SR 400 (I-4) Project Development and Environment (PD&E) Study
FM No.: 432100-1-22-01

Location Hydraulic Report

Segment 4: State Road 400 (SR 400)/Interstate 4 (I-4) from East of SR 15-600/US 17-92 (Seminole/Volusia County Line) to ½ Mile East of SR 472

Volusia County (79110), Florida

August 2016

HNTB Corporation
610 Crescent Executive Court
Suite 400
Lake Mary, FL 32746

Professional Engineer Certificate

I hereby certify that I am a registered professional engineer in the State of Florida practicing with HNTB Corporation, Inc., a corporation authorized to operate as an engineering business, EB#6500, by the State of Florida, Department of Professional Regulation, Board of Professional Engineers, and that I have reviewed or approved the evaluation, findings, opinions, conclusions, or technical advice hereby reported for SR 400 (I-4) Project Development and Environment Study for the Florida Department of Transportation in Volusia County, Florida.

This Location Hydraulic Report (LHR) includes a summary of data collection efforts, floodplain impact estimates, limited cross drain evaluations, and an overall drainage review prepared for the conceptual analyses for the SR 400 (I-4) widening and extension from east of SR 15/600-US 17/92 (Seminole/Volusia County Line) to ½ mile east of SR 472 in Volusia County.

I acknowledge that the procedures and references used to develop the results contained in this report are standard to the professional practice of transportation engineering and planning as applied through professional judgments and experience. This document is for planning purposes only and is not to replace any effort required for final design.

SIGNATURE: _____

NAME: Sanam Rai, P.E.

FIRM: HNTB Corporation

P.E. No.: 69089

DATE: August 2016

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1.0 Introduction

I-4 is an integral part of Central Florida's transportation system. The Interstate carries the greatest number of people and vehicles of any transportation facility in the region and serves many of the area's primary activity centers. When the Interstate opened in February 1965, it was designed to serve intrastate and interstate travel by providing a critical link between the east and west coasts of Central Florida. Although this role continues to be a crucial transportation function of I-4, the highway has evolved to one that serves many shorter trips. Today, the highway serves as the primary link between hotel/motel complexes and tourist attractions such as Walt Disney World, Universal Studios, Sea World, the International Drive Resort Area and downtown Orlando. In addition, since I-4 is the only north-south limited access facility that is centrally located between the predominant employment centers and the major suburbs to the north, it has become the primary commuting corridor in the Central Florida metropolitan area.

Tremendous growth in Central Florida over the past decades has made it difficult for the transportation system to accommodate travel demand. A significant amount of this growth is occurring within close proximity to I-4. In recent years, congestion on I-4 has extended well beyond normal peak hours and major crashes have closed the highway, resulting in traffic congestion throughout the metropolitan area. Congestion and delays on I-4 and the parallel arterial highways are now considered to be major transportation problems facing the region. The congestion on I-4 is further evidenced by the less than desirable levels of service on the Interstate as well as the crossroads.

Projections of future population and employment in the region indicate that travel demand will continue to increase well into the future. The ability to accommodate the new travel patterns resulting from growth must be provided to sustain the region's economy. Without the improvements, extremely congested conditions are expected to occur for extended periods of time in both the morning and evening peak periods. Due to these congested conditions, user travel times will continue to increase, the movement of goods through the urban area will be slower, and the deliveries of goods within the urban area will be forced to other times throughout the day.

The need for improvements to I-4 is illustrated by the important transportation roles I-4 serves to the Central Florida region and the State of Florida. If no improvements are made to the Interstate, a loss in mobility for the area's residents, visitors, and employees can be expected, resulting in a severe threat to the continued viability of the economy and the quality of life.

This reevaluation project involves revising the original design concept showing two (2) High Occupancy Vehicle (HOV) lanes to four (4) Express Lanes as recommended in the Environmental Impact Statement (EIS) for I-4 from east of the Seminole/Volusia County Line to east of SR 472. The Express Lanes are tolled lanes and will extend the full length of the project. The access to/from the tolled lanes will be evaluated as part of this effort to determine if changes are needed from the previously approved concept for access to/from the HOV Lanes. The original I-4 PD&E Studies involved physical separation between the HOV lanes and the general use lanes on I-4. Additionally, a demand management tool was proposed during the EIS phase of the project to control the use of the lanes by requiring a minimum number of occupants per vehicle in order to maintain an acceptable level of service (Level of Service D).

This reevaluation addresses revising the demand management tool to convert the HOV lanes to tolled Express Lanes. A variable pricing tolling plan is proposed. The tolls will vary by time of day and day of week to maintain acceptable levels of service in the Express Lanes. The tolls will be collected electronically through existing E-Pass, Sun Pass and other systems currently in place in the Orlando metropolitan area. The conversion to Express Lanes will maintain the same right of way limits as documented previously and will not change the impacts to the social, natural or physical environment.

The primary objective of this Location Hydraulic Report (LHR) is to evaluate the hydraulic conditions along this project corridor in the existing and proposed conditions. This evaluation shall be accomplished by assessing and quantifying all floodplain impacts and providing recommendations to offset any impacts. The results of this evaluation will provide FDOT with the information necessary to reach a decision on the type, design, and location of improvements that are required for the widening of SR 400 (I-4).

This report has been prepared in accordance with the requirements set forth in Executive Order 11988, "Floodplain Management", US DOT Order 5650.2, "Floodplain Management and Protection", and Federal-Aid Policy Guide 23 CFR 650A. The intent of these regulations is to avoid or minimize roadway encroachments within the 100-year (base) floodplain, where practicable, and to avoid supporting land use development, which is incompatible with floodplain values. This report provides preliminary information on designated floodplains, cross culverts and potential floodplain impacts of the project on these areas.

General information regarding basin delineation, cross culvert location and culvert parameters used in the preparation of this report include the following:

- Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) for Volusia County: FM12127C0730G, FM12127C0735H, FM12127C0620H and FM12127C0610H (Figure 6)
- US Department of Agriculture (USDA) Soils Conservation Service (SCS) Soils Survey for Volusia County (Figure 2)
- US Geological Survey (USGS) Quadrangle Map (Figure 3)
- Florida Department of Transportation (FDOT) PD&E Manual, Part 2, Chapter 24 (revised January 2008)
- FDOT Drainage Manual (2014)
- Existing Construction Plans
- Various Existing Permits
- Site Investigation

2.0 Project Description

The Florida Department of Transportation (FDOT) is proposing to reconstruct and widen I-4 as part of the I-4 Ultimate concept. This involves the build-out of I-4 to its ultimate condition through Central Florida, including segments in Polk, Osceola, Orange, Seminole, and Volusia Counties. The concept design proposes the addition of two (2) new express lanes in each direction giving it a total of ten (10) dedicated lanes. The study area in this section, from east of SR 15/600-US 17/92 (Seminole/Volusia County Line) to ½ mile east of SR 472, provides for the required stormwater treatment with forty (40) potential pond sites along the corridor (See Figure 1 – Project Location Map). The typical section will ensure that the design will be contained within the existing right-of-way with the exception of several offsite ponds. This alignment serves as the basis for the development of the proposed improvements outlined in the Location Hydraulic Report.

2.1 Proposed Recommended Typical Section

The proposed roadway is intended to be an urban principal arterial interstate. In general, the existing roadway typical section has three 12-foot travel lanes with 12 feet wide outside and inside shoulders with 10 feet paved in each direction. The existing right-of-way varies, but is typically 300 feet. The typical section in the proposed condition will have three 12-foot general use travel lanes with a 10-foot inside and 12-foot outside shoulder and two 12-foot express lanes with a 4-foot inside and 10-foot outside shoulder, in each direction. A barrier wall between adjacent 10-foot shoulders will separate the express lanes from the general use lanes. Additionally, auxiliary lanes in both the eastbound and westbound directions will be provided in some areas. Storm water runoff will be collected by inlets and will be conveyed through pipes to retention / detention ponds. The total right-of-way proposed for the recommended sections are a minimum of 300 feet, with the exception of the bifurcated area, in which the right-of-way width extends up to 630 feet.

3.0 Design Criteria

The design of stormwater management facilities for this project is governed by the rules and criteria set forth by the St. Johns River Water Management District (SJRWMD) and the FDOT. These criteria were drawn from the 2013 FDOT Drainage Manual.

3.1 Culvert Design

- All cross drains, if applicable, shall be designed to have sufficient hydraulic capacity to convey the 50-year (Design Frequency) storm event. All culverts shall be analyzed for the base flood (100-year).
- Backwater shall not significantly change land use values unless flood rights are purchased.
- The headwater for design frequency conditions shall be kept at or below the travel lanes.
- The highest tailwater elevation, which can be reasonably expected to occur coincident with the design storm event, shall be used (typically, crown of pipe is used).
- The minimum culvert size is 18" or its equivalent size.
- The design of all cross culverts shall comply with the guidelines set forth in the FDOT Drainage Manual, Chapter 4.

Figure 1: Project Location Map

3.2 Floodplains/Floodways

- The proposed project may not cause a net reduction in flood storage within the 10-year floodplain.
- Structures shall cause no more than a one-tenth (0.1) of a foot increase in the 100-year flood elevation 500-feet upstream.
- Proposed construction shall not cause a reduction in flood conveyance capabilities.
- Best Management Practices (BMP's) shall be employed to minimize velocity to avoid undue erosion.
- The design of encroachments shall be consistent with standards established by FEMA.

The above criteria were collected from applicable portions of:

- FDOT Drainage Handbook – Culvert Design (January 2004)
- FDOT Drainage Manual (January 2014)
- FHWA Code of Federal Regulation 23 CFR 650A
- SJRWMD Management and Storage of Surface Waters (MSSW) Permit Information Manual (October 2013)

4.0 Site Conditions

This project lies within the jurisdiction of the SJRWMD. Wetlands, wildlife, soils conditions, land use, cross culverts, and floodplains describe the site conditions present within the limits of this study. Involvement within wetlands and impact of wildlife are specifically addressed in two separate reports, "*Wetlands Evaluation Report*" and "*Endangered Species Biological Assessment*" prepared as part of this PD&E Study.

4.1 Soils

The Soil Survey of Volusia County, Florida, published by the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) has been reviewed for the project vicinity. There are twenty-one (21) mapped soil types located in the project vicinity. Table 1 lists these soil types and their hydraulic properties. The Soil Survey Map for the project is illustrated in Figure 2.

Table 1: NRCS Soil Survey Information

Soil Type	Hydrologic Soil Group
Apopka fine sands (1)	A
Astatula fine sands (4,5)	A
Basinger fine sand (8)	A/D
Bluff sandy clay loam (10)	C/D
Cassia fine sand (13)	A/D
Daytona sand (17)	A
EauGallie fine sand (20)	A/D
Electra fine sand (22)	A

Soil Type	Hydrologic Soil Group
Myakka fine sand, depressional (33)	A/D
Immokalee sand (29)	B/D
Orsino fine sand (37)	A
Paola fine sand (42, 43)	A
Pomona fine sand (50)	A/D
Placid (48)	A
Quartzipsamments, gently sloping (54)	A
Tavares fine sand (63)	A
Riviera fine sand (42)	A
Smyrna fine sand (60)	A/D
St. Johns fine sand (61)	B/D

Based on a review of the Volusia County, Florida United States Geographical Survey (USGS) quadrangle map, the existing ground surface elevations along the project alignment vary approximately from +5 to +75 feet NGVD. A reproduction of the USGS quadrangle map for the project vicinity is shown in Figure 3.

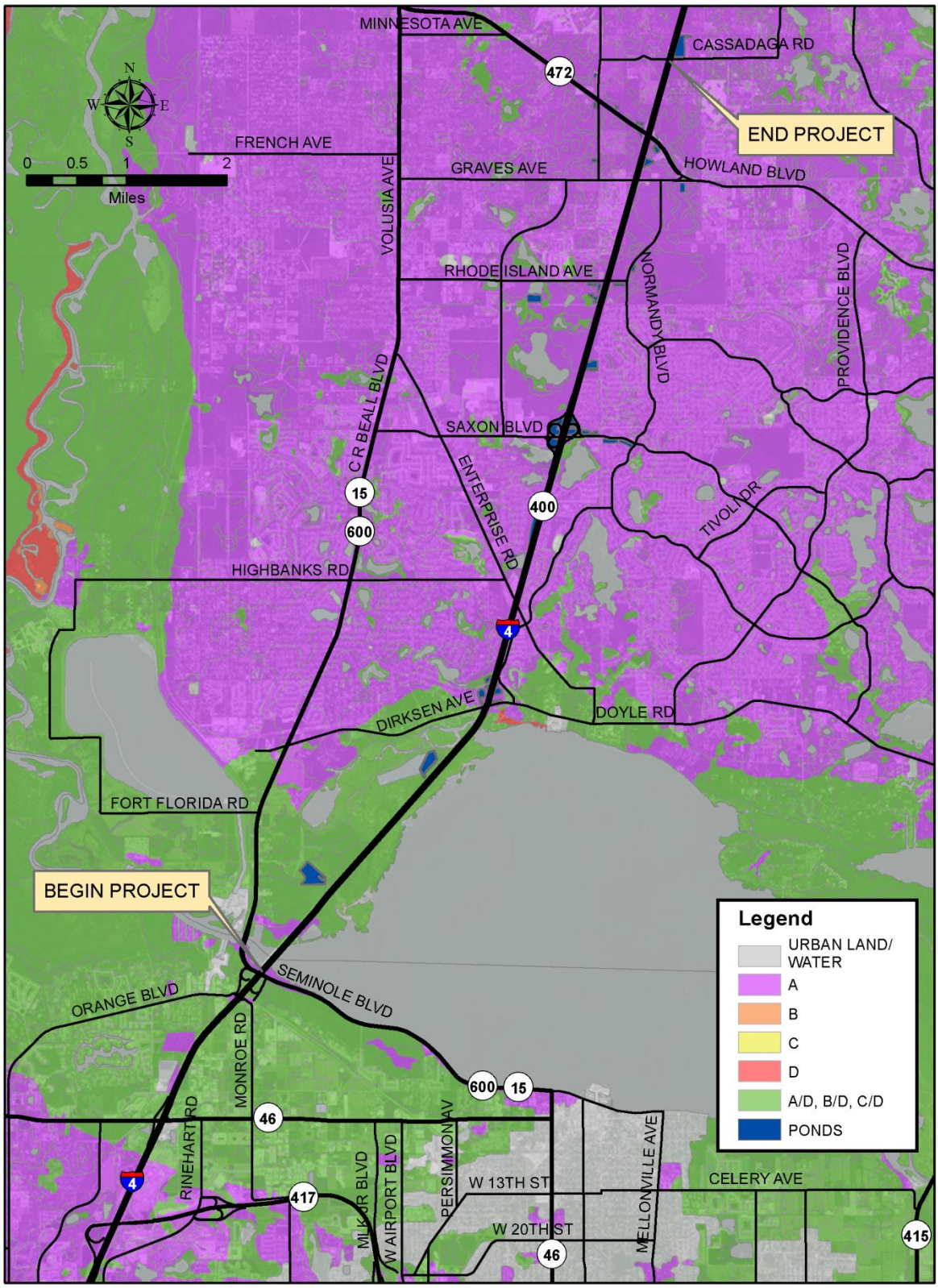

Figure 2: Soil Survey Map

Figure 3: USGS Quadrangle Map

4.2 Land Use

The proposed improvements to the 10-mile I-4, Segment 4 corridor lie within Volusia County, with portions of the segment adjacent to or within the cities of Debary, Deltona, Orange City and DeLand. The existing land use map was created using information from FDOT 2012 parcel tax data records compiled by the Florida Geographic Data Library (FGDL). The future land use map was created using FGDL future land use data from the adopted comprehensive plan amendments for each municipality within the project's limits.

4.2.1 Existing Land Use

The existing land use along the I-4, Segment 4 corridor varies with a mixture of uses. The southern end of the corridor is characterized by a large portion of conservation area along both sides of I-4. This area on the west side of roadway is owned by the SJRWMD and is classified as public/semi-public land. The middle portion of the corridor consists largely of residential land use interspersed with a few undeveloped, non-residential parcels, parcels designated as "other" land use and some acreage not zoned for agriculture. The remainder of the corridor, which comprises the northern section of the corridor limits, consists of a variety of land uses including residential, agricultural and retail/office use, along with several undeveloped nonresidential parcels. Figure 4 illustrates the existing land use within the project area.

4.2.2 Future Land Use

Future land use along the I-4, Segment 4 corridor is similar to the existing land use in this area. The southern end of the corridor will remain as conservation area along both sides of I-4. The middle portion of the corridor consists largely of low and medium density residential land use interspersed with several commercial parcels and some mixed use parcels. The northern section of the corridor consists primarily of mixed use parcels along with some low and medium density residential and commercial land uses. The future land uses along the corridor are illustrated in Figure 5. The widening of I-4 will not alter the existing or future land uses in the area.

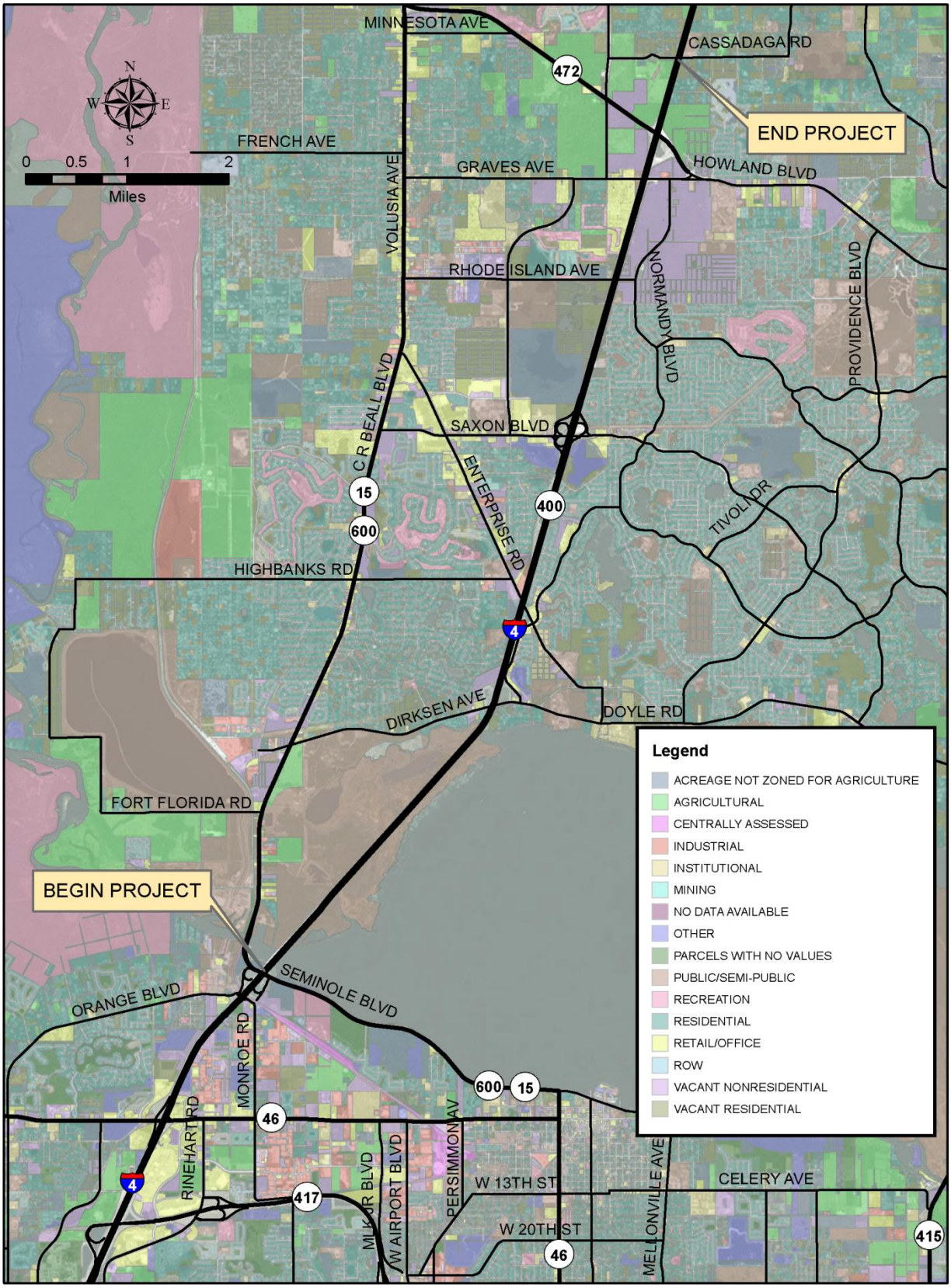

Figure 4: Existing Land Use Map

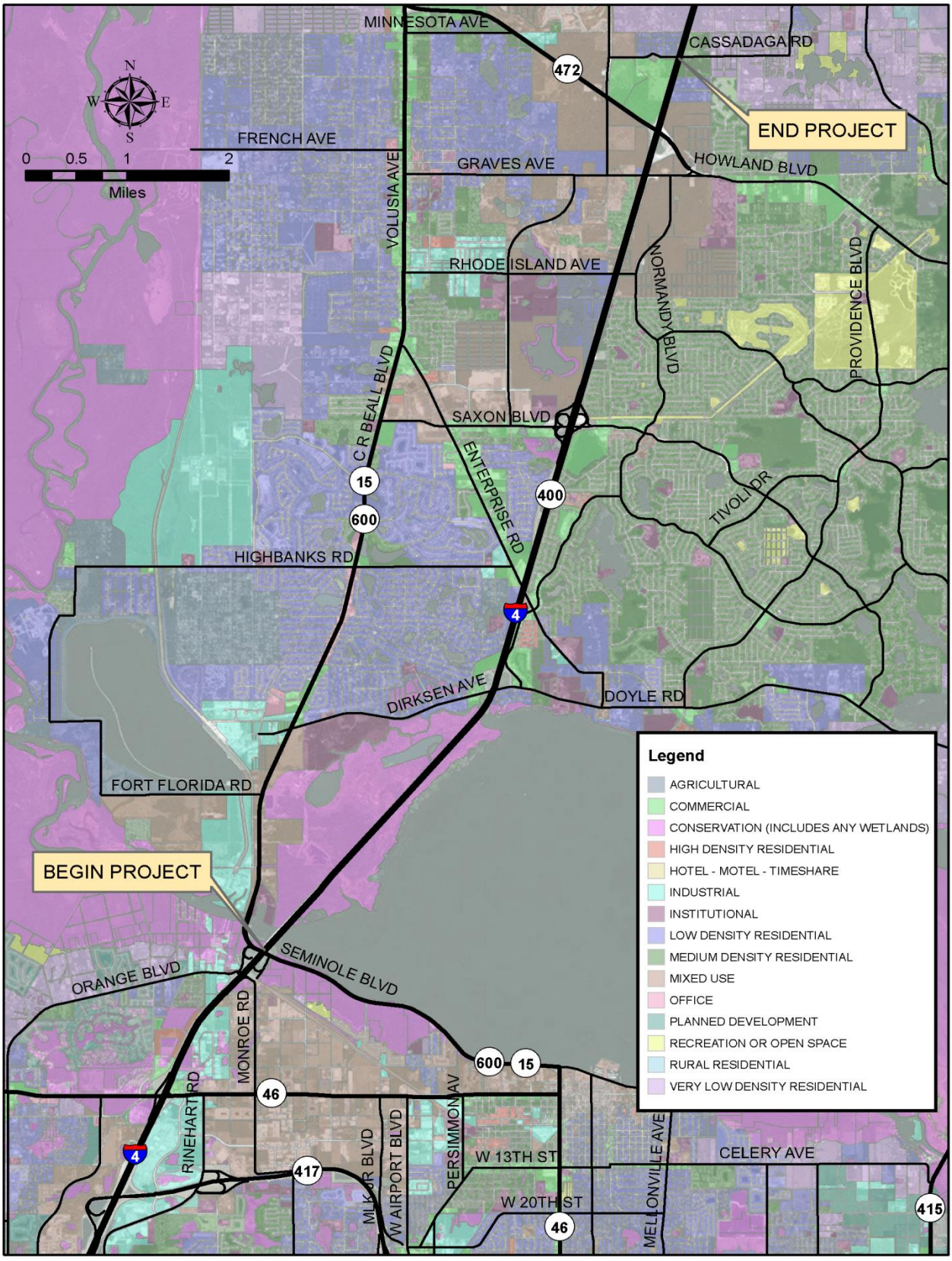

Figure 5: Future Land Use Map

4.3 Cross Culverts

4.3.1 Existing Conditions

There are three (3) existing cross drains within the study area. The Permitted Plans show the existing culvert at Station 2904+29 as a 36 inch concrete pipe, whereas the Straight Line Diagram of Road Inventory shows it as a 24 inch pipe. It was field verified by HNTB staff that the existing culvert is a 36 inch pipe. Additionally, there is a 36 inch steel casing culvert located at Station 2946+25 and was permitted (Permit No. 64105-6) for 75.36 acres of contributing area. The culvert located at Station 2988+72.86 was permitted with a contributing area of 706 acres. Table 2 depicts the existing cross culvert data obtained from the Straight Line Diagram of Road Inventory (Appendix A) pertinent to the project study area as well as original I-4 Permitted Plans.

Table 2: Existing Cross Drains

Milepost	Station	Description from Original Construction Plans						
		Count	Span (in)	Rise (in)	Type	Length (Ft)	Elevation (Ft NAVD)	
							Upstream	Downstream
6.169	2904+29	1	36*	36*	RCP	342	18.88	18.74
6.960	2946+25	1	36	36	SCP	210	27.10	26.02
7.556	2988+72.86	1	36	36	SCP	237	28.24	20.33

Abbreviations: RCP – Reinforced Concrete Pipe, SCP – Steel Casing Pipe, *FV – Field Verified

4.3.2 Proposed Conditions

Through hydraulic analysis, it was determined that the cross drains will be extended in length and the will all remain 36 inches in size. Table 3 depicts the results of the hydraulic analysis. Appendix B illustrates the Cross Drain Calculations.

Table 3: Proposed Cross Drains

Milepost	Station	Description from Original Construction Plans						
		Count	Span (in)	Rise (in)	Type	Length (Ft)	Elevation (Ft NAVD)	
							Upstream	Downstream
6.169	2904+29	1	36	36	RCP	357	18.88	18.73
6.960	2946+25	1	36	36	SCP	247	27.15	26.00
7.556	2988+72.86	1	36	36	SCP	253	28.24	19.80

Abbreviations: RCP – Reinforced Concrete Pipe, SCP – Steel Casing Pipe

4.3.3 Padgett Creek / Lake Monroe Hydraulic Connection

The National Marine Fisheries Service (NMFS) determined that the wetlands in this area are classified as EFH under their guidelines and requires in-kind compensatory mitigation for wetland impacts. Due to the I-4 roadway improvements, wetlands are impacted within the Padgett Creek / Lake Monroe area. Stantec performed an Essential Fish Habitat Assessment (EFH) study at the St. Johns River, Lake Monroe, Padgett Creek, and the DeBary Bayou as part of the I-4 PD&E Reevaluation Study. The best option to offset the EFH

impacts will involve restoring hydraulic connections between Lake Monroe and the wetlands west of I-4. Stantec's EFH memo recommended adding two 100-foot span bridges located at Station 2678+00.

4.4 Bridge Structures

4.4.1 Existing Condition

There are twelve (12) existing bridges located within the project corridor; four that cross over a body of water. The first two bridges cross over Lake Monroe, and the next two bridges cross over Padgett Creek. Bridge number 0196 and 0197 (Lake Monroe) are located within the 100-year floodplain. Table 4 depicts the attributes of the existing bridges. Structure attributes were provided from the Straight Line Diagram of Road Inventory.

Table 4: Existing Bridges

Structure No.	Milepost	Station	Location	Length	Structure Type
0196	0.000	2578+09	US 17/92 / SR 15/600	2,566	BR
0197	0.000	2578+57	US 17/92 / SR 15/600	2,566	BR
0941	3.296	2752+57	PADGETT CREEK	153	BR
0099	3.296	2752+57	PADGETT CREEK	153	BR
0042	3.501	2762+31	DIRKSEN ROAD	327	BR
0100	3.501	2762+31	DIRKSEN ROAD	327	BR
0191	4.615	2823+00	ENTERPRISE ROAD	142	UP
0167	6.351	2913+24	SAXON BLVD EB	58	UP
0166	6.362	2913+82	SAXON BLVD WB	73	UP
0218	9.040	3055+55	GRAVES AVE	63	UP
0053	9.504	3079+47	SR 472	58	UP
0190	9.518	3080+43	SR 472	58	UP

Abbreviations: UP – UP (I-4 travels under facility), BR – Bridge (I-4 travels over facility)

4.4.2 Proposed Condition

In the proposed condition, the bridges will either be widened or replaced to accommodate the widening of the I-4. The bridges over the St. Johns River and Padgett Creek will require a scour analysis. There will be a total of three newly proposed bridges.

4.5 Floodplain/Floodways

The Federal Emergency Management Agency (FEMA) has developed Flood Insurance Rate Maps (FIRM) for Volusia County. According to FEMA Map Nos. 12127C0730G, 12127C0735H, 12127C0620H and 12127C0610H, large portions of the roadway and several ponds lie within the 100-year floodplain. Based on the FEMA floodplain lines, the roadway widening will impact the floodplain on both sides of the roadway. The FEMA Flood Insurance Rate Maps for the project is provided in Figure 6.

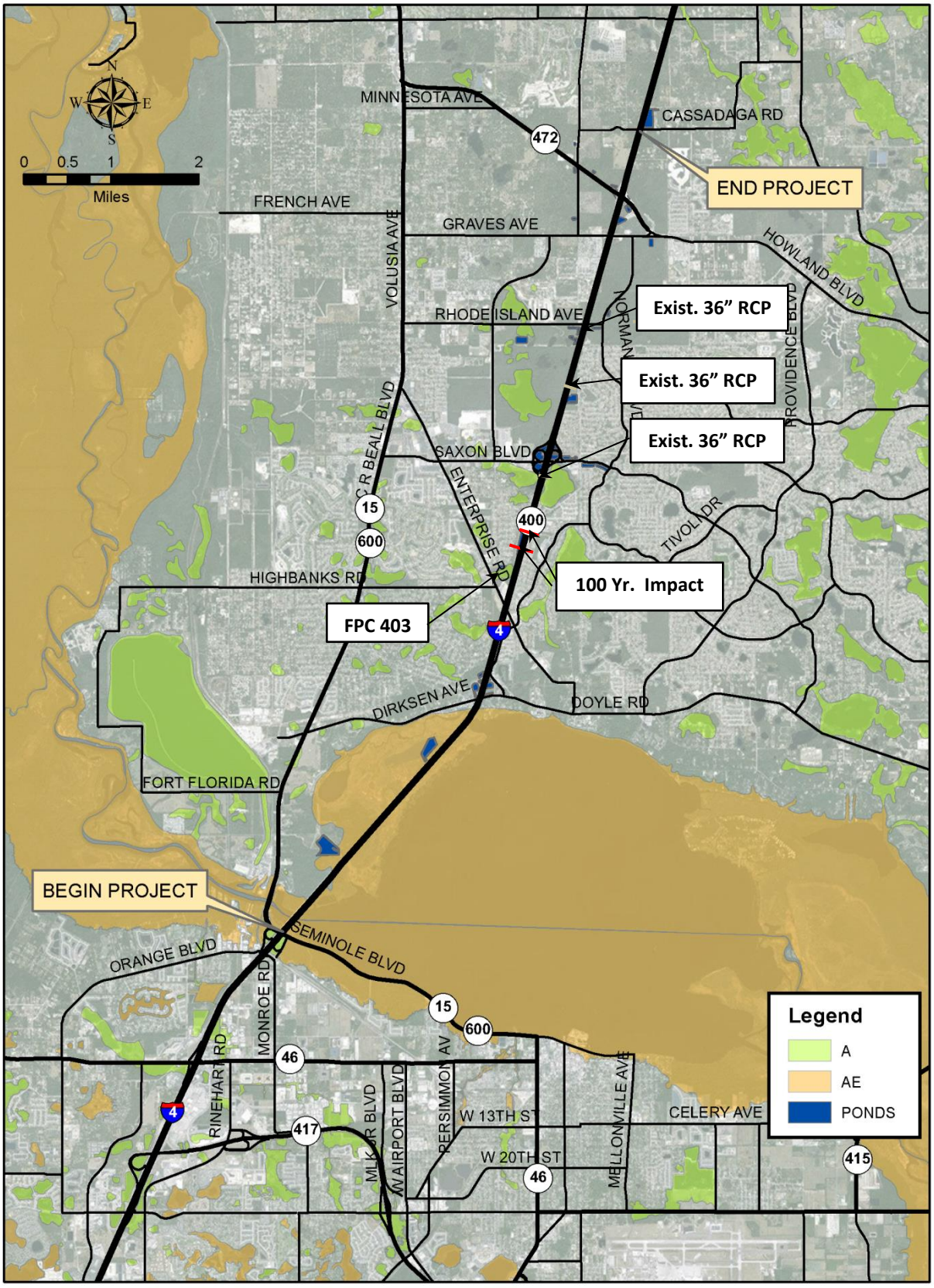

Figure 6: FEMA Flood Insurance Rate Map

4.5.1 Basin 400

The Federal Emergency Management Agency (FEMA) has developed Flood Insurance Rate Maps (FIRM) for Volusia County. According to FEMA Map Nos. 12127C0730G, 12127C0735H, 12127C0620H and 12127C0610H, large portions of the roadway and several ponds lie within the 100-year floodplain. Based on the FEMA floodplain lines, the roadway widening within Lake Monroe Floodplain will impact the floodplain on both sides of the roadway and are located in Zone AE of the floodplain with an elevation of 9 feet NAVD. The roadway impacts the floodplain for a total of 55.75 acre-feet. The westbound impacts occur from Station 2634+00 to 2752+00. The eastbound impacts occur from Station 2640+00 to 2752+00. Compensation for the two basins will be provided in Pond 400 for this impact for a total of 64.58 acre-feet of compensation.

4.5.2 Basin 403

Based on FEMA floodplain lines, a small portion of the widening will impact the Gasline Lake Floodplain. The floodplain at Gasline Lake is classified as Zone A. Based on available contours the elevation for the floodplain is approximately 40 feet NAVD. The westbound portion of the shoulder will impact the Lake Gasline floodplain from Station 2842+20 to Station 2848+20 for a total of 2.41 acre-feet of impacts. A floodplain compensation pond (FPC 403) has been added adjacent to Lake Gasline to compensate for the fill to the floodplain from Station 2847+00 to 2849+00. Additional right-of-way will be required for floodplain compensation pond FPC 403 with an acquisition of one parcel.

4.5.3 Basin 405

Based on the FEMA FIRM map, the roadway right-of-way is located within the 100-year floodplain of Goose Lake and Trout Lake at Station 2905+00. An existing culvert hydraulically connects the two lakes. Goose Lake lies within Zone A and Trout Lake lies within Zone AE with an elevation of 26 NAVD. The ramps and ponds within the southwest quadrant of the Saxon Boulevard Interchange are located within this floodplain. Previously, SR 400 (I-4) was widened from four lanes to six lanes and compensation was provided in the existing ponds. Additional pavement and fill is not proposed within this area; therefore, no floodplain impacts are anticipated.

4.5.4 Basin 407- 408

Based on FEMA floodplain lines, a small portion of the widening will impact the Trout Lake Floodplain. The floodplain at Trout Lake is classified as Zone A. Based on permit application number 42-127-3037-AN, the elevation for the floodplain is approximately 24.3 feet NAVD. The I-4 eastbound off-ramp to Saxon Blvd. will impact the Lake Trout floodplain for approximately 645 ft. for a total of 6.85 acre-feet of impacts. A floodplain compensation pond (FPC 407) has been added adjacent to Lake Trout to compensate for the fill to the floodplain from Station 2908+00 to 2912+00. Additional right-of-way will be required for the proposed ramp alignment.

4.5.5 Basin A (Rhode Island Avenue)

A portion of proposed right-of-way along Rhode Island Avenue lies within the 100-year floodplain from Station 26+82 to Station 32+18. The floodplain is classified as Zone A and has a determined elevation of 17.86 NAVD (Permit No. 111974-1). Compensation for Rhode Island Avenue is provided in a compensation

pond that is adjacent to Pond A (Refer to Appendix E for permitted floodplain calculations). The floodplain pond lies within the existing Volusia County right-of-way.

5.0 Recommendations and Conclusion

5.1 Cross Drains

There are three (3) cross drains within the study area. The existing cross drains have been evaluated for headwater impacts to see if replacement is necessary. Due to the proposed widening, the cross drains will require total replacement. Through hydraulic analysis, it was determined that all cross drain sizes will remain the same. See Appendix B for Cross Drain Calculations.

5.2 Bridge Structures

There are twelve (12) existing bridges. There are three newly proposed bridges. There are two 100-foot span proposed bridges recommended for the Padgett Creek / Lake Monroe area to mitigate for the Essential Fish Habitat (EFH) impacts and one proposed bridge along Rhode Island. Additional study will be required during the final design phase to determine the resultant scour of the four (4) water crossings.

5.3 Floodplains and Floodways

Floodplains are present within the study limits; however, no floodways are located within the project area. The floodplains that are present are located in Zone A and Zone AE. Compensation will be provided for the impacts to the 100-year floodplain as a result of this project. Refer to the Pond Siting Report (PSR) for more details on floodplain compensation alternatives and floodplain impacts and compensation calculations.

5.4 Project Classification

In accordance with FDOT's PD&E Manual, Part 2, Chapter 24, Section 24-2.1, Figure 24.1 "Floodplain" Statements, the proposed corridor has been evaluated to determine the impact of the proposed hydraulic modifications. Hydraulic improvements are grouped into six categories based upon the type of the hydraulic improvements and estimated floodplain impact. The proposed project can be best described in two categories:

Category 3: Projects involving modification to existing drainage structures. The proposed project does not involve the replacement of any existing drainage structures or the construction of any new drainage structures. Projects that affect flood heights and flood limits, even minimally, may require further evaluation to support statements that emphasize the insignificance of the modifications (FDOT PD&E Manual, Part 1, Chapter 24). "The modifications to drainage structures included in this project will result in an insignificant change in their capacity to carry floodwater. This change will cause minimal increases in flood heights and flood limits. These minimal increases will not result in any significant adverse impacts on the natural and beneficial floodplain values or any significant change in flood risks or damage. There will not be a significant change in the potential for interruption or termination of emergency service or emergency evacuation routes. Therefore, it has been determined that this encroachment is not significant."

Category 4: Projects on existing alignment involving replacement of existing drainage structures with no record of drainage problems. The proposed project does not involve replacement activities that would reduce the hydraulic performance of existing facilities. Also, there should be no record of drainage problems and no unresolved complaints from residents in the area (FDOT PD&E Manual, Part 1, Chapter 24). "The proposed structure will perform hydraulically in a manner equal to or greater than the existing structure, and backwater surface elevations are not expected to increase. As a result, there will be no significant adverse impacts on natural and beneficial floodplain values. There will be no significant change in flood risk, and there will not be a significant change in the potential for interruption or termination of emergency service or emergency evacuation routes. Therefore, it has been determined that this encroachment is not significant."

5.5 Project Summary

The proposed reconstruction and widening of SR 400 (I-4) involves adding two new lanes in each direction and providing stormwater management systems. There are three (3) existing cross drains that will necessitate cross drain replacement, which is dependent on the condition of the cross drain. There are twelve (12) existing bridges and three (3) proposed bridges within the corridor. The existing bridges may need to be replaced to meet the proposed geometry. The proposed alignment does impact the 100-year floodplain as well as existing pond sites that will be modified. Compensation will be provided for these impacts. Wetland impacts to Essential Fish Habitat Assessment (EFH) are proposed to be compensated for by restoring the hydraulic connection between Lake Monroe and the wetlands west of I-4. By complying with regulatory criteria, the implementation of this project will not adversely affect the area adjacent to the corridor and meets the expectations of the stakeholders.

APPENDIX A –

STRAIGHT LINE DIAGRAMS

STRAIGHT LINE DIAGRAM OF ROAD INVENTORY

FLORIDA DEPARTMENT OF TRANSPORTATION

INTERIM REVISIONS	5 YR INV	SLD REV	BMP	EMP	INV	SLD REV
DATE	11/07/08	12/04/08	000.000	028.020	02/19/10 DP	03/15/10 MR
BY	DP	URS	000.000	028.020	10/01/09 DP	10/27/09 MR

INT. or US ROUTE NO	STATE ROAD NO.	COUNTY	DISTRICT	ROADWAY ID	SHEET NO.:
I-4	SR 400	VOLUSIA	5	79 110 000	1 OF 6

LANE WIDTHS ARE AVERAGED

INVENTORY DIRECTION N

ROADWAY FEATURES

0.000 INSIDE CITY, NOT URBAN
DE BARY,
I<=I-4
I<SR 400

SEMINOLE COUNTY LINE

US 17/92 / SR15/600

RIVER

ST JOHNS

MM 105 — 0.702

MM 105 — 0.757

MM 106 — 1.685

MM 106 — 1.735

0484 — 2.500

MM 107 — 2.738

245.0' - 72.0'
6 - 12.0' RDWY
153.0' BWALL>1.5 MED
2 - 10.0' PVD INSHLD1
2 - 10.0' PVD SHLD1

0.435 243.0' - 72.0'
6 - 12.0' RDWY
153.0' BWALL>1.5 MED
2 - 10.0' PVD INSHLD1
8.0' PVD/WD SHLD1 - LT
10.0' PVD SHLD1 - RT

0.483 243.0' - 72.0'
6 - 12.0' RDWY
153.0' LWN MED
2 - 10.0' PVD INSHLD1
8.0' PVD/WD SHLD1 - LT
10.0' PVD SHLD1 - RT

0.486 243.0' - 72.0'
6 - 12.0' RDWY
153.0' LWN MED
2 - 10.0' PVD/WD INSHLD1
2 - 8.0' PVD/WD SHLD1
2.0' VG SHLD2 - RT

0.702 246.0' - 72.0'
6 - 12.0' RDWY
153.0' LWN MED
2 - 10.0' PVD/WD INSHLD1
2 - 8.0' PVD/WD SHLD1
3.0' VG SHLD2 - LT
2.0' VG SHLD2 - RT

0.746 258.0' - 72.0'
6 - 12.0' RDWY
153.0' LWN MED
2 - 10.0' PVD/WD INSHLD1
8.0' PVD/WD SHLD1 - LT
3.0' VG SHLD2 - LT
10.0' PVD/WD SHLD1 - RT
12.0' LWN SHLD2 - RT

0.970 269.0' - 72.0'
6 - 12.0' RDWY
153.0' LWN MED
2 - 10.0' PVD/WD INSHLD1
2 - 10.0' PVD/WD SHLD1
2 - 12.0' LWN SHLD2

1.016 259.0' - 72.0'
6 - 12.0' RDWY
153.0' LWN MED
2 - 10.0' PVD/WD INSHLD1
10.0' PVD/WD SHLD1 - LT
12.0' LWN SHLD2 - LT
12.0' PVD/WD SHLD1 - RT

1.032 146.0' - 72.0'
6 - 12.0' RDWY
40.0' LWN/DBL GR MED
2 - 10.0' PVD/WD INSHLD1
10.0' PVD/WD SHLD1 - LT
12.0' LWN SHLD2 - LT
12.0' PVD/WD SHLD1 - RT

ROADWAY COMPOSITION: 28/FC-5 | 28/FC-5

HORIZONTAL ALIGNMENT: CURVE DATA IS NOT FIELD VERIFIED — B=N41°25'15"E

STRUCTURE DESCRIPTION:
0.000 0196 2566 BS 0197 2566 BR 0.486

1.129 1-48" X 200' CC

2.048 1-16" X 95' CC

2.388 1-24" X 99' CC

2.786 1-24" X 95' CC

DISTRICT USE:

SIS: SIS HIGHWAY FACILITY

FUN CLASS: RURAL PRINCIPAL ARTERIAL – INTERSTATE

3.242 INSIDE CITY & URBAN
DELTONA, DELTONA

CREEK

PADGETT

2Quad. CLV
108

DIRKSEN RD

RAMP 005 — A — 3.685 — 3.707

RAMP 004 — A — 3.812

RAMP 006 — A — 3.699 — 3.745

RAMP 007 — A — 3.845

MM 108

MM 108

9906

MM 109

ENTERPRISE RD — 4.668 — 4.681

4.751

MM 109

ROADWAY FEATURES

LANE WIDTHS ARE AVERAGED

INVENTORY DIRECTION N

3.056 134.0' - 72.0'
6 - 12.0' RDWY
40.0' LWN/DBL GR MED
12.0' PVD/WD INSHLD1 - LT
10.0' PVD/WD INSHLD1 - RT
8.0' PVD SHLD1 - LT
2.0' C&G SHLD2 - LT
12.0' PVD/WD SHLD1 - RT

3.026 146.0' - 72.0'
6 - 12.0' RDWY
40.0' LWN/DBL GR MED
12.0' PVD/WD INSHLD1 - LT
10.0' PVD/WD INSHLD1 - RT
10.0' PVD/WD SHLD1 - LT
12.0' LWN SHLD2 - LT
12.0' PVD/WD SHLD1 - RT

3.080 142.0' - 72.0'
6 - 12.0' RDWY
48.0' PVD/GR MED
12.0' PVD/WD INSHLD1 - LT
10.0' PVD/WD INSHLD1 - RT
8.0' PVD SHLD1 - LT
2.0' C&G SHLD2 - LT
12.0' PVD/WD SHLD1 - RT

3.504 140.0' - 72.0'
6 - 12.0' RDWY
48.0' PVD/GR MED
12.0' PVD/WD INSHLD1 - LT
10.0' PVD/WD INSHLD1 - RT
8.0' PVD SHLD1 - LT
2.0' C&G SHLD2 - LT
10.0' PVD SHLD1 - RT

3.610 152.0' - 72.0'
6 - 12.0' RDWY
48.0' PVD/GR MED
12.0' PVD/WD INSHLD1 - LT
10.0' PVD/WD INSHLD1 - RT
10.0' PVD/WD SHLD1 - LT
12.0' LWN SHLD2 - LT
10.0' PVD SHLD1 - RT

3.657 144.0' - 72.0'
6 - 12.0' RDWY
40.0' LWN/DBL GR MED
12.0' PVD/WD INSHLD1 - LT
10.0' PVD/WD INSHLD1 - RT
10.0' PVD/WD SHLD1 - LT
12.0' LWN SHLD2 - LT
10.0' PVD SHLD1 - RT

3.738 144.0' - 72.0'
6 - 12.0' RDWY
40.0' LWN/DBL GR MED
12.0' PVD/WD INSHLD1 - LT
10.0' PVD/WD INSHLD1 - RT
10.0' PVD/WD SHLD1 - LT
12.0' LWN SHLD2 - LT
10.0' PVD/WD SHLD1 - RT

3.845 150.0' - 72.0'
6 - 12.0' RDWY
40.0' LWN/DBL GR MED
12.0' PVD/WD INSHLD1 - LT
10.0' PVD/WD INSHLD1 - RT
10.0' PVD/WD SHLD1 - LT
12.0' LWN SHLD2 - LT
4.0' PVD SHLD1 - RT
12.0' LWN SHLD2 - RT

4.069 156.0' - 72.0'
6 - 12.0' RDWY
40.0' LWN/DBL GR MED
12.0' PVD/WD INSHLD1 - LT
10.0' PVD/WD INSHLD1 - RT
2 - 10.0' PVD/WD SHLD1
2 - 12.0' LWN SHLD2

4.606 156.0' - 72.0'
6 - 12.0' RDWY
40.0' PVD/GR MED
12.0' PVD/WD INSHLD1 - LT
10.0' PVD/WD INSHLD1 - RT
2 - 10.0' PVD/WD SHLD1
2 - 12.0' LWN SHLD2

4.659 156.0' - 72.0'
6 - 12.0' RDWY
40.0' PVD/GR MED
2 - 10.0' PVD/WD INSHLD1
2 - 10.0' PVD/WD SHLD1
2 - 12.0' LWN SHLD2

4.720 156.0' - 72.0'
6 - 12.0' RDWY
40.0' LWN/DBL GR MED
2 - 10.0' PVD/WD INSHLD1
2 - 10.0' PVD/WD SHLD1
2 - 12.0' LWN SHLD2

4.832 144.0' - 72.0'
6 - 12.0' RDWY
40.0' LWN/DBL GR MED
2 - 10.0' PVD/WD INSHLD1
8.0' PVD/WD SHLD1 - LT
2.0' VG SHLD2 - LT
10.0' PVD/WD SHLD1 - RT
12.0' LWN SHLD2 - RT

4.893 304.0' - 72.0'
6 - 12.0' RDWY
200.0' LWN MED
2 - 10.0' PVD/WD INSHLD1
8.0' PVD/WD SHLD1 - LT
2.0' VG SHLD2 - LT
10.0' PVD/WD SHLD1 - RT
12.0' LWN SHLD2 - RT

ROADWAY COMPOSITION: 28/FC-5 | 28/FC-5

HORIZONTAL ALIGNMENT: Δ=25°48'00" D=1°00' PC=3.165 PI=3.414 PT=3.654 — CURVE DATA IS NOT FIELD VERIFIED — B=N15°37'15"E — Δ=10°36'15" D=0°45' PC=4.880 PI=5.015 PT=5.148

STRUCTURE DESCRIPTION:
3.117 1-24" X 95' CC
3.296 0941 153' BR 0099 153' BR 3.325
3.501 0042 327' BR 0100 327' BR 3.563
3.878 1-24" X 181' CC
4.391 1-30" X 99' CC
4.615 0191 142' UP 4.642

DISTRICT USE:

SIS: SIS HIGHWAY FACILITY

FUN CLASS: RURAL PRINCIPAL ARTERIAL – INTERSTATE | 3.242 URBAN PRINCIPAL ARTERIAL – INTERSTATE

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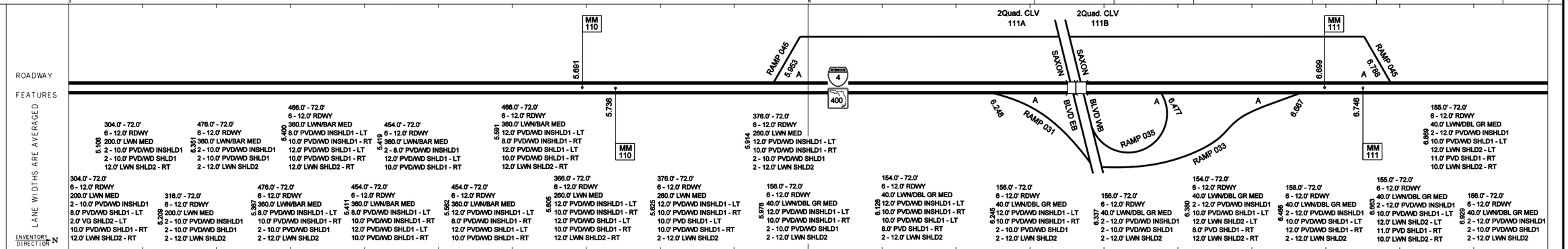
PRINTED: 3/15/2010 8:41:00 AM

INTERIM REVISIONS								
	5 YR INV	SLD REV	BMP	EMP	INV		SLD REV	
DATE	11/07/08	12/04/08	000.000	028.020	02/19/10	DP	03/15/10	MR
BY	DP	URS	000.000	028.020	10/01/09	DP	10/27/09	MR

STRAIGHT LINE DIAGRAM OF ROAD INVENTORY

FLORIDA DEPARTMENT OF TRANSPORTATION

INT. or US ROUTE NO	STATE ROAD NO.	COUNTY	DISTRICT	ROADWAY ID	SHEET NO.:
I-4	SR 400	VOLUSIA	5	79 110 000	2 OF 6



ROADWAY COMPOSITION: 28/FC-5 | 28/FC-5

HORIZONTAL ALIGNMENT: CURVE DATA IS NOT FIELD VERIFIED

PC=5.312 PI=5.496 PT=5.837 D=0°45' Δ=20°56'43"

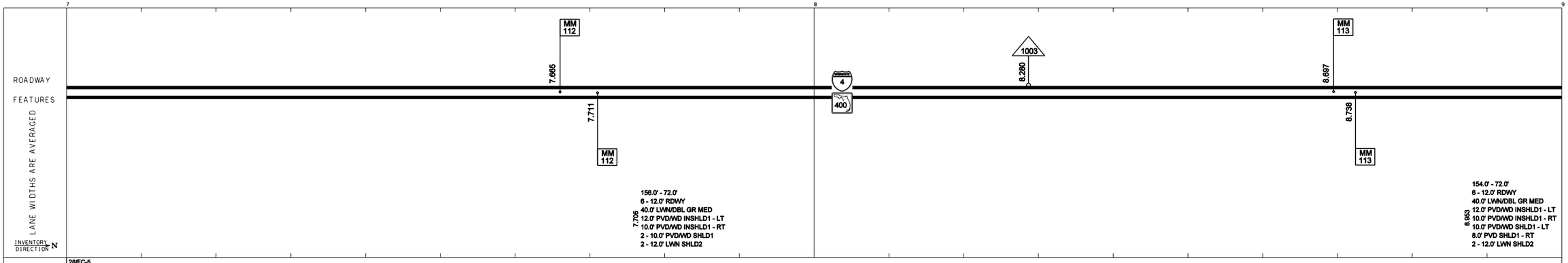
B=N5°01'00"E | B=N25°05'02"E | B=N15°44'30"E | Δ=0°00'40" PI=6.570 | B=N15°45'10"E

STRUCTURE DESCRIPTION: 5.067 1-24" X 235' CI | 5.942 1-18" X 120' CC | 6.169 1-24" X 342' CC | 6.351 6.362 6.362 6.376 0167 58' UP 0166 73' UP | 6.980 1-36" X 203' CI

DISTRICT USE:

SIS: SIS HIGHWAY FACILITY

FUN CLASS: URBAN PRINCIPAL ARTERIAL – INTERSTATE



ROADWAY COMPOSITION: 28/FC-5 | 28/FC-5

HORIZONTAL ALIGNMENT: Δ=0°00'36" PI=7.136 CURVE DATA IS NOT FIELD VERIFIED B=N15°44'34"E

STRUCTURE DESCRIPTION: 7.083 1-18" X 96' CM | 7.346 1-18" X 96' CM | 7.551 1-18" X 89' CC | 7.566 1-24" X 237' CC | 7.582 1-18" X 96' CM | 7.766 1-18" X 96' CM | 8.106 1-18" X 96' CM | 8.147 1-24" X 95' CC | 8.314 1-18" X 87' CM | 8.465 1-18" X 87' CM | 8.806 1-18" X 83' CM | 8.920 1-24" X 87' CC

DISTRICT USE:

SIS: SIS HIGHWAY FACILITY

FUN CLASS: URBAN PRINCIPAL ARTERIAL – INTERSTATE

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PRINTED: 3/15/2010 8:41:30 AM

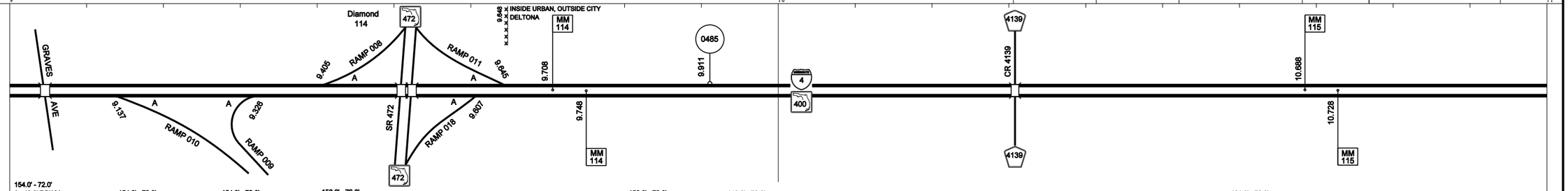
STRAIGHT LINE DIAGRAM OF ROAD INVENTORY

FLORIDA DEPARTMENT OF TRANSPORTATION

INTERIM REVISIONS	5 YR INV	SLD REV	BMP	EMP	INV	SLD REV
DATE	11/07/08	12/04/08	000.000	028.020	02/19/10 DP	03/15/10 MR
BY	DP	URS	000.000	028.020	10/01/09 DP	10/27/09 MR

INT. or US ROUTE NO	STATE ROAD NO.	COUNTY	DISTRICT	ROADWAY ID	SHEET NO.:
I-4	SR 400	VOLUSIA	5	79 110 000	3 OF 6

9 10 11



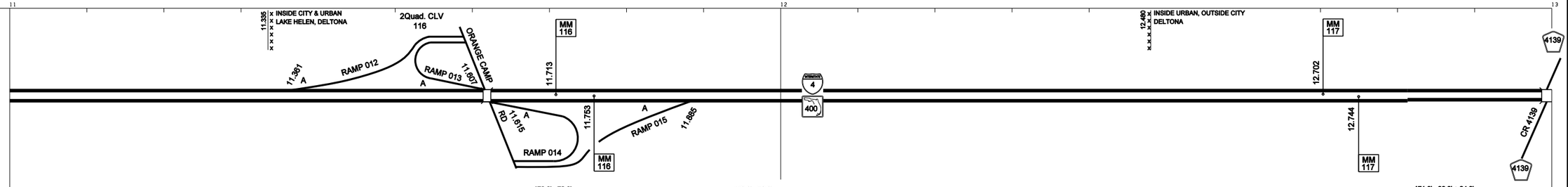
ROADWAY COMPOSITION	28/FC-5
	28/FC-5
HORIZONTAL ALIGNMENT	CURVE DATA IS NOT FIELD VERIFIED
	Δ=0°00'19" PI=9.708 B=N15°44'53E

STRUCTURE DESCRIPTION

9.003 1-18" X 101' CM
9.040 9.052 0218 63' UP
9.101 1-24" X 110' CM
9.117 1-24" X 250' CC
9.130 1-24" X 87' CC
9.185 1-18" X 95' CM
9.279 1-18" X 95' CM
9.504 9.515 9.518 9.529 0053_0190 58' UP 58' UP
9.763 1-18" X 85' CM
9.785 1-18" X 95' CC
9.924 1-18" X 96' CM
10.078 1-18" X 85' CM
10.151 1-18" X 103' CM
10.275 2-36" X 210' CC
10.303 10.313 0210 52' UP
10.323 1-36" X 210' CI
10.328 1-36" X 210' CI
10.653 1-18" X 83' CC

DISTRICT USE	
SIS	SIS HIGHWAY FACILITY
FUN CLASS	URBAN PRINCIPAL ARTERIAL – INTERSTATE

11 12 13



ROADWAY COMPOSITION	28/FC-5
	28/FC-5
HORIZONTAL ALIGNMENT	CURVE DATA IS NOT FIELD VERIFIED

STRUCTURE DESCRIPTION

11.012 1-18" X 95' CM
11.391 2-42" X 210' CC
11.614 11.624 0211 58' UP
11.883 1-42" X 220' CC
12.773 1-30" X 178' CI
12.987 13.005 0212 96' UP

DISTRICT USE	
SIS	SIS HIGHWAY FACILITY
FUN CLASS	URBAN PRINCIPAL ARTERIAL – INTERSTATE

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APPENDIX B –

CROSS DRAIN CALCULATIONS

CROSS DRAIN ANALYSIS - PROPOSED CONDITION

HNTB Corporation
610 Crescent Executive Court, Suite 400
Lake Mary, FL 32746

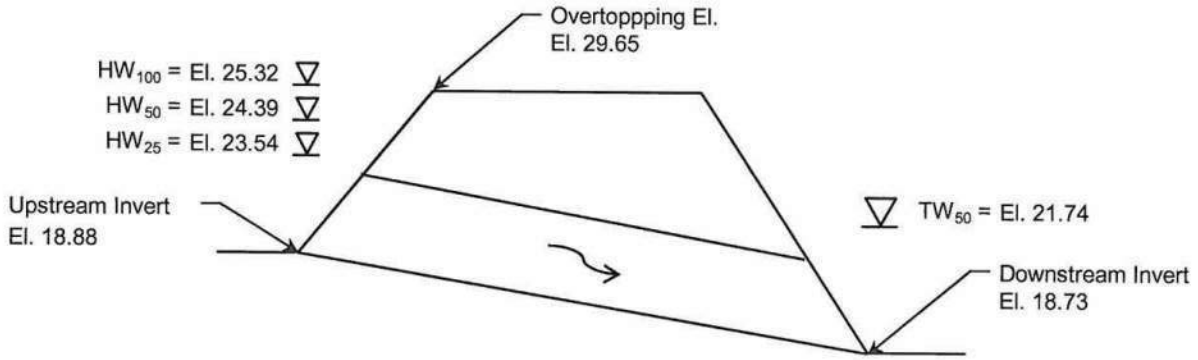
	DATE
made by: LDP	12-Nov-13
checked by: HHJ	7-Apr-14
HNTB job #: 59219	

PROJECT: **I-4 PD&E - Segment 4**

LOCATION: **6.169**

Cross Drain Characteristics:

Number of Barrels:	1	
Cross Drain Shape:	Round	
Manning's "n":	0.012	
Entrance Loss Coef.:	0.20	
Span (B):	3.0 ft	
Height (D):	3.0 ft	
Length (L):	357 ft	
Slope (So):	0.0004 ft/ft	
Upstream Invert:	18.88	(NAVD)
Downstream Invert:	18.73	
Overtopping El.:	29.65	
Tailwater El.:	21.74	
Description:	36" Pipe	



Culvert Description	# of Barrels	Q (cfs)	Size		Headwater Computation											Con. HW	Outlet Velocity	Comments
					Inlet Control			Outlet Control HW = H + DTW - LSo										
			D	B	Q/B	HW/D*	HW	Ke	H**	d_c***	$(d_c+D)/2$	TW	DTW	LSo	HW			
36" Pipe 25 Yr	1	42.4	3.0 ft	3.0 ft	14.14	1.15	3.45	0.20	1.80	2.10	2.55	3.01	3.01	0.15	4.66	4.66	6.00	
36" Pipe 50 Yr	1	51.0	3.0 ft	3.0 ft	17.00	1.39	4.17	0.20	2.65	2.30	2.65	3.01	3.01	0.15	5.51	5.51	7.22	
36" Pipe 100 Yr	1	59.4	3.0 ft	3.0 ft	19.79	1.60	4.80	0.20	3.58	2.50	2.75	3.01	3.01	0.15	6.44	6.44	8.40	

* From Chart 1 of HDS-5
** From Chart 5 of HDS-5
*** From Chart 4 of HDS-5

CROSS DRAIN ANALYSIS - EXISTING CONDITION

HNTB Corporation
610 Crescent Executive Court, Suite 400
Lake Mary, FL 32746

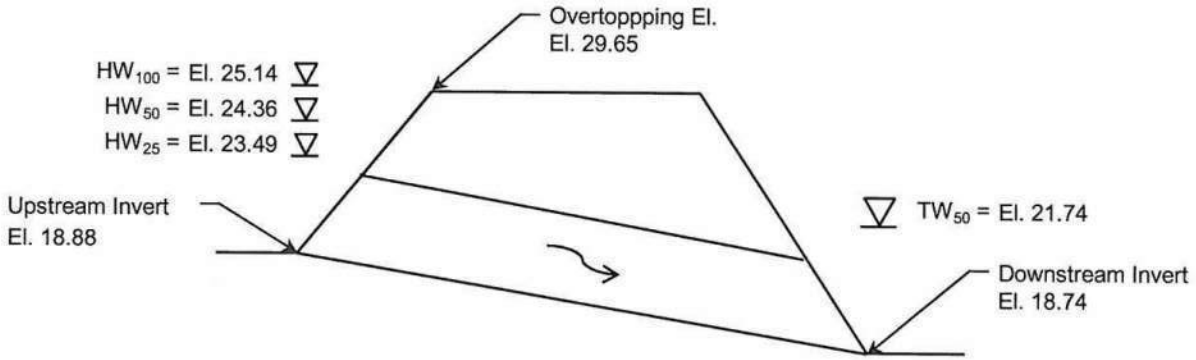
		DATE
made by:	LDP	12-Nov-13
checked by:	HJJ	7-Apr-14
HNTB job #:	59219	

PROJECT: **I-4 PD&E - Segment 4**

LOCATION: **6.169**

Cross Drain Characteristics:

Number of Barrels:	1	
Cross Drain Shape:	Round	
Manning's "n":	0.012	
Entrance Loss Coef.:	0.20	
Span (B):	3.0 ft	
Height (D):	3.0 ft	
Length (L):	342 ft	
Slope (So):	0.0004 ft/ft	
Upstream Invert:	18.88	(NAVD)
Downstream Invert:	18.74	
Overtopping El.:	29.65	
Tailwater El.:	21.74	(Based on crown of pipe)
Description:	36" Pipe	



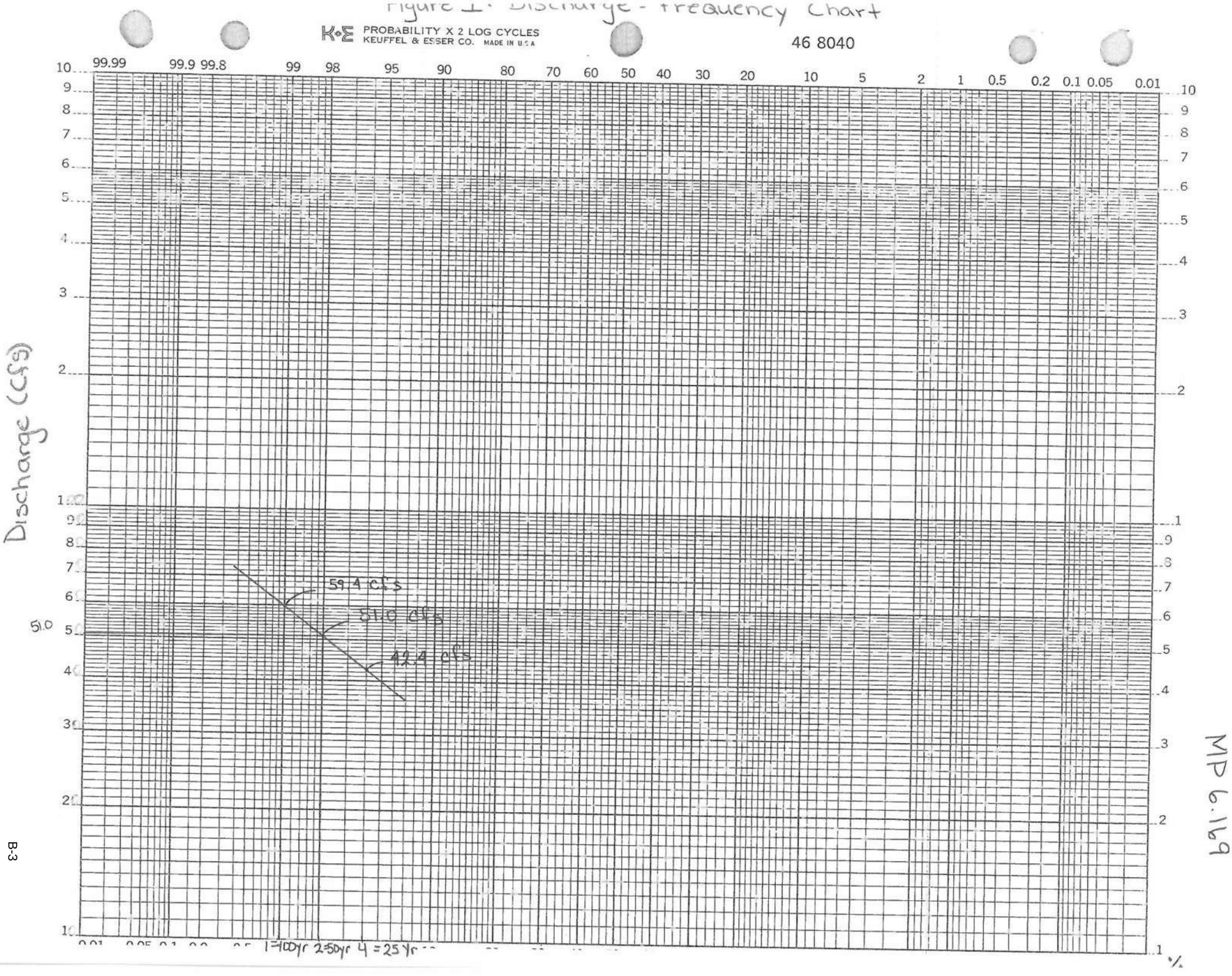
$Q_{25} = V*A = 6 \text{ fps} * (\pi D^2/4) =$ 42.4 cfs

$Q_{100} = 1.4 * Q_{25} =$ 59.4 cfs

Culvert Description	# of Barrels	Q (cfs)	Size		Headwater Computation											Con. HW	Outlet Velocity	Comments
					Inlet Control			Outlet Control HW = H + DTW - LSo										
			D	B	Q/B	HW/D*	HW	Ke	H**	d_c***	$(d_c+D)/2$	TW	DTW	LSo	HW			
36" Pipe 25 Yr	1	42.4	3.0 ft	3.0 ft	14.14	1.15	3.45	0.20	1.75	2.10	2.55	3.00	3	0.14	4.61	4.61	6.00	
36" Pipe 50 Yr	1	51.0	3.0 ft	3.0 ft	17.00	1.39	4.17	0.20	2.62	2.30	2.65	3.00	3	0.14	5.48	5.48	7.22	
36" Pipe 100 Yr	1	59.4	3.0 ft	3.0 ft	19.79	1.60	4.80	0.20	3.40	2.50	2.75	3.00	3	0.14	6.26	6.26	8.40	

* From Chart 1 of HDS-5
** From Chart 5 of HDS-5
*** From Chart 4 of HDS-5

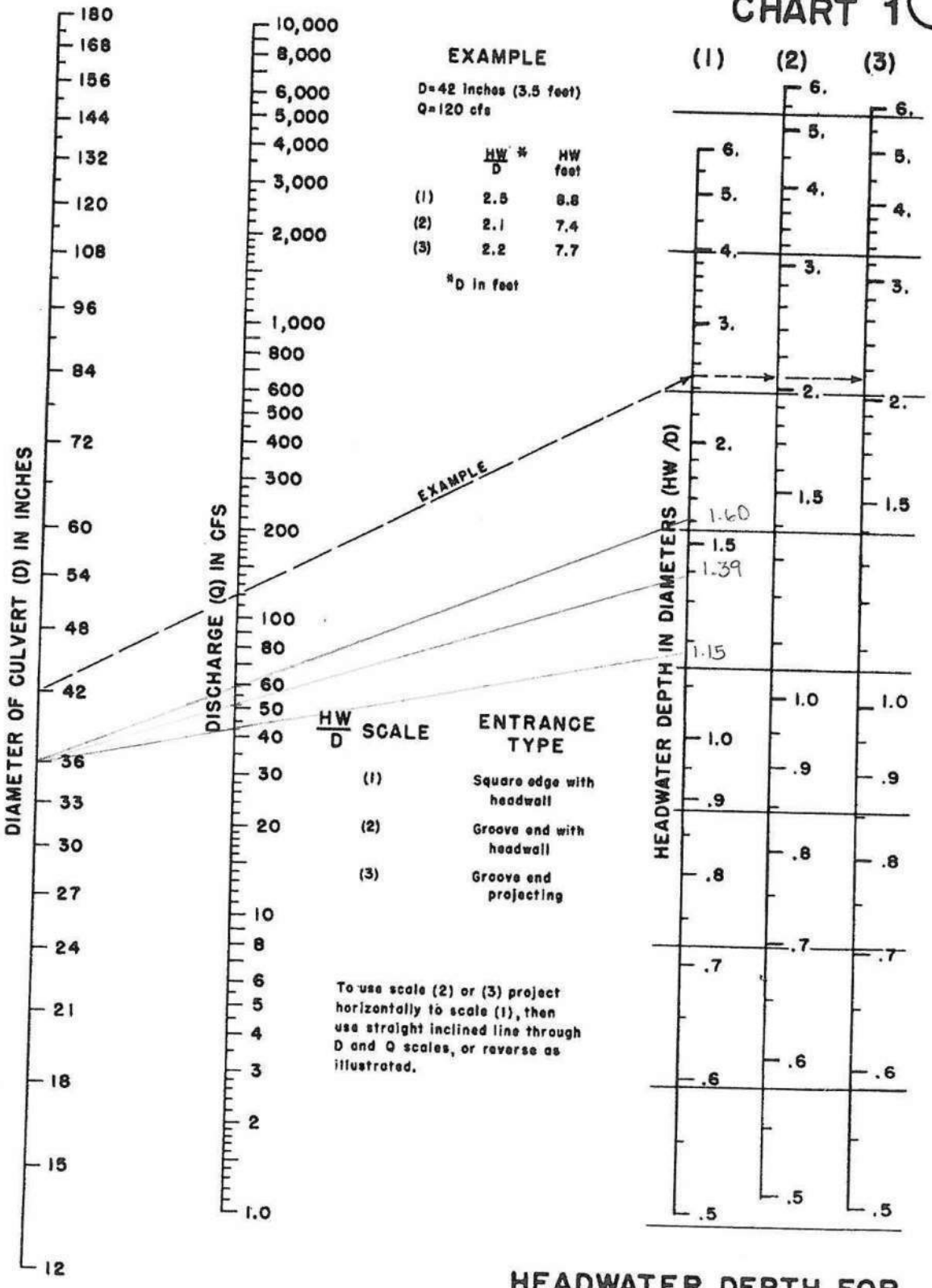
Figure 1: Discharge - Frequency Chart



MP 6.169

MP 6.169

CHART 1



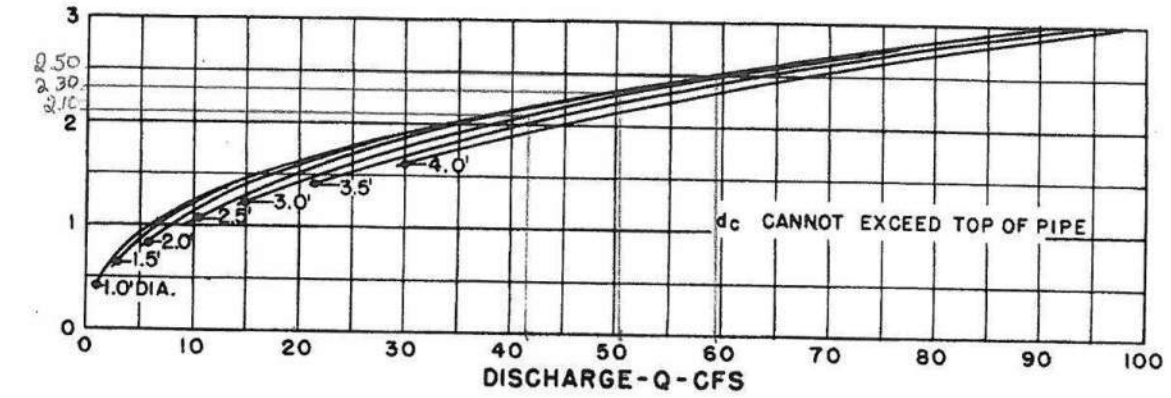
HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

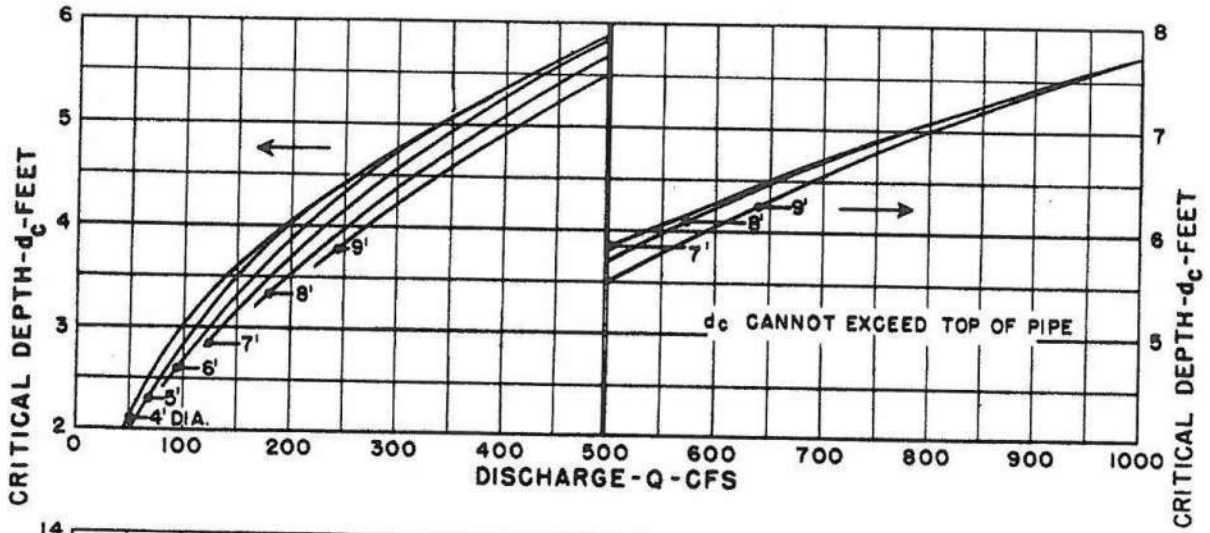
HEADWATER SCALES 2&3
REVISED MAY 1964

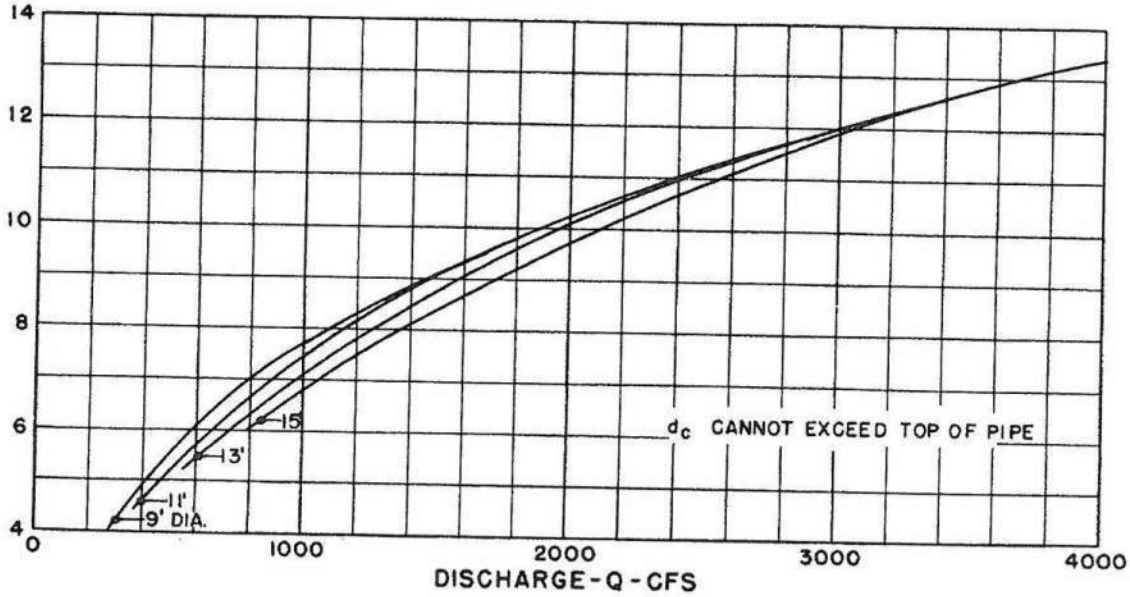
BUREAU OF PUBLIC ROADS JAN. 1963

MP 6.169

CHART 4







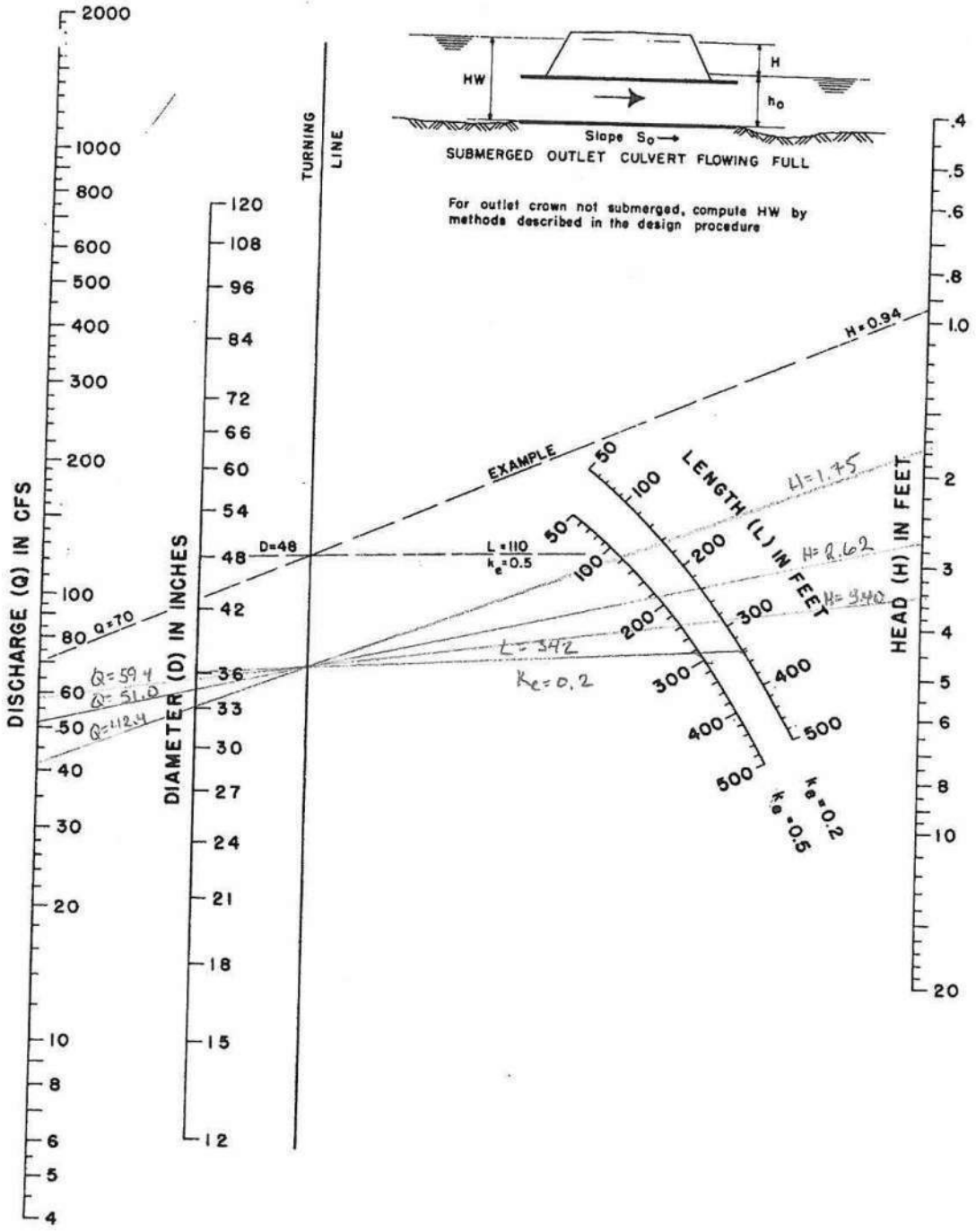
BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

MP 6.169 (Ex)

CHART 5

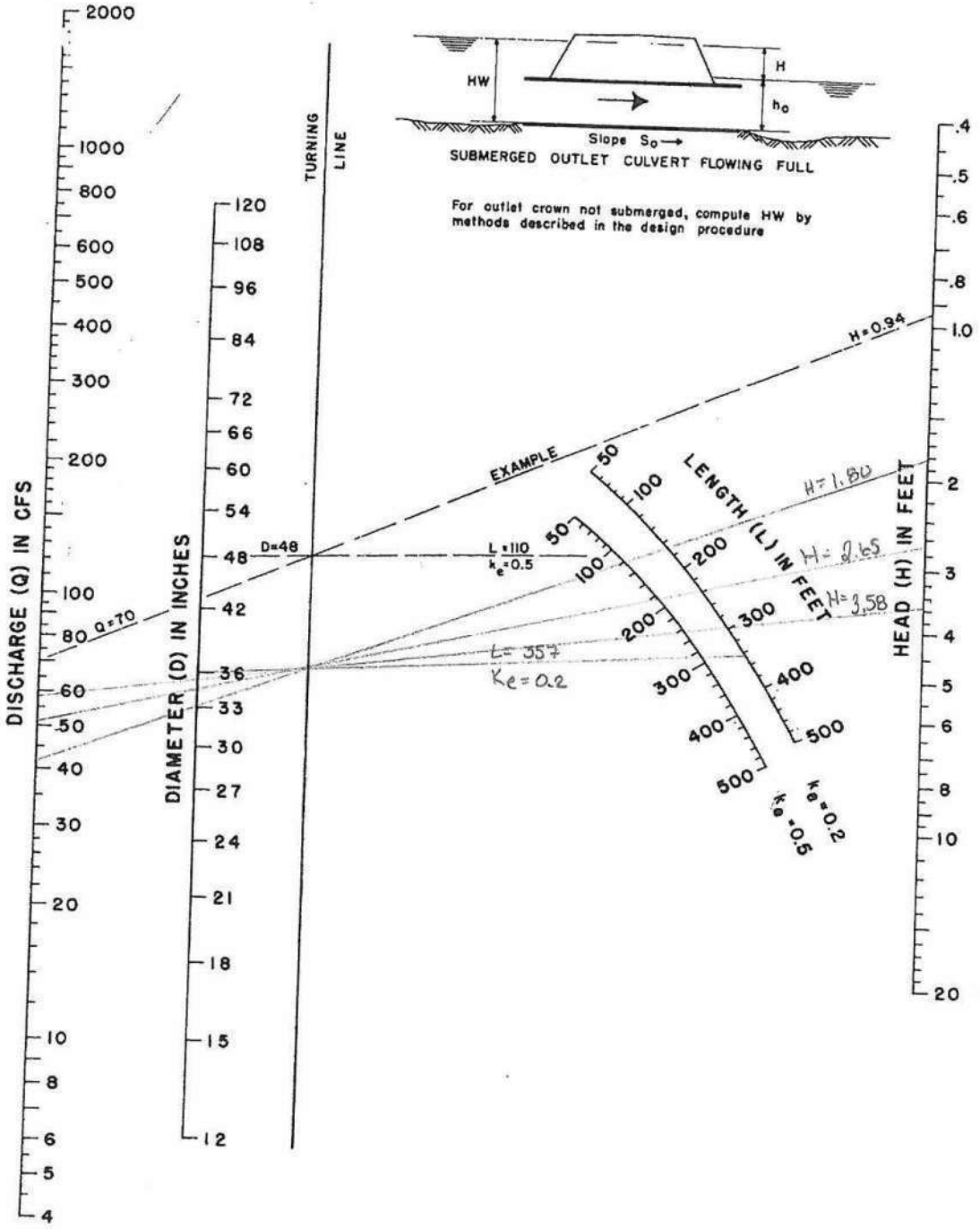


HEAD FOR
CONCRETE PIPE CULVERTS
FLOWING FULL
n = 0.012

BUREAU OF PUBLIC ROADS JAN. 1963

MP 6.169 (PR)

CHART 5



HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL n = 0.012

BUREAU OF PUBLIC ROADS JAN. 1963

CROSS DRAIN ANALYSIS - PROPOSED CONDITION

HNTB Corporation
610 Crescent Executive Court, Suite 400
Lake Mary, FL 32746

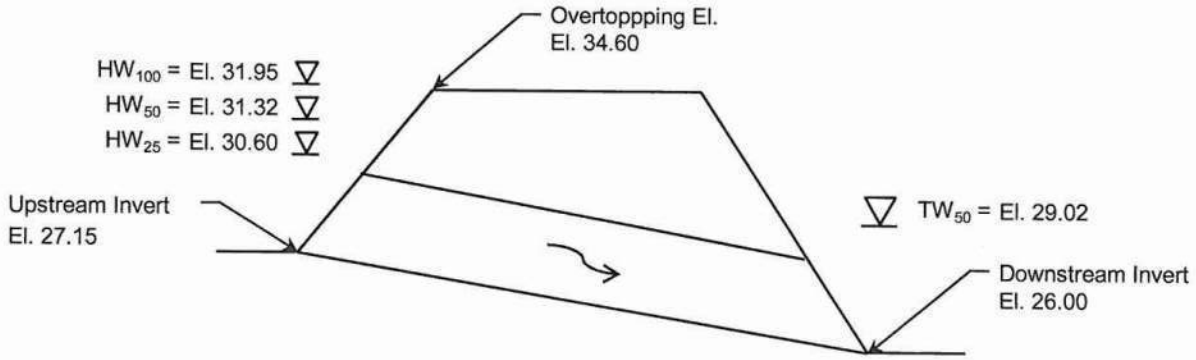
	DATE
made by: LDP	12-Nov-13
checked by: HHJ	7-Apr-14
HNTB job #: 59219	

PROJECT: **I-4 PD&E - Segment 4**

LOCATION: **6.96**

Cross Drain Characteristics:

Number of Barrels:	1	
Cross Drain Shape:	Round	
Manning's "n":	0.022	
Entrance Loss Coef.:	0.20	
Span (B):	3.0 ft	
Height (D):	3.0 ft	
Length (L):	247 ft	
Slope (So):	0.005 ft/ft	
Upstream Invert:	27.15	(NAVD)
Downstream Invert:	26.00	
Overtopping El.:	34.60	
Tailwater El.:	29.02	
Description:	36" Pipe	



Culvert Description	# of Barrels	Q (cfs)	Size		Headwater Computation											Con. HW	Outlet Velocity	Comments
					Inlet Control			Outlet Control HW = H + DTW - LSo										
			D	B	Q/B	HW/D*	HW	Ke	H**	d_c***	$(d_c+D)/2$	TW	DTW	LSo	HW			
36" Pipe 25 Yr	1	42.4	3.0 ft	3.0 ft	14.14	1.15	3.45	0.20	1.50	2.10	2.55	3.02	3.02	1.15	3.37	3.45	6.00	
36" Pipe 50 Yr	1	51.0	3.0 ft	3.0 ft	17.00	1.39	4.17	0.20	2.18	2.30	2.65	3.02	3.02	1.15	4.05	4.17	7.22	
36" Pipe 100 Yr	1	59.4	3.0 ft	3.0 ft	19.79	1.60	4.80	0.20	2.90	2.50	2.75	3.02	3.02	1.15	4.77	4.80	8.40	

* From Chart 1 of HDS-5
** From Chart 5 of HDS-5
*** From Chart 4 of HDS-5

CROSS DRAIN ANALYSIS - EXISTING CONDITION

HNTB Corporation
610 Crescent Executive Court, Suite 400
Lake Mary, FL 32746

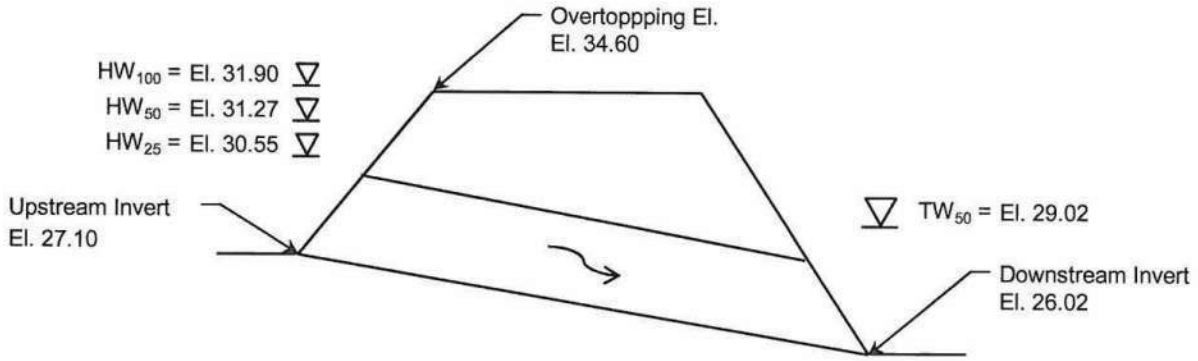
	DATE
made by: LDP	12-Nov-13
checked by: HHJ	7-Apr-14
HNTB job #: 59219	

PROJECT: **I-4 PD&E - Segment 4**

LOCATION: **6.96**

Cross Drain Characteristics:

Number of Barrels:	1	
Cross Drain Shape:	Round	
Manning's "n":	0.022	
Entrance Loss Coef.:	0.20	
Span (B):	3.0 ft	
Height (D):	3.0 ft	
Length (L):	210 ft	
Slope (So):	0.005 ft/ft	
Upstream Invert:	27.10	(NAVD)
Downstream Invert:	26.02	
Overtopping El.:	34.60	
Tailwater El.:	29.02	(Based on crown of pipe)
Description:	36" Pipe	



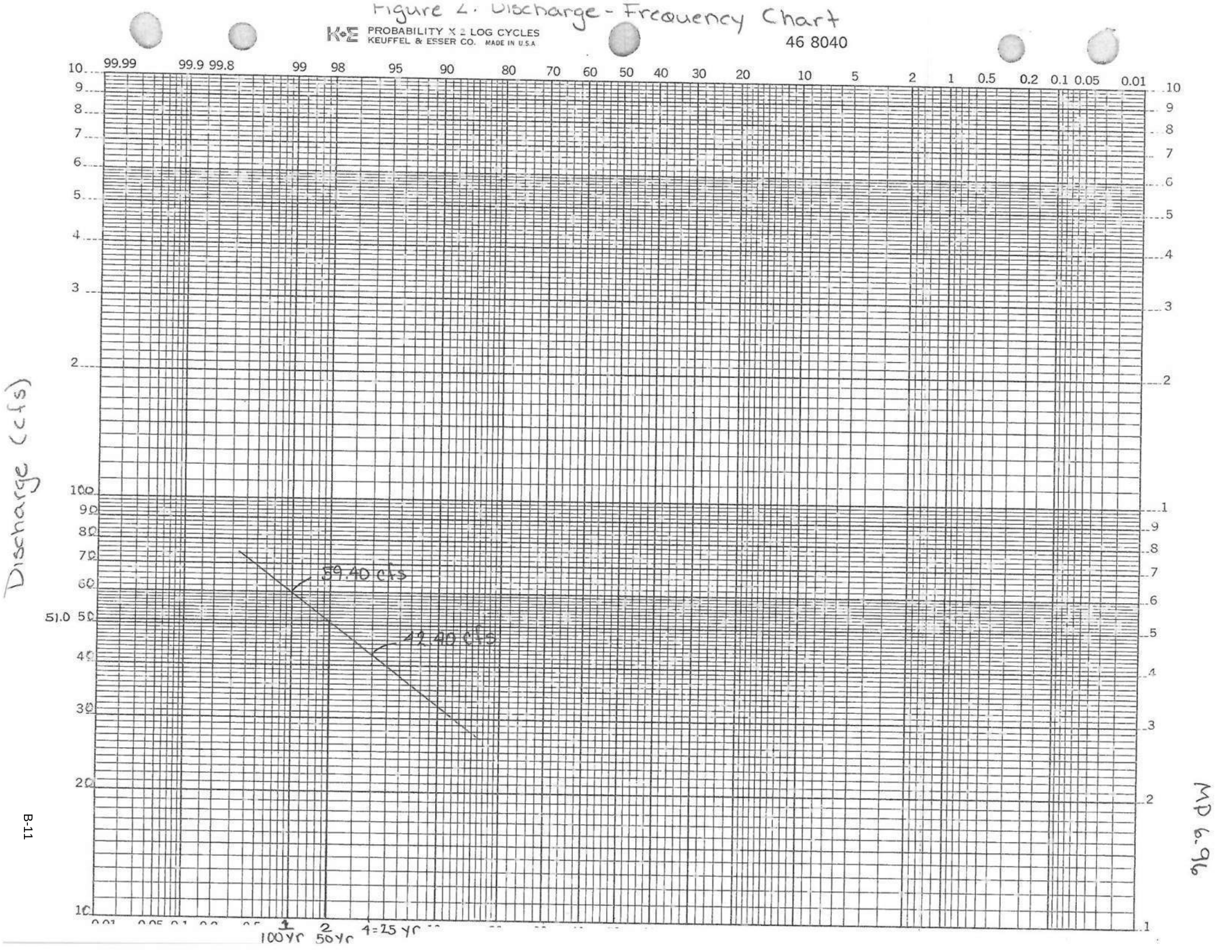
$Q_{25} = V*A = 6 \text{ fps} * (\pi D^2/4) =$ 42.4 cfs

$Q_{100} = 1.4 * Q_{25} =$ 59.4 cfs

Culvert Description	# of Barrels	Q (cfs)	Size		Headwater Computation											Con. HW	Outlet Velocity	Comments
					Inlet Control			Outlet Control HW = H + DTW - LSo										
			D	B	Q/B	HW/D*	HW	Ke	H**	d_c***	$(d_c+D)/2$	TW	DTW	LSo	HW			
36" Pipe 25 Yr	1	42.4	3.0 ft	3.0 ft	14.14	1.15	3.45	0.20	1.49	2.10	2.55	3.00	3	1.08	3.41	3.45	6.00	
36" Pipe 50 Yr	1	51.0	3.0 ft	3.0 ft	17.00	1.39	4.17	0.20	2.18	2.30	2.65	3.00	3	1.08	4.10	4.17	7.22	
36" Pipe 100 Yr	1	59.4	3.0 ft	3.0 ft	19.79	1.60	4.80	0.20	2.80	2.50	2.75	3.00	3	1.08	4.72	4.80	8.40	

* From Chart 1 of HDS-5
** From Chart 5 of HDS-5
*** From Chart 4 of HDS-5

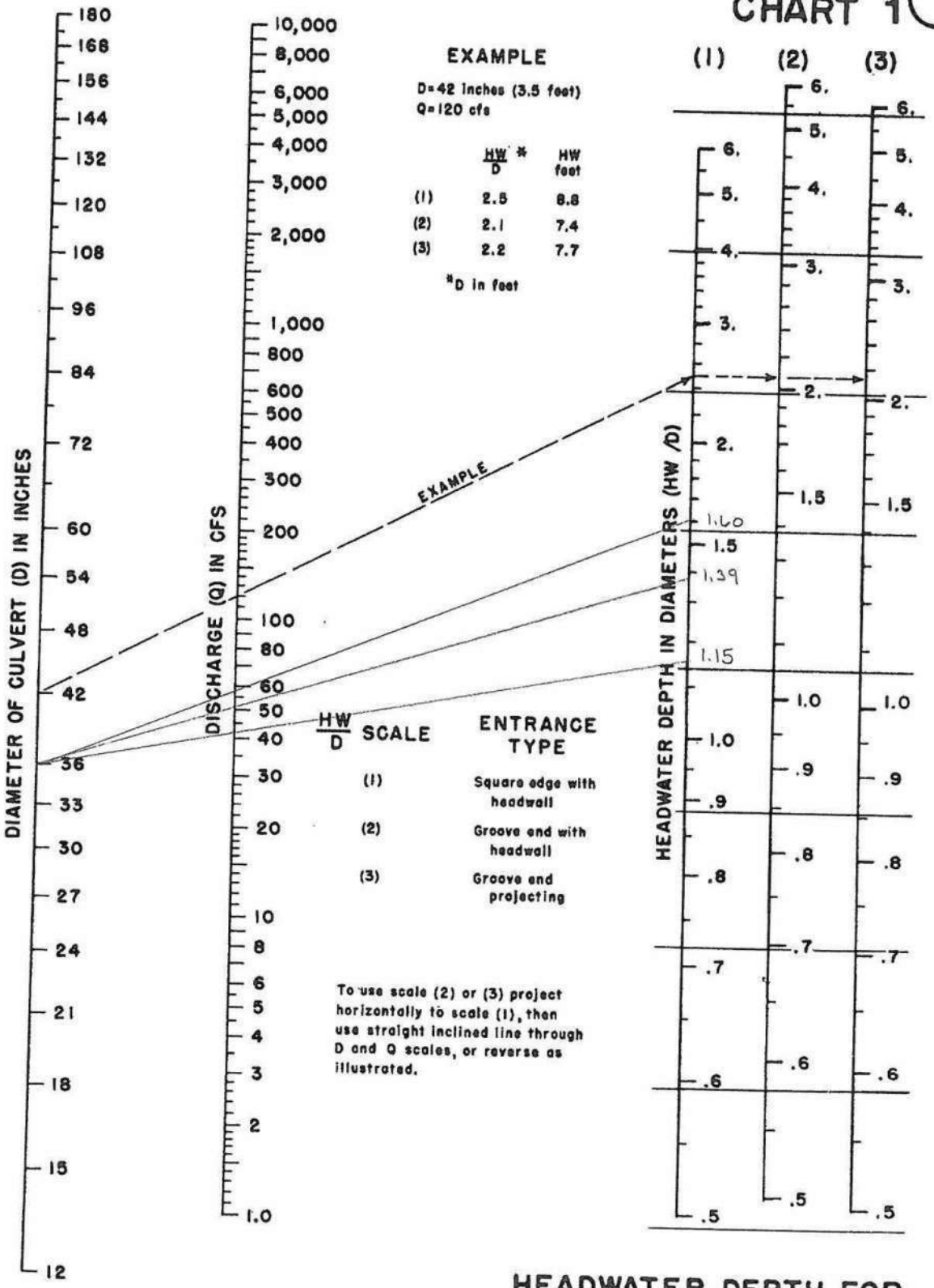
Figure 2. Discharge - Frequency Chart



MD 6-96

MP 6.96

CHART 1

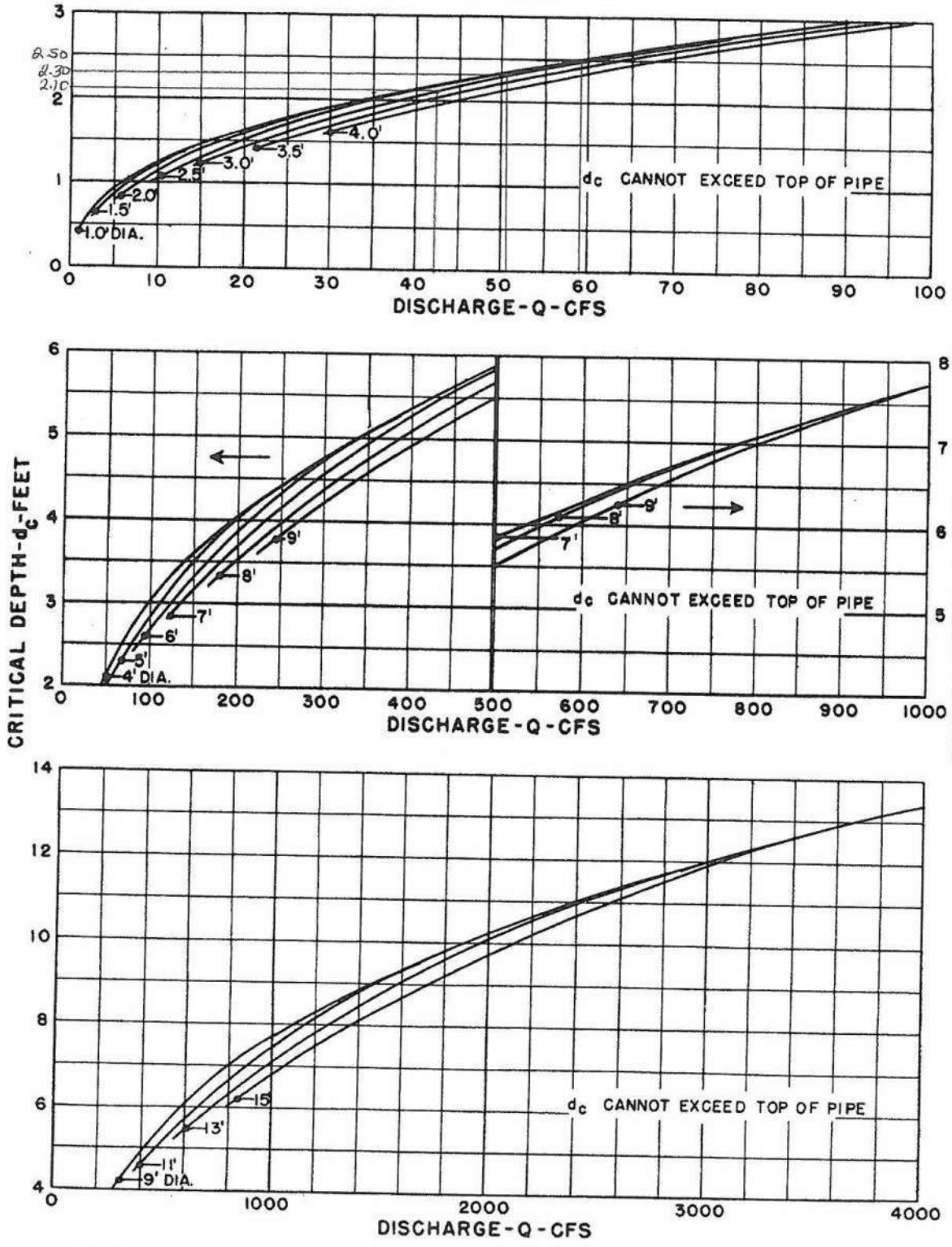


HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

CHART 4



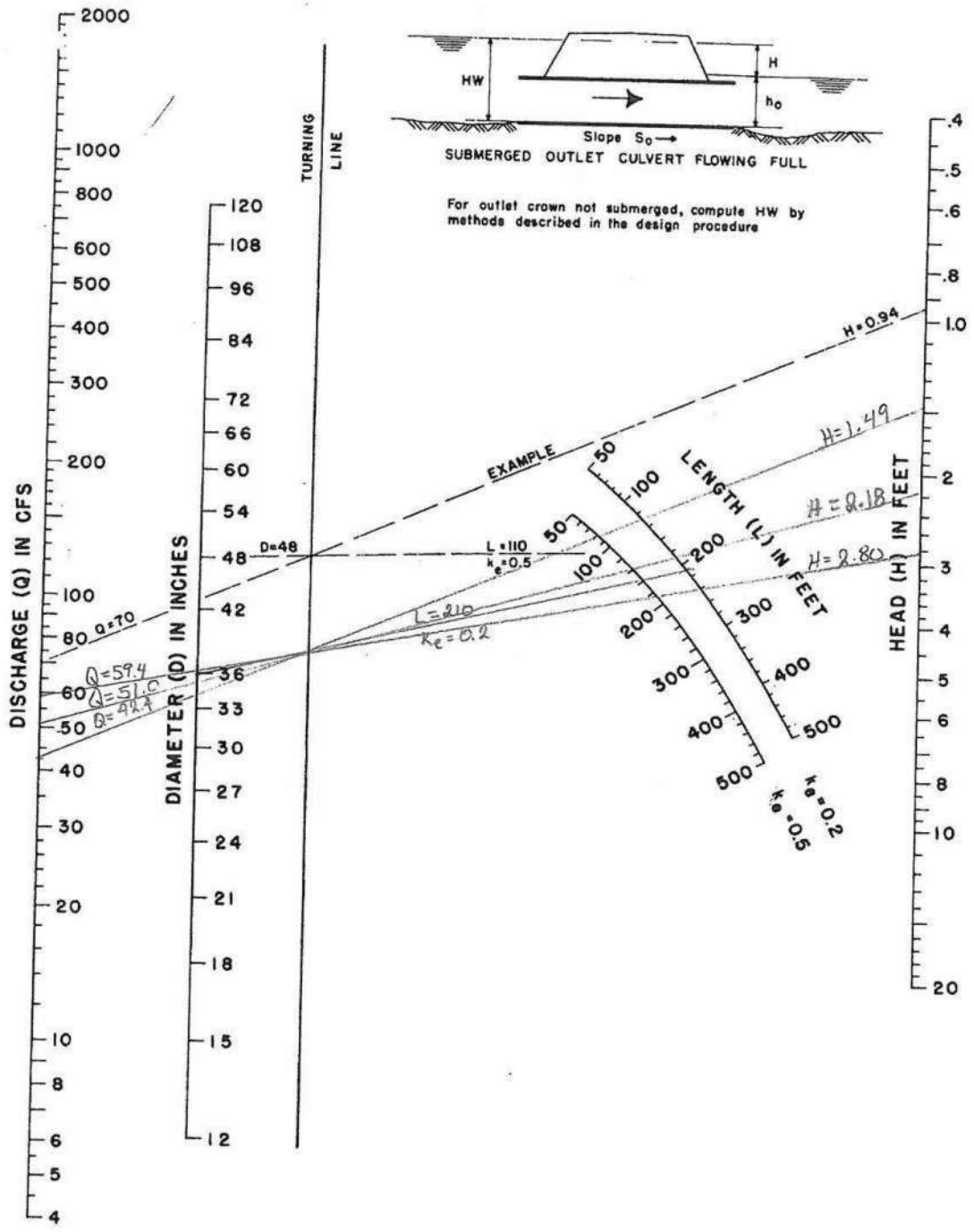
BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

MP 6.96 (Ex)

CHART 5

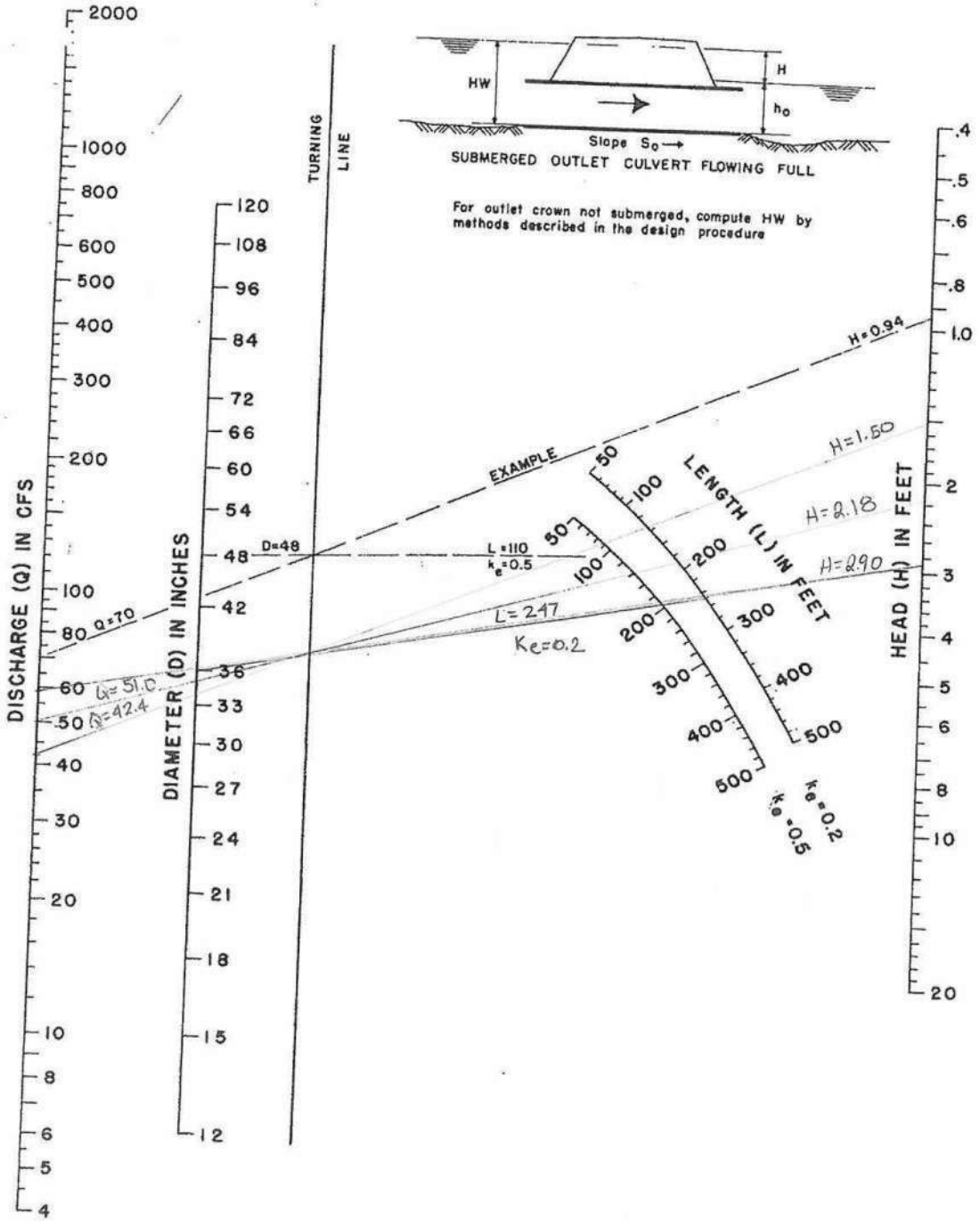


HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL n = 0.012

BUREAU OF PUBLIC ROADS JAN. 1963

MP 6.96 (PR)

CHART 5



BUREAU OF PUBLIC ROADS JAN. 1963

HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL n = 0.012

CROSS DRAIN ANALYSIS - EXISTING CONDITION

HNTB Corporation
610 Crescent Executive Court, Suite 400
Lake Mary, FL 32746

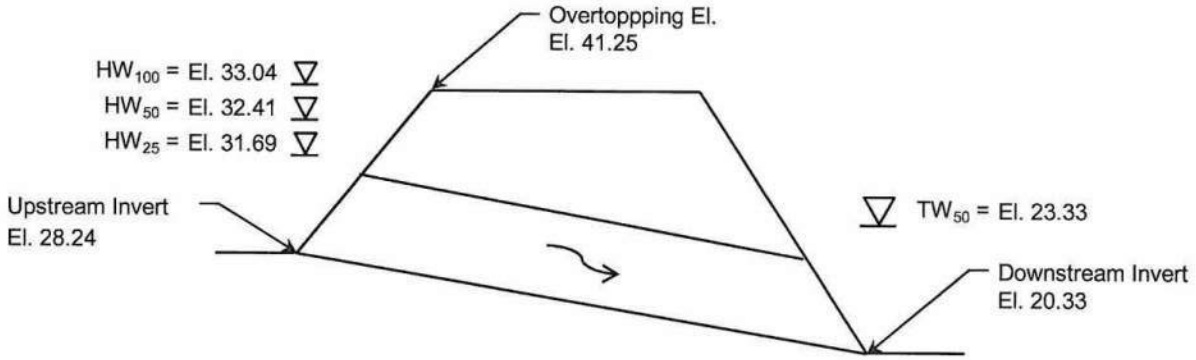
		DATE
made by:	LDP	12-Nov-13
checked by:	HHJ	7-Apr-14
HNTB job #:	59219	

PROJECT: **I-4 PD&E - Segment 4**

LOCATION: **7.556**

Cross Drain Characteristics:

Number of Barrels:	1	
Cross Drain Shape:	Round	
Manning's "n":	0.022	
Entrance Loss Coef.:	0.50	
Span (B):	3.0 ft	
Height (D):	3.0 ft	
Length (L):	237 ft	
Slope (So):	0.0334 ft/ft	
Upstream Invert:	28.24	(NAVD)
Downstream Invert:	20.33	
Overtopping El.:	41.25	
Tailwater El.:	23.33	(Based on crown of pipe)
Description:	36" Pipe	



$Q_{25} = V^*A = 6 \text{ fps} * (\pi D^2/4) =$ 42.4 cfs

$Q_{100} = 1.4 * Q_{25} =$ 59.4 cfs

Culvert Description	# of Barrels	Q (cfs)	Size		Headwater Computation											Con. HW	Outlet Velocity	Comments
					Inlet Control			Outlet Control HW = H + DTW - LSo										
			D	B	Q/B	HW/D*	HW	Ke	H**	d_c***	$(d_c+D)/2$	TW	DTW	LSo	HW			
36" Pipe 25 Yr	1	42.4	3.0 ft	3.0 ft	14.14	1.15	3.45	0.50	1.70	2.10	2.55	3.00	3	7.91	-3.21	3.45	6.00	
36" Pipe 50 Yr	1	51.0	3.0 ft	3.0 ft	17.00	1.39	4.17	0.50	2.50	2.30	2.65	3.00	3	7.91	-2.41	4.17	7.22	
36" Pipe 100 Yr	1	59.4	3.0 ft	3.0 ft	19.79	1.60	4.80	0.50	3.20	2.50	2.75	3.00	3	7.91	-1.71	4.80	8.40	

* From Chart 1 of HDS-5
** From Chart 5 of HDS-5
*** From Chart 4 of HDS-5

CROSS DRAIN ANALYSIS - PROPOSED CONDITION

HNTB Corporation
610 Crescent Executive Court, Suite 400
Lake Mary, FL 32746

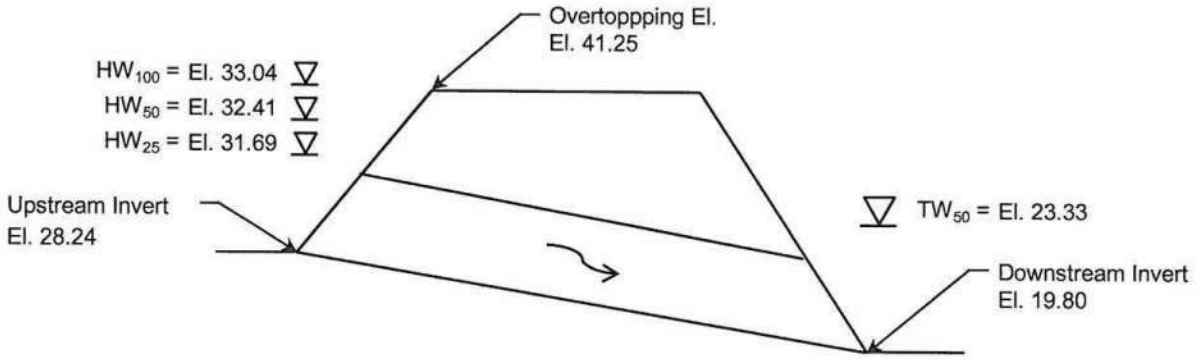
	DATE
made by: LDP	12-Nov-13
checked by: HHJ	7-Apr-14
HNTB job #: 59219	

PROJECT: **I-4 PD&E - Segment 4**

LOCATION: **7.556**

Cross Drain Characteristics:

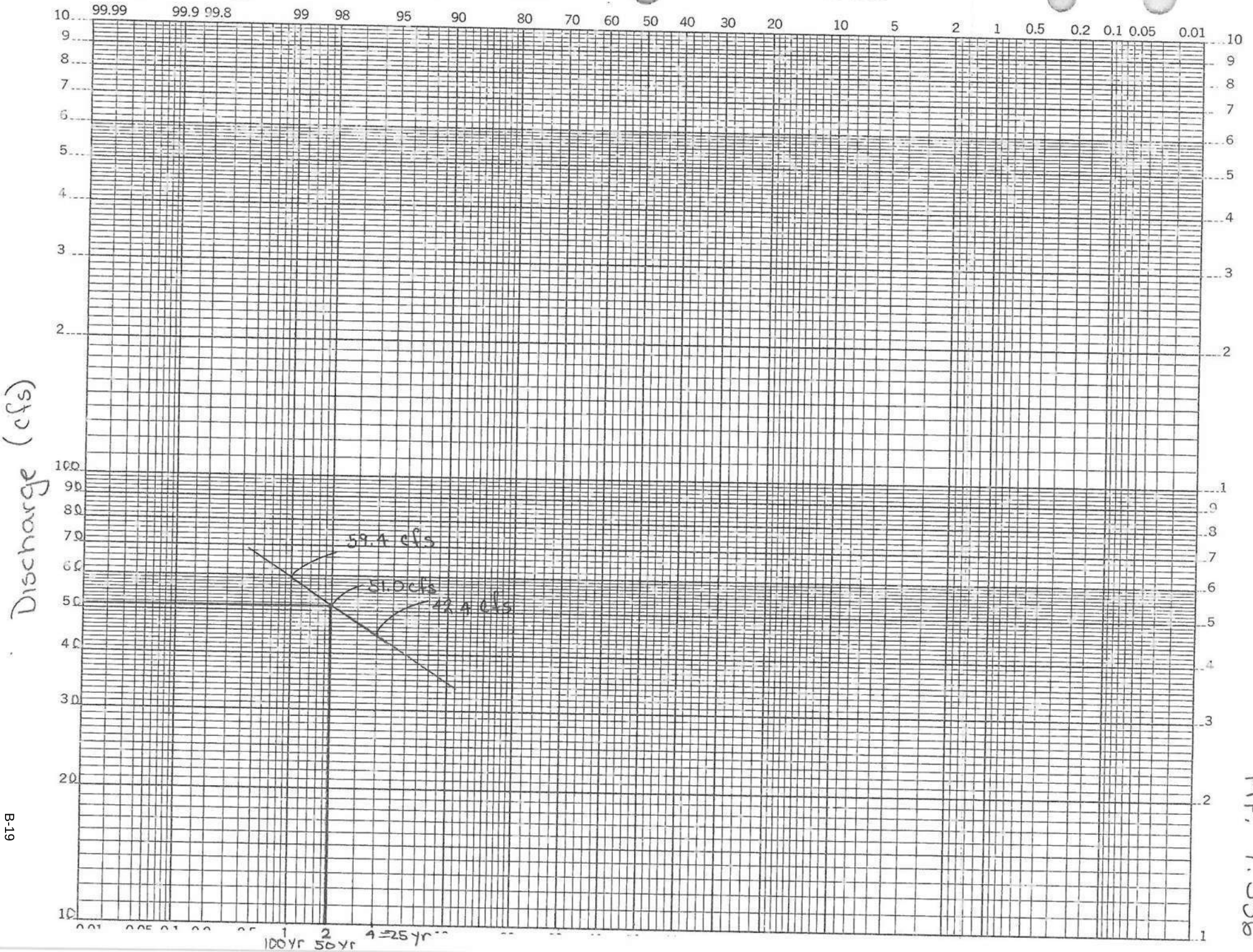
Number of Barrels:	1	
Cross Drain Shape:	Round	
Manning's "n":	0.022	
Entrance Loss Coef.:	0.50	
Span (B):	3.0 ft	
Height (D):	3.0 ft	
Length (L):	253 ft	
Slope (So):	0.0334 ft/ft	
Upstream Invert:	28.24	(NAVD)
Downstream Invert:	19.80	
Overtopping El.:	41.25	
Tailwater El.:	23.33	
Description:	36" Pipe	



Culvert Description	# of Barrels	Q (cfs)	Size		Headwater Computation											Con. HW	Outlet Velocity	Comments
					Inlet Control			Outlet Control HW = H + DTW - LSo										
			D	B	Q/B	HW/D*	HW	Ke	H**	d_c***	$(d_c+D)/2$	TW	DTW	LSo	HW			
36" Pipe 25 Yr	1	42.4	3.0 ft	3.0 ft	14.14	1.15	3.45	0.50	1.80	2.10	2.55	3.53	3.53	8.44	-3.11	3.45	6.00	
36" Pipe 50 Yr	1	51.0	3.0 ft	3.0 ft	17.00	1.39	4.17	0.50	2.58	2.30	2.65	3.53	3.53	8.44	-2.33	4.17	7.22	
36" Pipe 100 Yr	1	59.4	3.0 ft	3.0 ft	19.79	1.60	4.80	0.50	3.40	2.50	2.75	3.53	3.53	8.44	-1.51	4.80	8.40	

* From Chart 1 of HDS-5
** From Chart 5 of HDS-5
*** From Chart 4 of HDS-5

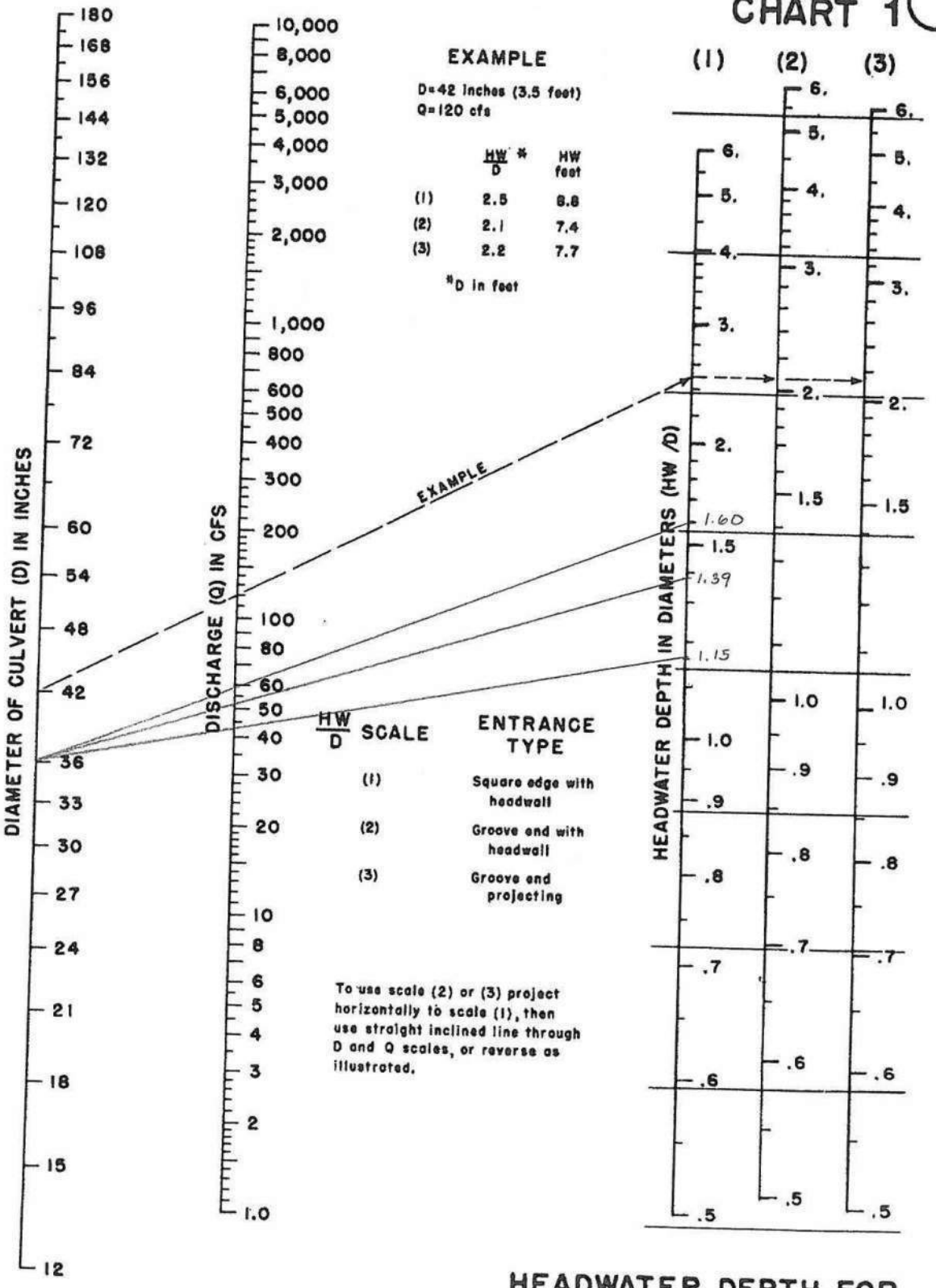
Figure 3: Discharge- frequency Chart



MP. 7.559

MP 7.556

CHART 1

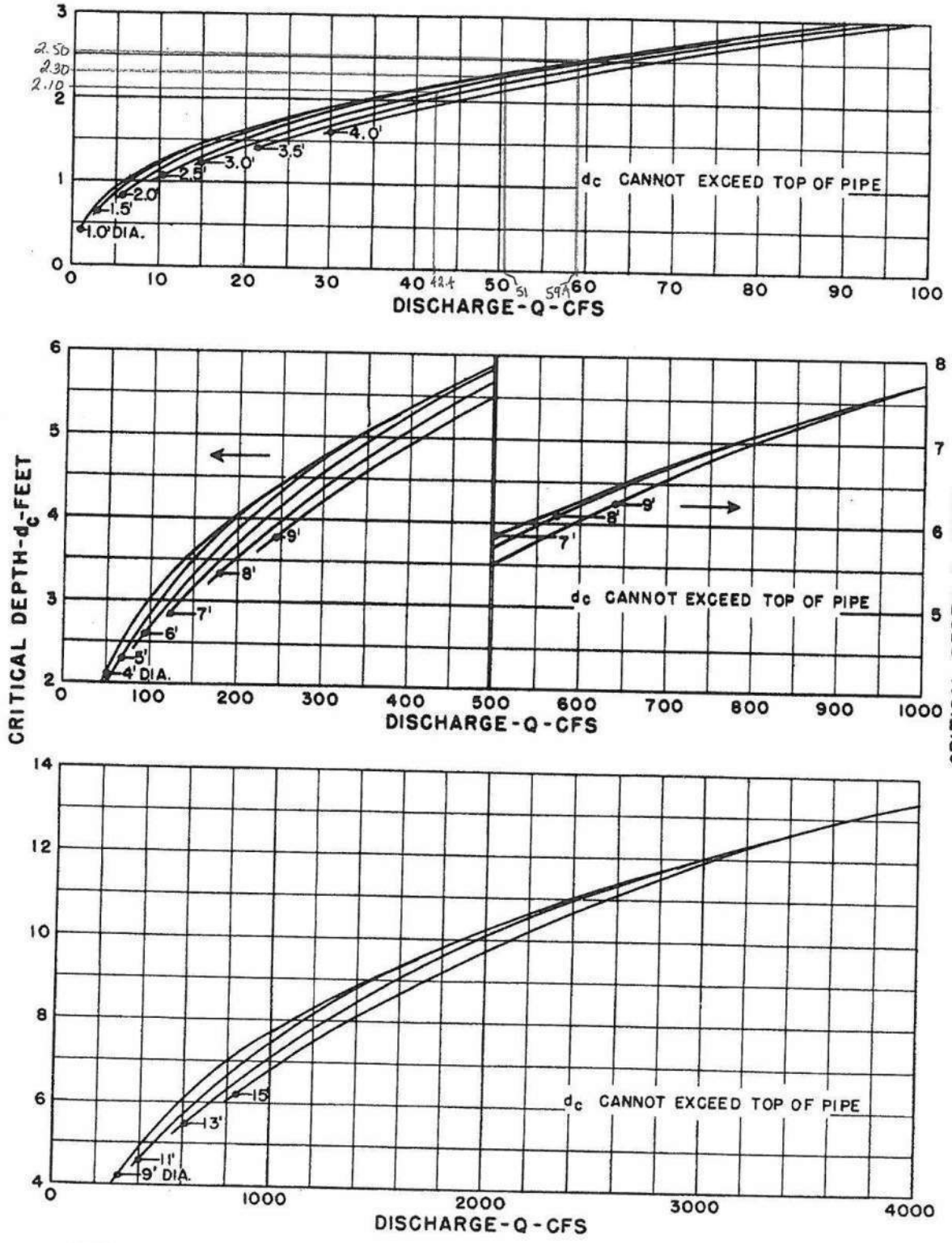


HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

CHART 4



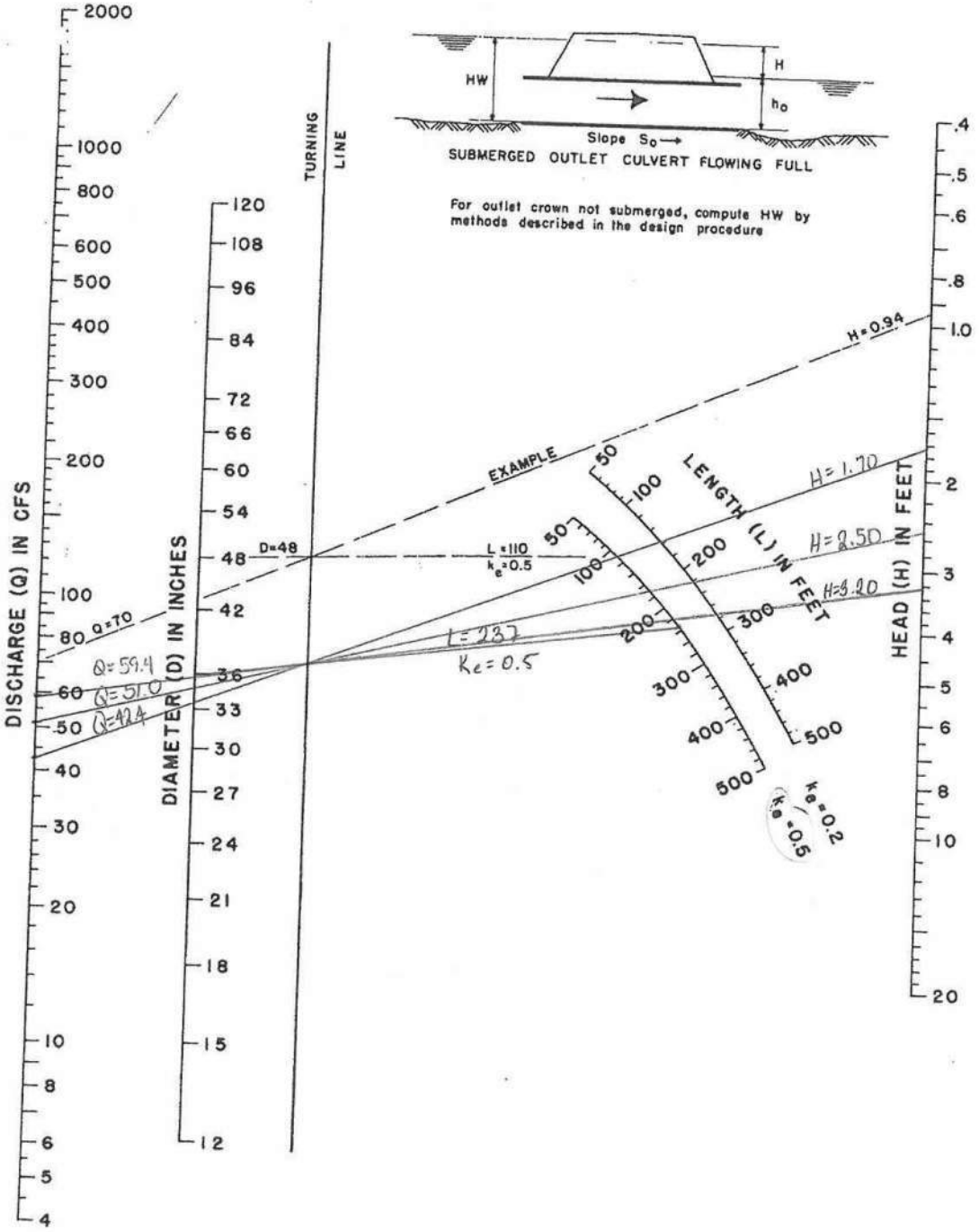
BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

MP 7.556 (Ex)

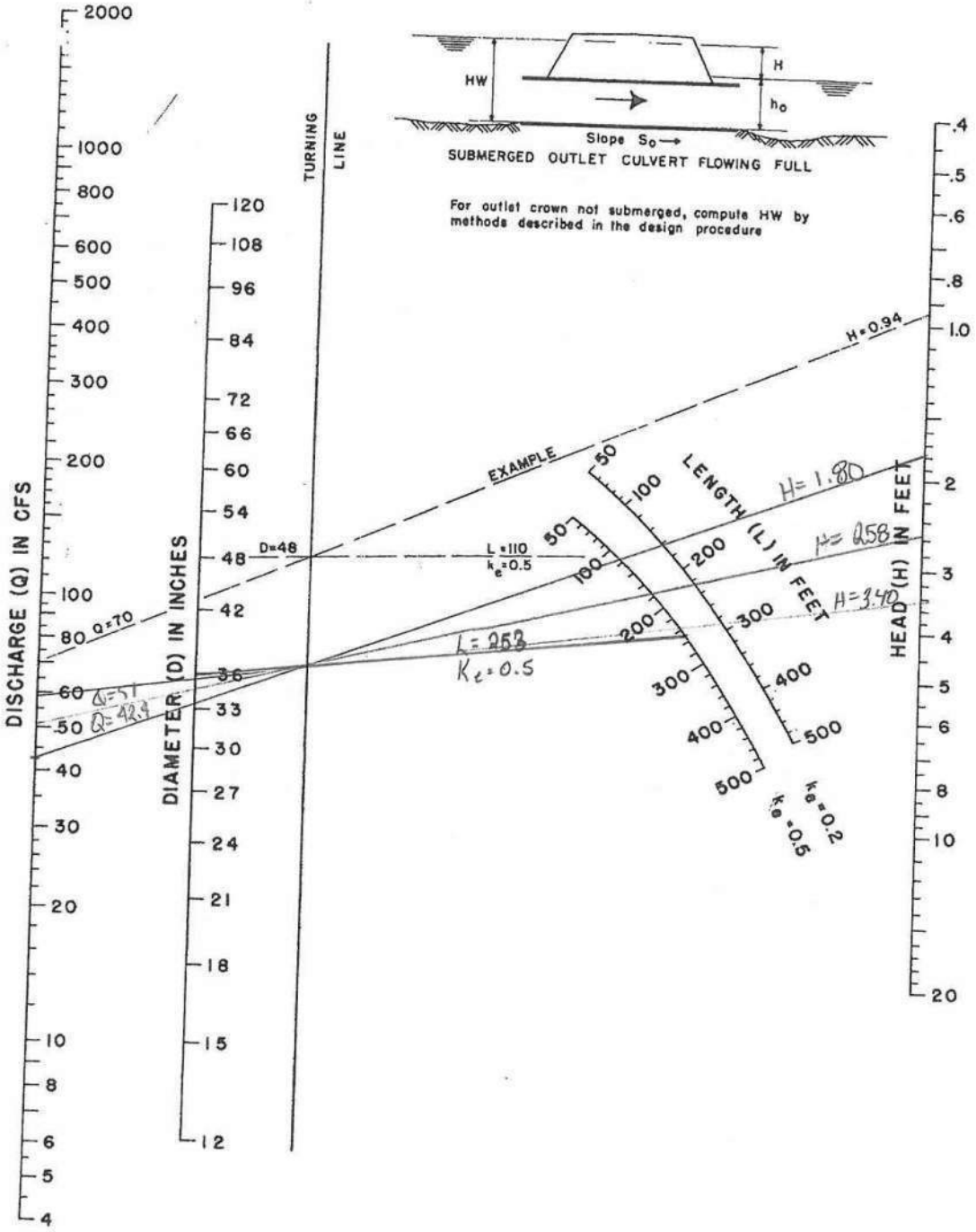
CHART 5



BUREAU OF PUBLIC ROADS JAN. 1963

HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL n = 0.012

CHART 5



BUREAU OF PUBLIC ROADS JAN. 1963

HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL n = 0.012

APPENDIX C –

CORRESPONDENCE

From: Sanam Rai
Sent: Wednesday, October 07, 2015 8:46 AM
To: Luz Phillip
Subject: FW: I4 Segment 4 Cross Drains

From: Meade, Ron [mailto:Ron.Meade@dot.state.fl.us]
Sent: Thursday, January 29, 2015 9:50 AM
To: Sanam Rai; 'Richard Archambault'; Read, James; Golloway, Jeremy
Cc: Kirts, Scott; Snow, Rick; Barry Switzer
Subject: RE: I4 Segment 4 Cross Drains

You are welcome and I've had no known issues at these locations from internal staff.

Thanks,

Ron

Ron J. Meade
Deland Operations Engineer
Office (386) 740-3401
Main (386)740-3400
Cell (386) 956-8959

From: Sanam Rai [mailto:sarai@HNTB.com]
Sent: Thursday, January 29, 2015 9:45 AM
To: 'Richard Archambault'; Read, James; Golloway, Jeremy
Cc: Kirts, Scott; Meade, Ron; Snow, Rick; Barry Switzer
Subject: RE: I4 Segment 4 Cross Drains

All,

Thank you for helping me out with this task.

Ron, thanks again for coordinating and responding so promptly.

Sanam

From: Richard Archambault [mailto:ozzy.archambault@tmeenterprises.com]
Sent: Wednesday, January 28, 2015 3:31 PM
To: 'Read, James'; 'Golloway, Jeremy'
Cc: 'Kirts, Scott'; Sanam Rai; 'Meade, Ron'; 'Snow, Rick'
Subject: RE: I4 Segment 4 Cross Drains

Jim,

I am unaware of any issues with the referenced cross drains. Let me know if you need anything else.

Richard "Ozzy" Archambault
Project Manager – Orlando, Fl.
Office: (407) 730–2232
Cell: (407) 494–9032
Fax: (407) 704–7642
Email: Richard.archambault@tmeenterprises.com

TME ENTERPRISES
INCORPORATED
RIGHT OF WAY MAINTENANCE

From: Read, James [mailto:James.Read@dot.state.fl.us]
Sent: Wednesday, January 28, 2015 2:44 PM
To: Richard Archambault; Golloway, Jeremy
Cc: Kirts, Scott; sarai@HNTB.com; Meade, Ron; Snow, Rick
Subject: FW: I4 Segment 4 Cross Drains

Jeremy, Ozzy

We would like your input as well. Please see below and respond to all. Thanks

James Read
Field Operations Manager
Deland Operations
386-740-3406
M - F 7:00 am to 3:30 pm

FDOT

From: Meade, Ron
Sent: Wednesday, January 28, 2015 1:59 PM
To: Read, James; Snow, Rick; McGhee, William; Woods, Charles
Subject: FW: I4 Segment 4 Cross Drains

Team,
Do we have any known issues at these locations that we can share with these designers?

Ron J. Meade
Deland Operations Engineer
Office (386) 740-3401
Main (386)740-3400

Cell (386) 956-8959

From: Sanam Rai [mailto:sarai@HNTB.com]
Sent: Wednesday, January 28, 2015 1:39 PM
To: Meade, Ron
Cc: Barry Switzer; Luz Phillip
Subject: I4 Segment 4 Cross Drains

Ron,

Attached are the drainage maps that show the existing crossdrains located along the I-4 project limits within Volusia County. I have placed a text note and a pop up note box at each crossdrain location for your reference.

As I mentioned earlier over the phone, I need to know of any issues (flooding, scour, sedimentation) with any of the crossdrains for our Location Hydraulics Report (LHR).

If you have any questions or comments, feel free to email or call me.

Thanks,

Sanam

Sanam Rai, PE
Project Engineer - Drainage

HNTB Corporation
610 Crescent Executive Court, Suite 400
Lake Mary, FL 32746

Tel (407) 805-0355
Direct (407) 547-3025
Fax (407) 805-0227
www.hntb.com

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