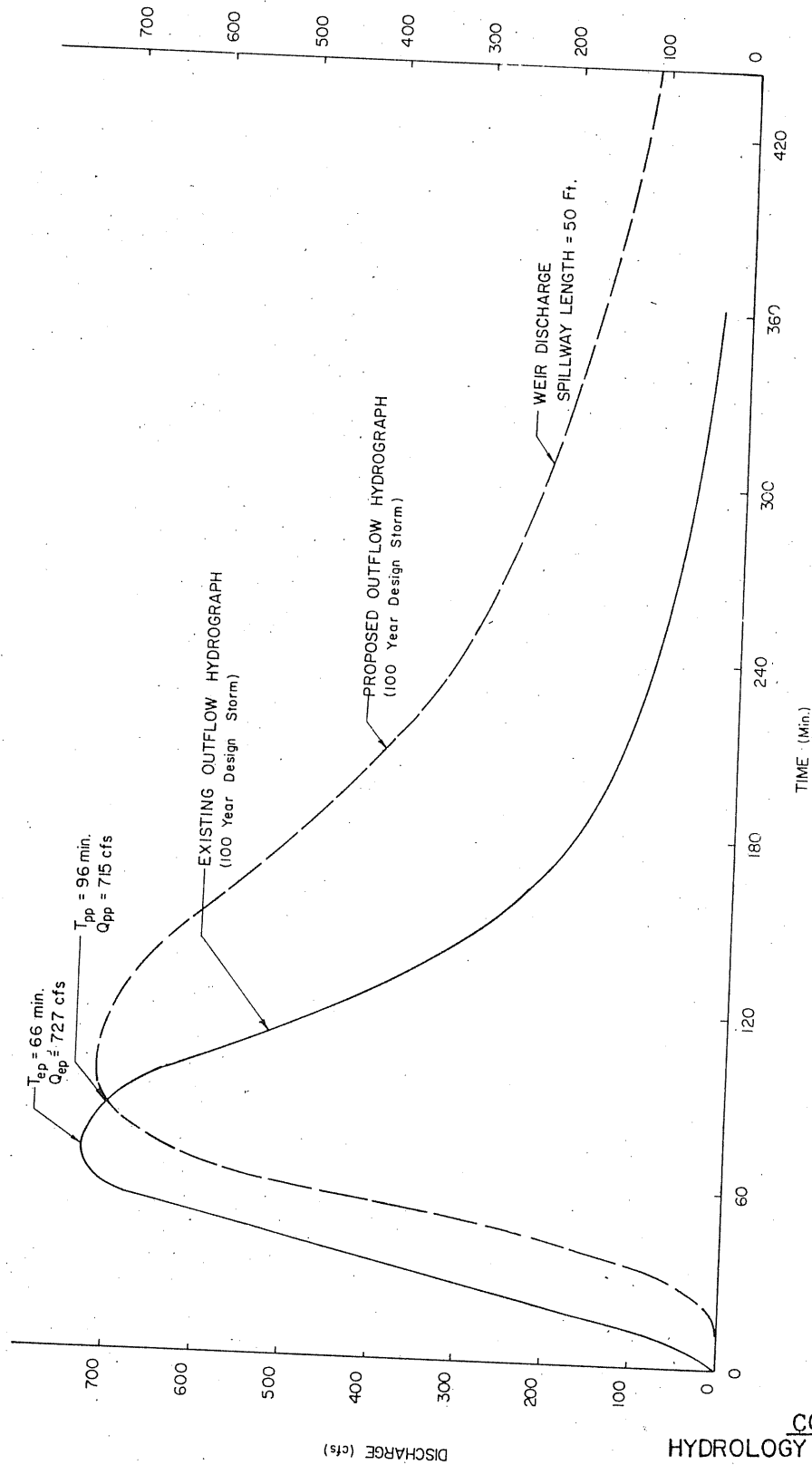
COMOTARA  
 HYDROLOGY AND HYDRAULICS  
 ANALYSIS  
 WICHITA, KANSAS  
 100 YEAR FLOOD ROUTING CURVE  
 FOR  
 LAKE "C"

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.  
 ENGINEERS  
 WICHITA, KANSAS



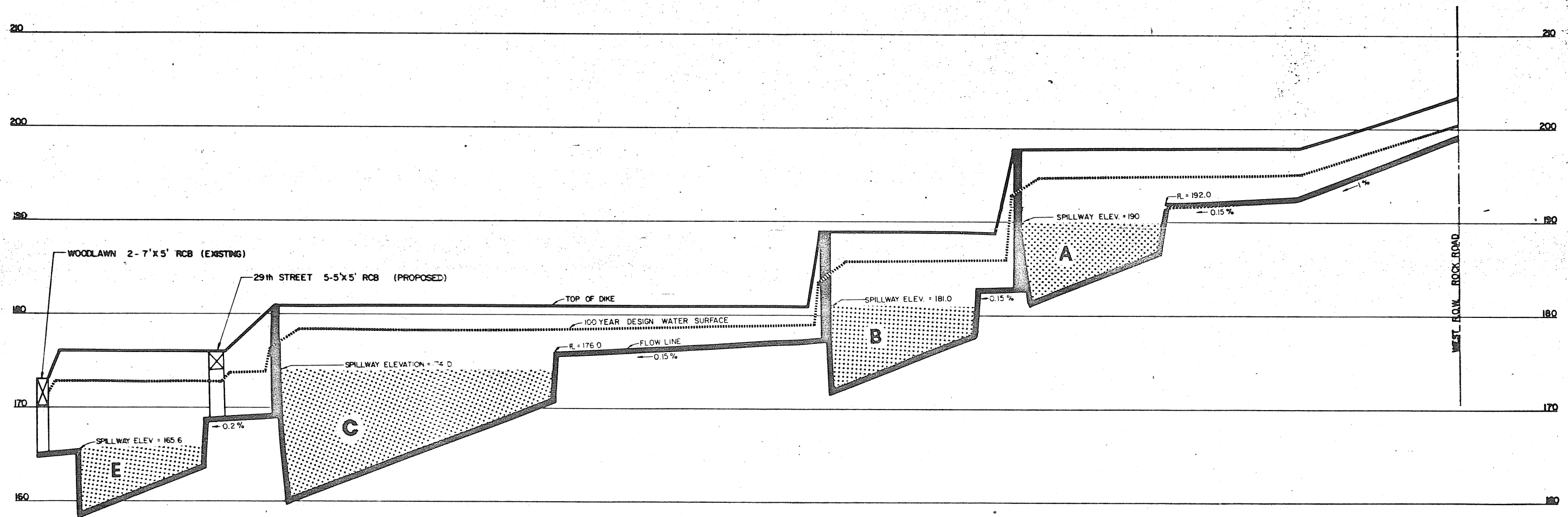
COMOTARA  
 HYDROLOGY AND HYDRAULICS  
 ANALYSIS  
 WICHITA, KANSAS  
 100 YEAR FLOOD ROUTING CURVE  
 FOR  
 LAKE "D"

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.  
 ENGINEERS  
 WICHITA, KANSAS



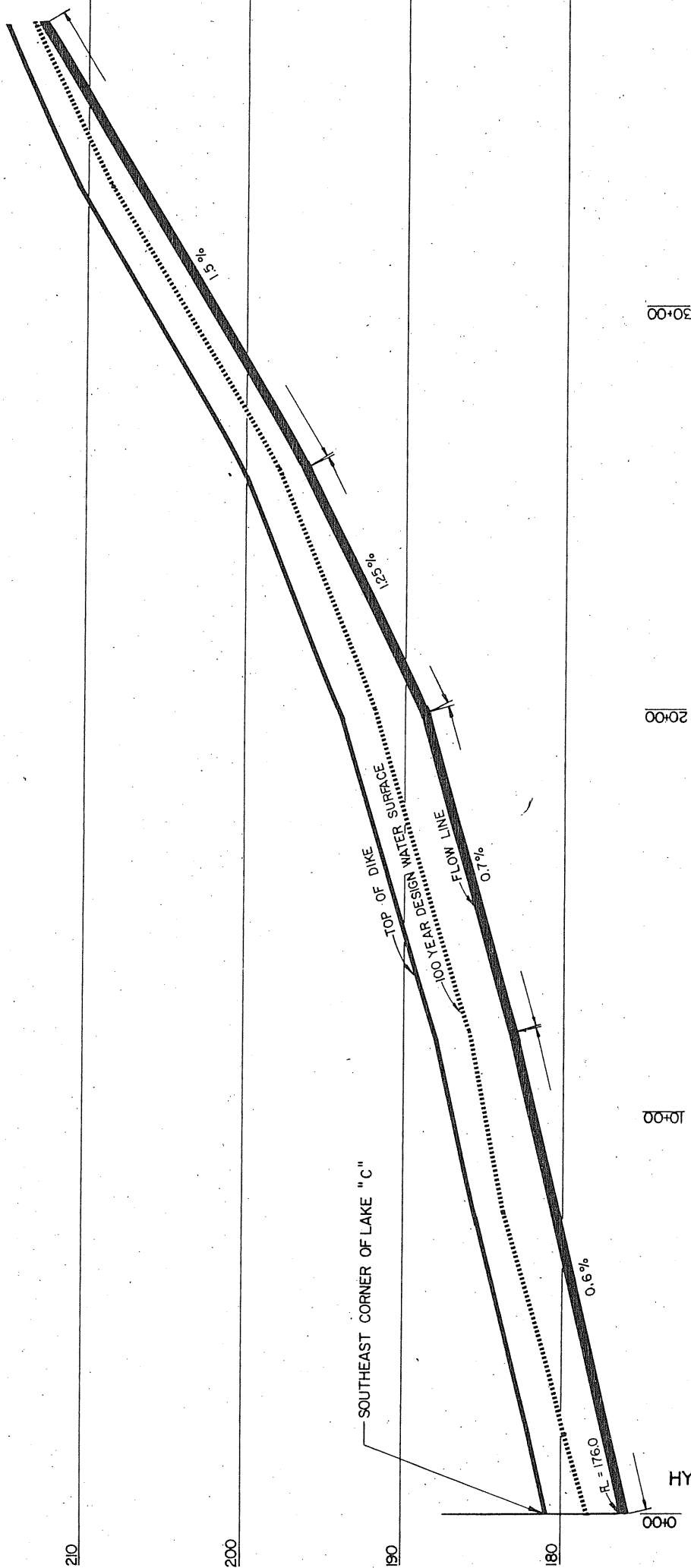
COMOTARA  
 HYDROLOGY AND HYDRAULICS  
 ANALYSIS  
 WICHITA, KANSAS  
 100 YEAR FLOOD ROUTING CURVE  
 FOR  
 LAKE "E"

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.  
 ENGINEERS  
 WICHITA, KANSAS



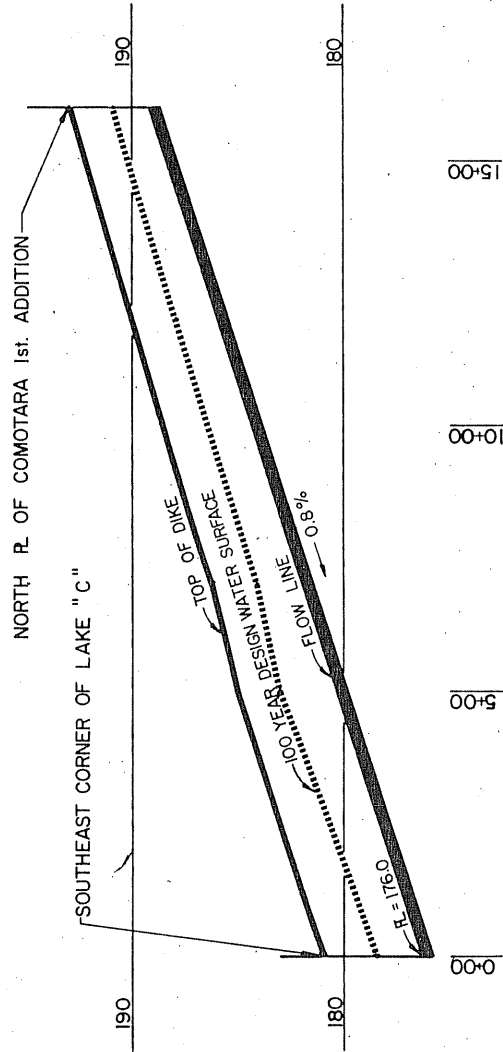
COMOTARA  
 HYDROLOGY AND HYDRAULICS  
 ANALYSIS  
 WICHITA, KANSAS  
 DRAINAGE PROFILE A  
 PROFESSIONAL ENGINEERING CONSULTANTS, P.A.  
 ENGINEERS  
 WICHITA, KANSAS

FIG.-V-6



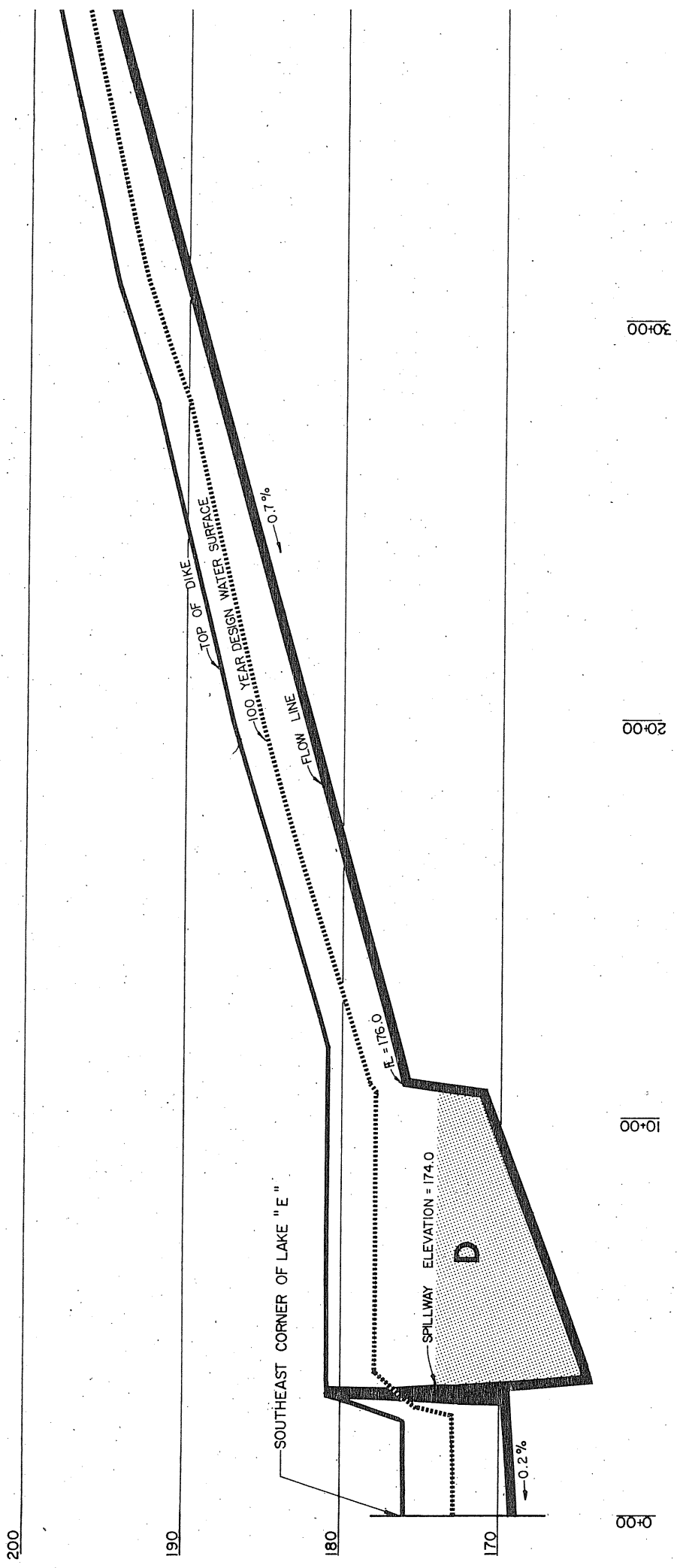
COMOTARA  
 HYDROLOGY AND HYDRAULICS  
 ANALYSIS  
 WICHITA, KANSAS  
 DRAINAGE PROFILE B  
 PROFESSIONAL ENGINEERING CONSULTANTS, P.A.  
 ENGINEERS  
 WICHITA, KANSAS

FIG. -V-7



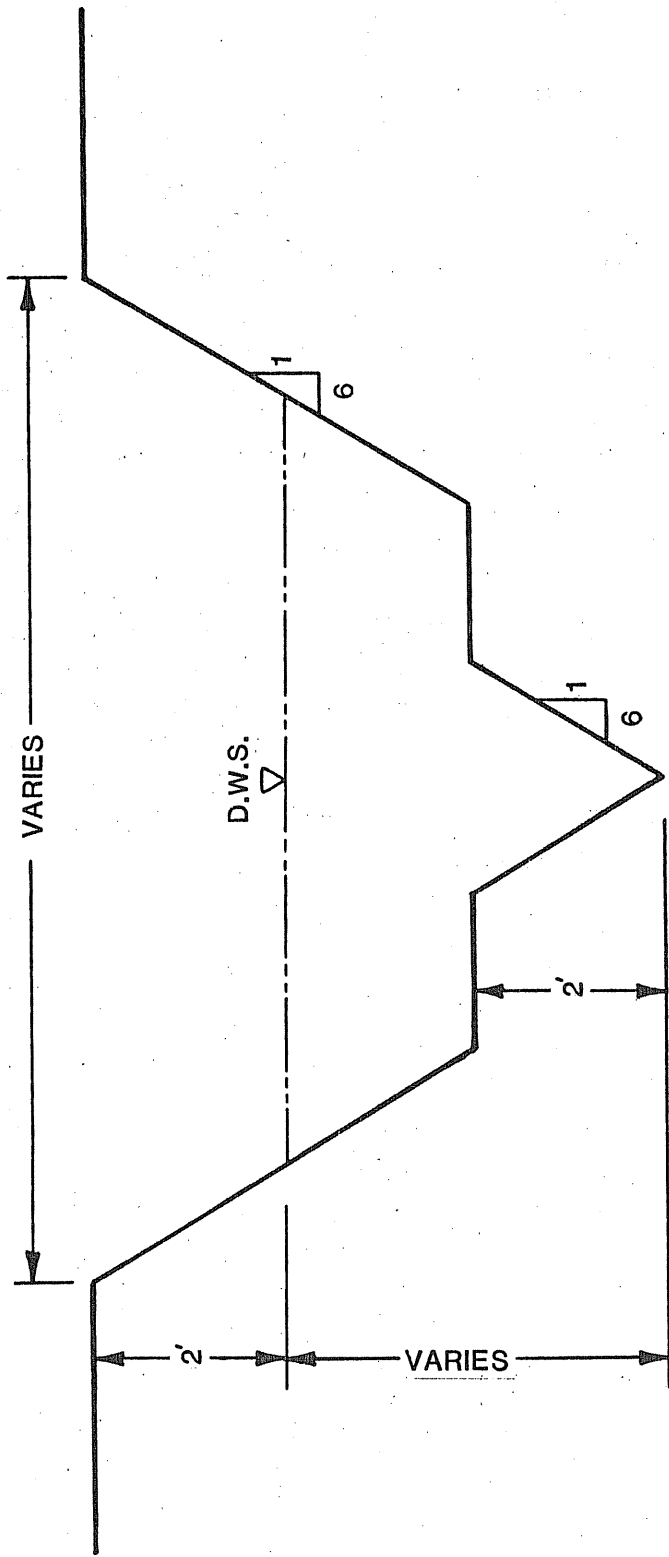
COMOTARA  
 HYDROLOGY AND HYDRAULICS  
 ANALYSIS  
 WICHITA, KANSAS  
 DRAINAGE PROFILE C  
 PROFESSIONAL ENGINEERING CONSULTANTS, P.A.  
 ENGINEERS  
 WICHITA, KANSAS

FIG.-V-8



COMOTARA  
 HYDROLOGY AND HYDRAULICS  
 ANALYSIS  
 WICHITA, KANSAS  
 DRAINAGE PROFILE D  
 PROFESSIONAL ENGINEERING CONSULTANTS, P.A.  
 ENGINEERS  
 WICHITA, KANSAS

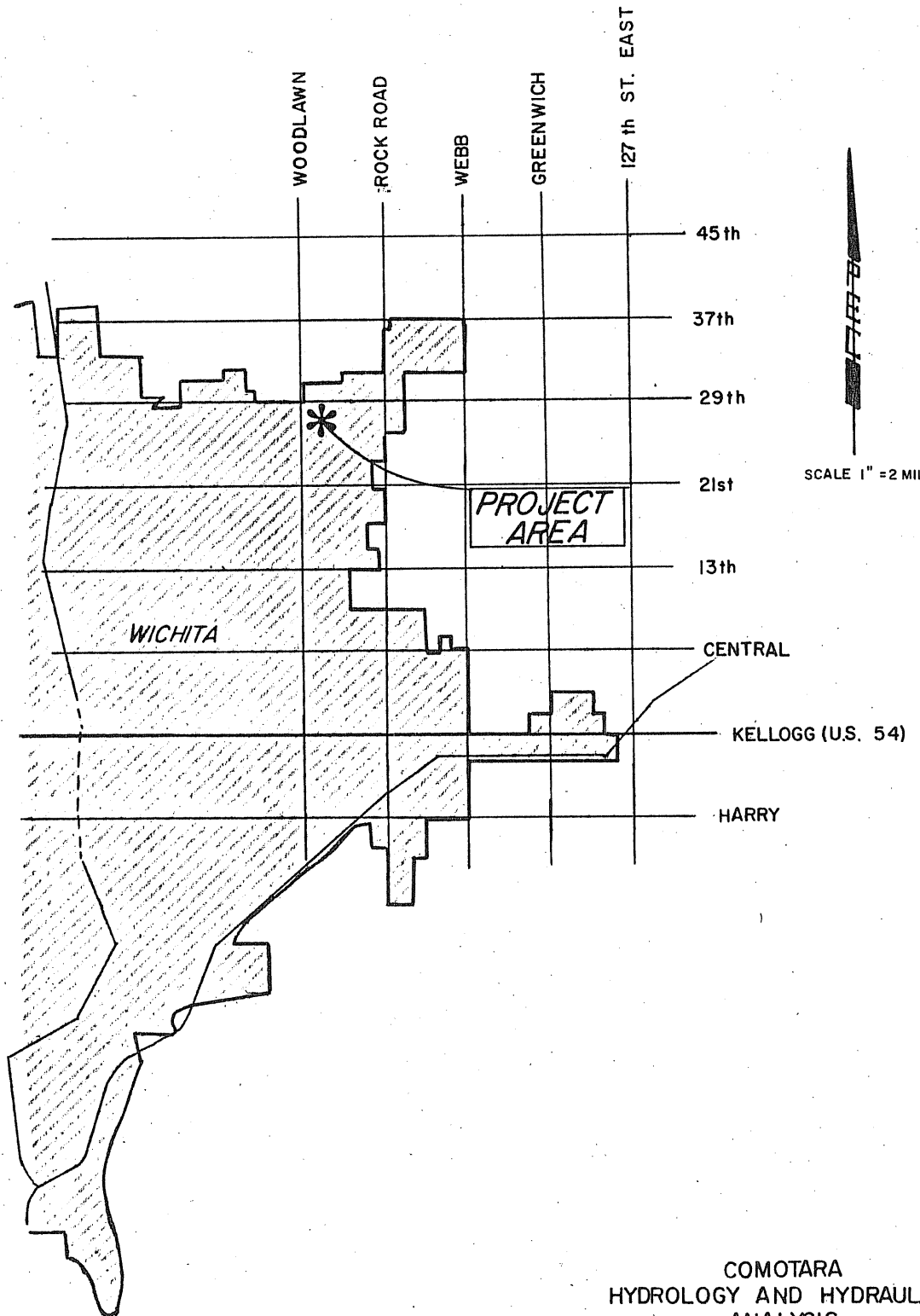
FIG.-V-9



**TYPICAL CHANNEL CROSS-SECTION**

COMOTARA  
 HYDROLOGY AND HYDRAULICS  
 ANALYSIS  
 WICHITA, KANSAS  
**CROSS-SECTION**

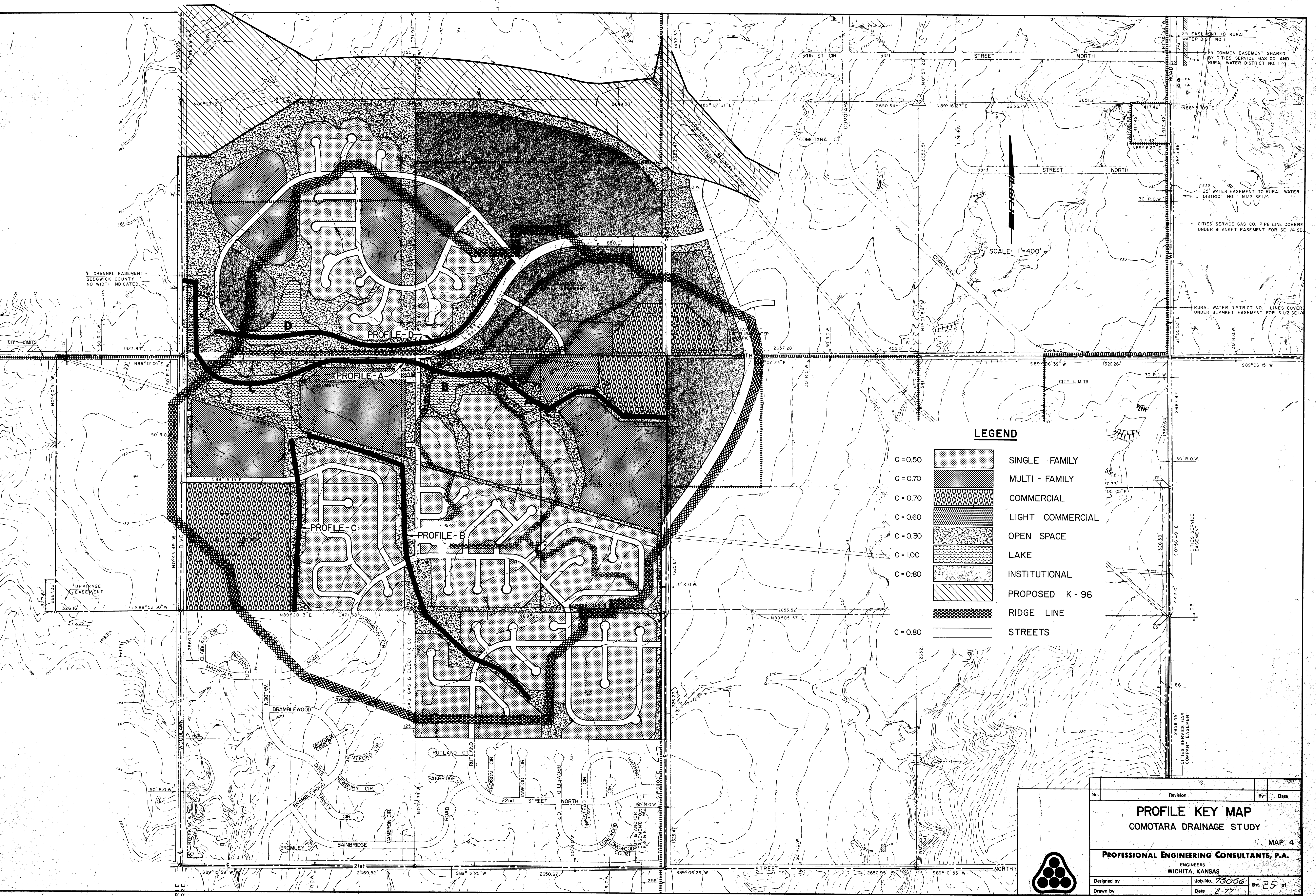
PROFESSIONAL ENGINEERING CONSULTANTS, P.A.  
 ENGINEERS  
 WICHITA, KANSAS  
 FIG.-X-10



COMOTARA  
 HYDROLOGY AND HYDRAULICS  
 ANALYSIS  
 WICHITA, KANSAS  
 VICINITY MAP

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.  
 ENGINEERS  
 WICHITA, KANSAS

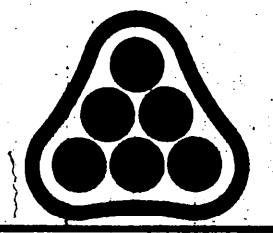
MAP

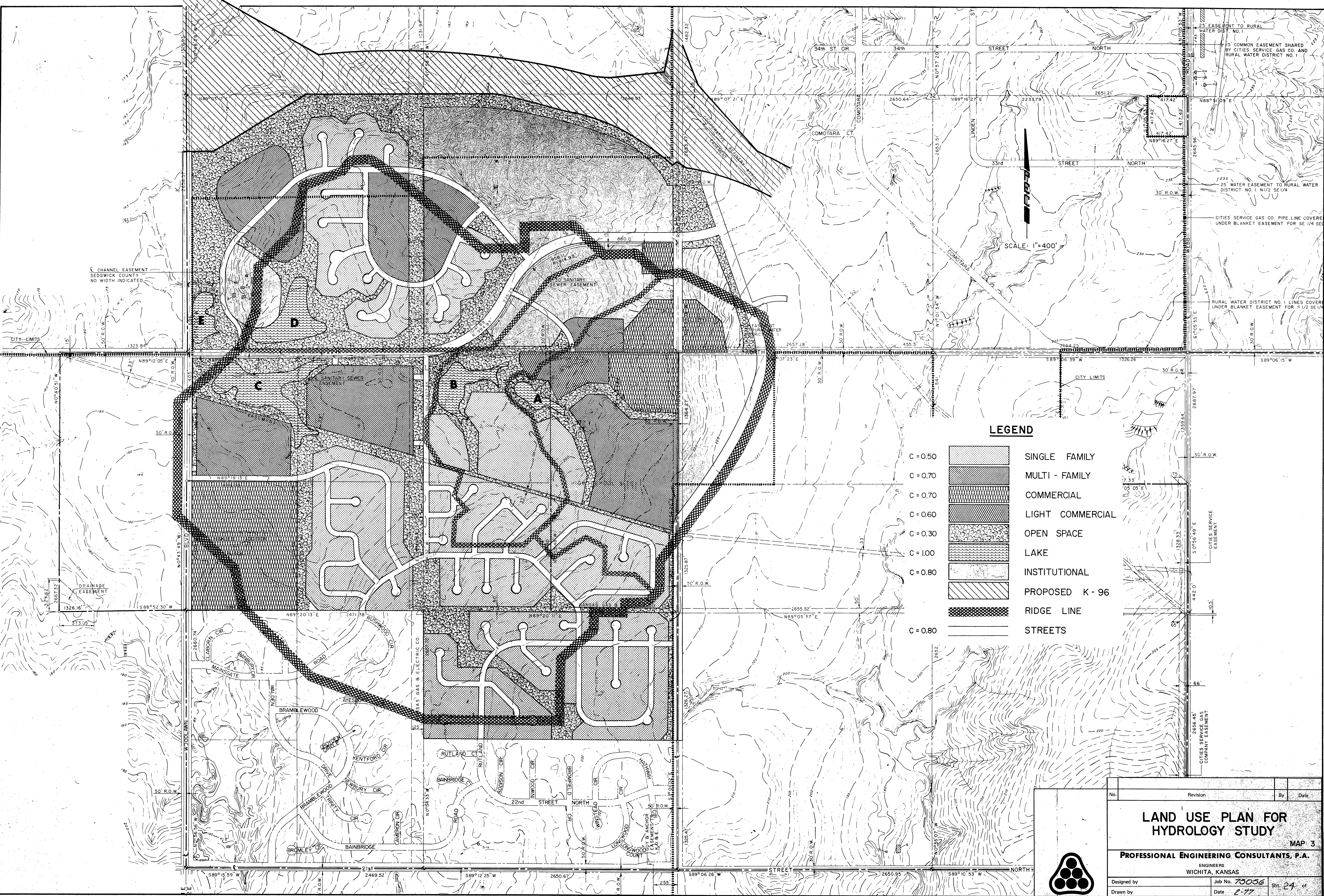


**LEGEND**


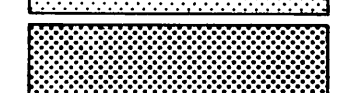
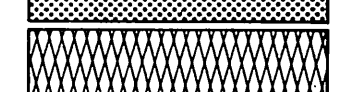
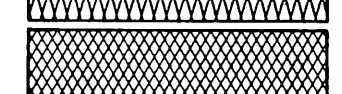






- C = 0.50 SINGLE FAMILY
- C = 0.70 MULTI - FAMILY
- C = 0.70 COMMERCIAL
- C = 0.60 LIGHT COMMERCIAL
- C = 0.30 OPEN SPACE
- C = 1.00 LAKE
- C = 0.80 INSTITUTIONAL
- PROPOSED K - 96
- RIDGE LINE
- C = 0.80 STREETS

No.	Revision	By	Date
<b>PROFILE KEY MAP</b>			
COMOTARA DRAINAGE STUDY			
MAP 4			
<b>PROFESSIONAL ENGINEERING CONSULTANTS, P.A.</b>			
ENGINEERS WICHITA, KANSAS			
Designed by	Job No. 70056	Sht. 25 of	
Drawn by	Date 2-77		

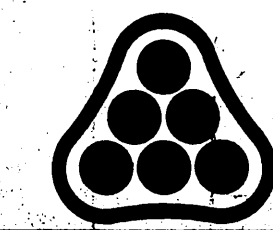


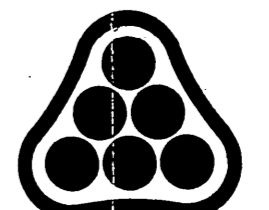
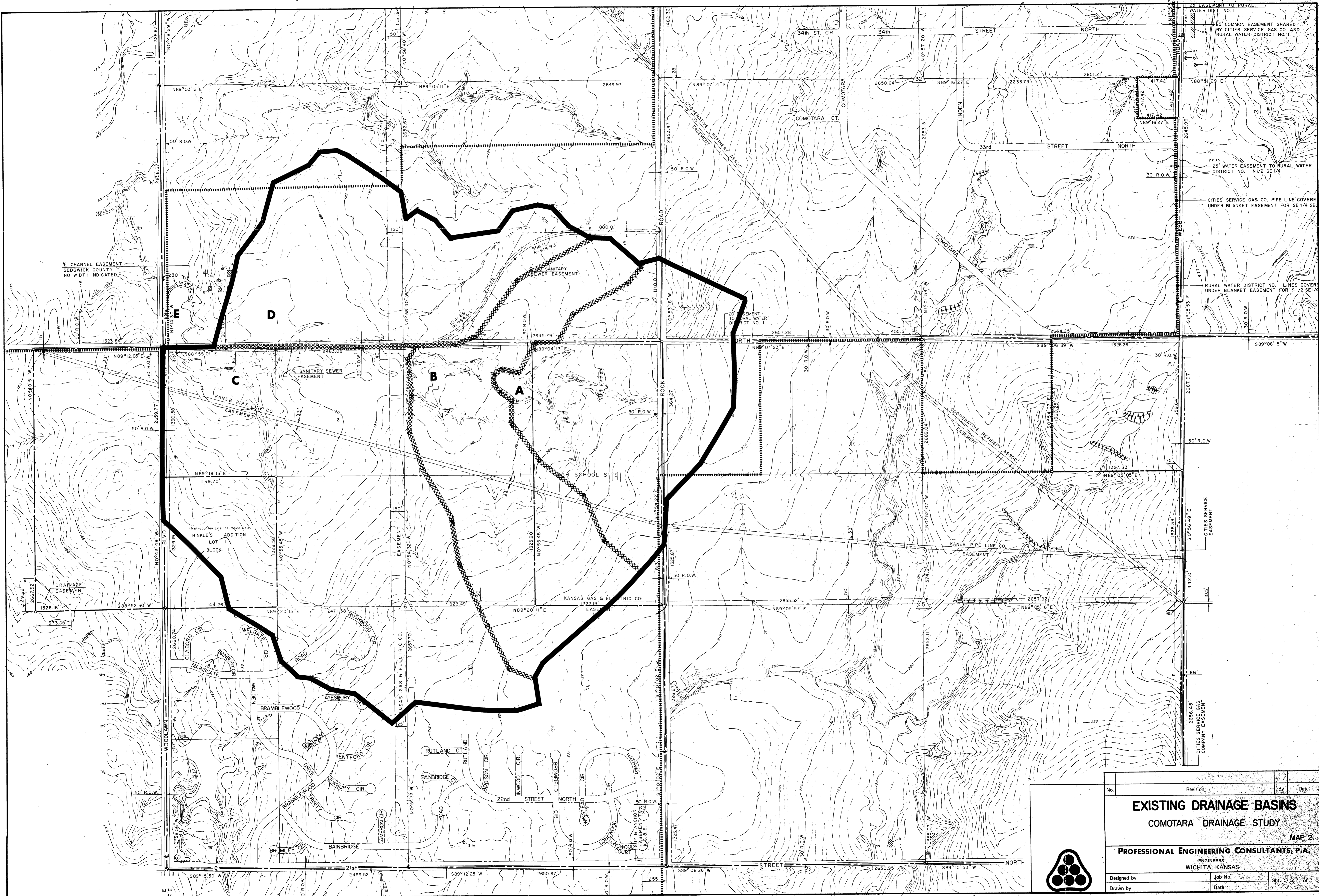


**LEGEND**

- C = 0.50  SINGLE FAMILY
- C = 0.70  MULTI - FAMILY
- C = 0.70  COMMERCIAL
- C = 0.60  LIGHT COMMERCIAL
- C = 0.30  OPEN SPACE
- C = 1.00  LAKE
- C = 0.80  INSTITUTIONAL
-  PROPOSED K - 96
-  RIDGE LINE
- C = 0.80  STREETS

No.	Revision	By	Date
<b>LAND USE PLAN FOR HYDROLOGY STUDY</b> MAP 3 <b>PROFESSIONAL ENGINEERING CONSULTANTS, P.A.</b> ENGINEERS WICHITA, KANSAS			
Designed by	Job No. 70056	Sht. 24 of	
Drawn by	Date 2-77		





No.	Revision	By	Date
<b>EXISTING DRAINAGE BASINS</b>			
COMOTARA DRAINAGE STUDY			
MAP 2			
<b>PROFESSIONAL ENGINEERING CONSULTANTS, P.A.</b>			
ENGINEERS WICHITA, KANSAS			
Designed by	Job No.	Sht. 23 of	
Drawn by	Date		

APPENDIX A

HYDRAULIC  
COMPUTATIONS

for

PROFILE A

\*\*\*\*\*  
 HEAD VERSION UPDATE AUG 1976  
 ERROR CORRECTIONS 01,02,03,04,05,06,07,08,09,10  
 MODIFICATIONS 52,53,54,55,56,57,58,59  
 \*\*\*\*\*

11 CANADA 20-26056-660  
 12 MARCH 8, 1977  
 13 HYDR. FOR LAKES A,B,C,E

J1	ICHECK	INO	NIRV	1DIR	START	METRIC	HVINS	Q	WSEL	F0
	-10.	0.	0.	0.000000	0.00	0.00	0.0	715.	171.500	0.000
0000	300	CELU=	500							
SECNO	DEPTH	CHSEL	CRINS	WSELK	EG	HV	AROS	HL	ALOSS	BANK ELEV
Q	QLOS	QCH	QROS	ALOS	ACH	UOL	UOL	UOL	TMA	LEFT,RIGHT
TIME	ULOS	UCH	UROS	UOL	YNCH	YNE	YNE	YNE	ELMIN	SSIA
SLOPE	NLOS	NLCH	NLOS	ITRIAL	INC	ICONT	CORAR	CORAR	TOPMID	ENDST
1.00	6.18	171.50	0.00	171.50	172.56	1.06	0.00	0.00	0.00	172.00
715.	0.	715.	0.	0.	87.	0.	0.	0.	0.	172.00
0.00	0.00	8.26	0.00	.035	.015	.035	0.000	0.000	165.32	943.00
.001426	0.	0.	0.	0	0	1	0.00	0.00	14.00	1007.00

3301 HV CHANGED MORE THAN HVINS

2.00	7.35	172.65	0.00	0.00	172.87	.02	.00	.00	.31	175.00
715.	0.	715.	0.	0.	584.	0.	0.	0.	0.	175.00
0.00	0.00	1.22	0.00	.035	.035	.035	0.00	0.00	145.50	945.58
.000090	10.	10.	10.	2	0	1	0.00	0.00	108.83	1054.42
3.00	7.22	172.86	0.00	0.00	172.88	.02	.01	.00	.00	175.14
715.	0.	715.	0.	0.	569.	0.	1.	0.	0.	175.14
.02	0.00	1.26	0.00	.035	.035	.035	0.00	0.00	165.64	946.13
.000097	140.	90.	40.	2	0	1	0.00	0.00	107.75	1053.87
4.00	7.14	172.84	0.00	0.00	172.90	.06	.00	.00	.02	175.00
715.	0.	715.	0.	0.	358.	0.	1.	0.	0.	175.00
.02	0.00	2.00	0.00	.035	.015	.035	0.00	0.00	165.20	925.00
.000041	20.	20.	20.	1	0	1	0.00	0.00	50.00	1025.00
5.00	12.92	172.92	0.00	0.00	172.92	.01	.00	.00	.02	175.00
715.	0.	715.	0.	0.	1259.	0.	3.	0.	1.	175.00
.07	0.00	.57	0.00	.035	.035	.035	0.00	0.00	160.00	912.50
.000013	178.	100.	22.	2	0	1	0.00	0.00	175.01	1087.50
6.00	10.42	172.92	0.00	0.00	172.93	.01	.00	.00	.00	175.00
715.	0.	715.	0.	0.	1173.	0.	10.	0.	2.	175.00
.19	0.00	.61	0.00	.035	.035	.035	0.00	0.00	162.50	912.46
.000017	250.	250.	250.	0	0	1	0.00	0.00	175.09	1087.54

SECTO	DEPTH	CHSEL	CRIMS	MSELK	EG	HV	HL	BLOSS	BANK ELEV
0	0LOS	0CH	0FOS	ALOS	ACH	AFOS	UOL	TMA	LEFT,RIGHT
TIME	VLOS	VCH	VFOS	XNIL	XNCH	XNR	RTH	ELMIN	SSTA
SLOPE	SLOS	SCH	SLOS	TRIAL	INC	ICENT	COEAF	TORFID	ENOST
2.00	9.42	172.92	0.00	0.00	172.93	0.00	0.00	0.00	175.00
612.	0.	612.	0.	0.	1117.	0.	13.	2.	175.00
.25	0.00	55	0.00	.035	.035	.035	.034	163.50	912.45
.000014	120.	120.	120.	0	0	0	0.00	175.11	1037.53
8.00	4.08	172.88	0.00	0.00	172.98	.11	.00	.05	176.00
612.	0.	612.	0.	0.	232.	0.	15.	2.	176.00
.26	0.00	2.63	0.00	.035	.035	.035	.034	168.80	963.02
.000052	50.	50.	50.	2	0	0	0.00	73.97	1036.98
3265 DIVIDED FLOW									
3301	HV CHANGED MORE THAN HUINS								
9.00	3.77	172.67	0.00	0.00	173.32	.65	.07	.27	173.90
612.	0.	612.	0.	0.	94.	0.	15.	2.	173.90
.26	0.00	6.49	0.00	.035	.015	.035	.033	168.90	986.00
.000290	50.	50.	50.	2	0	0	0.00	25.00	1015.00
3265 DIVIDED FLOW									
10.00	3.89	172.84	0.00	0.00	173.46	.61	.12	.01	173.95
612.	0.	612.	0.	0.	97.	0.	15.	2.	173.95
.26	0.00	6.29	0.00	.035	.015	.035	.032	168.95	986.00
.000230	50.	50.	50.	2	0	0	0.00	25.00	1015.00
3301 HV CHANGED MORE THAN HUINS									
11.00	4.54	173.54	0.00	0.00	173.63	.68	.01	.16	176.00
612.	0.	612.	0.	0.	265.	0.	15.	2.	176.00
.26	0.00	2.31	0.00	.035	.035	.035	.032	169.00	961.80
.000025	10.	10.	10.	2	0	0	0.00	76.41	1038.20
12.00	4.41	173.61	0.00	0.00	173.70	.69	.07	.00	176.20
612.	0.	612.	0.	0.	254.	0.	16.	3.	176.20
.28	0.00	2.41	0.00	.035	.035	.035	.032	169.20	962.35
.000046	82.	120.	157.	2	0	0	0.00	75.30	1037.65
3685 20 TRIALS USED MSEL:CHSEL									
7185 MIN SPECIFIC ENERGY									
3720 ASSUMED CRITICAL DEPTH									
SECTO	DEPTH	CHSEL	CRIMS	MSELK	EG	HV	HL	BLOSS	BANK ELEV
0	0LOS	0CH	0FOS	ALOS	ACH	AFOS	UOL	TMA	LEFT,RIGHT

TIME	VLOS	VCH	VROB	NHL	NMCH	NHR	WTH	ELMIN	SSTA
SLOPE	XLOS	XLCH	XLOS	ITRIAL	IBC	ICONT	CORAR	TOPHID	ENDST
13.00	2.64	178.64	178.64	0.00	177.98	1.33	.02	0.00	178.00
612.	0.	612.	0.	0.	66.	0.	16.	3.	176.00
.28	0.00	9.27	0.00	.035	.015	.035	.031	174.00	968.00
.003092	60.	60.	60.	30	14	1	0.00	25.00	1013.00

3391 HU CHANGED MORE THAN HUINS

SECHD	DEPTH	CUSEL	CRIMS	USELK	EG	HU	HL	ALOSS	BANK	ELEV
0	0LOS	0CH	0ROB	ALOS	ACH	AFOS	VOL	TMA	LEFT	RIGHT
TIME	VLOS	VCH	VROB	XHL	XNCH	NHR	WTH	ELMIN	SSTA	
SLOPE	XLOS	XLCH	XLOS	ITRIAL	IBC	ICONT	CORAR	TOPHID	ENDST	

14.00	17.38	178.38	0.00	0.00	178.38	.00	.00	.40	180.50
680.	0.	680.	0.	0.	5447.	0.	22.	3.	180.50
.50	0.00	.12	0.00	.035	.035	.035	.031	161.00	808.50
.000000	100.	100.	100.	2	0	1	0.00	383.00	1191.50

15.00	15.38	178.38	0.00	0.00	178.38	.00	.00	.00	181.00
750.	0.	750.	0.	0.	4862.	0.	46.	5.	181.00
.86	0.00	.15	0.00	.035	.035	.035	.032	163.00	810.50
.000000	200.	200.	200.	2	0	1	0.00	379.00	1189.50

16.00	12.38	178.38	0.00	0.00	178.38	.00	.00	.00	181.00
810.	0.	810.	0.	0.	4078.	0.	77.	7.	181.00
1.88	0.00	.20	0.00	.035	.035	.035	.032	166.00	810.50
.000001	300.	300.	300.	2	0	1	0.00	379.00	1189.50

17.00	11.38	178.38	0.00	0.00	178.38	.00	.00	.00	181.00
160.	0.	160.	0.	0.	950.	0.	83.	8.	181.00
1.45	0.00	.17	0.00	.035	.035	.035	.033	167.00	935.50
.000001	100.	100.	100.	0	0	1	0.00	129.00	1064.50

18.00	8.38	178.38	0.00	0.00	178.38	.00	.00	.00	181.00
160.	0.	160.	0.	0.	549.	0.	88.	9.	181.00
1.75	0.00	.29	0.00	.035	.035	.035	.033	170.00	950.50
.000005	320.	320.	320.	0	0	1	0.00	99.01	1049.50

19.00	2.37	178.37	0.00	0.00	178.39	.01	.00	.01	181.00
160.	0.	160.	0.	0.	165.	0.	90.	9.	181.00
1.80	0.00	.97	0.00	.035	.035	.035	.033	176.00	960.49
.000197	180.	180.	180.	0	0	1	0.00	79.01	1029.51

20.00	1.20	178.65	0.00	0.00	178.91	.02	.50	.03	182.65
160.	0.	160.	0.	0.	76.	0.	93.	11.	182.65
1.95	0.00	2.05	0.00	.035	.035	.035	.034	177.65	965.18
.000015	1100.	1100.	1100.	2	0	1	0.00	69.63	1024.82

3685.20 TRIAL\$ USEL USEL CUSEL

7185 MIN SPECIFIC ENERGY

3720 ASSUMED CRITICAL DEPTH

SECHD	DEPTH	CHSEL	CRIMS	USELK	EG	HU	HL	LOSS	BANK ELEV
0	BLDS	OCH	GROS	ALOS	ACH	AROS	VOL	TMA	LEFT-RIGHT
TIME	ULOS	UCH	UROS	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	VLDS	VLCH	VLOR	ITRVAL	ITC	ICONT	COEAR	TOEWIN	ERDST
21.00	2.98	183.92	183.92	0.00	185.39	1.47	.16	0.00	185.00
142.	0.	142.	0.	0.	15.	0.	93.	11.	186.00
1.95	0.00	9.74	0.00	.035	.015	.035	0.00	181.00	998.00
.000000	50.	50.	50.	30	17	1	0.00	5.00	1003.00

3301 HU CHANGED MORE THAN HVINS

SECHD	DEPTH	CHSEL	CRIMS	USELK	EG	HU	HL	LOSS	BANK ELEV
0	BLDS	OCH	GROS	ALOS	ACH	AROS	VOL	TMA	LEFT-RIGHT
TIME	ULOS	UCH	UROS	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	VLDS	VLCH	VLOR	ITRVAL	ITC	ICONT	COEAR	TOEWIN	ERDST
22.00	12.83	185.83	0.00	0.00	185.83	0.00	.00	.44	188.00
142.	0.	142.	0.	0.	3738.	0.	97.	12.	188.00
2.69	0.00	.04	0.00	.035	.035	.035	0.00	173.00	828.68
.000000	100.	100.	100.	2	0	1	0.00	342.64	1171.32

23.00 11.83 185.83

23.00	11.83	185.83	0.00	0.00	185.83	0.00	.00	.00	188.00
510.	0.	510.	0.	0.	5150.	0.	110.	13.	188.00
3.05	0.00	.10	0.00	.035	.035	.035	0.00	174.00	758.68
.000000	130.	130.	130.	2	0	1	0.00	482.64	1241.32

24.00 10.83 185.83

24.00	10.83	185.83	0.00	0.00	185.83	0.00	.00	.00	188.00
395.	0.	395.	0.	0.	2809.	0.	118.	14.	188.00
3.21	0.00	.14	0.00	.035	.035	.035	0.00	175.00	848.68
.000001	80.	80.	80.	0	0	1	0.00	302.64	1151.32

25.00 8.83 185.83

25.00	8.83	185.83	0.00	0.00	185.83	0.00	.00	.00	190.00
395.	0.	395.	0.	0.	2219.	0.	129.	15.	190.00
3.52	0.00	.18	0.00	.035	.035	.035	0.00	177.00	856.68
.000001	200.	200.	200.	0	0	1	0.00	285.64	1143.32

26.00 2.80 185.80

26.00	2.80	185.80	0.00	0.00	185.86	0.06	.00	.03	190.00
296.	0.	296.	0.	0.	155.	0.	133.	16.	190.00
3.54	0.00	1.91	0.00	.035	.035	.035	0.00	183.00	966.79
.000066	150.	150.	150.	2	0	1	0.00	66.42	1033.21

27.00 2.69 185.89

27.00	2.69	185.89	0.00	0.00	185.95	0.06	.00	.00	190.20
296.	0.	296.	0.	0.	147.	0.	134.	16.	190.20
3.56	0.00	2.01	0.00	.035	.035	.035	0.00	183.20	967.26
.000025	120.	120.	120.	2	0	1	0.00	65.49	1032.74

3685 20 TRIALS USCO USELCHSEL

3720 ASSUMED CRITICAL DEPTH

SECTO	DEPTH	CUSEL	CRINS	USELK	EG	HV	HL	BLOSS	BANK ELEV
TIME	SLOPE	ACH	ACH	ACH	ACH	ACH	ACH	ACH	ACH
SLOPE	SLOPE	VCH	VCH	VCH	VCH	VCH	VCH	VCH	VCH
SLOPE	SLOPE	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH
28.00	3.00	193.00	193.00	0.00	194.51	1.51	0.00	0.00	195.00
296.	0.	296.	0.	0.	30.	0.	134.	16.	195.00
3.56	0.00	9.86	0.00	0.00	0.05	0.05	0.03	190.00	955.00
0000000	50.	50.	50.	30	0	1	0.00	10.00	1005.00

3301 HV CHANGED MORE THAN HVINS

SECTO	DEPTH	CUSEL	CRINS	USELK	EG	HV	HL	BLOSS	BANK ELEV
TIME	SLOPE	ACH	ACH	ACH	ACH	ACH	ACH	ACH	ACH
SLOPE	SLOPE	VCH	VCH	VCH	VCH	VCH	VCH	VCH	VCH
SLOPE	SLOPE	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH
29.00	12.96	194.96	0.00	0.00	194.97	0.00	0.00	0.45	197.00
296.	0.	296.	0.	0.	1061.	0.	135.	16.	197.00
3.56	0.00	0.28	0.00	0.00	0.035	0.035	0.033	182.00	933.14
0000003	100.	100.	100.	2	0	1	0.00	133.71	1055.86

SECTO	DEPTH	CUSEL	CRINS	USELK	EG	HV	HL	BLOSS	BANK ELEV
TIME	SLOPE	ACH	ACH	ACH	ACH	ACH	ACH	ACH	ACH
SLOPE	SLOPE	VCH	VCH	VCH	VCH	VCH	VCH	VCH	VCH
SLOPE	SLOPE	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH
30.00	10.96	194.96	0.00	0.00	194.97	0.00	0.00	0.00	197.00
621.	0.	621.	0.	0.	1972.	0.	140.	16.	197.00
3.78	0.00	0.31	0.00	0.00	0.035	0.035	0.034	184.00	888.14
0000003	140.	140.	140.	2	0	1	0.00	223.72	1111.86

SECTO	DEPTH	CUSEL	CRINS	USELK	EG	HV	HL	BLOSS	BANK ELEV
TIME	SLOPE	ACH	ACH	ACH	ACH	ACH	ACH	ACH	ACH
SLOPE	SLOPE	VCH	VCH	VCH	VCH	VCH	VCH	VCH	VCH
SLOPE	SLOPE	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH
31.00	9.96	194.96	0.00	0.00	194.97	0.00	0.00	0.00	197.00
463.	0.	463.	0.	0.	1035.	0.	146.	17.	197.00
3.88	0.00	0.45	0.00	0.00	0.035	0.035	0.034	185.00	928.14
0000008	160.	160.	160.	0	0	1	0.00	143.72	1071.86

SECTO	DEPTH	CUSEL	CRINS	USELK	EG	HV	HL	BLOSS	BANK ELEV
TIME	SLOPE	ACH	ACH	ACH	ACH	ACH	ACH	ACH	ACH
SLOPE	SLOPE	VCH	VCH	VCH	VCH	VCH	VCH	VCH	VCH
SLOPE	SLOPE	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH
32.00	8.47	194.97	0.00	0.00	194.97	0.00	0.00	0.00	198.50
463.	0.	463.	0.	0.	828.	0.	149.	18.	198.50
3.96	0.00	0.56	0.00	0.00	0.035	0.035	0.034	186.50	934.14
0000015	150.	150.	150.	0	0	1	0.00	131.73	1055.86

SECTO	DEPTH	CUSEL	CRINS	USELK	EG	HV	HL	BLOSS	BANK ELEV
TIME	SLOPE	ACH	ACH	ACH	ACH	ACH	ACH	ACH	ACH
SLOPE	SLOPE	VCH	VCH	VCH	VCH	VCH	VCH	VCH	VCH
SLOPE	SLOPE	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH
33.00	2.96	194.96	0.00	0.00	194.99	0.00	0.00	0.01	197.00
300.	0.	300.	0.	0.	213.	0.	150.	18.	197.00
3.98	0.00	1.41	0.00	0.00	0.035	0.035	0.034	192.00	958.16
0000322	50.	100.	150.	1	0	1	0.00	83.59	1041.84

SECTO	DEPTH	CUSEL	CRINS	USELK	EG	HV	HL	BLOSS	BANK ELEV
TIME	SLOPE	ACH	ACH	ACH	ACH	ACH	ACH	ACH	ACH
SLOPE	SLOPE	VCH	VCH	VCH	VCH	VCH	VCH	VCH	VCH
SLOPE	SLOPE	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH	XLCH
34.00	2.30	195.20	0.00	0.00	195.25	0.05	0.26	0.01	197.90
275.	0.	275.	0.	0.	160.	0.	153.	19.	197.90
4.07	0.00	1.72	0.00	0.00	0.035	0.035	0.034	192.90	960.78
0000646	590.	590.	590.	2	0	1	0.00	78.44	1039.22

3685 20 TRIALS USED USELK=CUSEL

7185 MIN SPECIFIC ENERGY





1040.	C	I	ME	L
1060.	C	I	ME	L
1080.	C	I	E	L
1100.	C	I	E	L
1120.	C	I	E	L
1140.	C	I	E	L
1160.	C	I	E	L
1180.	C	I	E	L
1200.	C	I	E	L
1220.	C	I	E	L
1240.	C	I	E	L
1260.	C	I	E	L
1280.	C	I	E	L
1300.	C	I	E	L
1320.	C	I	E	L
1340.	C	I	E	L
1360.	C	I	E	L
1380.	C	I	E	L
1400.	C	I	E	L
1420.	C	I	E	L
1440.	C	I	E	L
1460.	C	I	E	L
1480.	C	I	E	L
1500.	C	I	E	L
1520.	C	I	E	L
1540.	C	I	E	L
1560.	C	I	E	L
1580.	C	I	E	L
1600.	C	I	E	L
1620.	C	I	E	L
1640.	C	I	E	L
1660.	C	I	E	L
1680.	C	I	E	L
1700.	C	I	E	L
1720.	C	I	E	L
1740.	C	I	E	L
1760.	C	I	E	L
1780.	C	I	E	L
1800.	C	I	E	L
1820.	C	I	E	L
1840.	C	I	E	L
1860.	C	I	E	L
1880.	C	I	E	L
1900.	C	I	E	L
1920.	C	I	E	L
1940.	C	I	E	L
1960.	C	I	E	L
1980.	C	I	E	L
2000.	C	I	E	L
2020.	C	I	E	L
2040.	C	I	E	L
2060.	C	I	E	L
2080.	C	I	E	L
2100.	C	I	E	L
2120.	C	I	E	L
2140.	C	I	E	L
2160.	C	I	E	L
2180.	C	I	E	L
2200.	C	I	E	L
2220.	C	I	E	L
2240.	C	I	E	L
2260.	C	I	E	L
2280.	C	I	E	L
2300.	C	I	E	L

2320.00	C	I	E	L					
2340.00	C	I	E	L					
2360.00	C	I	E	L					
2380.00	C	I	E	L					
2400.00	C	I	E	L					
2420.00	C	I	E	L					
2440.00	C	I	E	L					
2460.00	C	I	E	L					
2480.00	C	I	E	L					
2500.00	C	I	E	L					
2520.00	C	I	E	L					
2540.00	C	I	E	L					
2560.00	C	I	E	L					
2580.00	C	I	E	L					
2600.00	C	I	E	L					
2620.00	C	I	E	L					
2640.00	C	I	E	L					
2660.00	C	I	E	L					
2680.00	C	I	E	L					
2700.00	C	I	E	L					
2720.00	C	I	E	L					
2740.00	C	I	E	L					
2760.00	C	I	E	L					
2780.00	C	I	E	L					
2800.00	C	I	E	L					
2820.00	C	I	E	L					
2840.00	C	I	E	L					
2860.00	C	I	E	L					
2880.00	C	I	E	L					
2900.00	C	I	E	L					
2920.00	C	I	E	L					
2940.00	C	I	E	L					
2960.00	C	I	E	L					
2980.00	C	I	E	L					
3000.00	C	I	E	L					
3020.00	C	I	E	L					
3040.00	C	I	E	L					
3060.00	C	I	E	L					
3080.00	C	I	E	L					
3100.00	C	I	E	L					
3120.00	C	I	E	L					
3140.00	C	I	E	L					
3160.00	C	I	E	L					
3180.00	C	I	E	L					
3200.00	C	I	E	L					
3220.00	C	I	E	L					
3240.00	C	I	E	L					
3260.00	C	I	E	L					
3280.00	C	I	E	L					
20.00	C	I	E	L					

PROFILE FOR RIVER HYDR. FOR LAKES A, B,

PLOTTED POINTS (BY PRIORITY)-E-ENERGY; H-WATER SURFACE; I-INVERT; C-CRITICAL H.S.; L-LEFT BANK; R-RIGHT BANK; M-LOWER END STA

ELEVATION-FT	160.	165.	170.	175.	180.	185.	190.	195.	200.	205.	210.
SECHO	CUMULIS-FT										
21.00	C				I	M					
3320.					I	E					
3340.	C				I	M					
3360.	C					E					
3380.	C			I							
3400.	C			I							
3420.	C										
3440.	C			I							
3460.	C			I							
3480.	C			I							
3500.	C			I							
3520.	C			I							
3540.	C			I							
23.00	C			I							
3560.	C			I							
3580.	C			I							
3600.	C			I							
3620.	C			I							
3640.	C			I							
3660.	C			I							
3680.	C			I							
3700.	C			I							
3720.	C			I							
3740.	C			I							
3760.	C			I							
3780.	C			I							
25.00	C			I							
3800.	C			I							
3820.	C			I							
3840.	C			I							
3860.	C			I							
3880.	C			I							
3900.	C			I							
3920.	C			I							
3940.	C			I							
3960.	C			I							
3980.	C			I							
4000.	C			I							
4020.	C			I							
4040.	C			I							
4060.	C			I							
4080.	C			I							
4100.	C			I							
4120.	C			I							
4140.	C			I							
26.00	C			I							
4160.	C			I							
4180.	C			I							
4200.	C			I							
4220.	C			I							
4240.	C			I							
4260.	C			I							
4280.	C			I							
4300.	C			I							
4320.	C			I							
4340.	C			I							
4360.	C			I							





**Figure 1.3**

---

Pepperwood Village Drainage Report

**Hydrology and  
Hydraulic Analysis  
for  
Pepperwood Detention Reservoir**

**Pepperwood Addition  
in  
Comotara  
Wichita, Kansas**

August 1979

**Van Doren-Hazard-Stallings  
Architects-Engineers-Planners  
Wichita-Topeka-Minneapolis-Kansas City**

## Table of Contents

	Page No.
I. INTRODUCTION	
A. Purpose	I-1
B. Scope	I-1
II. DESIGN METHODOLOGY	
A. Design Criteria	II-1
B. Hydrology Computation Methods	II-1
III. COMPUTATIONS	
A. Drainage Area	III-1
B. Hydrographs and Detention Reservoir	III-1
IV. APPENDIX	
A. Hydrograph and Routing Printouts	

## SECTION I

### INTRODUCTION

- A. **Purpose:** The purpose of this study is to evaluate the use of detention reservoirs A, B and Pepperwood in the Pepperwood Addition of Comotara development such that there will be no net increase of stormwater runoff from development of the basin and to insure that any reservoir construction meets dam safety requirements. These calculations for the National Dam Safety Requirements will be required only when the storage volume between the top of the structure and the existing channel flowline exceeds 30 acre feet. The Division of Water Resources does not review the reservoir when the volume is less than 30 acre feet and does not require consideration of the PMP events. After initial studies Lakes A and B were combined into one lake which will be referred to as Lake B.
- B. **Scope:** The scope of the study involves the following major tasks:
1. Develop existing and future runoff hydrographs for the 100 year 6 hour storm event.
  2. Develop emergency spillway and freeboard hydrographs when required based on the PMP (Probable Maximum Precipitation) event for the area.
  3. Through the use of reservoir routing, determine the maximum water surface elevations in the detention reservoir for the 100 year 6 hour storm and for the PMP emergency spillway and freeboard hydrographs.
  4. Develop a proposed grading plan for the detention reservoir.

## SECTION II

### DESIGN METHODOLOGY

A. **Design Criteria:** The following criteria were utilized in the development of the detention reservoir:

1. The net increase in peak runoff due to development for the 100 year 6 hour storm event would be zero for the basin.
2. The detention structure would be able to pass the 100 year 6 hour storm and maintain a minimum freeboard of three feet under the condition in item 1 above.
3. Lake B would be classified as "high hazard" and would meet requirements of the Division of Water Resources concerning the PMP (Probable Maximum Precipitation) storm event, i.e., contain the freeboard hydrograph and allow at least 3' freeboard for emergency spillway hydrograph.

B. **Hydrology Computation Methods:** Runoff volumes and peak flows were calculated through the use of SCS (Soil Conservation Service) procedures.

Runoff volumes were determined through the use of SCS Hydrologic Soil Groupings and appropriate runoff curve numbers (CN) for the drainage basin under consideration. Runoff volume was also distributed over the storm duration in accordance with SCS recommendations.

Time of concentration was determined by basin characteristics and through the use of the Kirpich Nomograph

$$T_c = \left( \frac{11.9 L^3}{H} \right)^{.385}$$

L = Length of Basin (miles)  
H = Elevation Difference in Basin (feet)

Unit hydrographs were developed and summed for the 100 year storm as well as the PMP storm event. Computer calculations utilizing SCS Soil Group Numbers, CN, T<sub>c</sub>, drainage basin areas, etc. were performed to develop hydrographs and to provide the inflow hydrographs for routing purposes. The following formula was utilized in the computations:

$$Q_p = \frac{484 AR}{T_p}$$

where A = Area in square miles

R = Total runoff in inches (1 inch for unit hydrograph)

T<sub>p</sub> = Time in hours from start of rise to peak rate

The relationship of T<sub>p</sub> to storm duration and time of concentration was established through the relationship of T<sub>p</sub> = D/2 + 0.6 T<sub>c</sub>. Therefore the formula for peak flow took the form of;

$$Q_p = \frac{484 AR}{D/2 + 0.6 T_c}$$

where D = Duration of storm event (or storm segment for unit hydrograph)

T<sub>c</sub> = Time of concentration

The inflow hydrographs for the various conditions were routed through the detention reservoir by use of a computer model.

In development of the discharge curve, the flow in the outlet pipe was omitted because of its relatively low capacity and the high possibility it could become partially or completely plugged by debris during high flows.

The following references were utilized for the computations:

1. Design of Small Dams - 1974, Bureau of Reclamation.
2. Probable Maximum Precipitation Estimates, U.S. East of 105th Meridian. HR No. 51, U.S. Dept. of Commerce.
3. Earth Dams and Reservoirs, TR 60 U.S. Dept. of Agriculture. SCS.
4. SCS National Engineering Handbook, Section 4.
5. Determination of Peak Discharge From Rainfall Data for Urbanized Basins, Wichita, Kansas, U.S.G.S. Open File Report 78-974.

### SECTION III

#### COMPUTATIONS

- A. **Drainage Areas:** The total drainage area into the Pepperwood Detention Reservoir is 551 acres. The drainage area into Lake B is 233 acres.
- B. **Hydrographs and Detention Reservoir:** To produce the required detention, each of the reservoirs was designed to serve a dual purpose of flood control and also to serve as a recreational lake. The lakes as designed would maintain a normal pool and would attenuate the 100 year 6 hour design storm to compensate for the additional development.

In order to meet landscaping and storage requirements, the general shape of each of the lakes varies considerably from that of existing contours. A small pipe (18 inches in diameter) will be provided to maintain the normal water pool elevation in Lake B. In addition, an emergency spillway would be provided to pass the storm flows based on probable maximum precipitation events.

Pepperwood Detention Reservoir will have a concrete control structure to produce the required detention. The normal water pool elevation will be controlled by a 4 foot notch in this structure.

The following computations and parameters were utilized in the development of the design hydrographs, routing, and dam design.

General Procedure from Ref. 1, p. 76-83

Drainage Area - 143 Acres -  $0.223 \text{ mi.}^2$

Rainfall - Ref. 2

Fig. 18 All season PMP for  $6 \text{ hr. } 10 \text{ m.}^2 = 27.7''$

From Ref. 3, Fig. 2-3

100 Yr, 6 hr. rainfall for 10 square miles

$P = 5.9''$

6 Hr. Rainfall Distributed by the Hour  
(See Graph C, Fig. 2-6, Ref. 3)

Hour	%	PMP - 6 hr.		100 yr. - 6 hr.	
		Accum. Rainfall	Inc. Rainfall	Accum. Rainfall	Inc. Rainfall
1	.08	2.2	2.2	0.5	0.5
2	.22	6.1	3.9	1.3	0.8
3	.70	19.4	13.3	4.1	2.8
4	.84	23.3	3.9	5.0	0.9
5	.93	25.8	2.5	5.5	0.5
6	1.00	27.7	1.9	5.9	0.4

Soil Complex Number (CN)

100 Yr. Storm (Pepperwood and Lake B)

25% Soil Type B, 75% Soil Type D

From Local SCS Office in Wichita

From Ref. 5, p. 19

Existing Condition:

Meadow: good condition

$$CN = 0.25 (58) + (0.75) 78 = 73$$

Future Condition:

1/4 Acre residential lot, 38% impervious

$$CN = 0.25 (75) + (0.75) 87 = 84$$

PMP (Lake B)

From Ref. 1, Table A-7, p. 543

Assume above condition is II

From table:

$$CN = 73 \text{ becomes } CN = 87$$

$$CN = 84 \text{ becomes } CN = 93$$

Dam Design (Lake B)

Assume we are in a high hazard area. Therefore design for following precipitation conditions:

Freeboard Hydrograph - Use PMP

Emergency Spillway Hydrograph - Use  $P_{100} + 0.26 (PMP - P_{100})$

Emergency Spillway - Rainfall (Lake B)

Hour	PMP	P <sub>100</sub>	PMP-P <sub>100</sub>	P <sub>100</sub> + 0.26 (PMP-P <sub>100</sub> )
1	2.2	0.5	1.7	0.9
2	6.1	1.3	4.8	2.5
6	19.4	4.1	15.3	8.1
4	23.3	5.0	18.3	9.8
5	25.8	5.5	20.3	10.8
6	27.7	5.9	21.8	11.6

Emergency Spillway Design

The computer program utilized by Van Doren-Hazard-Stallings to determine routing elevations considers the entire spillway area and is based on a calculated backwater curve. The method currently being used by the Division of Water Resources only recognizes the rectangular spillway areas and gives no credit for backslope areas. However, the results of the two methodologies are so close that mutual agreement can be arrived at easily. The results of the two different methods are presented in the following tables for ease in review.

Lake B  
Storage/Discharge Information

<u>Elevation (ft.)</u>	<u>Accumulated Storage (AFT)</u>	<u>Discharge VHS (cfs)</u>	<u>Discharge Div. of Water Res. (cfs)</u>	
181	0.00	0	0	Normal Pool
182	6.58	0	0	
183	14.00	0	0	Emergency Spillway
184	20.62	15	9	
185	27.80	55	32	
186	36.02	145	112	
187	44.50	510	370	
188	54.22	1070	837	
189	66.00	1800	1441	
190	80.04	2630	2189	
191	96.00	3600	3050	Top of Dam

Pepperwood Detention Reservoir  
Storage/Discharge Information

<u>Elevation (ft.)</u>	<u>Accumulated Storage (AFT)</u>	<u>Discharge (cfs)</u>	
168	0.00	0	Normal Pool
169	8.20	11	
170	16.89	31	Top of Structure
171	26.07	209	
172	35.76	535	
173	45.96	957	
174	56.67	1457	
175	67.90	2023	

Lake B  
Hydrograph and Elevation Information

	Inflow (cfs)	Outflow (cfs)		Elevations	
		VHS	DWR	VHS	DWR
Existing 100 yr.*	412	125	-	185.77	-
Future 2 yr.	139	6	-	183.69	-
Future 100 yr.	541	298	-	186.42	-
Emergency Spillway	1287	1188	1224	188.16	188.64
Freeboard	3071	2974	2956	190.35	190.89
Top of Dam	-	-	-	191.0	
Spillway (Upper Segment)	-	-	-	185.0	
Spillway (Lower Segment)	-	-	-	183.0	
Normal Pool	-	-	-	181.0	

\* 6-Hour Duration on All Design Storms

Pepperwood Detention Reservoir  
Hydrograph and Elevation Information

Existing 100 yr. (cfs)	854
Future Routed 100 yr. (cfs)	777
Future 100 yr. Elevation	172.57
Spillway Elevation (Lower Segment)	168.0
Spillway Elevation (Upper Segment)	170.0
Normal Pool Elevation	160.0
Top of Structure	170.0

Miscellaneous Information

		<u>Lake B</u>	<u>Pepperwood</u>
Spillway (Main Channel)	Width	5	4
	Side Slopes	4:1	0:1
	Top Width	25	4
Spillway (Upper Segment)	Width	75	54
	Side Slopes	4:1	4:1
Flood Storage (100 yr-6 hr)		39.6 Ac.Ft.	41.6 Ac.Ft.
Storage to Top of Structure		96.0 Ac.Ft.	16.9 Ac.Ft.
Outlet Pipe (Normal Pool)		18"	-

Individual hydrographs were developed by computer and the printout data are shown in Appendix A. The existing inflow hydrographs are based on the present undeveloped state of the drainage basin. The design inflow hydrographs are based on the future development of the entire basin. The routed outflow hydrograph indicates the effect of the proposed detention reservoirs on the design inflow hydrographs. The hydrographs of the PMP storm event also indicate the effect of the detention reservoir. The 100 year 6 hour design peak inflow of cfs for the total basin was reduced via storage to a cfs peak on the reservoir outflow hydrograph. This is less than the calculated existing undeveloped peak inflow of cfs, therefore the detention reservoirs will function to prevent any increase in peak runoff rates from the basin due to development. In addition, the Lake B will meet spillway and freeboard requirements to provide adequate dam safety for the PMP storm event.

**APPENDIX A**

**HYDROGRAPH AND  
ROUTING PRINTOUTS**

2 Yr. Future

1/18

HYDROGRAPH FROM RAINFALL AND WATERSHED DATA

HYDROLOGY FOR LAKES A AND B COMBINED - 2 YEAR STORM

WATERSHED DATA

-----

AREA (SQ.MI.) = 0.36  
 LENGTH (MI.) = 0.75  
 HEIGHT (FT.) = 51.00  
 CURVE NUMBER = 84.00  
 TIME OF CONCENTRATION (COMPUTED IF NOT GIVEN) = 0.409 HR.

RAINFALL DATA

-----

TIME (HRS.)	TOTAL ACCUM. RAINFALL (IN.)
1.00	0.19
2.00	0.51
3.00	1.64
4.00	1.97
5.00	2.18
6.00	2.34

OUTPUT HYDROGRAPH--PLOTTING INTERVAL 0.25 HRS.

-----

TIME (HRS.)	DISCHARGE Q CFS
0.25	0.0
0.50	0.0
0.75	0.0
1.00	0.0
1.25	0.0
1.50	0.0
1.75	0.2
2.00	3.5
2.25	25.0
2.50	70.2
2.75	112.4
3.00	139.4
3.25	115.5
3.50	67.7
3.75	51.8
4.00	52.6
4.25	46.5
4.50	37.9
4.75	35.4
5.00	35.7
5.25	32.8
5.50	29.0
5.75	28.0
6.00	28.1
6.25	17.1
6.50	3.9
6.75	0.0

*2 Yr. Future*

*2/18*

OUTFLOW HYDROGRAPH FROM STORAGE AND OUTLET DATA

HYDROLOGY FOR LAKES A AND B COMBINED - 2 YEAR STORM

STORAGE AND OUTFLOW VS. ELEVATION

ELEV. FT.	STORAGE AC.FT.	OUTFLOW CFS
181.00	0.00	0.00
182.00	6.58	0.00
183.00	14.00	0.00
184.00	20.62	9.00
185.00	27.80	32.00
186.00	36.02	112.00
187.00	44.50	370.00
188.00	54.22	837.00
189.00	66.00	1441.00
190.00	80.04	2189.00
191.00	96.00	3050.00

DISCHARGE, STORAGE, AND ELEVATION VS TIME

TIME HRS.	Q-IN CFS	Q-OUT CFS	STORAGE AC.FT.	ELEV. FT.
0.00	0.00	0.00	0.00	181.00
0.25	0.00	0.00	0.00	181.00
0.50	0.00	0.00	0.00	181.00
0.75	0.00	0.00	0.00	181.00
1.00	0.00	0.00	0.00	181.00
1.25	0.00	0.00	0.00	181.00
1.50	0.00	0.00	0.00	181.00
1.75	0.29	0.00	0.00	181.00
2.00	3.54	0.00	0.07	181.01
2.25	25.03	0.00	0.59	181.09
2.50	70.25	0.00	2.04	181.31
2.75	112.49	0.00	4.37	181.66
3.00	139.41	0.00	7.25	182.09
3.25	115.53	0.00	9.64	182.41
3.50	67.79	0.00	11.04	182.60
3.75	51.80	0.00	12.11	182.74
4.00	52.68	0.00	13.19	182.89
4.25	46.52	0.21	14.16	183.02
4.50	37.91	1.26	14.92	183.14
4.75	35.40	2.20	15.62	183.24
5.00	35.72	3.13	16.30	183.34
5.25	32.85	3.96	16.91	183.44
5.50	29.03	4.65	17.42	183.51
5.75	28.00	5.30	17.89	183.58
6.00	28.12	5.93	18.36	183.65
6.25	17.15	6.24	18.59	183.69
6.50	3.91	6.17	18.54	183.68
6.75	0.00	6.17	18.54	183.68

100 Yr. Existing

3/18

HYDROGRAPH FROM RAINFALL AND WATERSHED DATA

HYDROLOGY FOR LAKES A AND B COMBINED

WATERSHED DATA

AREA (SQ. MI.) = 0.36  
LENGTH (MI.) = 0.75  
HEIGHT (FT.) = 51.00  
CURVE NUMBER = 73.00  
TIME OF CONCENTRATION (COMPUTED IF NOT GIVEN) = 0.409 HR.

RAINFALL DATA

TIME (HRS.)	TOTAL ACCUM. RAINFALL (IN.)
1.00	0.50
2.00	1.30
3.00	4.10
4.00	5.00
5.00	5.50
6.00	5.90

OUTPUT HYDROGRAPH--PLOTING INTERVAL 0.25 HRS.

TIME (HRS.)	DISCHARGE Q CFS
-------------	--------------------

0.25	0.0
0.50	0.0
0.75	0.0
1.00	0.0
1.25	0.0
1.50	1.8
1.75	11.9
2.00	30.0
2.25	107.3
2.50	244.2
2.75	352.5
3.00	411.6
3.25	336.5
3.50	203.3
3.75	159.2
4.00	160.9
4.25	136.6
4.50	103.5
4.75	93.4
5.00	93.9
5.25	87.5
5.50	79.0
5.75	76.7
6.00	76.8
6.25	46.8
6.50	10.6
6.75	0.0

100 Yr. Existing 4/18

OUTFLOW HYDROGRAPH FROM STORAGE AND OUTLET DATA

HYDROLOGY FOR LAKES A AND B COMBINED

STORAGE AND OUTFLOW VS. ELEVATION

ELEV. FT.	STORAGE AC.FT.	OUTFLOW CFS
181.00	0.00	0.00
182.00	6.58	0.00
183.00	14.00	0.00
184.00	20.62	15.00
185.00	27.80	55.00
186.00	36.02	145.00
187.00	44.50	510.00
188.00	54.22	1070.00
189.00	66.00	1800.00
190.00	80.04	2630.00

DISCHARGE, STORAGE, AND ELEVATION VS TIME

TIME HRS.	Q-IN CFS	Q-OUT CFS	STORAGE AC.FT.	ELEV. FT.
0.00	0.00	0.00	0.00	181.00
0.25	0.00	0.00	0.00	181.00
0.50	0.00	0.00	0.00	181.00
0.75	0.00	0.00	0.00	181.00
1.00	0.00	0.00	0.00	181.00
1.25	0.00	0.00	0.00	181.00
1.50	1.80	0.00	0.03	181.00
1.75	11.92	0.00	0.28	181.04
2.00	30.02	0.00	0.90	181.13
2.25	107.38	0.00	3.12	181.47
2.50	244.23	0.00	8.16	182.21
2.75	352.50	3.29	15.45	183.21
3.00	411.66	32.04	23.67	184.42
3.25	336.59	74.55	29.58	185.21
3.50	203.34	100.42	31.94	185.50
3.75	159.29	112.38	33.04	185.63
4.00	160.98	122.22	33.93	185.74
4.25	136.63	124.99	34.19	185.77
4.50	103.56	120.58	33.79	185.72
4.75	93.42	115.10	33.29	185.66
5.00	93.95	110.87	32.90	185.62
5.25	87.51	106.18	32.47	185.56
5.50	79.02	100.76	31.97	185.50
5.75	76.71	96.00	31.54	185.45
6.00	76.88	92.26	31.20	185.41
6.25	46.83	83.09	30.36	185.31
6.50	10.68	68.54	29.03	185.15
6.75	0.00	68.54	29.03	185.15

100 Yr. Future

5/18

HYDROGRAPH FROM RAINFALL AND WATERSHED DATA

HYDROLOGY FOR LAKES A AND B COMBINED

WATERSHED DATA

AREA (SQ.MI.) = 0.36  
LENGTH (MI.) = 0.75  
HEIGHT (FT.) = 51.00  
CURVE NUMBER = 84.00  
TIME OF CONCENTRATION (COMPUTED IF NOT GIVEN) = 0.409 HR.

RAINFALL DATA

TIME (HRS.)	TOTAL ACCUM. RAINFALL (IN.)
1.00	0.50
2.00	1.30
3.00	4.10
4.00	5.00
5.00	5.50
6.00	5.90

OUTPUT HYDROGRAPH--PLOTING INTERVAL 0.25 HRS.

TIME (HRS.)	DISCHARGE Q CFS
-------------	--------------------

0.25	0.0
0.50	0.0
0.75	0.0
1.00	2.1
1.25	16.5
1.50	41.9
1.75	65.8
2.00	89.3
2.25	215.4
2.50	401.0
2.75	506.4
3.00	540.5
3.25	421.5
3.50	247.4
3.75	190.1
4.00	190.1
4.25	160.0
4.50	120.4
4.75	108.0
5.00	108.1
5.25	100.3
5.50	90.3
5.75	87.3
6.00	87.3
6.25	53.0
6.50	12.1
6.75	0.0

100 Year Future

6/18

OUTFLOW HYDROGRAPH FROM STORAGE AND OUTLET DATA

HYDROLOGY FOR LAKES A AND B COMBINED

STORAGE AND OUTFLOW VS. ELEVATION

ELEV. FT.	STORAGE AC.FT.	OUTFLOW CFS
181.00	0.00	0.00
182.00	6.58	0.00
183.00	14.00	0.00
184.00	20.62	15.00
185.00	27.80	55.00
186.00	36.02	145.00
187.00	44.50	510.00
188.00	54.22	1070.00
189.00	66.00	1800.00
190.00	80.04	2630.00

DISCHARGE, STORAGE, AND ELEVATION VS TIME

TIME HRS.	Q-IN CFS	Q-OUT CFS	STORAGE AC.FT.	ELEV. FT.
0.00	0.00	0.00	0.00	181.00
0.25	0.00	0.00	0.00	181.00
0.50	0.00	0.00	0.00	181.00
0.75	0.00	0.00	0.00	181.00
1.00	2.11	0.00	0.04	181.00
1.25	16.53	0.00	0.38	181.05
1.50	41.98	0.00	1.25	181.19
1.75	65.86	0.00	2.61	181.39
2.00	89.36	0.00	4.45	181.67
2.25	215.41	0.00	8.91	182.31
2.50	401.09	7.21	17.18	183.48
2.75	506.42	51.41	27.15	184.91
3.00	540.50	155.79	36.27	186.02
3.25	421.55	298.37	39.58	186.42
3.50	247.48	258.81	38.66	186.31
3.75	190.19	213.62	37.61	186.18
4.00	190.16	195.23	37.18	186.13
4.25	160.07	168.75	36.57	186.06
4.50	120.49	142.69	35.80	185.97
4.75	108.07	135.40	35.14	185.89
5.00	108.19	129.63	34.61	185.82
5.25	100.38	123.44	34.05	185.76
5.50	90.31	116.51	33.41	185.68
5.75	87.38	110.44	32.86	185.61
6.00	87.31	105.60	32.42	185.56
6.25	53.09	94.70	31.42	185.44
6.50	12.10	77.80	29.88	185.25
6.75	0.00	77.80	29.88	185.25

7/18

HYDROGRAPH FROM RAINFALL AND WATERSHED DATA

HYDROLOGY FOR LAKES A AND B COMBINED - EMERGENCY SPILLWAY

WATERSHED DATA

-----  
AREA (SQ. MI.) = 0.36  
LENGTH (MI.) = 0.75  
HEIGHT (FT.) = 51.00  
CURVE NUMBER = 93.00  
TIME OF CONCENTRATION (COMPUTED IF NOT GIVEN) = 0.409 HR.

RAINFALL DATA

-----  
TIME (HRS.)      TOTAL ACCUM.  
                    RAINFALL (IN.)  
1.00              0.90  
2.00              2.50  
3.00              8.10  
4.00              9.80  
5.00              10.80  
6.00              11.60

OUTPUT HYDROGRAPH--PLOTING INTERVAL 0.25 HRS.

-----  
TIME (HRS.)      DISCHARGE Q  
                    CFS  
0.25              4.3  
0.50              31.0  
0.75              83.8  
1.00              128.8  
1.25              204.4  
1.50              289.5  
1.75              329.7  
2.00              360.1  
2.25              702.6  
2.50              1134.7  
2.75              1288.6  
3.00              1280.1  
3.25              954.5  
3.50              534.2  
3.75              396.7  
4.00              394.0  
4.25              334.6  
4.50              258.0  
4.75              233.7  
5.00              233.3  
5.25              215.9  
5.50              193.8  
5.75              187.1  
6.00              186.6  
6.25              113.3  
6.50              25.8  
6.75              0.0

8/18

OUTFLOW HYDROGRAPH FROM STORAGE AND OUTLET DATA

HYDROLOGY FOR LAKES A AND B COMBINED - EMERGENCY SPILLWAY

STORAGE AND OUTFLOW VS. ELEVATION

ELEV. FT.	STORAGE AC.FT.	OUTFLOW CFS
181.00	0.00	0.00
182.00	6.58	0.00
183.00	14.00	0.00
184.00	20.62	15.00
185.00	27.80	55.00
186.00	36.02	145.00
187.00	44.50	510.00
188.00	54.22	1070.00
189.00	66.00	1800.00
190.00	80.04	2630.00
191.00	96.00	3600.00

DISCHARGE, STORAGE, AND ELEVATION VS TIME

TIME HRS.	Q-IN CFS	Q-OUT CFS	STORAGE AC.FT.	ELEV. FT.
0.00	0.00	0.00	0.00	181.00
0.25	4.37	0.00	0.09	181.01
0.50	31.06	0.00	0.73	181.11
0.75	83.84	0.00	2.46	181.37
1.00	128.86	0.00	5.12	181.77
1.25	204.47	0.00	9.35	182.37
1.50	289.54	3.02	15.33	183.20
1.75	329.72	22.29	21.92	184.18
2.00	360.16	63.04	28.53	185.08
2.25	702.61	339.61	40.54	186.53
2.50	1134.72	909.12	51.42	187.71
2.75	1288.69	1187.76	56.12	188.16
3.00	1280.18	1251.95	57.15	188.24
3.25	954.54	1005.11	53.09	187.88
3.50	534.25	664.12	47.17	187.27
3.75	396.79	491.18	44.06	186.94
4.00	394.08	439.70	42.86	186.80
4.25	334.66	381.46	41.51	186.64
4.50	258.09	315.14	39.97	186.46
4.75	233.76	276.04	39.06	186.35
5.00	233.35	260.42	38.70	186.31
5.25	215.94	243.50	38.30	186.26
5.50	193.83	224.50	37.86	186.21
5.75	187.14	213.73	37.61	186.18
6.00	186.64	209.46	37.51	186.17
6.25	113.37	161.37	36.40	186.04
6.50	25.82	125.10	34.20	185.77
6.75	0.00	125.10	34.20	185.77

9/8

HYDROGRAPH FROM RAINFALL AND WATERSHED DATA

HYDROLOGY FOR LAKES A AND B COMBINED - EMERGENCY SPILLWAY DWR

WATERSHED DATA

AREA (SQ.MI.) = 0.36  
LENGTH (MI.) = 0.75  
HEIGHT (FT.) = 51.00  
CURVE NUMBER = 93.00  
TIME OF CONCENTRATION (COMPUTED IF NOT GIVEN) = 0.409 HR.

RAINFALL DATA

TIME (HRS.)	TOTAL ACCUM. RAINFALL (IN.)
1.00	0.90
2.00	2.50
3.00	8.10
4.00	9.80
5.00	10.80
6.00	11.60

OUTPUT HYDROGRAPH--PLOTING INTERVAL 0.25 HRS.

TIME (HRS.)	DISCHARGE Q CFS
0.25	4.3
0.50	31.0
0.75	83.8
1.00	128.8
1.25	204.4
1.50	289.5
1.75	329.7
2.00	360.1
2.25	702.6
2.50	1134.7
2.75	1288.6
3.00	1280.1
3.25	954.5
3.50	534.2
3.75	396.7
4.00	394.0
4.25	334.6
4.50	258.0
4.75	233.7
5.00	233.3
5.25	215.9
5.50	193.8
5.75	187.1
6.00	186.6
6.25	113.3
6.50	25.8
6.75	0.0

10/18

OUTFLOW HYDROGRAPH FROM STORAGE AND OUTLET DATA

HYDROLOGY FOR LAKES A AND B COMBINED - EMERGENCY SPILLWAY DWR

STORAGE AND OUTFLOW VS. ELEVATION

ELEV. FT.	STORAGE AC.FT.	OUTFLOW CFS
181.00	0.00	0.00
182.00	6.58	0.00
183.00	14.00	0.00
184.00	20.62	9.00
185.00	27.80	32.00
186.00	36.02	112.00
187.00	44.50	370.00
188.00	54.22	837.00
189.00	66.00	1441.00
190.00	80.04	2189.00
191.00	96.00	3050.00

DISCHARGE, STORAGE, AND ELEVATION VS TIME

TIME HRS.	Q-IN CFS	Q-OUT CFS	STORAGE AC.FT.	ELEV. FT.
0.00	0.00	0.00	0.00	181.00
0.25	4.37	0.00	0.09	181.01
0.50	31.06	0.00	0.73	181.11
0.75	83.84	0.00	2.46	181.37
1.00	128.86	0.00	5.12	181.77
1.25	204.47	0.00	9.35	182.37
1.50	289.54	1.81	15.33	183.20
1.75	329.72	13.46	22.01	184.19
2.00	360.16	43.22	28.95	185.14
2.25	702.61	277.43	41.45	186.64
2.50	1134.72	821.98	53.90	187.96
2.75	1288.69	1129.97	59.93	188.48
3.00	1280.18	1223.89	61.76	188.64
3.25	954.54	1016.49	57.72	188.29
3.50	534.25	695.11	51.26	187.69
3.75	396.79	510.01	47.41	187.29
4.00	394.08	440.75	45.97	187.15
4.25	334.66	375.28	44.60	187.01
4.50	258.09	321.61	42.90	186.81
4.75	233.76	284.10	41.67	186.66
5.00	233.35	264.33	41.02	186.59
5.25	215.94	245.50	40.40	186.51
5.50	193.83	225.72	39.75	186.44
5.75	187.14	212.58	39.32	186.38
6.00	186.64	205.60	39.09	186.36
6.25	113.37	165.99	37.79	186.20
6.50	25.82	109.67	35.78	185.97
6.75	0.00	109.67	35.78	185.97

11/18

HYDROGRAPH FROM RAINFALL AND WATERSHED DATA

HYDROLOGY FOR LAKES A AND B COMBINED - PMP

WATERSHED DATA

-----  
AREA (SQ.MI.)= 0.36  
LENGTH (MI.) = 0.75  
HEIGHT (FT.) = 51.00  
CURVE NUMBER = 93.00  
TIME OF CONCENTRATION (COMPUTED IF NOT GIVEN) = 0.409 HR.

RAINFALL DATA

-----  
TIME (HRS.)      TOTAL ACCUM.  
                    RAINFALL (IN.)  
1.00              2.20  
2.00              6.10  
3.00              19.40  
4.00              23.30  
5.00              25.80  
6.00              27.70

OUTPUT HYDROGRAPH--PLOTING INTERVAL 0.25 HRS.

-----  
TIME (HRS.)      DISCHARGE Q  
                    CFS  
0.25              37.8  
0.50              207.9  
0.75              371.0  
1.00              449.1  
1.25              621.0  
1.50              817.0  
1.75              888.2  
2.00              939.2  
2.25              1755.1  
2.50              2771.4  
2.75              3110.7  
3.00              3070.7  
3.25              2271.6  
3.50              1249.1  
3.75              915.0  
4.00              909.2  
4.25              789.6  
4.50              635.6  
4.75              586.7  
5.00              585.3  
5.25              532.8  
5.50              466.1  
5.75              445.9  
6.00              444.7  
6.25              270.1  
6.50              61.5  
6.75              0.0

12/18

OUTFLOW HYDROGRAPH FROM STORAGE AND OUTLET DATA

HYDROLOGY FOR LAKES A AND B COMBINED - PMP

STORAGE AND OUTFLOW VS. ELEVATION

ELEV. FT.	STORAGE AC.FT.	OUTFLOW CFS
181.00	0.00	0.00
182.00	6.58	0.00
183.00	14.00	0.00
184.00	20.62	15.00
185.00	27.80	55.00
186.00	36.02	145.00
187.00	44.50	510.00
188.00	54.22	1070.00
189.00	66.00	1800.00
190.00	80.04	2630.00
191.00	96.00	3600.00

DISCHARGE, STORAGE, AND ELEVATION VS TIME

TIME HRS.	Q-IN CFS	Q-OUT CFS	STORAGE AC.FT.	ELEV. FT.
0.00	0.00	0.00	0.00	181.00
0.25	37.81	0.00	0.78	181.11
0.50	207.91	0.00	5.07	181.77
0.75	371.08	0.00	12.74	182.83
1.00	449.12	21.97	21.87	184.17
1.25	621.06	117.74	33.53	185.69
1.50	817.00	504.25	44.36	186.98
1.75	888.22	768.59	48.98	187.46
2.00	939.20	891.38	51.11	187.68
2.25	1755.15	1600.14	62.77	188.72
2.50	2771.41	2467.00	77.28	189.80
2.75	3110.76	2902.01	84.51	190.28
3.00	3070.79	2973.87	85.69	190.35
3.25	2271.60	2350.46	75.31	189.66
3.50	1249.18	1485.19	60.92	188.56
3.75	915.00	1050.85	53.88	187.96
4.00	909.24	934.03	51.85	187.75
4.25	789.62	809.24	49.69	187.53
4.50	635.68	673.08	47.33	187.29
4.75	586.71	605.98	46.16	187.17
5.00	585.34	587.17	45.83	187.13
5.25	532.83	542.85	45.07	187.05
5.50	466.18	493.13	44.10	186.95
5.75	445.97	467.17	43.50	186.88
6.00	444.70	456.86	43.26	186.85
6.25	270.12	342.19	40.60	186.54
6.50	61.52	177.55	36.77	186.08
6.75	0.00	177.55	36.77	186.08

13/  
18

HYDROGRAPH FROM RAINFALL AND WATERSHED DATA

HYDROLOGY FOR LAKES A AND B COMBINED - PMP (DWR)

WATERSHED DATA

AREA (SQ.MI.) = 0.36  
LENGTH (MI.) = 0.75  
HEIGHT (FT.) = 51.00  
CURVE NUMBER = 93.00  
TIME OF CONCENTRATION (COMPUTED IF NOT GIVEN) = 0.409 HR.

RAINFALL DATA

TIME (HRS.)	TOTAL ACCUM. RAINFALL (IN.)
1.00	2.20
2.00	6.10
3.00	19.40
4.00	23.30
5.00	25.80
6.00	27.70

OUTPUT HYDROGRAPH--PLOTING INTERVAL 0.25 HRS.

TIME (HRS.)	DISCHARGE Q CFS
0.25	37.8
0.50	207.9
0.75	371.0
1.00	449.1
1.25	621.0
1.50	817.0
1.75	888.2
2.00	939.2
2.25	1755.1
2.50	2771.4
2.75	3110.7
3.00	3070.7
3.25	2271.6
3.50	1249.1
3.75	915.0
4.00	909.2
4.25	789.6
4.50	635.6
4.75	586.7
5.00	585.3
5.25	532.8
5.50	466.1
5.75	445.9
6.00	444.7
6.25	270.1
6.50	61.5
6.75	0.0

14/18

OUTFLOW HYDROGRAPH FROM STORAGE AND OUTLET DATA

HYDROLOGY FOR LAKES A AND B COMBINED - PMP (DWR)

STORAGE AND OUTFLOW VS. ELEVATION

ELEV. FT.	STORAGE AC.FT.	OUTFLOW CFS
181.00	0.00	0.00
182.00	6.58	0.00
183.00	14.00	0.00
184.00	20.62	9.00
185.00	27.80	32.00
186.00	36.02	112.00
187.00	44.50	370.00
188.00	54.22	837.00
189.00	66.00	1441.00
190.00	80.04	2189.00
191.00	96.00	3050.00

DISCHARGE, STORAGE, AND ELEVATION VS TIME

TIME HRS.	Q-IN CFS	Q-OUT CFS	STORAGE AC.FT.	ELEV. FT.
0.00	0.00	0.00	0.00	181.00
0.25	37.81	0.00	0.78	181.11
0.50	207.91	0.00	5.07	181.77
0.75	371.08	0.00	12.74	182.83
1.00	449.12	13.20	21.93	184.18
1.25	621.06	92.27	33.99	185.75
1.50	817.00	435.86	45.87	187.14
1.75	888.22	718.26	51.74	187.74
2.00	939.20	861.51	54.69	188.04
2.25	1755.15	1513.39	67.35	189.09
2.50	2771.41	2386.17	83.69	190.22
2.75	3110.76	2850.85	92.30	190.76
3.00	3070.79	2956.19	94.26	190.89
3.25	2271.60	2386.02	83.69	190.22
3.50	1249.18	1560.85	68.24	189.16
3.75	915.00	1117.61	59.69	188.46
4.00	909.24	964.62	56.70	188.21
4.25	789.62	828.92	54.05	187.98
4.50	635.68	694.03	51.24	187.69
4.75	586.71	619.66	49.69	187.53
5.00	585.34	593.12	49.14	187.47
5.25	532.83	548.73	48.22	187.38
5.50	466.18	493.67	47.07	187.26
5.75	445.97	463.68	46.44	187.20
6.00	444.70	453.18	46.23	187.17
6.25	270.12	344.88	43.67	186.90
6.50	61.52	212.24	39.31	186.38
6.75	0.00	212.24	39.31	186.38

100 Existing

15/18

HYDROGRAPH FROM RAINFALL AND WATERSHED DATA

PEPPERWOOD LAKE 100 YEAR HYDROGRAPH

WATERSHED DATA

-----

AREA (SQ. MI.) = 0.86 - *Total Watershed*  
 LENGTH (MI.) = 1.25  
 HEIGHT (FT.) = 61.00  
 CURVE NUMBER = 73.00  
 TIME OF CONCENTRATION (COMPUTED IF NOT GIVEN) = 0.694 HR.

RAINFALL DATA

-----

TIME (HRS.)	TOTAL ACCUM. RAINFALL (IN.)
1.00	0.50
2.00	1.30
3.00	4.10
4.00	5.00
5.00	5.50
6.00	5.90

OUTPUT HYDROGRAPH--PLOTING INTERVAL 0.25 HRS.

-----  
TIME (HRS.) DISCHARGE Q  
CFS

0.25	0.0
0.50	0.0
0.75	0.0
1.00	0.0
1.25	0.0
1.50	1.7
1.75	13.8
2.00	37.6
2.25	139.8
2.50	345.4
2.75	594.7
3.00	821.7
3.25	853.9
3.50	694.7
3.75	527.9
4.00	414.8
4.25	355.1
4.50	302.5
4.75	258.0
5.00	229.9
5.25	215.3
5.50	201.8
5.75	190.6
6.00	168.8
6.25	114.5
6.50	55.4
6.75	18.6
7.00	0.2

100 Yr. Future

10/18

HYDROGRAPH FROM RAINFALL AND WATERSHED DATA

PEPPERWOOD LAKE 100 YEAR HYDROGRAPH

WATERSHED DATA

AREA (SQ. MI.) = 0.49 - Area minus Lake B D.A.  
 LENGTH (MI.) = 1.25  
 HEIGHT (FT.) = 61.00  
 CURVE NUMBER = 84.00  
 TIME OF CONCENTRATION (COMPUTED IF NOT GIVEN) = 0.694 HR.

RAINFALL DATA

TIME (HRS.)	TOTAL ACCUM. RAINFALL (IN.)
1.00	0.50
2.00	1.30
3.00	4.10
4.00	5.00
5.00	5.50
6.00	5.90

OUTPUT HYDROGRAPH--PLOTING INTERVAL 0.25 HRS.

TIME (HRS.)	DISCHARGE Q CFS	Lake B Discharge	Total
0.25	13.2	0.00	13.2
0.50	26.4	0.00	26.4
0.75	18.5	0.00	18.5
1.00	11.6	0.00	11.6
1.25	13.4	0.00	13.4
1.50	32.0	0.00	32.0
1.75	61.2	0.00	61.2
2.00	91.0	0.00	91.0
2.25	186.0	0.00	186.0
2.50	360.1	7.21	367.3
2.75	534.6	51.41	586.0
3.00	670.5	155.79	826.3
3.25	654.2	298.37	952.6
3.50	508.7	258.81	767.5
3.75	374.6	213.62	588.2
4.00	286.7	195.23	481.9
4.25	242.2	168.75	411.0
4.50	204.7	142.69	347.4
4.75	173.4	135.40	308.8
5.00	153.5	129.63	283.1
5.25	143.0	123.44	266.4
5.50	133.6	116.51	250.1
5.75	125.7	110.44	236.1
6.00	111.0	105.60	216.6
6.25	75.2	94.70	169.9
6.50	36.3	77.80	114.1
6.75	12.2	77.80	90.0
7.00	0.1		

100 Yr. Future

17/18

HYDROGRAPH FROM RAINFALL AND WATERSHED DATA

PEPPERWOOD LAKE 100 YEAR HYDROGRAPH

WATERSHED DATA

AREA (SQ. MI.) = 0.86  
LENGTH (MI.) = 1.25  
HEIGHT (FT.) = 61.00  
CURVE NUMBER = 73.00  
TIME OF CONCENTRATION (COMPUTED IF NOT GIVEN) = 0.694 HR.

RAINFALL DATA

TIME (HRS.)	TOTAL ACCUM. RAINFALL (IN.)
1.00	0.50
2.00	1.30
3.00	4.10
4.00	5.00
5.00	5.50
6.00	5.90

OUTPUT HYDROGRAPH--PLOTING INTERVAL 0.25 HRS.

TIME (HRS.)	DISCHARGE Q CFS
-------------	--------------------

0.25	13.2
0.50	26.4
0.75	18.5
1.00	11.6
1.25	13.4
1.50	32.0
1.75	61.2
2.00	91.0
2.25	186.0
2.50	367.3
2.75	586.0
3.00	826.3
3.25	952.6
3.50	767.5
3.75	588.2
4.00	481.9
4.25	411.0
4.50	347.4
4.75	308.8
5.00	283.1
5.25	266.4
5.50	250.1
5.75	236.1
6.00	216.6
6.25	169.9
6.50	114.1
6.75	90.0
7.00	0.0

Note: This hydrograph  
feed in from  
calculations on  
p 16.

100 Yr Future

18/18

OUTFLOW HYDROGRAPH FROM STORAGE AND OUTLET DATA

PEPPERWOOD LAKE 100 YEAR HYDROGRAPH

STORAGE AND OUTFLOW VS. ELEVATION

ELEV. FT.	STORAGE AC.FT.	OUTFLOW CFS
168.00	0.00	0.00
169.00	8.20	11.00
170.00	16.89	31.00
171.00	26.07	209.00
172.00	35.76	535.00
173.00	45.96	957.00
174.00	56.67	1457.00
175.00	67.90	2023.00

DISCHARGE, STORAGE, AND ELEVATION VS TIME

TIME HRS.	Q-IN CFS	Q-OUT CFS	STORAGE AC.FT.	ELEV. FT.
0.00	0.00	0.00	0.00	168.00
0.25	13.20	0.36	0.26	168.03
0.50	26.40	1.07	0.79	168.09
0.75	18.50	1.54	1.15	168.14
1.00	11.60	1.82	1.35	168.16
1.25	13.40	2.14	1.59	168.19
1.50	32.00	2.95	2.20	168.26
1.75	61.20	4.54	3.39	168.41
2.00	91.00	6.91	5.15	168.62
2.25	186.00	12.38	8.80	169.06
2.50	367.30	28.87	15.96	169.89
2.75	586.00	204.18	25.82	170.97
3.00	826.30	522.67	35.39	171.96
3.25	952.60	776.72	41.60	172.57
3.50	767.50	767.59	41.38	172.55
3.75	588.20	658.11	38.73	172.29
4.00	481.90	551.69	36.16	172.03
4.25	411.00	477.81	34.06	171.82
4.50	347.40	411.37	32.08	171.62
4.75	308.80	359.83	30.55	171.46
5.00	283.10	322.02	29.42	171.34
5.25	266.40	295.54	28.64	171.26
5.50	250.10	274.80	28.02	171.20
5.75	236.10	257.93	27.52	171.15
6.00	216.60	240.06	26.99	171.09
6.25	169.90	208.23	26.03	170.99
6.50	114.10	178.32	24.48	170.82
6.75	90.00	58.21	18.29	170.15
7.00	0.00	17.57	11.05	169.32

**Figure 1.4**

---

Plat

# FINAL PLAT

## NORTH POINTE SENIOR LIVING ADDITION

### AN ADDITION TO WICHITA, SEDGWICK COUNTY, KANSAS

#### CERTIFICATE OF SURVEY

We MKEC Engineering Consultants, Inc., a Registered Corporate Land Surveyor in Kansas, do hereby certify that we have been in responsible charge of surveying and plating of "NORTH POINTE SENIOR LIVING ADDITION" an addition to Wichita, Sedgwick County, Kansas, into a Lot, and a Block, the same being accurately set forth in the accompanying plat and described herein:

A tract of land lying in Lots 2, 3, 4, and 5, Block 1, Lot 1, Block 2 and a portion of Reserve "A", all in Woodlawn North Pointe Addition, an addition to Wichita, Sedgwick County, Kansas, being more particularly described as follows:

COMMENCING at the SW corner Northwest Quarter, Section 6, Township 27 South, Range 2 East of the 6th P.M., Sedgwick County, Kansas; thence along the West line of said Northwest Quarter on a Kansas South zone grid bearing of N00°43'23"E, 890.77 feet; thence N89°16'36"E, 59.88 feet to a point on the East right-of-way of North Woodlawn Boulevard, said point being the POINT OF BEGINNING; thence along said right-of-way, N00°43'18"W, 147.00 feet; thence along the south line of Lot 1, Block 1, of said Addition, the next three (3) calls: S45°43'21"E, 61.51 feet; thence N89°16'36"E, 102.29 feet to a point on a curve to the left; thence along said curve, 98.82 feet, bearing N89°15'13"E, to the Northeast corner of said Lot 1; thence along the East line of said Addition, N89°19'18"E, 329.28 feet to the Northeast corner of said Addition; thence along the North line of said Addition, S00°54'44"E, 528.23 feet to the Southeast corner of said Addition; thence along the East line of said Addition, S89°20'44"W, 723.49 feet to the Southwest corner of said Lot 1, Block 2; thence along the West line of said Lot 1, the next two (2) calls: on a curve to the left, 110.64 feet, said curve having a central angle of 10°03'43", a radius of 630.00 feet, and a long chord of 110.50 feet, bearing N11°46'25"W, thence N16°48'17"W, 57.09 feet to the Northwest corner of said Lot 1; thence on a curve to the right, 178.77 feet, said curve having a central angle of 12°50'12", a radius of 530.00 feet, and a long chord of 177.93 feet bearing S79°36'49"W; thence S89°16'36"W, 102.28 feet; thence S44°16'39"W, 61.52 feet to the POINT OF BEGINNING.

The dedicated streets and/or public rights-of-way, platted easements, building setbacks, access control, and public dedications within the above described property, are hereby vacated and replatted by virtue of K.S.A. 12-512(b).

I hereby certify that the details of this plat are correct to the best of my knowledge and belief this \_\_\_ day of 2009.

Gregory J. Allison, PE, LS #1257  
MKEC Engineering Consultants, Inc.  
411 North Webb Road  
Wichita, Kansas 67206

#### OWNER'S CERTIFICATE

Know all men by these presents that the undersigned property owners of the land above set forth in the Registered Land Surveyor's Certificate, have caused the same to be surveyed and platted into a Lot and a Block, the same to be known as "NORTH POINTE SENIOR LIVING ADDITION" an addition to Wichita, Sedgwick County, Kansas. Easements for the construction and maintenance of public utilities and drainage, as indicated on the accompanying plat are hereby granted to the public. The City of Wichita is hereby granted the right to enter upon said premises at any time for the purposes of operating, maintaining, and repairing and or removing utilities. This temporary easement shall expire and terminate upon the removal and or abandonment of the utilities contained within said easement. Reserve "A" is platted for a private street, landscaping, irrigation, drainage, utilities, street lights, monuments, signs, and parking. The Reserve shall be owned and maintained by the lot owner's association and/or the owners of Lot 1, Block 1. All abutters rights of access to or from N. Woodlawn Blvd. over and across the west line of "NORTH POINTE SENIOR LIVING ADDITION," are hereby granted to the appropriate governing body, as indicated hereon. A drainage plan has been developed for this plat. All drainage easements, rights-of-way, and reserves shall remain at established grades or as modified with the approval of the applicable City or County Engineer, and unobstructed to allow for the conveyance of storm water.

NORTH POINTE SENIOR LIVING, LLC, a Kansas limited liability company

\_\_\_\_\_, Member  
Larry D. Wilkerson, Member  
\_\_\_\_\_, Member  
Carol Sue Wilkerson, Member

STATE OF KANSAS, \_\_\_\_\_ COUNTY) ss:

This instrument was acknowledged before me on \_\_\_ day of \_\_\_\_\_, 2009, by Larry D. Wilkerson and Carol Sue Wilkerson, members, North Pointe Senior Living, LLC, a Kansas limited liability company.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal, the day and year last above written.

My Term Expires: \_\_\_\_\_ Notary Public  
\_\_\_\_\_, Notary Public

#### MORTGAGE CERTIFICATE

Midland National Bank, holder of a mortgage on the above described property, does hereby consent to the plat of "NORTH POINTE SENIOR LIVING ADDITION."

MIDLAND NATIONAL BANK

\_\_\_\_\_, Sr. Vice President  
Dwight W. Ray, Sr. Vice President

This instrument was acknowledged before me on this \_\_\_ day of \_\_\_\_\_, 2009, by Dwight W. Ray, Sr. Vice President, Midland National Bank.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal, the day and year last above written.

\_\_\_\_\_, Notary Public  
\_\_\_\_\_, Notary Public

My Term Expires: \_\_\_\_\_

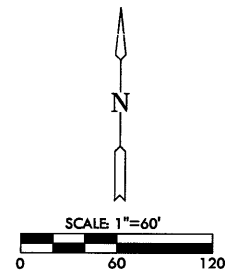


411 N. WEBB ROAD  
WICHITA, KS. 67206  
316-684-9600

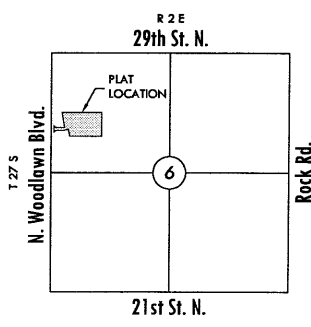
- #### LEGEND
- △ = Section Corner Monument Found
  - = Found Monument as shown
  - = Set 3/8" Rebar w/ MKEC CLS 39 id. cap
  - (M) = Measured
  - (P) = Platted
  - C.A.C. = Complete Access Control
  - ▨ = Temporary Easement

#### BENCH MARK

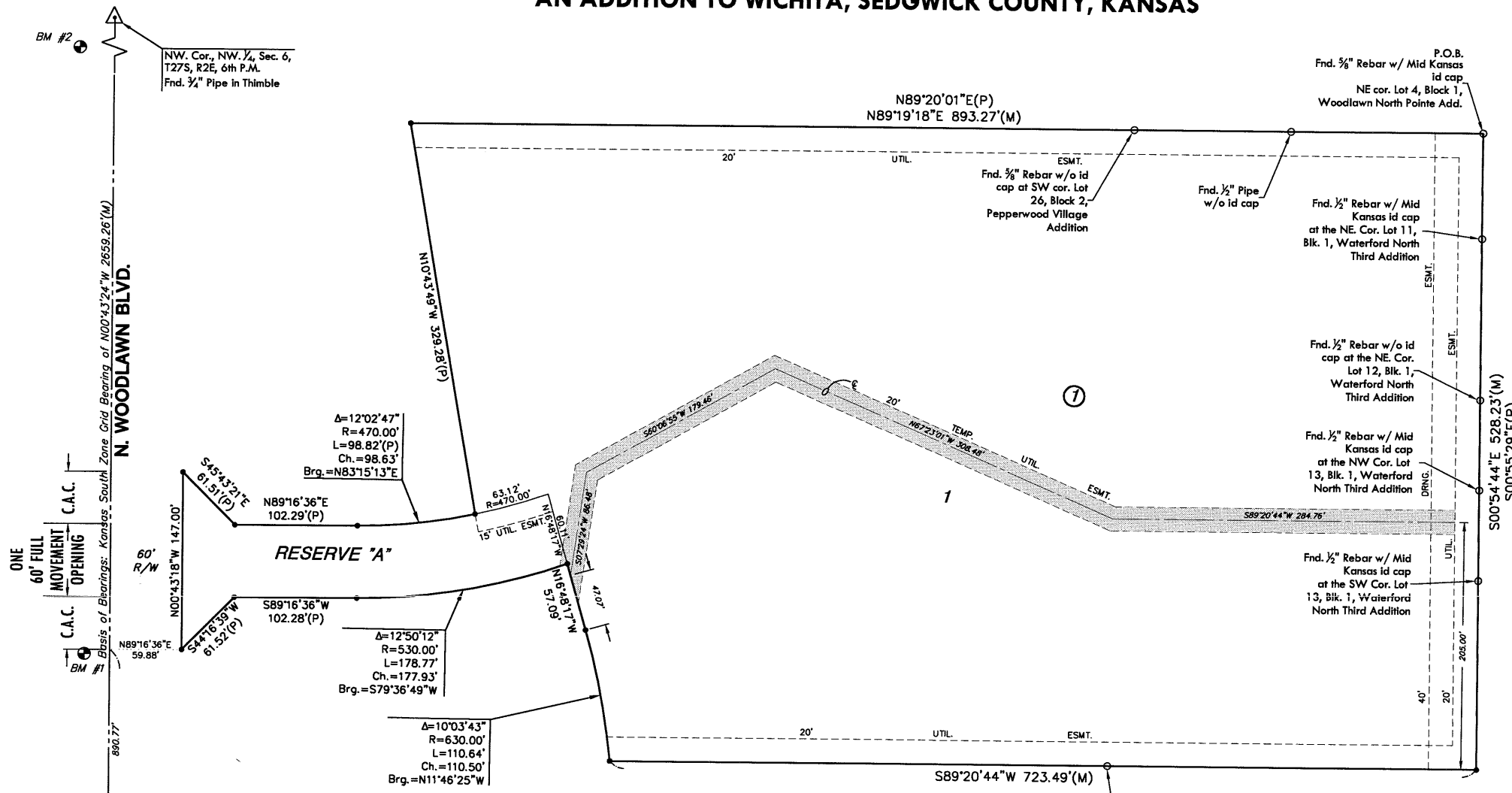
- BM # C.O.W. Benchmark Disc 24' North and 95' West of the Southwest corner of Hinkle's Addition. Elev. = 1376.56 (NGVD 29)
- BM#1 RR Spike in West face of power pole, 443' South and 81' West of the Northwest Corner of Hinkle's Addition. Elev. = 1378.15 (NGVD 29)
- BM#2 RR spike in West Face of power pole, 116' North and 82' West of the Northwest Corner of Hinkle's Addition. Elev. = 1375.89 (NGVD 29)



Basis of Bearings: Kansas coordinate system  
1983 south zone bearing of N00°43'23"E along the west line of Northwest Quarter, Section 6, T27S, R2E, 6th P.M.



VICINITY MAP



#### TRANSFER RECORD

STATE OF KANSAS, SEDGWICK COUNTY) ss:  
Entered on transfer record this \_\_\_ day of \_\_\_\_\_, 2009

\_\_\_\_\_, County Clerk  
Kelly B. Arnold, County Clerk

#### REGISTER OF DEEDS CERTIFICATE

This is to certify that this instrument was filed for record in the Register of Deeds office this \_\_\_ day of \_\_\_\_\_, 2009, at \_\_\_\_\_ o'clock \_\_\_\_\_ M., and is duly recorded.

\_\_\_\_\_, Register of Deeds  
Bill Meek, Register of Deeds

Attest:  
\_\_\_\_\_, Deputy  
Tonya E. Buckingham, Deputy

#### COUNTY SURVEYOR

Reviewed in accordance with K.S.A. 58-2005 on this \_\_\_ day of \_\_\_\_\_, 2009.

\_\_\_\_\_, Deputy County Surveyor  
Tricia L. Robello, LS #1246  
Deputy County Surveyor  
Sedgwick County, Kansas

#### PLANNING COMMISSION CERTIFICATE

This plat of "NORTH POINTE SENIOR LIVING ADDITION" has been submitted to and approved by the Wichita-Sedgwick County Metropolitan Area Planning Commission, Wichita, Kansas.

Dated this \_\_\_ day of \_\_\_\_\_, 2009

WICHITA-SEGWICK COUNTY METROPOLITAN AREA PLANNING COMMISSION

\_\_\_\_\_, Chair  
Darrell Downing, Chair

Attest:  
\_\_\_\_\_, Secretary  
John L. Schlegel, Secretary

#### GOVERNING BODY CERTIFICATE

The dedications shown on this plat are hereby accepted and this plat is hereby approved by the governing body of the City of Wichita, Kansas.

Dated this \_\_\_ day of \_\_\_\_\_, 2009

At the direction of the City Council.

\_\_\_\_\_, Mayor  
Carl Brewer, Mayor

Attest:  
\_\_\_\_\_, City Clerk  
Karen Sublett, City Clerk

**Figure 1.5**

---

Preliminary Grading Plan

**NORTH POINTE SENIOR LIVING**  
NORTH POINTE SENIOR LIVING  
WICHITA, KANSAS  
**LOT GRADING PLAN**

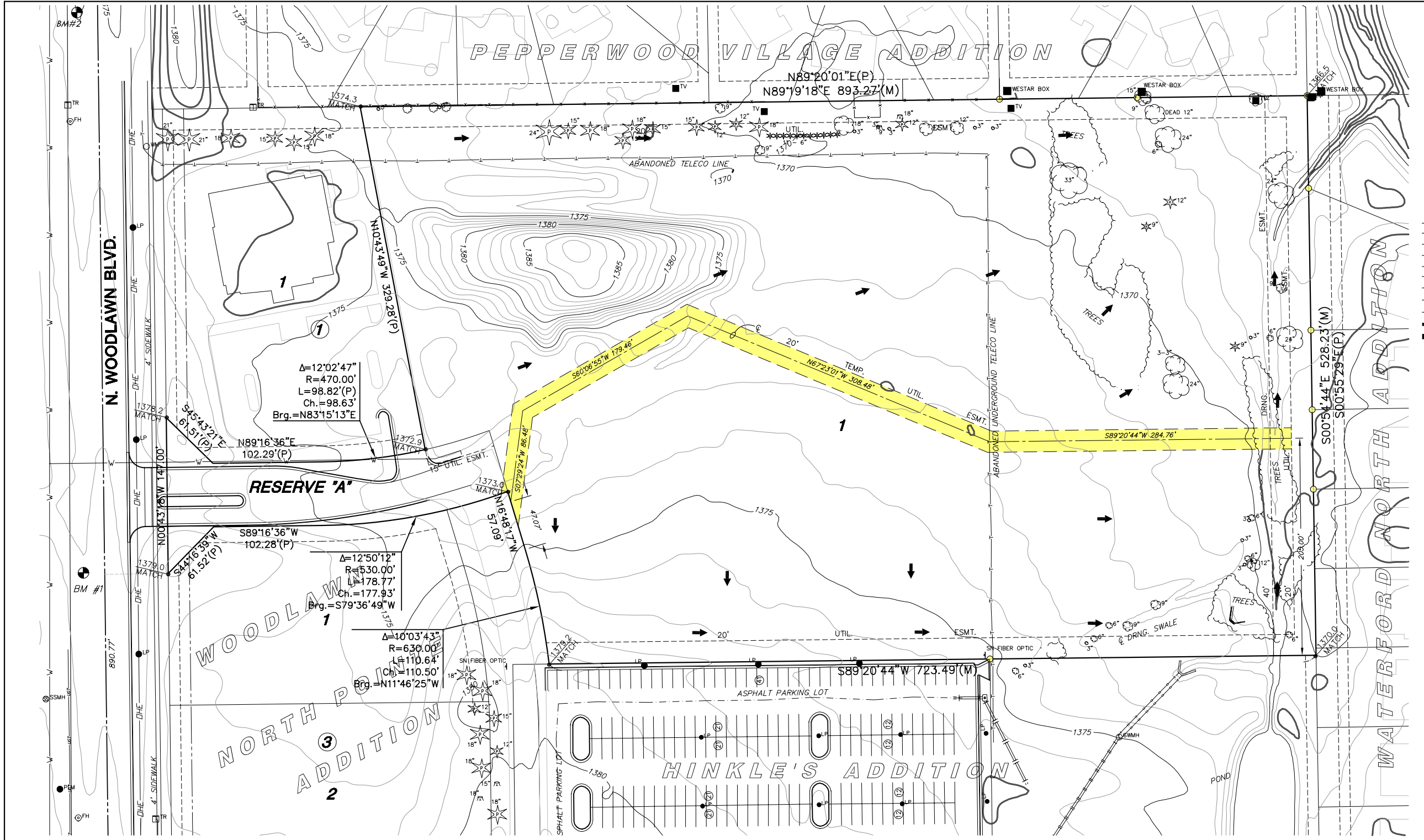
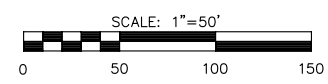
DATE	FEBRUARY 2009
REVISED	

DESIGN BY	KLA
DRAWN BY	CMJ
CHECKED BY	GJA

SHEET NUMBER	1
--------------	---

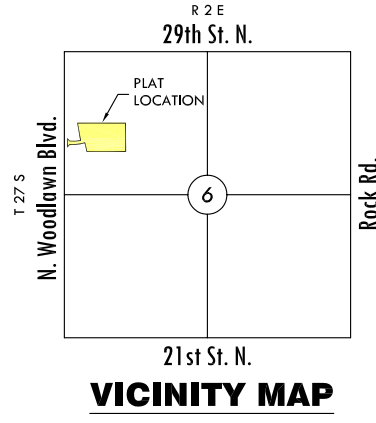
**LEGEND**

- ✱ CONIFEROUS TREE
- DECIDUOUS TREE
- SN SIGN
- PH POWER POLE
- ELEC BOX ELECTRIC BOX
- LP LIGHT POLE
- FH FIRE HYDRANT
- WV WATER VALVE
- WM WATER METER
- SC SECTION CORNER
- BM BENCHMARK
- EASEMENT
- BUILDING SETBACK
- FENCE
- STORM SEWER PIPE
- WATER LINE
- SANITARY SEWER LINE
- GAS LINE
- GAS PIPELINE
- TELEPHONE LINE
- UNDERGROUND ELEC.
- OVERHEAD ELECTRIC
- FIBER OPTIC CABLE
- DRAINAGE SUB BASIN
- DRAINAGE BASIN
- FLOW ARROW
- AREA FOR SWS SIZING



**BENCH MARK**

- BM** C.O.W. Benchmark Disc 24' North and 95' West of the Southwest corner of Hinkle's Addition  
Elev. = 1376.56 (NGVD 29)  
1377.06 (NAVD 88)
- BM#1** RR Spike in West face of power pole, 443' South and 81' West of the Northwest Corner of Hinkle's Addition  
Elev. = 1378.15 (NGVD 29)  
1378.65 (NAVD 88)
- BM#2** RR spike in West Face of power pole, 116' North and 82' West of the Northwest Corner of Hinkle's Addition  
Elev. = 1375.89 (NGVD 29)  
1376.49 (NAVD 88)



## **Tab 2. Existing Conditions Runoff Calculations**

---

### ***A. Orthophotograph***

The aerial photograph is included, Figure 2.1.

### ***B. Runoff Method***

The SCS method in was used to determine pre- and post-project runoff rates.

### ***C. Existing Topography***

Elevations on the site range from 1377 feet on the west edge of the property to 1365 near the northeast corner. A channel crosses the site from the pond on Galichia Heart Hospital to the reserve in Waterford North flowing from south to north. The existing topography is shown on the Existing Conditions Drawing, Figure 2.2.

### ***D. Site Areas***

The site is 10.4 acres.

### ***E. Benchmarks***

The benchmarks used for survey are as follows:

Benchmark #1: COW Benchmark Disc 24' North and 95' West of the Southwest corner of Hinkle's Addition, Elevation = 1376.56 (NGVD 29)

Benchmark #2: Railroad spike in West face of power pole, 443' South and 81' West of the Northwest Corner of Hinkle's Addition, Elevation = 1378.15 (NGVD 29)

Benchmark #3: Railroad spike west face of power pole, 116' north and 82' west of the northwest corner of Hinkle's Addition, Elevation=1375.89 (NGVD 29)

### ***F. Streams, Creeks, and Waterways***

No portion of the site is included in a regulatory floodplain. The site is in Zone X, areas outside the 0.2% annual chance event, as shown on FIRM Panel 0357E, Sedgwick County, Kansas February 2, 2007, Figure 2.3. The nearest floodplains are approximately ½-mile north or west of the site.

### ***G. Soils***

According to the NRCS (SCS) Sedgwick County Soil Survey, Figure 2.4, soils on the site are Rosehill silty clay loam 1 to 3% slopes (HSG "D"). The Hydraulic Soil Group used to select runoff coefficients and curve numbers is "D".

### ***H. Natural Features***

According to the USGS quadrangle map a runs from south to north along the east edge of the property.

### ***I. Location of Existing Impervious Areas***

A majority of the site is undeveloped open land. There is an existing driveway to an existing medical facility on Woodlawn North Point Addition. The site is about 4% impervious with the existing driveway.

### ***J. Location of Existing Utilities***

There is an existing water line on the west side of Woodlawn Avenue. There is an existing sanitary sewer line through the site that will be replaced and removed. There are existing storm water sewer pipes on Galichia that outlet onto this site.

### ***K. Location of Existing Conveyance Systems***

There are no stormwater conveyance systems onsite. There are two storm sewer pipes on Galichia Hospital's site that outlet near the site and flow onto the property. One pipe is the outlet for the existing pond and the second pipe is the outlet for a parking lot storm water sewer system.

### ***L. Flow Paths***

Flow paths are shown on the Existing Conditions Drawing, Figure 2.2.

### ***M. Location and Sizes of Existing Structures***

There is no existing detention or drainage structures onsite.

### ***N. Existing Conditions Hydrologic Analysis***

The hydrologic analysis was done with the Pepperwood Village drainage report, Figure 1.3. Flow rates for the basin can be found in the report.

### ***O. Pre-Developed Runoff Curve Numbers***

The pre-project runoff curve number 73 for meadow was used in the calculations.

### ***P. Existing Time of Concentration***

The existing time of concentrations were determined using the Kirpich Nomograph in the Pepperwood Village drainage report.

### ***Q. Downstream Drainage Capacity***

The site drains into a drainage reserve designed with the existing site considered developed.

### ***R. Existing Structural Elevations***

There are no existing drainage structures on site.

### ***S. Open Channels***

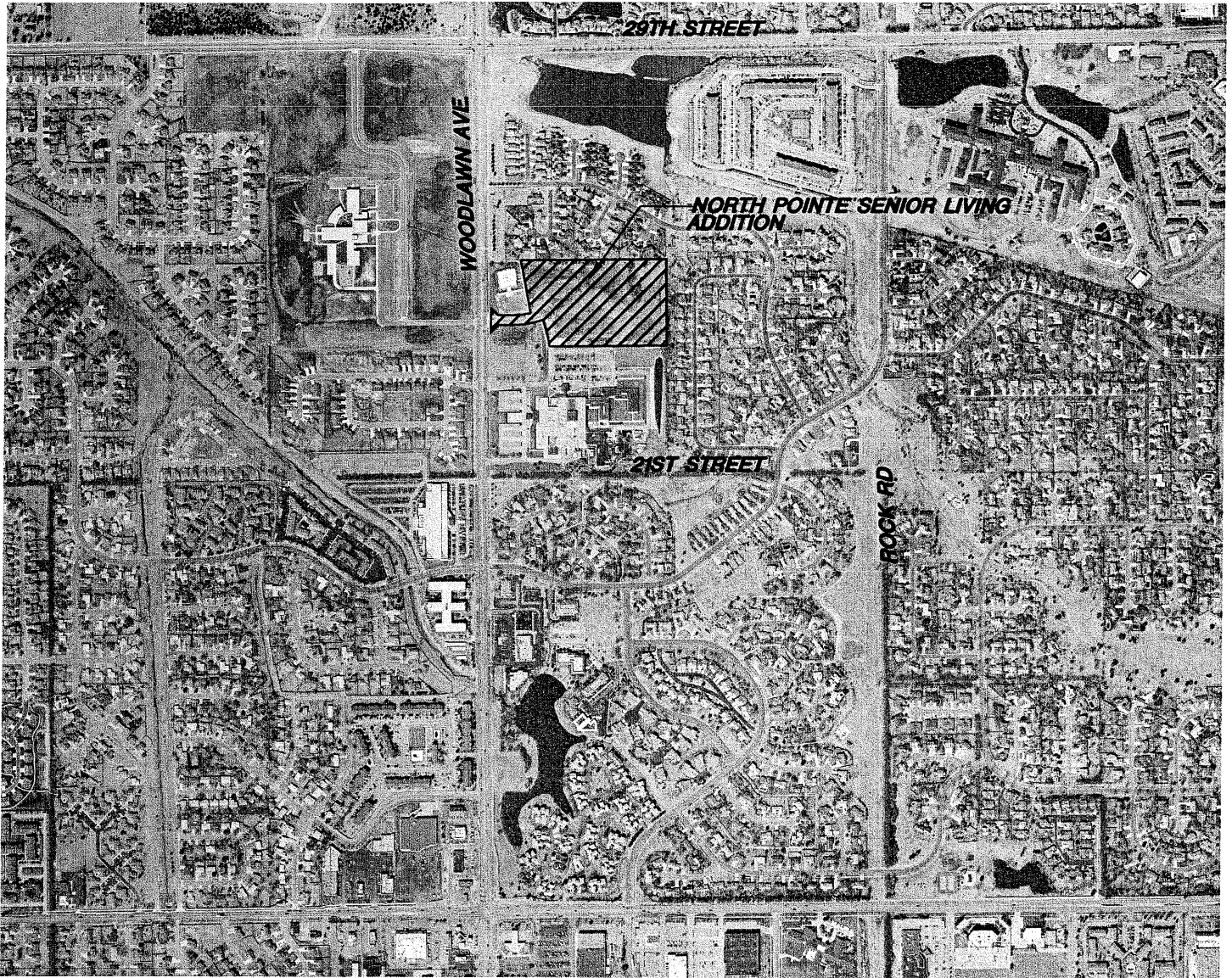
There is an existing open channel on site to convey water from Galichia Hospital to Waterford North Addition.

***T. Groundwater Elevations***

Groundwater elevations are not applicable for this project.

**Figure 2.1**  
Orthophotograph

---



SCALE: 1" = 1000'



1000      0      1000      2000



J:\Civil\09040 North Point Senior Living\dwg\Drng\09040\_aerial.dwg

**NORTH POINTE SENIOR LIVING**

PROJECT NAME

**MKEC**  
ENGINEERING  
CONSULTANTS, INC.

**AERIAL MAP**

SHEET TITLE

411 N. WEBB ROAD  
WICHITA, KS. 67206  
316 - 684 - 9600

*KLA*  
DESIGN BY:

*CMJ*  
DRAWN BY:

*GJA*  
CHECKED BY:

*FEBRUARY 2009*  
DATE

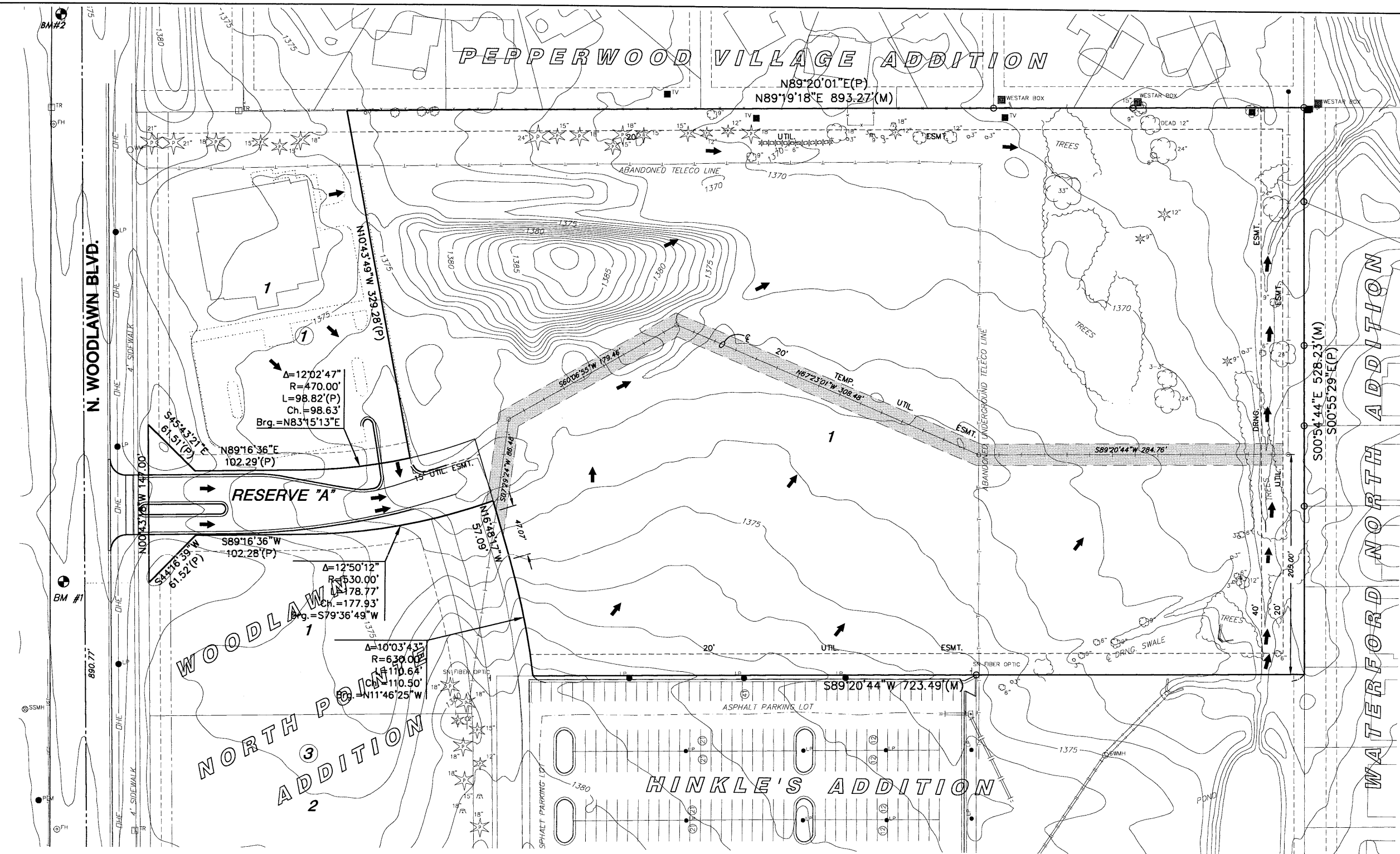
*09040*  
JOB NO.

*1 / 1*  
SHEET/OF

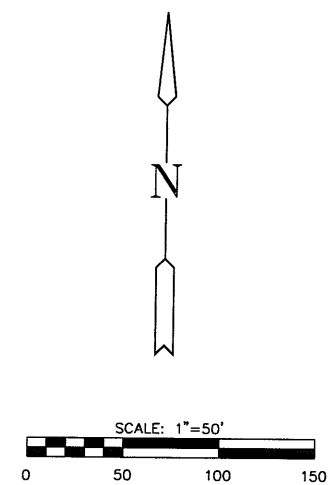
**Figure 2.2**

---

Existing Conditions Drawing

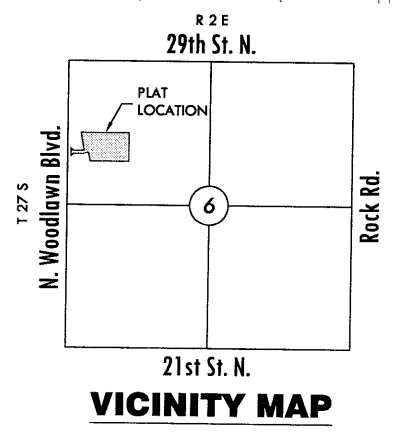


- LEGEND**
- ☉ - CONIFEROUS TREE
  - - DECIDUOUS TREE
  - - SIGN
  - - POWER POLE
  - ☐ - ELECTRIC BOX
  - ☉ - LIGHT POLE
  - ☉ - FIRE HYDRANT
  - ☉ - WATER VALVE
  - ☉ - WATER METER
  - ☐ - SECTION CORNER
  - ☉ - BENCHMARK
  - - EASEMENT
  - - BUILDING SETBACK
  - - FENCE
  - - STORM SEWER PIPE
  - - WATER LINE
  - - SANITARY SEWER LINE
  - - GAS LINE
  - - GAS PIPELINE
  - - TELEPHONE LINE
  - - UNDERGROUND ELEC.
  - - OVERHEAD ELECTRIC
  - - FIBER OPTIC CABLE
  - - DRAINAGE SUB BASIN
  - - DRAINAGE BASIN
  - - FLOW ARROW
  - A17 - AREA FOR SWS SIZING



**BENCH MARK**

- BM C.O.W. Benchmark Disc 24' North and 95' West of the Southwest corner of Hinkle's Addition  
Elev. = 1376.56 (NGVD 29)  
1377.06 (NAVD 88)
- BM#1 RR Spike in West face of power pole, 443' South and 81' West of the Northwest Corner of Hinkle's Addition  
Elev. = 1378.15 (NGVD 29)  
1378.65 (NAVD 88)
- BM#2 RR spike in West Face of power pole, 116' North and 82' West of the Northwest Corner of Hinkle's Addition  
Elev. = 1375.89 (NGVD 29)  
1376.49 (NAVD 88)



**MKEC**  
ENGINEERING  
CONSULTANTS, INC.  
411 N. WEBB ROAD  
WICHITA, K.S. 67206  
316 - 684 - 9600

**NORTH POINTE SENIOR LIVING**  
NORTH POINTE SENIOR LIVING  
WICHITA, KANSAS  
**EXISTING CONDITIONS**

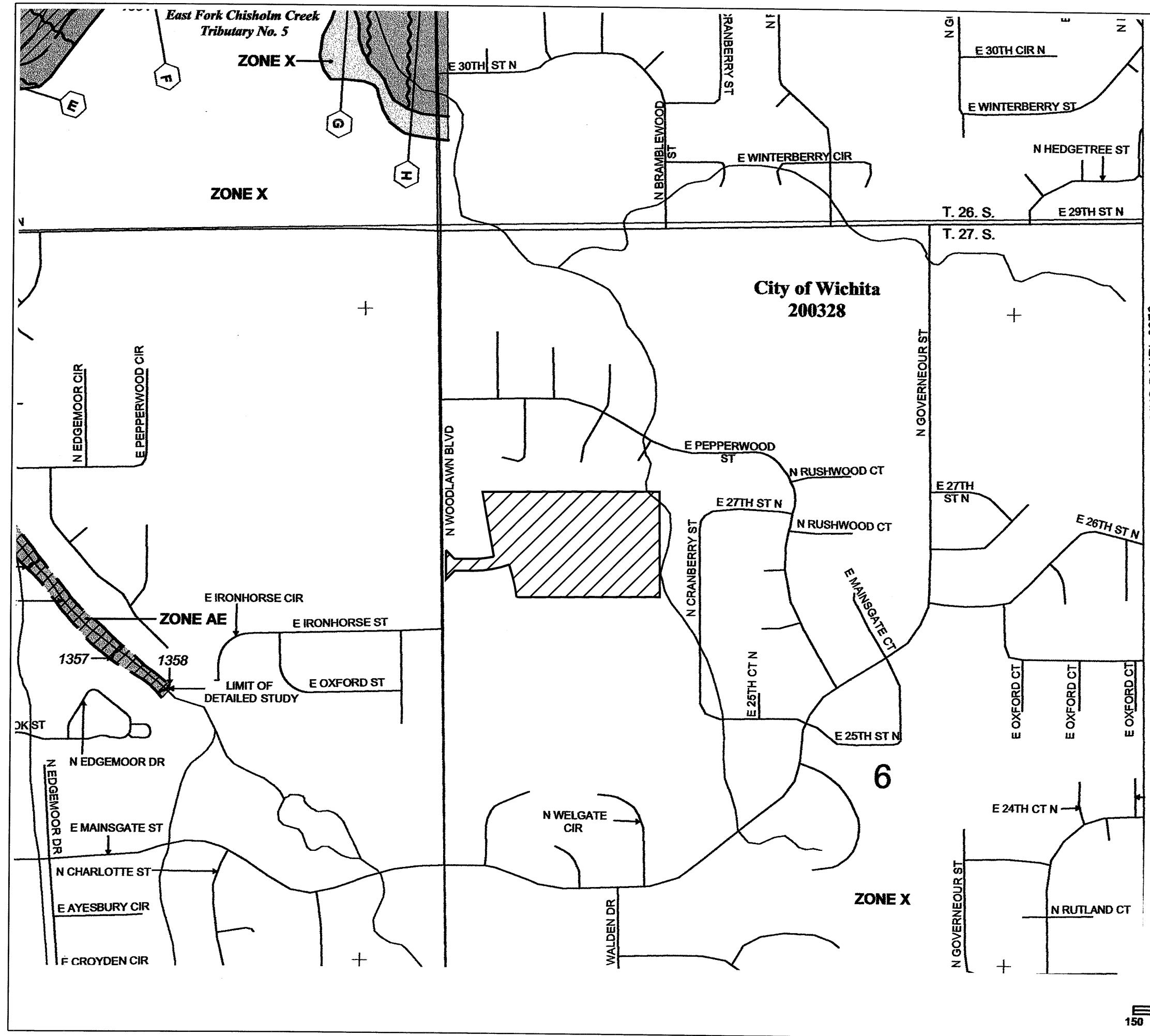
DATE	FEBRUARY 2009
REVISED	
DESIGN BY	KLA
DRAWN BY	CMJ
CHECKED BY	GJA
SHEET NUMBER	1

j:\Civil\09040 North Pointe Senior Living\dwg\Drng\09040\_EXISTING.dwg

**Figure 2.3**

---

FIRM



**NATIONAL FLOOD INSURANCE PROGRAM**

PANEL 0357E

**FIRM**  
FLOOD INSURANCE RATE MAP

SEDGWICK COUNTY,  
KANSAS  
AND INCORPORATED AREAS

PANEL 357 OF 700  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:  
COMMUNITY NUMBER PANEL SHEET  
WICHITA, CITY OF 200328 0357 E

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

**MAP NUMBER**  
20173C0357E

**EFFECTIVE DATE**  
FEBRUARY 2, 2007

Federal Emergency Management Agency

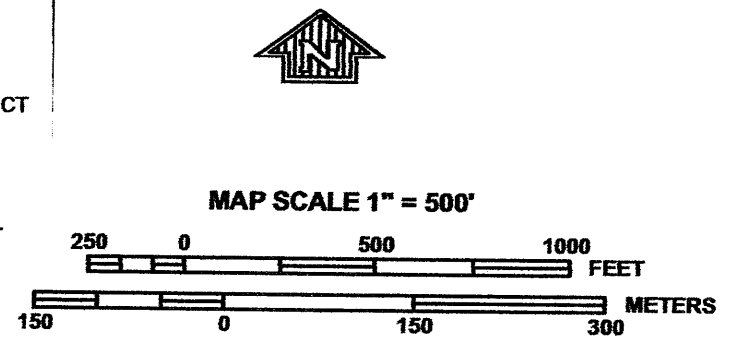
**MKEC**  
ENGINEERING  
CONSULTANTS, INC.

411 N. WEBB ROAD  
WICHITA, K.S. 67206  
316-684-9600

**NORTH POINTE SENIOR LIVING**  
NORTH POINTE SENIOR LIVING  
WICHITA, KANSAS  
**FIRM MAP**

DATE	FEBRUARY 2009
REVISED	
DESIGN BY	KLA
DRAWN BY	CMJ
CHECKED BY	GJA

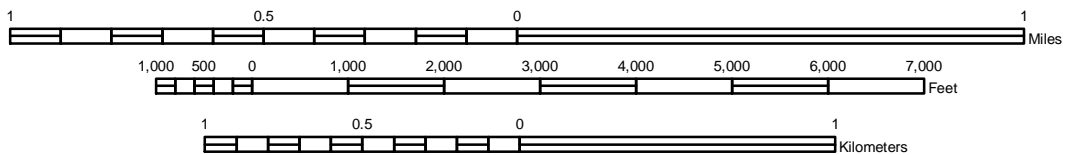
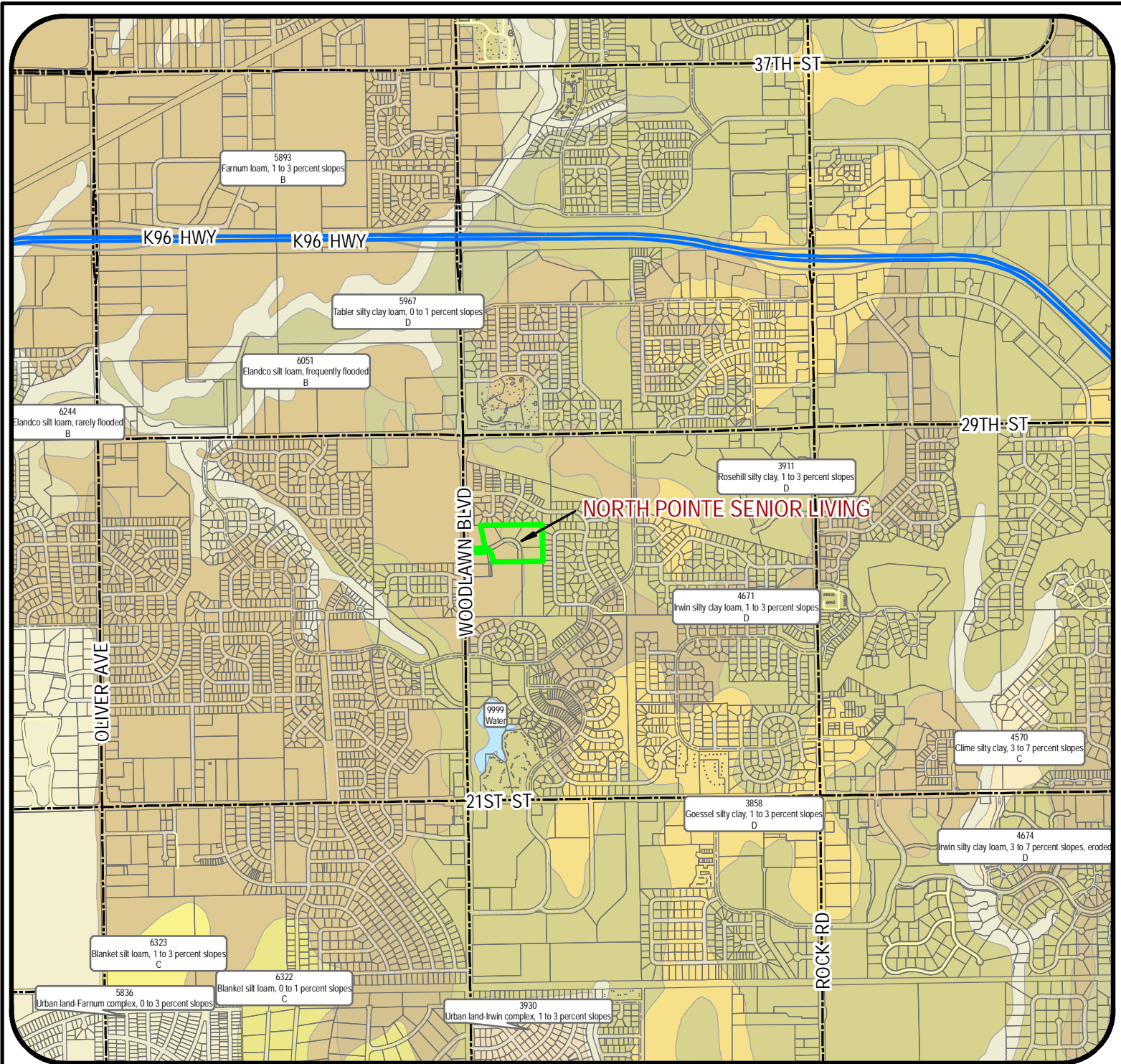
SHEET NUMBER  
**1**



J:\Civil\09040\_North\_Point\_Senior\_Living\dwg\Drwg\_09040\_firm.dwg

**Figure 2.4**  
Soil Survey

---



J:\CIVIL\09040\DWG\drng\DRNG-NRCS-USGS.mxd

### NORTH POINTE SENIOR LIVING

Project Name:  
 USGS - Sedgwick County, KS

Sheet Title:

	CMJ	FEB. 2009
	Drawn By: KLA	Date: 09040
	Design / Review:	Job No.:

## **Tab 3. Post-Development Hydrologic Analysis**

---

### ***A. Proposed Conditions Hydrologic and Hydraulic Analysis***

The SCS method was used to determine post-project flow rates.

### ***B. Proposed Time of Concentration***

The existing time of concentrations were determined using the Kirpich Nomograph in the Pepperwood Village drainage report.

### ***C. Assumed Post-Developed Curve Numbers***

A curve number of 87 was used to represent neighborhood commercial development.

### ***D. Proposed Contours for Detention***

The detention facility for this development is already constructed.

### ***E. Preliminary SWS Sizing Calculations***

The entire site drains to the northeast. Depending on final site layout, onsite storm water sewer may be required. Layout and size will be determined if it is needed.

### ***F. Stage-Storage-Discharge***

The stage-storage-discharge for the existing detention is shown in the drainage reports for Comotara and Pepperwood Village.

### ***G. Analysis of upstream/downstream impact***

A channel will be maintained from Galichia Hospital to the northeast corner of the property. Two existing 24" pipes on Galichia Hospital property outlet into the existing channel. The proposed channel will be improved. Based on the ditch designed with the Galichia Hospital storm water sewer extension, the ditch needs to be have a bottom width of 6' with 4:1 side slopes at 0.5% slope minimum.

### ***H. Existing and Proposed Structural Elevations***

There are no existing or proposed drainage structures on the site.

### ***I. Pond Design Elevations***

The existing pond in the basin will not be modified and won't change from the original plan.

***J. Structure Details***

There are no proposed drainage structures on site.

***K. Limits of Clearing and Grading***

The site will be cleared and graded.

***L. Location of Impervious Areas***

Roads, parking areas and buildings will be located as shown on the Drainage and Utility Plan, Figure 3.1.

***M. Location of Utilities***

Proposed utilities are shown on the Drainage and Utility Plan, Figure 3.1.

***N. Location of Conveyance Systems***

Proposed grading will direct runoff from the site to the, Figure 3.1.

***O. Location of Channel Modifications***

The existing channel will be improved to convey flow from Galichia Hospital.

***P. Selection and Location of Stormwater Controls***

On site storm water sewer may be needed depending on the final site layout. Location and size will be determined with site design.

***Q. Emergency Overflow***

The site will escape into Waterford North.

***R. Freeboard***

The existing detention pond in Pepperwood Village provides 5 feet of freeboard above the 100-year water surface elevation.

***S. 100-Year High Water Line***

The 100-year water surface elevation for the detention pond is 1360.0.

***T. Lowest Openings***

No minimum pads are set for this site.

***U. Stormwater Management Facilities***

The drainage swale will be confined within a drainage easement.

***V. Maintenance Responsibility***

The maintenance of the reserve will be the responsibility of the owner.

***W. Offsite-Drainage Easements***

The site will drain into a reserve previously platted for drainage.

**Figure 3.1**

---

Drainage and Utility Plan

**NORTH POINTE SENIOR LIVING**  
NORTH POINTE SENIOR LIVING  
WICHITA, KANSAS  
**DRAINAGE AND UTILITY PLAN**

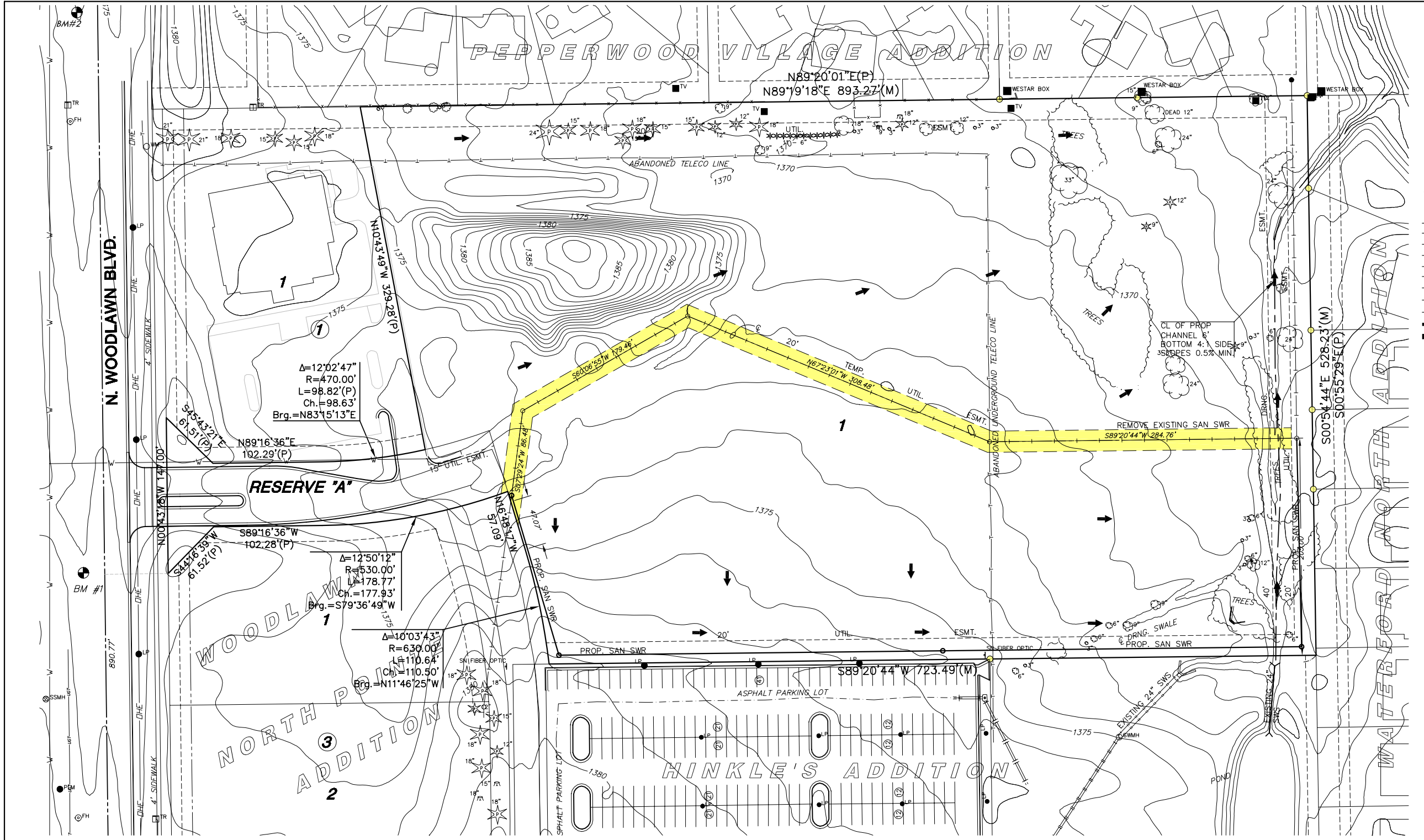
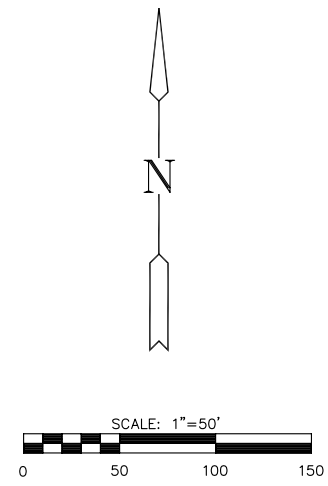
DATE	FEBRUARY 2009
REVISED	

DESIGN BY	KLA
DRAWN BY	CMJ
CHECKED BY	GJA

SHEET NUMBER	1
--------------	---

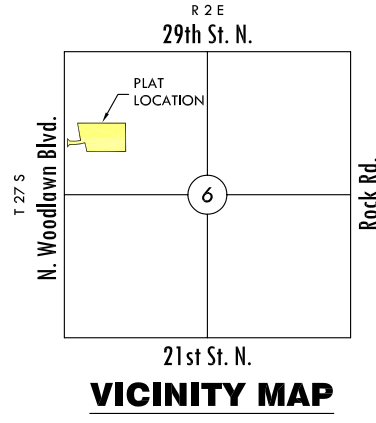
**LEGEND**

- ✱ CONIFEROUS TREE
- DECIDUOUS TREE
- SN SIGN
- PH POWER POLE
- ELEC BOX ELECTRIC BOX
- LP LIGHT POLE
- FH FIRE HYDRANT
- WV WATER VALVE
- WM WATER METER
- SC SECTION CORNER
- BM BENCHMARK
- EASEMENT
- BUILDING SETBACK
- FENCE
- STORM SEWER PIPE
- WATER LINE
- SANITARY SEWER LINE
- GAS LINE
- GAS PIPELINE
- TELEPHONE LINE
- UNDERGROUND ELEC.
- OVERHEAD ELECTRIC
- FIBER OPTIC CABLE
- DRAINAGE SUB BASIN
- DRAINAGE BASIN
- FLOW ARROW
- AREA FOR SWS SIZING



**BENCH MARK**

- BM** C.O.W. Benchmark Disc 24' North and 95' West of the Southwest corner of Hinkle's Addition  
Elev. = 1376.56 (NGVD 29)  
1377.06 (NAVD 88)
- BM#1** RR Spike in West face of power pole, 443' South and 81' West of the Northwest Corner of Hinkle's Addition  
Elev. = 1378.15 (NGVD 29)  
1378.65 (NAVD 88)
- BM#2** RR spike in West Face of power pole, 116' North and 82' West of the Northwest Corner of Hinkle's Addition  
Elev. = 1375.89 (NGVD 29)  
1376.49 (NAVD 88)



## **Tab 4. Floodplain Submittal**

---

Not applicable to Summit Crossing.

## Tab 5. Permits

---

### ***A. US Army Corps of Engineers***

There are no areas under US Army Corps of Engineers jurisdiction.

### ***B. Kansas Department of Agriculture***

Not applicable to Summit Crossing.

### ***C. Federal Emergency Agency (FEMA)***

Not applicable to Summit Crossing.

### ***D. Kansas Department of Transportation***

Not applicable to Summit Crossing.

### ***E. Sedgwick County Right-of-way Permit***

Not applicable to Summit Crossing.