OATES ASSOCIATES

# Hydraulic Report
# IL Route 115 over Drainage Ditch
# Structure No. 027-0040
# Ford County, Illinois
# Section 107-B
# Job No. P-93-039-03

Prepared for:

Illinois Department of Transportation
District 3
Ottawa, Illinois

Prepared by:

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Oates Project Number: 22041

June 2004

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# 1.0 PROJECT NARRATIVE

## 1.1 PROJECT SUMMARY

The Illinois Department of Transportation ("the Department") hired Oates Associates to perform a bridge condition study and a hydraulic analysis for Structure No. 027-0040 which carries Illinois Route 115 over a drainage ditch in Brenton Township, Ford County, Illinois. A Bridge Condition Report for this structure is being submitted to the Department concurrently with this report.

Considering the condition of the existing structure, the Bridge Condition Report recommends complete removal and replacement of the existing bridge with a three span, reinforced concrete deck superstructure supported on solid concrete piers and integral abutments. This report will examine how the ditch functions hydraulically assuming this reconstruction.

As is subsequently shown, reconstructing the bridge meets current Department created head guidelines, but two variances will be required to reconstruct the bridge without two feet of clearance and three feet of freeboard. As an alternative to seeking a variance, the roadway could be raised; however, this alternative is not recommended due to excessive construction costs.

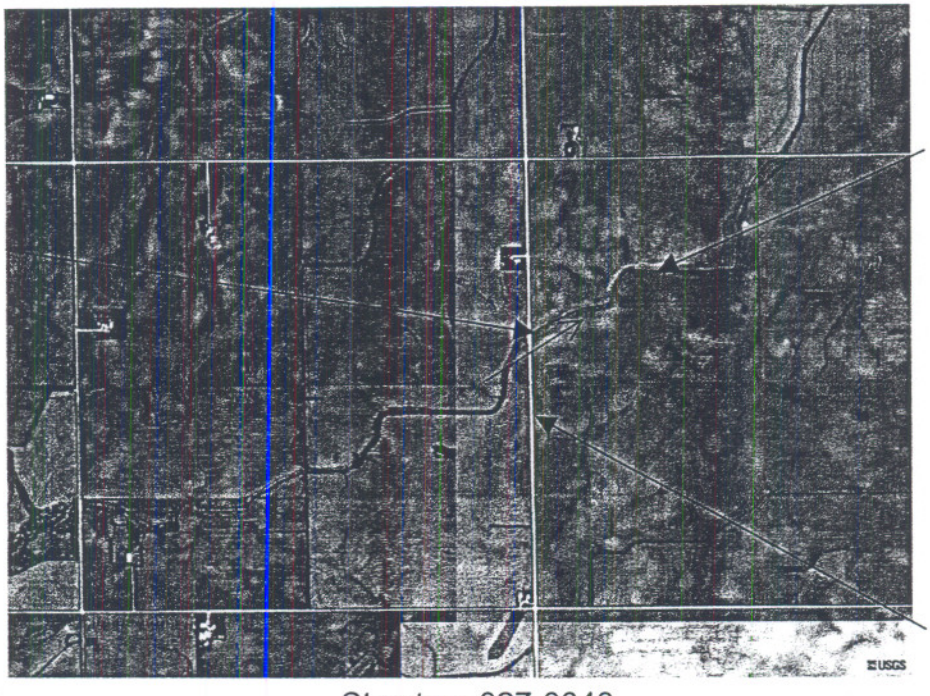
## 1.2 EXISTING CONDITIONS

Illinois Route 115 is currently carried over the drainage ditch by a single span reinforced concrete slab bridge with a bituminous overlay. The existing structure was constructed in 1928. The existing bridge is approximately 36'-3" wide and 30'-3¾" long with a 30° right forward skew. The approach roadway is 24' feet wide with 3' wide aggregate shoulders and 1' earth shoulders. Guardrail is used in the vicinity of the bridge. The existing structure is in poor condition.

The existing bridge originally provided 210 square feet of flow area below the low beam. Current measurements indicate approximately 222 square feet of available flow area below the low beam. Hydraulic analysis of the existing bridge indicates the roadway barely overtops during the 500-year storm. There is no history of detrimental flooding upstream of the existing structure. There are no other drainage structures within 1000' upstream or downstream of the IL Route 115 structure. Several buildings located on a farm on the north side of the ditch upstream of the IL Route 115 are within 1000' upstream of the highway structure; however, the farm is well above the 500-year flood elevation. The channel has only minor debris within 1,000 feet upstream and downstream of IL Route 115 and has a channel bottom consisting mostly of clays and silt deposits.

The drainage area is rural with isolated residential and farm developments. Rainfall accumulates and travels over mainly cultivated agricultural fields and pasture at the upper end of the reach. Water then accumulates and flows through the ditch northeasterly to the North Fork of the Vermillion River which eventually outlets to the Illinois River. According to local representatives, this ditch crossing is not within an organized drainage district. There is no history of detrimental flooding.

Overbank conditions in the vicinity of this project vary only slightly according to location. The northwest and southwest overbanks immediately upstream of IL Route 115 consists of tall grass immediately adjacent to the ditch with cultivated fields beyond the ditch floodplain. As with the upstream channel, the northeast and southeast overbanks downstream of IL Route 115 consists of tall grass immediately adjacent to the ditch with cultivated fields making up the remainder of the floodplain.




Structure 027-0040
IL Route 115 over Drainage Ditch

## 1.3 PROPOSED IMPROVEMENTS

The proposed structure would consist of a 1'-3" thick (minimum) reinforced concrete deck superstructure supported on solid concrete piers and integral abutments. The bridge width would be 35'-2" with a length of 72' 0" back to back of abutment. New abutments would be located outside the existing abutments. The channel underneath the structure would consist of a 20-foot flat bottom with 2:1 side slopes. The channel banks beneath the bridge will be protected with riprap. The proposed structure would more closely align with the natural channel than does the existing structure. The proposed bridge would reduce the existing skew to a 25° right forward skew. The roadway would not be raised.

The proposed structure meets the State of Illinois' requirements for constructing a replacement structure since the proposed structure provides a larger available opening area, does not increase the water surface profiles over the existing conditions, and there is no history of detrimental flooding upstream of the proposed structure. Furthermore, the proposed structure meets the State of Illinois' created head requirements for permitting a new structure.

The existing structure does not meet clearance and freeboard requirements. Since the natural water surface near the bridge is less than three feet below the crown of the roadway, freeboard and clearance requirements cannot be satisfied without raising the roadway. Since raising the road is not proposed, design variances for less than three feet of freeboard and less than two feet of clearance will be necessary.

## 1.4 HYDROLOGIC AND HYDRAULIC ANALYSES

### 1.4.1 HYDROLOGIC ANALYSIS

Detailed flood insurance study information for this drainage ditch is not available. The Flood Insurance Rate Map (FIRM) has no information available for comparing the calculated discharges and water surface elevations for this reach. The FIRM indicates areas of flooding in the vicinity of the bridge shown as "Zone A." A "Zone A" is an area of a 100-year flood with base flood elevations and flood hazard factors not determined. Copies of the Flood Insurance Maps are included in Appendix K.

Per IDOT guidelines, runoff was calculated using USGS regression equations. The following table summarizes the calculated discharges:

| Storm Frequency (year) | Design Flows (cfs) |
|---|---|
| 10 | 896 |
| 50 | 1,353 |
| 100 | 1,543 |
| 500 | 1,988 |

These discharge values were calculated using the overall drainage area, the hydraulic slope determined from the Buckley Northwest and Chatsworth South Quadrangle USGS Topographic Maps, field data, and rainfall intensities for the region.

### 1.4.2 HYDRAULIC ANALYSIS

Water surface profiles were computed using the HEC-RAS Version 3.1.1 computer program. A survey crew compiled the cross section information used to develop the HEC-RAS model. Bridge size, roadway profiles, Manning's roughness coefficients, and various other pertinent information were all field verified.

The following Manning's roughness coefficients were used:

| Land Use Characteristic | Manning's "n" Value |
|---|---|
| Rip Rap | 0.035 |
| Farm Field | 0.040 |
| Composite Stream Channel | 0.045 |

These values were selected using Figure 5-301 of the Illinois Department of Transportation Drainage Manual. Where the channel is relatively uniform, contraction and expansion coefficients were set to 0.1 and 0.3, respectively. To account for the energy loss resulting from the ditch's contraction and expansion at the bridge, these coefficients were set at 0.3 and 0.5, respectively, at the cross sections immediately downstream of the bridge, the cross sections immediately upstream of the bridge, and at the cross section a bridge length upstream of the bridge.

The normal depth method of calculating a water surface was used to determine the initial water surface elevation for each profile. The cross section located approximately 1000 feet downstream was used in this calculation. The slope of the ditch was calculated by using a linear regression statistical analysis of the surveyed streambed profile shots.

The hydraulic analysis in this report is based upon the ditch's unobstructed flow through the proposed structure. At locations where the floodplain abruptly widens and where the water in the widened portions of the floodplain is merely stored and does not flow, an ineffective flow area was set at a location that approximates the location where stream flow is minimal. These locations are in proximity to the bridge structure.

The following conditions were studied:

| HEC RAS Abbreviation | Description |
|---|---|
| Natural | Natural conditions without any structures obstructing the flow of the ditch. |
| Existing | Existing conditions. |
| Proposed | Proposed conditions. |

The waterway information table following this narrative summarizes the hydraulic characteristics of the existing bridge, the proposed replacement structure, as well as how the ditch flows naturally.

The existing IL Route 115 bridge influences the hydraulic character of the ditch by creating 0.24, 0.58, 1.13, and 1.99 feet of additional head at the structure over the natural 10-year, 50-year, 100-year, and 500-year water surface profiles, respectively. The proposed structure creates 0.06, 0.14, 0.19, and 0.33 feet of additional head at the structure over the natural 10-year, 50-year, 100-year, and 500-year water surface profiles, respectively.

At 1000' upstream, the existing bridge influences the hydraulic character of the ditch by creating 0.03, 0.00, 0.00, and 0.00 feet of additional head at the structure over the natural 10-year, 50-year, 100-year, and 500-year water surface profiles, respectively. The proposed structure creates 0.01, 0.00, 0.00, and 0.00 feet of additional head at the structure over the natural 10-year, 50-year, 100-year, and 500-year water surface profiles, respectively. The proposed structure is less of an obstruction to the ditch flow and meets the created head requirements for new construction.

The existing bridge provides approximately 219 square feet of waterway area below the 50-year natural water surface elevation. The proposed structure provides approximately 356 square feet of waterway area below the 50-year water surface elevation. Since this alternative produces acceptable created head, increases the waterway area, and does not increase the roadway profile, the alternative is an acceptable solution.

Scour analyses for the 100-year and 500-year storms were performed to determine locations of potential scour following construction of the proposed bridge. The analysis predicts a 4.84 feet and 5.20 feet deep scour at the piers for the 100-year and 500-year, respectively. The elevations of the scour holes would be approximately 693.1 and 692.8 for the two storms. In order to prevent damage to the structure, the embankment will be lined with riprap and the piling will be designed with the potential scour depth taken into consideration.

## 1.5 REQUIRED PERMITS

Since the basin draining through Structure 027-0040 is less than 10 square miles in size and the ditch is not considered a public waterway, a permit from the Illinois Department of Natural Resources, Office of Water Resources, is not required; however, permits from the Corps of Engineers and Illinois Environmental Protection Agency would still be required.

## 1.6 CONCLUSION

The replacement structure proposed in the Bridge Condition Report improves the hydraulic functioning of the drainage ditch and meets created head requirements for new construction. As such, the proposed structure is reasonable and would help return the ditch to nearer its natural flow pattern.

# 2.0 WATERWAY INFORMATION TABLE

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Route: | FAP Route 798 (IL 115) | S.N.: | 027-0040 | Exist. | Computed by: | LDT | 5-25-04 |
| Section: | 107-B | S.N.: | | Prop. | Checked by: | DMO | 5-25-04 |
| County: | Ford | Waterway: | Drainage Ditch | | | | |

| Drainage Area = | 6.19 sq. mi. | | Existing Low Grade Elev. = | | 710.76 | @ Sta. | 182+00 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Proposed Low Grade Elev. = | | 710.76 | @ Sta. | 182+00 | | |
| Flood | Freq. Year | Q C.F.S. | Waterway Opening (sq. ft.) Exist.[1] | Prop.[1] | Natural H.W.E. | Head (ft.) Exist. | Prop. | Headwater Elev. Exist. | Prop. |
| | 10 | 896 | 185 | 280 | 706.63 | 0.24 | 0.06 | 706.87 | 706.69 |
| Design | 50 | 1,353 | 219 | 356 | 708.12 | 0.58 | 0.14 | 708.70 | 708.26 |
| Base | 100 | 1,543 | 222 | 372 | 708.40 | 1.13 | 0.19 | 709.53 | 708.59 |
| Max. Calc. | 500 | 1,988 | 222 | 389 | 708.68 | 1.99 | 0.33 | 710.67 | 709.01 |

10 Year Velocity through Existing Structure = 5.25 fps  10 Year Velocity through Proposed Structure = 3.16 fps

1. Existing total opening area = 222 sq. ft. Proposed total opening area = 422 sq. ft.

DATUM: NAVD 88
All-Time H.W.E. & Date: Unknown

Scope of Work:

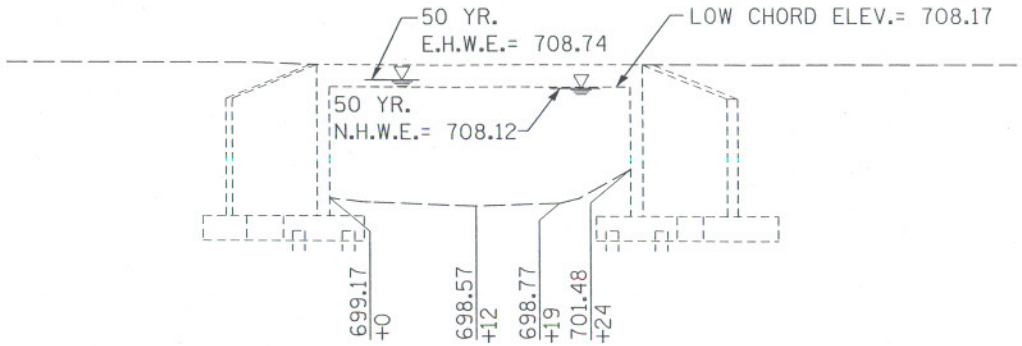
**Existing Structure**

| | |
|---|---|
| Type: | Cont. Slab Bridge w/ Roadway on Embankment |
| Length: | 26'-3" Bk-Bk |
| Spans: | 1 |
| Low Beam: | 708.17 |
| Skew: | 30° |

**Proposed Structure**

| | |
|---|---|
| Type: | Continuously reinforced conc. slab bridge |
| Length: | 72'-0" Bk-Bk |
| Spans: | 3 |
| Low Beam: | 709.25 |
| Skew: | 25° |

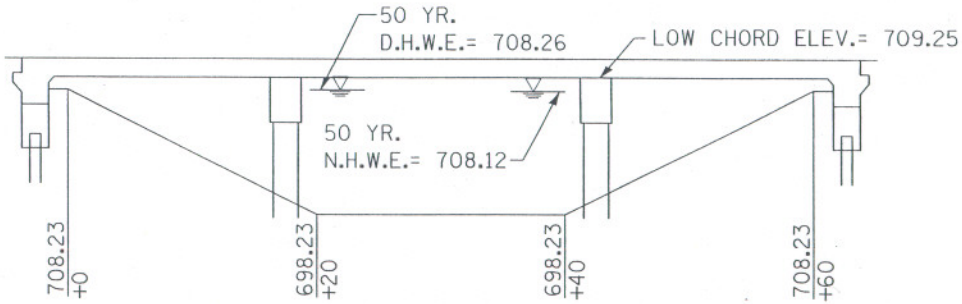
Note: Proposed structure details are preliminary; subject to refinement in TSL stage.




50 YEAR FLOW AREA BELOW ELEV. 708.12 (NATURAL) = 219 SQ. FT.
50 YEAR FLOW AREA BELOW ELEV. 708.74 (EXISTING) = 222 SQ. FT.
TOTAL OPENING AREA = 222 SQ. FT.

# EXISTING OPENING

SECTION SHOWN AT DOWNSTREAM FACE
GEOMETRY SHOWN AT RIGHT ANGLES TO FLOWLINE OF DRAINAGE DITCH




50 YEAR FLOW AREA BELOW ELEV. 708.12 (NATURAL) = 356 SQ. FT.
50 YEAR FLOW AREA BELOW ELEV. 708.26 (DESIGN) = 364 SQ. FT.
TOTAL OPENING AREA = 422 SQ. FT.

# PROPOSED OPENING

SECTION SHOWN AT UPSTREAM FACE
GEOMETRY SHOWN AT RIGHT ANGLES TO FLOWLINE OF DRAINAGE DITCH

N

OATES ASSOCIATES

IL RTE 115
OVER DRAINAGE DITCH
S.N. 027-0040

## 3.0 HYDRAULIC REPORT DATA SHEETS

IL Route 115
Section 107-B
Ford County

General Information

1. Name of Stream Drainage Ditch

2. Location of structure S.W. 1 /4 of the N.W. 1 /4, Section 27
Township 26N Range 9E of the 3rd P.M.

Site Design Data

3. Drainage area upstream of bridge 6.2 square miles.

4. Character of drainage area (for areas less than 10 sq. mi.): _____
cultivated 90 %, pasture 5 %, timber 5 %, urbanized 0 %,
other %.

5. Design frequency 50 years. Road design classification Minor Arterial (Rural)

6. Elevation of design frequency high water 708.12 feet.

7. Maximum known high water elevation Unknown feet. Date _____

8. Cause of maximum known high water (head water, backwater, etc.) N/A.

9. Flow line elevation 698.1 Feet.

10. Approximate waterway area proposed below design high water 356 sq. ft.

11. Elevation of low point on proposed approach roadway 710.76 feet.

12. Is any particularly valuable property located upstream within possible bridge backwater influence? No . Describe and list critical upstream flood elevation(s): _____

13. Will drift or ice permit pier in low flow channel? Yes

14. Type of streambed soil Clay / Silt . Does it scour easily? Yes

15. If bridge is proposed, supply abutment type: closed _____ open X
skew 25°

16. If culvert is proposed, supply: type N/A , length _____ feet,
flow line slope _____ entrance type _____ Skew _____

17. Is necessity for separate overflow structure(s) indicated by field conditions? No.

18. Is reliable information available to unconstricted water surface slope during some particular high water stage? No. . _____ Ft. / 100 Ft.

19. Existing Structure Data

| Requested Data | Upstream Structure | Proposed Structure | Downstream Structure |
|---|---|---|---|
| Distance from proposed structure ..... | 1.5 mi. | N/A | 0.5 mi. |
| Type of Structure ..... | Single span | Three span on conc. piers | Three span |
| Low beam elevation ..... | Unknown | 709.25 | Unknown |
| Design Frequency..... | Unknown | 50 | Unknown |
| Right angle waterway opening below design high water (50-Yr)..... | 383 Sq. Ft. | 356 Sq. Ft. | 432 Sq. Ft. |
| Maximum known high water elevation.. | Unknown | Unknown | Unknown |
| Flow line elevation ..... | Unknown | 698.1 | Unknown |
| Date of maximum high water ..... | Unknown | Unknown | Unknown |
| Cause (backwater, headwater, etc.)... | N/A | N/A | N/A |
| Does structure carry entire design flood flow? ..... | Unknown | Yes | Unknown |
| If not, state kind and area of additional waterway ..... | N/A | N/A | N/A |
| Has detrimental scour occurred under or adjacent to the structure? ..... | Unknown | N/A | Unknown |
| Apparent reason for scouring..... | N/A | N/A | N/A |

Required Additional Data

20. Information regarding high water from other streams, reservoirs, flood control projects, proposed channel changes, or other controls affecting proposed waterway area:

There are no upstream reservoirs or other waterways that effect the flow of this reach of the drainage ditch. Several miles downstream, the ditch is part of an organized drainage district; however, this reach is either natural or else maintained by adjacent farmers. Stream maintenance by these farmers does not have an appreciable effect on the waterway opening.

21. To be attached:

a. Reproduction of applicable portion of USGS quadrangle sheet or map of equal detail showing locations of structures described in Item 19 and the proposed structure.

b. Aerial photo of general site, showing alignment of proposed crossing.

c. Sketch of waterway opening of existing structure(s) at site.

d. Streambed profile extending 1,000 feet upstream and downstream from the proposed structure. Indicate profile plan location on map or photo.

e. Existing and proposed roadway profile across floodplain.

f. Typical right angle channel cross sections including floodplain above elevation of design high water. Manning's roughness coefficients, descriptions and boundaries are necessary within each section.

g. A stream cross-section immediately adjacent and parallel to the roadway taken across the full width of the floodplain.

h. If field conditions indicate that channel change is necessary, indicate location, cross section and gradient.

i. If available, map showing 1 or 2-foot contour intervals, stream meanders, vegetation and manmade improvements.

j. Identify the datum correlation with other reports (such as the FIS) used in the Hydraulic Report.

22. Site inspection made by: L. Thomason, D. Ogle Date: 1-20-04.

Report prepared by: Larry Thomason

Remarks QA/QC by Bruce Schopp and Rich Wilburn

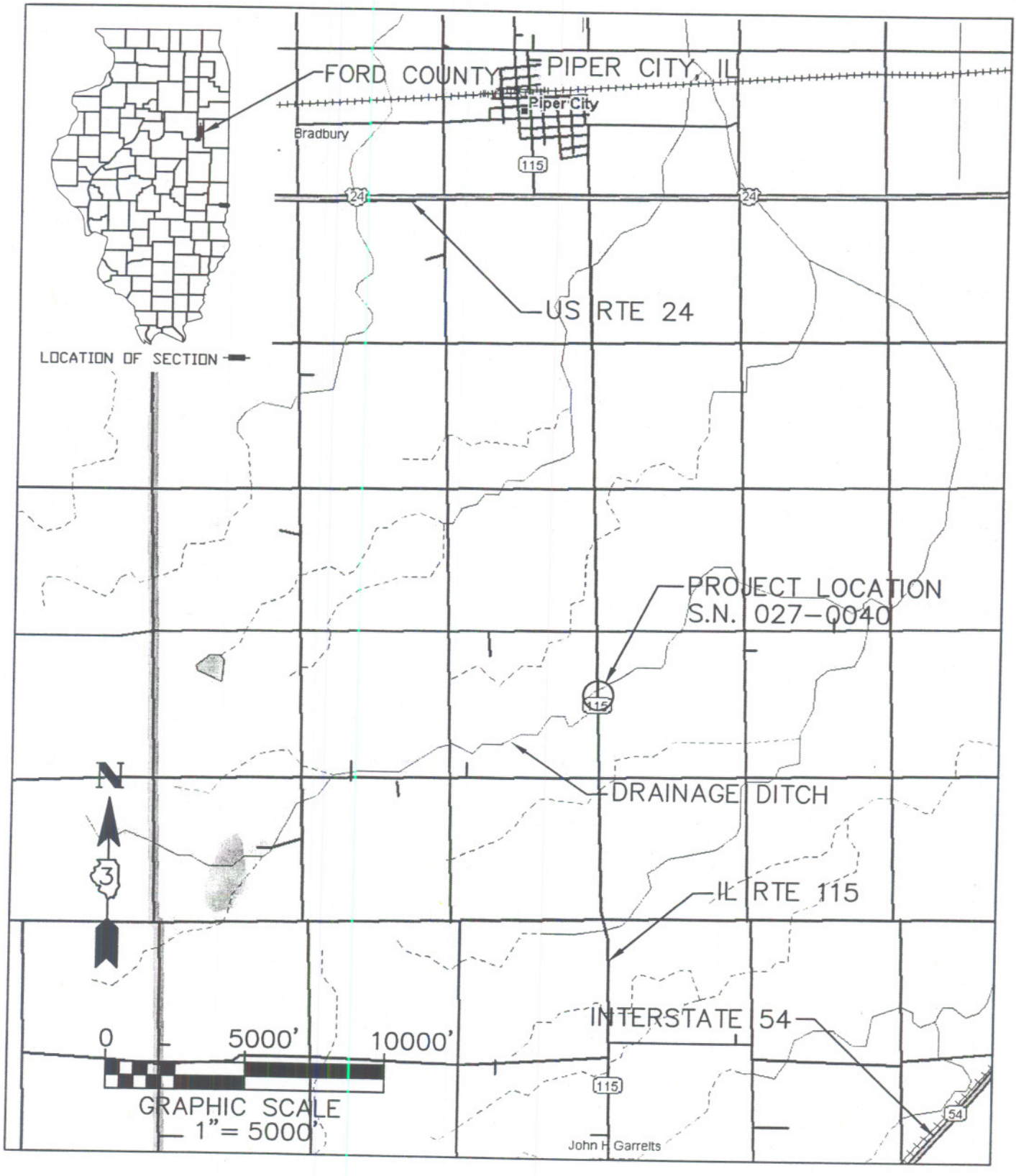
Hydraulic Report Checklist

The following checklist should be completed by the districts before submitting Hydraulic Reports to the Bridge Office for approval.

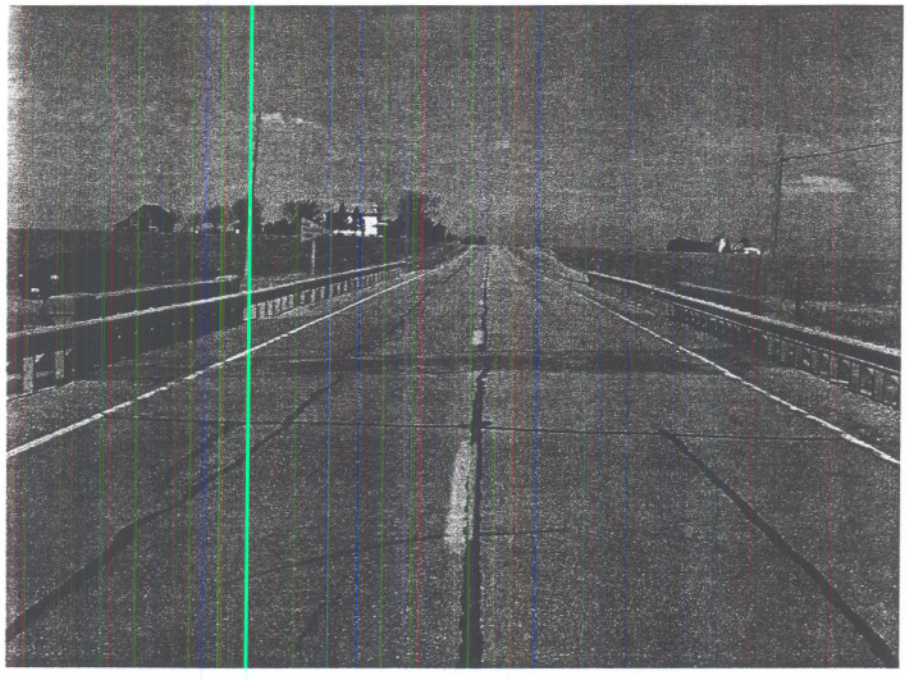
1. _____ Table of Contents
2. _____ Narrative
3. _____ Hydraulic Report Data Sheets
4. _____ Location Map
5. _____ USGS Quadrangle Map
6. _____ Plan view drawing
7. _____ Sketches of bridge openings
8. _____ Proper cross sections and drawings
9. _____ Streambed profile
10. _____ 1' or 2' Contour Map (if available)
11. _____ Datum correlation
12. _____ Copies of survey notes
13. _____ Photographs
14. _____ Diskette containing computer model

# APPENDIX A

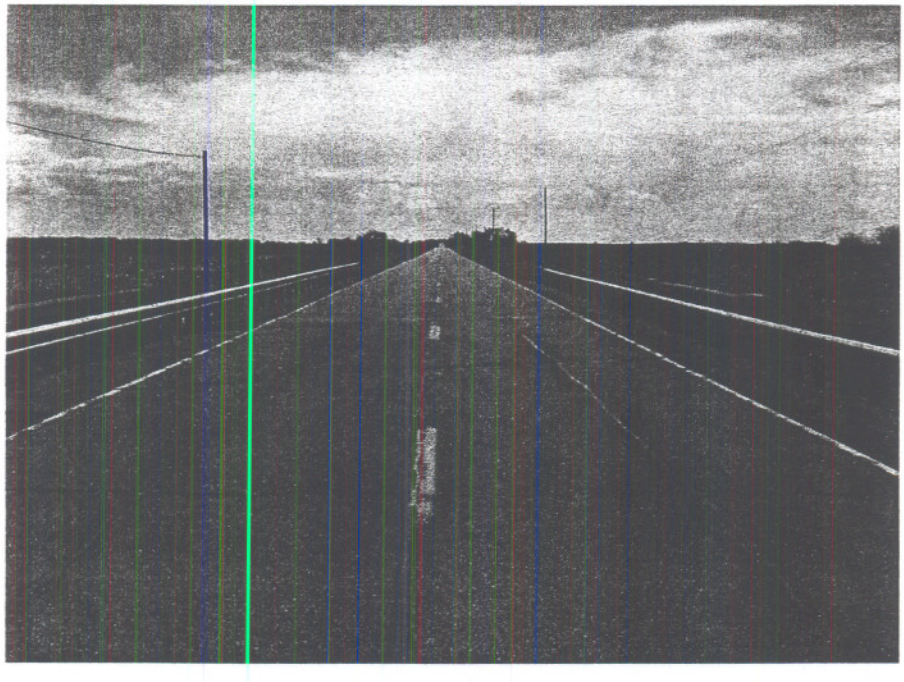
# LOCATION MAP & PHOTOGRAPHS



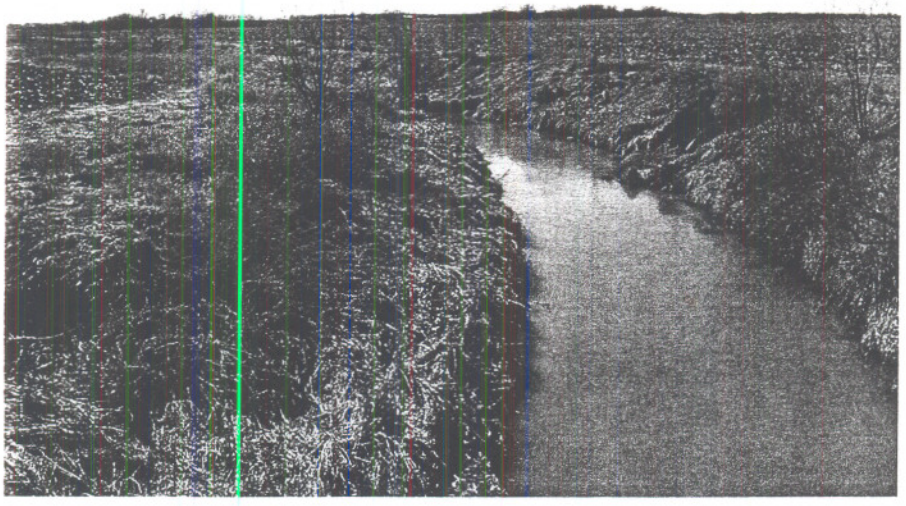

**LOCATION MAP**



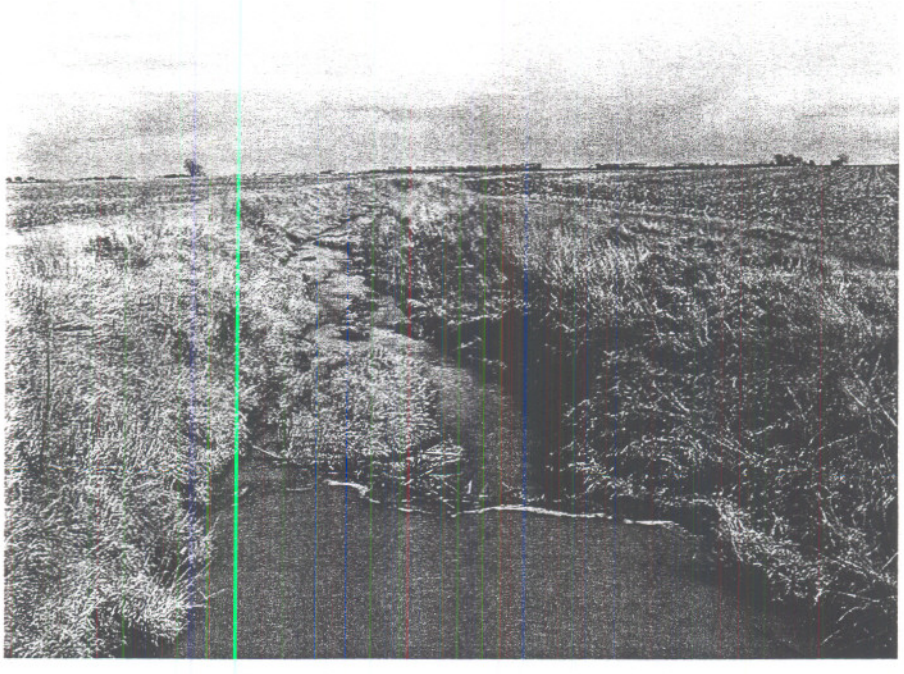
IL ROUTE 115
LOOKING NORTH FROM STRUCTURE



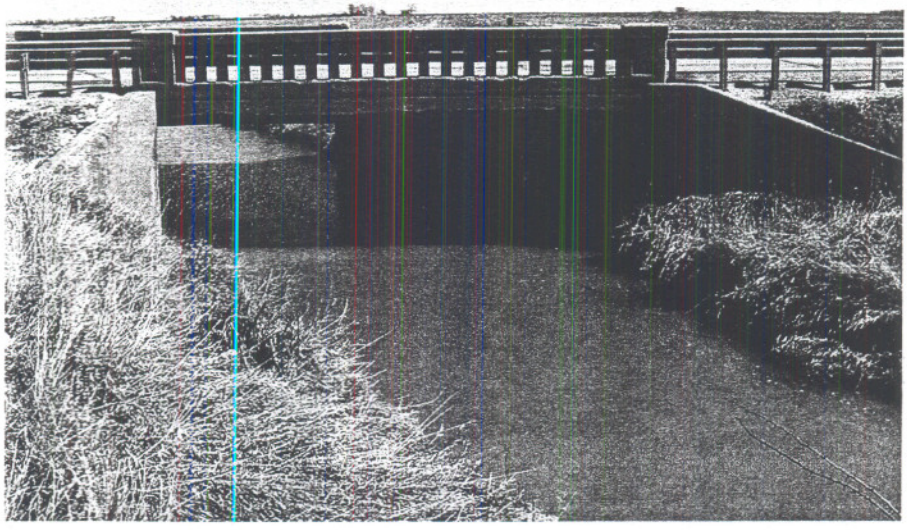
IL ROUTE 115
LOOKING SOUTH FROM STRUCTURE



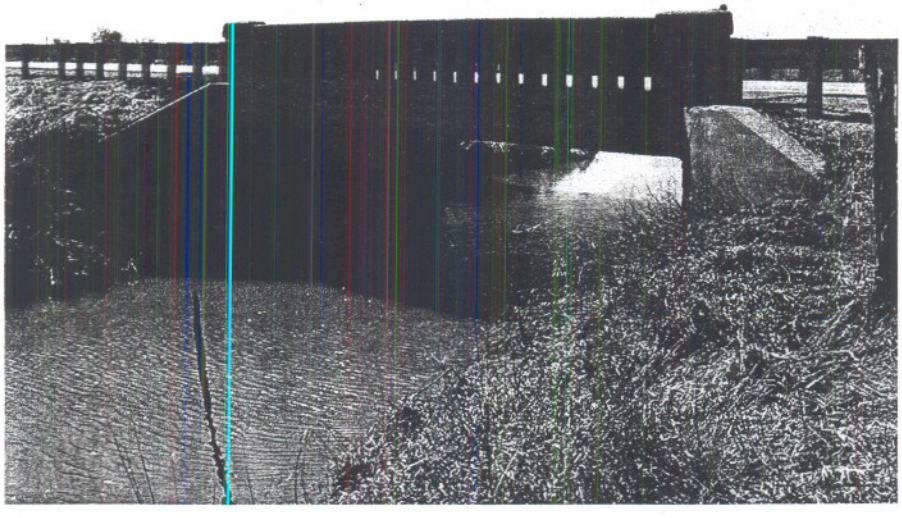
DRAINAGE DITCH
LOOKING UPSTREAM FROM STRUCTURE



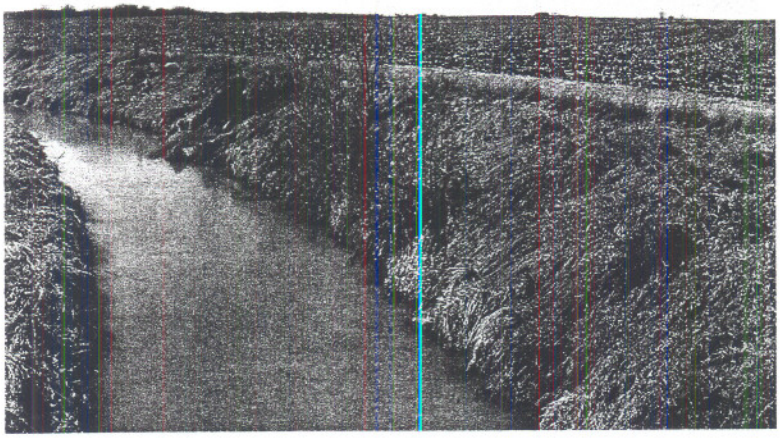
DRAINAGE DITCH
LOOKING DOWNSTREAM FROM STRUCTURE

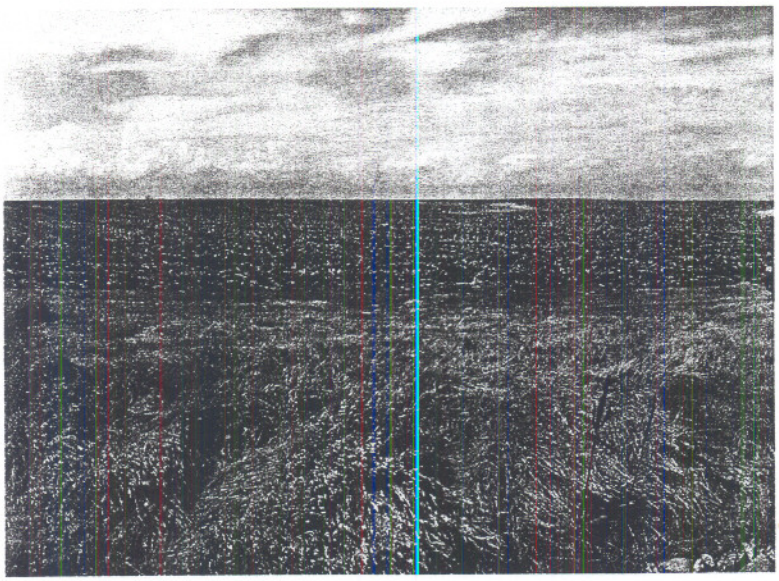


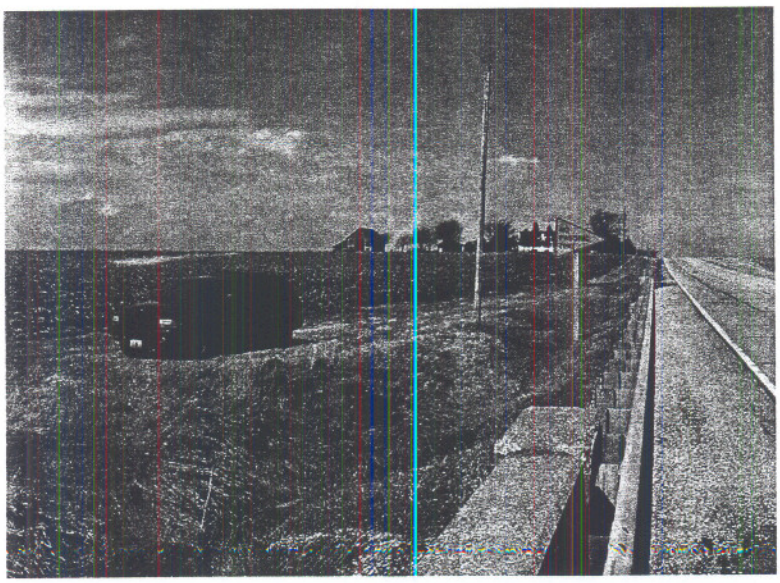
IL ROUTE 115 OVER DRAINAGE DITCH
LOOKING DOWNSTREAM FROM APPX. 50' UPSTREAM



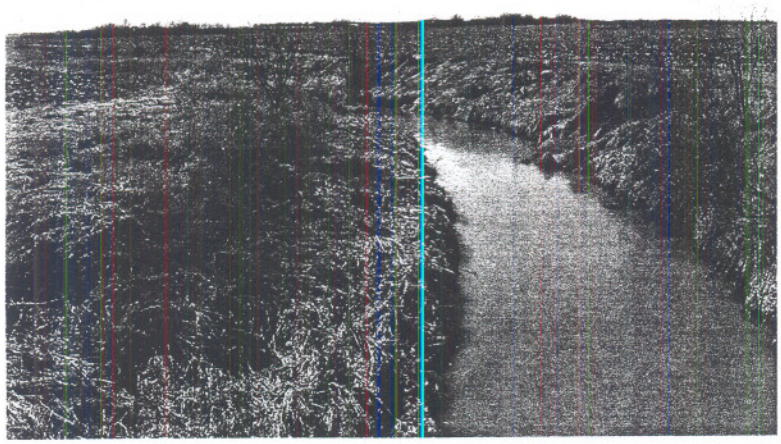
IL ROUTE 115 OVER DRAINAGE DITCH
LOOKING UPSTREAM FROM APPX. 50' DOWNSTREAM

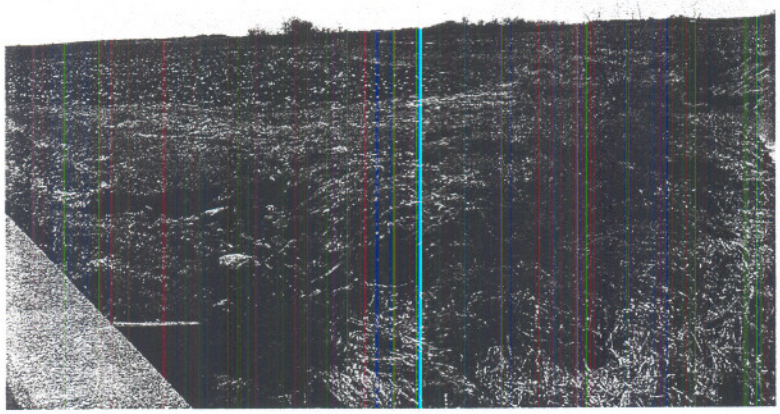




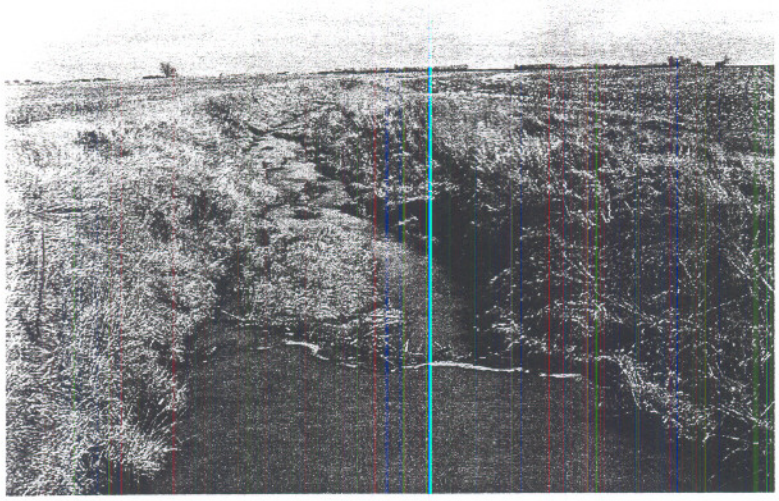


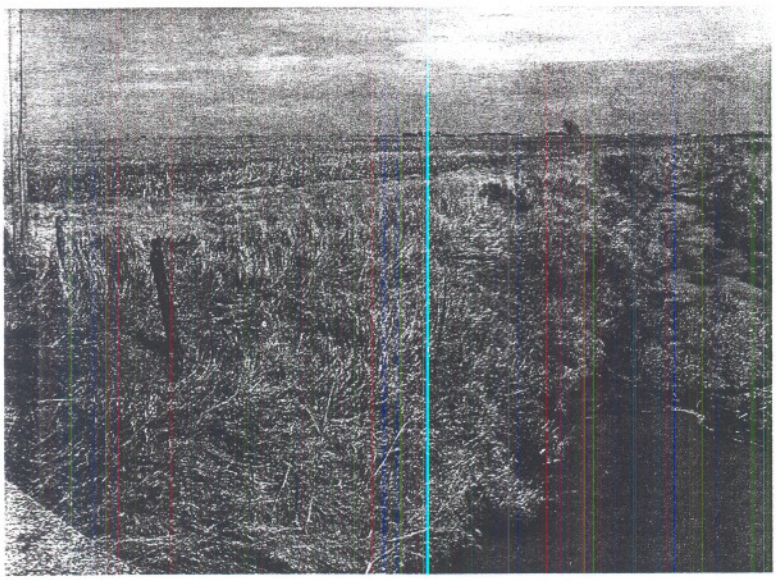
OVERBANK CONDITIONS LOOKING NORTHWEST OF EXISTING STRUCTURE (UPSTREAM LEFT OVERBANK)

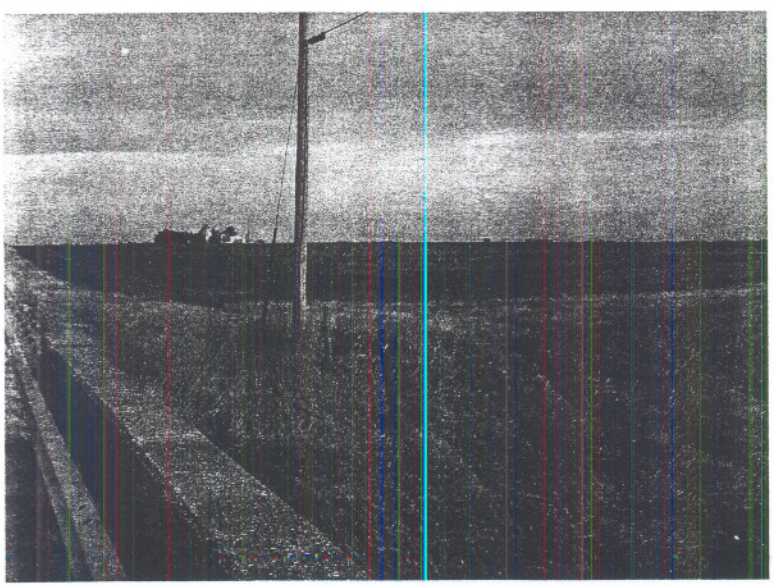




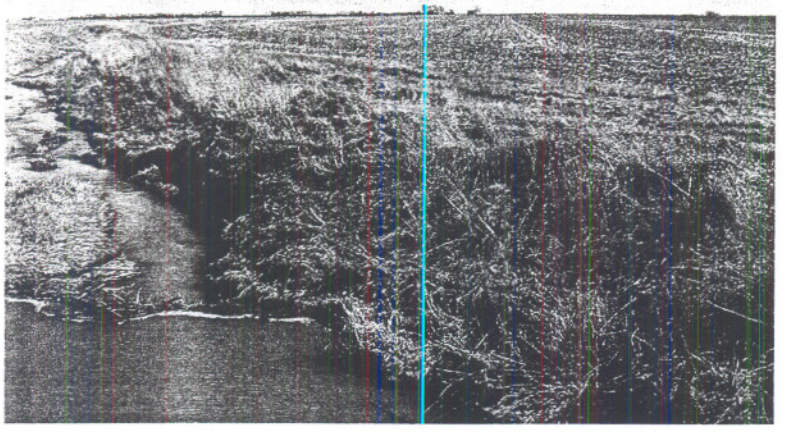
OVERBANK CONDITIONS LOOKING SOUTHWEST OF EXISTING STRUCTURE (UPSTREAM RIGHT OVERBANK)



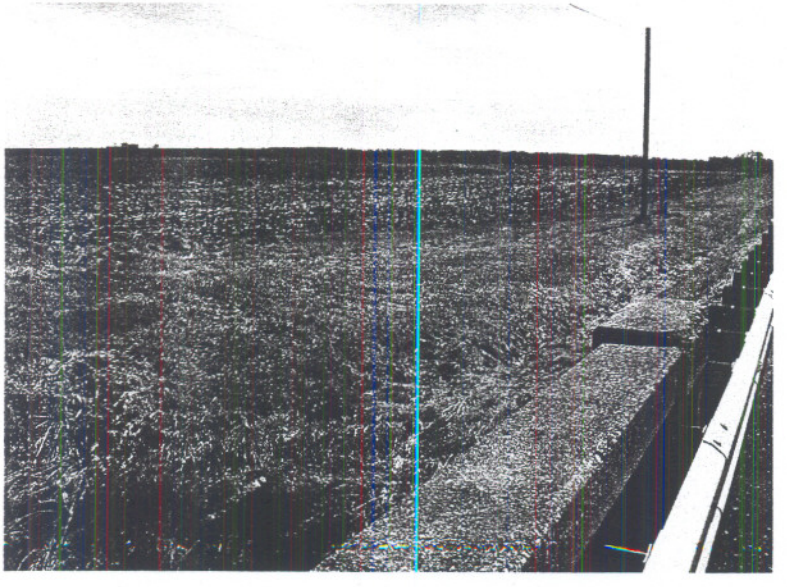




OVERBANK CONDITIONS LOOKING NORTHEAST OF EXISTING STRUCTURE (DOWNSTREAM LEFT OVERBANK)



OVERBANK CONDITIONS LOOKING SOUTHEAST OF EXISTING STRUCTURE (DOWNSTREAM RIGHT OVERBANK)



# APPENDIX B

# HYDROLOGY

## HYDROLOGY

# USGS METHOD - DISCHARGE COMPUTATIONS

PROJECT : District 3 Structure 027-0040
LOCATION : IL Route 115 over drainage ditch

DATE : 03/09/04
PROJ. NO: 22041
PREP. BY: DMO

DRAINAGE AREA = 3,962 ACRES = 6.191 SQ. MI.

HYDRAULIC LENGTH (HL) = 31,574 '
ELEV. @ 85% OF HL= 795.0 ' DISTANCE @ 85% OF HL= 26838 '
ELEV. @ 10% OF HL= 714.0 ' DISTANCE @ 10% OF HL= 3157 '

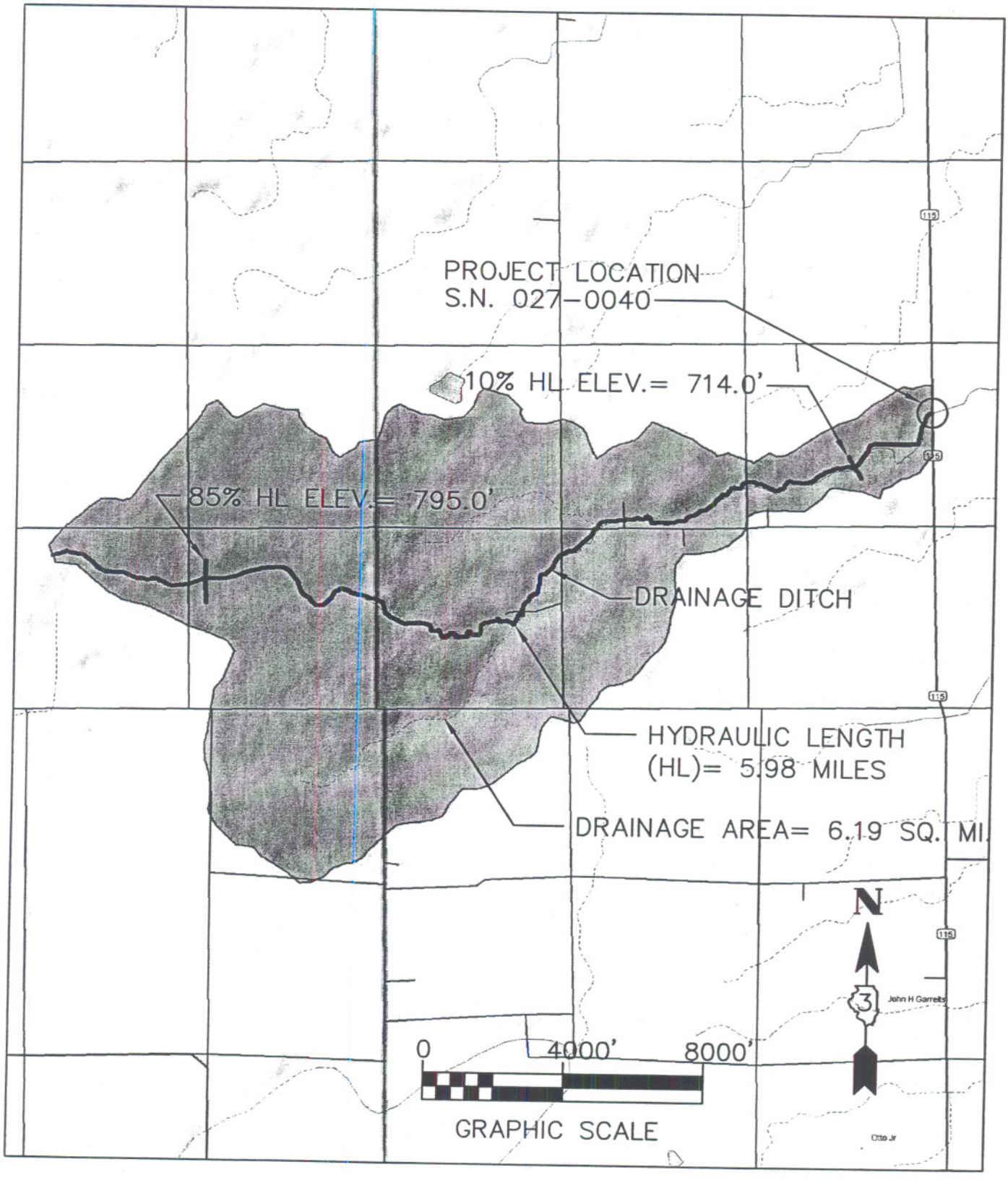
SLOPE, S = 18.060 FEET/MILE

INTENSITY, I = 2.95 INCHES

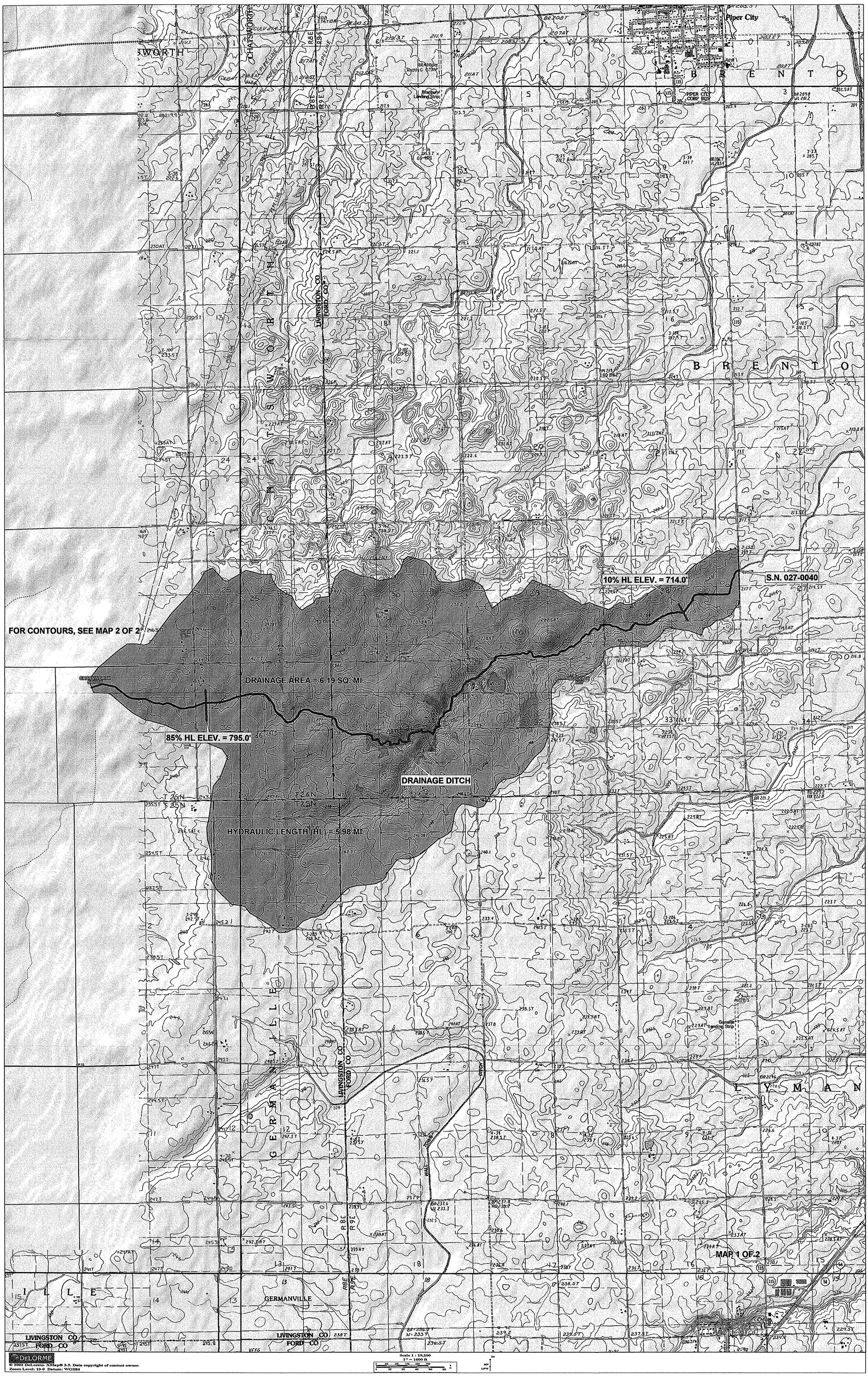
REGION = 1 (1,2,3,or 4)

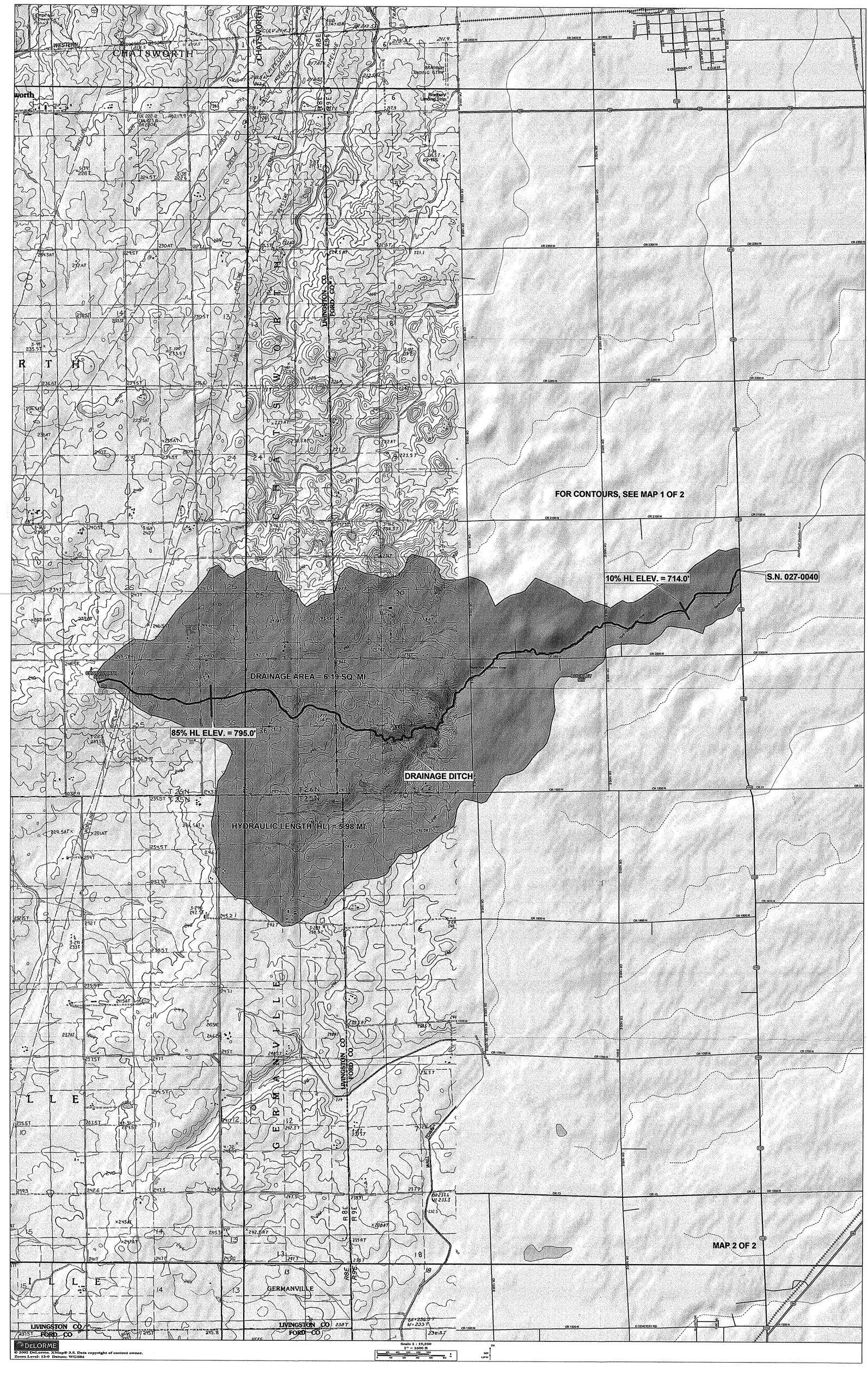
Q10 = 896
Q25 = 1157
Q30 = 1187
Q50 = 1353
Q100 = 1543
Q500 = 1988

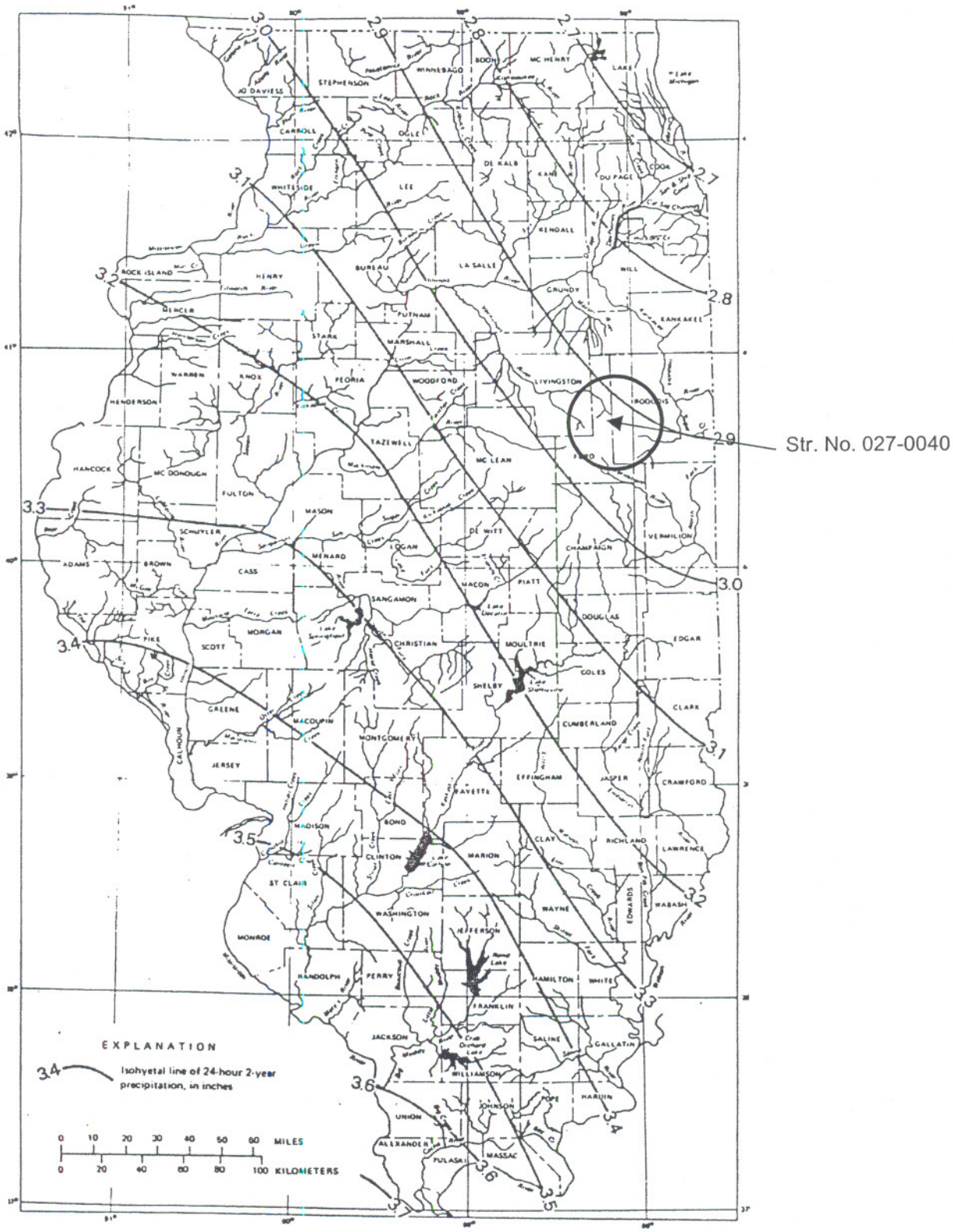
Checked by: LDT 3-11-04




**DRAINAGE BASIN**

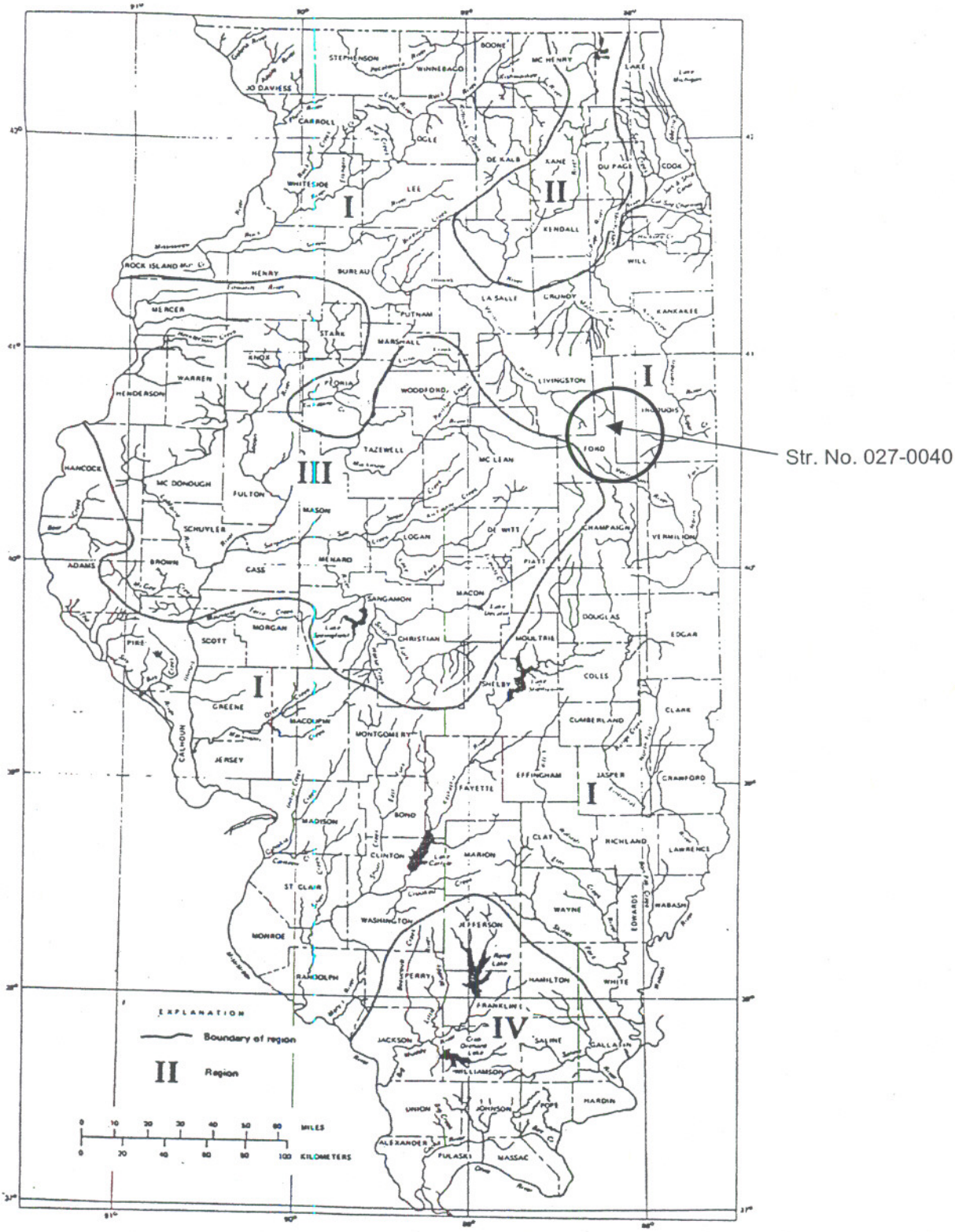

Piper City
BRENTO
BRENTO
LYMAN
GERMANVILLE
LIVINGSTON CO
FORD CO
10% HL ELEV. = 714.0'
S.N. 027-0040
FOR CONTOURS, SEE MAP 2 OF 2
DRAINAGE AREA = 6.19 SQ. MI.
85% HL ELEV. = 795.0'
DRAINAGE DITCH
HYDRAULIC LENGTH (HL) = 5.98 MI.
MAP 1 OF 2
DELORME
© 2002 DeLorme. XMap® 3.5. Data copyright of content owner.
Zoom Level: 13-0 Datum: WGS84


CHATSWORTH
FOR CONTOURS, SEE MAP 1 OF 2
10% HL ELEV. = 714.0'
S.N. 027-0040
DRAINAGE AREA = 6.19 SQ. MI.
85% HL ELEV. = 795.0'
DRAINAGE DITCH
HYDRAULIC LENGTH (HL) = 5.98 MI.
GERMANVILLE
MAP 2 OF 2
LIVINGSTON CO
FORD CO
DELORME
© 2003 DeLorme. XMap® 3.5. Data copyright of content owner.
Zoom Level: 13-0 Datum: WGS84
Scale 1 : 15,200
1" = 1600 ft




Distribution of rainfall intensity ( 24-hour 2-year ) I, in inches, in Illinois ( modified from Hershfield, 1961 ).

Figure 4-101.01 c




' Geographic regions, R, in Illinois

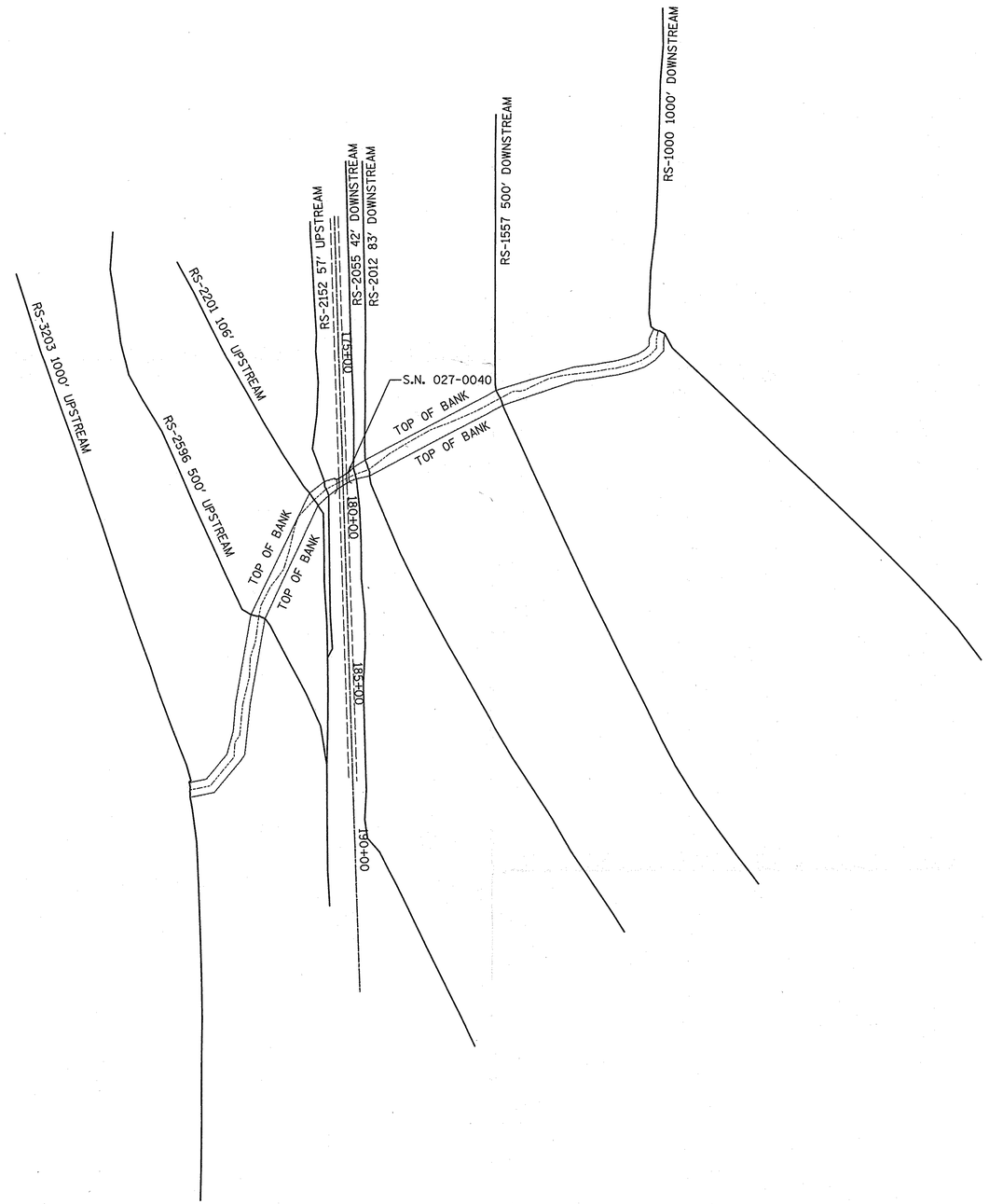
Figure 4-101.01 d

# APPENDIX C

# CROSS SECTION LOCATIONS

| FAP ROUTE | SECTION | COUNTY | TOTAL SHEETS | SHEET NO |
|---|---|---|---|---|
| 798 | 107-B | FORD | 1 | 1 |
| STA. 159+00 | | TO STA. 169+00 | | |
| HYDRAULIC CROSS SECTIONS | | | | |

| PLAN | | BY | DATE |
|---|---|---|---|
| NOTE BOOK NO. ____ | SURVEYED ____<br>PLOTTED ____<br>ALIGNMENT CHECKED ____<br>RT OF WAY CHECKED ____<br>FIELD BK. NO. ____<br>TOP FILE NAME ____ | | |




N

200' 0 200' 400'
SCALE: 1" = 200'

ILLINOIS DEPARTMENT OF TRANSPORTATION

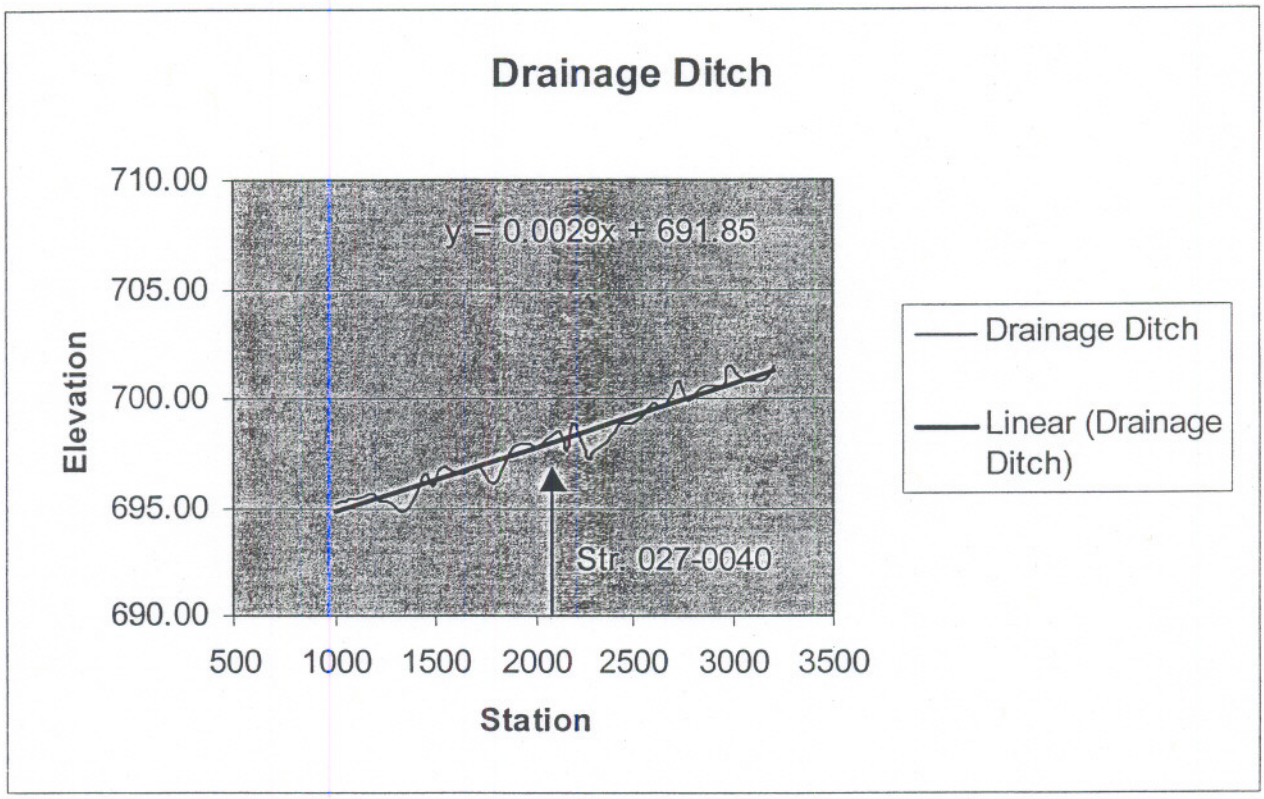
PLAN VIEW

FAP ROUTE 798
SECTION 107-B
FORD COUNTY

# APPENDIX D

# STREAMBED PROFILE

## STREAMBED PROFILE



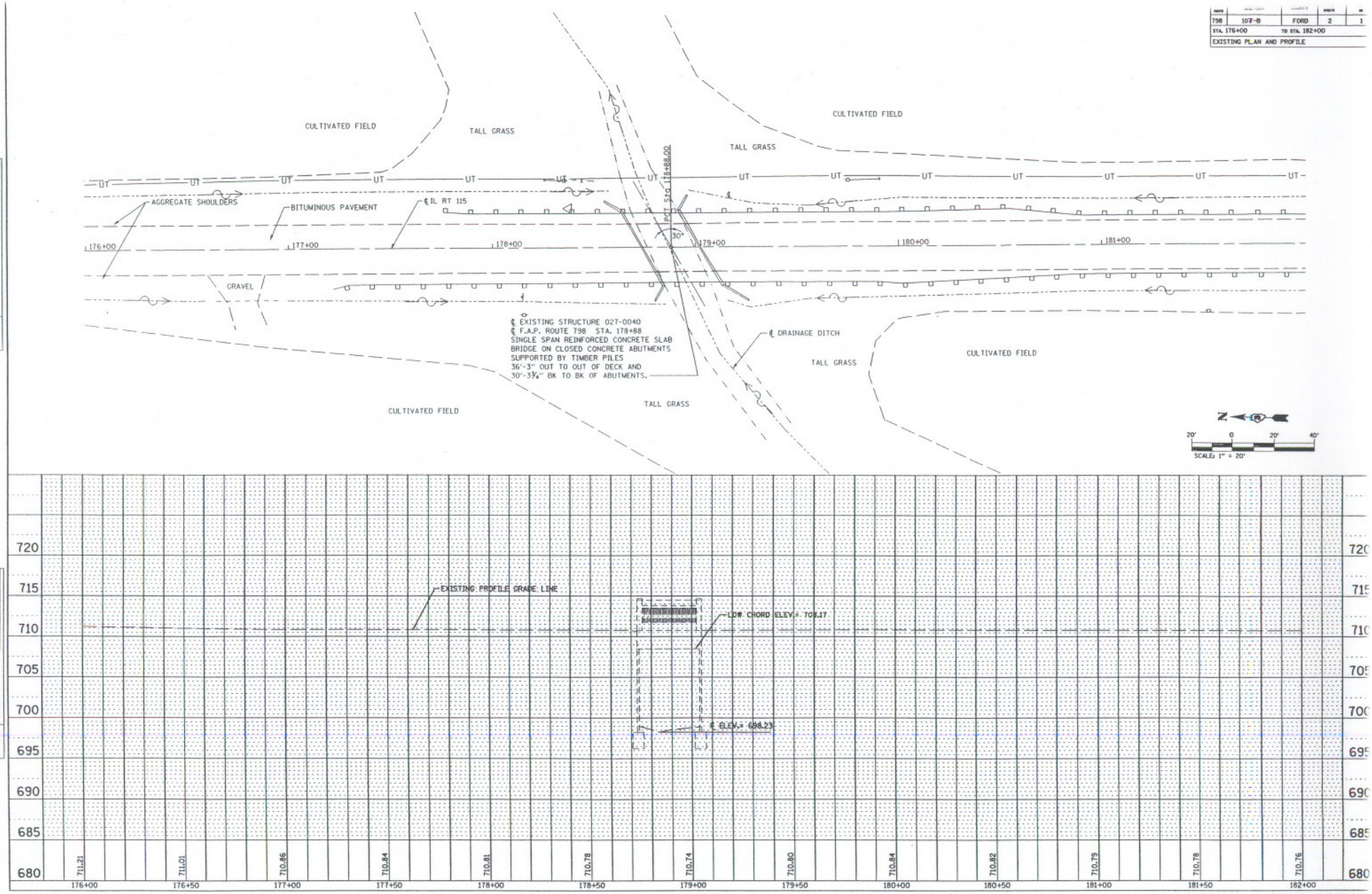
## STREAMBED PROFILE

| STA | ELEVATION |
|---|---|
| 1000 | 695.21 |
| 1027 | 695.29 |
| 1053 | 695.25 |
| 1082 | 695.36 |
| 1114 | 695.40 |
| 1147 | 695.47 |
| 1191 | 695.66 |
| 1224 | 695.34 |
| 1259 | 695.32 |
| 1352 | 694.78 |
| 1397 | 695.50 |
| 1452 | 696.54 |
| 1475 | 696.07 |
| 1491 | 696.01 |
| 1505 | 696.11 |
| 1514 | 696.71 |
| 1557 | 696.91 |
| 1645 | 696.53 |
| 1721 | 696.90 |
| 1789 | 696.09 |
| 1868 | 697.42 |
| 1932 | 697.93 |
| 2012 | 697.78 |
| 2055 | 698.19 |
| 2116 | 698.45 |
| 2152 | 697.64 |
| 2201 | 698.83 |
| 2269 | 697.21 |
| 2303 | 697.57 |
| 2375 | 698.03 |
| 2435 | 698.84 |
| 2502 | 698.90 |
| 2562 | 699.31 |
| 2596 | 699.74 |
| 2670 | 699.71 |
| 2723 | 700.77 |
| 2783 | 699.94 |
| 2865 | 700.59 |
| 2959 | 700.63 |
| 2985 | 701.47 |
| 3029 | 701.03 |
| 3140 | 700.83 |
| 3203 | 701.55 |

# APPENDIX E

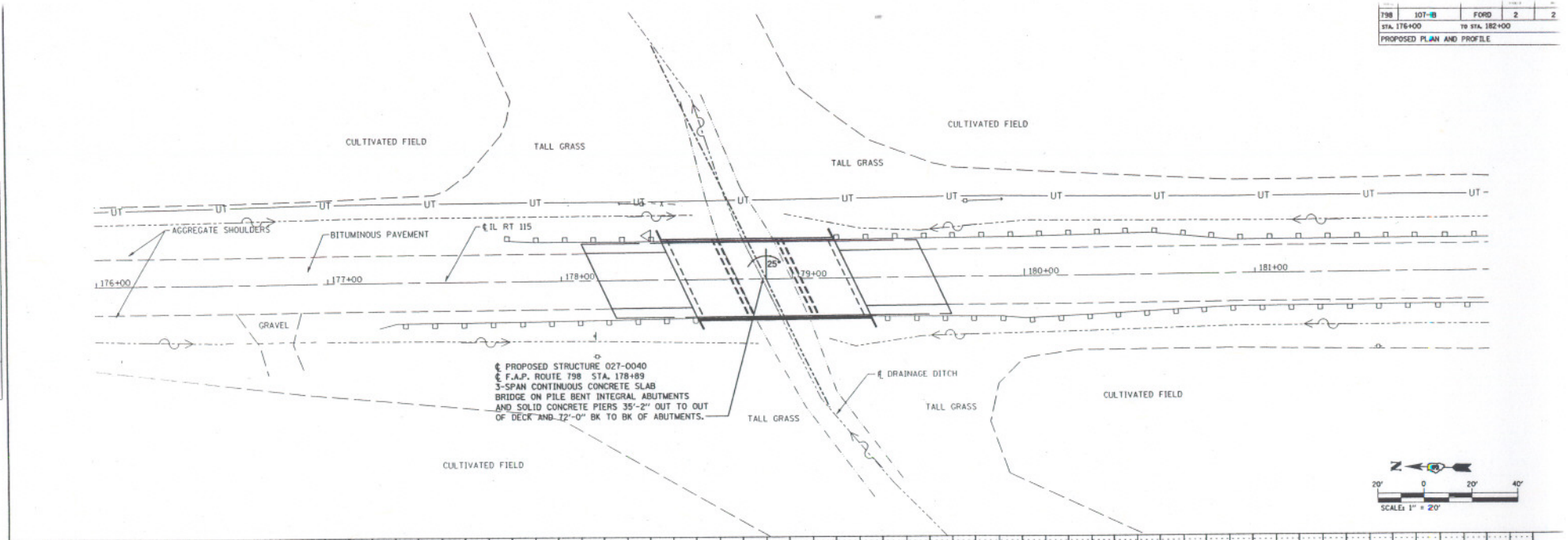
# ROADWAY PROFILE

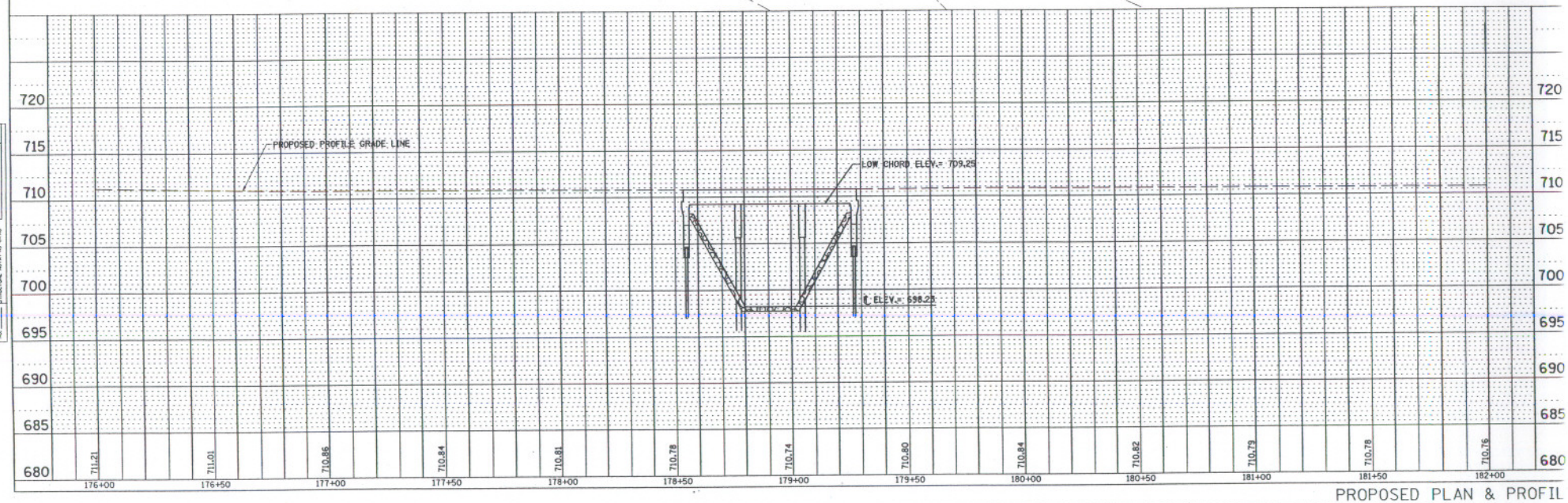
| ROUTE | SECTION | COUNTY | SHEET | NO. |
|---|---|---|---|---|
| 798 | 107-B | FORD | 2 | 1 |
| STA. 176+00 | | TO STA. 182+00 | | |
| EXISTING PLAN AND PROFILE | | | | |




EXISTING PLAN & PROFILE

| 798 | 107-IB | FORD | 2 | 2 |
|---|---|---|---|---|
| STA. 176+00 | | TO STA. 182+00 | | |
| PROPOSED PLAN AND PROFILE | | | | |



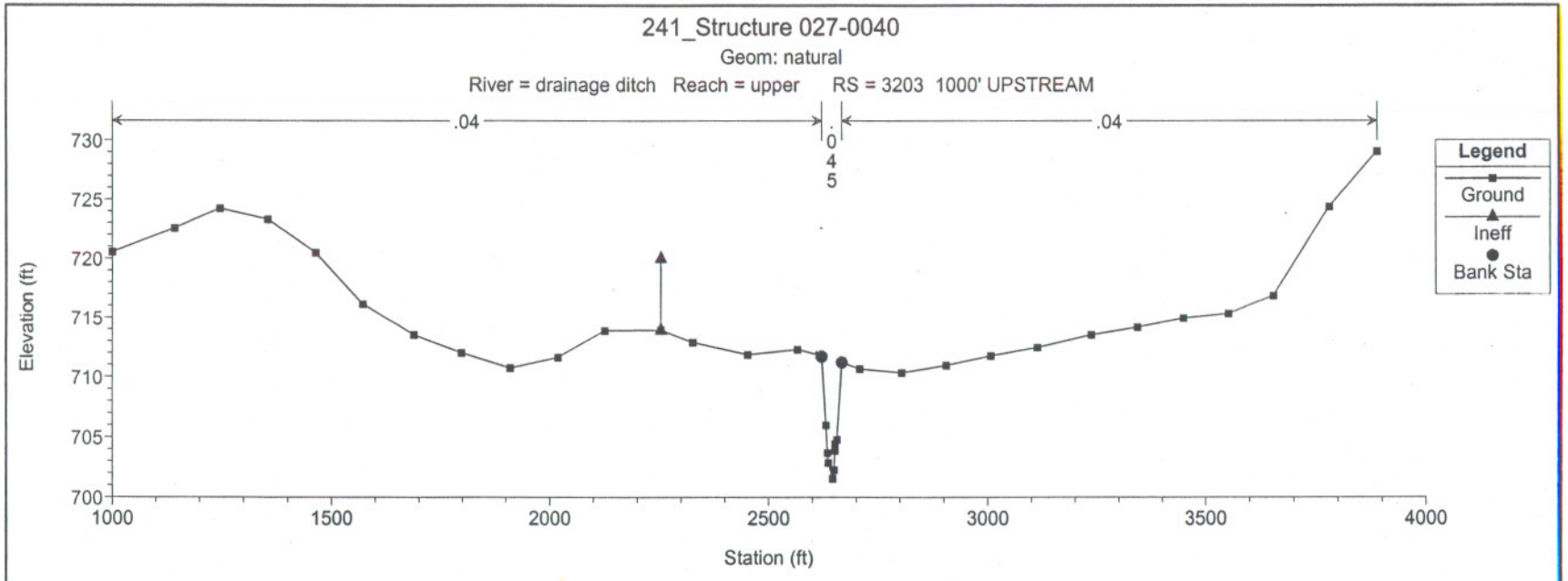

PROPOSED PLAN & PROFIL

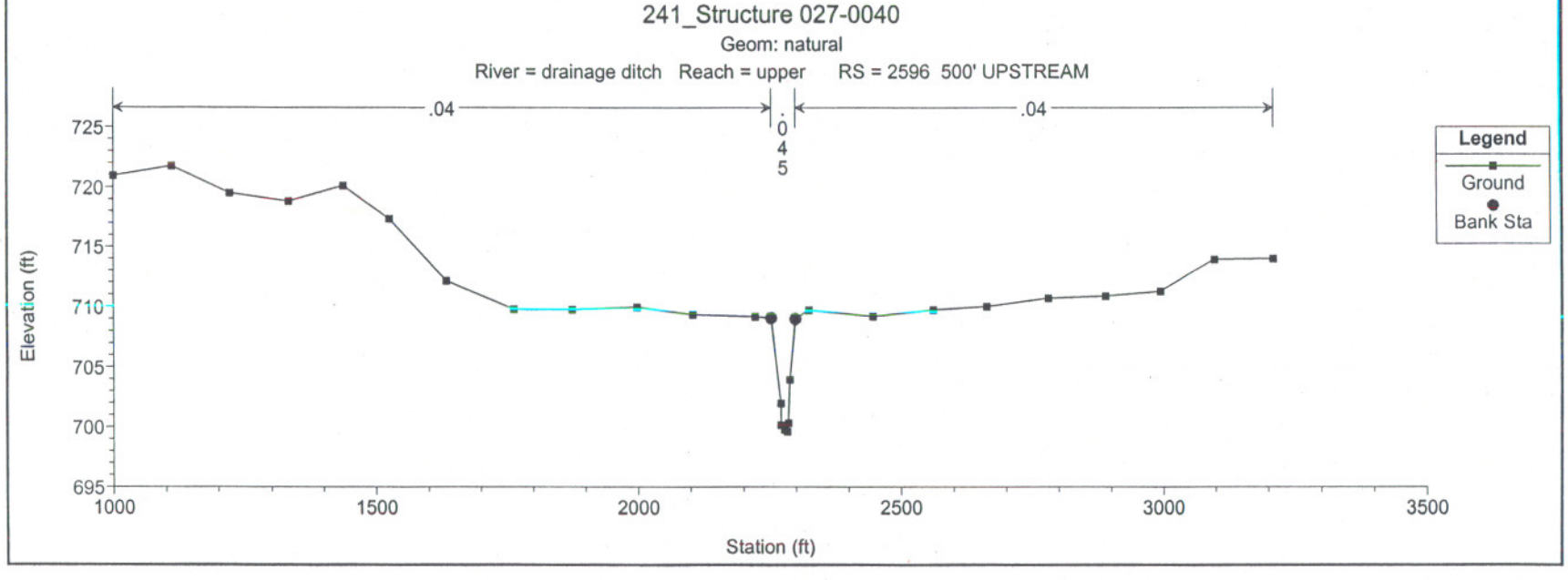
PLAN
NOTE BOOK NO.
SURVEYED
PLOTTED
ALIGNMENT CHECKED
BY OF R/W CHECKED
BY OF TILE TAKE

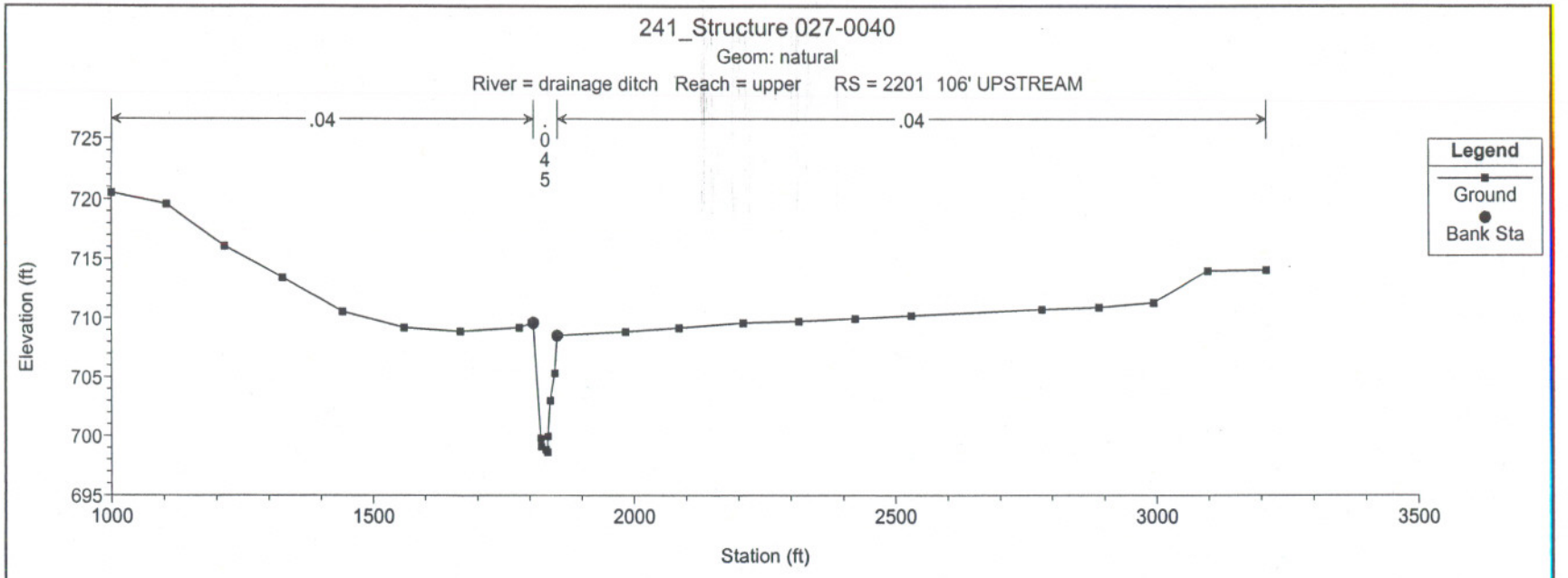
PROFILE
NOTE BOOK NO.
SURVEYED
PLOTTED
GRADES CHECKED
BY STRUCTURE NOTATIONS CHKD
DATE

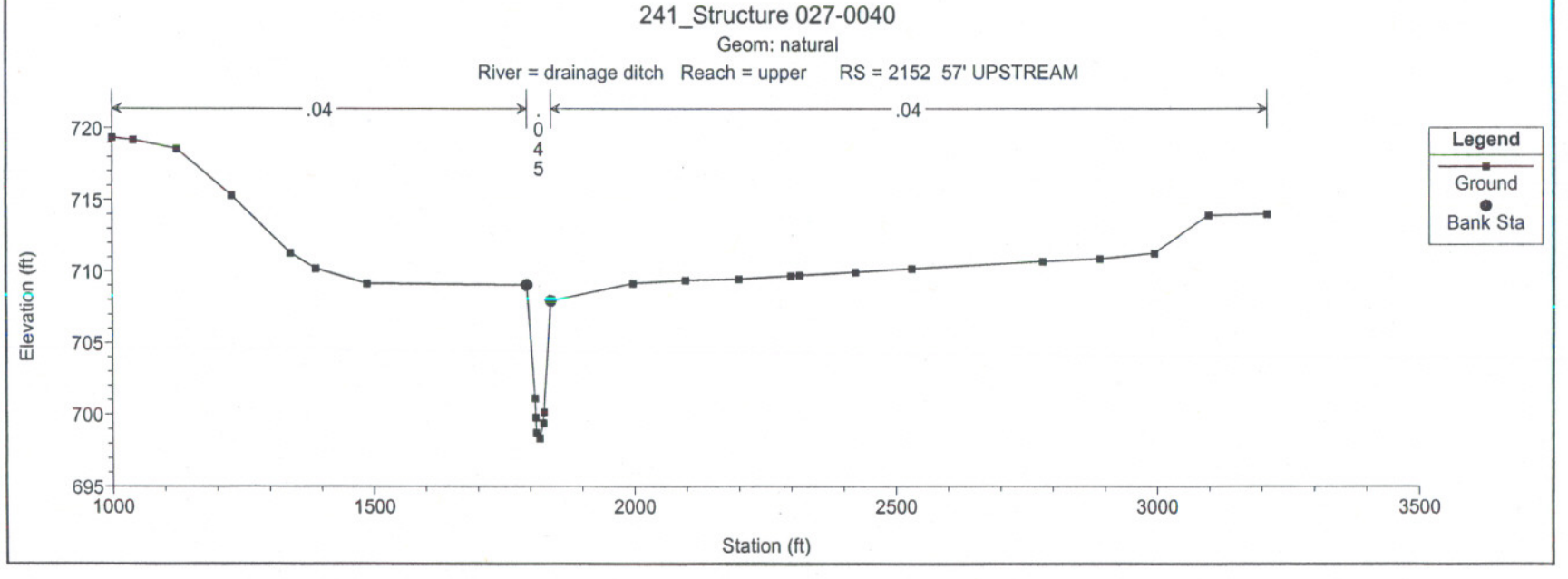
# APPENDIX F

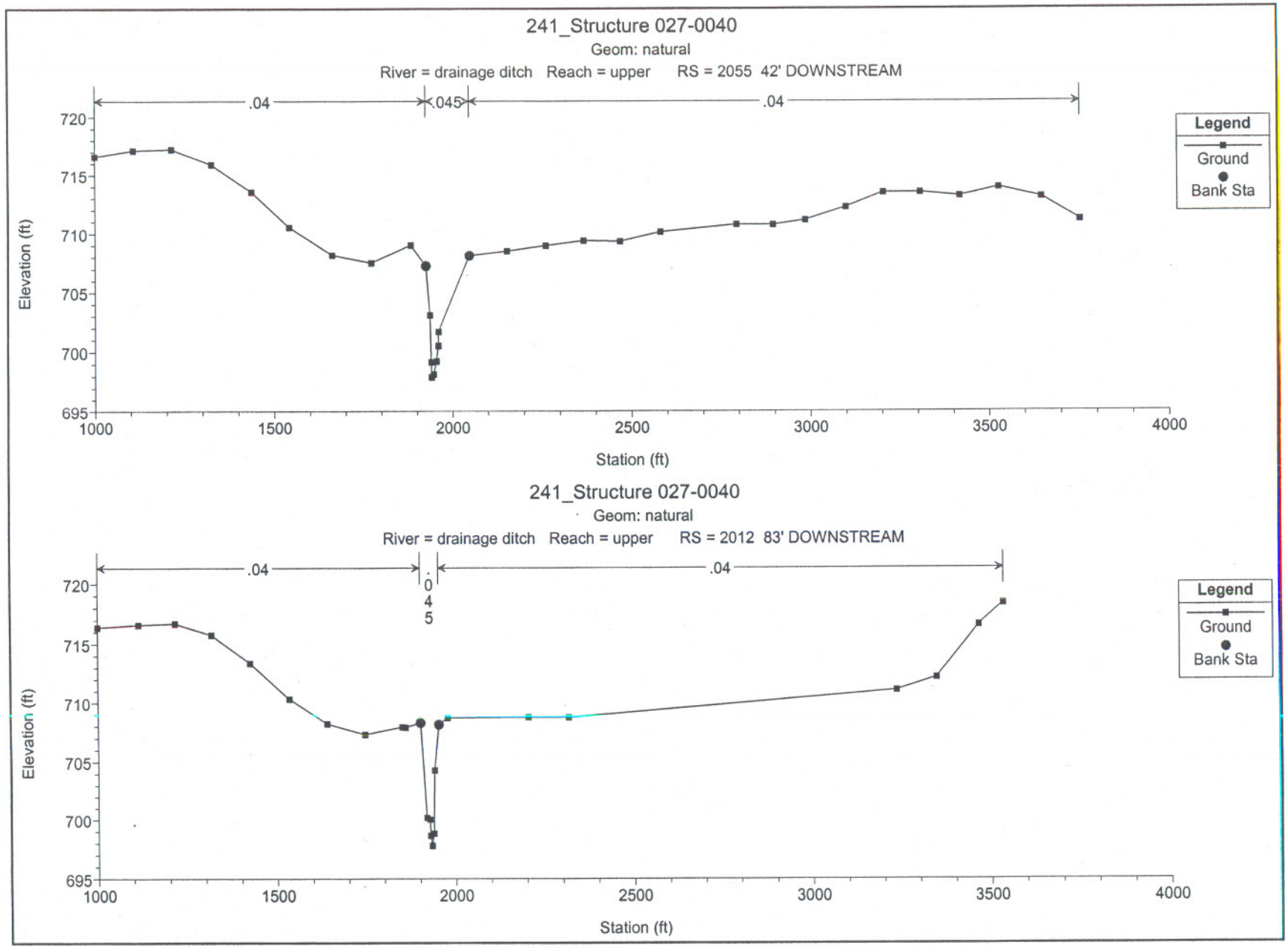
# CROSS SECTION PLOTS

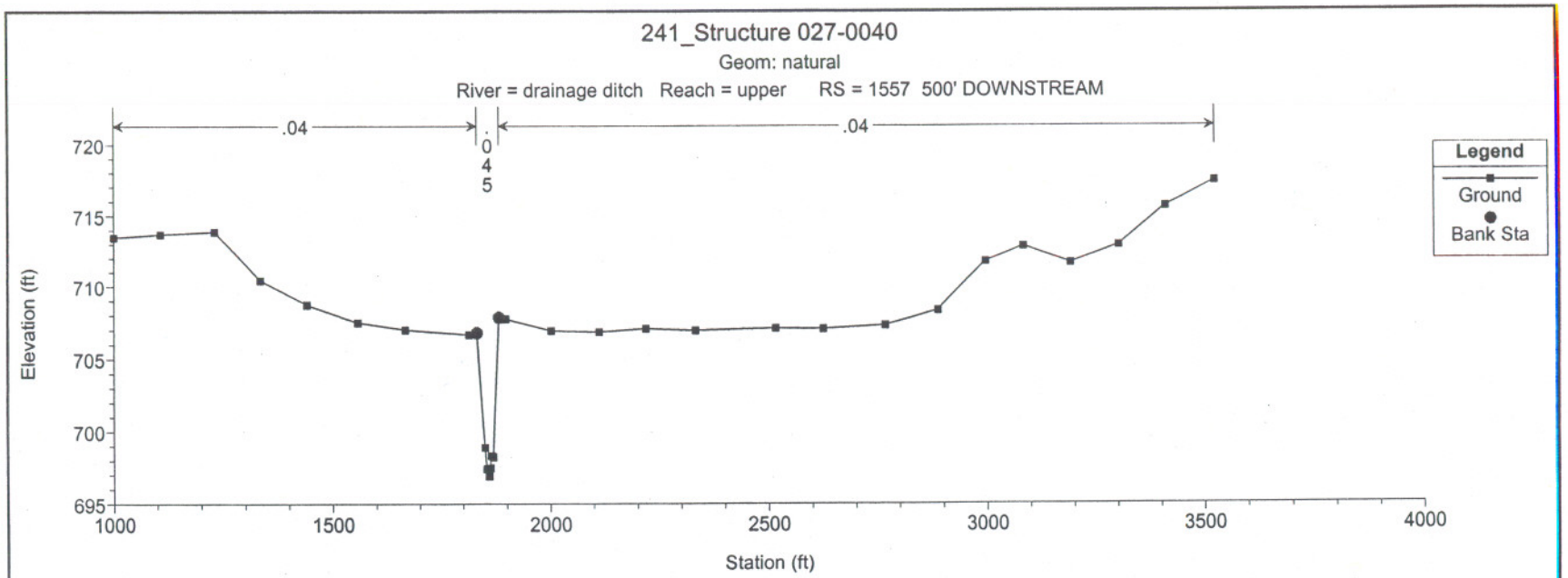

241_Structure 027-0040
Geom: natural
River = drainage ditch Reach = upper RS = 3203 1000' UPSTREAM
.04
.045
.04
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
730
725
720
715
710
705
700
1000
1500
2000
2500
3000
3500
4000
Station (ft)

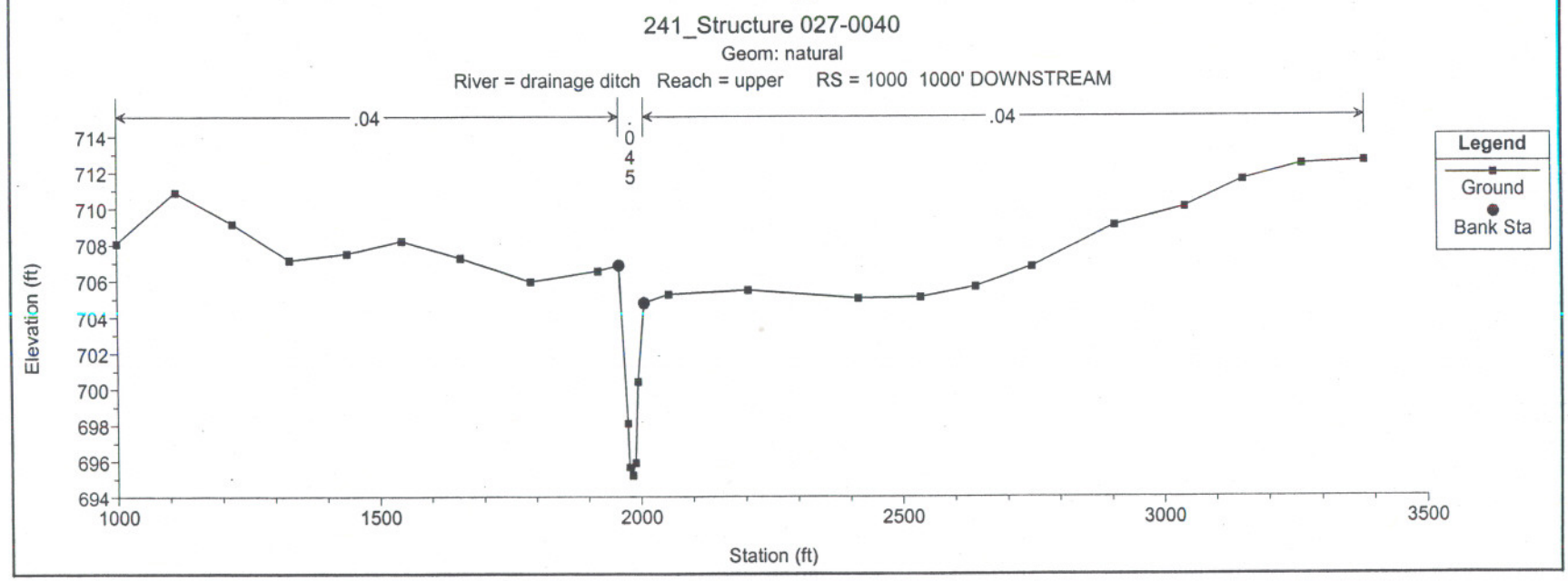

241_Structure 027-0040
Geom: natural
River = drainage ditch Reach = upper RS = 2596 500' UPSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
725
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
Station (ft)

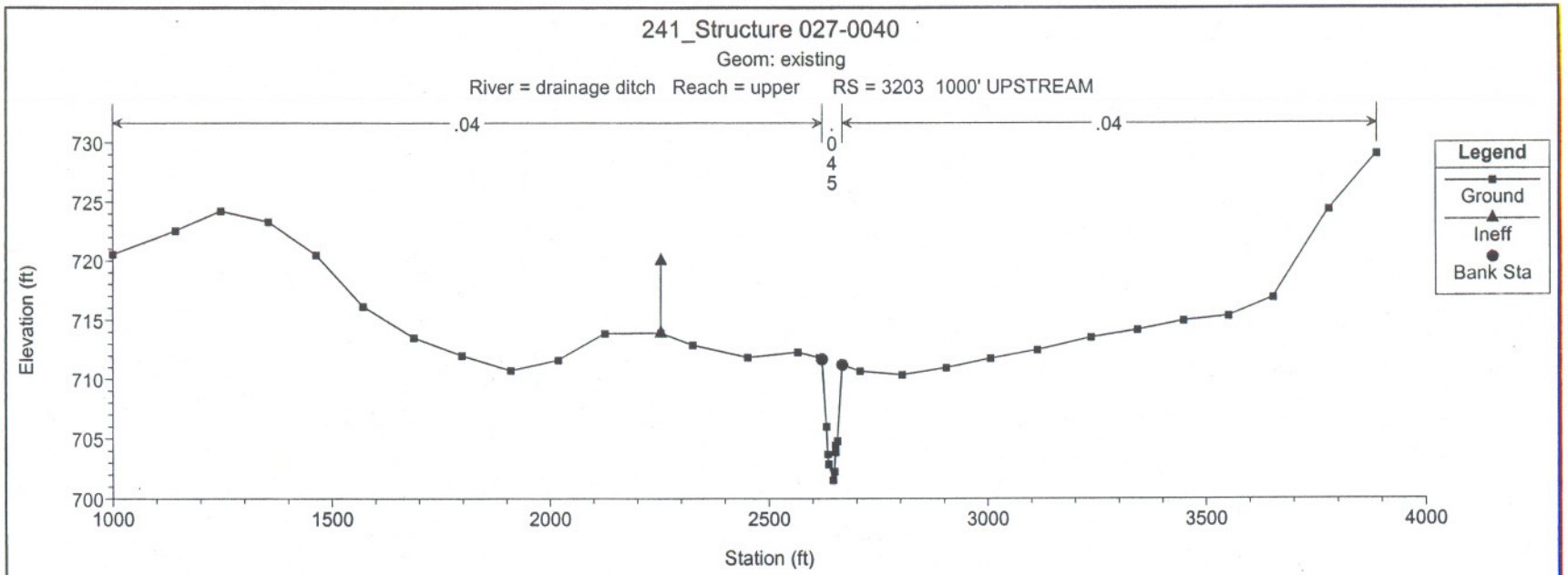

241_Structure 027-0040
Geom: natural
River = drainage ditch Reach = upper RS = 2201 106' UPSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
Station (ft)
725
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500

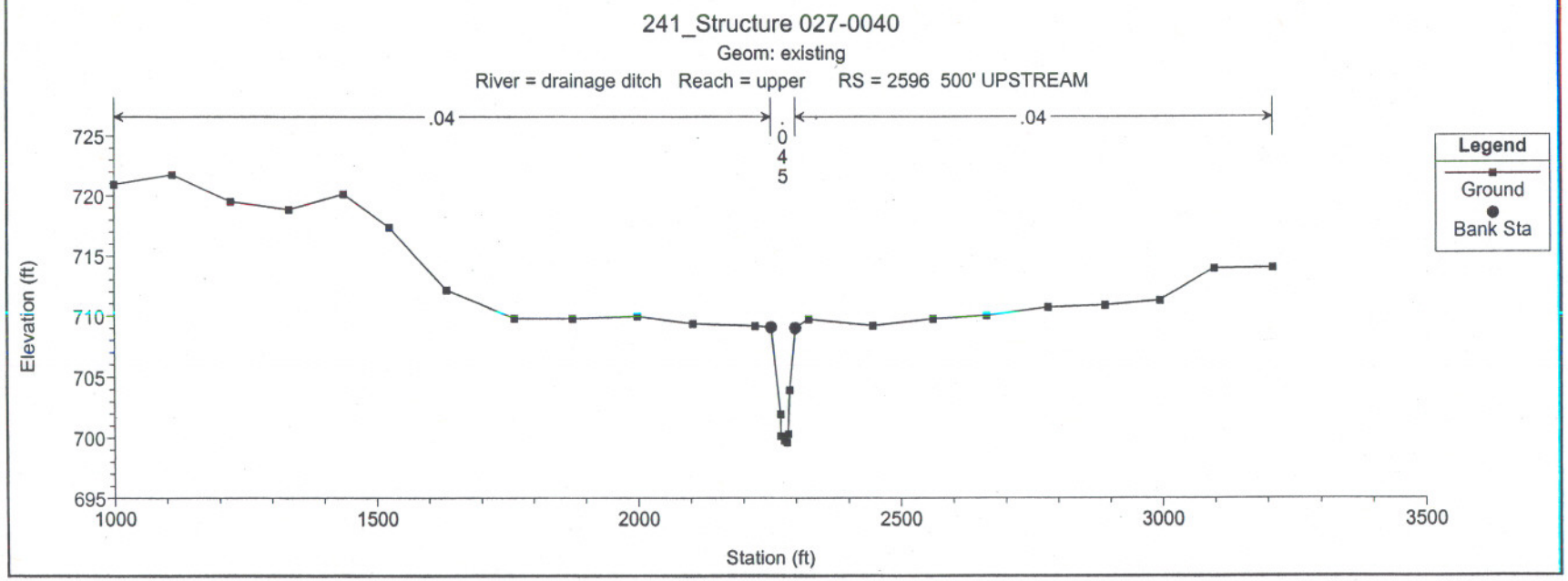

241_Structure 027-0040
Geom: natural
River = drainage ditch Reach = upper RS = 2152 57' UPSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
Station (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500

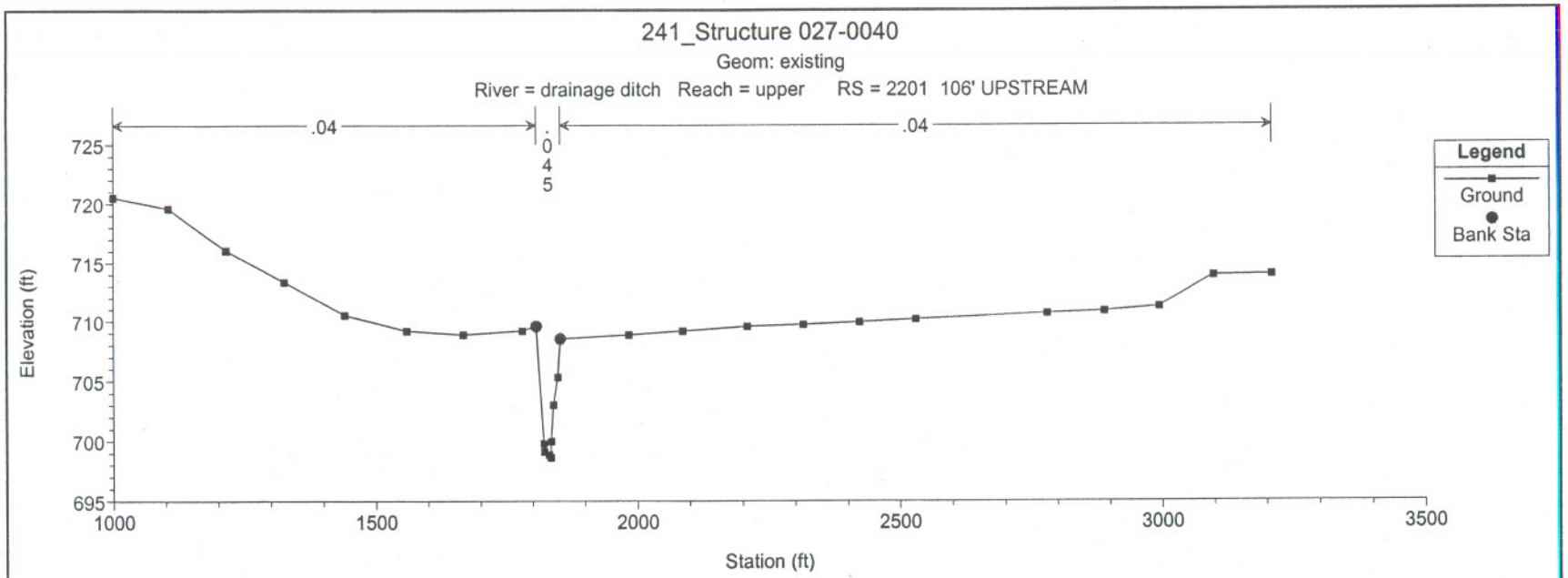

241_Structure 027-0040
Geom: natural
River = drainage ditch Reach = upper RS = 2055 42' DOWNSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
4000
Station (ft)
241_Structure 027-0040
Geom: natural
River = drainage ditch Reach = upper RS = 2012 83' DOWNSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
4000
Station (ft)

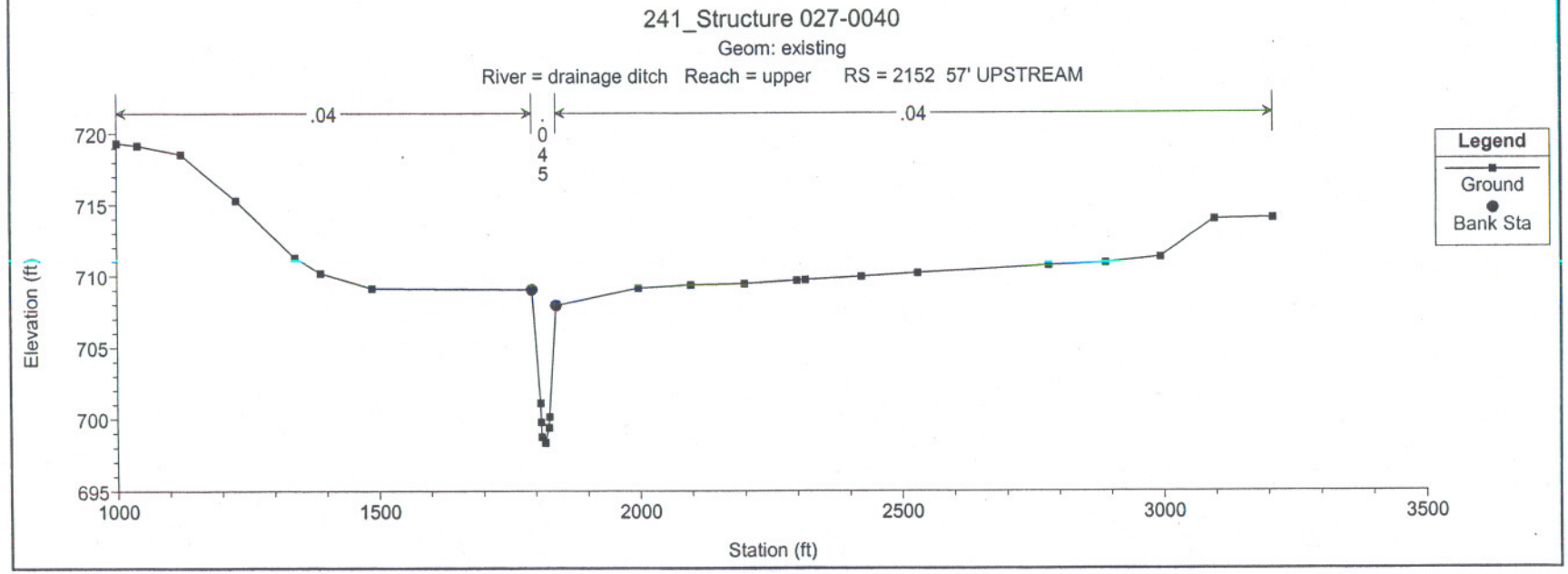

241_Structure 027-0040
Geom: natural
River = drainage ditch Reach = upper RS = 1557 500' DOWNSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
4000
Station (ft)

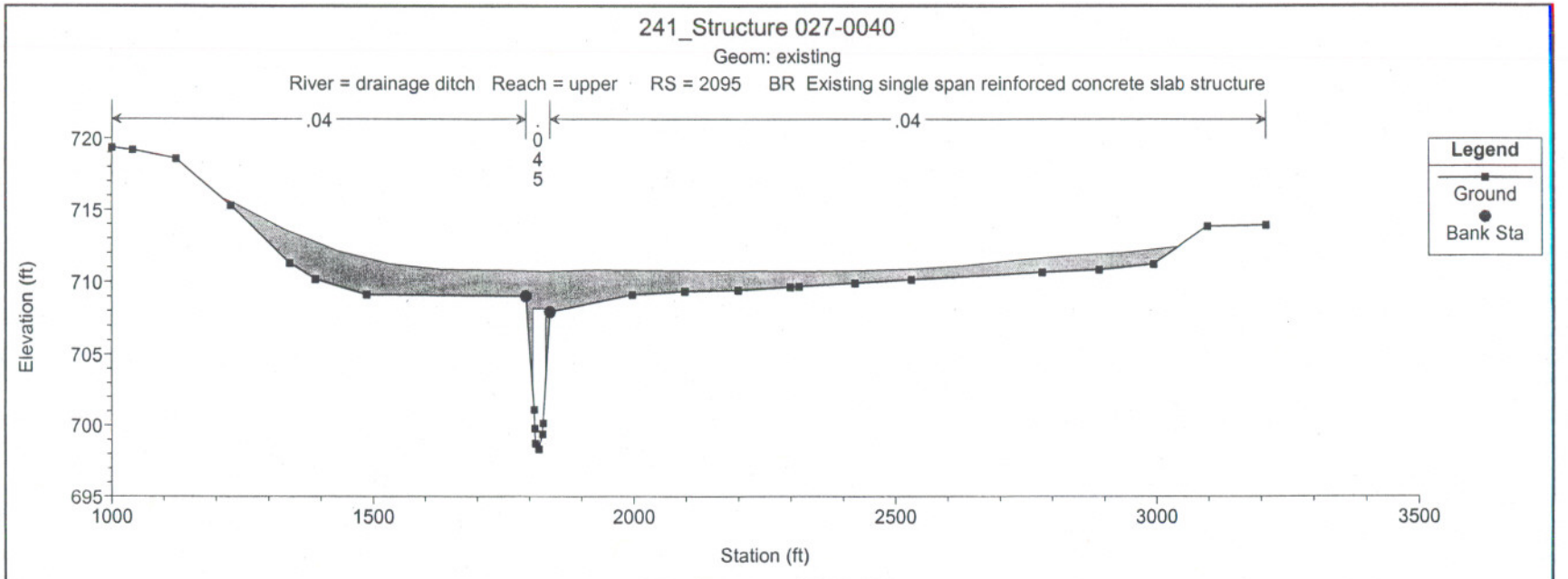

241_Structure 027-0040
Geom: natural
River = drainage ditch Reach = upper RS = 1000 1000' DOWNSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
714
712
710
708
706
704
702
700
698
696
694
1000
1500
2000
2500
3000
3500
Station (ft)

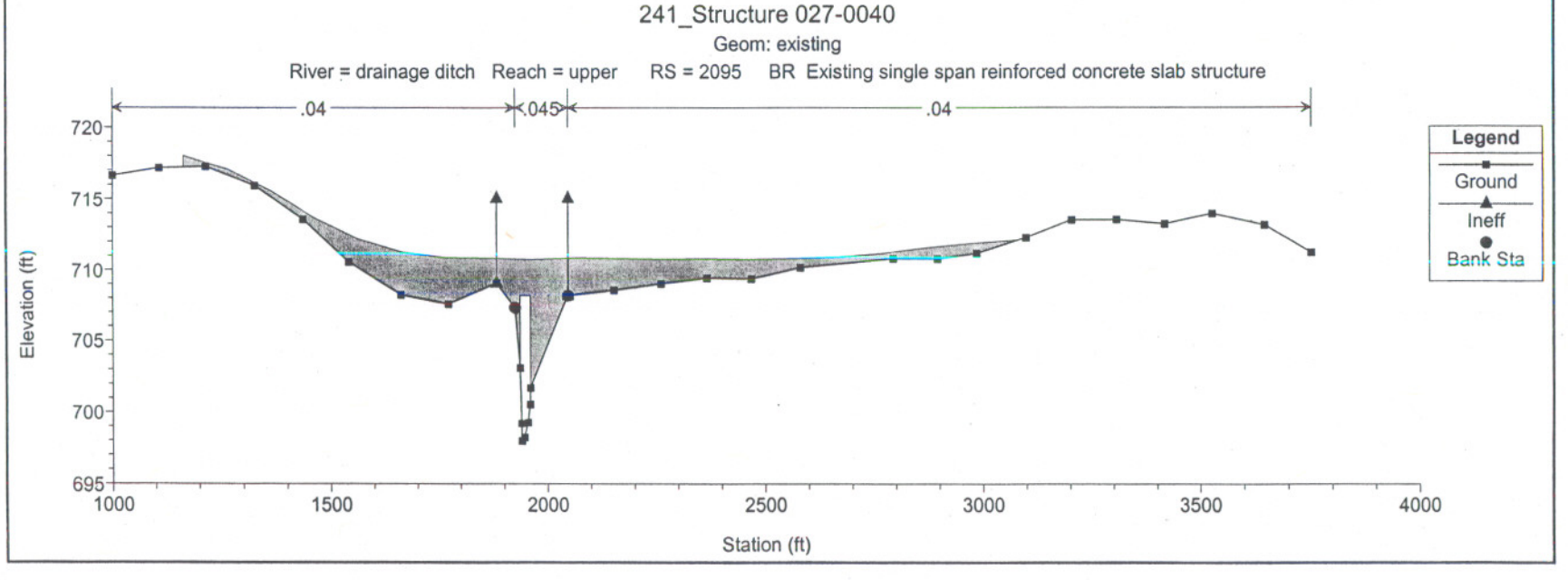

241_Structure 027-0040
Geom: existing
River = drainage ditch Reach = upper RS = 3203 1000' UPSTREAM
.04
.045
.04
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
730
725
720
715
710
705
700
1000
1500
2000
2500
3000
3500
4000
Station (ft)

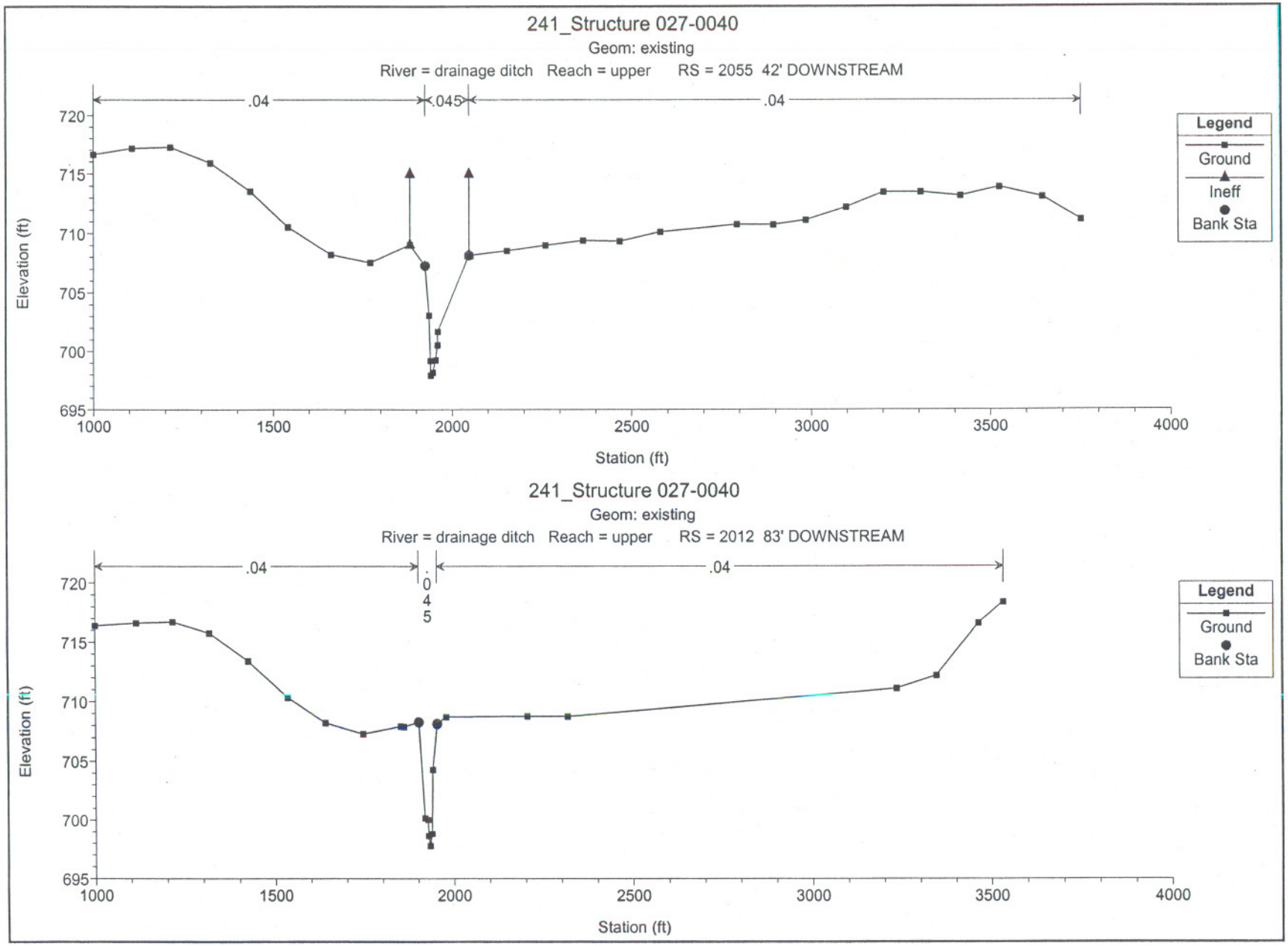

241_Structure 027-0040
Geom: existing
River = drainage ditch Reach = upper RS = 2596 500' UPSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
725
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
Station (ft)

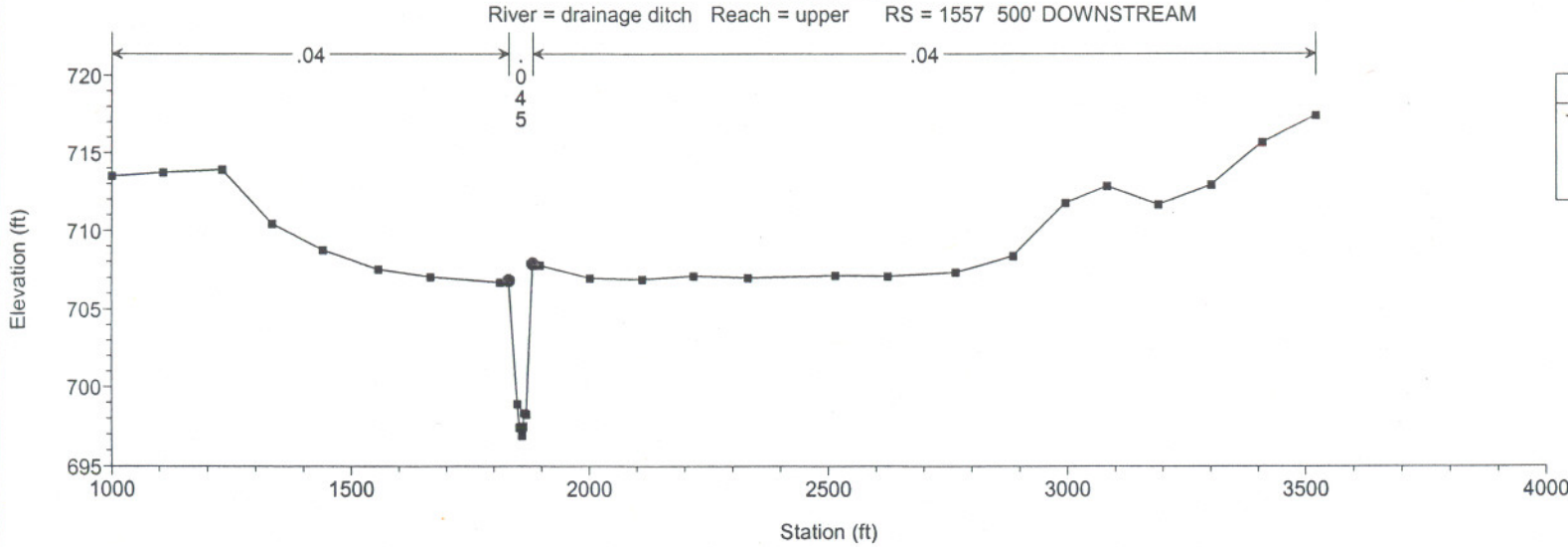

241_Structure 027-0040
Geom: existing
River = drainage ditch Reach = upper RS = 2201 106' UPSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
725
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
Station (ft)

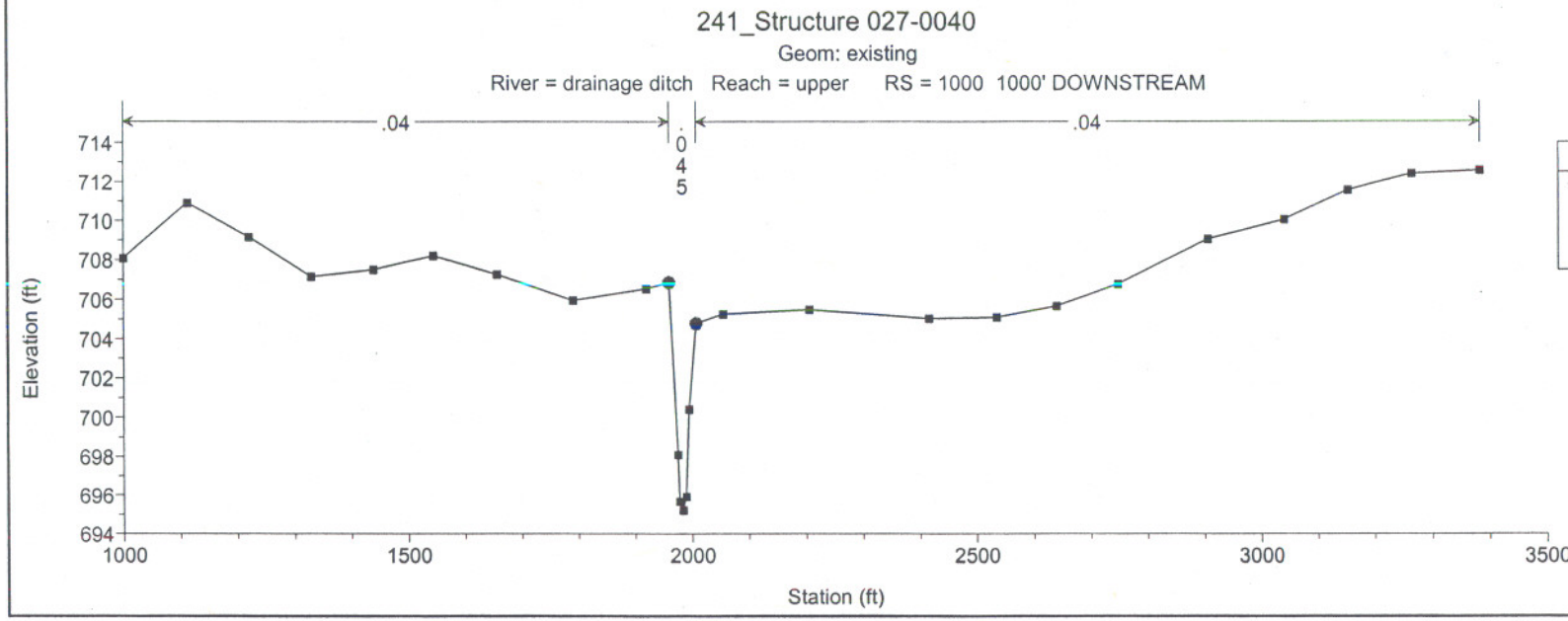

241_Structure 027-0040
Geom: existing
River = drainage ditch Reach = upper RS = 2152 57' UPSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
Station (ft)

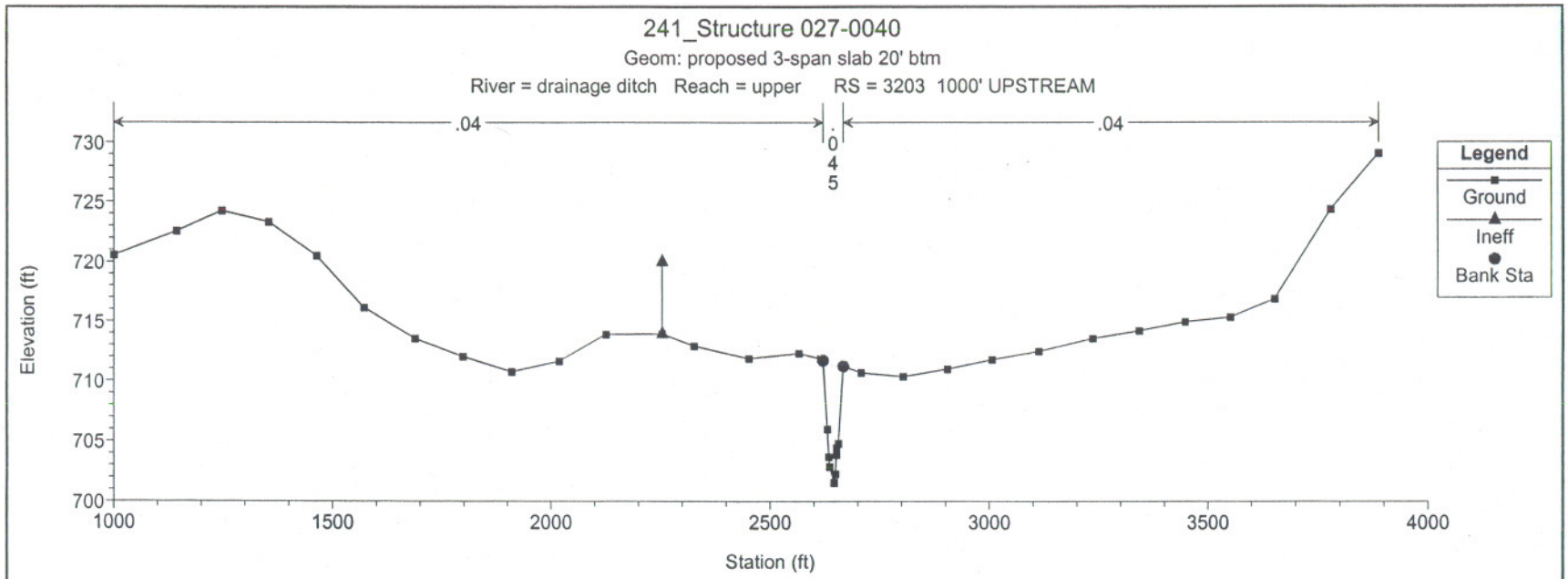

241_Structure 027-0040
Geom: existing
River = drainage ditch Reach = upper RS = 2095 BR Existing single span reinforced concrete slab structure
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
Station (ft)

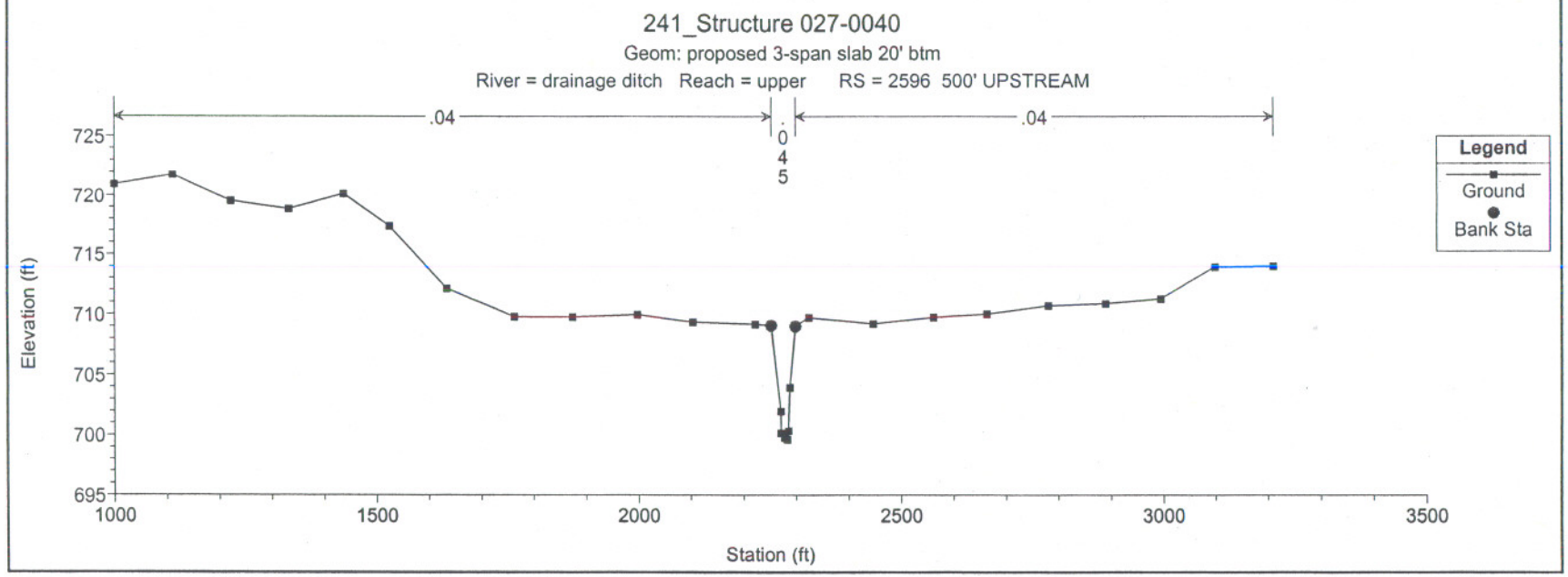

241_Structure 027-0040
Geom: existing
River = drainage ditch Reach = upper RS = 2095 BR Existing single span reinforced concrete slab structure
.04
.045
.04
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
4000
Station (ft)

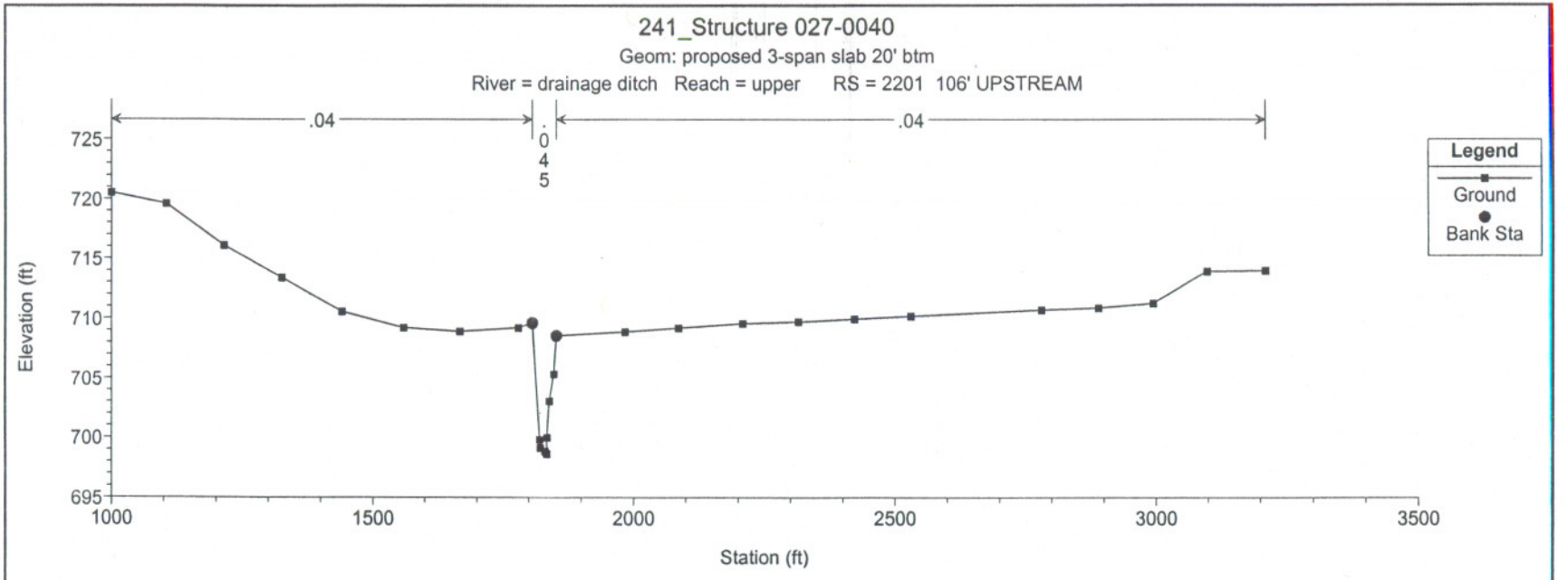

241_Structure 027-0040
Geom: existing
River = drainage ditch Reach = upper RS = 2055 42' DOWNSTREAM
.04
.045
.04
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
4000
Station (ft)
241_Structure 027-0040
Geom: existing
River = drainage ditch Reach = upper RS = 2012 83' DOWNSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
4000
Station (ft)

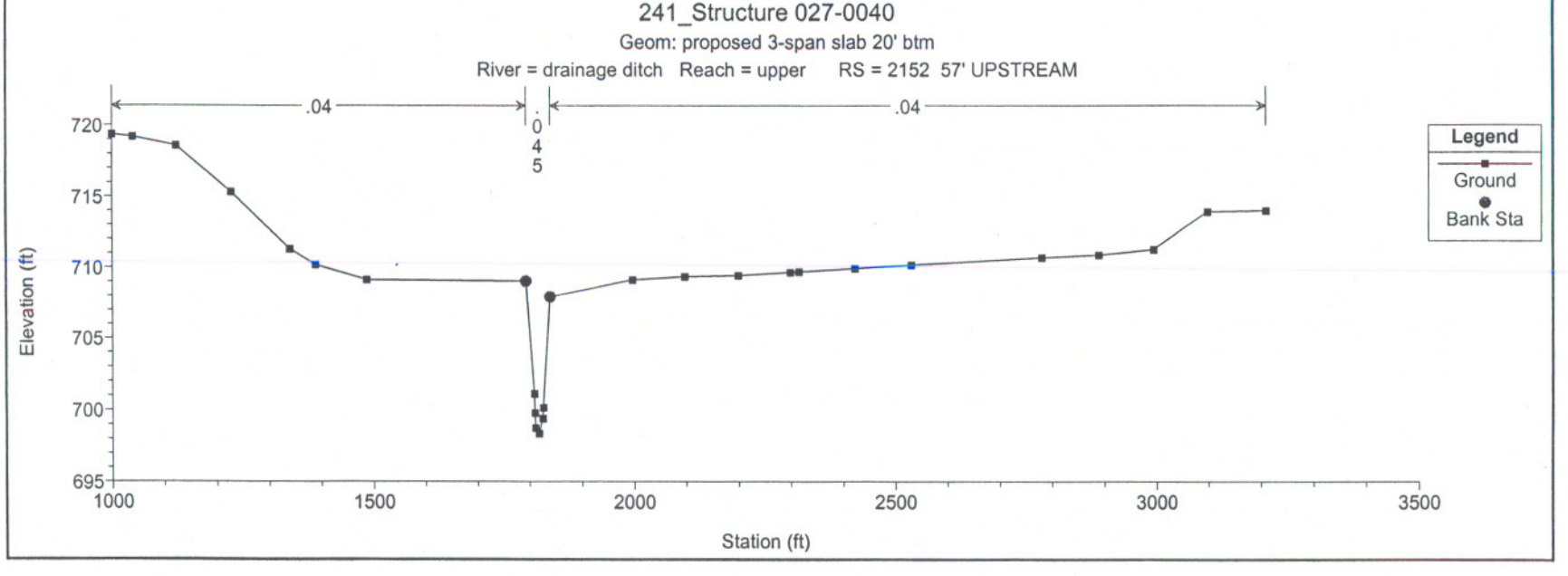

241_Structure 027-0040
Geom: existing
River = drainage ditch Reach = upper RS = 1557 500' DOWNSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
4000
Station (ft)

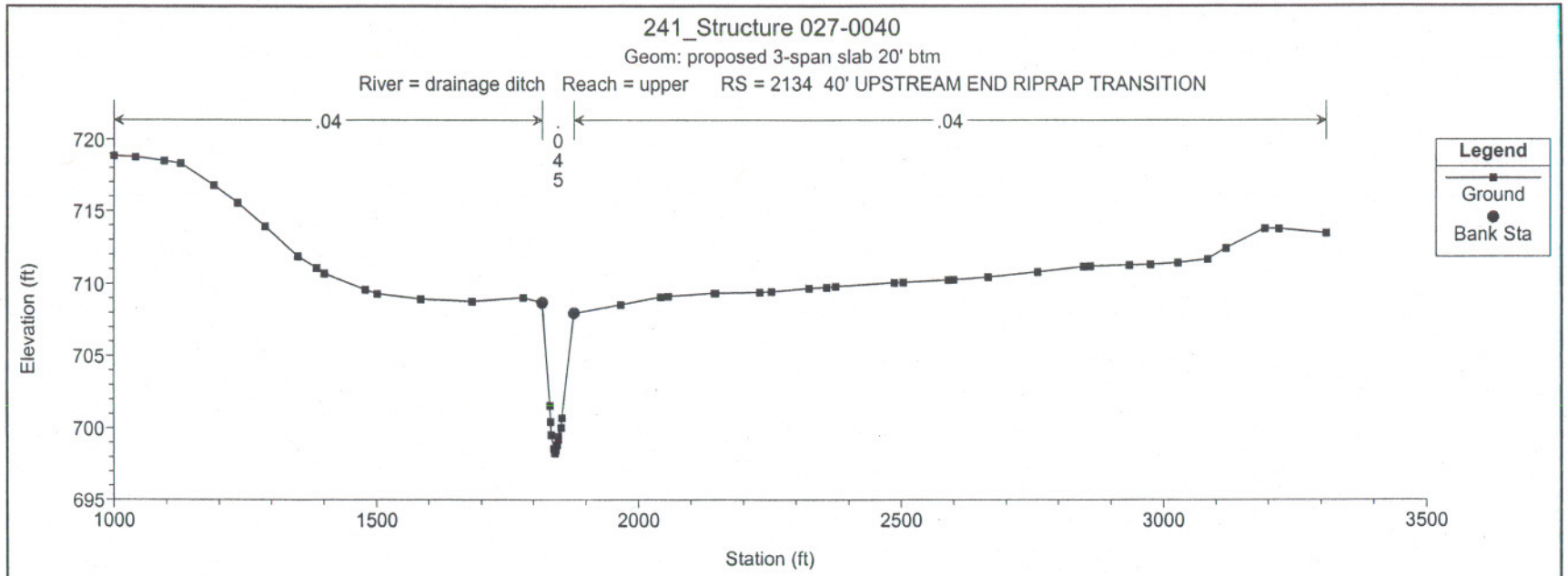

241_Structure 027-0040
Geom: existing
River = drainage ditch Reach = upper RS = 1000 1000' DOWNSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
714
712
710
708
706
704
702
700
698
696
694
1000
1500
2000
2500
3000
3500
Station (ft)

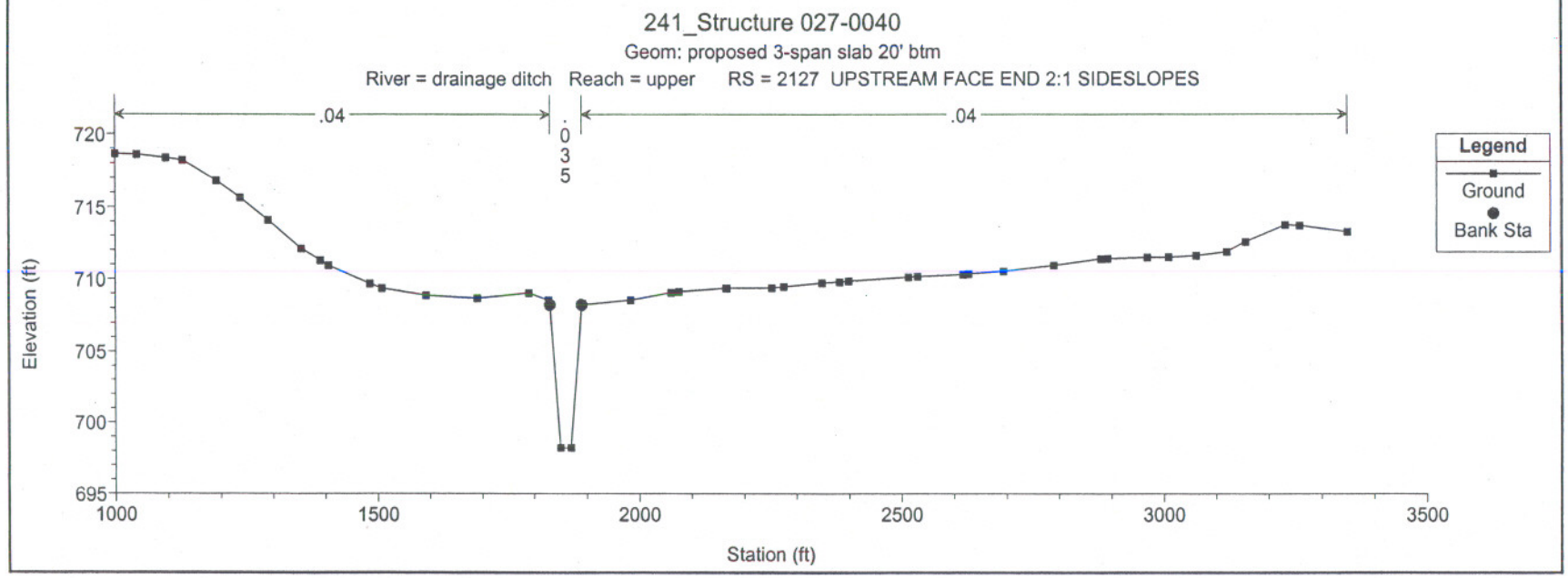

241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 3203 1000' UPSTREAM
.04
.045
.04
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

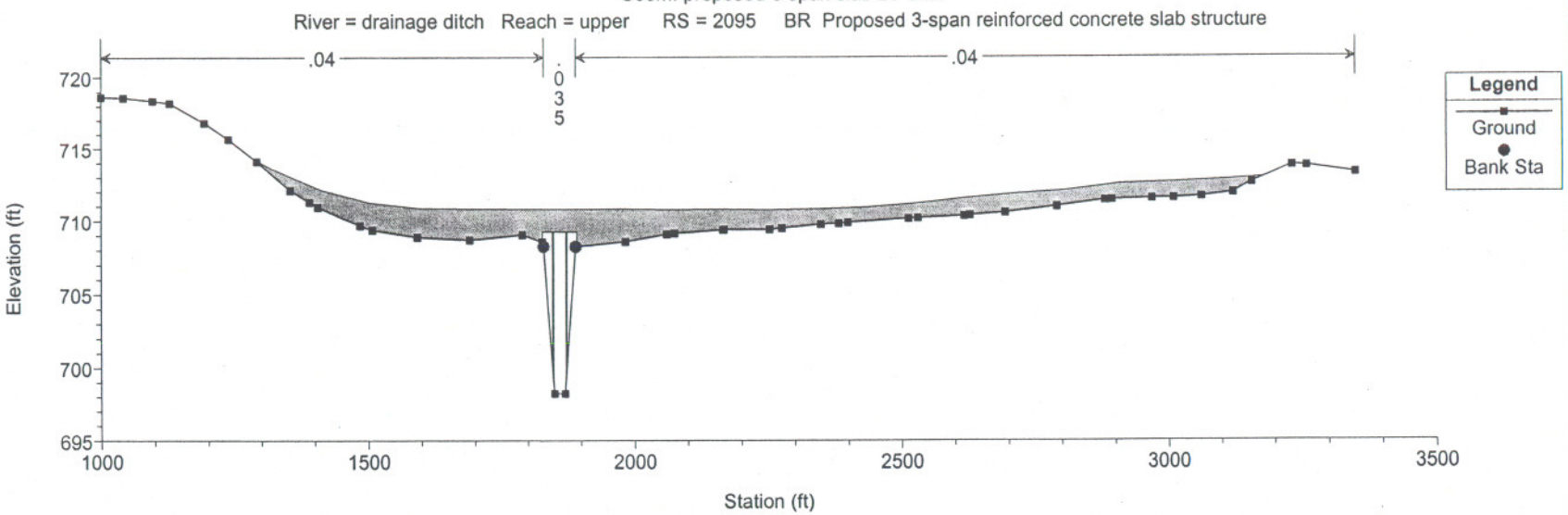

241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 2596 500' UPSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
Station (ft)

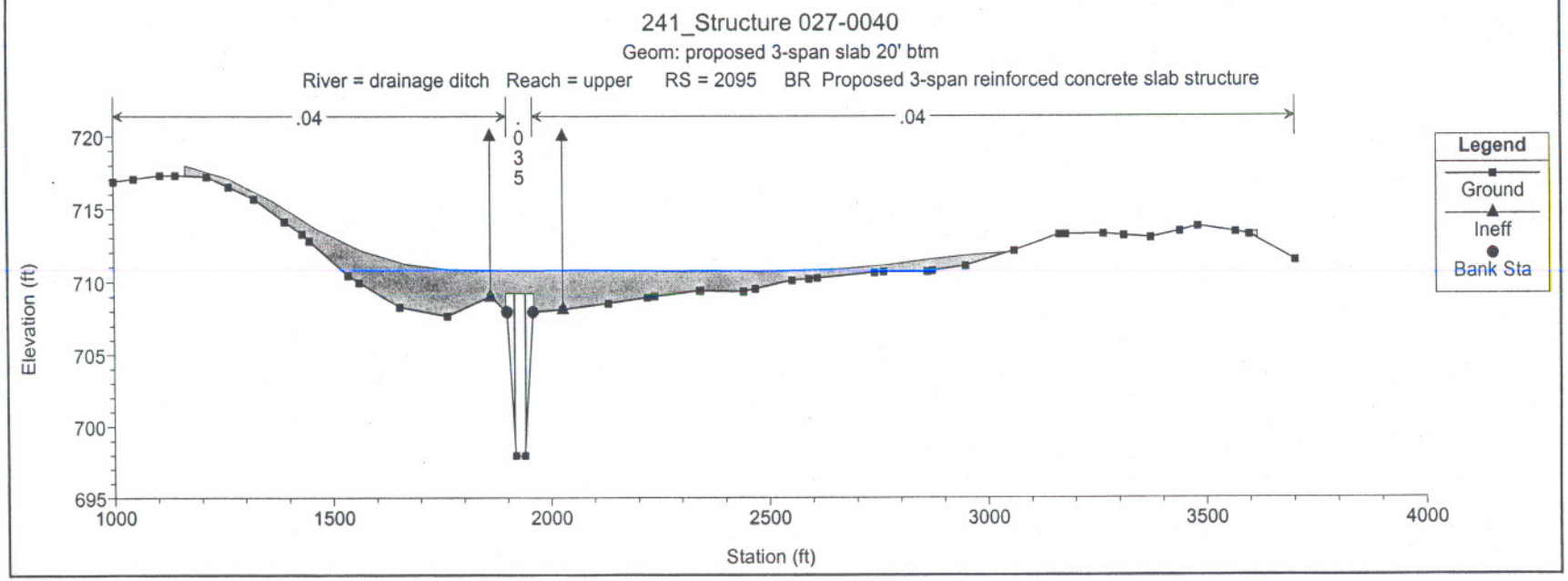

241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 2201 106' UPSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
Station (ft)

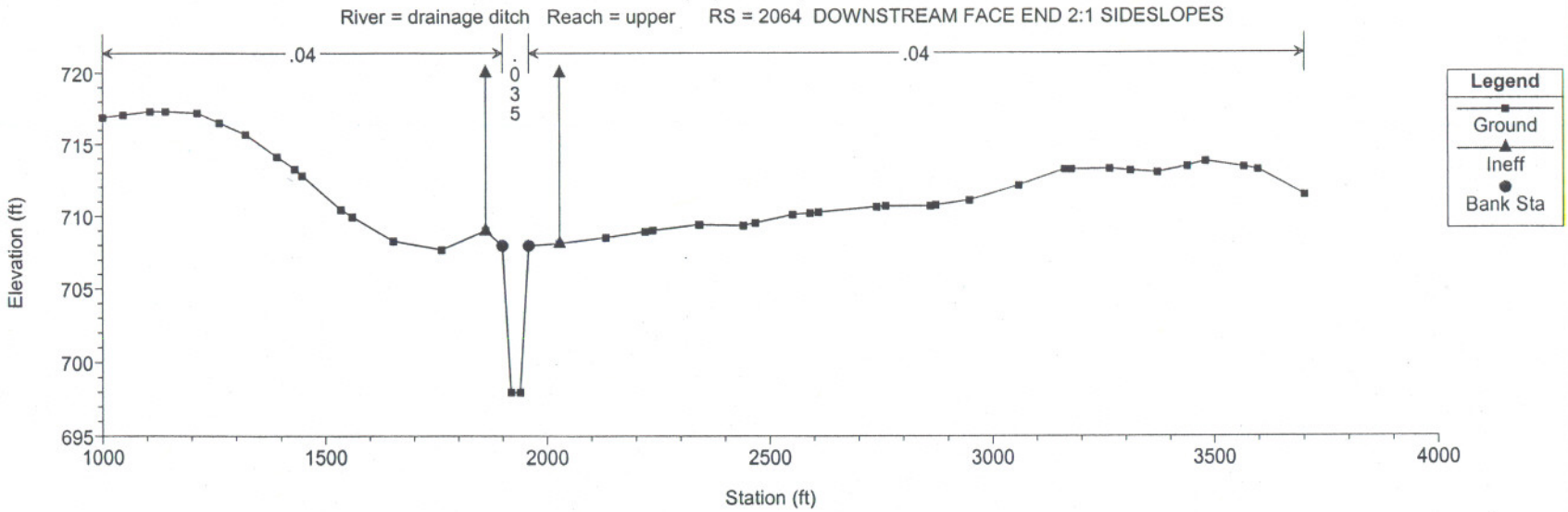

241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 2152 57' UPSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
Station (ft)

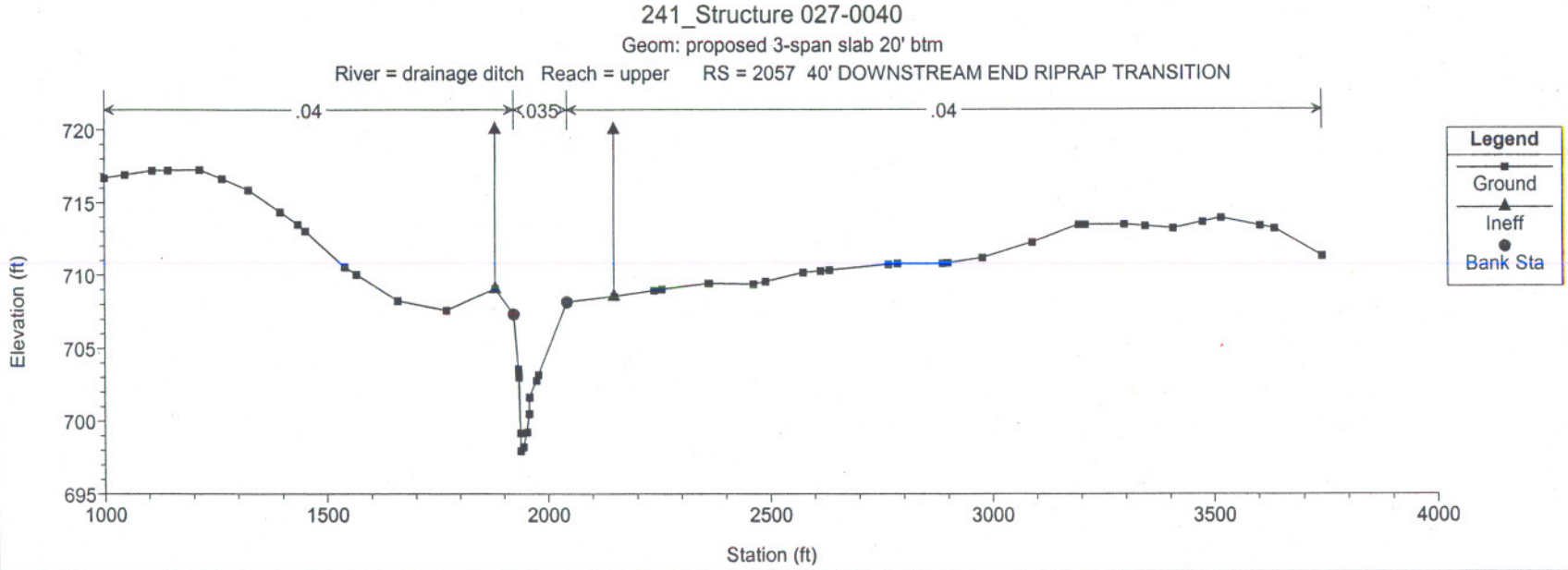

241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 2134 40' UPSTREAM END RIPRAP TRANSITION
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
Station (ft)

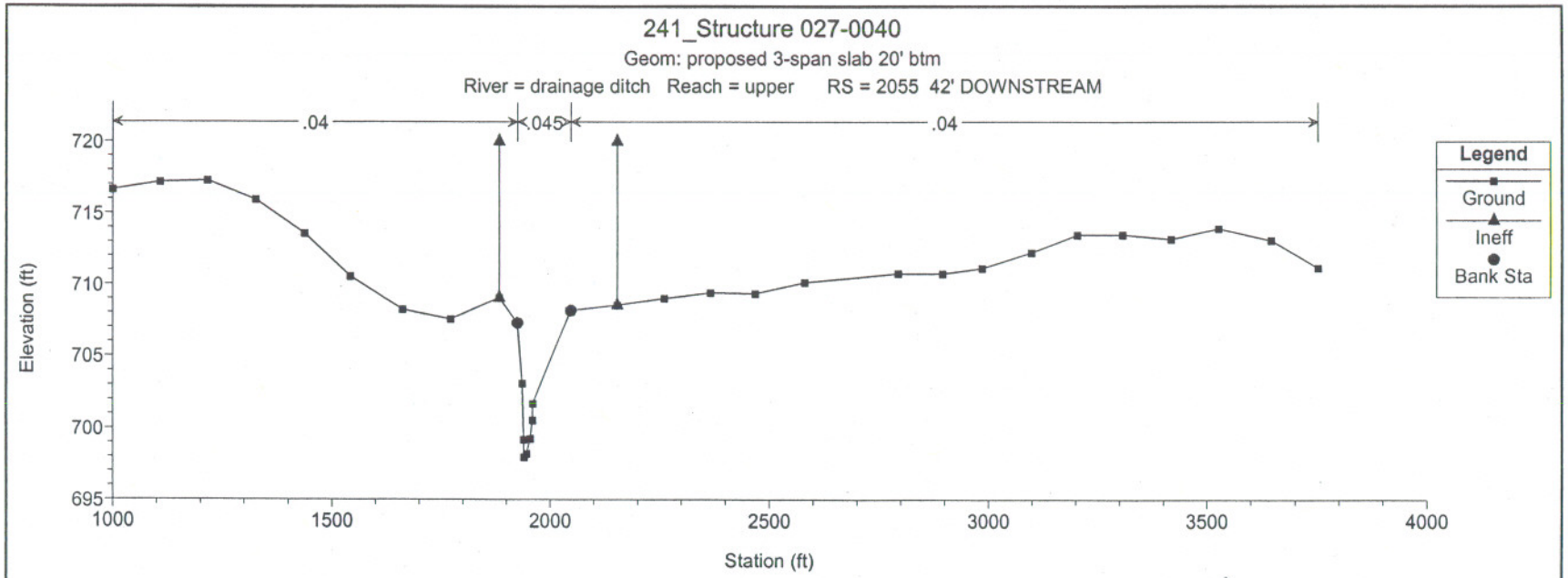

241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 2127 UPSTREAM FACE END 2:1 SIDESLOPES
.04
.035
.04
Legend
Ground
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
Station (ft)

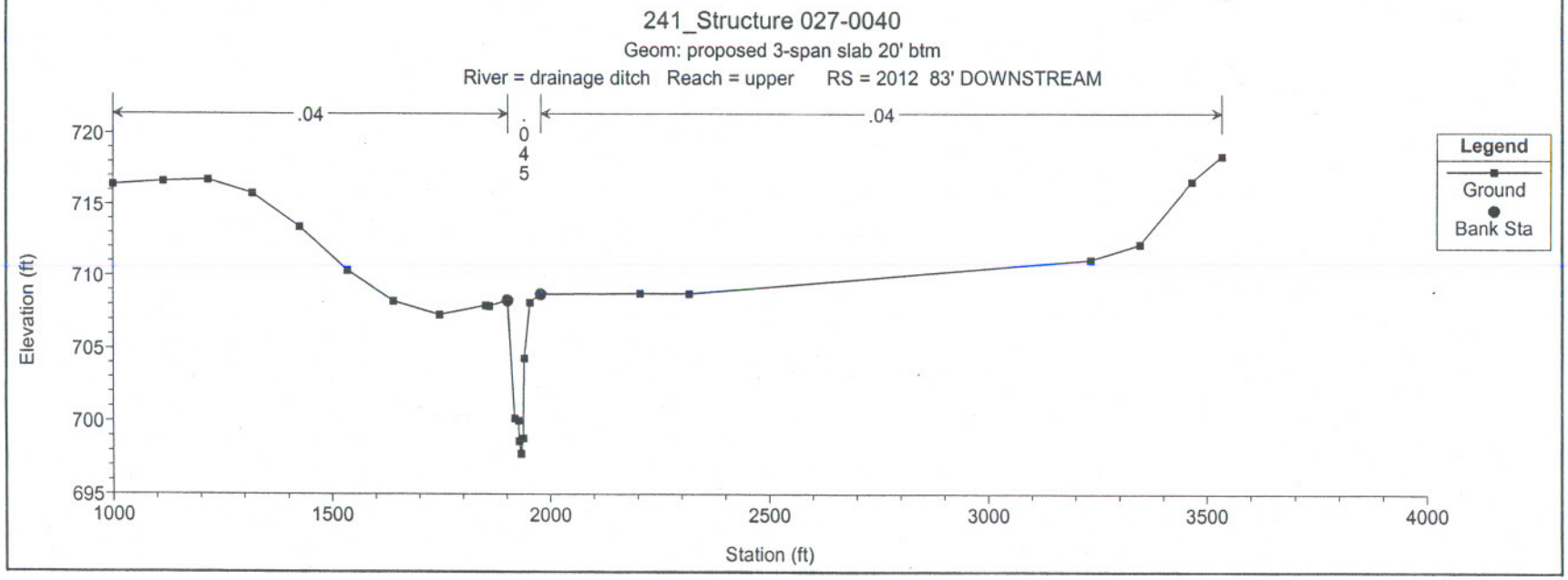

241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 2095 BR Proposed 3-span reinforced concrete slab structure
.04
.035
.04
Legend
Ground
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
Station (ft)

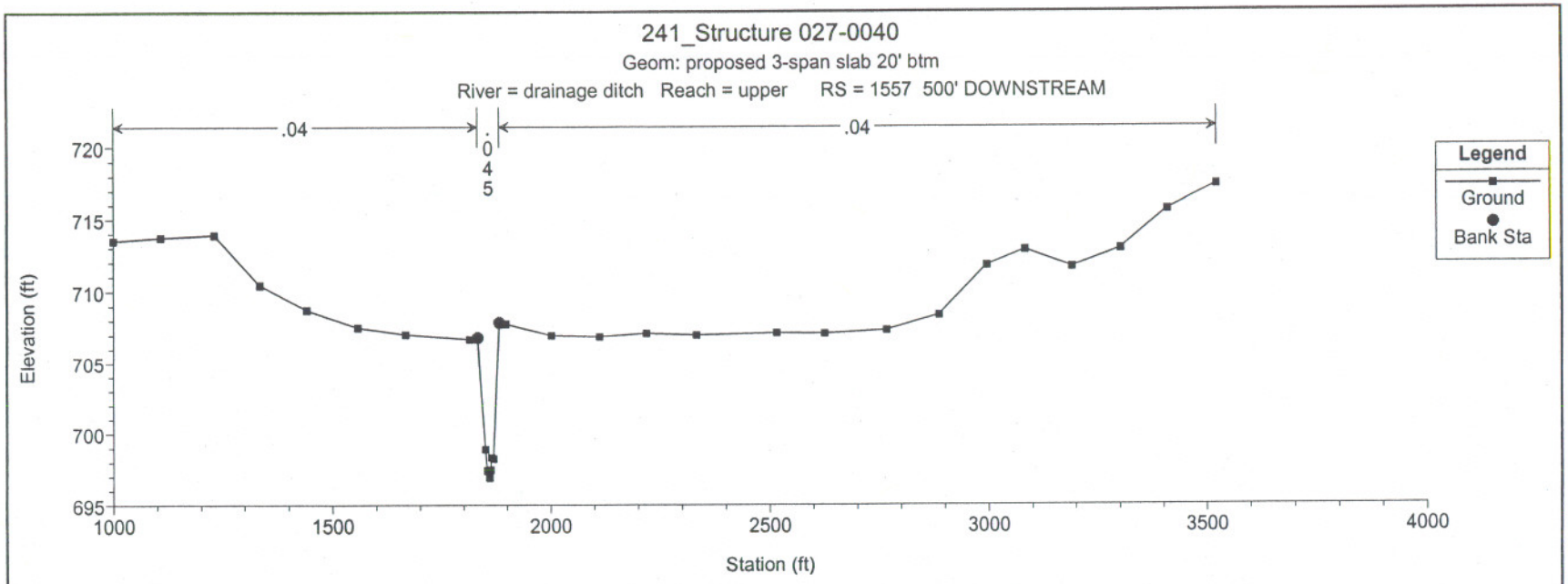

241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 2095 BR Proposed 3-span reinforced concrete slab structure
.04
.035
.04
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
4000
Station (ft)

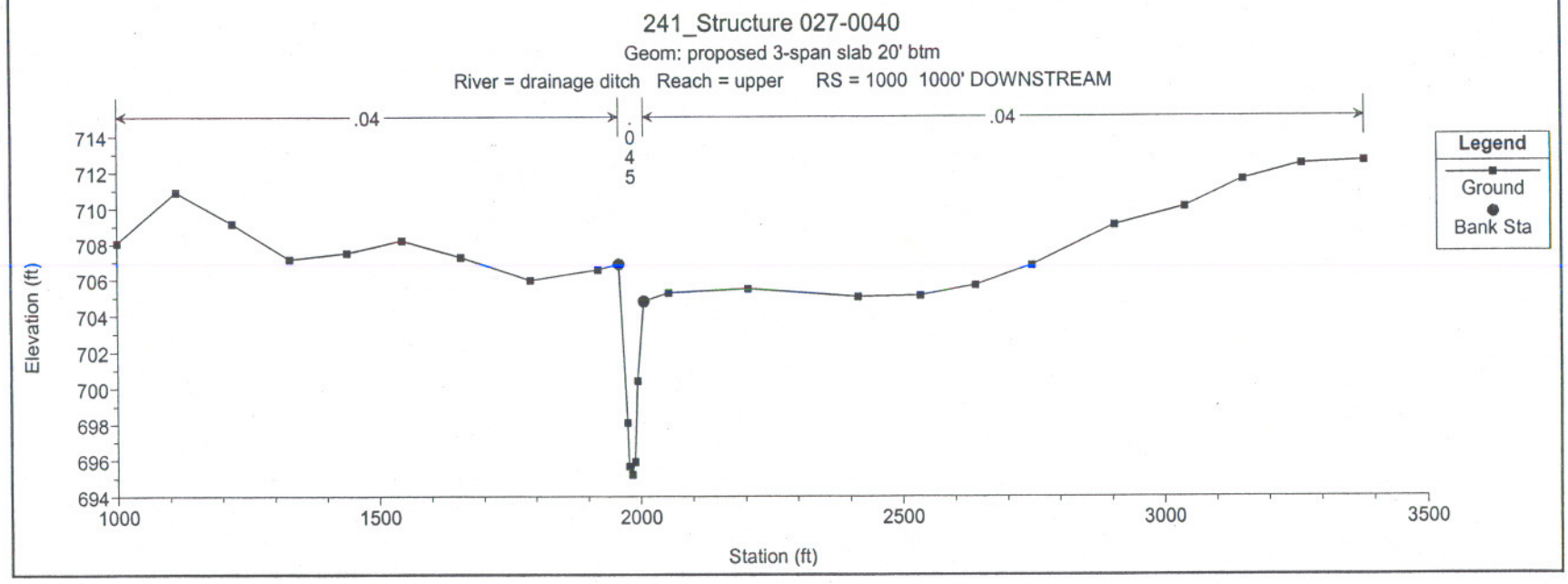

241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 2064 DOWNSTREAM FACE END 2:1 SIDESLOPES
.04
.035
.04
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
4000
Station (ft)


241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 2057 40' DOWNSTREAM END RIPRAP TRANSITION
.04
.035
.04
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
4000
Station (ft)


241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 2055 42' DOWNSTREAM
.04
.045
.04
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
4000
Station (ft)


241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 2012 83' DOWNSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
4000
Station (ft)


241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 1557 500' DOWNSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
720
715
710
705
700
695
1000
1500
2000
2500
3000
3500
4000
Station (ft)


241_Structure 027-0040
Geom: proposed 3-span slab 20' btm
River = drainage ditch Reach = upper RS = 1000 1000' DOWNSTREAM
.04
.045
.04
Legend
Ground
Bank Sta
Elevation (ft)
714
712
710
708
706
704
702
700
698
696
694
1000
1500
2000
2500
3000
3500
Station (ft)

# APPENDIX G

# NATURAL RUN

HEC-RAS River: drainage ditch Reach: upper

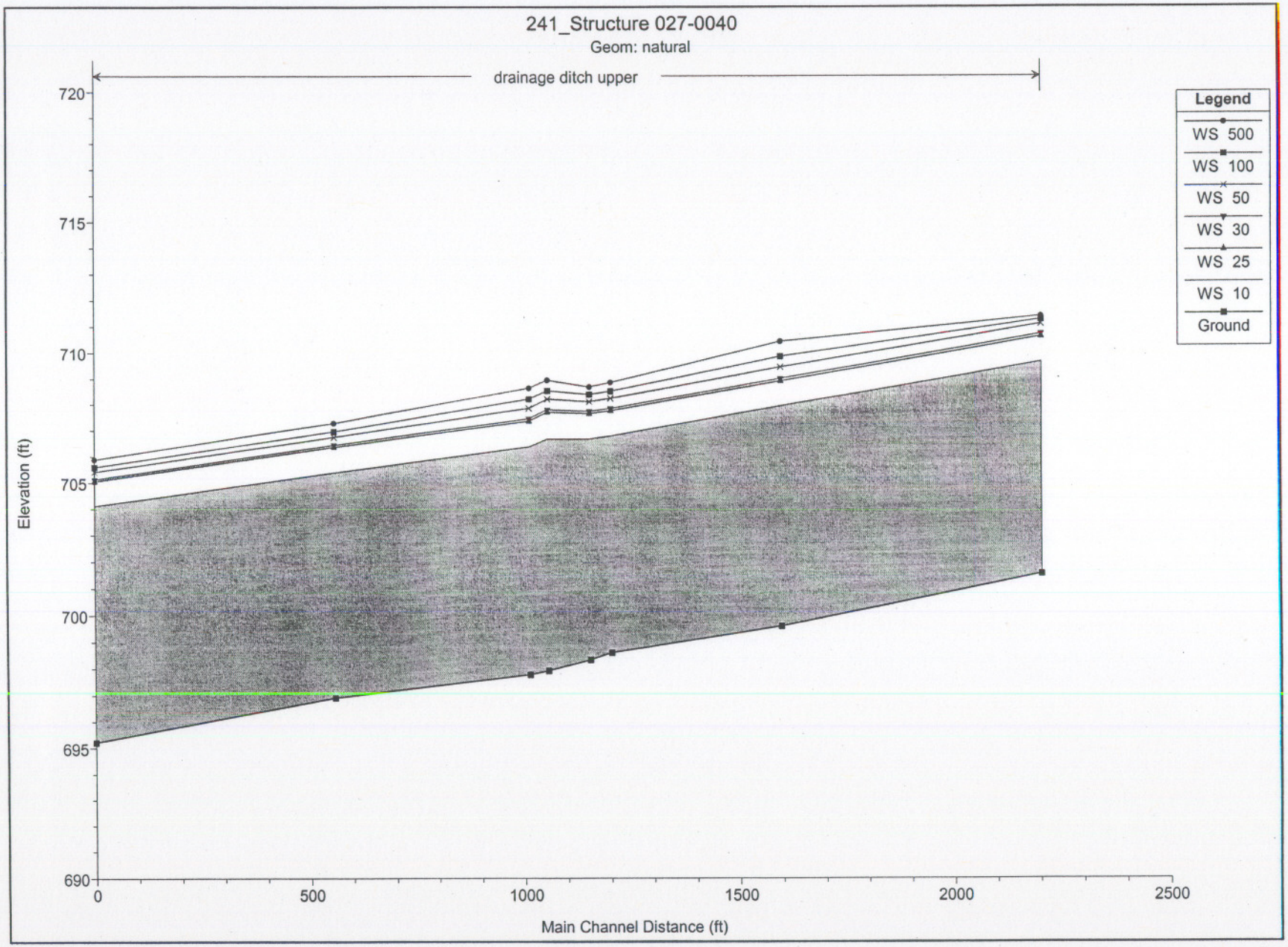
| Reach | River Sta | Profile | Plan | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| upper | 3203 | 10 | pr 3-span 20 | 896.00 | 701.55 | 709.65 | 706.59 | 709.97 | 0.002663 | 4.58 | 195.58 | 39.83 | 0.36 |
| upper | 3203 | 10 | existing | 896.00 | 701.55 | 709.67 | 706.59 | 710.00 | 0.002623 | 4.56 | 196.67 | 39.93 | 0.36 |
| upper | 3203 | 10 | natural | 896.00 | 701.55 | 709.64 | 706.59 | 709.97 | 0.002676 | 4.59 | 195.25 | 39.80 | 0.37 |
| upper | 3203 | 50 | pr 3-span 20 | 1353.00 | 701.55 | 711.06 | 707.67 | 711.40 | 0.002450 | 4.85 | 363.80 | 363.09 | 0.36 |
| upper | 3203 | 50 | existing | 1353.00 | 701.55 | 711.03 | 707.67 | 711.38 | 0.002535 | 4.92 | 353.69 | 348.14 | 0.36 |
| upper | 3203 | 50 | natural | 1353.00 | 701.55 | 711.07 | 707.67 | 711.40 | 0.002427 | 4.83 | 366.55 | 367.08 | 0.36 |
| upper | 3203 | 100 | pr 3-span 20 | 1543.00 | 701.55 | 711.22 | 708.04 | 711.58 | 0.002719 | 5.16 | 410.39 | 424.85 | 0.38 |
| upper | 3203 | 100 | existing | 1543.00 | 701.55 | 711.10 | 708.04 | 711.52 | 0.003085 | 5.45 | 373.36 | 376.87 | 0.40 |
| upper | 3203 | 100 | natural | 1543.00 | 701.55 | 711.25 | 708.04 | 711.60 | 0.002616 | 5.08 | 421.28 | 436.57 | 0.37 |
| upper | 3203 | 500 | pr 3-span 20 | 1988.00 | 701.55 | 711.35 | 708.87 | 711.86 | 0.003875 | 6.23 | 453.84 | 470.69 | 0.45 |
| upper | 3203 | 500 | existing | 1988.00 | 701.55 | 711.22 | 708.87 | 711.82 | 0.004474 | 6.62 | 412.89 | 427.56 | 0.48 |
| upper | 3203 | 500 | natural | 1988.00 | 701.55 | 711.37 | 708.87 | 711.87 | 0.003757 | 6.15 | 462.77 | 479.83 | 0.45 |
| | | | | | | | | | | | | | |
| upper | 2596 | 10 | pr 3-span 20 | 896.00 | 699.60 | 707.96 | | 708.29 | 0.002901 | 4.61 | 194.51 | 41.00 | 0.37 |
| upper | 2596 | 10 | existing | 896.00 | 699.60 | 708.04 | | 708.36 | 0.002768 | 4.52 | 198.02 | 41.40 | 0.36 |
| upper | 2596 | 10 | natural | 896.00 | 699.60 | 707.93 | | 708.26 | 0.002949 | 4.63 | 193.31 | 40.86 | 0.38 |
| upper | 2596 | 50 | pr 3-span 20 | 1353.00 | 699.60 | 709.52 | | 709.88 | 0.002557 | 4.92 | 340.30 | 393.35 | 0.36 |
| upper | 2596 | 50 | existing | 1353.00 | 699.60 | 709.75 | | 710.02 | 0.001947 | 4.41 | 446.82 | 538.14 | 0.32 |
| upper | 2596 | 50 | natural | 1353.00 | 699.60 | 709.45 | | 709.84 | 0.002739 | 5.06 | 315.17 | 348.44 | 0.37 |
| upper | 2596 | 100 | pr 3-span 20 | 1543.00 | 699.60 | 709.94 | | 710.19 | 0.001906 | 4.45 | 587.38 | 870.49 | 0.32 |
| upper | 2596 | 100 | existing | 1543.00 | 699.60 | 710.18 | | 710.33 | 0.001234 | 3.68 | 809.73 | 952.71 | 0.26 |
| upper | 2596 | 100 | natural | 1543.00 | 699.60 | 709.86 | | 710.15 | 0.002164 | 4.71 | 522.16 | 776.09 | 0.34 |
| upper | 2596 | 500 | pr 3-span 20 | 1988.00 | 699.60 | 710.46 | | 710.59 | 0.001176 | 3.69 | 1083.74 | 1014.63 | 0.25 |
| upper | 2596 | 500 | existing | 1988.00 | 699.60 | 710.98 | | 711.03 | 0.000469 | 2.45 | 1663.65 | 1223.27 | 0.16 |
| upper | 2596 | 500 | natural | 1988.00 | 699.60 | 710.42 | | 710.56 | 0.001269 | 3.82 | 1044.40 | 1005.98 | 0.26 |
| | | | | | | | | | | | | | |
| upper | 2201 | 10 | pr 3-span 20 | 896.00 | 698.61 | 706.81 | | 707.15 | 0.002835 | 4.67 | 191.72 | 39.36 | 0.37 |
| upper | 2201 | 10 | existing | 896.00 | 698.61 | 706.99 | | 707.31 | 0.002560 | 4.51 | 198.84 | 39.90 | 0.36 |
| upper | 2201 | 10 | natural | 896.00 | 698.61 | 706.75 | | 707.09 | 0.002946 | 4.74 | 189.12 | 39.17 | 0.38 |
| upper | 2201 | 50 | pr 3-span 20 | 1353.00 | 698.61 | 708.38 | | 708.81 | 0.002854 | 5.26 | 257.07 | 44.05 | 0.38 |
| upper | 2201 | 50 | existing | 1353.00 | 698.61 | 708.82 | | 709.18 | 0.002267 | 4.86 | 294.75 | 166.80 | 0.34 |
| upper | 2201 | 50 | natural | 1353.00 | 698.61 | 708.24 | | 708.69 | 0.003048 | 5.39 | 251.05 | 43.64 | 0.40 |
| upper | 2201 | 100 | pr 3-span 20 | 1543.00 | 698.61 | 708.72 | | 709.22 | 0.003120 | 5.65 | 280.53 | 127.06 | 0.40 |
| upper | 2201 | 100 | existing | 1543.00 | 698.61 | 709.66 | | 709.84 | 0.001236 | 3.84 | 700.48 | 764.17 | 0.26 |
| upper | 2201 | 100 | natural | 1543.00 | 698.61 | 708.53 | | 709.06 | 0.003453 | 5.85 | 263.83 | 49.21 | 0.42 |
| upper | 2201 | 500 | pr 3-span 20 | 1988.00 | 698.61 | 709.18 | 706.13 | 709.78 | 0.003691 | 6.39 | 408.17 | 488.32 | 0.44 |
| upper | 2201 | 500 | existing | 1988.00 | 698.61 | 710.84 | | 710.88 | 0.000308 | 2.13 | 2007.29 | 1449.00 | 0.13 |
| upper | 2201 | 500 | natural | 1988.00 | 698.61 | 708.85 | 706.14 | 709.62 | 0.004790 | 7.08 | 300.70 | 179.57 | 0.50 |
| | | | | | | | | | | | | | |
| upper | 2152 | 10 | pr 3-span 20 | 896.00 | 698.34 | 706.70 | | 707.01 | 0.002425 | 4.48 | 200.16 | 39.25 | 0.35 |
| upper | 2152 | 10 | existing | 896.00 | 698.34 | 706.89 | 703.25 | 707.18 | 0.002195 | 4.31 | 207.73 | 39.96 | 0.33 |
| upper | 2152 | 10 | natural | 896.00 | 698.34 | 706.63 | | 706.95 | 0.002509 | 4.53 | 197.64 | 39.02 | 0.35 |
| upper | 2152 | 50 | pr 3-span 20 | 1353.00 | 698.34 | 708.26 | | 708.66 | 0.002521 | 5.07 | 273.36 | 88.13 | 0.37 |

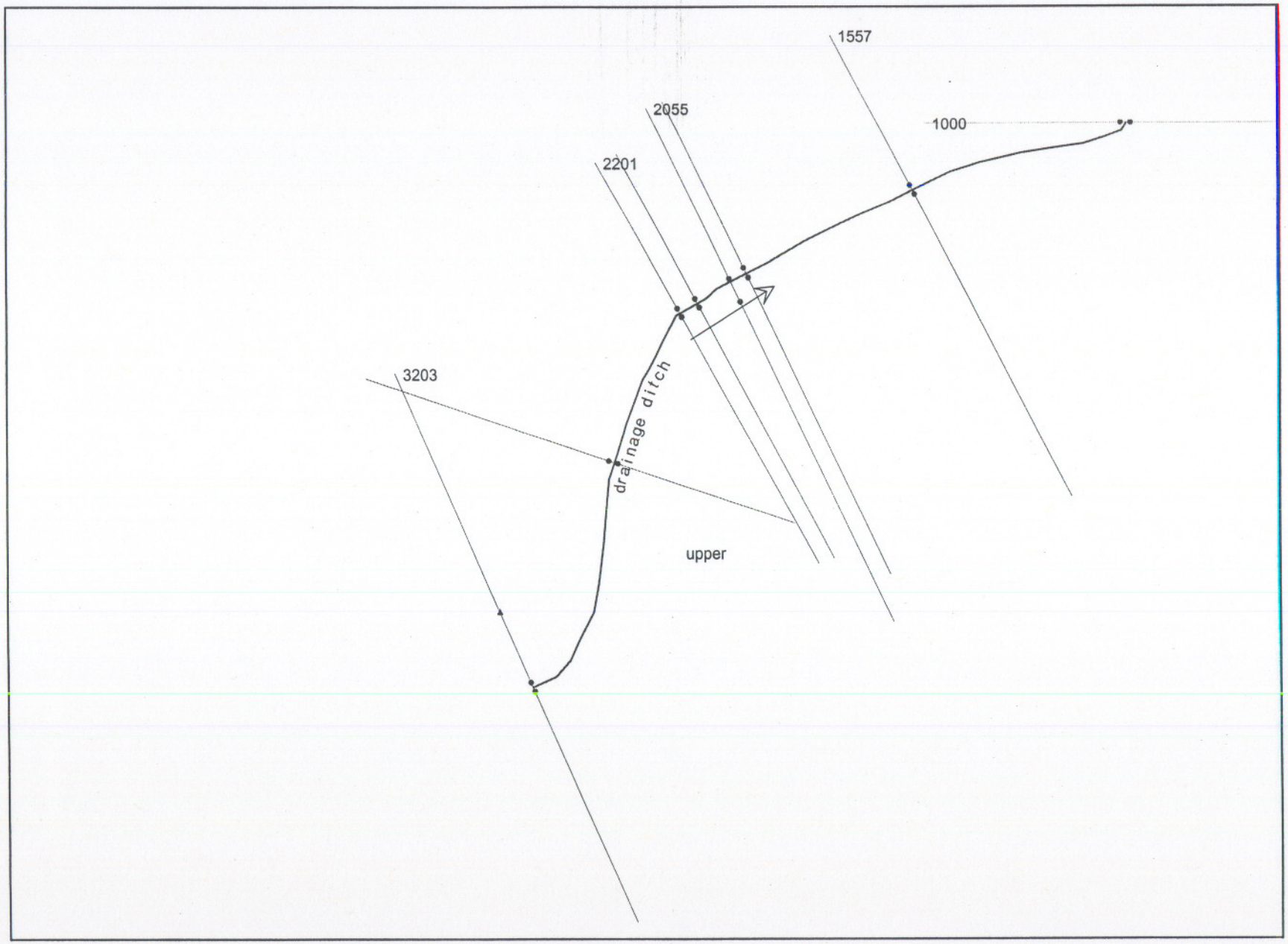
HEC-RAS River: drainage ditch Reach: upper (Continued)

| Reach | River Sta | Profile | Plan | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| upper | 2152 | 50 | existing | 1353.00 | 698.34 | 708.74 | 704.43 | 709.06 | 0.001904 | 4.57 | 330.34 | 151.26 | 0.32 |
| upper | 2152 | 50 | natural | 1353.00 | 698.34 | 708.12 | | 708.54 | 0.002719 | 5.20 | 262.21 | 69.35 | 0.38 |
| upper | 2152 | 100 | pr 3-span 20 | 1543.00 | 698.34 | 708.61 | | 709.05 | 0.002694 | 5.38 | 311.18 | 133.40 | 0.38 |
| upper | 2152 | 100 | existing | 1543.00 | 698.34 | 709.60 | 704.85 | 709.78 | 0.001093 | 3.75 | 729.63 | 829.80 | 0.25 |
| upper | 2152 | 100 | natural | 1543.00 | 698.34 | 708.40 | | 708.89 | 0.003034 | 5.62 | 286.93 | 106.61 | 0.40 |
| upper | 2152 | 500 | pr 3-span 20 | 1988.00 | 698.34 | 709.02 | 705.72 | 709.60 | 0.003400 | 6.24 | 378.35 | 195.69 | 0.43 |
| upper | 2152 | 500 | existing | 1988.00 | 698.34 | 710.83 | 705.69 | 710.86 | 0.000257 | 2.02 | 2153.46 | 1509.04 | 0.12 |
| upper | 2152 | 500 | natural | 1988.00 | 698.34 | 708.68 | | 709.38 | 0.004281 | 6.83 | 320.95 | 142.78 | 0.48 |
| | | | | | | | | | | | | | |
| upper | 2134 | 10 | pr 3-span 20 | 896.00 | 698.26 | 706.72 | | 706.92 | 0.001562 | 3.57 | 251.02 | 52.06 | 0.29 |
| upper | 2134 | 50 | pr 3-span 20 | 1353.00 | 698.26 | 708.31 | | 708.55 | 0.001535 | 3.97 | 348.38 | 109.22 | 0.29 |
| upper | 2134 | 100 | pr 3-span 20 | 1543.00 | 698.26 | 708.65 | | 708.93 | 0.001620 | 4.21 | 395.53 | 161.23 | 0.30 |
| upper | 2134 | 500 | pr 3-span 20 | 1988.00 | 698.26 | 709.10 | | 709.43 | 0.001915 | 4.79 | 532.69 | 492.66 | 0.33 |
| | | | | | | | | | | | | | |
| upper | 2127 | 10 | pr 3-span 20 | 896.00 | 698.23 | 706.75 | 701.72 | 706.88 | 0.000468 | 2.84 | 315.66 | 54.09 | 0.21 |
| upper | 2127 | 50 | pr 3-span 20 | 1353.00 | 698.23 | 708.34 | 702.68 | 708.51 | 0.000531 | 3.33 | 407.99 | 90.11 | 0.23 |
| upper | 2127 | 100 | pr 3-span 20 | 1543.00 | 698.23 | 708.68 | 703.04 | 708.88 | 0.000577 | 3.59 | 456.11 | 185.94 | 0.24 |
| upper | 2127 | 500 | pr 3-span 20 | 1988.00 | 698.23 | 709.13 | 703.79 | 709.39 | 0.000722 | 4.18 | 625.26 | 524.12 | 0.27 |
| | | | | | | | | | | | | | |
| upper | 2095 | | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | | |
| upper | 2064 | 10 | pr 3-span 20 | 896.00 | 697.97 | 706.68 | 701.47 | 706.79 | 0.000430 | 2.75 | 325.75 | 54.83 | 0.20 |
| upper | 2064 | 50 | pr 3-span 20 | 1353.00 | 697.97 | 708.24 | 702.44 | 708.41 | 0.000487 | 3.24 | 431.17 | 308.24 | 0.22 |
| upper | 2064 | 100 | pr 3-span 20 | 1543.00 | 697.97 | 708.58 | 702.78 | 708.76 | 0.000529 | 3.48 | 479.48 | 454.13 | 0.23 |
| upper | 2064 | 500 | pr 3-span 20 | 1988.00 | 697.97 | 708.93 | 703.53 | 709.19 | 0.000722 | 4.20 | 535.03 | 589.69 | 0.27 |
| | | | | | | | | | | | | | |
| upper | 2057 | 10 | pr 3-span 20 | 896.00 | 697.94 | 706.68 | 702.95 | 706.78 | 0.000628 | 2.46 | 364.38 | 99.69 | 0.23 |
| upper | 2057 | 50 | pr 3-span 20 | 1353.00 | 697.94 | 708.27 | 703.88 | 708.37 | 0.000485 | 2.49 | 554.48 | 340.84 | 0.21 |
| upper | 2057 | 100 | pr 3-span 20 | 1543.00 | 697.94 | 708.61 | 704.21 | 708.72 | 0.000485 | 2.61 | 630.92 | 481.45 | 0.21 |
| upper | 2057 | 500 | pr 3-span 20 | 1988.00 | 697.94 | 708.99 | 704.82 | 709.13 | 0.000600 | 3.05 | 728.54 | 625.31 | 0.24 |
| | | | | | | | | | | | | | |
| upper | 2055 | 10 | pr 3-span 20 | 896.00 | 697.93 | 706.68 | 702.95 | 706.78 | 0.001046 | 2.45 | 365.24 | 100.74 | 0.23 |
| upper | 2055 | 10 | existing | 896.00 | 697.93 | 706.68 | 702.93 | 706.78 | 0.001046 | 2.45 | 365.25 | 100.74 | 0.23 |
| upper | 2055 | 10 | natural | 896.00 | 697.93 | 706.64 | | 706.73 | 0.001081 | 2.48 | 360.61 | 100.00 | 0.23 |
| upper | 2055 | 50 | pr 3-span 20 | 1353.00 | 697.93 | 708.27 | 703.89 | 708.37 | 0.000798 | 2.47 | 558.24 | 345.48 | 0.21 |
| upper | 2055 | 50 | existing | 1353.00 | 697.93 | 708.27 | 703.90 | 708.37 | 0.000799 | 2.47 | 556.16 | 345.45 | 0.21 |
| upper | 2055 | 50 | natural | 1353.00 | 697.93 | 708.22 | | 708.31 | 0.000797 | 2.45 | 603.58 | 324.34 | 0.21 |
| upper | 2055 | 100 | pr 3-span 20 | 1543.00 | 697.93 | 708.61 | 704.20 | 708.72 | 0.000791 | 2.58 | 635.60 | 485.92 | 0.21 |
| upper | 2055 | 100 | existing | 1543.00 | 697.93 | 708.59 | 704.21 | 708.69 | 0.000821 | 2.62 | 602.77 | 475.06 | 0.21 |
| upper | 2055 | 100 | natural | 1543.00 | 697.93 | 708.55 | | 708.64 | 0.000750 | 2.49 | 732.90 | 462.18 | 0.20 |
| upper | 2055 | 500 | pr 3-span 20 | 1988.00 | 697.93 | 708.99 | 704.83 | 709.12 | 0.000964 | 3.00 | 734.52 | 629.60 | 0.23 |
| upper | 2055 | 500 | existing | 1988.00 | 697.93 | 708.94 | 704.83 | 709.09 | 0.001055 | 3.12 | 659.33 | 613.00 | 0.24 |
| upper | 2055 | 500 | natural | 1988.00 | 697.93 | 708.95 | | 709.05 | 0.000819 | 2.75 | 944.58 | 613.21 | 0.21 |

HEC-RAS River: drainage ditch Reach: upper (Continued)

| Reach | River Sta | Profile | Plan | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| | | | | | | | | | | | | | |
| upper | 2012 | 10 | pr 3-span 20 | 896.00 | 697.78 | 706.32 | | 706.64 | 0.002805 | 4.53 | 197.94 | 41.06 | 0.36 |
| upper | 2012 | 10 | existing | 896.00 | 697.78 | 706.32 | | 706.64 | 0.002805 | 4.53 | 197.94 | 41.06 | 0.36 |
| upper | 2012 | 10 | natural | 896.00 | 697.78 | 706.32 | | 706.64 | 0.002805 | 4.53 | 197.94 | 41.06 | 0.36 |
| upper | 2012 | 50 | pr 3-span 20 | 1353.00 | 697.78 | 707.87 | | 708.23 | 0.002767 | 4.91 | 314.19 | 210.87 | 0.37 |
| upper | 2012 | 50 | existing | 1353.00 | 697.78 | 707.87 | | 708.23 | 0.002767 | 4.91 | 314.19 | 210.87 | 0.37 |
| upper | 2012 | 50 | natural | 1353.00 | 697.78 | 707.87 | | 708.23 | 0.002767 | 4.91 | 314.19 | 210.87 | 0.37 |
| upper | 2012 | 100 | pr 3-span 20 | 1543.00 | 697.78 | 708.29 | | 708.60 | 0.002772 | 4.70 | 430.88 | 323.45 | 0.37 |
| upper | 2012 | 100 | existing | 1543.00 | 697.78 | 708.22 | | 708.56 | 0.002628 | 4.89 | 409.59 | 312.05 | 0.36 |
| upper | 2012 | 100 | natural | 1543.00 | 697.78 | 708.22 | | 708.56 | 0.002628 | 4.89 | 409.59 | 312.05 | 0.36 |
| upper | 2012 | 500 | pr 3-span 20 | 1988.00 | 697.78 | 708.79 | | 709.02 | 0.002959 | 4.44 | 615.74 | 719.33 | 0.38 |
| upper | 2012 | 500 | existing | 1988.00 | 697.78 | 708.62 | | 708.97 | 0.002713 | 5.20 | 542.87 | 354.14 | 0.37 |
| upper | 2012 | 500 | natural | 1988.00 | 697.78 | 708.62 | | 708.97 | 0.002713 | 5.20 | 542.87 | 354.14 | 0.37 |
| | | | | | | | | | | | | | |
| upper | 1557 | 10 | pr 3-span 20 | 896.00 | 696.91 | 705.31 | | 705.57 | 0.001951 | 4.08 | 219.68 | 42.89 | 0.32 |
| upper | 1557 | 10 | existing | 896.00 | 696.91 | 705.31 | | 705.57 | 0.001951 | 4.08 | 219.68 | 42.89 | 0.32 |
| upper | 1557 | 10 | natural | 896.00 | 696.91 | 705.31 | | 705.57 | 0.001951 | 4.08 | 219.68 | 42.89 | 0.32 |
| upper | 1557 | 50 | pr 3-span 20 | 1353.00 | 696.91 | 706.77 | | 707.11 | 0.002171 | 4.73 | 288.07 | 94.75 | 0.34 |
| upper | 1557 | 50 | existing | 1353.00 | 696.91 | 706.77 | | 707.11 | 0.002171 | 4.73 | 288.07 | 94.75 | 0.34 |
| upper | 1557 | 50 | natural | 1353.00 | 696.91 | 706.77 | | 707.11 | 0.002171 | 4.73 | 288.07 | 94.75 | 0.34 |
| upper | 1557 | 100 | pr 3-span 20 | 1543.00 | 696.91 | 707.00 | 703.17 | 707.40 | 0.002454 | 5.12 | 337.76 | 445.81 | 0.37 |
| upper | 1557 | 100 | existing | 1543.00 | 696.91 | 707.00 | 703.17 | 707.40 | 0.002454 | 5.12 | 337.76 | 445.81 | 0.37 |
| upper | 1557 | 100 | natural | 1543.00 | 696.91 | 707.00 | 703.17 | 707.40 | 0.002454 | 5.12 | 337.76 | 445.81 | 0.37 |
| upper | 1557 | 500 | pr 3-span 20 | 1988.00 | 696.91 | 707.32 | | 707.73 | 0.002692 | 5.51 | 617.13 | 1092.14 | 0.39 |
| upper | 1557 | 500 | existing | 1988.00 | 696.91 | 707.32 | | 707.73 | 0.002692 | 5.51 | 617.13 | 1092.14 | 0.39 |
| upper | 1557 | 500 | natural | 1988.00 | 696.91 | 707.32 | | 707.73 | 0.002692 | 5.51 | 617.13 | 1092.14 | 0.39 |
| | | | | | | | | | | | | | |
| upper | 1000 | 10 | pr 3-span 20 | 896.00 | 695.21 | 703.90 | 700.56 | 704.25 | 0.002906 | 4.69 | 191.15 | 39.99 | 0.38 |
| upper | 1000 | 10 | existing | 896.00 | 695.21 | 703.90 | 700.56 | 704.25 | 0.002906 | 4.69 | 191.15 | 39.99 | 0.38 |
| upper | 1000 | 10 | natural | 896.00 | 695.21 | 703.90 | 700.56 | 704.25 | 0.002906 | 4.69 | 191.15 | 39.99 | 0.38 |
| upper | 1000 | 50 | pr 3-span 20 | 1353.00 | 695.21 | 705.31 | 701.87 | 705.72 | 0.002905 | 5.20 | 319.93 | 423.83 | 0.39 |
| upper | 1000 | 50 | existing | 1353.00 | 695.21 | 705.31 | 701.87 | 705.72 | 0.002906 | 5.20 | 319.90 | 423.75 | 0.39 |
| upper | 1000 | 50 | natural | 1353.00 | 695.21 | 705.31 | 701.87 | 705.72 | 0.002905 | 5.20 | 319.93 | 423.83 | 0.39 |
| upper | 1000 | 100 | pr 3-span 20 | 1543.00 | 695.21 | 705.53 | 702.32 | 705.92 | 0.002905 | 5.30 | 439.03 | 652.69 | 0.39 |
| upper | 1000 | 100 | existing | 1543.00 | 695.21 | 705.53 | 702.29 | 705.92 | 0.002905 | 5.30 | 439.03 | 652.69 | 0.39 |
| upper | 1000 | 100 | natural | 1543.00 | 695.21 | 705.53 | 702.32 | 705.92 | 0.002905 | 5.30 | 439.03 | 652.69 | 0.39 |
| upper | 1000 | 500 | pr 3-span 20 | 1988.00 | 695.21 | 705.82 | 703.20 | 706.17 | 0.002904 | 5.44 | 637.49 | 693.51 | 0.39 |
| upper | 1000 | 500 | existing | 1988.00 | 695.21 | 705.82 | 703.20 | 706.17 | 0.002904 | 5.44 | 637.49 | 693.51 | 0.39 |
| upper | 1000 | 500 | natural | 1988.00 | 695.21 | 705.82 | 703.20 | 706.17 | 0.002904 | 5.44 | 637.49 | 693.51 | 0.39 |


241_Structure 027-0040
Geom: natural
drainage ditch upper
Legend
WS 500
WS 100
WS 50
WS 30
WS 25
WS 10
Ground
Elevation (ft)
720
715
710
705
700
695
690
0
500
1000
1500
2000
2500
Main Channel Distance (ft)


1557
2055
1000
2201
3203
drainage ditch
upper

HEC-RAS Version 3.1.1 May 2003
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

```
X   X XXXXXX  XXXX    XXXX    XX   XXXX
X   X X    X  X   X  X  X   X X  X
X   X X    X      X  X  X  X  X  X
XXXXXXX XXXX   X   XXX XXXX   XXXXXX  XXXX
X   X X    X      X X  X  X    X
X   X X    X  X   X  X  X  X    X
X   X XXXXXX  XXXX    X  X  X  X  XXXXX
```

PROJECT DATA
Project Title: 241_Structure 027-0040
Project File : 241_0040.prj
Run Date and Time: 5/24/2004 1:19:34 PM

Project in English units

Project Description:
IL Route 114 over Yellowhead Creek near Momence, IL

PLAN DATA

Plan Title: natural
Plan File : h:\P\22041\Hydraulics\027-0040\241_0040.p02

Geometry Title: natural
Geometry File : h:\P\22041\Hydraulics\027-0040\241_0040.g01

Flow Title : Normal Depth Flow
Flow File : h:\P\22041\Hydraulics\027-0040\241_0040.f02

Plan Summary Information:
Number of: Cross Sections = 8 Mulitple Openings = 0
Culverts = 0 Inline Structures = 0
Bridges = 0 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculaton tolerance = 0.01
Maximum number of interations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Normal Depth Flow
Flow File : h:\P\22041\Hydraulics\027-0040\241_0040.f02

Flow Data (cfs)

| River | Reach | RS | 10 | 25 | 30 | 50 | 100 | 500 |
|---|---|---|---|---|---|---|---|---|
| drainage ditch | upper | 3203 | 896 | 1157 | 1187 | 1353 | 1543 | 1988 |

Boundary Conditions

| River | Reach | Profile | Upstream | Downstream |
|---|---|---|---|---|
| drainage ditch | upper | 10 | | Normal S = 0.0026 |
| drainage ditch | upper | 25 | | Normal S = 0.0026 |
| drainage ditch | upper | 30 | | Normal S = 0.0026 |
| drainage ditch | upper | 50 | | Normal S = 0.0026 |
| drainage ditch | upper | 100 | | Normal S = 0.0026 |
| drainage ditch | upper | 500 | | Normal S = 0.0026 |

GEOMETRY DATA

Geometry Title: natural
Geometry File : h:\P\22041\Hydraulics\027-0040\241_0040.g01

CROSS SECTION

RIVER: drainage ditch
REACH: upper RS: 3203

INPUT
Description: 1000' UPSTREAM
Station Elevation Data num= 38

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 1000 | 720.53 | 1143 | 722.53 | 1247 | 724.22 | 1355 | 723.29 | 1464 | 720.48 |
| 1572 | 716.13 | 1688 | 713.5 | 1798 | 712 | 1910 | 710.73 | 2019 | 711.59 |
| 2126 | 713.84 | 2254 | 713.9 | 2327 | 712.88 | 2452 | 711.81 | 2566 | 712.25 |
| 2615 | 711.79 | 2621 | 711.66 | 2631 | 705.97 | 2634 | 703.68 | 2636 | 702.86 |
| 2646 | 701.55 | 2649 | 702.25 | 2651 | 703.86 | 2651 | 704.43 | 2656 | 704.77 |
| 2667 | 711.18 | 2708 | 710.64 | 2804 | 710.32 | 2905 | 710.93 | 3007 | 711.71 |
| 3113 | 712.43 | 3236 | 713.51 | 3342 | 714.15 | 3447 | 714.92 | 3551 | 715.32 |
| 3653 | 716.86 | 3780 | 724.38 | 3888 | 729.05 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 1000 | .04 | 2621 | .045 | 2667 | .04 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 2621 | 2667 | 534 | 607 | 580 | .1 | .3 |

Ineffective Flow num= 1

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 1000 | 2254 | 720 | F |

CROSS SECTION

RIVER: drainage ditch
REACH: upper RS: 2596

INPUT
Description: 500' UPSTREAM
Station Elevation Data num= 29

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 1000 | 720.94 | 1111 | 721.75 | 1222 | 719.53 | 1333 | 718.83 | 1437 | 720.13 |
| 1525 | 717.37 | 1634 | 712.13 | 1763 | 709.79 | 1874 | 709.75 | 1998 | 709.96 |
| 2104 | 709.33 | 2222 | 709.17 | 2253 | 709.05 | 2271 | 701.95 | 2271 | 700.14 |
| 2278 | 699.74 | 2283 | 699.6 | 2285 | 700.31 | 2288 | 703.92 | 2299 | 708.98 |
| 2324 | 709.71 | 2446 | 709.2 | 2561 | 709.72 | 2663 | 709.99 | 2780 | 710.69 |
| 2889 | 710.86 | 2994 | 711.26 | 3098 | 713.91 | 3209 | 713.99 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 1000 | .04 | 2253 | .045 | 2299 | .04 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 2253 | 2299 | 405 | 395 | 374 | .1 | .3 |

CROSS SECTION

RIVER: drainage ditch
REACH: upper RS: 2201

INPUT
Description: 106' UPSTREAM
Station Elevation Data num= 28

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 1000 | 720.51 | 1105 | 719.59 | 1215 | 716.07 | 1326 | 713.37 | 1441 | 710.53 |
| 1559 | 709.2 | 1667 | 708.88 | 1780 | 709.2 | 1807 | 709.59 | 1821 | 699.79 |
| 1822 | 699.12 | 1831 | 698.83 | 1834 | 698.61 | 1835 | 699.97 | 1839 | 703.02 |
| 1848 | 705.32 | 1853 | 708.52 | 1984 | 708.84 | 2086 | 709.18 | 2209 | 709.56 |
| 2315 | 709.7 | 2422 | 709.93 | 2530 | 710.18 | 2780 | 710.69 | 2889 | 710.86 |
| 2994 | 711.26 | 3098 | 713.91 | 3209 | 713.99 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 1000 | .04 | 1807 | .045 | 1853 | .04 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 1807 | 1853 | 57 | 49 | 45 | .1 | .3 |

CROSS SECTION

RIVER: drainage ditch
REACH: upper RS: 2152

INPUT
Description: 57' UPSTREAM
Station Elevation Data num= 27

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 1000 | 719.35 | 1040 | 719.19 | 1123 | 718.57 | 1228 | 715.32 | 1340 | 711.3 |
| 1389 | 710.19 | 1487 | 709.14 | 1793 | 709.02 | 1809 | 701.1 | 1810 | 699.78 |
| 1811 | 698.73 | 1818 | 698.34 | 1825 | 699.39 | 1826 | 700.14 | 1839 | 707.93 |
| 1997 | 709.14 | 2097 | 709.35 | 2199 | 709.44 | 2299 | 709.66 | 2315 | 709.7 |
| 2422 | 709.93 | 2530 | 710.18 | 2780 | 710.69 | 2889 | 710.86 | 2994 | 711.26 |
| 3098 | 713.91 | 3209 | 713.99 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 1000 | .04 | 1793 | .045 | 1839 | .04 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 1793 | 1839 | 97 | 97 | 97 | .1 | .3 |

CROSS SECTION

RIVER: drainage ditch
REACH: upper RS: 2055

INPUT
Description: 42' DOWNSTREAM
Station Elevation Data num= 33

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 1000 | 716.62 | 1108 | 717.15 | 1215 | 717.25 | 1326 | 715.92 | 1437 | 713.56 |
| 1542 | 710.56 | 1662 | 708.22 | 1772 | 707.55 | 1883 | 709.05 | 1925 | 707.27 |
| 1936 | 703.08 | 1939 | 699.18 | 1940 | 697.93 | 1946 | 698.19 | 1954 | 699.24 |
| 1959 | 700.52 | 1960 | 701.68 | 2047 | 708.15 | 2153 | 708.54 | 2261 | 709 |
| 2366 | 709.42 | 2468 | 709.35 | 2580 | 710.16 | 2793 | 710.78 | 2895 | 710.77 |
| 2985 | 711.16 | 3098 | 712.26 | 3203 | 713.5 | 3306 | 713.52 | 3416 | 713.2 |
| 3526 | 713.95 | 3646 | 713.12 | 3752 | 711.2 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 1000 | .04 | 1925 | .045 | 2047 | .04 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 1925 | 2047 | 42 | 43 | 41 | .1 | .3 |

CROSS SECTION

RIVER: drainage ditch
REACH: upper RS: 2012

INPUT
Description: 83' DOWNSTREAM
Station Elevation Data num= 25

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 1000 | 716.4 | 1115 | 716.61 | 1216 | 716.71 | 1318 | 715.75 | 1426 | 713.4 |
| 1535 | 710.33 | 1640 | 708.22 | 1746 | 707.29 | 1851 | 707.92 | 1860 | 707.89 |
| 1902 | 708.27 | 1918 | 700.15 | 1927 | 700.02 | 1928 | 698.63 | 1933 | 697.78 |
| 1938 | 698.82 | 1940 | 704.28 | 1953 | 708.13 | 1978 | 708.71 | 2205 | 708.77 |
| 2317 | 708.75 | 3234 | 711.06 | 3346 | 712.15 | 3465 | 716.57 | 3533 | 718.34 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 1000 | .04 | 1902 | .045 | 1953 | .04 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 1902 | 1953 | 449 | 455 | 456 | .1 | .3 |

CROSS SECTION

RIVER: drainage ditch
REACH: upper RS: 1557

INPUT
Description: 500' DOWNSTREAM
Station Elevation Data num= 33

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 1000 | 713.49 | 1108 | 713.72 | 1231 | 713.91 | 1335 | 710.44 | 1442 | 708.75 |
| 1558 | 707.52 | 1667 | 707.03 | 1814 | 706.69 | 1832 | 706.8 | 1850 | 698.89 |
| 1854 | 697.39 | 1855 | 697.43 | 1859 | 696.91 | 1862 | 697.45 | 1862 | 697.46 |
| 1864 | 698.32 | 1868 | 698.24 | 1882 | 707.86 | 1897 | 707.76 | 2002 | 706.95 |