Olive Avenue
L303 to Reems Road

Final Design

Drainage Report

Volume 1 of 2

Prepared for:



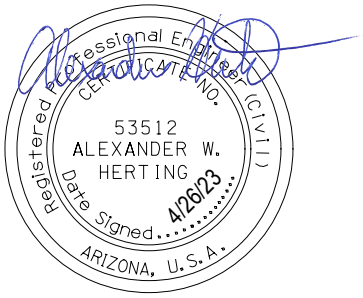

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TABLE OF CONTENTS

1.0 Introduction 1
2.0 Overview 3
3.0 Drainage Design Criteria 7
4.0 Offsite Hydrology 9
5.0 Offsite Hydraulics 16
6.0 Onsite Storm Water 18
7.0 Utility Conflicts 24
8.0 Conclusions 25
9.0 References 26

LIST OF FIGURES

Figure 1-1: Vicinity Map 2
Figure 2-1: Project Limits 5
Figure 4-1: Offsite Watershed 10
Figure 6-1: Olive Avenue Typical Section 18

LIST OF TABLES

Table 3-1: Offsite Drainage Design Criteria 8
Table 4-1: NOAA 14 Rainfall 11
Table 4-2: Design Storm and Discharge Summary 14
Table 4-3: Eastern Offsite Comparison of HEC-1 Discharges 15
Table 6-1: Design Criteria for Onsite Runoff 19

LIST OF EXHIBITS

Exhibit 1 – Eastern Offsite Watershed Map ..... Appendix F
Exhibit 2 – Eastern Offsite Soils Map ..... Appendix F
Exhibit 3 – Eastern Offsite Land Use Map ..... Appendix F
Exhibit 4 – Eastern Offsite HEC-1 Schematic ..... Appendix F
Exhibit 5 – Cotton Lane to Sarival Ave Drainage Areas and Infrastructure Exhibits (1-5) ..... Appendix F
Exhibit 6 – Drywell Exhibit ..... Appendix F
Exhibit 7 – Olive Avenue Channel HEC-RAS Exhibit ..... Appendix F
Exhibit 8 –Sarival Ave to Reems Road Drainage Areas and Infrastructure Exhibits (1-3) ..... Appendix F



TABLE OF CONTENTS (continued)

LIST OF APPENDICES

Appendix A: FEMA Special Flood Hazard Areas
Appendix B: Offsite Hydrology
- **B.1 HEC-1: 100-yr, 6-hr Results**
- **B.2 HEC-1: 100-yr, 24-hr Results**
- **B.3 HEC-1: 50-yr, 6-hr Results**
- **B.4 HEC-1: 50-yr, 24-hr Results**
- **B.5 HEC-1 Input Summary Tables**

Appendix C: Offsite Flow Analyses
- **C.1A HEC-RAS Calculations –Olive Avenue Channel**
- **C.1B HEC-RAS Calculations – Existing Conditions Reems Channel**
- **C.1C HEC-RAS Calculations – Proposed Conditions Reems Channel**
- **C.1D Culvert Calculations**
- **C.2 Channel and Ditch Calculations**

Appendix D: Onsite Collection and Conveyance Systems
- **D.1 Rational Method Calculations**
- **D.2 First Flush and Retention Basin Calculations**
- **D.3 Inlet Calculations**
- **D.4 StormCAD Hydraulic Calculations and Profiles**
- **D.5 Erosion Protection Summary**

Appendix E: Drainage Plans (half-size)
Appendix F: Drainage Exhibits

LIST OF ABBREVIATIONS

ADMP .....Area Drainage Master Plan
ADMPU .....Area Drainage Master Plan Update
ADOT .....Arizona Department of Transportation
BFE's ..... Base Flood Elevations
CIP .....Capital Improvement Project
COEM ..... City of El Mirage
COG .....City of Glendale
DDMSW ..... Drainage Design Management System for Windows
District..... Flood Control District of Maricopa County
FEMA .....Federal Emergency Management Agency
(H:V) .....Horizontal to Vertical Ratio
I-10 .....Interstate 10

TABLE OF CONTENTS (continued)

LIST OF ABBREVIATIONS (continued)

I-17 ..... Interstate 17
MAG ..... Maricopa Association of Governments
MCDOT ..... Maricopa County Department of Transportation
MWD ..... Metro Water District
NOAA ..... National Oceanic and Atmospheric Administration
NRCS ..... Natural Resources Conservation Service
R/W ..... Right-of-Way
SR ..... State Route
Tc ..... Time of Concentration
US-60 ..... Grand Avenue

1.0 Introduction

1.1 Project Introduction

The Maricopa Department of Transportation (MCDOT) is the lead agency undertaking improvements along Olive Avenue between Cotton Lane and Reems Road (MCDOT Project Number TT0561). The project was originally broken into two separate projects (Cotton Lane to Sarival Avenue and Sarival Avenue to Reems Road). However, the two projects were combined into one project. Therefore two drainage report volumes were created to encompass the entirety of the project:

- Volume 1 – Cotton Lane to Sarival Avenue, with select calculations (storm drain/offsite channel calculations) provided to Reems Road
- Volume 2 – Sarival Avenue to Reems Road

Olive Avenue is a prominent east-west roadway in the central portion of Maricopa County connecting the White Tank Mountain Regional Park to north-south routes such as State Route (SR) 303L, SR 101L, Grand Avenue (US-60) and Interstate-17 (I-17). With continued growth and development in the western valley, it is anticipated that increasing traffic demands will necessitate improvement of Olive Avenue to a major thoroughfare. The long-range traffic forecasts of the Maricopa Association of Governments (MAG) traffic model were calibrated to include data from the Northern Parkway Design Concept Report. The projected capacity requirements indicate that Olive Avenue should be designed as an ultimate four-lane facility by 2032.

The primary purpose of this project is to increase vehicular capacity along the roadway through construction of additional travel lanes, widening intersections to their ultimate widths and reducing the risk of roadway flooding.

1.2 Project Background

The area surrounding Olive Avenue is primarily active agricultural fields with a few commercial properties and State Route 303 infrastructure. When fully built-out, the need for ultimate (4-lane) improvements along Olive Avenue between Cotton Lane and Reems Road has been recommended as part of MCDOT's and the City of Glendale's long range planning.

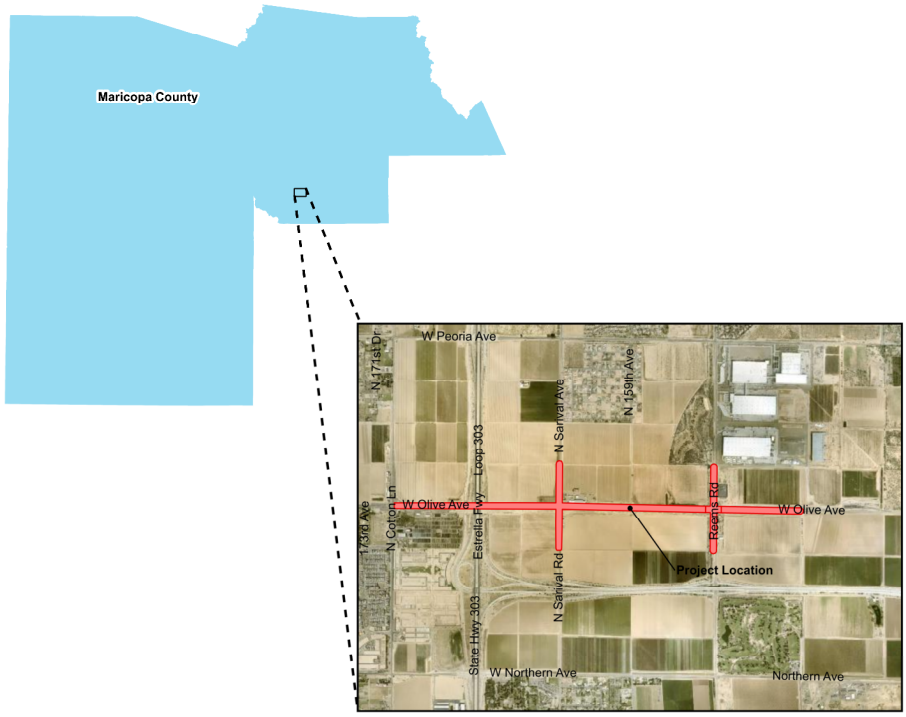
Under existing conditions Olive Avenue is a 2-lane roadway without curb or gutter. The primary goals of the final design and construction project will be to provide a roadway of uniform cross-section to a design standard that meets the future travel demands of this area.

In addition to the roadway improvements, the offsite drainage reaching Olive Avenue is also incorporated into the project design. Flows in this region generally flow to the southeast. Offsite flows are proposed to be collected, channelized and discharged at specified outfalls to protect the Burlington Northern Santa Fe (BNSF) railroad, Olive Avenue and Sarival Avenue from overtopping. In addition, Olive Avenue will maintain the existing roadway profile as close as possible.

1.3 Project Location

The project is located along Olive Avenue between Cotton Lane and Sarival Avenue in central Maricopa County within township and range T3N, R2W, between section lines 25 and 36. The length of the project along Olive Avenue is approximately 7,000 feet, originating 200-feet east of the Olive Avenue and Cotton Lane intersection and tying into the existing roadway approximately ½ mile east of the Sarival Avenue intersection. Improvements at Sarival Avenue extend approximately ½ mile north and south. **Figure 1-1** depicts the approximate project limits.

Figure 1-1 – Vicinity Map



1.4 Existing Features

The existing corridor consists of a two-lane paved roadway adjacent to vacant land, residential communities and one commercial site. The existing half-street right-of-way (R/W) along Olive Avenue is approximately 33 feet where proposed or existing developments have dedicated the ultimate R/W adjacent to the property's frontage. In the MCDOT Major Streets and Routes Plan, Olive Avenue is classified as an urban minor arterial.

2.0 Overview

This report documents the drainage improvements for Olive Avenue from Cotton Lane to ½ mile east of Sarival Avenue (Volume 1). It also includes the offsite channel to Reems Road and storm drain calculations. Volume 2 is from Sarival Avenue to Reems Road. The purpose of this study is to: (1) Provide an overview of the drainage conditions affecting the Olive Avenue project alignment;(2) Perform site reconnaissance and compile background data; (3) Review and compare results of previous hydrologic studies; (4) Perform an up-to-date project specific hydrologic analysis referencing previous drainage studies to determine offsite storm water flows; (5) Evaluate onsite roadway storm water flows; (6) Determine the type and combination of drainage facilities required to handle offsite and onsite flows; and (7) Provide hydraulic calculations for existing and proposed offsite infrastructure, onsite culverts, ditches, storm drains, catch basins and retention areas to safely handle storm water flows.

2.1 Previous Studies

Previous studies in the area include:

- *Loop 303/White Tanks Area Drainage Master Plan Update Hydrologic Analysis (ADMPU). HDR Engineering, Inc. August 20, 2009.*
- *Loop 303/White Tanks Area Drainage Master Plan Update: Phase 1 – Update the Existing Hydrology Model – Final Hydrology Report, Parsons Brinckerhoff, July 2015.*

The **Loop 303/ White Tanks Area Drainage Master Plan** (ADMP) was originally completed in 2009 by HDR and has been recently updated in a Final Hydrology Report by Parsons Brinckerhoff in July of 2015 and defines the contributing offsite watershed to Olive Avenue. The updated HEC-1 model was used as the basis for calculating offsite flows. The Loop 303/White Tanks ADMP Final Hydrology Report updated the offsite hydrology to incorporate Capital Improvement Projects (CIP) including the completion of the State Route 303 Freeway (L303) from US 60 to Interstate 10 (I-10) and the Flood Control District of Maricopa County's (District) Loop 303 Outfall Drainage System from Woodlands Avenue to the Gila River. An optional task including the addition of Arizona Department of Transportation (ADOT) basins within Suncor properties was also included in the model.

- *Olive Avenue – Citrus Road to El Mirage Road (TT404), Technical Memorandum No. 5: Preliminary Drainage Report (Scoping Document). J2 Engineering and Environmental Design for NFra Inc. June 9, 2014.*

The **Olive Avenue – Citrus Road to El Mirage Road (TT404) Technical memorandum No. 5: Preliminary Drainage Report** prepared by J2 Engineering for NFra Inc. documents the seven-mile corridor along Olive Avenue from Citrus Road to El Mirage Road with the evaluated alternatives based on offsite and onsite drainage concepts. Concept plans were prepared for four main concepts, A, B, C and D. Concepts A, B and C collect and convey offsite flows to outfall locations. From Citrus Road to Cotton lane, a trapezoidal channel is proposed north of Olive Avenue to convey offsite flows. From Cotton Lane to the SR 303L Channel, an offsite channel is proposed on the south side of Olive Avenue. The recommended concept is D, which provides

drainage solutions at the lowest cost and maintains existing drainage patterns upstream and downstream of Olive Avenue.

Based on the scoping document, offsite flows are allowed to overtop the roadway in the same manner as the existing condition. Overtopping depths for the 100-year storm are to be limited to 0.5 feet in depth and the existing roadway profile is to be maintained as much as possible. Onsite concepts are similar for all concepts and consist of first flush basins/ditches north and south of Olive Avenue. Where existing development is present, 100-year 2-hour retention basins are proposed.

- *Final Drainage Report – SR 303L Glendale Ave. to Peoria Ave. (TRACS NO. H7874 01 C) Michael Baker Jr., Inc. June 2011.*

The final drainage report includes the offsite hydrology and hydraulic analysis for the regional L303 channel on the west side of the L303 freeway. The segment ultimately connects to other segments of the channel, creating a continuous regional channel with an ultimate outfall at the Gila River.

The L303 regional channel has been designed based on the Loop 303/White Tanks ADMPU Area Drainage Master Plan Update and is sized for the 100-year, 24-hour storm event. The regional channel is designed to collect offsite flows from the west before impacting the proposed freeway. At Olive Avenue, an existing 3-barrel 10-foot by 6-foot box culvert is designed to convey 1,742 cfs. A HEC-RAS analysis was provided in the report, where the high water elevation was used as a tailwater condition for the proposed offsite storm drain system described in **Section 5** of this report.

- *TT0497: Olive Avenue – Citrus Road to Cotton Lane – Final Design Drainage Report, TY Lin Internationa, May 12, 2017.*

The TT0497 Olive Avenue Final Drainage Report documents the existing and proposed offsite and onsite stormwater infrastructure along Olive Avenue from Citrus Road to Cotton Lane. The proposed improvements consist of first flush and retention basins, onsite ditches, culverts and overtopping analyses. A proposed channel east of Cotton Lane with a 50-year flow of 204.4 cfs ties into the TT0561 project and requires design to convey flows to the L303 regional channel.

2.2 Existing Conditions

The project extends along Olive Avenue approximately 200 feet east from the centerline of Cotton Lane to about ½ mile east of the centerline of Sarival Avenue (Volume 1). Volume 2 covers Sarival Avenue to ½ mile east of Reems Road. These limits are shown graphically in **Figure 2-1**. Olive Avenue exists as a rural two lane road without curb and gutter between Cotton Lane and Sarival Avenue. Existing offsite drainage crossings exist at the L303 freeway, where a regional channel and box culvert parallel the freeway and at the Sarival Avenue and Olive Avenue intersection. Currently offsite flows overtop the BNSF railroad west of Sarival Avenue, continuing to the east along the northern portion of Olive Avenue, eventually reaching the Reems Road channel. Based on the Loop 303/White Tanks Area Drainage Master Plan Update by Parsons Brinckerhoff, the contributing watershed west of the L303 freeway is

approximately four square miles and approximately 0.9 square miles east of the L303 freeway (see **Figure 4-1**).

Figure 2-1 – Project Limits



2.3 Federal Emergency Management Agency (FEMA) Special Flood Hazard Areas

A review of the effective Flood Insurance Rate Map (Map No. 04013C1660L found in **Appendix A)** indicates that the project lies within a shaded Zone X which is described as:

> An area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods. It is also used to designate base floodplains of lesser hazards, such as areas protected by levees from the 100-year flood, or shallow flooding areas with average depths of less than one foot or having drainage areas less than 1 square mile.

The existing flow patterns are proposed to be maintained throughout this project.

2.4 Partnering/Stakeholders

2.4.1 Arizona Department of Transportation (ADOT)

The Olive Avenue corridor travels underneath L303, which is a north/south freeway. Currently there are not any existing connections from Olive Avenue to the L303 freeway. However, the

proposed Olive Avenue improvements has been aligned to accommodate a future conceptual traffic interchange planned by ADOT.

ADOT operates a regional channel collecting offsite runoff west of the L303 freeway. An existing 3-barrel 10-ft x 6-ft box culvert crosses Olive Avenue with an existing peak discharge of 1,742 cfs. An encroachment permit will be needed from ADOT to connect a new offsite storm drain to the box culvert.

2.4.2 City of Glendale

The City of Glendale has future annexation plans for the Olive Avenue corridor. It is anticipated that the City will take over long term maintenance of the roadway and associated drainage facilities when the corridor is annexed.

2.4.3 Maricopa Water District (MWD)

There has been ongoing coordination with MWD regarding the existing and active irrigation facilities along Olive Avenue between Cotton Lane and Sarival Avenue that are owned and operated by MWD. The irrigation water flows from west to east starting from the Beardsley Canal, which is approximately 2.5 miles west of the Cotton Lane/Olive Avenue intersection. MWD facilities are located along the south side of the road and generally consist of concrete-lined channels varying from 10 feet to 16 feet from the edge of pavement to the edge of the ditch. The existing ditches are part of MWD's 'Lateral Number 9' system. Although the ditches exist within the existing MCDOT R/W, MWD has prior rights for all of their facilities. The existing concrete ditches on the south side of Olive Avenue are currently proposed to be converted to an underground piping system when Olive Avenue is improved.

2.4.4 Private Irrigation Systems

Private irrigation systems are present within the Olive Avenue corridor that include existing channels, small wells, underground conveyance pipes and drains both north and south of Olive Avenue. It is anticipated that the existing infrastructure impacted by the Olive Avenue improvements will be replaced in kind on the existing properties.

2.4.5 BNSF Railroad

There has been ongoing coordination with BNSF regarding an existing at-grade railroad crossing at the Olive Avenue/Sarival Avenue intersection that will be impacted by the improvements. The location is at Olive Avenue approximate station 216+30. This at-grade crossing is proposed to be kept intact and improved as part of the roadway improvements.

2.4.6 Local Businesses

G Farms is located along the east side of Sarival Avenue just north of the BNSF Railroad and Olive Avenue intersection. G Farms grows numerous crops such as onions, potatoes and watermellons along with hay and specialized pellets for animals. The business currently has an east-west railroad spur adjacent to Olive Avenue that will not be impacted. Coordination and construction phasing with this business owner is planned to not disrupt their business operations.

3.0 Drainage Design Criteria

The following publications provide the County's Design Standard Criteria:

1. Drainage Policies and Standards Manual for Maricopa County, Arizona (Revised Draft). January 2018.
2. Flood Control District of Maricopa County. Drainage Design Manual for Maricopa County, Arizona, Volume I: Hydrology. August 15, 2018.
3. Flood Control District of Maricopa County. Drainage Design Manual for Maricopa County, Arizona, Volume II: Hydraulics. August 15, 2018.
4. Flood Control District of Maricopa County. Drainage Design Manual for Maricopa County, Arizona, Volume III: Erosion Control. August 15, 2018.
5. Maricopa County Roadway Design Manual, 2023.

The design of Olive Avenue was prepared using the following list of specific design criteria referenced from the design manuals identified above.

Table 3-1 Offsite Drainage Design Criteria

Criteria	Criteria Value	Reference
Offsite Hydrology:		
HEC-1 (Unit Hydrograph Method)	Larger of 6-hr or 24-hr storm using Clark Unit Hydrograph	Drainage Policies and Standards Manual (FCDMC)
Culverts: (Arterial/All Weather Streets) **Note:** 50 and 100-year storms are also applicable to driveway culverts when headwater impacts the subgrade of adjacent arterial streets		
50-year storm	Water surface to stay below lowest adjacent subgrade	Drainage Policies and Standards Manual (FCDMC)
100-year storm	Water depth in travel lane not to exceed 6 inches	Drainage Policies and Standards Manual (FCDMC)
Offsite Roadside Channels: (Adjacent to Arterial/All Weather Access Streets)		
50-year storm	Water surface to stay below lowest adjacent subgrade	Drainage Policies and Standards Manual (FCDMC)
100-year storm	Water depth in travel lane not to exceed 6 inches	Drainage Policies and Standards Manual (FCDMC)
Pipe Culvert Sizes:		
Roadway	24-inches minimum	Roadway Design Manual (MCDOT)
Driveway	18-inches minimum	Roadway Design Manual (MCDOT)
Box Culvert	4-ft minimum height (in desert wash areas, 5-ft minimum height is preferred with 6 inches buried below existing flow line)	Roadway Design Manual (MCDOT)
Maximum Allowable Velocities:		
Culverts	15.0 feet per second	Drainage Policies and Standards Manual (FCDMC)
Channel Side Slopes:		
Roadside Channels	6:1 foreslopes within the clear zone area; 4:1 otherwise	Roadway Design Manual (MCDOT)
Erosion Protection Requirements:		
Culvert Outlet	When outlet velocity exceeds allowable downstream channel velocity	Drainage Policies and Standards Manual (FCDMC)
Roadside Earthen Channel	When channel flow velocity exceeds allowable maximum channel velocity	Drainage Policies and Standards Manual (FCDMC)

4.0 Offsite Hydrology

Two existing offsite watersheds contribute to Olive Avenue from Cotton Lane to Sarival Avenue, which is separated by the L303 freeway. West of the L303 freeway, offsite flows travel southeast from the White Tanks Mountain/McMicken Dam with multiple outfalls into a concrete-lined regional channel west of the L303. East of the L303 freeway, offsite flows travel southeast from the L303 freeway, with outfalls along the Northern Parkway Channel south of Olive Avenue and Reems Road Channel to the east. For a description of the offsite watershed from Sarival Avenue to Reems Road, please refer to Volume 2 – Sarival Avenue to Reems Road.

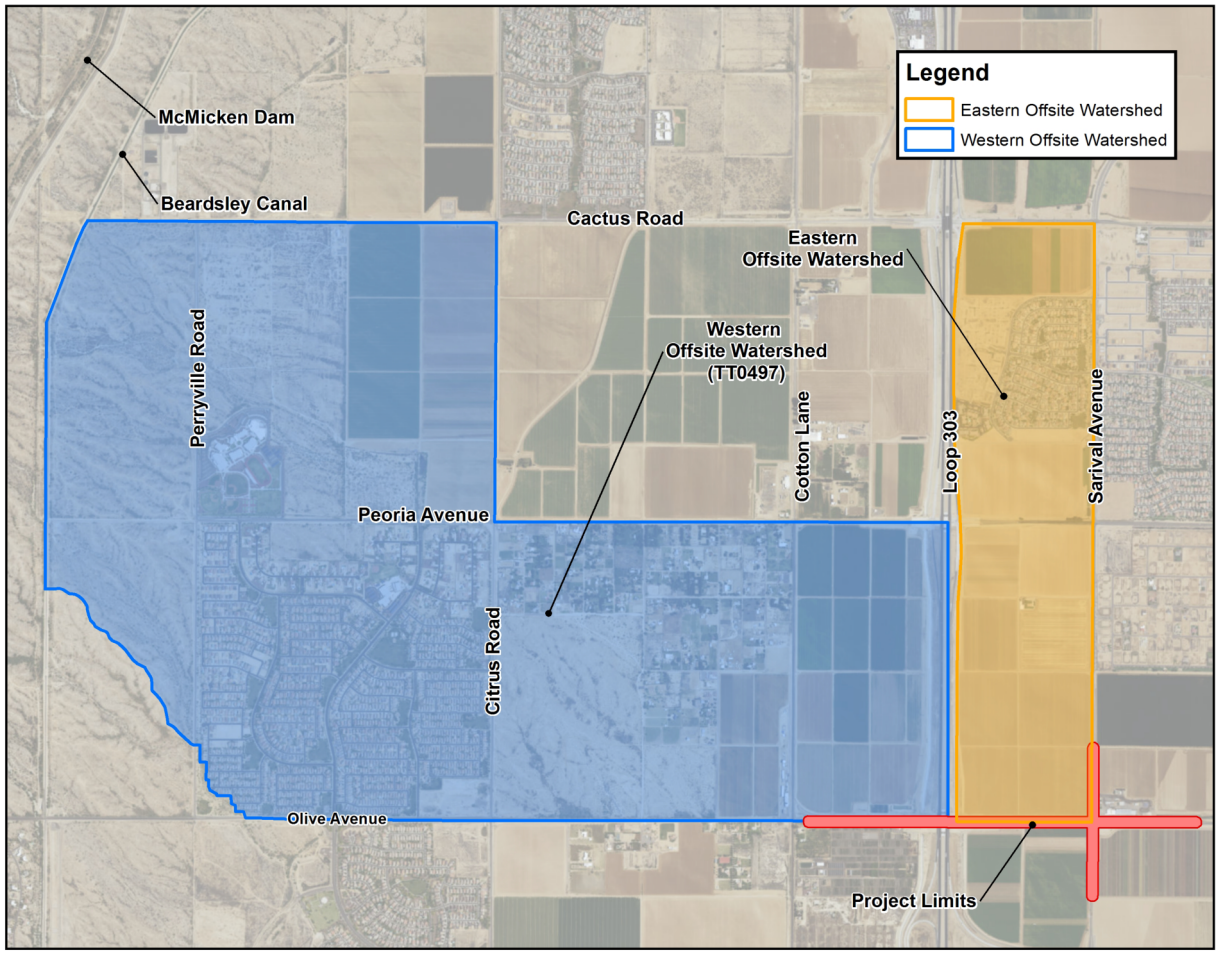
The overall watershed has been modeled and documented in the Loop 303 /White Tanks ADMPU Area Hydrologic Analysis and encompasses both contributing watersheds, which was originally prepared by HDR, Inc. in August of 2009 and was recently updated by Parsons Brinckerhoff (PB) in July of 2015. The hydrologic modeling software used for the watershed was completed using the Army Corps of Engineers Hydrologic Engineering Center's HEC-1 modeling program version 4.1. The overall study area consists of approximately 238 square miles divided into two major basins.

PB updated the major basin which incorporates the offsite watershed to Olive Avenue from Cotton Lane to Sarival Avenue. For the offsite watershed west of the L303, TY Lin International updated PB's Existing Conditions with completed CIP's HEC-1 model for the MCDOT TT0497 project (Olive Avenue, Citrus Road to Cotton Lane), identifying contributing subbasins along Olive Avenue and further defining concentration points, flow splits and routes based on a site visit, offsite topography and project survey. The storm event modeled was the 100-year 24-hour storm using the S-graph unit hydrograph. Land use, rainfall data, subbasins, routes, storage areas, diversions and concentration points were not modified from PB's 'Existing Conditions with Completed CIP's' HEC-1 model except as documented in the TT0497 Olive Avenue Final Drainage Report.

East of the L303 freeway, a new HEC-1 model was used to delineate the contributing offsite watershed to Olive Avenue from the L303 freeway to Sarival Avenue. Aerial photography, contours, land use and soil shapefiles were used with ESRI ArcMap 10.1 to determine and generate updated flow splits, ratio of conveyance and subbasin parameters. The District's Drainage Design Management System for Windows (DDMSW) program was used to develop the HEC-1 model using Clark unit hydrograph and Green-Ampt methods.

Digital copies of the TY Lin's and PB's original HEC-1 files, schematics and reports can be viewed in the **CD** in the back pocket of the report.

Figure 4-1 – Offsite Watershed



4.1 Parameter Estimation

4.1.1 Drainage Area Boundaries

The majority of the watershed is located within unincorporated Maricopa County jurisdiction. However, the City of Glendale boundary is south of the Olive Avenue existing right-of-way from the L303 freeway to Reems Road. The City of Glendale also has plans to annex the Olive Avenue project area based on their 2025 Municipal Planning Area. The western offsite watershed is generally bounded by the Beardsley Canal and McMicken Dam to the West, Cactus Road/Peoria Avenue to the north, the L303 Freeway and drainage channel to the east and farmland and existing residential properties to the south. The eastern offsite watershed is bounded by the L303 to the west, Cactus Road to the north, Sarival Avenue to the east and farmland/BNSF railroad to the south. Storm water generally flows in a southeasterly direction in both watersheds.

The western offsite watershed from the TT0497 Olive Avenue project and subsequent HEC-RAS analysis along Cotton Lane was used to determine the offsite discharge impacting Olive Avenue south of the BNSF railroad. The elevated BNSF railroad north of Olive Avenue and east of Cotton Lane acts as the southern boundary and diverts offsite flows into ADOT's L303 regional

channel. The elevated BNSF railroad continues to the east and is also the southern offsite boundary for the eastern offsite watershed. At roadway intersections, the BNSF railroad transitions from an elevated railroad to an at-grade crossing. Sarival Avenue is an at-grade crossing where offsite flows concentrate and overtop the existing intersection.

4.1.2 Watershed Work Maps

The following maps have been prepared to document the HEC-1 modeling input and results:

- **Exhibit 1** – Eastern Offsite Watershed Map – Prepared using aerial photographs, county contours, project specific survey and a site visit. This map depicts the overall watershed boundary, subbasin drainage boundaries, subbasin identification nomenclature and the longest flow path lengths/slopes and routing lengths.
- **Exhibit 2** – Eastern Offsite Soils Map - This exhibit was prepared using the District's soil shapefiles and identifies soils within each subbasin.
- **Exhibit 3** – Eastern Offsite Land Use Map – This exhibit was prepared using aerial photography and land use data from the Maricopa County Assessor's website to determine existing conditions. Land use designations are based on the District's Hydrology Manual in Table 4.2.
- **Exhibit 4** – Eastern Offsite HEC-1 Schematic – This exhibit was prepared using the subbasin drainage boundaries and includes a schematic of the operations performed within the HEC-1 model. Concentration points are labeled to define the corresponding subbasins they are located within (i.e. CP57 which is located within subbasin D57). Routes are labeled with the originating and destination subbasin/concentration point numbers. Diversions are labeled with the same number as the contributing concentration point and the general flow direction (i.e. L45L57). All model nomenclature was labeled to match as close as possible to the Loop 303/White Tanks Area Drainage Master Plan Update HEC-1 model, updated by Parsons Brinckerhoff in July, 2015.

4.1.3 Gage Data

No gage data was available within the watershed.

4.1.4 Precipitation

The National Oceanic and Atmospheric (NOAA) Atlas 14, Precipitation Frequency Atlas of the Western United States, Arizona was the source of the data used to determine the 50 and 100-year 6-hr and 24-hr rainfall depths for the eastern offsite watershed. Within the DDMSW program a shapefile of the watershed and subbasin boundaries was imported to delineate the boundaries. The District's program spatially averaged the rainfall data within the subbasin boundaries resulting in a single average rainfall depth for the HEC-1 model. The following table summarizes these results:

Table 4-1 NOAA 14 Rainfall

Duration	Contributing Area (sq. mi.)	50-year (inches)	100-year (inches)
6-hr	0.907	2.10	2.36
24-hr	0.907	3.08	3.47

Within the HEC-1 model, the point rainfall was aerially reduced using JD records (depth/area relationship) to obtain an equivalent depth of rainfall based upon the contributing watershed. Within the HEC-1 model, at the concentration points, the HC records (hydrograph combination record) include the contributing area to that concentration point which is used with the JD records to aerially reduce the point rainfall.

4.1.5 Physical Parameters

The following sections describe how the physical parameters were estimated for the modified subbasins. DDMSW output of these parameter estimations can be found in **Appendix B** and on **Exhibit 1**.

4.1.5.1 Rainfall Losses

Rainfall infiltration losses for the modified subbasins were calculated using DDMSW. The rainfall loss method used was Green-Ampt. Soil parameters were taken from Natural Resources Conservation Service (NRCS) soil surveys and are detailed below.

The soil survey used for this project comes from the NRCS contained within Book 651 titled *Maricopa County, Arizona, Central Part.* Soil data was used within DDMSW using the soil GIS shapefiles provided by the District and the delineated subbasin drainage boundaries. This method is also consistent with the soils from the Loop 303 /White Tanks ADMPU Area Hydrologic Analysis Update.

Land use assigned was based on the most applicable land use. Three residential land uses were selected based on density and an agricultural land use based on active irrigated fields. GIS shapefiles representing existing land use information was imported into DDMSW, which distributed the land use based on the subbasin boundaries.

Surface retention losses include all rainfall losses not associated with infiltration. These losses include depression storage, interception and evaporation. For this project, these losses are based upon land use and surface cover. The District has a prepared table in their Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology covering land use and surface retention loss. These values, used for initial abstraction, were applied to the subbasins in the DDMSW program.

The percent impervious input data is based upon a combination of soils and land use data. Representative values were used utilizing the District's Drainage Design Manual and are included in the default parameters of DDMSW program.

The DDMSW program partially bases rainfall losses on both soils and land use data. **Appendix B** includes output tables for soils, land use and a combined basin data table that documents parameters estimation for each subbasin.

4.1.5.2 Unit Hydrograph

The Clark Unit hydrograph method was used for the eastern offsite watershed based on the contributing drainage area being less than 1 square mile. A time-area relation of 'Urban' was used based on development within the subbasins. The subbasins vary in size but are

approximately a half square mile each. The DDMSW program calculates the lag and Kn values per the District's Drainage Design Manual based on subbasin parameters.

4.1.5.3 NSTPS

Initially, the number of routing steps for each route was set to one (1) within the HEC-1 model. The model was run and discharges determined for each route. The HEC-1 cross-section data along with the estimated discharge was then modeled in Bentley FlowMaster V8i to obtain channel velocities. A new number of routing steps for each channel route was then estimated using the following equation:

NSTPS = [Length of Route (ft) / (Avg. Velocity (ft/sec) * 60 seconds/minute)] / NMIN

The routing lengths were measured in GIS, velocities calculated within FlowMaster, and NMIN was a constant (5 minutes). Once new NSTPS were calculated, these values were replaced within the model and it was rerun. The process was repeated until the NSTPS no longer fluctuated. If the NSTPS value continually fluctuated between two numbers, the lower value was used.

4.1.5.4 Soils

The soil survey used for this project comes from the Natural Resources Conservation Service (NRCS) contained within Book 651 titled 'Maricopa County, Arizona, Central Part', dated Version 10, September 29, 2016. Soil data was cut for each subbasin within DDMSW using the soil GIS shapefiles and the delineated subbasin drainage boundaries.

4.1.5.5 Land Use/Vegetative Cover

Three residential land uses were selected based on density and an agricultural land use based on active irrigated fields. GIS shapefiles representing existing land use information was imported into DDMSW, which distributed the land use based on the subbasin boundaries.

Land use assigned was based on the most applicable land use. The boundaries were verified with aerial photographs and a site visit. The land use information was developed for individual subbasins using DDMSW.

4.1.5.6 Diversions/Storage

The Sycamore Farms development north of Peoria Avenue has multiple retention basins as well as underground storage at the Wyngate apartment complex. Based on aerial photography and a site visit, the existing retention basins appear were assumed to hold the 100-year 2-hour storage volume for the respective developments. The retention volumes were calculated based on a weighted C value based on land use. Calculations are provided in **Appendix B**.

4.2 Problems Encountered During the Study

4.2.1 Special Problems and Solutions

No special problems were encountered during the preparation of this study.

4.2.2 Modeling Warning and Error Messages

No warning or error messages occurred in any of the models for this study.

4.3 Results

Based on the results of the TT0497 project and the new eastern offsite watershed HEC-1 model, the 100-year 6-hour and 24-hour flows are provided below at corresponding concentration points along Olive Avenue. The 100-year, 6-hour results were higher and are used for design of the offsite facilities at Olive Avenue and Sarival Avenue. Per Maricopa County standards, the hydrologic analysis uses a 50-year storm for design of facilities to handle offsite flows. HEC-1 models for the 50-year 6-hour and 24-hour storm frequency were created to determine the controlling 50-year design storm. The 6-hour storm event is again higher and controls for the design of channels and culverts. The following table provides a comparison of return intervals and design discharges for each major concentration point located along Olive Avenue:

Table 4-2 Design Storm and Discharge Summary

Location Along Olive Avenue	HEC-1 ID	100-yr, 6-hr Discharge (cfs)	100-yr, 24-hr Discharge (cfs)	50-yr, 6-hr Discharge (cfs)	50-yr, 24-hr Discharge (cfs)
Cotton Lane and Olive Avenue Intersection (Box Culvert)	N/A	N/A	242	N/A	204
Subbasin between Cactus Road and Peoria Avenue	D45	330	305	275	245
Subbasin between Peoria Avenue and Olive Avenue	D57	212	196	160	150
Route between D45 & D57	L45L57	33	39	0	3
Concentration point at Olive Avenue & Sarival Avenue	CP57	210	195	157	149

4.3.1 Hydrologic Analysis Results

The results/output data for the HEC-1 models are located within **Appendix B**. Input and output files are provided in the **CD** in the back pocket of this report.

4.432 Calibration/Verification of Results

The western offsite watershed modified based on the TT0497 project has been reviewed and has been approved by MCDOT. The original model from the Loop 303/White Tanks Area Drainage Master Plan Update by PB has been reviewed and accepted by the District. Therefore, additional calibration/verification of results is not required.

Peak runoff values were compared with the previous Loop 303/White Tanks Area Drainage Master Plan Update by PB for similar discharge locations. Differences primarily can be attributed to routing reach geometry and subbasin size.

4.3.3 Comparison with Loop 303/White Tanks Hydrology Update

Peak runoff values (100-year 24-hour) were compared with those from the recently completed Loop 303/White Tanks Hydrology and Delineation Update, completed by PB in 2015. The following table summarizes the results comparison.

Table 4-3 Eastern Offsite Comparison of HEC-1 Discharges

Location	T.Y. Lin Concentration Point	T.Y. Lin HEC-1 100-Year, 24-Hr Flow	L303 / White Tanks Concentration Point	L303 / White Tanks EC-1 100-Year, 24-Hr Flow
	(ID)	(cfs)	(ID)	(cfs)
Subbasin 45	D45	305	D45	384
Route to Subbasin 57	L45L57	39	D45D57	29
Subbasin 57	D57	196	D57	173
Olive and Sarival Ave Intersection	CP57	195	CPD57	173

A comparison of results shows a small increase in flows for the 24-hour event except at subbasin D45, which was small reductions along the western subbasin boundary due to the L303 freeway and recent residential developments within Sycamore Farms, which added additional onsite retention previously not accounted for. The other subbasins and routes are higher for the T.Y Lin International model due to the different unit hydrographs being used. The L303/White Tanks model uses the S-Graph, a dimensionless form of an unit hydrograph, due to the large overall size of the watershed being modeled. The T.Y. Lin International model used the Clark unit hydrograph, which is for smaller watersheds and applicable for this project. The concentration point at Olive Avenue and Sarival Avenue (CP57) are similar, with TY Lin's model approximately 10% higher than the L303/White Tanks study. Overall, the HEC-1 model results are similar to the Loop 303 / White Tanks Hydrology and Delineation Update. Based on the additional development provided in the T.Y. Lin HEC-1 model, the T.Y. Lin results were used for designing offsite infrastructure.

5.0 Offsite Hydraulics

5.1 Overview

Based on the Final Scoping and Design Report, the recommended offsite drainage plan was to allow offsite flows to overtop the roadway in the same manner as in the existing condition while maintaining the existing roadway profile as much as possible. However, based on lack of downstream infrastructure at offsite concentration points and regional outfalls nearby, offsite improvements are proposed to safely and effectively capture and route flows to their ultimate outfall.

West of the L303 freeway, a drop inlet and 60-inch storm drain is proposed to capture and convey offsite stormwater from the TT0497 Olive Avenue channel and connect to an existing three barrel 10-ft by 6-ft ADOT box culvert. The remaining local offsite flow east of Cotton Lane is diverted east to the L303 offsite channel by the existing BNSF railroad embankment. East of the L303 freeway, offsite improvements include constructing an offsite collection channel north of the BNSF railroad to capture offsite flows and convey them underneath the BNSF railroad in an 8-ft by 5-ft box culvert. The box culvert will angle southeast, discharging to the southeast corner of Olive Avenue into a local offsite channel, which ultimately conveys flow to Reems Channel. Full modeling is provided in this report. Additional information is provided in Volume 2 – Sarival Avenue to Reems Road.

5.2 Offsite Storm Drain Analyses and Design

A proposed offsite channel is located just east of the Cotton Lane and Olive Avenue intersection from the TT0497 Olive Avenue Project. The 50-year offsite flow is 204.4 cfs while the 100-year offsite flow is 242 cfs. A proposed drop inlet and 60-inch storm drain is proposed to capture and convey offsite flows from the channel east to connect to an existing three barrel 10-ft by 6-ft ADOT box culvert. Based on the Loop 303/White Tanks Area Drainage Master Plan Update by PB and the Final Drainage Report for the SR 303L Glendale Avenue to Peoria Avenue by Michael Baker in June, 2011, the L303 regional channel is designed for the 100-year, 24-hour storm event (approximately 1,319 cfs) and includes offsite flows contributing to Olive Avenue.

In lieu of a storm drain system, an open channel was conceptually designed to tie into the TT0497 Olive Avenue offsite channel and continue to the ADOT drop inlet, where a drop inlet was proposed with a short connection to the ADOT box culvert. However, the proposed channel would encroach significantly into BNSF right-of-way and prohibit the construction of first flush basins along the north side of Olive Avenue. Based on these constraints, a storm drain system was determined to be the most cost effective and feasible solution for conveying offsite flows.

StormCAD version V8i (Select Series 4, Bentley 2014) was used to calculate and document the offsite 60-inch storm drain hydraulics. The captured flow from the drop inlet were input into the StormCAD model to calculate the storm drain system hydraulic grade line (HGL) accounting for friction loss, junctions, bends, transitions, manholes and backwater condition at the existing ADOT box culvert. The 100-year hydraulic grade line for the ADOT box culvert of 1161.95 was input as the controlling tailwater elevation per the unsealed Michael Baker Drainage Report.

The HGL is maintained at least 1-foot below the top of pavement. The drop inlet calculations and storm drain mainline, manholes and outlet summary tables and profile is provided in **Appendix D** in conjunction with the onsite storm drain systems.

5.3 Offsite Channels and Culverts

Significant coordination with BNSF occurred throughout the project. Orignially a large offsite channel north of the BNSF railroad was designed to collect, contain and convey offsite flows to protect the BNSF railroad, Sarival Avenue and Olive Avenue from overtopping. Existing flows reaching the railroad overtop both the railroad and eventually Sarival and Olive Avenue. The channel paralleled the BNSF railroad and discharge south through an 8-ft by 4-ft box culvert. The box culvert is proposed to discharge into a concrete channel, which connects to a 8-ft by 5-ft box culvert to the east underneath Sarival Avenue. The box culvert angles southeast, discharging to the southeast corner of Olive Avenue into a proposed offsite channel, which ultimately conveys flow to Reems Channel. Full modeling is provided in this report. Additional information is provided in Volume 2 – Sarival Avenue to Reems Road.

After further coordination with BNSF, the offsite channel was redesigned to incorporate and work with future track widening and improvements. The channel was redesigned and relocated to capture and convey the contributing offsite flows, realigning the 8'x4' box culvert, and updating local grading north of Olive Avenue to ensure the design was compatible with BNSF's future design.

In addition to the channels and box culverts, driveway culverts are proposed along Olive Avenue and Sarival Avenue to convey local 10-year storm events.

Supporting calculations can be found in **Appendix C**.

5.4 Erosion Protection

Erosion protection is necessary when the velocity at the outlet of a culvert exceeds the natural ability of the native and/or engineered soil to resist erosion. The erosion protection generally performs two functions, the first is to prevent erosion while the second, depending upon the method of erosion protection, is to act as an energy dissipater to reduce the flow velocities to non-erosive levels. **Table 5-3** summarizes the erosion protection for the culverts. Calculations for the rock size and apron dimensions can be found in **Appendix D**.

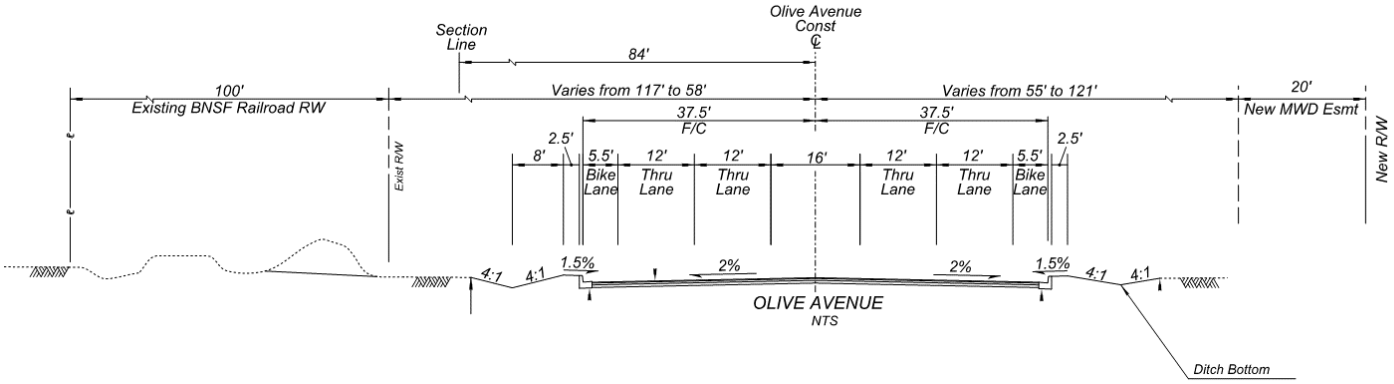
6.0 Onsite Storm Water

6.1 Olive Avenue Configuration

6.1.1 Typical Section

Olive Avenue is being developed as a Urban Minor Arterial Roadway based on meetings between MCDOT, the City of Glendale (COG) and the COEM. The typical section is defined below and will have two 12-foot travel lanes in each direction, a 14-foot to 16-foot median and a five and a half foot bike lane in each direction. The minimum R/W for this section is 110 feet. Sidewalks are being deferred until development occurs adjacent to the roadways. The typical roadway cross section is shown in **Figure 6-1** below.

Figure 6-1: Olive Avenue Typical Section



6.1.2 Intersections

The Sarival Avenue intersection is proposed to be graded to the north/south of the Olive Avenue centerline. The intersection will have a larger contributing area of pavement compared to the normal section. Flows reaching the left gutter (north) will travel east along the northern gutter line, while flows reaching the right gutter (south) will be conveyed both east and south. Flows west of the Sarival Avenue centerline will flow south while flows east of the left turn median will flow east within the intersection. The Reems Road intersection is described in Volume 2 – Sarival Avenue to Reems Road.

6.1.3 Sidewalks and Ramps

Sidewalks are being constructed along the northern portion of Olive Avenue as part of this project. Also, Americans with Disabilities (ADA) ramps are being provided at intersections and slope toward the street so that runoff will be captured in the street.

6.1.4 Discharge and Accumulated Drainage

County guidelines require the retention of the first 0.5-inches of onsite storm water runoff called "first-flush". Scuppers and a new storm drain system consisting of inlets, connector pipes and a storm drain mainlines will collect onsite runoff for the 10-year storm and discharge to either a first-flush basin or a proposed 100-year, 2-hour retention basin.

6.1.5 Proposed Onsite Improvements

Proposed improvements include a combination of catch basin inlets, storm drains and scuppers discharging to first flush basins or 100-year 2-hour retention basins. Small roadside ditches are proposed to convey 10-year flows to the proposed basins. Driveway culverts are provided to allow positive drainage and continuation of proposed ditches to their respective outfalls. Two area drains are also proposed in two first flush basins to provide an outfall for larger storm events. The area drains tie into the proposed offsite storm drain mainline, which connects to the L303 freeway regional channel.

Due to the Olive Avenue widening under the L303 freeway, an existing 18-inch storm drain line and manhole will be impacted. The storm drain line is proposed to be removed and relocated to the north. Existing pipes will be connected with manholes and the proposed pipes will be increased to 24-inches to ensure adequate capacity. The outfall for the existing storm drain is to the existing 3-barrel 10-ft by 6-ft ADOT box culvert.

6.2 Onsite Design Criteria

Drainage design meets the requirements of MCDOT and of the District.

Table 6-1 Design Criteria for Onsite Runoff

Criteria	Criteria Value	Reference
Onsite Hydrology:		
Rational Method	Up to 160 acres and allowable if only peak discharge is needed. Minimum Tc = 5 minutes	Drainage Policies and Standards Manual (FCDMC)
Pipe Cover:		
Pipe Culvert	18-inches minimum	Roadway Design Manual (MCDOT)
Concrete Box Culvert	12-inches minimum	Roadway Design Manual (MCDOT)
Spread:		
Urban Principal Arterial	10-year: One 12-foot dry driving lane maintained in each direction, and flow depths not to exceed curb height	Drainage Policies and Standards Manual (FCDMC)
Urban Minor Arterial	10-year flow depths not to exceed curb height	Drainage Policies and Standards Manual (FCDMC)
Storm Water Retention:		
First Flush	Treat or retain the first 0.5 inches of direct runoff	Drainage Policies and Standards Manual (FCDMC)

6.3 Methodology for On-site Drainage Systems

6.3.1 Runoff Calculation Method

Stormwater management for Olive Avenue resulted in the design of a combination of scuppers and a storm drain system consisting of collection inlets discharging to first flush basins and one 100-year 2-hour retention basins. In order to quantify the onsite runoff, the Rational Method was used for computing peak discharges for small watersheds per the effective *Drainage Design Manual for Maricopa County* (DDM) *Hydrology – Volume I.* Small watersheds are those covering 160 acres or less. Onsite drainage areas were delineated to the proposed R/W and included the calculation of a composite runoff "C" values, time-of-concentration (Tc), and calculation of longitudinal slopes. The 10-year peak discharge rates were used for determining sizing and spacing of inlets and for sizing storm drain connector and main line pipes.

In order to calculate a composite runoff "C" coefficient, Table 3.2 from Volume 1 (Hydrology) of the County's DDM was used. Impervious areas (pavement and sidewalks) were assigned a runoff coefficient of 0.95 for the 10 and 100-year storm frequencies. Other areas within the R/W designated as desert landscape were assigned a coefficient of 0.40 to 0.50, depending upon storm frequency. A composite C-value was calculated based on the amount of pervious/impervious area in the proposed roadway cross-section.

Scupper and inlet calculations were performed using Bentley Flowmaster V8i. The captured flows for the proposed inlets were input into Bentley StormCAD V8i to model the hydraulic properties of the storm drain. Please refer to **Exhibit 5** in **Appendix F** for subbasin boundaries.

6.3.2 First Flush and Retention Basin Design

Based on the Final Scoping and Design Report, the recommended onsite drainage alternative is to collect and convey onsite flows to first flush basins. The outfalls of the first flush basins are to maintain the existing flowpath of onsite and offsite flows. The first flush volume equation is from Section 3.4 of Volume 1 (Hydrology) of the District's DDM and requires the runoff coefficient C set to 1.0 and rainfall set to 0.5 inches.

If located within the roadway clear area, the first-flush basin side slope, adjacent to the travel lane, must be 6:1 horizontal to vertical ratio (H:V) or flatter for safety reasons. The opposite side slope can be 4:1 (H:V) or flatter and likewise if the basin is located outside the clear area then both slopes can be 4:1 (H:V). The closest edge of a basin must be 2.0 feet or more from the edge of any sidewalk to minimize the chance of a person stumbling into a basin. The closest edge of a basin must also be 6.0 feet or more from the back of a roadway curb to minimize trapping of a vehicle that may partially leave the roadway. Based on the Final Scoping Report by NFra, the clear zone along Olive Avenue is 6 feet from the travel lane with curb and gutter.

First flush basins were designed where excess flows would continue along existing flowpaths and/or outfalls and not negatively impact adjacent properties. However, if a feasible outfall was not present or if adjacent properties could be negatively impacted, a 100-year 2-hour retention basin was designed with 1-foot of freeboard.

For this project, first flush basins were designed to store the first flush volume before overtopping. All first flush basins were designed to be 1-foot in depth with an outfall provided. Volumes greater than the first flush basins will overtop and flow to the existing outfalls that are being maintained. The outfall for basins 1 and 2 are area drains, which convey excess flows into the offsite storm drain connecting to the L303 regional channel. Drainage Area 3 (DA-2) at approximate station 194+50 discharges to existing ADOT area drains, which matches existing conditions. A first flush basin is not needed for this location. Basin 3 follows existing grading to the south where the start of the Northern Parkway channel begins along the eastern side of the L303 freeway. Basin 301 is located on the southern portion of Sarival Avenue, where excess flows will reach a ditch that conveys flows south to an existing area drain connecting to the Northern Parkway Channel.

Multiple retention basins were designed along Olive Avenue and Sarival Avenue in lieu of first flush basins when a feasible outfall was not available or when adjacent properties would be impacted by overtopping flows. 100-year 2-hour retention basins were designed to have a maximum water surface elevation of 3-feet with a minimum of 1-foot of freeboard.

A first flush and outfall channel alternative was conceptually explored to determine if the right-of-way impact would be less. However, based on the existing topography and grading necessary to connect the first flush basins and channels, it was determined the right-of-way impact would be approximately the same as the retention basin alternative. Therefore, the retention basin improvements are used to determine the right-of-way acquisitions.

Please refer to **Exhibit 5** in **Appendix F** for first flush and retention basin locations.

6.3.3 Gutter Flow Capture Method

New scuppers and a storm drain system with catch basin inlets have been designed to convey street runoff to first flush basins and retention basins.

6.4 Hydraulic Results

StormCAD version V8i (Select Series 4, Bentley-2014) was used to calculate and document the onsite storm drain hydraulics.

6.4.1 Drainage Areas

The catchment areas to each storm drain catch basin were delineated based upon the proposed roadway profile, cross section and inlet spacing.

6.4.2 Runoff Coefficients

Runoff coefficients are used to describe the relative runoff characteristics of surfaces. For simplicity, surfaces were considered to be pervious or impervious, and their coefficients were 0.40-0.50 and 0.95 respectively, depending upon storm frequency. Computed values for composite coefficients for the different types of runoff coefficients are provided in the drainage area summaries found in **Appendix D**.

6.4.3 Rainfall Intensity and Time of Concentration

The rainfall intensity values were based upon NOAA Atlas 14 and were developed using the tabular values for 5, 10, 15 and 30 minutes from the Point Precipitation Frequency Estimates for Waddell, Arizona, as shown in **Appendix D**. Intermediate values were computed using straight-line interpolation. The time-of-concentration (Tc) and rainfall intensities were calculated for each drainage area. A summary of the results are located in **Appendix D**.

6.4.4 Storm Drain Inlets and Scuppers

The City of Phoenix standard inlet details and ADOT construction standard drawings have been used to design the new storm drain. The standard detail for type M-1 inlets (P1569-1) has a 3-foot to 17-foot long curb opening and can come with either one or two wings of variable length. The standard detail for type R inlets (P1572 & P1573) is a curb opening and grate combination inlet and can be configured as double, triple or higher number of inlets. The standard detail for the ADOT catch basin (C-15.80) are flush concrete aprons surrounding a depressed grate. The inlet geometry for each location was created in Bentley Flowmaster using an effective opening of 80% for clogging, which was based upon the County's DDM. Grates use an effective opening of 50% for clogging. Inlet depths (V-depth) meet the minimum requirements identified within the City of Phoenix and ADOT details.

Scuppers are also used to dewater the roadway. The MAG standard scupper detail is used for drainage design. The standard detail used with this project is MAG 206-(1 thru 3) which is inlet depressed. Please refer to **Exhibit 5** in **Appendix F** for storm drain and scupper locations.

6.4.5 Ratio of Flow Interception

Inlets located in sag have an interception efficiency of 100%. Interception for inlets located on-grade are calculated using Bentley Flowmaster, which includes inlet efficiency for each inlet type to determine capture and flow-by. Flow bypassing an inlet is routed downstream to the next inlet. The minimum interception efficiency for new inlets is 80%.

6.4.6 Storm Drain Elements

StormCAD was used to model the storm drain systems. The captured flows from the catch basin inlets were input into the StormCAD model to calculate the storm drain system hydraulic grade line (HGL) accounting for friction loss, junctions, bends, transitions, manholes and backwater conditions at the outfalls. The HGL is maintained at least 1-foot below the top of pavement. The storm drain inlets, storm drain pipes, manholes and outlet summary tables and profiles are provided in in **Appendix D**.

6.4.7 Municipal Separate Storm Sewer System (MS4)

To prevent polluted storm water runoff from being transported through MCDOT storm drains, the County has developed a storm water management program which establishes criteria for handling and/or treating storm water when that runoff would be conveyed through a County storm sewer system.

For this project the use of "first flush" basins as the outfall of a storm water collection system prior to discharging to an outfall. Four first flush basins are designed along Olive Avenue and Sarival Avenue. In each instance, the first flush basins dewater the onsite roadways. During

large storm events, the first flush basins will overtop and flow along existing flowpaths to the maintained existing outfalls.

The contributing area and required basin volumes are provided in **Table 6-2a** below.

First flush basins are designed with the maximum allowable ponding depth of 1 to 2-feet in order for the stormwater to percolate within 36 hours. However, retention basins were designed to be a maximum of 3-feet in water depth with 1-foot of freeboard. Infiltration tests were performed at all basin locations to verify basins will drain within 36 hours. Drywells have been proposed where necessary to limit ponding duration to less than 36 hours. Drywells required and percolation results are provided in **Appendix D.2**.

6.4.8 Erosion Protection

Erosion protection is necessary when the velocity within a ditch, channel or outlet of a storm drain or scupper exceeds the natural ability of the native and/or engineered soil to resist erosion. The erosion protection generally performs two functions, the first is to prevent erosion while the second, depending upon the method of erosion protection, is to act as an energy dissipator to reduce the flow velocities to non-erosive levels. The design D_{50} of the rock size for all of the riprap aprons is 6-inches, with a thickness of 1-foot. At specific locations where the curb and gutter end, smaller rock (design D_{50} of 3-inches, 6-inches thick) were placed to protect the edge of pavement and curb and gutter from erosion. A summary of the calculations for the rock size and apron dimensions can be found in **Appendix D**.

7.0 Utility Conflicts

The majority of the existing utilities are located immediately adjacent to the existing roadway and require relocation/adjustments to facilitate the roadway widening. The roadway R/W are widened to accommodate first flush and 100-year retention basins and the relocation of MWD's irrigation channel along the south side of Olive Avenue, which is to be replaced underground in an irrigation pipe. In addition, the City of Glendale has water facilities that may require vertical realignment at the proposed culvert and storm drain crossings. Cox Communications, CenturyLink and Southwest Gas have facilities that may require similar relocation.

7.1 Culvert Crossings

One proposed box culvert crossing across Sarival Avenue crosses a water line and multiple telecom lines (fiber optic and/or telephone). At this time vertical locations are not known. Approximate locations are shown in the profiles while potholes are being obtained

7.2 Inlets, Scuppers, and Local Basins

Catch basin inlets and scuppers are proposed to dewater Olive Avenue, Citrus Road and Cotton Lane. The location of the new curb, gutter, and proposed inlets will be located outside of the existing utility corridors and shouldn't pose any additional conflicts with existing utilities. The first flush basins are designed and located outside of existing utility corridors and should not pose any additional conflicts with existing utilities.

7.3 Storm Drain Piping

The offsite storm drain alignment is located within a clear alignment north of Olive Avenue with minimal utility impacts. The remaining onsite storm drains are all cross-drainage systems discharging directly to basins. However, they do cross telecom lines (fiber optic, telephone) and water lines that will need to be potholed to determine if there are conflicts requiring relocations.

7.4 Existing MWD Facilities

Existing MWD facilities within the Olive Avenue corridor from Cotton Lane to Sarival Avenue are proposed to be relocated south. Conflicts with proposed storm drain and retention basin facilities are not anticipated.

8.0 Conclusions

- Based on the Final Scoping and Design Report, the recommended offsite drainage plan allows offsite flows to overtop the roadway in the same manner as in the existing condition while maintaining the existing roadway profile as much as possible. The onsite stormwater management plan is also to capture and convey onsite flows to first flush facilities using scuppers, catch basin inlets and storm drains.
- The western offsite watershed extends up to the Beardsley Canal and the McMicken Dam. Runoff is conveyed via sheet flow through natural desert and small natural washes until it reaches existing residential developments and roadways. The eastern offsite watershed extends from the L303 freeway and Cactus Road southwesterly through a majority of existing active agricultural land and residential development.
- Conveyance of offsite flows across the BNSF railroad, Sarival Avenue and Olive Avenue will be accomplished via a proposed storm drain connecting to the L303 regional channel west of the L303 freeway and proposed channels and box culverts east of the L303 freeway. In all locations, the 50 and 100-year design flows are accommodated without overtopping.
- Within the R/W, onsite runoff will be collected and discharged either directly to a first flush basin via scuppers or catch basin inlets and storm drain systems or a 100-year, 2-hour retention basin. Retention basins were designed along Olive Avenue and Sarival Avenue in lieu of first flush basins when a feasible outfall was not available or when adjacent properties would be impacted by overtopping flows.
- City of Phoenix curb opening and grate catch basins as well as MAG scuppers will be installed throughout the project to capture and convey onsite stormwater flows.

9.0 References

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16. Final Drainage Report – SR 303L Glendale Ave. to Peoria Ave. (TRACS NO. H7874 01 C) Michael Baker Jr., Inc. June 2011.
17. TT0497: Olive Avenue – Citrus Road to Cotton Lane – Final Design Drainage Report, TY Lin Internationa, May 12, 2017.

Appendix A

FEMA Special Flood Hazard Areas

sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Arizona State Plane Central zone (FIPSZONE 0202). The **horizontal datum** was NAD 83 HARN, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988 (NAVD 88). These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. Map users wishing to obtain flood elevations referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29) may use the following Maricopa County website application: http://www.fcd.maricopa.gov/Maps/gismaps/apps/gdacs/application/index.cfm

This web tool allows users to obtain point-specific datum conversion values by zooming in and hovering over a VERTCON checkbox on the layers menu on the left side of the screen. The VERTCON grid referenced in this web application was also used to convert existing flood elevations from NGVD 29 to NAVD 88.

To obtain current elevation, description, and/or location information for National Geodetic Survey bench marks shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at http://www.ngs.noaa.gov. To obtain information about Geodetic Densification and Cadastral Survey bench marks produced by the Maricopa County Department of Transportation, please visit the Flood Control District of Maricopa County website at: http://www.fcd.maricopa.gov/Maps/gismaps/apps/gdacs/application/index.cfm.

Base map information shown on this FIRM was derived from multiple sources. Aerial imagery was provided in digital format by the Maricopa County Department of Public Works, Flood Control District. The imagery is dated October 2009 to November 2009. Additional National Agricultural Imagery Program (NAIP) imagery was provided by the Arizona State Land Department (ALRIS) and is dated 2007. The coordinate system used for the production of the digital FIRM is State Plane Arizona Central NAD83 HARN, International Feet.

The **profile base line** depicted on this map represents the hydraulic modeling baselines that match flood profiles in the FIS report. As a result of improved topographic data, the profile base line, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community, as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM, visit the **FEMA Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, or digital versions of this map. Many of those products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.



The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 — 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid ticks, zone 12
6000000 M	5000-foot grid ticks: Arizona State Plane coordinate system, central zone (FIPSZONE 0202), Transverse Mercator
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
April 15, 1988
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
September 30, 1995 July 19, 2001 September 30, 2005
October 16, 2013 - to incorporate previously issued letters of map revision, to add floodway, to add roads and road names, to update corporate limits, to change floodway, to add base flood elevation, to change base flood elevations, to add special flood hazard areas, and to advance suffix.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP

PANEL 1660L

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 1660 OF 4425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	1660	L
GLENDALE, CITY OF	040045	1660	L
SURPRISE, CITY OF	040053	1660	L

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

MAP NUMBER
04013C1660L

MAP REVISED
OCTOBER 16, 2013

NATIONAL FLOOD INSURANCE PROGRAM

Appendix B
Offsite Hydrology

Appendix B.1

HEC-1: 100-yr, 6-hr Results

```
1****************************************                                                  ***************************************
 *                                      *                                                  *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                  *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998              *                                                  *    HYDROLOGIC ENGINEERING CENTER    *
 *           VERSION 4.1                *                                                  *          609 SECOND STREET          *
 *                                      *                                                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   18OCT17  TIME  18:19:21  *                                                  *           (916) 756-1104            *
 *                                      *                                                  *                                     *
 ****************************************                                                  ***************************************


                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X         XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X               X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                  HEC-1 INPUT                                                  PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             1          ID        MARICOPA COUNTY DOT
             2          ID        TT0561-OLIVE AVE - TT0561-OLIVE AVE-Exst
             3          ID        100 YEAR
             4          ID        6 Hour  Storm
             5          ID        Unit Hydrograph: Clark
             6          ID        Storm: Multiple
             7          ID        10/16/2017
             8          ID
             9          ID        MCDOT Project Number TT0561 - Olive Avenue, L303 to Sarival Ave
            10          ID        Model:  Existing Conditions
            11          ID
            12          ID        This model is the contributing offsite watershed from the L303 to
            13          ID        Sarival Avenue.  Main Concentration point is northwest of Olive Avenue
            14          ID        And Sarival Avenue, north of the BNSF Railroad Tracks
            15          ID        *Retention in Basin D45 based on available drainage reports and as-built
                        *
                        *DIAGRAM
            16          IT       5  1JAN99       0    2000
            17          IO       5
            18          IN      15
                        *
            19          JD   2.360  0.0001
            20          PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
            21          PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
            22          PC   0.962   0.972   0.983   0.991   1.000
            23          JD   2.340   0.500
            24          PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
            25          PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
            26          PC   0.962   0.972   0.983   0.991   1.000
            27          JD   2.329   1.000
            28          PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
            29          PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
            30          PC   0.962   0.972   0.983   0.991   1.000
            31          JD   2.301     2.8
            32          PC   0.000   0.009   0.016   0.025   0.034   0.042   0.051   0.059   0.067   0.076
            33          PC   0.087   0.100   0.120   0.163   0.252   0.451   0.694   0.837   0.900   0.938
            34          PC   0.950   0.963   0.975   0.988   1.000
                        *

            35          KK     D45   BASIN
            36          BA   0.459
            37          LG    0.38    0.25    4.87    0.41      17
            38          UC   0.668   0.440
            39          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
            40          UA     100
                        *

            41          KK     R45 STORAGE - 100-year 2 hour Development Storage
            42          DT    R45S   22.66     0.0
            43          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
            44          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                        *
                        *
1                                                  HEC-1 INPUT                                                  PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


            45          KK  L45L57   ROUTE
            46          RS      19    FLOW
            47          RC   0.060   0.030   0.040    5150  0.0033    0.00
            48          RX    0.00   10.00   22.00   62.00   87.00   87.50   97.50  107.50
            49          RY   10.00    9.50    6.00    7.00    6.50    7.00    8.00    9.00
                        *
                        *

            50          KK     D57   BASIN
            51          BA   0.448
            52          LG    0.50    0.25    4.33    0.61       0
            53          UC   0.788   0.463
            54          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
            55          UA     100
                        *

            56          KK    CP57 COMBINE
            57          HC       2
                        *
            58          ZZ
```

```
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    35         D45
                 .
                 .
    42           .-------->    R45S
    41         R45
                 V
                 V
    45       L45L57
                 .
                 .
    50           .          D57
                 .            .
                 .            .
    56        CP57............

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************                                  ****************************************
*                                      *                                  *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS      *
*             JUN   1998               *                                  *    HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1               *                                  *          609 SECOND STREET           *
*                                      *                                  *       DAVIS, CALIFORNIA 95616        *
*  RUN DATE   18OCT17  TIME  18:19:21  *                                  *           (916) 756-1104             *
*                                      *                                  *                                      *
****************************************                                  ****************************************



                              MARICOPA COUNTY DOT
                              TT0561-OLIVE AVE - TT0561-OLIVE AVE-Exst
                              100 YEAR
                              6 Hour  Storm
                              Unit Hydrograph: Clark
                              Storm: Multiple
                              10/16/2017

                                 MCDOT Project Number TT0561 - Olive Avenue, L303 to Sarival Ave
                                 Model:  Existing Conditions

                                 This model is the contributing offsite watershed from the L303 to
                                 Sarival Avenue.  Main Concentration point is northwest of Olive Avenue
                                 And Sarival Avenue, north of the BNSF Railroad Tracks
                              *Retention in Basin D45 based on available drainage reports and as-built

   17 IO          OUTPUT CONTROL VARIABLES
                        IPRNT          5  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                         NMIN          5  MINUTES IN COMPUTATION INTERVAL
                        IDATE      1JAN99  STARTING DATE
                        ITIME        0000  STARTING TIME
                           NQ        2000  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE      7JAN99  ENDING DATE
                       NDTIME        2235  ENDING TIME
                       ICENT          19  CENTURY MARK

                    COMPUTATION INTERVAL    0.08 HOURS
                         TOTAL TIME BASE  166.58 HOURS

             ENGLISH UNITS
                  DRAINAGE AREA         SQUARE MILES
                  PRECIPITATION DEPTH   INCHES
                  LENGTH, ELEVATION     FEET
                  FLOW                  CUBIC FEET PER SECOND
                  STORAGE VOLUME        ACRE-FEET
                  SURFACE AREA          ACRES
                  TEMPERATURE           DEGREES FAHRENHEIT

   19 JD          INDEX STORM NO. 1
                         STRM        2.36  PRECIPITATION DEPTH
                         TRDA        0.00  TRANSPOSITION DRAINAGE AREA

   20 PI            PRECIPITATION PATTERN
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.01      0.01      0.01      0.01      0.01      0.01      0.03
                       0.03      0.03      0.05      0.05      0.05      0.15      0.15      0.15      0.03      0.03
                       0.03      0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00

   23 JD          INDEX STORM NO. 2
                         STRM        2.34  PRECIPITATION DEPTH
                         TRDA        0.50  TRANSPOSITION DRAINAGE AREA

   24 PI            PRECIPITATION PATTERN
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.01      0.01      0.01      0.01      0.01      0.01      0.03
                       0.03      0.03      0.05      0.05      0.05      0.15      0.15      0.15      0.03      0.03
                       0.03      0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00

   27 JD          INDEX STORM NO. 3
                         STRM        2.33  PRECIPITATION DEPTH
                         TRDA        1.00  TRANSPOSITION DRAINAGE AREA

   28 PI            PRECIPITATION PATTERN
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.01      0.01      0.01      0.01      0.01      0.01      0.03
```

```
                    0.03      0.03      0.05      0.05      0.05      0.15      0.15      0.15      0.03      0.03
                    0.03      0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00

   31 JD          INDEX STORM NO. 4
                        STRM        2.30  PRECIPITATION DEPTH
                        TRDA        2.80  TRANSPOSITION DRAINAGE AREA

   32 PI            PRECIPITATION PATTERN
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00      0.00      0.01      0.01      0.01      0.01      0.01      0.01      0.03
                    0.03      0.03      0.07      0.07      0.07      0.08      0.08      0.08      0.05      0.05
                    0.05      0.02      0.02      0.02      0.01      0.01      0.01      0.00      0.00      0.00
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00
1
                                                    RUNOFF SUMMARY
                                                FLOW IN CUBIC FEET PER SECOND
                                              TIME IN HOURS,  AREA IN SQUARE MILES

                                    PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION   FLOW     PEAK                                           AREA      STAGE     MAX STAGE
+                                                                6-HOUR     24-HOUR     72-HOUR
          HYDROGRAPH AT
+                           D45      330.    4.25          51.         13.          4.       0.46
          DIVERSION TO
+                          R45S      330.    4.25          46.         11.          4.       0.46
          HYDROGRAPH AT
+                           R45       59.    5.25           5.          1.          0.       0.46
          ROUTED TO
+                        L45L57       33.    6.25           5.          1.          0.       0.46
          HYDROGRAPH AT
+                           D57      212.    4.33          31.          8.          3.       0.45
          2 COMBINED AT
+                          CP57      210.    4.33          35.          9.          3.       0.91


 *** NORMAL END OF HEC-1 ***
```

Appendix B.2

HEC-1: 100-yr, 24-hr Results

```
1****************************************                                                  ***************************************
 *                                      *                                                  *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                  *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998              *                                                  *    HYDROLOGIC ENGINEERING CENTER    *
 *           VERSION 4.1                *                                                  *          609 SECOND STREET          *
 *                                      *                                                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   16OCT17  TIME  11:00:46  *                                                  *           (916) 756-1104            *
 *                                      *                                                  *                                     *
 ****************************************                                                  ***************************************


                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X         XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X               X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                  HEC-1 INPUT                                                  PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID        MARICOPA COUNTY DOT
            2           ID        TT0561-OLIVE AVE - TT0561-OLIVE AVE-Exst
            3           ID        100 YEAR
            4           ID        24 Hour  Storm
            5           ID        Unit Hydrograph: Clark
            6           ID        Storm: Multiple
            7           ID        10/16/2017
            8           ID
            9           ID        MCDOT Project Number TT0561 - Olive Avenue, L303 to Sarival Ave
           10           ID        Model:  Existing Conditions
           11           ID
           12           ID        This model is the contributing offsite watershed from the L303 to
           13           ID        Sarival Avenue.  Main Concentration point is northwest of Olive Avenue
           14           ID        And Sarival Avenue, north of the BNSF Railroad Tracks
           15           ID        *Retention in Basin D45 based on available drainage reports and as-built
                        *
                        *DIAGRAM
           16           IT       5  1JAN99       0    2000
           17           IO       5
           18           IN      15
                        *
           19           JD   3.470  0.0001
           20           PC   0.000   0.002   0.005   0.008   0.011   0.014   0.017   0.020   0.023   0.026
           21           PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056   0.060
           22           PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
           23           PC   0.110   0.115   0.120   0.126   0.133   0.140   0.147   0.155   0.163   0.172
           24           PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
           25           PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
           26           PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
           27           PC   0.913   0.918   0.922   0.926   0.930   0.934   0.938   0.942   0.946   0.950
           28           PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977   0.980
           29           PC   0.983   0.986   0.989   0.992   0.995   0.998   1.000
           30           JD   3.270    10.0
                        *

           31           KK     D45   BASIN
           32           BA   0.459
           33           LG    0.38    0.25    4.87    0.41      17
           34           UC   0.668   0.440
           35           UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
           36           UA     100
                        *

           37           KK     R45 STORAGE - 100-year 2 hour Development Storage
           38           DT    R45S   22.66     0.0
           39           DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
           40           DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                        *
                        *
1                                                  HEC-1 INPUT                                                  PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


           41           KK  L45L57   ROUTE
           42           RS      19    FLOW
           43           RC   0.060   0.030   0.040    5150  0.0033    0.00
           44           RX    0.00   10.00   22.00   62.00   87.00   87.50   97.50  107.50
           45           RY   10.00    9.50    6.00    7.00    6.50    7.00    8.00    9.00
                        *
                        *

           46           KK     D57   BASIN
           47           BA   0.448
           48           LG    0.50    0.25    4.33    0.61       0
           49           UC   0.788   0.463
           50           UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
           51           UA     100
                        *

           52           KK    CP57 COMBINE
           53           HC       2
                        *
           54           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW
```

```
  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   31         D45
                .
                .
   38           .-------->    R45S
   37         R45
                V
                V
   41      L45L57
                .
                .
   46           .          D57
                .            .
                .            .
   52        CP57............

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************                                    ****************************************
*                                      *                                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
*             JUN   1998               *                                    *    HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1               *                                    *         609 SECOND STREET            *
*                                      *                                    *       DAVIS, CALIFORNIA 95616        *
*  RUN DATE   16OCT17  TIME  11:00:46  *                                    *           (916) 756-1104             *
*                                      *                                    *                                      *
****************************************                                    ****************************************
```

MARICOPA COUNTY DOT
TT0561-OLIVE AVE - TT0561-OLIVE AVE-Exst
100 YEAR
24 Hour Storm
Unit Hydrograph: Clark
Storm: Multiple
10/16/2017

MCDOT Project Number TT0561 - Olive Avenue, L303 to Sarival Ave
Model: Existing Conditions

This model is the contributing offsite watershed from the L303 to
Sarival Avenue. Main Concentration point is northwest of Olive Avenue
And Sarival Avenue, north of the BNSF Railroad Tracks
*Retention in Basin D45 based on available drainage reports and as-built

```
  17 IO          OUTPUT CONTROL VARIABLES
                       IPRNT          5  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN          5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1JAN99  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ        2000  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      7JAN99  ENDING DATE
                      NDTIME        2235  ENDING TIME
                      ICENT          19  CENTURY MARK

                   COMPUTATION INTERVAL    0.08 HOURS
                       TOTAL TIME BASE  166.58 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
                STORAGE VOLUME        ACRE-FEET
                SURFACE AREA          ACRES
                TEMPERATURE           DEGREES FAHRENHEIT

  19 JD          INDEX STORM NO. 1
                        STRM        3.47  PRECIPITATION DEPTH
                        TRDA        0.00  TRANSPOSITION DRAINAGE AREA

  20 PI            PRECIPITATION PATTERN
                     0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
```

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix B.3

HEC-1: 50-yr, 6-hr Results

```
1****************************************                                                  ****************************************
 *                                      *                                                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                  *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                  *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                                  *          609 SECOND STREET           *
 *                                      *                                                  *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   18OCT17  TIME  18:55:37  *                                                  *           (916) 756-1104             *
 *                                      *                                                  *                                      *
 ****************************************                                                  ****************************************


                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X        XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X       XXXXX   X
                                                X     X  X        X               X
                                                X     X  X        X     X         X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                  HEC-1 INPUT                                                  PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             1          ID        MARICOPA COUNTY DOT
             2          ID        TT0561-OLIVE AVE - TT0561-OLIVE AVE-Exst
             3          ID        50 YEAR
             4          ID        6 Hour  Storm
             5          ID        Unit Hydrograph: Clark
             6          ID        Storm: Multiple
             7          ID        10/16/2017
             8          ID
             9          ID        MCDOT Project Number TT0561 - Olive Avenue, L303 to Sarival Ave
            10          ID        Model:  Existing Conditions
            11          ID
            12          ID        This model is the contributing offsite watershed from the L303 to
            13          ID        Sarival Avenue.  Main Concentration point is northwest of Olive Avenue
            14          ID        And Sarival Avenue, north of the BNSF Railroad Tracks
            15          ID        *Retention in Basin D45 based on available drainage reports and as-built
                        *
                        *DIAGRAM
            16          IT       5  1JAN99       0    2000
            17          IO       5
            18          IN      15
                        *
            19          JD   2.100  0.0001
            20          PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
            21          PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
            22          PC   0.962   0.972   0.983   0.991   1.000
            23          JD   2.087   0.500
            24          PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
            25          PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
            26          PC   0.962   0.972   0.983   0.991   1.000
            27          JD   2.072   1.000
            28          PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
            29          PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
            30          PC   0.962   0.972   0.983   0.991   1.000
            31          JD   2.047     2.8
            32          PC   0.000   0.009   0.016   0.025   0.034   0.042   0.051   0.059   0.067   0.076
            33          PC   0.087   0.100   0.120   0.163   0.252   0.451   0.694   0.837   0.900   0.938
            34          PC   0.950   0.963   0.975   0.988   1.000
                        *

            35          KK     D45   BASIN
            36          BA   0.459
            37          LG    0.38    0.25    4.87    0.41      17
            38          UC   0.668   0.440
            39          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
            40          UA     100
                        *

            41          KK     R45 STORAGE - 100-year 2 hour Development Storage
            42          DT    R45S   22.66     0.0
            43          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
            44          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                        *
                        *
1                                                  HEC-1 INPUT                                                  PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


            45          KK  L45L57   ROUTE
            46          RS      19    FLOW
            47          RC   0.060   0.030   0.040    5150  0.0033    0.00
            48          RX    0.00   10.00   22.00   62.00   87.00   87.50   97.50  107.50
            49          RY   10.00    9.50    6.00    7.00    6.50    7.00    8.00    9.00
                        *
                        *

            50          KK     D57   BASIN
            51          BA   0.448
            52          LG    0.50    0.25    4.33    0.61       0
            53          UC   0.788   0.463
            54          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
            55          UA     100
                        *

            56          KK    CP57 COMBINE
            57          HC       2
                        *
            58          ZZ
```

```
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    35         D45
                 .
                 .
    42           .------->    R45S
    41         R45
                 V
                 V
    45      L45L57
                 .
                 .
    50           .         D57
                 .           .
                 .           .
    56        CP57............

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                                                  ****************************************
 *                                       *                                                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                  *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998               *                                                  *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1                *                                                  *          609 SECOND STREET           *
 *                                       *                                                  *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   18OCT17  TIME  18:55:37   *                                                  *           (916) 756-1104             *
 *                                       *                                                  *                                      *
 *****************************************                                                  ****************************************


                                 MARICOPA COUNTY DOT
                                 TT0561-OLIVE AVE - TT0561-OLIVE AVE-Exst
                                 50 YEAR
                                 6 Hour  Storm
                                 Unit Hydrograph: Clark
                                 Storm: Multiple
                                 10/16/2017

                                    MCDOT Project Number TT0561 - Olive Avenue, L303 to Sarival Ave
                                    Model:  Existing Conditions

                                    This model is the contributing offsite watershed from the L303 to
                                    Sarival Avenue.  Main Concentration point is northwest of Olive Avenue
                                    And Sarival Avenue, north of the BNSF Railroad Tracks
                                 *Retention in Basin D45 based on available drainage reports and as-built

   17 IO          OUTPUT CONTROL VARIABLES
                        IPRNT           5  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                         NMIN           5  MINUTES IN COMPUTATION INTERVAL
                        IDATE      1JAN99  STARTING DATE
                        ITIME        0000  STARTING TIME
                           NQ        2000  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE      7JAN99  ENDING DATE
                       NDTIME        2235  ENDING TIME
                       ICENT          19  CENTURY MARK

                    COMPUTATION INTERVAL    0.08 HOURS
                         TOTAL TIME BASE  166.58 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
                STORAGE VOLUME        ACRE-FEET
                SURFACE AREA          ACRES
                TEMPERATURE           DEGREES FAHRENHEIT

   19 JD          INDEX STORM NO. 1
                         STRM        2.10  PRECIPITATION DEPTH
                         TRDA        0.00  TRANSPOSITION DRAINAGE AREA

   20 PI            PRECIPITATION PATTERN
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.01      0.01      0.01      0.01      0.01      0.01      0.03
                       0.03      0.03      0.05      0.05      0.05      0.15      0.15      0.15      0.03      0.03
                       0.03      0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00

   23 JD          INDEX STORM NO. 2
                         STRM        2.09  PRECIPITATION DEPTH
                         TRDA        0.50  TRANSPOSITION DRAINAGE AREA

   24 PI            PRECIPITATION PATTERN
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.01      0.01      0.01      0.01      0.01      0.01      0.03
                       0.03      0.03      0.05      0.05      0.05      0.15      0.15      0.15      0.03      0.03
                       0.03      0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00

   27 JD          INDEX STORM NO. 3
                         STRM        2.07  PRECIPITATION DEPTH
                         TRDA        1.00  TRANSPOSITION DRAINAGE AREA

   28 PI            PRECIPITATION PATTERN
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.01      0.01      0.01      0.01      0.01      0.01      0.03
```

```
                    0.03      0.03      0.05      0.05      0.05      0.15      0.15      0.15      0.03      0.03
                    0.03      0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00

   31 JD          INDEX STORM NO. 4
                       STRM        2.05  PRECIPITATION DEPTH
                       TRDA        2.80  TRANSPOSITION DRAINAGE AREA

   32 PI            PRECIPITATION PATTERN
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00      0.00      0.01      0.01      0.01      0.01      0.01      0.01      0.03
                    0.03      0.03      0.07      0.07      0.07      0.08      0.08      0.08      0.05      0.05
                    0.05      0.02      0.02      0.02      0.01      0.01      0.01      0.00      0.00      0.00
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00
1
                                                        RUNOFF SUMMARY
                                                    FLOW IN CUBIC FEET PER SECOND
                                                TIME IN HOURS,  AREA IN SQUARE MILES

                                        PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION       FLOW    PEAK                                           AREA      STAGE     MAX STAGE
+                                                                 6-HOUR     24-HOUR     72-HOUR

          HYDROGRAPH AT
+                           D45        275.    4.25          43.         11.          4.       0.46

          DIVERSION TO
+                          R45S        275.    4.25          43.         11.          4.       0.46

          HYDROGRAPH AT
+                           R45          0.    0.00           0.          0.          0.       0.46

          ROUTED TO
+                         L45L57         0.    0.00           0.          0.          0.       0.46

          HYDROGRAPH AT
+                           D57        160.    4.33          23.          6.          2.       0.45

          2 COMBINED AT
+                          CP57        157.    4.33          23.          6.          2.       0.91


 *** NORMAL END OF HEC-1 ***
```

Appendix B.4

HEC-1: 50-yr, 24-hr Results

```
1*****************************************                                                  ***************************************
 *                                       *                                                  *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                  *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998               *                                                  *    HYDROLOGIC ENGINEERING CENTER    *
 *           VERSION 4.1                 *                                                  *          609 SECOND STREET          *
 *                                       *                                                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   16OCT17  TIME  10:59:27   *                                                  *           (916) 756-1104            *
 *                                       *                                                  *                                     *
 *****************************************                                                  ***************************************


                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X         XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X               X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                  HEC-1 INPUT                                                  PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID        MARICOPA COUNTY DOT
            2           ID        TT0561-OLIVE AVE - TT0561-OLIVE AVE-Exst
            3           ID        50 YEAR
            4           ID        24 Hour  Storm
            5           ID        Unit Hydrograph: Clark
            6           ID        Storm: Multiple
            7           ID        10/16/2017
            8           ID
            9           ID        MCDOT Project Number TT0561 - Olive Avenue, L303 to Sarival Ave
           10           ID        Model:  Existing Conditions
           11           ID
           12           ID        This model is the contributing offsite watershed from the L303 to
           13           ID        Sarival Avenue.  Main Concentration point is northwest of Olive Avenue
           14           ID        And Sarival Avenue, north of the BNSF Railroad Tracks
           15           ID        *Retention in Basin D45 based on available drainage reports and as-built
                        *
                        *DIAGRAM
           16           IT       5  1JAN99       0    2000
           17           IO       5
           18           IN      15
                        *
           19           JD   3.080  0.0001
           20           PC   0.000   0.002   0.005   0.008   0.011   0.014   0.017   0.020   0.023   0.026
           21           PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056   0.060
           22           PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
           23           PC   0.110   0.115   0.120   0.126   0.133   0.140   0.147   0.155   0.163   0.172
           24           PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
           25           PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
           26           PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
           27           PC   0.913   0.918   0.922   0.926   0.930   0.934   0.938   0.942   0.946   0.950
           28           PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977   0.980
           29           PC   0.983   0.986   0.989   0.992   0.995   0.998   1.000
           30           JD   2.880    10.0
                        *

           31           KK     D45   BASIN
           32           BA   0.459
           33           LG    0.38    0.25    4.87    0.41      17
           34           UC   0.668   0.440
           35           UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
           36           UA     100
                        *

           37           KK     R45 STORAGE - 100-year 2 hour Development Storage
           38           DT    R45S   22.66     0.0
           39           DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
           40           DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                        *
                        *
1                                                  HEC-1 INPUT                                                  PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


           41           KK  L45L57   ROUTE
           42           RS      19    FLOW
           43           RC   0.060   0.030   0.040    5150  0.0033    0.00
           44           RX    0.00   10.00   22.00   62.00   87.00   87.50   97.50  107.50
           45           RY   10.00    9.50    6.00    7.00    6.50    7.00    8.00    9.00
                        *
                        *

           46           KK     D57   BASIN
           47           BA   0.448
           48           LG    0.50    0.25    4.33    0.61       0
           49           UC   0.788   0.463
           50           UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
           51           UA     100
                        *

           52           KK    CP57 COMBINE
           53           HC       2
                        *
           54           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW
```

```
  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   31         D45
                .
                .
   38           .-------->    R45S
   37         R45
                V
                V
   41       L45L57
                .
                .
   46           .          D57
                .            .
                .            .
   52        CP57............

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************                                    ****************************************
*                                      *                                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
*             JUN   1998               *                                    *    HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1               *                                    *         609 SECOND STREET            *
*                                      *                                    *       DAVIS, CALIFORNIA 95616        *
*  RUN DATE   16OCT17  TIME  10:59:27  *                                    *           (916) 756-1104             *
*                                      *                                    *                                      *
****************************************                                    ****************************************
```

```
                              MARICOPA COUNTY DOT
                              TT0561-OLIVE AVE - TT0561-OLIVE AVE-Exst
                              50 YEAR
                              24 Hour  Storm
                              Unit Hydrograph: Clark
                              Storm: Multiple
                              10/16/2017

                                 MCDOT Project Number TT0561 - Olive Avenue, L303 to Sarival Ave
                                 Model:  Existing Conditions

                                 This model is the contributing offsite watershed from the L303 to
                                 Sarival Avenue.  Main Concentration point is northwest of Olive Avenue
                                 And Sarival Avenue, north of the BNSF Railroad Tracks
                              *Retention in Basin D45 based on available drainage reports and as-built

  17 IO          OUTPUT CONTROL VARIABLES
                       IPRNT          5  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN          5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1JAN99  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ        2000  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      7JAN99  ENDING DATE
                      NDTIME        2235  ENDING TIME
                      ICENT          19  CENTURY MARK

                    COMPUTATION INTERVAL    0.08 HOURS
                        TOTAL TIME BASE  166.58 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
                STORAGE VOLUME        ACRE-FEET
                SURFACE AREA          ACRES
                TEMPERATURE           DEGREES FAHRENHEIT

  19 JD           INDEX STORM NO. 1
                         STRM        3.08  PRECIPITATION DEPTH
                         TRDA        0.00  TRANSPOSITION DRAINAGE AREA

  20 PI             PRECIPITATION PATTERN
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                       0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                       0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                       0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

  30 JD           INDEX STORM NO. 2
                         STRM        2.88  PRECIPITATION DEPTH
                         TRDA       10.00  TRANSPOSITION DRAINAGE AREA

   0 PI             PRECIPITATION PATTERN
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
```

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix B.5

HEC-1 Input Summary Tables

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)	Comments
Major Basin ID: 01									
D45	651	Bs	6512257	0.006	1.20	0.390	-	100	
	651	Es	6512857	0.001	0.20	0.250	-	100	
	651	Mp	6514451	0.144	31.30	0.250	-	100	
	651	AbA	651202320	0.001	0.20	0.380	-	100	
	651	GgA	651323320	0.085	18.50	0.250	-	100	
	651	LcA	651422520	0.224	48.70	0.250	-	100	
D57	651	Ae	6512029	0.000	0.10	0.390	-	100	
	651	Bs	6512257	0.029	6.40	0.390	-	100	
	651	Es	6512857	0.019	4.10	0.250	-	100	
	651	Ma	6514421	0.056	12.50	0.400	-	100	
	651	Pa	6515021	0.007	1.50	0.400	-	100	
	651	Va	6516221	0.021	4.60	0.390	-	100	
	651	AbA	651202320	0.185	41.40	0.380	-	100	
	651	GgA	651323320	0.076	17.00	0.250	-	100	
	651	LcA	651422520	0.056	12.50	0.250	-	100	

Flood Control District of Maricopa County
Drainage Design Management System
LAND USE
Project Reference: TT0561-OLIVE AVE

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetation Cover (%)	DTHETA	Kb	Description
Major Basin ID: 01									
D45	150	0.1506	32.8	0.25	30	50.0	NORMAL	0.025	Small Lot Residential - Single Family (4-6 du per acre)
	160	0.0632	13.7	0.25	40	50.0	NORMAL	0.025	Very Small Lot Residential - Single Family (>6 du per acre-i
	190	0.0149	3.2	0.25	45	50.0	NORMAL	0.025	Very High Density Residential - Multi Family (> 15 du per ac
	750	0.2311	50.3	0.50	0	85.0	NORMAL	0.046	Agriculture
		0.4598	**100.0**						
D57	750	0.4480	100.0	0.50	0	85.0	NORMAL	0.046	Agriculture
		0.4480	**100.0**						

* Non default value

Major Basin	Area (sq mi)	Storm	Duration	Tab Interval	Ordinates	Output	Description
01	0.9080	Multiple	24 Hour	5	2,000	5	Major Basin 01

Area ID	Sub Basin Parameters						Rainfall Losses						Return Period Parameters					
	Area (sq mi)	Length (mi)	Slope (ft/mi)	Adj Slope	Time-Area	Kb	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)		2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
Major Basin ID: 01																		
D45	0.460	1.25	28.8	28.8	Urban	0.035	0.38	0.25	4.87	0.413	17	**Tc (Hrs)**	0.961*	0.961*	0.870	0.771	0.715	0.668
												Vel (f/s)	1.91	1.91	2.11	2.38	2.56	2.74
												R (Hrs)	0.659	0.659	0.590	0.516	0.475	0.440
D57	0.448	1.04	28.8	28.8	Urban	0.046	0.50	0.25	4.33	0.611		**Tc (Hrs)**	1.451*	1.451*	1.174*	0.948*	0.856	0.788
												Vel (f/s)	1.05	1.05	1.30	1.61	1.78	1.94
												R (Hrs)	0.912	0.912	0.721	0.569	0.508	0.463

NOAA Atlas 14, Volume 1, Version 5
Location name: Waddell, Arizona, USA*
Latitude: 33.5664°, Longitude: -112.4145°
Elevation: 1171.87 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.183 (0.148-0.230)	0.238 (0.194-0.299)	0.323 (0.261-0.405)	0.390 (0.313-0.486)	0.479 (0.381-0.596)	0.549 (0.429-0.679)	0.621 (0.477-0.767)	0.695 (0.525-0.860)	0.794 (0.584-0.983)	0.868 (0.626-1.07)
10-min	0.278 (0.225-0.349)	0.361 (0.294-0.455)	0.492 (0.398-0.616)	0.593 (0.477-0.739)	0.729 (0.580-0.907)	0.835 (0.654-1.03)	0.945 (0.726-1.17)	1.06 (0.799-1.31)	1.21 (0.889-1.50)	1.32 (0.953-1.64)
15-min	0.344 (0.279-0.433)	0.448 (0.365-0.564)	0.610 (0.493-0.764)	0.735 (0.591-0.916)	0.905 (0.718-1.13)	1.04 (0.810-1.28)	1.17 (0.900-1.45)	1.31 (0.990-1.62)	1.50 (1.10-1.85)	1.64 (1.18-2.03)
30-min	0.464 (0.376-0.583)	0.603 (0.491-0.760)	0.821 (0.664-1.03)	0.990 (0.795-1.23)	1.22 (0.968-1.51)	1.40 (1.09-1.73)	1.58 (1.21-1.95)	1.77 (1.33-2.18)	2.02 (1.49-2.50)	2.21 (1.59-2.73)
60-min	0.574 (0.465-0.721)	0.746 (0.608-0.940)	1.02 (0.822-1.27)	1.23 (0.984-1.53)	1.51 (1.20-1.87)	1.73 (1.35-2.14)	1.95 (1.50-2.41)	2.19 (1.65-2.70)	2.50 (1.84-3.09)	2.73 (1.97-3.38)
2-hr	0.657 (0.544-0.807)	0.846 (0.700-1.04)	1.14 (0.936-1.40)	1.36 (1.11-1.66)	1.66 (1.34-2.03)	1.90 (1.51-2.31)	2.14 (1.67-2.60)	2.39 (1.83-2.89)	2.73 (2.05-3.31)	3.00 (2.19-3.64)
3-hr	0.688 (0.567-0.850)	0.879 (0.730-1.09)	1.16 (0.961-1.44)	1.39 (1.14-1.71)	1.70 (1.37-2.07)	1.95 (1.55-2.37)	2.21 (1.73-2.69)	2.50 (1.91-3.03)	2.89 (2.15-3.51)	3.21 (2.32-3.91)
6-hr	0.791 (0.674-0.954)	1.00 (0.856-1.21)	1.29 (1.10-1.55)	1.53 (1.28-1.83)	1.85 (1.53-2.20)	2.10 (1.71-2.49)	2.36 (1.89-2.81)	2.64 (2.07-3.14)	3.03 (2.31-3.60)	3.34 (2.49-3.98)
12-hr	0.892 (0.769-1.05)	1.12 (0.969-1.32)	1.43 (1.23-1.68)	1.67 (1.42-1.95)	1.99 (1.68-2.32)	2.24 (1.86-2.60)	2.49 (2.05-2.91)	2.75 (2.23-3.22)	3.12 (2.45-3.65)	3.40 (2.63-4.02)
24-hr	1.16 (1.02-1.31)	1.47 (1.30-1.66)	1.90 (1.68-2.15)	2.24 (1.97-2.52)	2.71 (2.37-3.04)	3.08 (2.68-3.45)	3.47 (2.99-3.88)	3.88 (3.31-4.33)	4.43 (3.75-4.96)	4.86 (4.08-5.46)
2-day	1.23 (1.07-1.41)	1.57 (1.37-1.79)	2.05 (1.79-2.34)	2.44 (2.12-2.78)	2.97 (2.57-3.39)	3.40 (2.93-3.86)	3.85 (3.29-4.36)	4.31 (3.67-4.89)	4.96 (4.16-5.64)	5.48 (4.55-6.26)
3-day	1.32 (1.16-1.51)	1.69 (1.48-1.93)	2.21 (1.94-2.53)	2.64 (2.31-3.01)	3.24 (2.81-3.68)	3.72 (3.21-4.22)	4.22 (3.63-4.79)	4.75 (4.05-5.39)	5.50 (4.63-6.25)	6.10 (5.09-6.96)
4-day	1.41 (1.25-1.62)	1.80 (1.59-2.06)	2.38 (2.09-2.71)	2.84 (2.50-3.24)	3.50 (3.06-3.98)	4.03 (3.50-4.57)	4.60 (3.96-5.21)	5.20 (4.44-5.88)	6.04 (5.11-6.85)	6.73 (5.63-7.65)
7-day	1.56 (1.38-1.80)	2.00 (1.76-2.30)	2.64 (2.32-3.02)	3.16 (2.77-3.61)	3.89 (3.39-4.43)	4.48 (3.88-5.09)	5.10 (4.39-5.79)	5.76 (4.92-6.54)	6.70 (5.65-7.61)	7.45 (6.22-8.48)
10-day	1.71 (1.51-1.95)	2.18 (1.93-2.50)	2.88 (2.54-3.29)	3.44 (3.02-3.92)	4.22 (3.69-4.79)	4.85 (4.21-5.50)	5.51 (4.75-6.24)	6.21 (5.32-7.03)	7.19 (6.09-8.15)	7.98 (6.69-9.06)
20-day	2.03 (1.80-2.29)	2.61 (2.32-2.95)	3.44 (3.05-3.88)	4.07 (3.60-4.58)	4.92 (4.33-5.52)	5.57 (4.88-6.24)	6.22 (5.44-6.99)	6.90 (6.00-7.73)	7.79 (6.73-8.75)	8.48 (7.28-9.56)
30-day	2.36 (2.08-2.68)	3.03 (2.67-3.44)	3.99 (3.51-4.52)	4.72 (4.14-5.34)	5.69 (4.97-6.43)	6.45 (5.61-7.27)	7.21 (6.25-8.14)	7.99 (6.89-9.03)	9.03 (7.72-10.2)	9.83 (8.35-11.2)
45-day	2.77 (2.46-3.13)	3.57 (3.16-4.03)	4.69 (4.15-5.29)	5.53 (4.88-6.22)	6.62 (5.82-7.45)	7.44 (6.52-8.38)	8.27 (7.21-9.31)	9.09 (7.89-10.2)	10.2 (8.78-11.5)	11.0 (9.43-12.4)
60-day	3.04 (2.71-3.42)	3.93 (3.50-4.41)	5.16 (4.58-5.78)	6.05 (5.36-6.78)	7.21 (6.38-8.07)	8.07 (7.12-9.04)	8.93 (7.84-10.0)	9.77 (8.54-11.0)	10.9 (9.44-12.2)	11.7 (10.1-13.2)

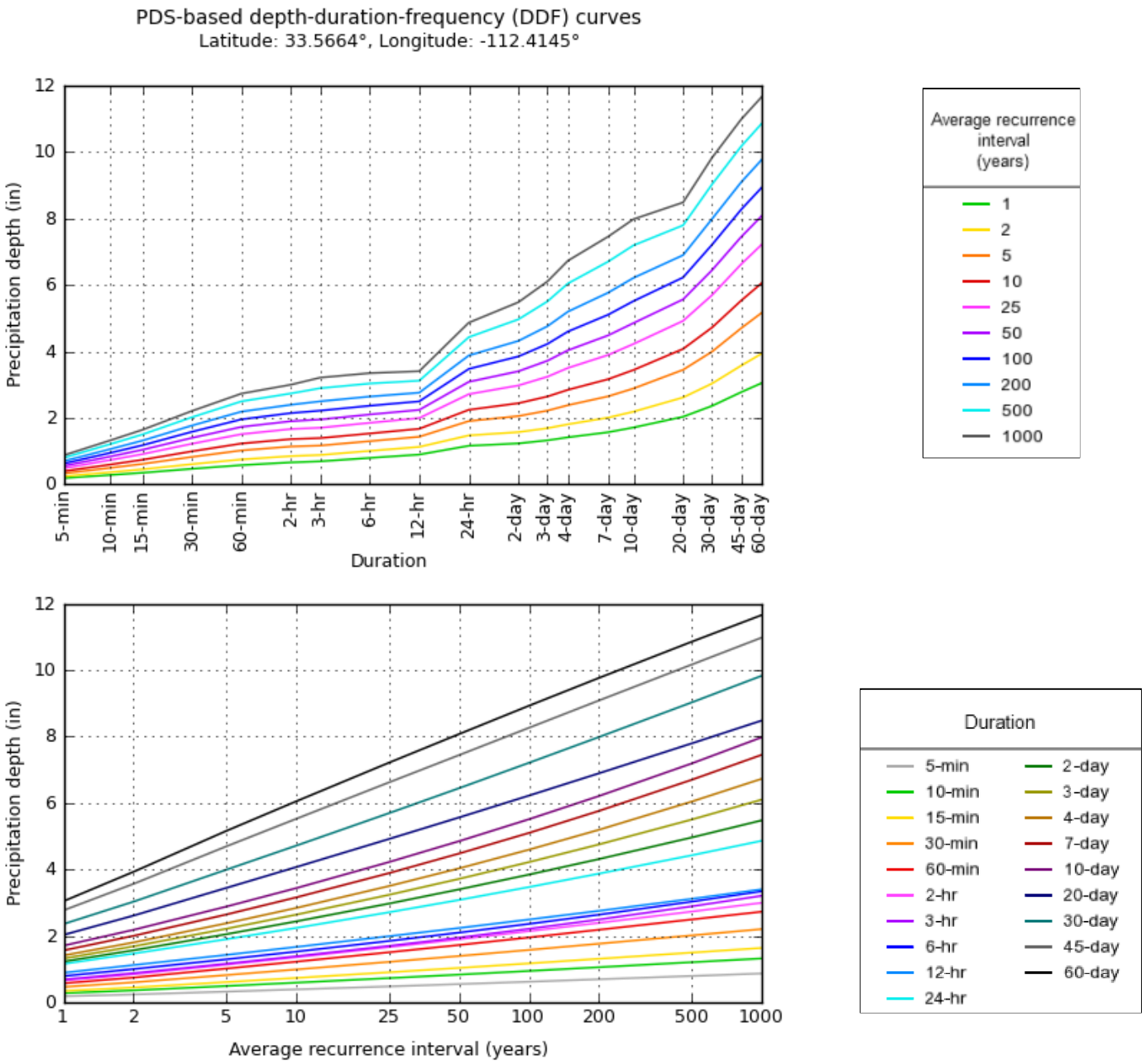
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



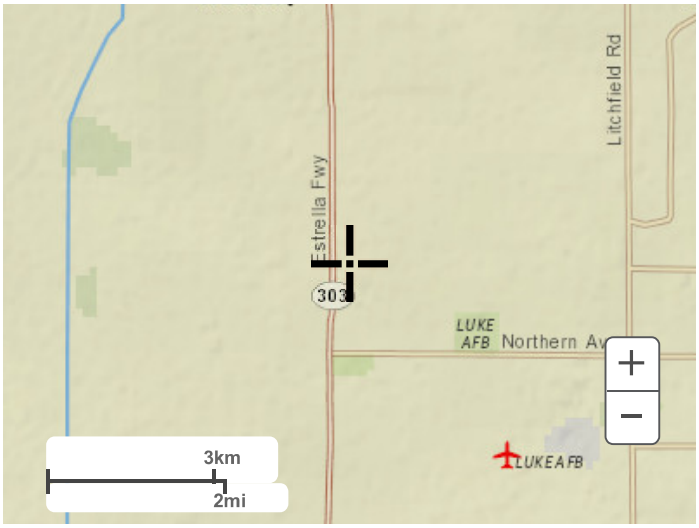
NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Fri Apr 21 18:47:17 2017

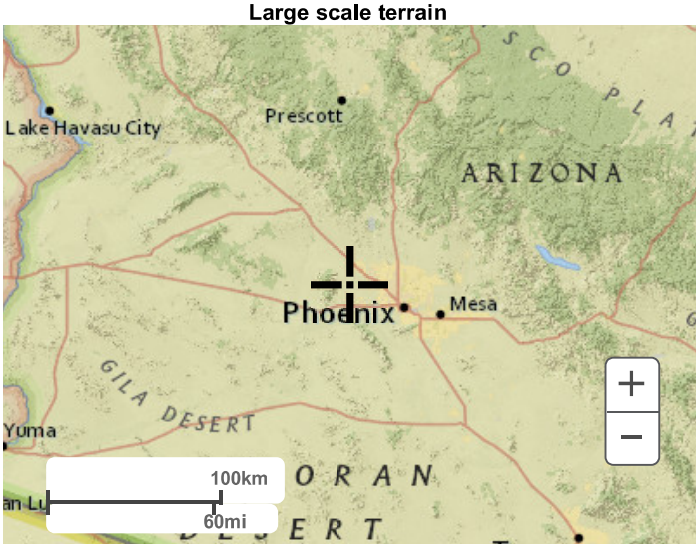
Back to Top

Maps & aerials

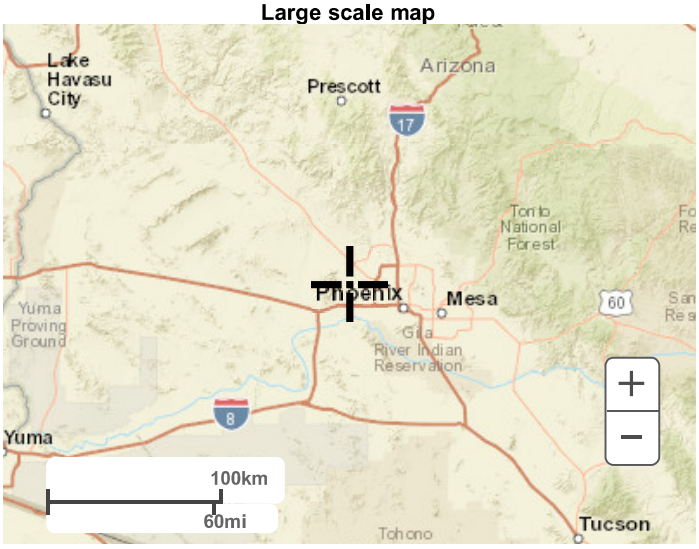
Small scale terrain



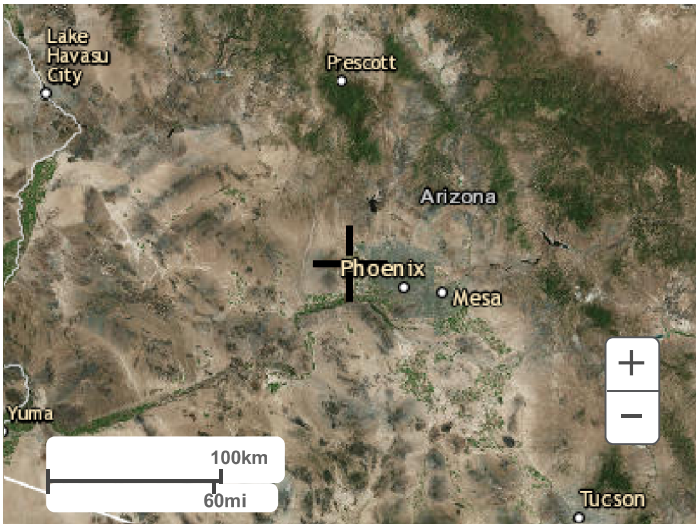
Large scale terrain



Large scale map



Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

NOAA Atlas 14, Volume 1, Version 5
Location name: Waddell, Arizona, USA*
Latitude: 33.5664°, Longitude: -112.4145°
Elevation: 1171.87 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.20 (1.78-2.76)	2.86 (2.33-3.59)	3.88 (3.13-4.86)	4.68 (3.76-5.83)	5.75 (4.57-7.15)	6.59 (5.15-8.15)	7.45 (5.72-9.20)	8.34 (6.30-10.3)	9.53 (7.01-11.8)	10.4 (7.51-12.9)
10-min	1.67 (1.35-2.09)	2.17 (1.76-2.73)	2.95 (2.39-3.70)	3.56 (2.86-4.43)	4.37 (3.48-5.44)	5.01 (3.92-6.20)	5.67 (4.36-7.01)	6.35 (4.79-7.85)	7.25 (5.33-8.98)	7.93 (5.72-9.82)
15-min	1.38 (1.12-1.73)	1.79 (1.46-2.26)	2.44 (1.97-3.06)	2.94 (2.36-3.66)	3.62 (2.87-4.50)	4.14 (3.24-5.13)	4.69 (3.60-5.79)	5.25 (3.96-6.49)	5.99 (4.41-7.42)	6.55 (4.73-8.12)
30-min	0.928 (0.752-1.17)	1.21 (0.982-1.52)	1.64 (1.33-2.06)	1.98 (1.59-2.47)	2.44 (1.94-3.03)	2.79 (2.18-3.45)	3.16 (2.42-3.90)	3.53 (2.67-4.37)	4.03 (2.97-4.99)	4.41 (3.18-5.47)
60-min	0.574 (0.465-0.721)	0.746 (0.608-0.940)	1.02 (0.822-1.27)	1.23 (0.984-1.53)	1.51 (1.20-1.87)	1.73 (1.35-2.14)	1.95 (1.50-2.41)	2.19 (1.65-2.70)	2.50 (1.84-3.09)	2.73 (1.97-3.38)
2-hr	0.328 (0.272-0.404)	0.423 (0.350-0.522)	0.568 (0.468-0.698)	0.679 (0.555-0.832)	0.831 (0.669-1.01)	0.948 (0.753-1.15)	1.07 (0.836-1.30)	1.20 (0.917-1.45)	1.37 (1.02-1.65)	1.50 (1.10-1.82)
3-hr	0.229 (0.189-0.283)	0.293 (0.243-0.363)	0.387 (0.320-0.479)	0.462 (0.379-0.568)	0.566 (0.457-0.689)	0.649 (0.515-0.790)	0.737 (0.576-0.896)	0.831 (0.636-1.01)	0.962 (0.715-1.17)	1.07 (0.773-1.30)
6-hr	0.132 (0.113-0.159)	0.167 (0.143-0.202)	0.216 (0.183-0.260)	0.255 (0.214-0.305)	0.308 (0.255-0.368)	0.351 (0.285-0.416)	0.394 (0.316-0.468)	0.441 (0.346-0.524)	0.506 (0.386-0.602)	0.558 (0.416-0.665)
12-hr	0.074 (0.064-0.087)	0.093 (0.080-0.110)	0.119 (0.102-0.139)	0.138 (0.118-0.162)	0.165 (0.139-0.193)	0.186 (0.155-0.216)	0.207 (0.170-0.241)	0.229 (0.185-0.267)	0.259 (0.204-0.303)	0.282 (0.218-0.334)
24-hr	0.048 (0.043-0.055)	0.061 (0.054-0.069)	0.079 (0.070-0.089)	0.093 (0.082-0.105)	0.113 (0.099-0.127)	0.128 (0.112-0.144)	0.145 (0.125-0.162)	0.161 (0.138-0.180)	0.184 (0.156-0.207)	0.203 (0.170-0.227)
2-day	0.026 (0.022-0.029)	0.033 (0.029-0.037)	0.043 (0.037-0.049)	0.051 (0.044-0.058)	0.062 (0.054-0.071)	0.071 (0.061-0.080)	0.080 (0.068-0.091)	0.090 (0.076-0.102)	0.103 (0.087-0.118)	0.114 (0.095-0.130)
3-day	0.018 (0.016-0.021)	0.023 (0.021-0.027)	0.031 (0.027-0.035)	0.037 (0.032-0.042)	0.045 (0.039-0.051)	0.052 (0.045-0.059)	0.059 (0.050-0.067)	0.066 (0.056-0.075)	0.076 (0.064-0.087)	0.085 (0.071-0.097)
4-day	0.015 (0.013-0.017)	0.019 (0.017-0.022)	0.025 (0.022-0.028)	0.030 (0.026-0.034)	0.036 (0.032-0.041)	0.042 (0.036-0.048)	0.048 (0.041-0.054)	0.054 (0.046-0.061)	0.063 (0.053-0.071)	0.070 (0.059-0.080)
7-day	0.009 (0.008-0.011)	0.012 (0.011-0.014)	0.016 (0.014-0.018)	0.019 (0.016-0.021)	0.023 (0.020-0.026)	0.027 (0.023-0.030)	0.030 (0.026-0.034)	0.034 (0.029-0.039)	0.040 (0.034-0.045)	0.044 (0.037-0.050)
10-day	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.012 (0.011-0.014)	0.014 (0.013-0.016)	0.018 (0.015-0.020)	0.020 (0.018-0.023)	0.023 (0.020-0.026)	0.026 (0.022-0.029)	0.030 (0.025-0.034)	0.033 (0.028-0.038)
20-day	0.004 (0.004-0.005)	0.005 (0.005-0.006)	0.007 (0.006-0.008)	0.008 (0.007-0.010)	0.010 (0.009-0.012)	0.012 (0.010-0.013)	0.013 (0.011-0.015)	0.014 (0.012-0.016)	0.016 (0.014-0.018)	0.018 (0.015-0.020)
30-day	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.006 (0.005-0.006)	0.007 (0.006-0.007)	0.008 (0.007-0.009)	0.009 (0.008-0.010)	0.010 (0.009-0.011)	0.011 (0.010-0.013)	0.013 (0.011-0.014)	0.014 (0.012-0.015)
45-day	0.003 (0.002-0.003)	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.005-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.008 (0.007-0.009)	0.009 (0.008-0.011)	0.010 (0.009-0.012)
60-day	0.002 (0.002-0.002)	0.003 (0.002-0.003)	0.004 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.004-0.006)	0.006 (0.005-0.006)	0.006 (0.005-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.008)	0.008 (0.007-0.009)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

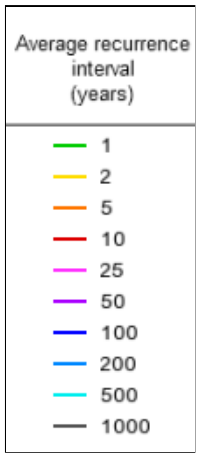
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

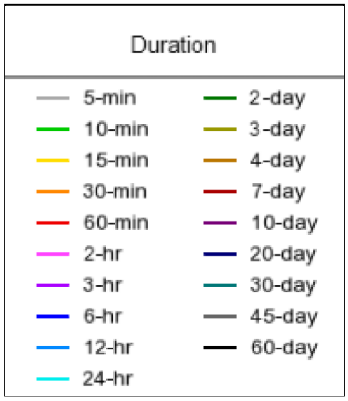
Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

PDS-based intensity-duration-frequency (IDF) curves

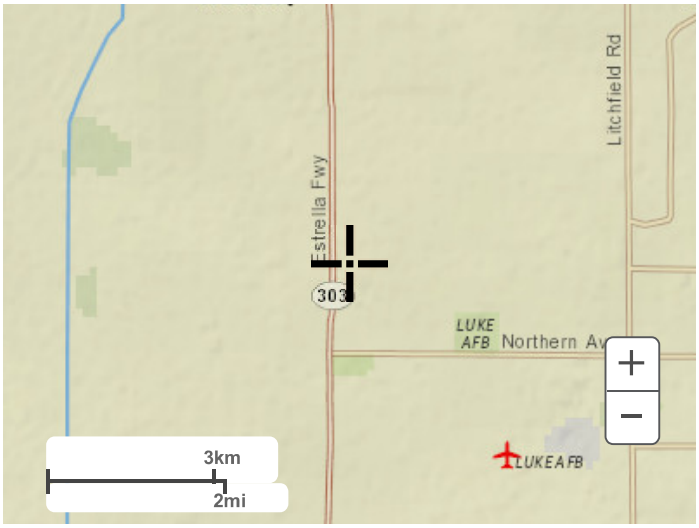




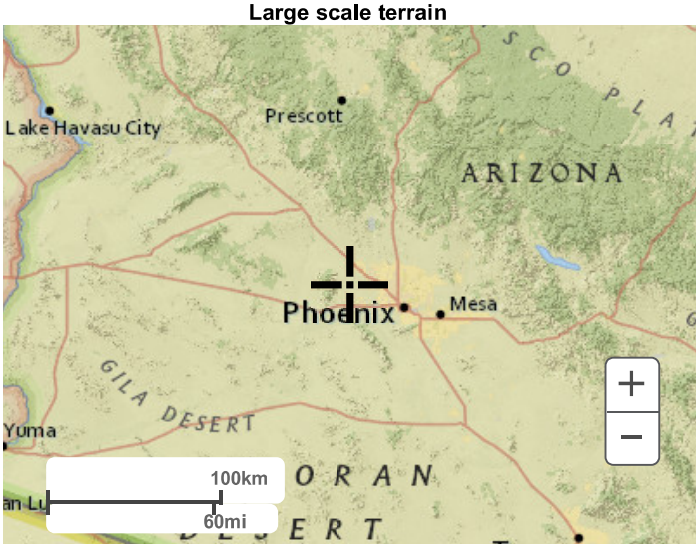
Back to Top

Maps & aerials

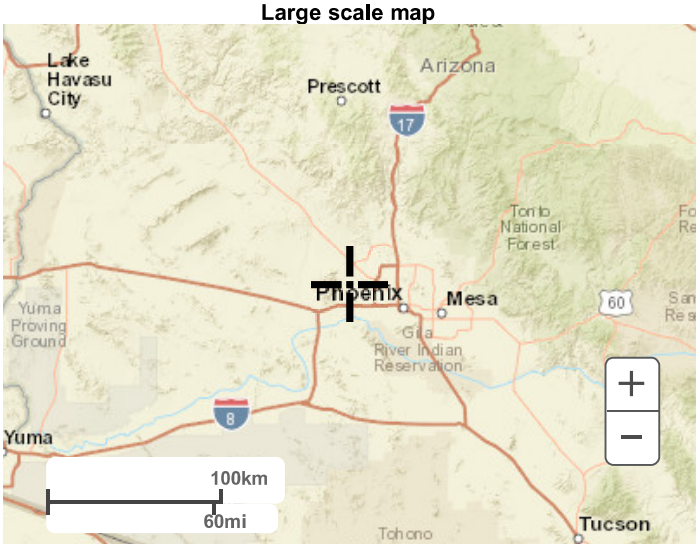
Small scale terrain



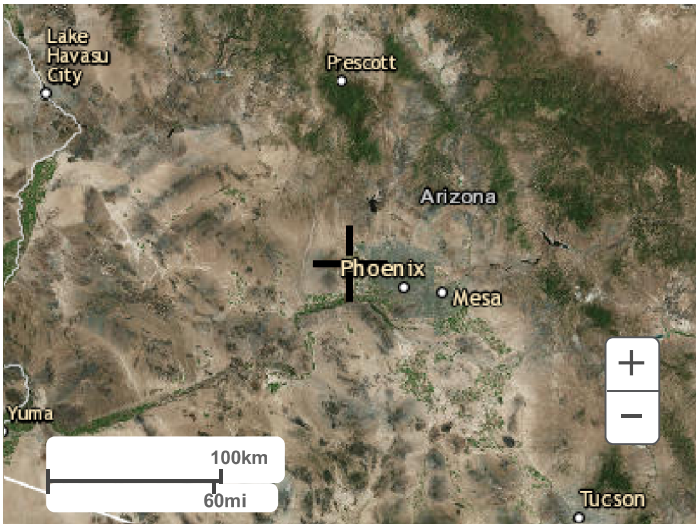
Large scale terrain



Large scale map



Large scale aerial



Back to Top

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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Project: TT0561 - Olive Avenue Widening
Location: Glendale, AZ
Date: April 25, 2017
Subject: HEC-1 Route NSTEP Calculations

100-Year 24-Hour Storm Event

Route	Route Length (ft)	Ave Slope (ft/ft)	Initial NSTPS	Discharge (cfs)	Velocity (ft/sec)	Calc NSTPS	New NSTPS	Discharge (cfs)	Velocity (ft/sec)	Calc NSTPS	Final NSTPS
L45L57	5150	0.0033	1	16	1.18	19	19	40	1.47	19	**19**

Notes:
1) Calculated velocities based on Bentley Flowmaster V8i calculations.

Project: TT0562 - Olive Avenue Widening
Location: Glendale, AZ
Date: October 5, 2017
Subject: Existing Conditions 'HEC-1 Retention Basin
Source: Effective Maricopa County Drainage Policies and Standards Manual, 2007

D45 - Existing 100-Year 2-Hour Retention Summary				
Basin ID	**Area (sq.ft.)**	**Subbasin Area (acres)**	**100-Year 2-Hour Depth (inches)**	**100-Year 2-Hr Volume (acre-ft)**
HEC-1 Basin D45				
Final Drainage Report for Sycamore Farms Phase 1 (North 2015)	848,931	19.49	2.13	3.54
Final Drainage Report for The Retreat at Sycamore Farms Parcel 12, Phase 2 (South)	-	-	-	2.33
Sycamore Farms Parcel 13 (2005)	3,357,169	77.07	2.13	13.68
HEC-1 Basin D46 in White Tanks Update - Does not contribute to Olive Ave & Sarival Ave				
Greer Ranch phase 1 North (school no data)	-	-	-	25.21
Greer Ranch Phase 2 As builts (volume)	-	-	2.13	14.75
Greer Ranch south pacel 12,14-21 data	-	-	-	39.61

Project: TT0561 - Olive Avenue Widening
Location: Glendale, AZ
Date: April 25, 2017
Subject: Existing Conditions 'HEC-1 Retention Basin

Source: Effective Maricopa County Drainage Policies and Standards Manual, 2007

D45 - Existing 100-Year 2-Hour Retention Summary						
Basin ID	**Area (sq.ft.)**	**Subbasin Area (acres)**	**100-Year 2-Hour Depth (inches)**	**Weighted C-Value**	**100-Year 2-Hr Volume (acre-ft)**	**100-Year 2-Hr Volume Required (ft^3)**
Multi-Family	415,935	9.55	2.13	0.94	1.59	69,399
Sycamore Farms Phases 1 & 2	From Drainage Reports and As-Builts				5.87	255,479
Estates at Sycamore Farms	From Drainage Reports and As-Builts				13.68	595,898
					Total	**987,113**
					Acre-Ft	**22.66**

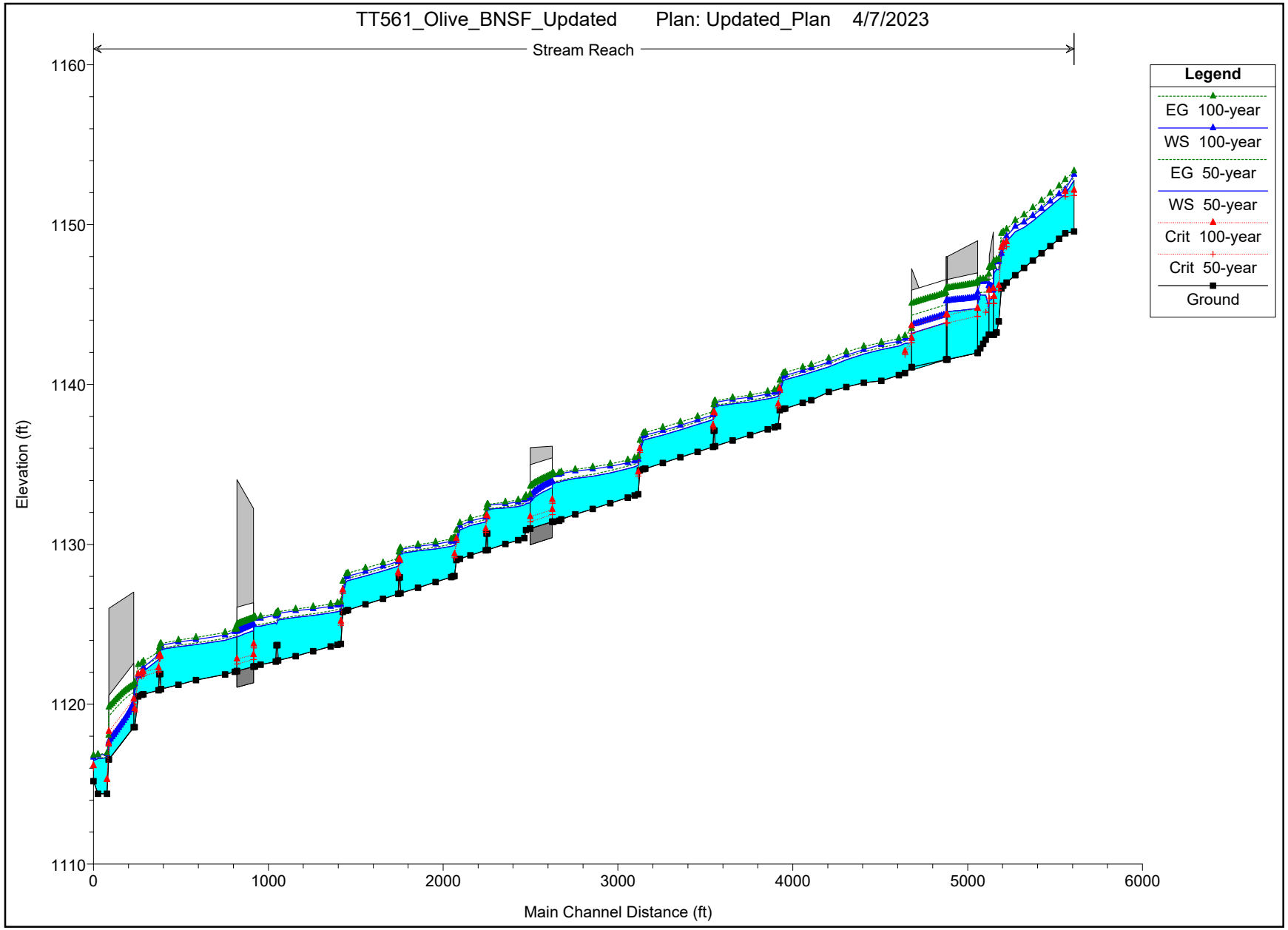
Notes:

1) Retention volumes provided are from drainage reports and as-builts.

Appendix C
Offsite Flow Analyses

Appendix C.1A

HEC-RAS Calculations – Olive Avenue Channel


TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
Stream Reach
Legend
EG 100-year
WS 100-year
EG 50-year
WS 50-year
Crit 100-year
Crit 50-year
Ground
Elevation (ft)
1160
1150
1140
1130
1120
1110
0
1000
2000
3000
4000
5000
6000
Main Channel Distance (ft)

HEC-RAS Plan: 2 River: Stream Reach: Reach Profile: 50-year

Reach	River Sta	Profile	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)	
Reach	11537	50-year	157.00	1149.58	1152.77	1151.83	1152.94	0.008945	3.34	46.96	27.46	0.45
Reach	11522	50-year	157.00	1149.45	1151.90	1151.75	1152.41	0.011011	5.77	27.22	20.50	0.88
Reach	11487	50-year	157.00	1149.12	1151.60		1152.04	0.009143	5.33	29.46	21.80	0.81
Reach	11437	50-year	157.00	1148.66	1151.14		1151.58	0.009152	5.33	29.43	21.76	0.81
Reach	11387	50-year	157.00	1148.21	1150.68		1151.12	0.009165	5.33	29.46	21.83	0.81
Reach	11337	50-year	157.00	1147.75	1150.23		1150.67	0.009055	5.31	29.59	21.87	0.80
Reach	11287	50-year	157.00	1147.29	1149.83		1150.23	0.008072	5.08	30.89	22.34	0.76
Reach	11237	50-year	157.00	1146.83	1149.55		1149.86	0.005743	4.48	35.07	23.76	0.65
Reach	11187	50-year	157.00	1146.37	1148.95	1148.62	1149.33	0.025474	4.95	31.74	22.62	0.74
Reach	11167	50-year	157.00	1146.18	1148.50	1148.50	1149.15	0.003688	6.46	24.32	19.23	1.01
Reach	11157	50-year	157.00	1146.01	1147.93	1148.26	1149.05	0.007937	8.49	18.49	17.32	1.45
Reach	11135	50-year	157.00	1143.95	1147.18	1145.90	1147.29	0.000376	2.67	58.81	31.78	0.35
Reach	11119	50-year	157.00	1143.25	1147.18		1147.28	0.000201	2.57	61.18	16.41	0.23
Reach	11114	50-year	157.00	1143.11	1146.98	1145.07	1147.23	0.000675	4.06	38.71	10.02	0.36
Reach	11088		Culvert									
Reach	11084	50-year	157.00	1143.11	1144.83	1145.08	1146.12	0.006931	9.12	17.22	10.01	1.23
Reach	11067	50-year	157.00	1142.81	1145.60	1144.53	1145.78	0.000591	3.48	45.15	22.41	0.43
Reach	11052	50-year	157.00	1142.54	1145.59		1145.77	0.000493	3.39	46.36	20.37	0.40
Reach	11036	50-year	157.00	1142.25	1145.61		1145.75	0.000353	3.02	52.04	21.03	0.34
Reach	11021	50-year	157.00	1141.98	1145.05	1144.26	1145.69	0.002262	6.38	24.59	8.01	0.64
Reach	11020		Culvert									
Reach	10843	50-year	157.00	1141.56	1144.56	1143.85	1145.22	0.001595	6.54	23.99	8.01	0.67
Reach	10838	50-year	157.00	1141.56	1144.54	1143.85	1145.21	0.001628	6.59	23.84	8.01	0.67
Reach	10837		Culvert									
Reach	10623	50-year	157.00	1140.90	1142.54	1142.47	1143.03	0.002075	5.64	27.86	24.36	0.93
Reach	10585	50-year	157.00	1140.71	1142.57		1142.71	0.008973	3.02	51.97	36.04	0.44
Reach	10550	50-year	157.00	1140.58	1142.40		1142.55	0.002809	3.08	50.97	36.00	0.46
Reach	10450	50-year	157.00	1140.23	1142.18		1142.30	0.002083	2.73	57.51	38.92	0.40
Reach	10350	50-year	157.00	1140.11	1141.90		1142.05	0.002990	3.13	50.13	36.17	0.47
Reach	10250	50-year	157.00	1139.85	1141.55		1141.72	0.003549	3.31	47.40	35.76	0.51
Reach	10150	50-year	157.00	1139.53	1141.11		1141.31	0.004648	3.63	43.23	34.79	0.57
Reach	10050	50-year	157.00	1139.01	1140.76		1140.92	0.003225	3.21	48.92	36.06	0.49
Reach	10000	50-year	157.00	1138.85	1140.60		1140.75	0.003217	3.20	49.04	36.21	0.49
Reach	9900	50-year	157.00	1138.50	1140.30		1140.45	0.002851	3.06	51.22	36.88	0.46
Reach	9889	50-year	157.00	1138.46	1140.25		1140.40	0.010013	3.10	50.63	36.71	0.47
Reach	9869	50-year	157.00	1138.39	1139.51	1139.51	1139.97	0.053178	5.46	28.76	31.33	1.00
Reach	9859	50-year	157.00	1137.39	1139.27	1138.54	1139.42	0.008825	3.05	51.54	34.81	0.44
Reach	9839	50-year	157.00	1137.32	1139.19		1139.33	0.002571	2.99	52.44	36.15	0.44
Reach	9800	50-year	157.00	1137.19	1139.10		1139.23	0.002382	2.91	53.91	36.58	0.42
Reach	9700	50-year	157.00	1136.84	1138.91		1139.02	0.001743	2.61	60.22	38.13	0.37
Reach	9600	50-year	157.00	1136.49	1138.79		1138.87	0.001179	2.27	69.19	40.23	0.31
Reach	9500	50-year	157.00	1136.14	1138.63		1138.70	0.002449	2.03	77.48	42.12	0.26
Reach	9496	50-year	157.00	1137.12	1138.49	1138.06	1138.67	0.019994	3.35	46.90	40.38	0.55
Reach	9491	50-year	157.00	1137.11	1138.05	1138.05	1138.47	0.075608	5.20	30.19	36.47	1.01
Reach	9487	50-year	157.00	1136.09	1137.81	1137.22	1137.98	0.003489	3.32	47.34	35.22	0.50
Reach	9400	50-year	157.00	1135.79	1137.50		1137.67	0.003494	3.31	47.45	35.48	0.50
Reach	9300	50-year	157.00	1135.44	1137.16		1137.33	0.003400	3.27	48.07	35.92	0.50
Reach	9200	50-year	157.00	1135.09	1136.84		1137.00	0.003171	3.18	49.42	36.53	0.48
Reach	9100	50-year	157.00	1134.74	1136.56		1136.70	0.002725	3.00	52.33	37.61	0.45
Reach	9089	50-year	157.00	1134.70	1136.50		1136.65	0.009492	3.03	51.89	37.52	0.45
Reach	9069	50-year	157.00	1134.63	1135.75	1135.75	1136.21	0.072435	5.42	28.95	31.78	1.00
Reach	9059	50-year	157.00	1133.13	1134.96	1134.28	1135.12	0.010060	3.23	48.58	33.05	0.47
Reach	9039	50-year	157.00	1133.06	1134.85		1135.02	0.003175	3.29	47.66	33.23	0.49
Reach	9000	50-year	157.00	1132.92	1134.73		1134.90	0.003049	3.25	48.31	33.35	0.48
Reach	8900	50-year	157.00	1132.57	1134.47		1134.61	0.002567	3.05	51.41	34.25	0.44
Reach	8800	50-year	157.00	1132.22	1134.26		1134.38	0.001942	2.76	56.82	35.67	0.39
Reach	8700	50-year	157.00	1131.87	1134.12		1134.21	0.001343	2.42	64.88	37.66	0.33
Reach	8620	50-year	157.00	1131.56	1133.95		1134.03	0.004404	2.18	71.88	40.05	0.29
Reach	8607	50-year	157.00	1131.47	1133.88		1133.97	0.004970	2.40	65.40	34.38	0.31
Reach	8575	50-year	157.00	1131.42	1133.86		1133.94	0.000267	2.29	68.49	36.16	0.29
Reach	8568	50-year	157.00	1131.42	1133.86	1132.57	1133.94	0.000261	2.26	69.59	37.07	0.29
Reach	8567		Culvert									
Reach	8440	50-year	157.00	1130.98	1132.60		1132.79	0.001060	3.52	44.56	35.05	0.55
Reach	8418	50-year	157.00	1130.90	1132.55		1132.72	0.019119	3.33	47.21	36.38	0.51
Reach	8408	50-year	157.00	1130.40	1132.47		1132.57	0.008726	2.54	61.84	39.65	0.36
Reach	8373	50-year	157.00	1130.26	1132.37		1132.46	0.001599	2.50	62.69	39.56	0.35
Reach	8300	50-year	157.00	1130.02	1132.28		1132.36	0.001227	2.28	68.96	41.15	0.31
Reach	8200	50-year	157.00	1129.66	1132.21		1132.24	0.000905	1.37	114.72	53.19	0.16
Reach	8196	50-year	157.00	1130.67	1132.04	1131.61	1132.21	0.019682	3.30	47.51	41.25	0.54
Reach	8191	50-year	157.00	1130.67	1131.60	1131.60	1132.02	0.075767	5.16	30.46	37.36	1.01
Reach	8187	50-year	157.00	1129.62	1131.40	1130.75	1131.55	0.002957	3.10	50.61	36.78	0.47
Reach	8100	50-year	157.00	1129.32	1131.17		1131.31	0.002551	2.94	53.33	37.53	0.44
Reach	8039	50-year	157.00	1129.09	1130.89		1131.04	0.009656	3.06	51.32	36.96	0.46
Reach	8019	50-year	157.00	1129.02	1130.13	1130.13	1130.59	0.073362	5.43	28.93	32.03	1.01
Reach	8009	50-year	157.00	1128.02	1129.93	1129.16	1130.07	0.008218	2.95	53.16	35.66	0.43
Reach	8000	50-year	157.00	1127.99	1129.90		1130.03	0.002370	2.91	54.02	36.61	0.42

HEC-RAS Plan: 2 River: Stream Reach: Reach Profile: 50-year (Continued)

Reach	River Sta	Profile	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)	
Reach	7989	50-year	157.00	1127.95	1129.88		1130.00	0.002297	2.88	54.59	36.72	0.42
Reach	7900	50-year	157.00	1127.64	1129.71		1129.82	0.001739	2.61	60.25	38.13	0.37
Reach	7800	50-year	157.00	1127.29	1129.59		1129.67	0.001179	2.27	69.14	40.15	0.31
Reach	7700	50-year	157.00	1126.94	1129.44		1129.50	0.002458	2.03	77.22	41.88	0.26
Reach	7696	50-year	157.00	1127.93	1129.29	1128.87	1129.47	0.020770	3.39	46.25	40.14	0.56
Reach	7691	50-year	157.00	1127.91	1128.85	1128.85	1129.27	0.075060	5.18	30.31	36.65	1.00
Reach	7687	50-year	157.00	1126.90	1128.63	1128.03	1128.80	0.003426	3.30	47.55	35.12	0.50
Reach	7600	50-year	157.00	1126.59	1128.34		1128.50	0.003318	3.28	47.90	34.91	0.49
Reach	7500	50-year	157.00	1126.24	1128.02		1128.18	0.003117	3.22	48.79	34.87	0.48
Reach	7400	50-year	157.00	1125.89	1127.74		1127.88	0.002743	3.09	50.87	35.15	0.45
Reach	7389	50-year	157.00	1125.85	1127.68		1127.83	0.009585	3.12	50.37	35.01	0.46
Reach	7369	50-year	157.00	1125.78	1126.91	1126.91	1127.39	0.072275	5.53	28.40	30.18	1.00
Reach	7359	50-year	157.00	1123.78	1125.85	1124.95	1125.98	0.006886	2.91	53.90	32.07	0.40
Reach	7339	50-year	157.00	1123.72	1125.78		1125.91	0.002039	2.91	53.93	32.29	0.40
Reach	7300	50-year	157.00	1123.61	1125.71		1125.84	0.001927	2.86	54.90	32.34	0.39
Reach	7200	50-year	157.00	1123.31	1125.55		1125.66	0.001521	2.64	59.55	33.16	0.35
Reach	7100	50-year	157.00	1123.01	1125.43		1125.52	0.001144	2.39	65.74	34.26	0.30
Reach	7000	50-year	157.00	1122.74	1125.27		1125.35	0.002774	2.26	69.62	35.04	0.28
Reach	6996	50-year	157.00	1123.70	1125.14		1125.32	0.013114	3.36	46.79	36.82	0.52
Reach	6991	50-year	157.00	1123.68	1125.01		1125.23	0.024462	3.76	41.79	34.99	0.61
Reach	6987	50-year	157.00	1122.67	1125.09		1125.17	0.001136	2.37	66.35	34.92	0.30
Reach	6912	50-year	157.00	1122.47	1124.88		1124.99	0.005406	2.56	61.42	30.88	0.32
Reach	6879	50-year	157.00	1122.37	1124.87		1124.96	0.000283	2.46	63.92	31.24	0.30
Reach	6873	50-year	157.00	1122.35	1124.87	1123.53	1124.96	0.000265	2.38	66.06	32.48	0.29
Reach	6872		Culvert									
Reach	6776	50-year	157.00	1122.07	1124.21		1124.32	0.000440	2.74	57.20	33.56	0.37
Reach	6765	50-year	157.00	1122.02	1124.20		1124.31	0.008570	2.68	58.56	33.84	0.36
Reach	6709	50-year	157.00	1121.87	1124.00		1124.12	0.001817	2.79	56.31	33.01	0.38
Reach	6600	50-year	157.00	1121.51	1123.72		1123.83	0.001558	2.64	59.54	33.81	0.35
Reach	6500	50-year	157.00	1121.21	1123.60		1123.69	0.001197	2.42	64.89	34.33	0.31
Reach	6400	50-year	157.00	1120.94	1123.43		1123.51	0.002930	2.29	68.50	35.10	0.29
Reach	6396	50-year	157.00	1121.90	1123.28	1122.86	1123.47	0.020815	3.51	44.68	36.72	0.56
Reach	6391	50-year	157.00	1121.88	1122.83	1122.83	1123.27	0.074076	5.30	29.60	34.10	1.00
Reach	6387	50-year	157.00	1120.87	1122.79	1122.03	1122.94	0.002591	3.13	50.09	32.20	0.44
Reach	6300	50-year	157.00	1120.62	1122.05	1121.78	1122.36	0.037955	4.43	35.40	29.51	0.71
Reach	6290	50-year	157.00	1120.59	1121.75	1121.75	1122.25	0.003817	5.68	27.62	27.67	1.00
Reach	6270	50-year	157.00	1120.49	1121.60	1121.65	1122.16	0.004419	5.98	26.27	27.26	1.07
Reach	6250	50-year	157.00	1118.56	1120.79	1119.52	1120.86	0.000243	2.20	71.47	35.72	0.27
Reach	6200		Culvert									
Reach	6100	50-year	157.00	1116.55	1117.38	1117.38	1117.78	0.047748	5.11	30.75	38.33	1.01
Reach	6092	50-year	157.00	1114.40	1116.66	1115.15	1116.68	0.001044	1.33	118.29	64.44	0.17
Reach	6040	50-year	157.00	1114.40	1116.60		1116.63	0.001147	1.37	114.56	63.83	0.18
Reach	6014	50-year	157.00	1115.18	1116.48	1116.03	1116.57	0.003004	2.50	62.70	64.10	0.45

HEC-RAS Plan: 2 River: Stream Reach: Reach Profile: 50-year

Reach	River Sta	Profile	E.G. US.	W.S. US.	E.G. IC	E.G. OC	Min El Weir Flow	Q Culv Group	Q Weir	Delta WS	Culv Vel US	Culv Vel DS
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(ft)	(ft/s)	(ft/s)
Reach	11088 Culvert #1	50-year	1147.23	1146.98	1146.91	1147.23	1149.54	157.00		1.66	8.58	9.24
Reach	11020 Culvert #1	50-year	1145.69	1145.05	1145.63	1145.69	1149.01	157.00		0.50	7.06	6.55
Reach	10837 Culvert #1	50-year	1145.22	1144.54	1145.21	1145.22	1147.26	157.00		2.00	8.51	8.58
Reach	8567 Culvert #1	50-year	1133.94	1133.86	1133.70	1133.94	1136.15	157.00		1.26	4.63	6.06
Reach	6872 Culvert #1	50-year	1124.96	1124.87	1124.63	1124.96	1134.07	157.00		0.66	4.35	4.59
Reach	6200 Culvert #1	50-year	1120.87	1120.79	1120.82	1120.87	1127.03	157.00		3.41	6.81	10.71

HEC-RAS Plan: 2 River: Stream Reach: Reach Profile: 100-year

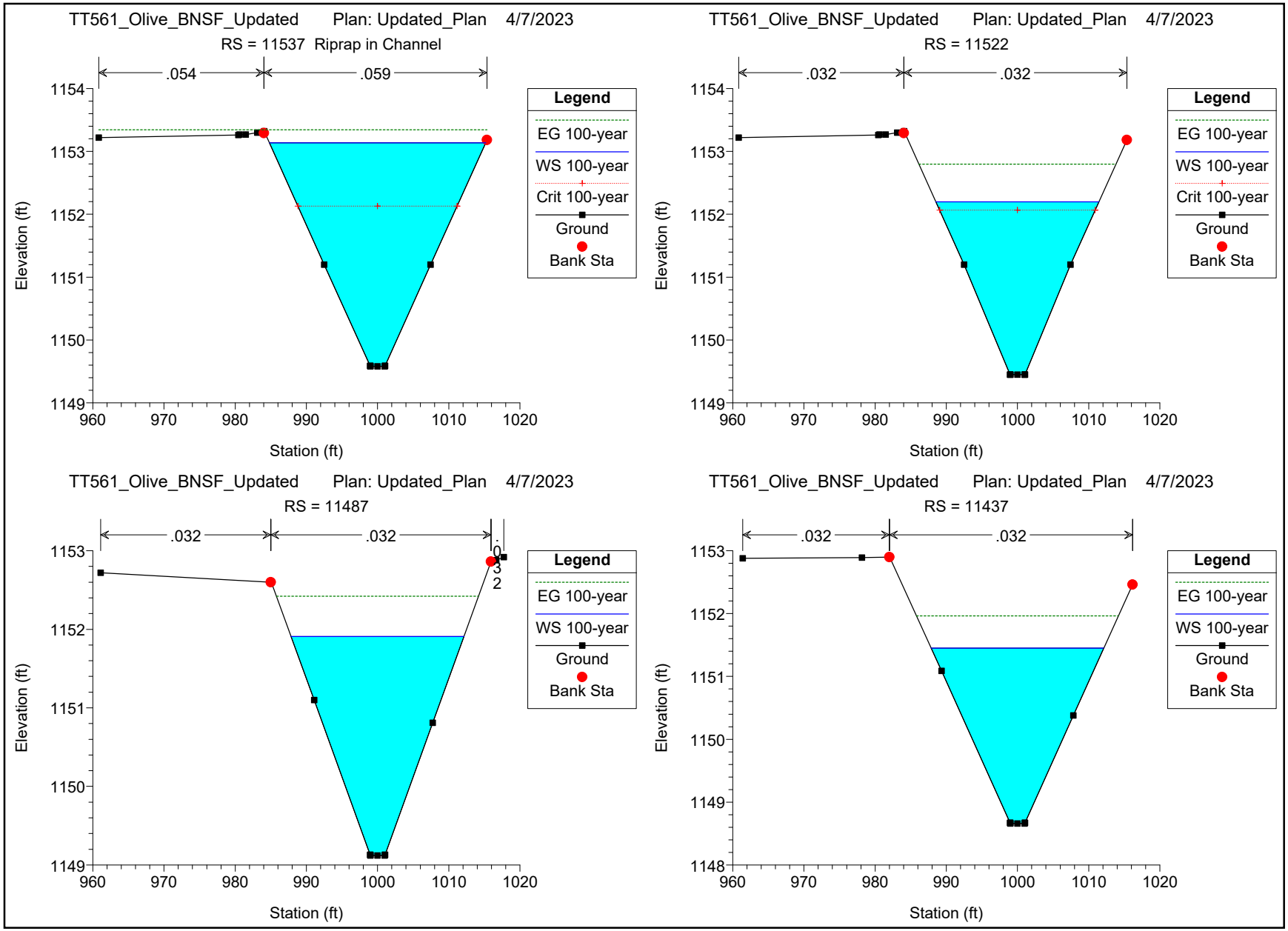
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach	11537	100-year	210.00	1149.58	1153.14	1152.13	1153.34	0.009259	3.64	57.65	30.41	0.47
Reach	11522	100-year	210.00	1149.45	1152.20	1152.07	1152.80	0.011101	6.21	33.81	22.92	0.90
Reach	11487	100-year	210.00	1149.12	1151.91		1152.42	0.009137	5.73	36.65	24.30	0.82
Reach	11437	100-year	210.00	1148.66	1151.45		1151.96	0.009173	5.74	36.58	24.25	0.82
Reach	11387	100-year	210.00	1148.21	1150.99		1151.50	0.009143	5.73	36.65	24.32	0.82
Reach	11337	100-year	210.00	1147.75	1150.55		1151.05	0.008963	5.69	36.93	24.41	0.82
Reach	11287	100-year	210.00	1147.29	1150.16		1150.61	0.007909	5.43	38.69	24.98	0.77
Reach	11237	100-year	210.00	1146.83	1149.89		1150.25	0.005779	4.83	43.50	26.45	0.66
Reach	11187	100-year	210.00	1146.37	1149.28	1148.92	1149.71	0.025154	5.30	39.66	25.26	0.75
Reach	11167	100-year	210.00	1146.18	1148.82	1148.82	1149.54	0.003555	6.83	30.74	21.74	1.01
Reach	11157	100-year	210.00	1146.01	1148.20	1148.56	1149.44	0.007466	8.93	23.52	19.50	1.43
Reach	11135	100-year	210.00	1143.95	1147.70	1146.18	1147.82	0.000329	2.75	76.24	35.49	0.33
Reach	11119	100-year	210.00	1143.25	1147.66		1147.81	0.000254	3.04	69.05	16.42	0.26
Reach	11114	100-year	210.00	1143.11	1147.35	1145.50	1147.73	0.000941	4.95	42.39	10.02	0.42
Reach	11088		Culvert									
Reach	11084	100-year	210.00	1143.11	1146.18		1146.91	0.002299	6.84	30.72	10.01	0.69
Reach	11067	100-year	210.00	1142.81	1146.45		1146.61	0.000371	3.18	65.95	26.22	0.35
Reach	11052	100-year	210.00	1142.54	1146.44		1146.60	0.000349	3.24	64.78	23.24	0.34
Reach	11036	100-year	210.00	1142.25	1146.45		1146.58	0.000269	2.96	70.92	23.79	0.30
Reach	11021	100-year	210.00	1141.98	1145.77	1144.75	1146.51	0.002279	6.93	30.32	8.01	0.63
Reach	11020		Culvert									
Reach	10843	100-year	210.00	1141.56	1145.24	1144.35	1146.03	0.001637	7.13	29.44	8.01	0.66
Reach	10838	100-year	210.00	1141.56	1145.22	1144.35	1146.02	0.001658	7.17	29.29	8.01	0.66
Reach	10837		Culvert									
Reach	10623	100-year	210.00	1140.90	1142.83	1142.73	1143.38	0.001938	5.96	35.21	26.85	0.92
Reach	10585	100-year	210.00	1140.71	1142.88		1143.05	0.009074	3.31	63.49	38.73	0.46
Reach	10550	100-year	210.00	1140.58	1142.71		1142.88	0.002816	3.36	62.46	38.70	0.47
Reach	10450	100-year	210.00	1140.23	1142.49		1142.63	0.002151	3.01	69.85	41.88	0.41
Reach	10350	100-year	210.00	1140.11	1142.19		1142.37	0.003055	3.44	61.02	38.80	0.48
Reach	10250	100-year	210.00	1139.85	1141.83		1142.04	0.003596	3.63	57.84	38.37	0.52
Reach	10150	100-year	210.00	1139.53	1141.39		1141.63	0.004511	3.92	53.51	37.46	0.58
Reach	10050	100-year	210.00	1139.01	1141.04		1141.24	0.003271	3.52	59.70	38.71	0.50
Reach	10000	100-year	210.00	1138.85	1140.88		1141.07	0.003275	3.51	59.76	38.86	0.50
Reach	9900	100-year	210.00	1138.50	1140.57		1140.76	0.003013	3.41	61.64	39.44	0.48
Reach	9889	100-year	210.00	1138.46	1140.51		1140.70	0.010638	3.45	60.80	39.22	0.49
Reach	9869	100-year	210.00	1138.39	1139.72	1139.72	1140.26	0.050803	5.89	35.64	33.43	1.01
Reach	9859	100-year	210.00	1137.39	1139.58	1138.76	1139.75	0.009065	3.35	62.67	37.38	0.46
Reach	9839	100-year	210.00	1137.32	1139.50		1139.66	0.002608	3.28	63.99	38.81	0.45
Reach	9800	100-year	210.00	1137.19	1139.40		1139.56	0.002445	3.20	65.53	39.24	0.44
Reach	9700	100-year	210.00	1136.84	1139.21		1139.34	0.001890	2.92	71.86	40.72	0.39
Reach	9600	100-year	210.00	1136.49	1139.07		1139.17	0.001364	2.60	80.77	42.69	0.33
Reach	9500	100-year	210.00	1136.14	1138.88		1138.97	0.003045	2.38	88.21	44.32	0.30
Reach	9496	100-year	210.00	1137.12	1138.72	1138.25	1138.93	0.020937	3.74	56.18	42.40	0.57
Reach	9491	100-year	210.00	1137.11	1138.24	1138.24	1138.73	0.071466	5.64	37.24	38.18	1.01
Reach	9487	100-year	210.00	1136.09	1138.09	1137.44	1138.30	0.003504	3.63	57.93	37.79	0.52
Reach	9400	100-year	210.00	1135.79	1137.79		1137.99	0.003507	3.62	58.09	38.09	0.52
Reach	9300	100-year	210.00	1135.44	1137.45		1137.65	0.003413	3.57	58.86	38.59	0.51
Reach	9200	100-year	210.00	1135.09	1137.12		1137.31	0.003228	3.49	60.25	39.24	0.50
Reach	9100	100-year	210.00	1134.74	1136.83		1137.00	0.002878	3.33	63.00	40.27	0.47
Reach	9089	100-year	210.00	1134.70	1136.77		1136.95	0.010072	3.37	62.38	40.14	0.48
Reach	9069	100-year	210.00	1134.63	1135.96	1135.96	1136.49	0.069627	5.86	35.81	33.90	1.01
Reach	9059	100-year	210.00	1133.13	1135.31	1134.51	1135.50	0.009550	3.47	60.51	35.53	0.47
Reach	9039	100-year	210.00	1133.06	1135.21		1135.40	0.002901	3.49	60.17	35.91	0.48
Reach	9000	100-year	210.00	1132.92	1135.11		1135.29	0.002740	3.42	61.36	36.12	0.46
Reach	8900	100-year	210.00	1132.57	1134.88		1135.04	0.002224	3.17	66.21	37.36	0.42
Reach	8800	100-year	210.00	1132.22	1134.71		1134.83	0.001669	2.86	73.50	39.10	0.37
Reach	8700	100-year	210.00	1131.87	1134.59		1134.69	0.001183	2.52	83.34	41.32	0.31
Reach	8620	100-year	210.00	1131.56	1134.44		1134.52	0.003878	2.27	92.50	44.16	0.28
Reach	8607	100-year	210.00	1131.47	1134.37		1134.47	0.004495	2.53	83.05	37.36	0.30
Reach	8575	100-year	210.00	1131.42	1134.35		1134.44	0.000240	2.41	87.21	39.45	0.29
Reach	8568	100-year	210.00	1131.42	1134.36	1132.80	1134.44	0.000234	2.36	88.83	40.53	0.28
Reach	8567		Culvert									
Reach	8440	100-year	210.00	1130.98	1132.89		1133.12	0.001025	3.80	55.25	37.78	0.55
Reach	8418	100-year	210.00	1130.90	1132.84		1133.05	0.018444	3.60	58.37	38.86	0.52
Reach	8408	100-year	210.00	1130.40	1132.77		1132.89	0.009415	2.84	73.98	42.44	0.38
Reach	8373	100-year	210.00	1130.26	1132.65		1132.77	0.001773	2.83	74.27	42.19	0.38
Reach	8300	100-year	210.00	1130.02	1132.55		1132.65	0.001424	2.61	80.43	43.68	0.34
Reach	8200	100-year	210.00	1129.66	1132.46		1132.50	0.001156	1.63	128.56	54.83	0.19
Reach	8196	100-year	210.00	1130.67	1132.26	1131.79	1132.48	0.020715	3.69	56.87	43.39	0.57
Reach	8191	100-year	210.00	1130.67	1131.79	1131.79	1132.27	0.071614	5.58	37.62	39.24	1.00
Reach	8187	100-year	210.00	1129.62	1131.70	1130.96	1131.88	0.002993	3.40	61.82	39.53	0.48
Reach	8100	100-year	210.00	1129.32	1131.46		1131.63	0.002661	3.26	64.50	40.25	0.45
Reach	8039	100-year	210.00	1129.09	1131.16		1131.34	0.010323	3.41	61.51	39.47	0.48
Reach	8019	100-year	210.00	1129.02	1130.34	1130.34	1130.88	0.069550	5.85	35.92	34.15	1.00
Reach	8009	100-year	210.00	1128.02	1130.24	1129.38	1130.40	0.008507	3.26	64.50	38.33	0.44
Reach	8000	100-year	210.00	1127.99	1130.21		1130.36	0.002434	3.20	65.64	39.28	0.44

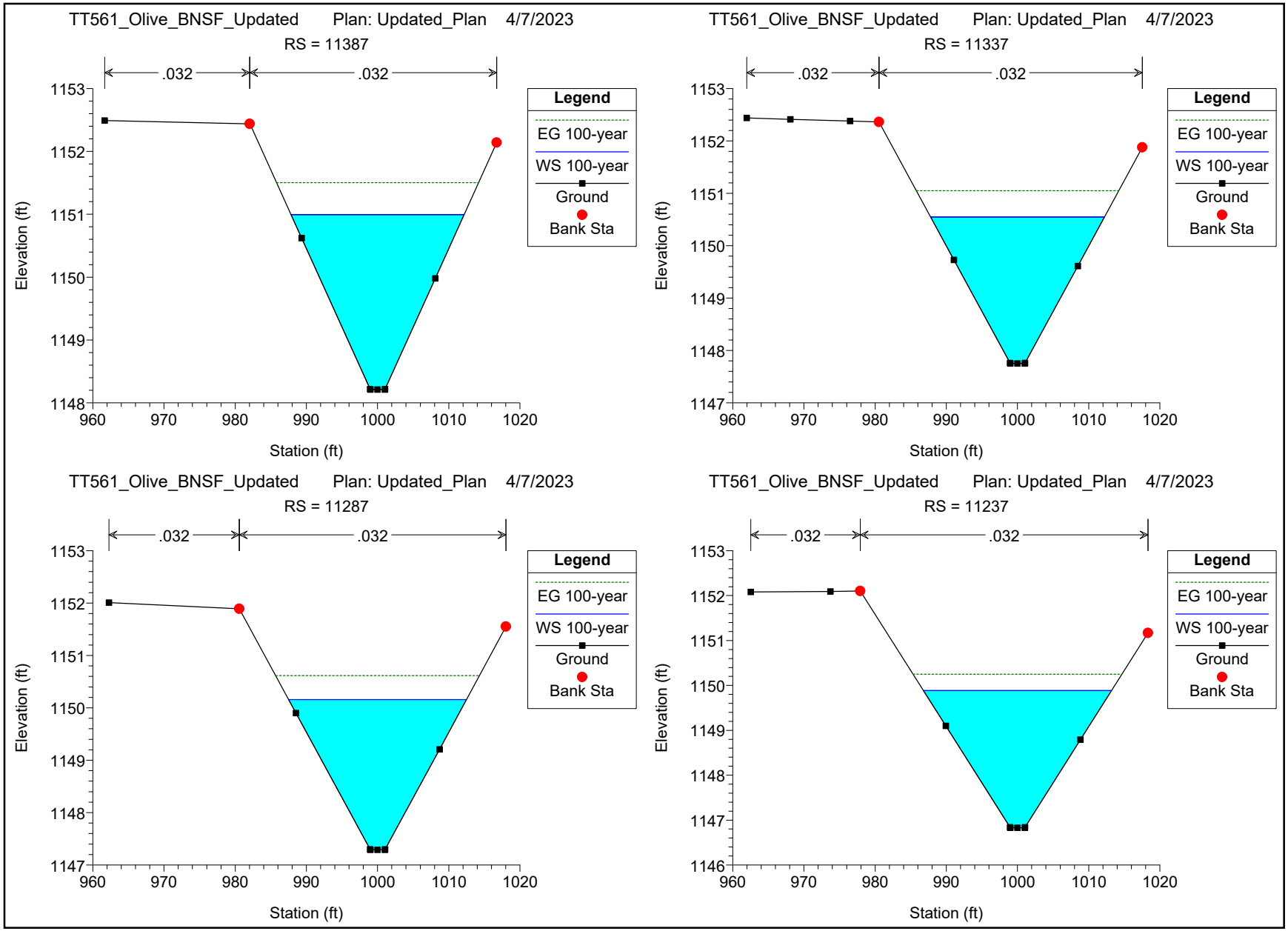
HEC-RAS Plan: 2 River: Stream Reach: Reach Profile: 100-year (Continued)

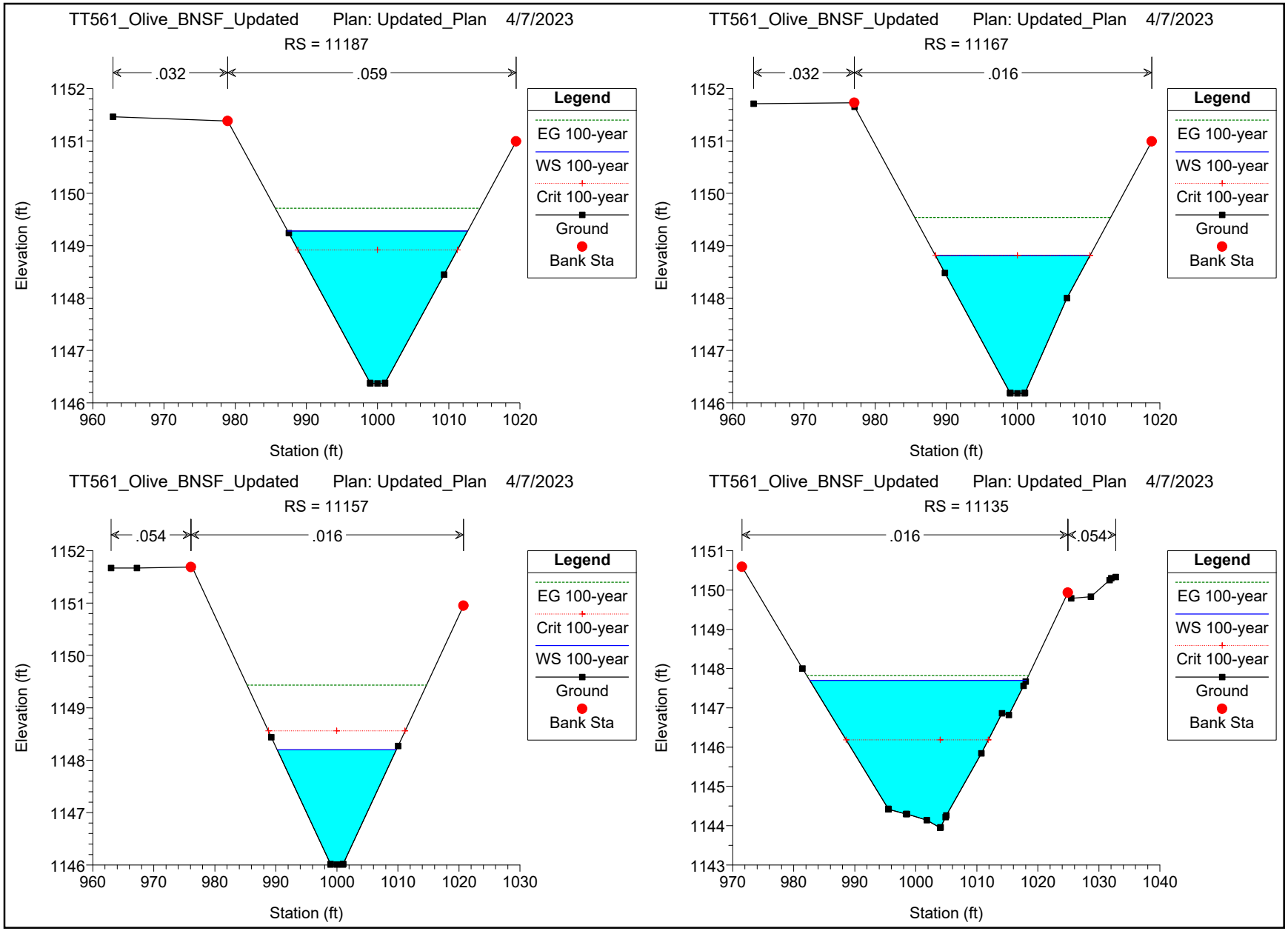
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach	7989	100-year	210.00	1127.95	1130.18		1130.34	0.002373	3.17	66.22	39.38	0.43
Reach	7900	100-year	210.00	1127.64	1130.01		1130.14	0.001886	2.92	71.90	40.71	0.39
Reach	7800	100-year	210.00	1127.29	1129.87		1129.97	0.001364	2.60	80.70	42.60	0.33
Reach	7700	100-year	210.00	1126.94	1129.68		1129.77	0.003061	2.39	87.87	44.05	0.30
Reach	7696	100-year	210.00	1127.93	1129.51	1129.06	1129.73	0.021748	3.79	55.40	42.12	0.58
Reach	7691	100-year	210.00	1127.91	1129.04	1129.04	1129.53	0.071413	5.63	37.33	38.38	1.01
Reach	7687	100-year	210.00	1126.90	1128.92	1128.25	1129.12	0.003405	3.60	58.40	37.73	0.51
Reach	7600	100-year	210.00	1126.59	1128.63		1128.83	0.003318	3.58	58.70	37.47	0.50
Reach	7500	100-year	210.00	1126.24	1128.31		1128.51	0.003171	3.53	59.42	37.33	0.49
Reach	7400	100-year	210.00	1125.89	1128.02		1128.20	0.002906	3.44	61.10	37.46	0.47
Reach	7389	100-year	210.00	1125.85	1127.96		1128.15	0.010206	3.48	60.38	37.28	0.48
Reach	7369	100-year	210.00	1125.78	1127.13	1127.13	1127.68	0.068792	5.98	35.14	31.98	1.01
Reach	7359	100-year	210.00	1123.78	1126.25	1125.18	1126.40	0.006531	3.13	67.11	34.38	0.39
Reach	7339	100-year	210.00	1123.72	1126.19		1126.34	0.001915	3.12	67.40	34.69	0.39
Reach	7300	100-year	210.00	1123.61	1126.12		1126.26	0.001814	3.06	68.56	34.73	0.38
Reach	7200	100-year	210.00	1123.31	1125.97		1126.09	0.001464	2.84	73.86	35.60	0.35
Reach	7100	100-year	210.00	1123.01	1125.85		1125.96	0.001141	2.60	80.62	36.73	0.31
Reach	7000	100-year	210.00	1122.74	1125.69		1125.78	0.002825	2.48	84.81	37.53	0.29
Reach	6996	100-year	210.00	1123.70	1125.59		1125.76	0.009202	3.29	63.82	39.55	0.46
Reach	6991	100-year	210.00	1123.68	1125.51		1125.70	0.014539	3.50	59.98	37.63	0.49
Reach	6987	100-year	210.00	1122.67	1125.56		1125.66	0.001048	2.51	83.67	37.86	0.30
Reach	6912	100-year	210.00	1122.47	1125.37		1125.49	0.005018	2.73	76.99	33.07	0.32
Reach	6879	100-year	210.00	1122.37	1125.35		1125.46	0.000267	2.63	79.71	33.43	0.30
Reach	6873	100-year	210.00	1122.35	1125.36	1123.76	1125.46	0.000249	2.54	82.55	34.91	0.29
Reach	6872		Culvert									
Reach	6776	100-year	210.00	1122.07	1124.55		1124.70	0.000455	3.03	69.24	35.77	0.38
Reach	6765	100-year	210.00	1122.02	1124.54		1124.68	0.008924	2.97	70.70	36.05	0.37
Reach	6709	100-year	210.00	1121.87	1124.33		1124.48	0.001912	3.10	67.69	35.06	0.39
Reach	6600	100-year	210.00	1121.51	1124.03		1124.17	0.001726	2.99	70.35	35.75	0.38
Reach	6500	100-year	210.00	1121.21	1123.89		1124.01	0.001405	2.79	75.15	36.07	0.34
Reach	6400	100-year	210.00	1120.94	1123.68		1123.80	0.003667	2.71	77.62	36.64	0.33
Reach	6396	100-year	210.00	1121.90	1123.51	1123.05	1123.75	0.021765	3.94	53.35	38.18	0.59
Reach	6391	100-year	210.00	1121.88	1123.03	1123.03	1123.55	0.070470	5.78	36.31	35.34	1.01
Reach	6387	100-year	210.00	1120.87	1123.09	1122.26	1123.28	0.002739	3.50	60.06	34.11	0.46
Reach	6300	100-year	210.00	1120.62	1122.30	1122.00	1122.67	0.038179	4.88	43.05	31.19	0.73
Reach	6290	100-year	210.00	1120.59	1121.97	1121.97	1122.57	0.003661	6.17	34.03	29.17	1.01
Reach	6270	100-year	210.00	1120.49	1121.82	1121.88	1122.47	0.004253	6.50	32.31	28.67	1.08
Reach	6250	100-year	210.00	1118.56	1121.27	1119.72	1121.36	0.000225	2.36	89.05	37.30	0.27
Reach	6200		Culvert									
Reach	6100	100-year	210.00	1116.55	1117.55	1117.55	1118.04	0.045468	5.61	37.41	38.83	1.01
Reach	6092	100-year	210.00	1114.40	1116.89	1115.30	1116.93	0.001308	1.57	133.67	66.93	0.20
Reach	6040	100-year	210.00	1114.40	1116.81		1116.86	0.001460	1.63	128.72	66.14	0.21
Reach	6014	100-year	210.00	1115.18	1116.68	1116.17	1116.80	0.003004	2.77	75.76	66.46	0.46

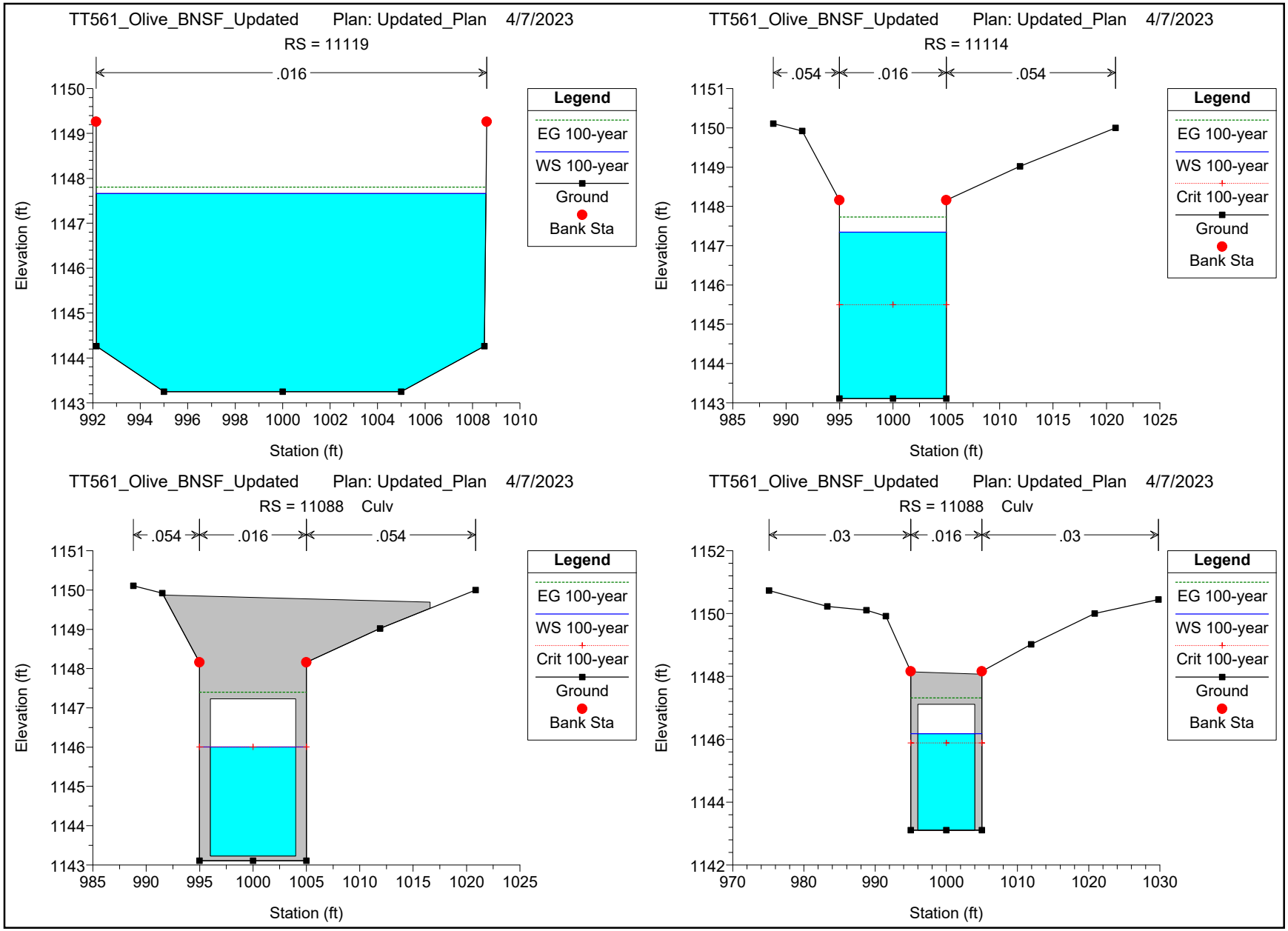
HEC-RAS Plan: 2 River: Stream Reach: Reach Profile: 100-year

Reach	River Sta	Profile	E.G. US.	W.S. US.	E.G. IC	E.G. OC	Min El Weir Flow	Q Culv Group	Q Weir	Delta WS	Culv Vel US	Culv Vel DS
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(ft)	(ft/s)	(ft/s)
Reach	11088 Culvert #1	100-year	1147.73	1147.35	1147.73	1148.09	1149.54	210.00		1.17	9.45	8.55
Reach	11020 Culvert #1	100-year	1146.52	1145.77	1146.45	1146.52	1149.01	210.00		0.53	7.56	7.14
Reach	10837 Culvert #1	100-year	1146.02	1145.22	1146.02	1146.00	1147.26	210.00		2.39	9.27	9.45
Reach	8567 Culvert #1	100-year	1134.44	1134.36	1134.21	1134.44	1136.15	210.00		1.46	5.21	6.86
Reach	6872 Culvert #1	100-year	1125.46	1125.36	1125.14	1125.46	1134.07	210.00		0.80	4.95	5.29
Reach	6200 Culvert #1	100-year	1121.36	1121.27	1121.33	1121.36	1127.03	210.00		3.72	7.50	11.69


TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11537 Riprap in Channel
.054
.059
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11522
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11487
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11437
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta


TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11387
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11337
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11287
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11237
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta


TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11187
.032
.059
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11167
.032
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11157
.054
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
Crit 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11135
.016
.054
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta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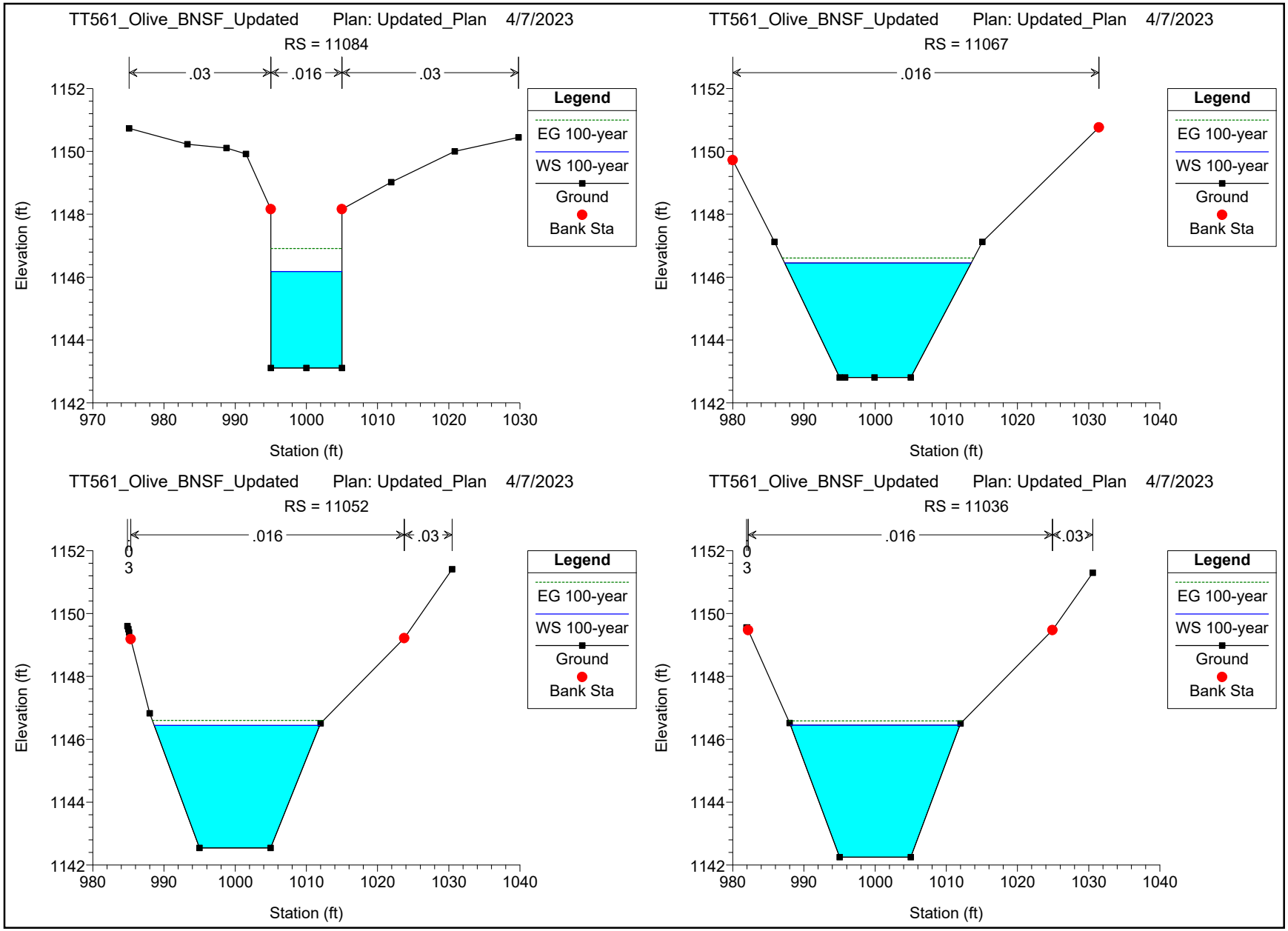
RS = 11119
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11114
.054
.016
.054
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11088 Culv
.054
.016
.054
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11088 Culv
.03
.016
.03
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta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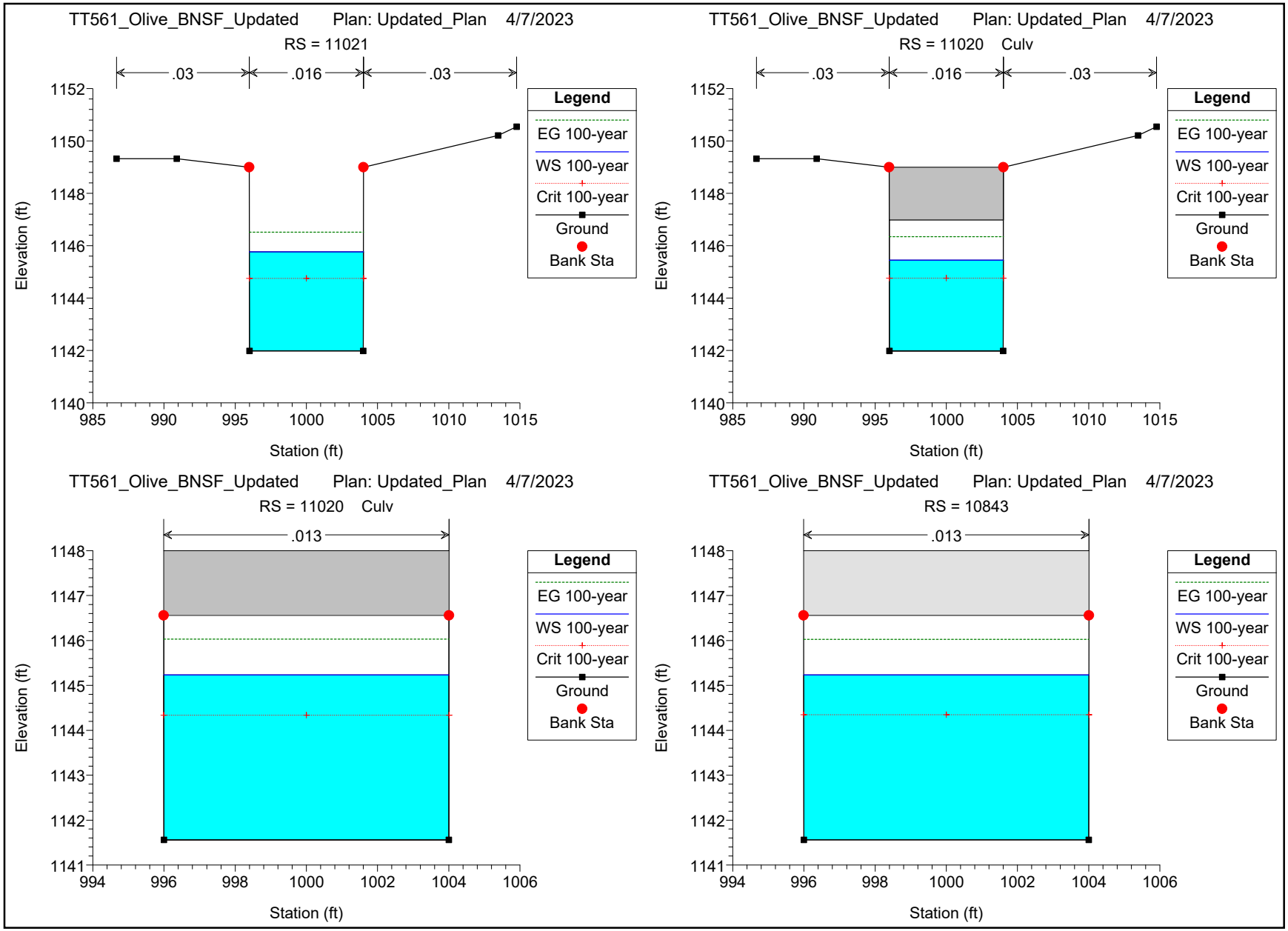
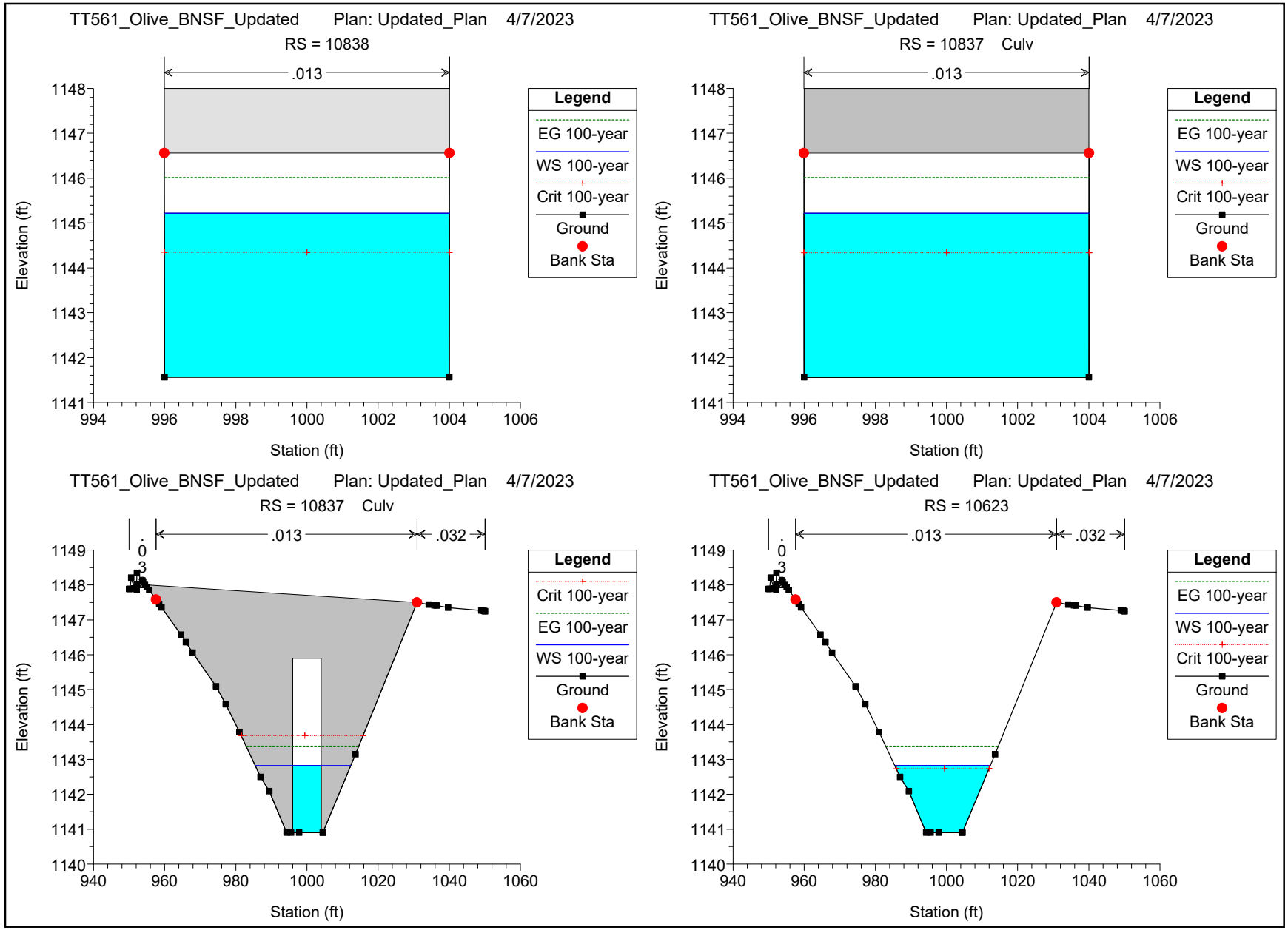
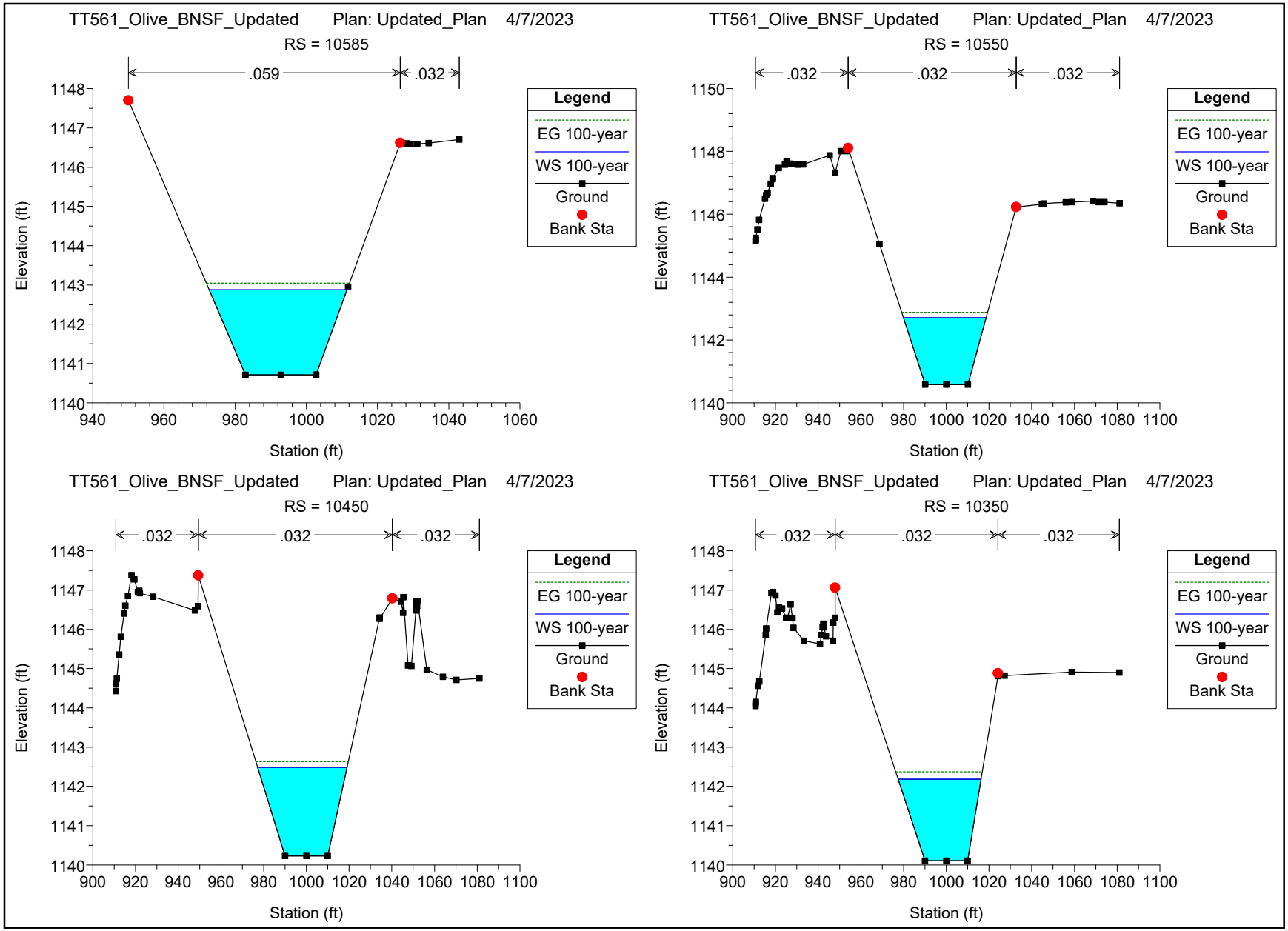
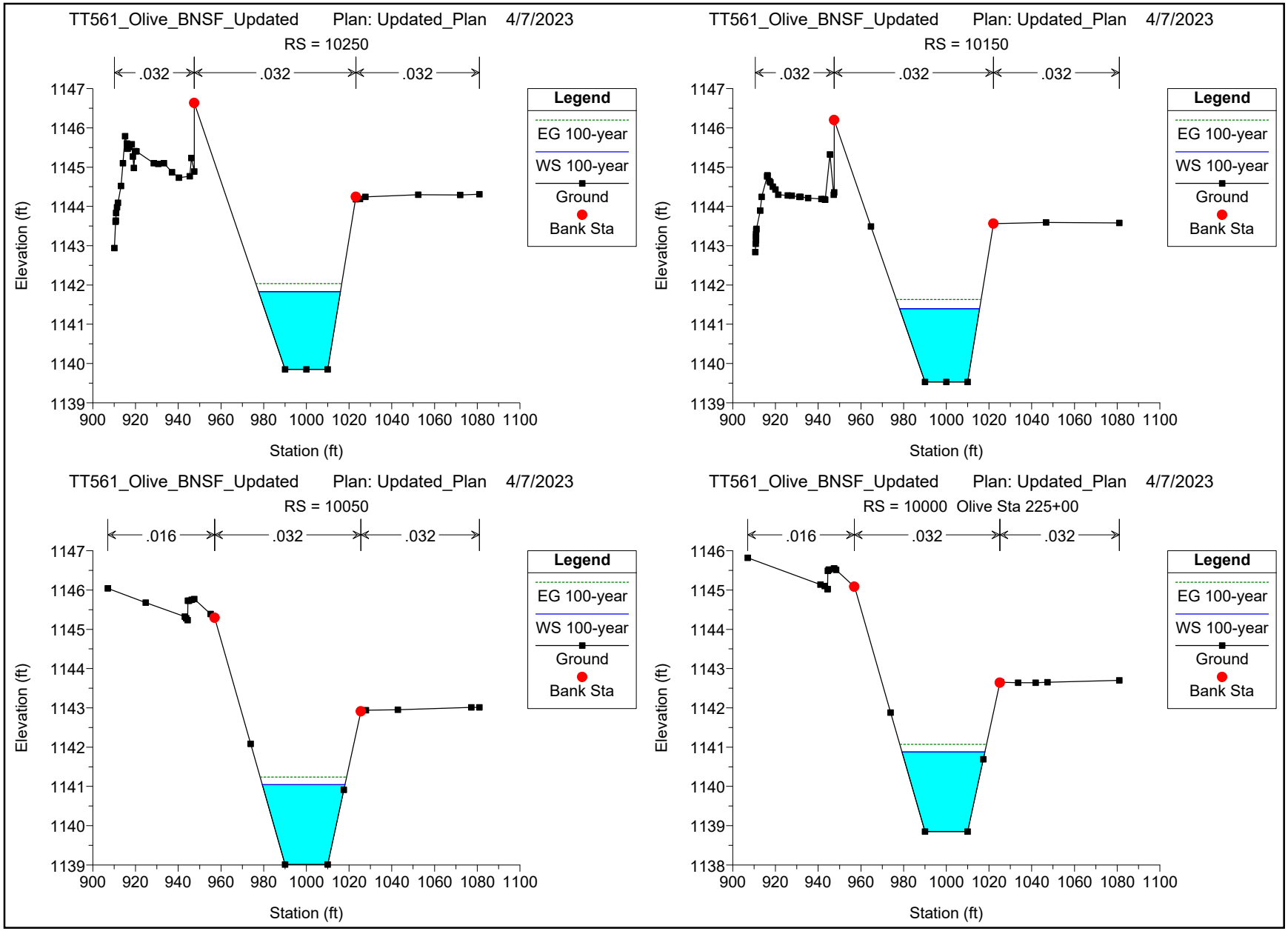
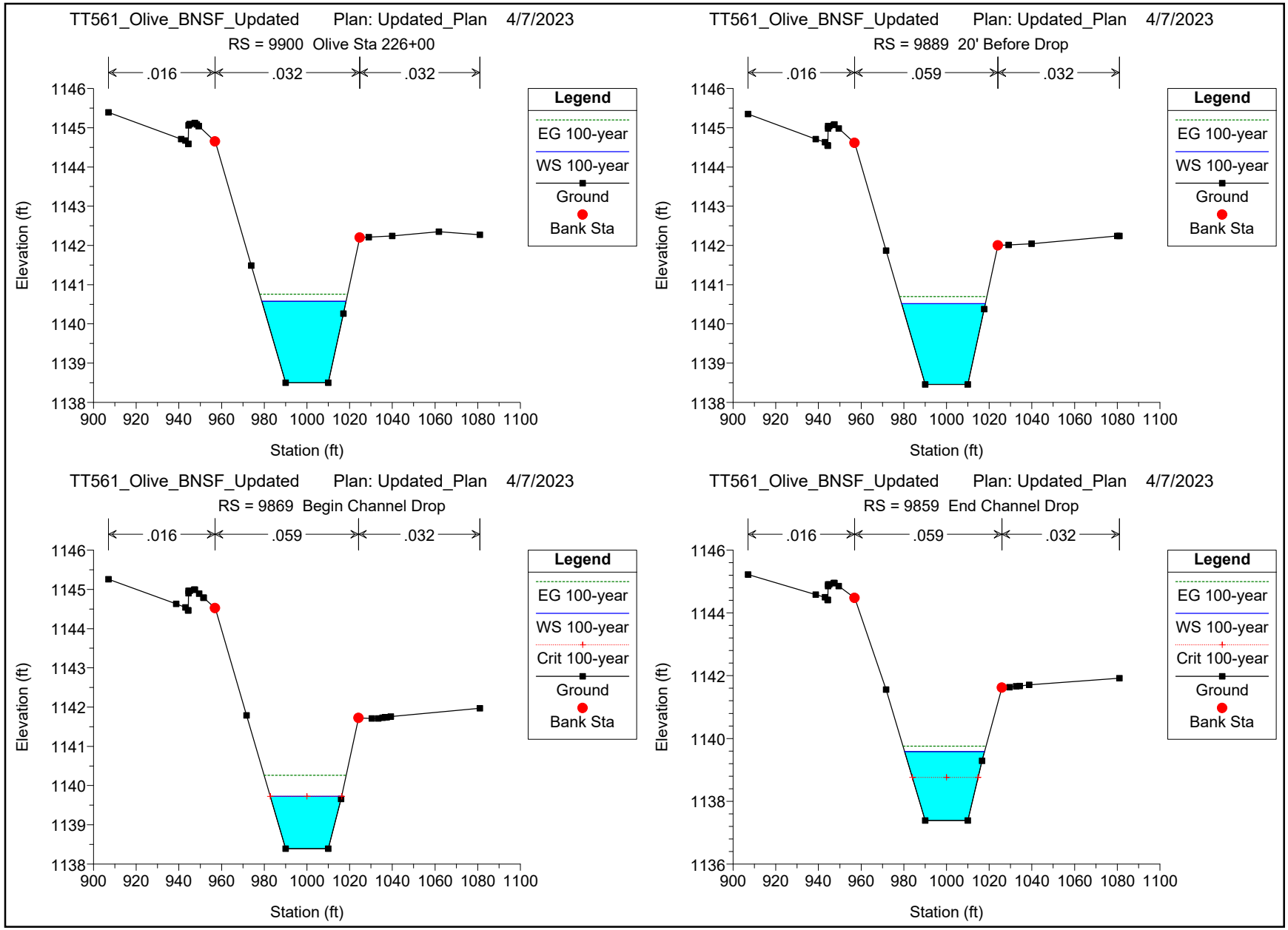
RS = 11084
.03
.016
.03
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11067
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11052
.016
.03
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11036
.016
.03
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta

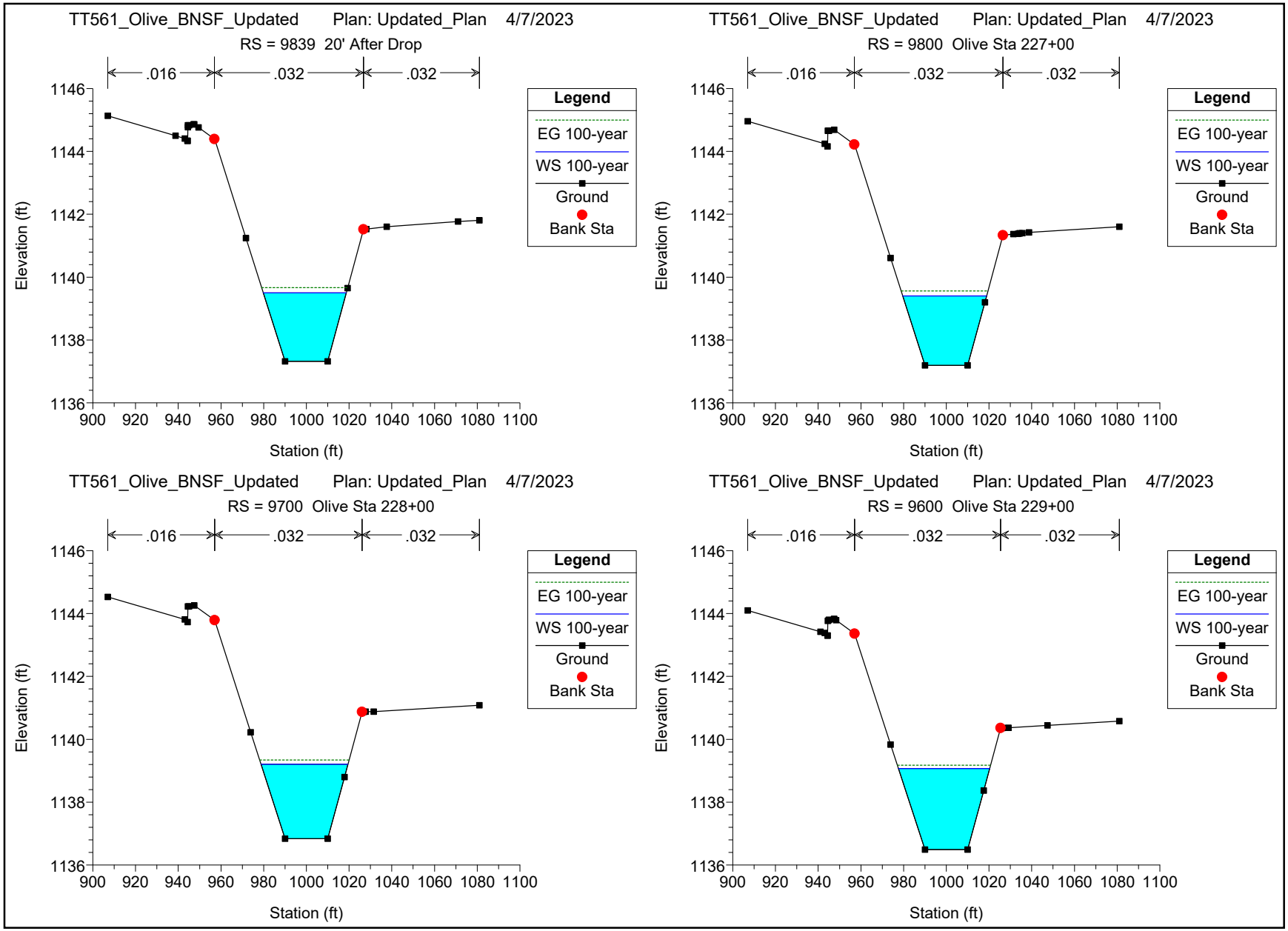

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11021
.03
.016
.03
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11020 Culv
.03
.016
.03
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 11020 Culv
.013
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 10843
.013
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta

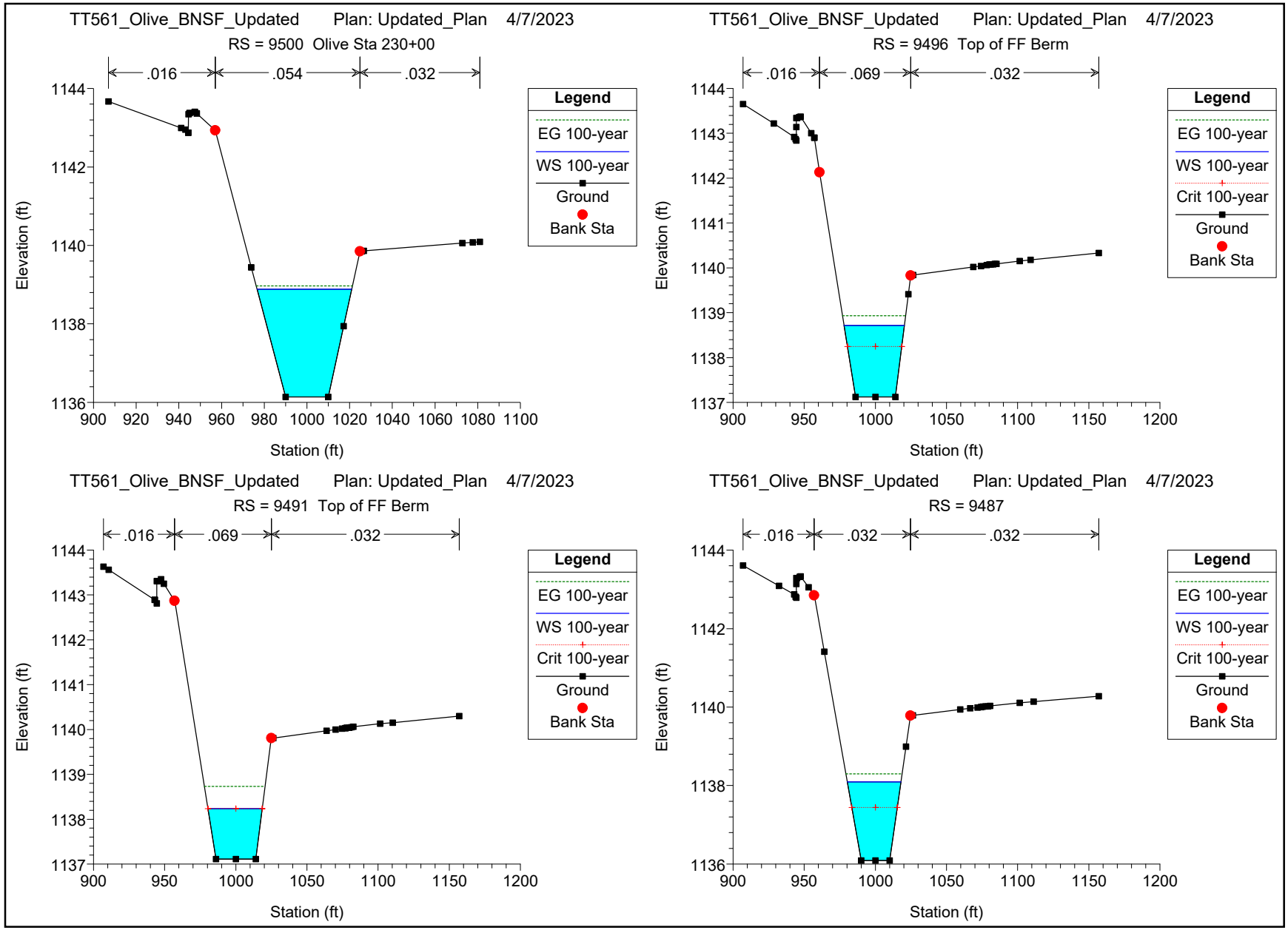

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 10838
.013
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 10837 Culv
.013
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 10837 Culv
.013
.032
Elevation (ft)
Station (ft)
Legend
Crit 100-year
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 10623
.013
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta

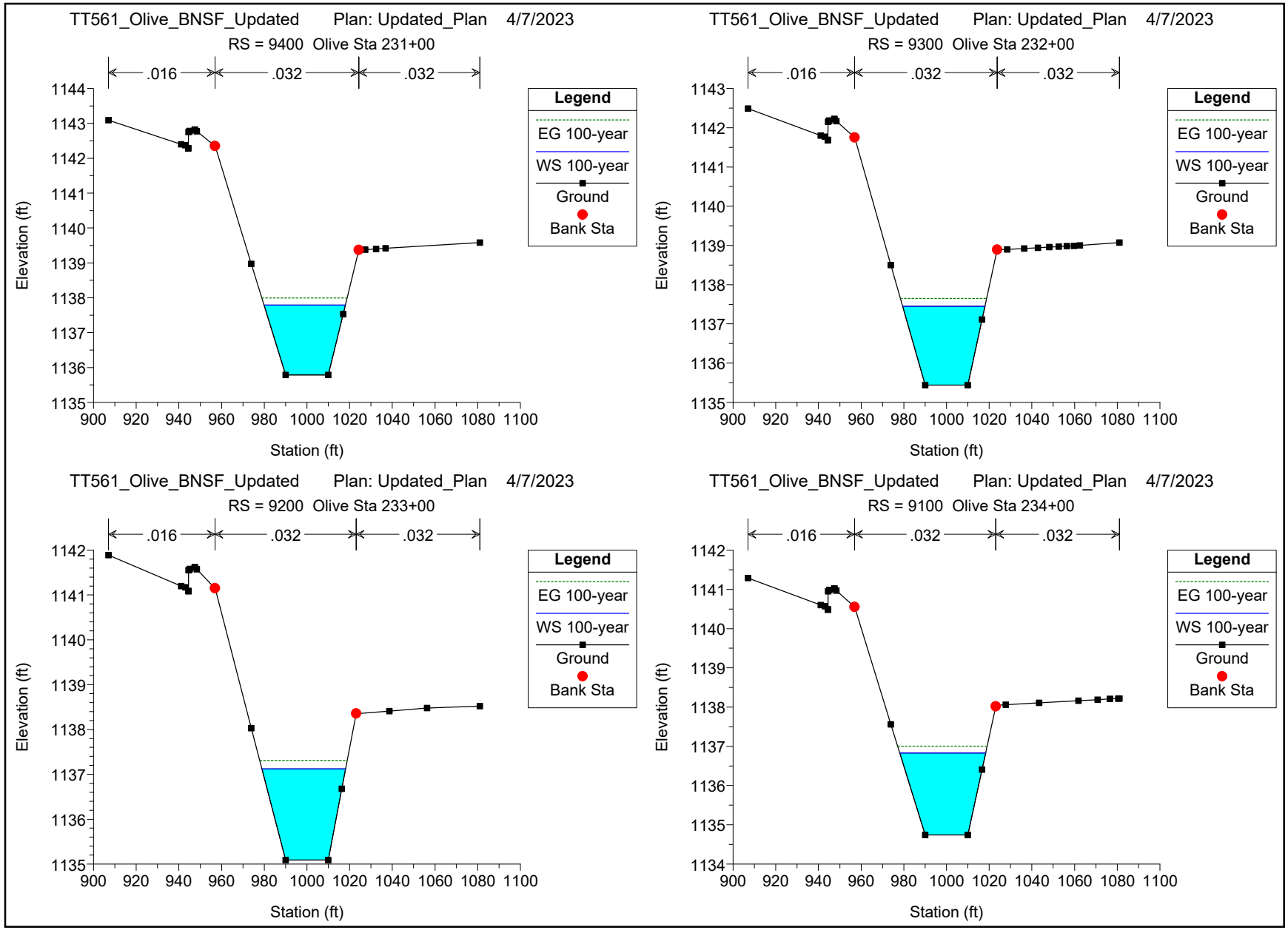

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 10585
.059
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 10550
.032
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 10450
.032
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 10350
.032
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta

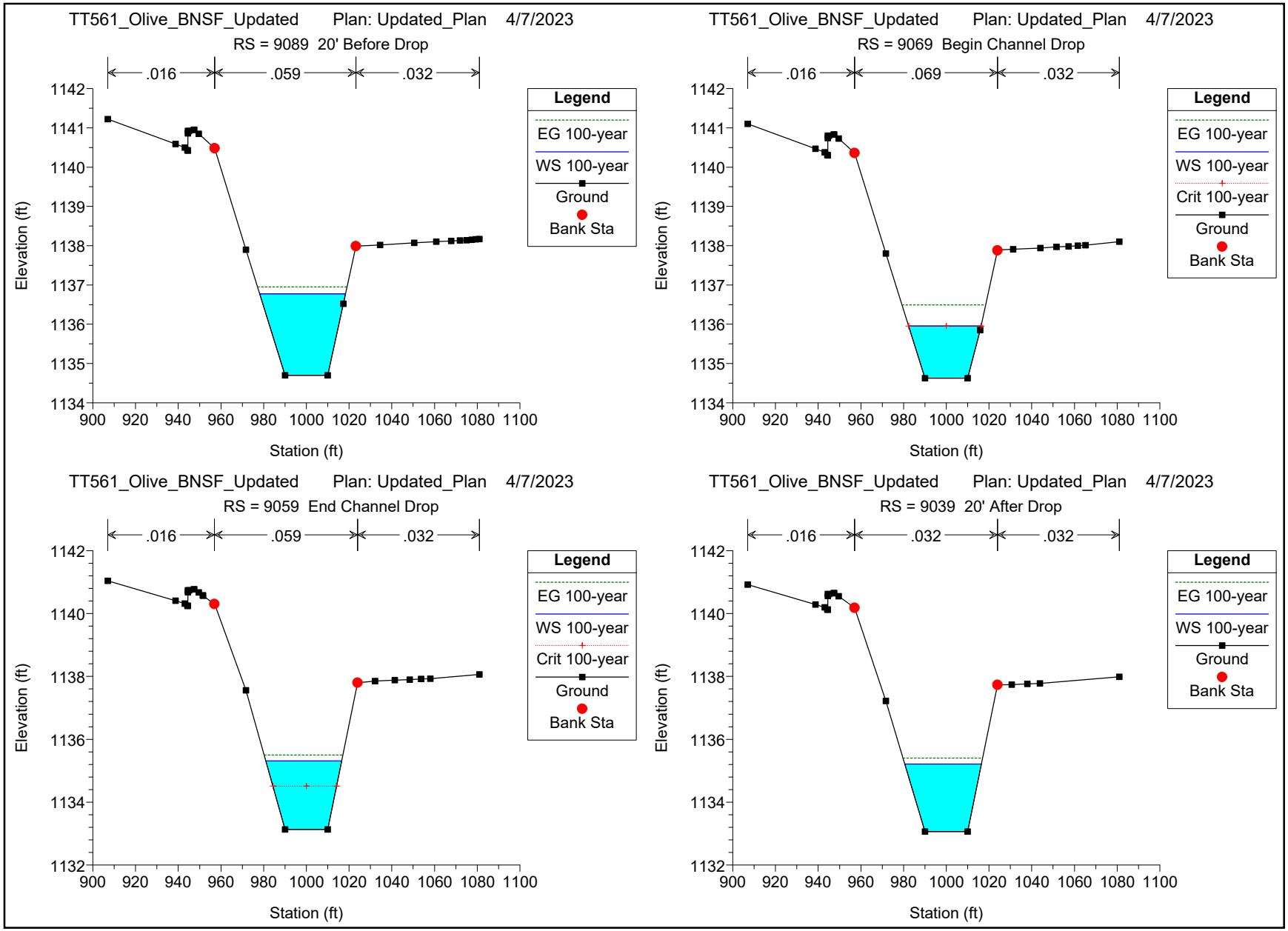

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 10250
.032
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 10150
.032
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 10050
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 10000 Olive Sta 225+00
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta

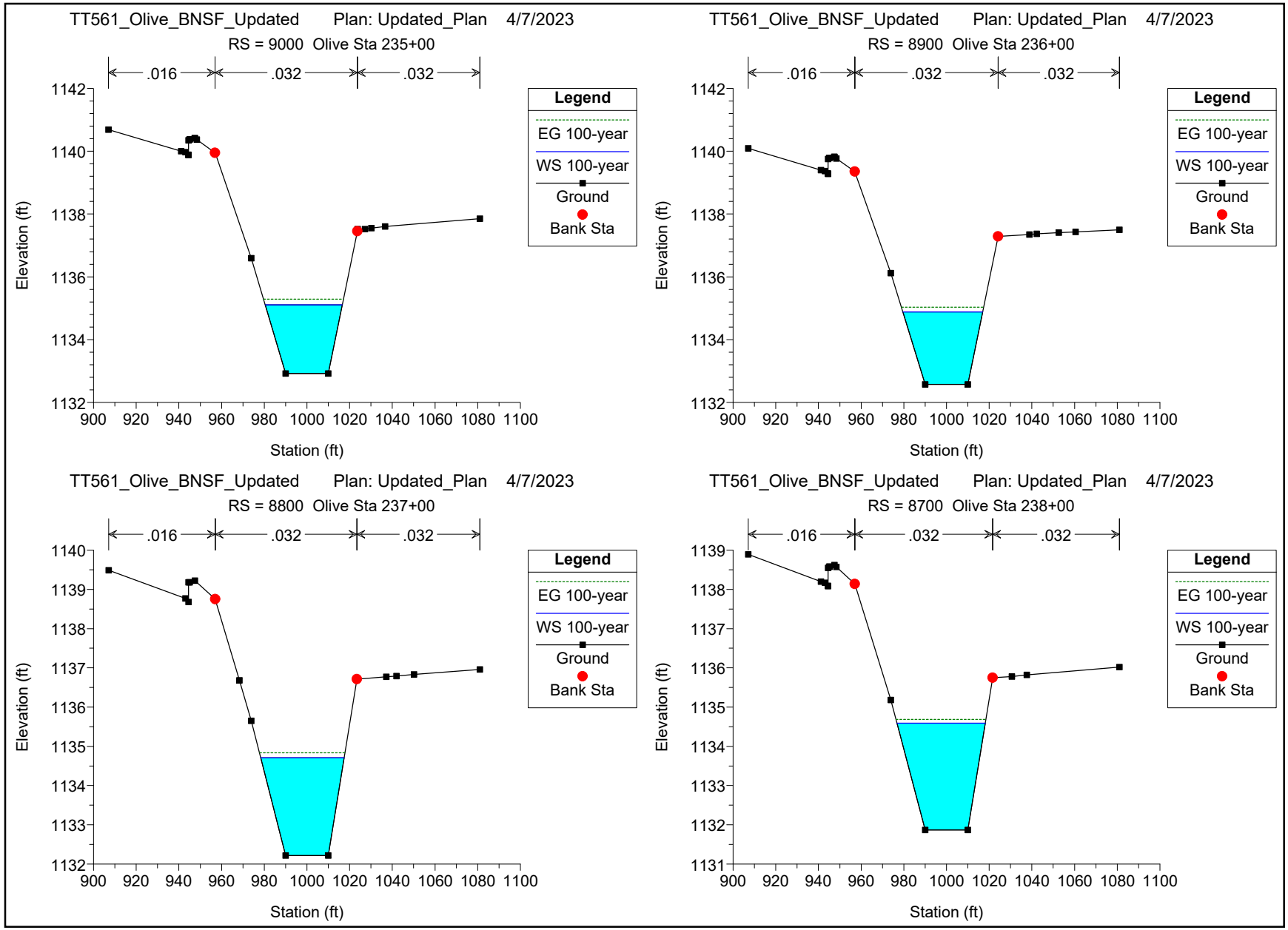

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9900 Olive Sta 226+00
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9889 20' Before Drop
.016
.059
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9869 Begin Channel Drop
.016
.059
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9859 End Channel Drop
.016
.059
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta

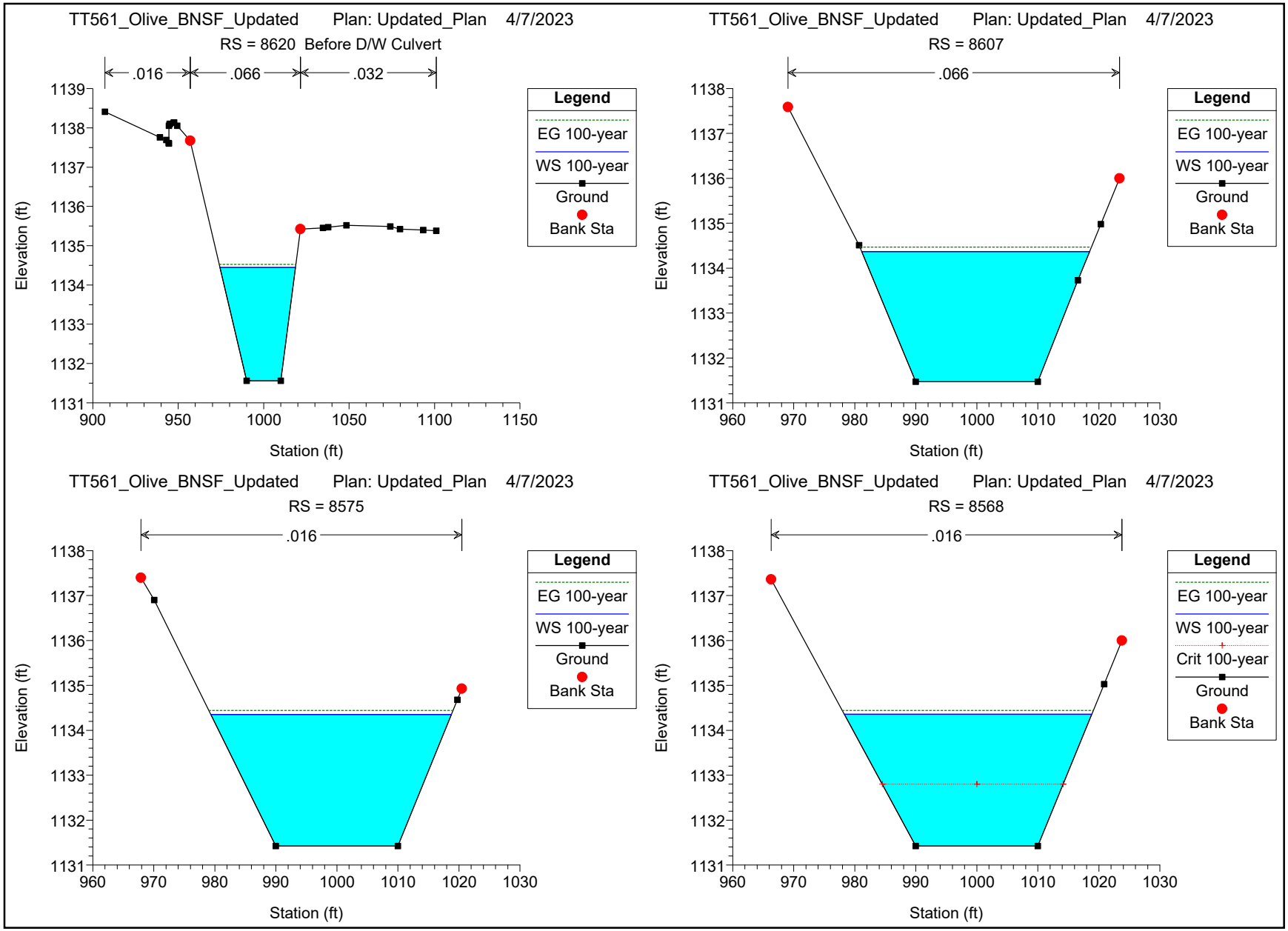

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9839 20' After Drop
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9800 Olive Sta 227+00
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9700 Olive Sta 228+00
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9600 Olive Sta 229+00

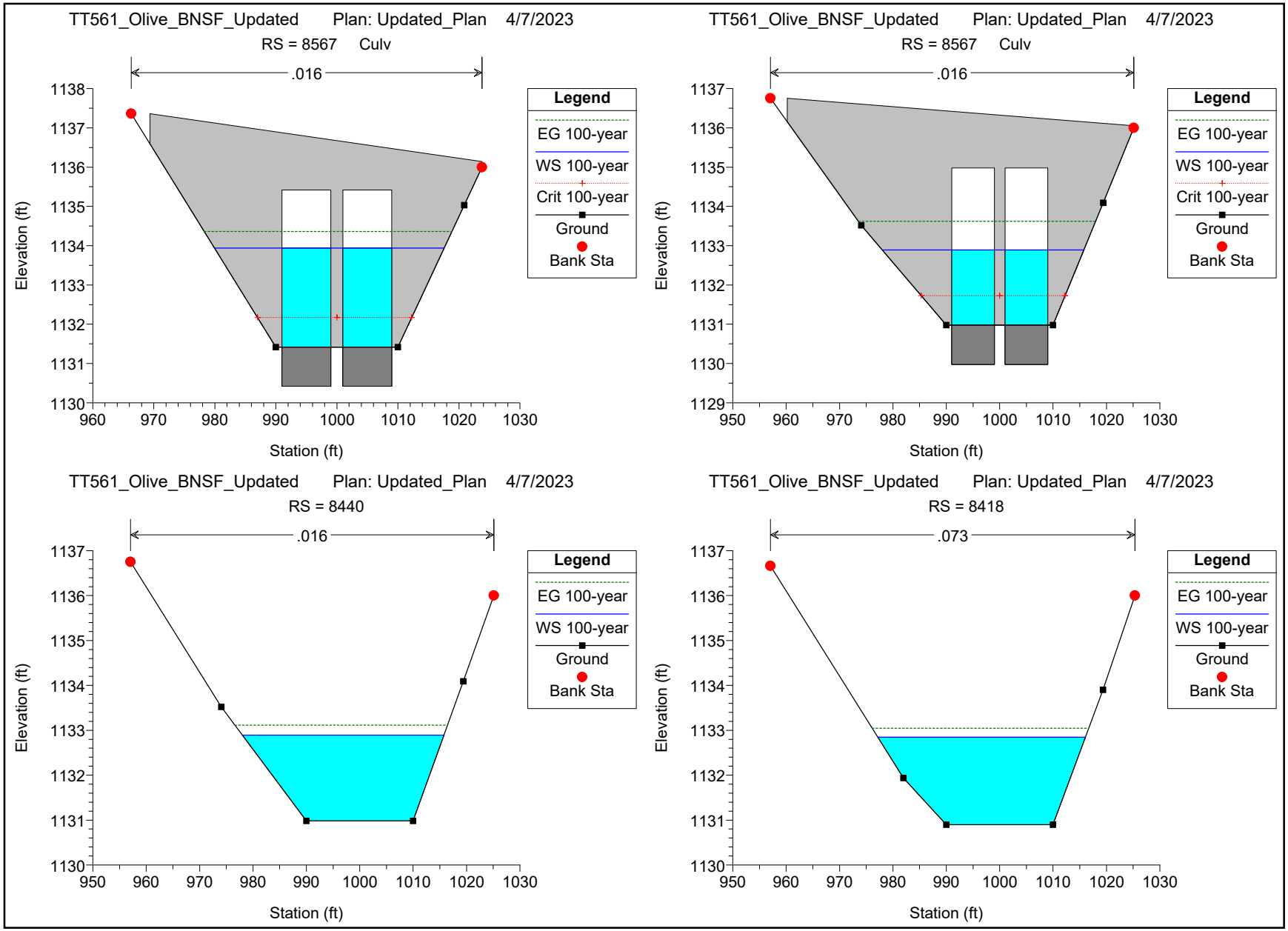

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9500 Olive Sta 230+00
.016
.054
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9496 Top of FF Berm
.016
.069
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9491 Top of FF Berm
.016
.069
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9487
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta

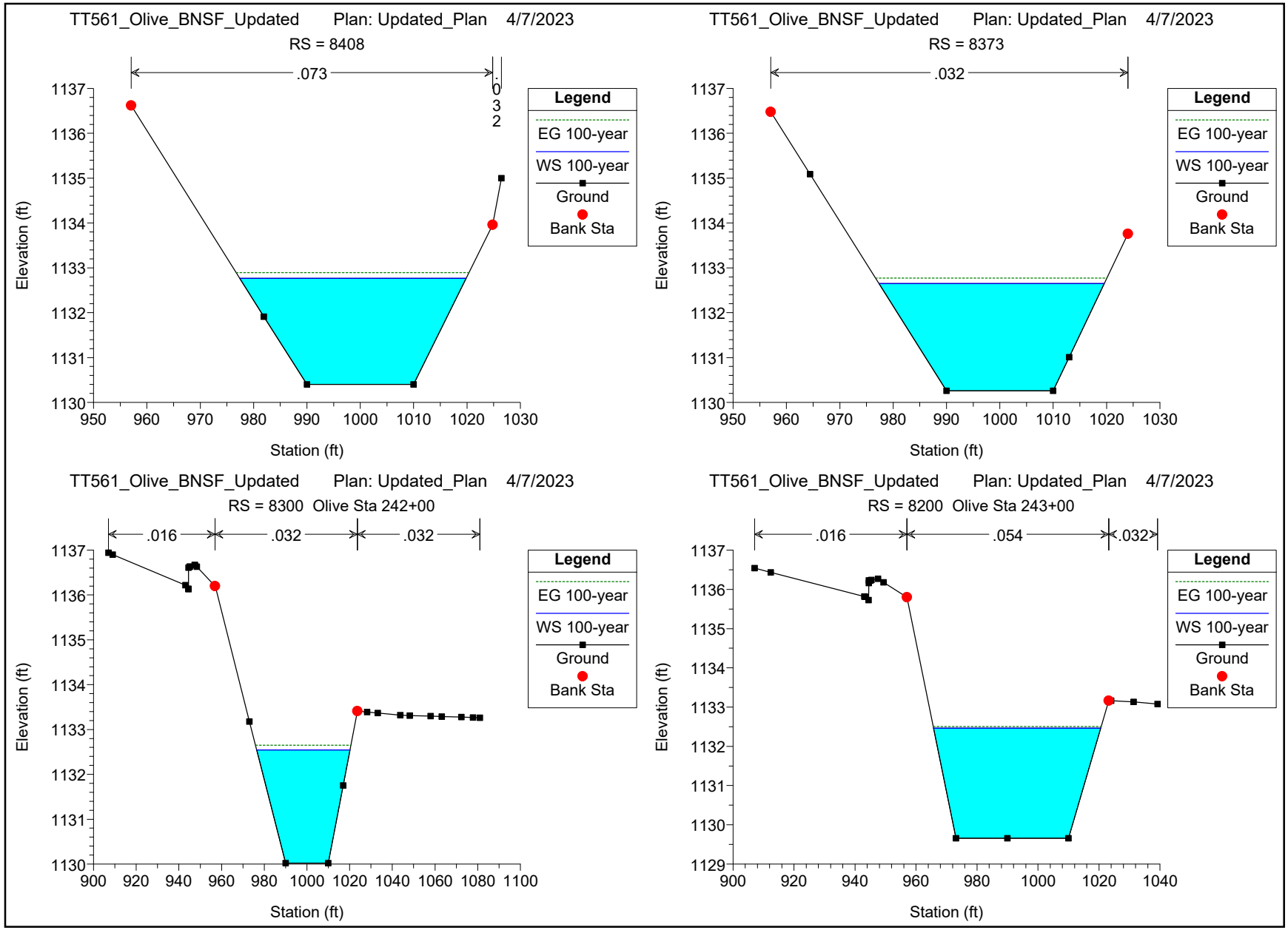

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9400 Olive Sta 231+00
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9300 Olive Sta 232+00
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9200 Olive Sta 233+00
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9100 Olive Sta 234+00
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)

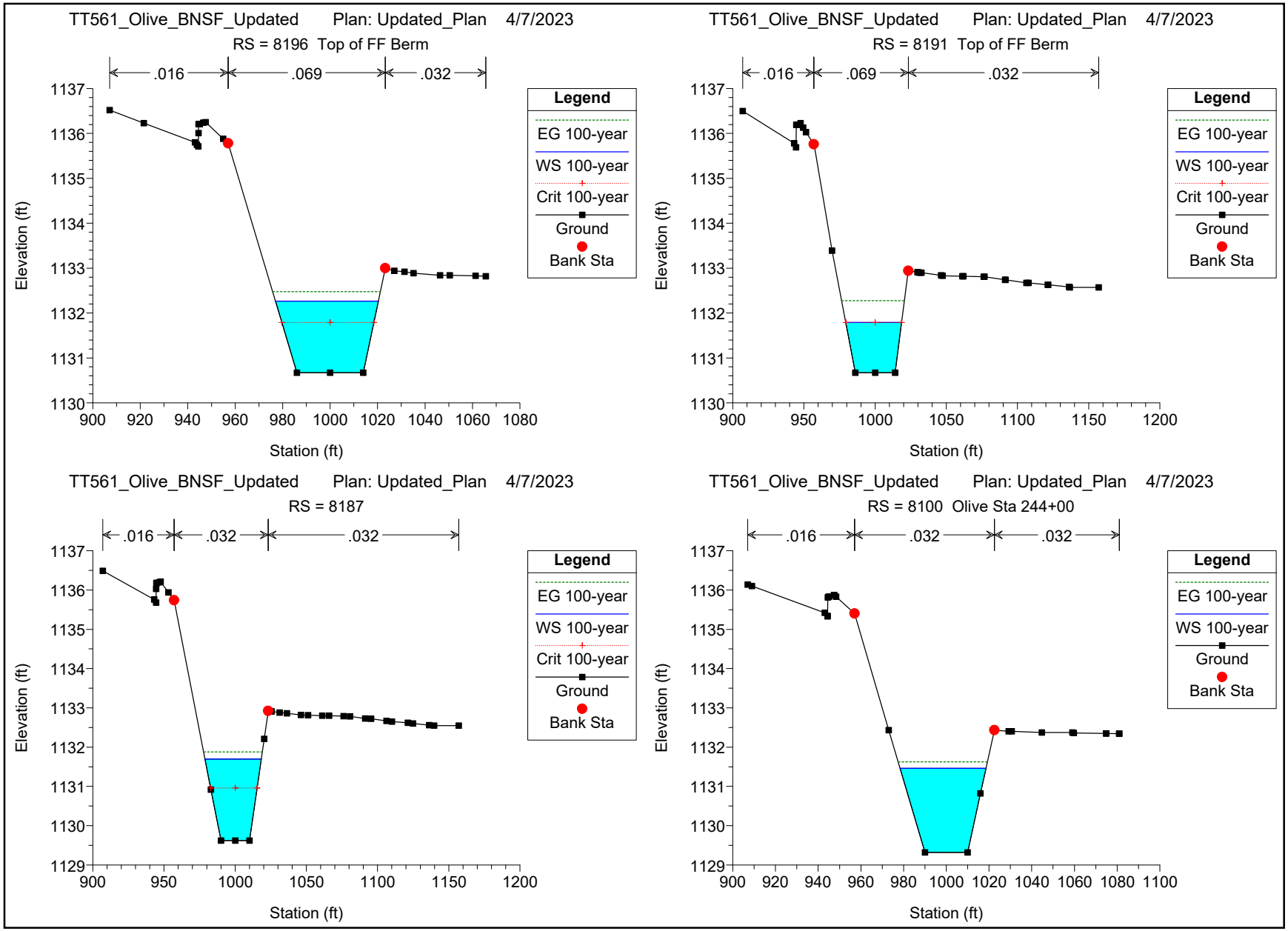

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9089 20' Before Drop
.016
.059
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9069 Begin Channel Drop
.016
.069
.032
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9059 End Channel Drop
.016
.059
.032
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9039 20' After Drop
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)

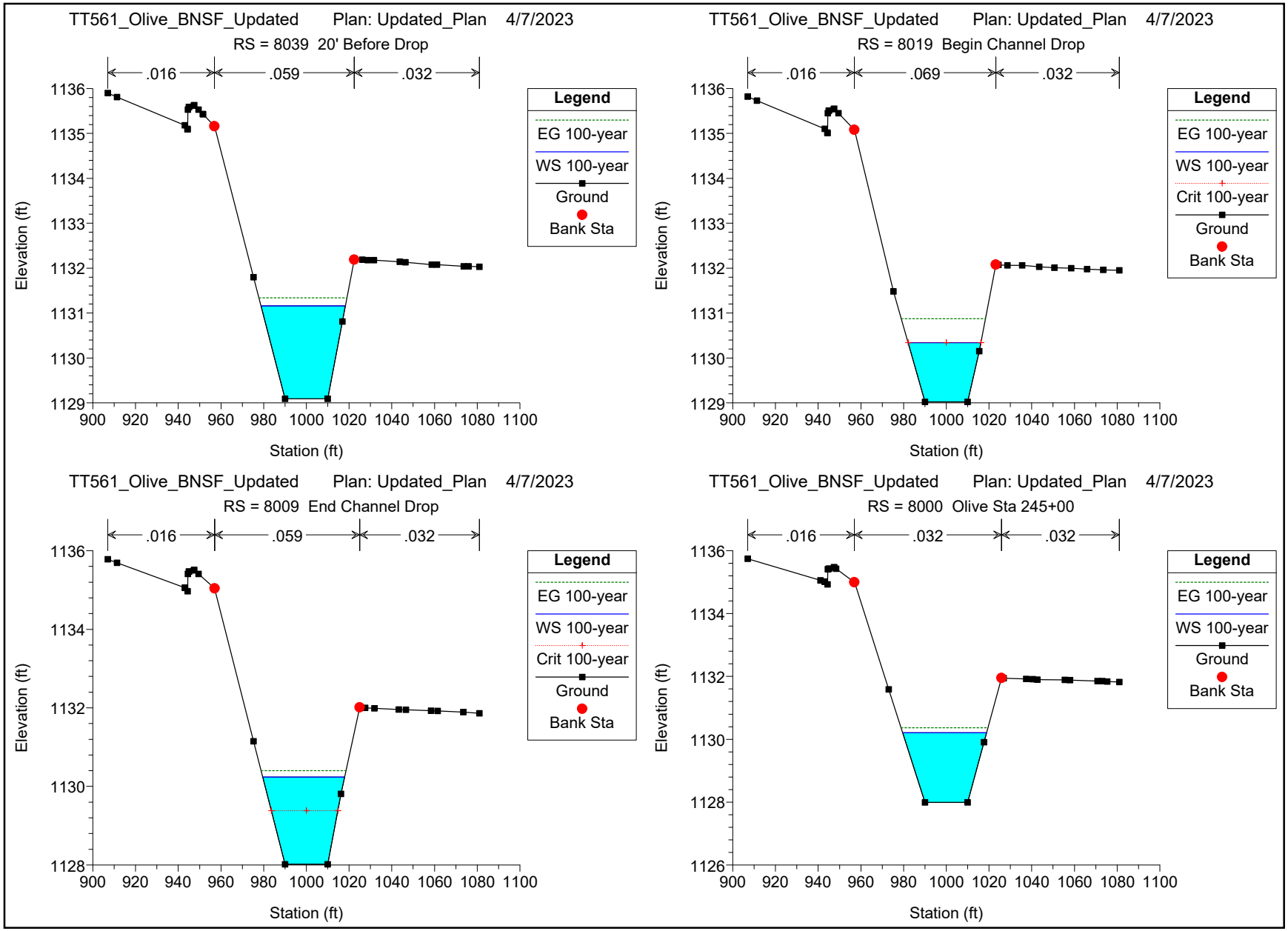

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 9000 Olive Sta 235+00
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8900 Olive Sta 236+00
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8800 Olive Sta 237+00
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8700 Olive Sta 238+00
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)

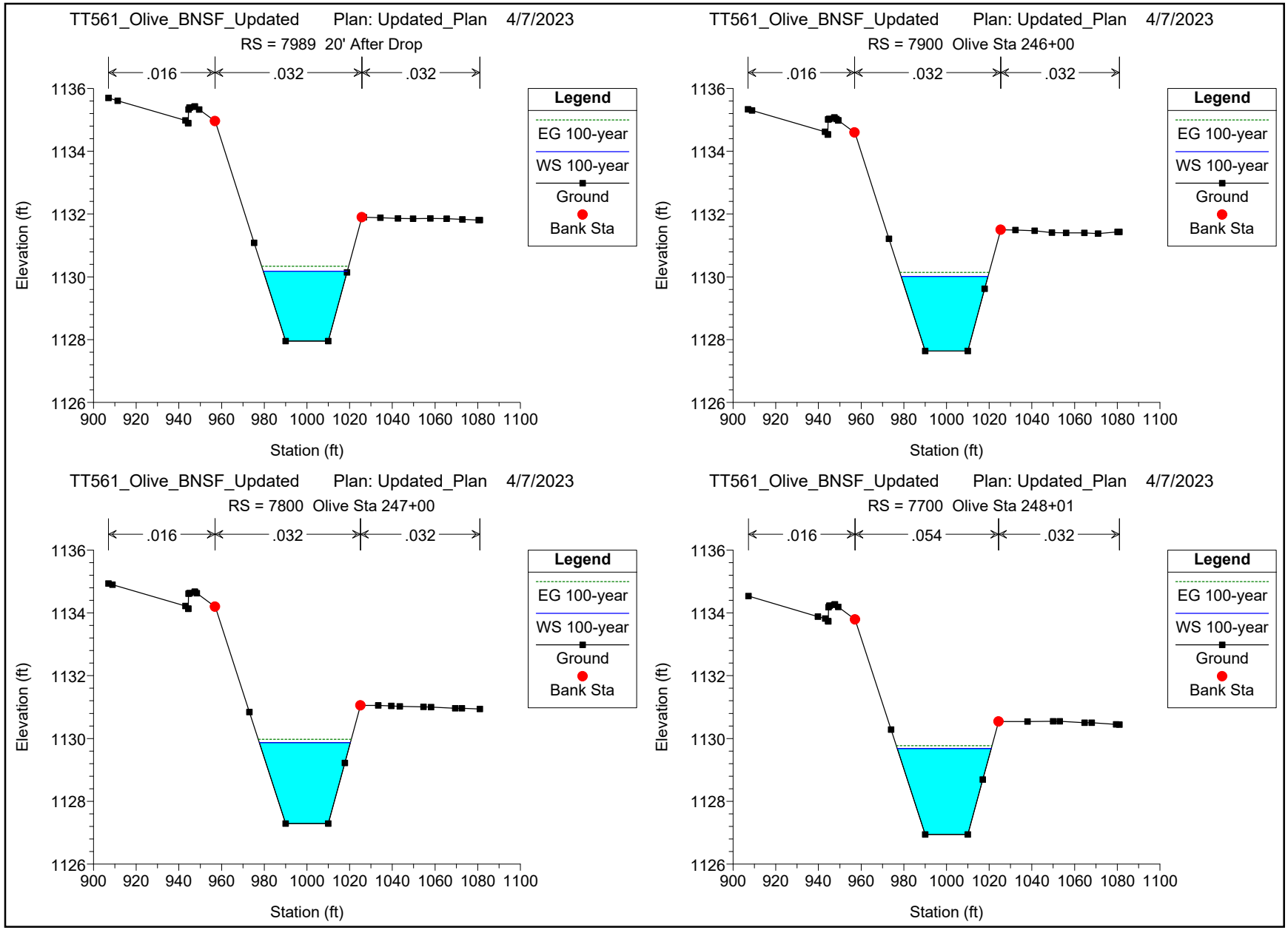

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8620 Before D/W Culvert
.016
.066
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8607
.066
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8575
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8568
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta

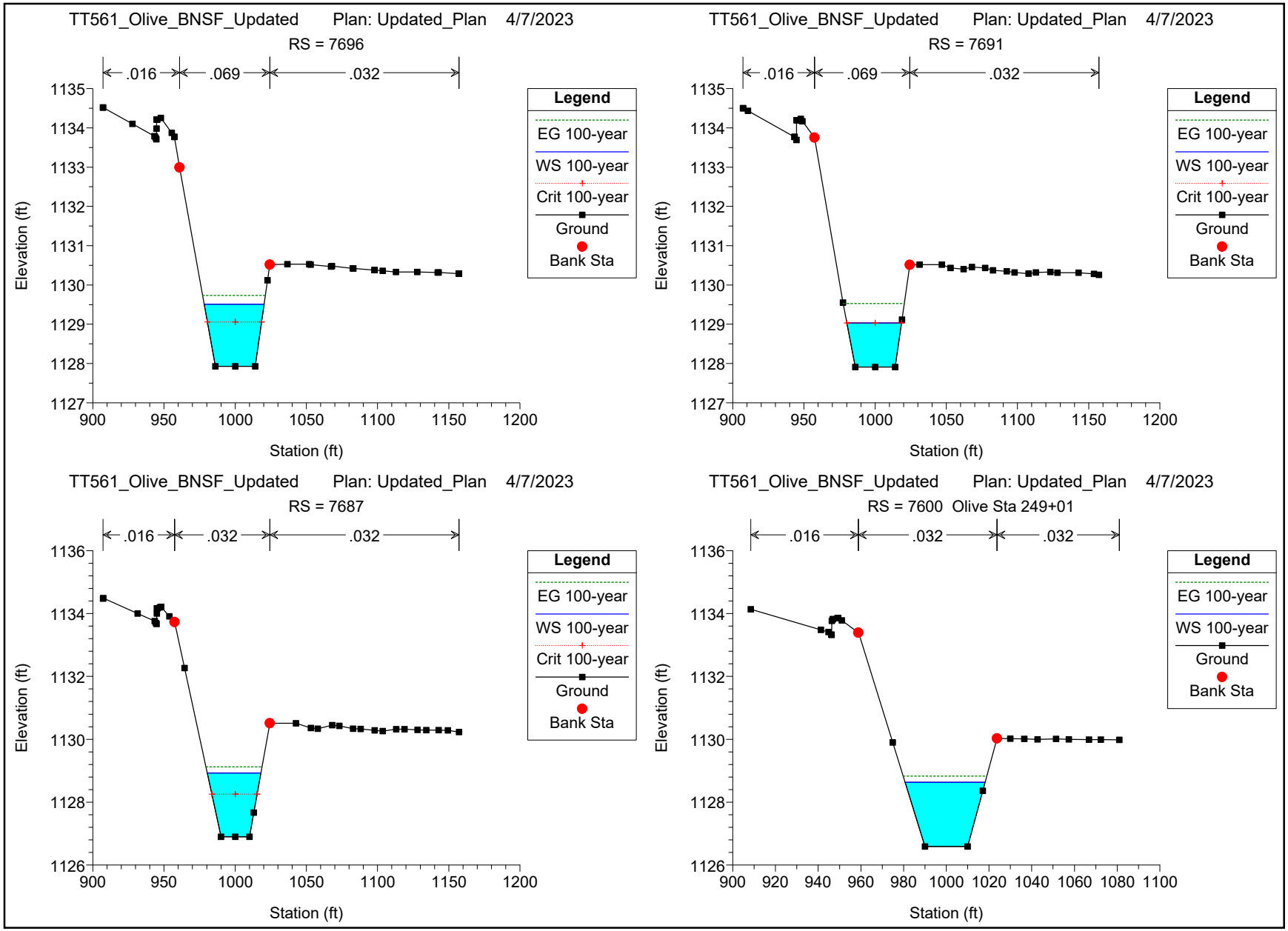

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8567 Culv
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8567 Culv
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8440
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8418
.073
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta

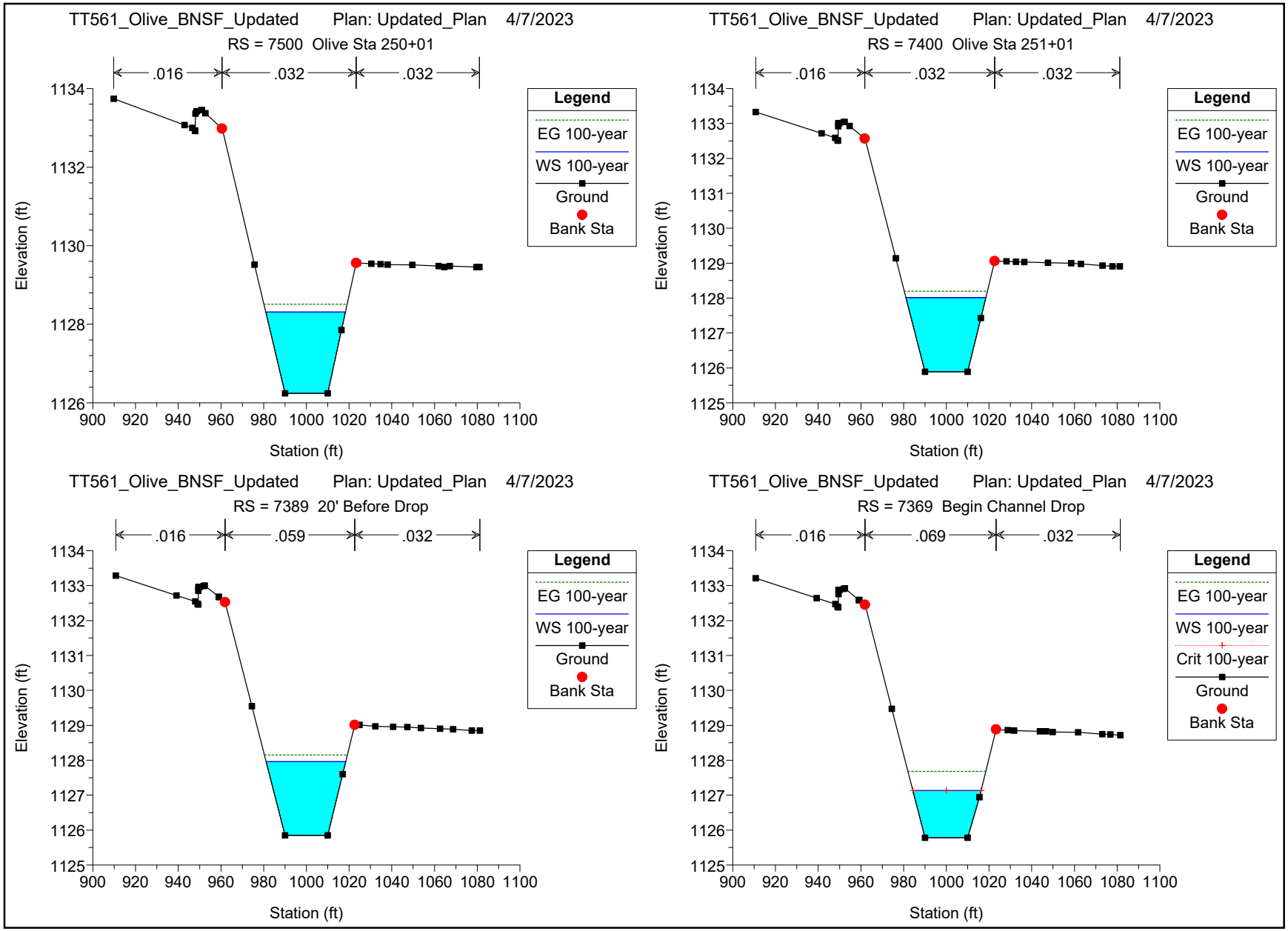

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8408
.073
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8373
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8300 Olive Sta 242+00
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8200 Olive Sta 243+00
.016
.054
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)

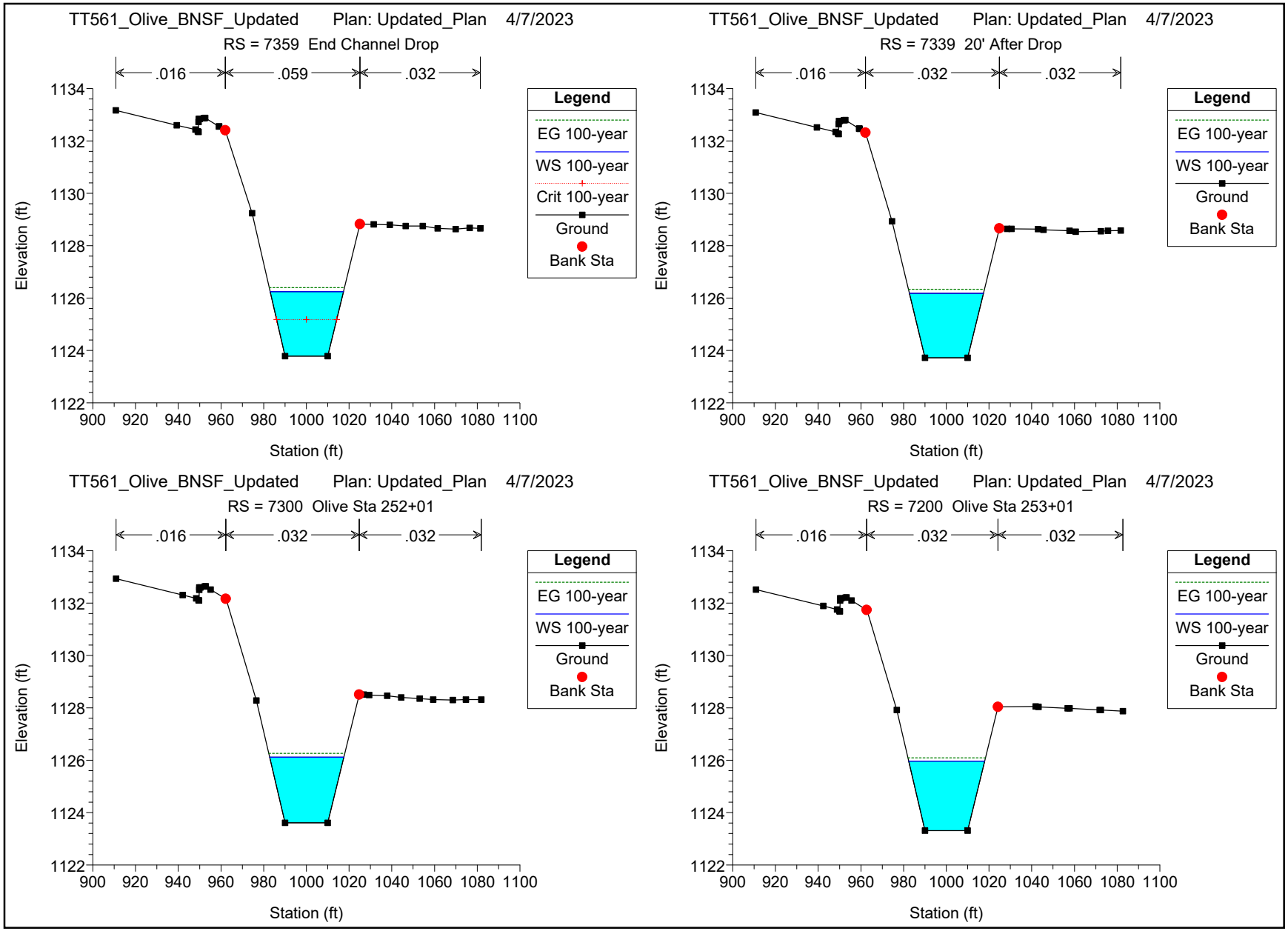

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8196 Top of FF Berm
.016
.069
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8191 Top of FF Berm
.016
.069
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8187
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8100 Olive Sta 244+00
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta

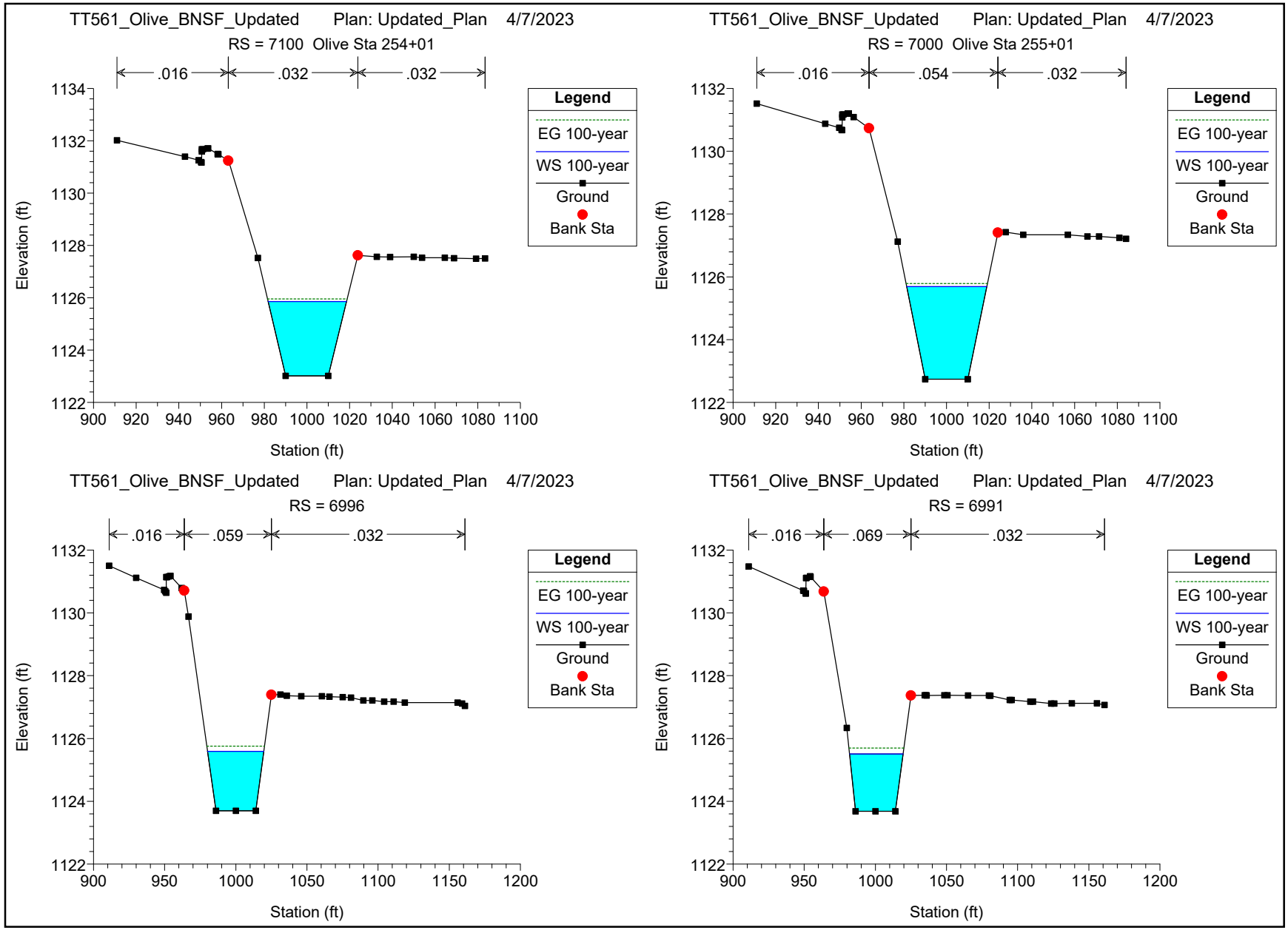

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8039 20' Before Drop
.016
.059
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8019 Begin Channel Drop
.016
.069
.032
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8009 End Channel Drop
.016
.059
.032
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 8000 Olive Sta 245+00
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)

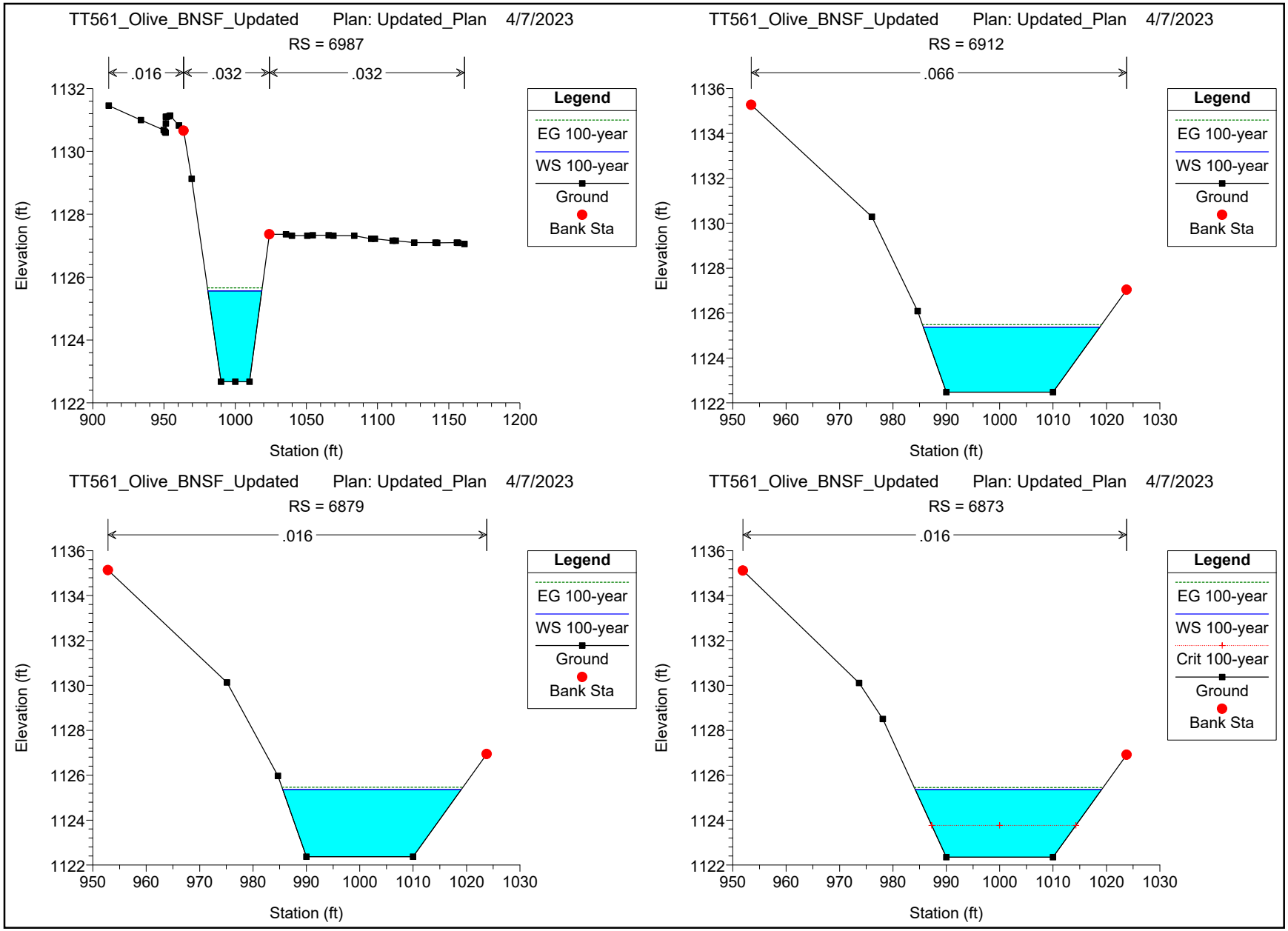

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7989 20' After Drop
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7900 Olive Sta 246+00
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7800 Olive Sta 247+00
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7700 Olive Sta 248+01
.016
.054
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)

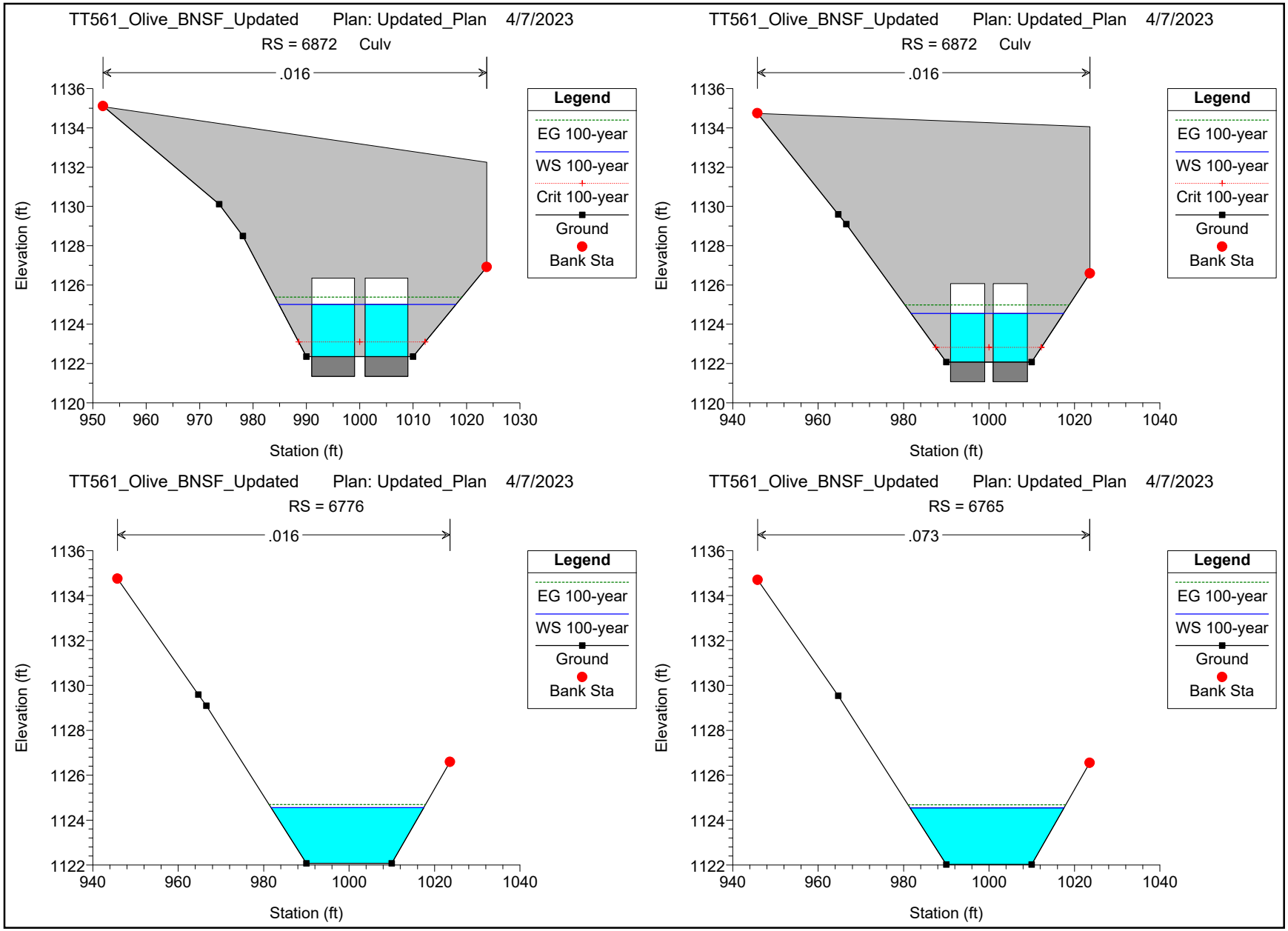

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7696
.016
.069
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7691
.016
.069
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7687
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7600 Olive Sta 249+01
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta

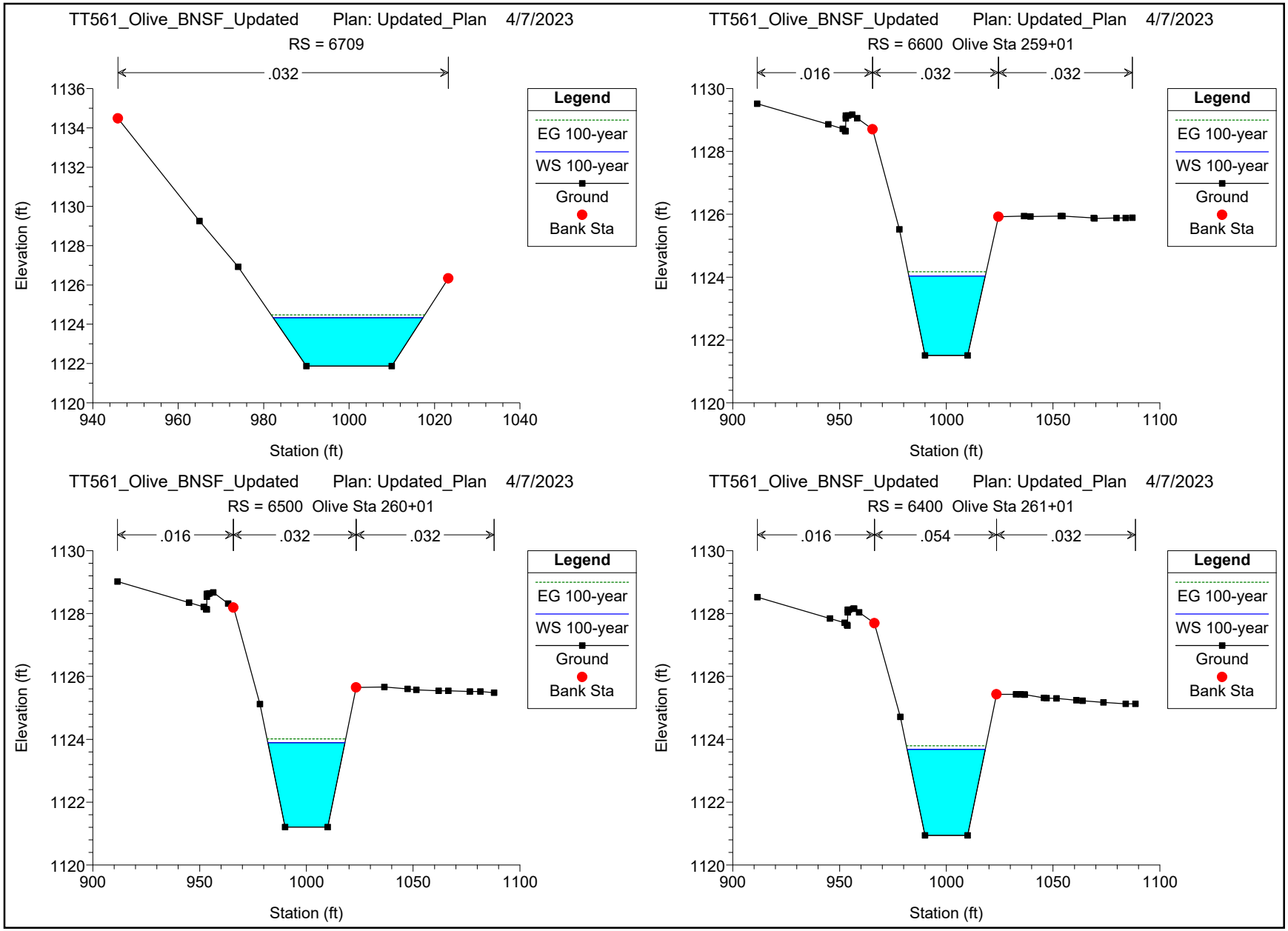

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7500 Olive Sta 250+01
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7400 Olive Sta 251+01
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7389 20' Before Drop
.016
.059
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7369 Begin Channel Drop
.016
.069
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta

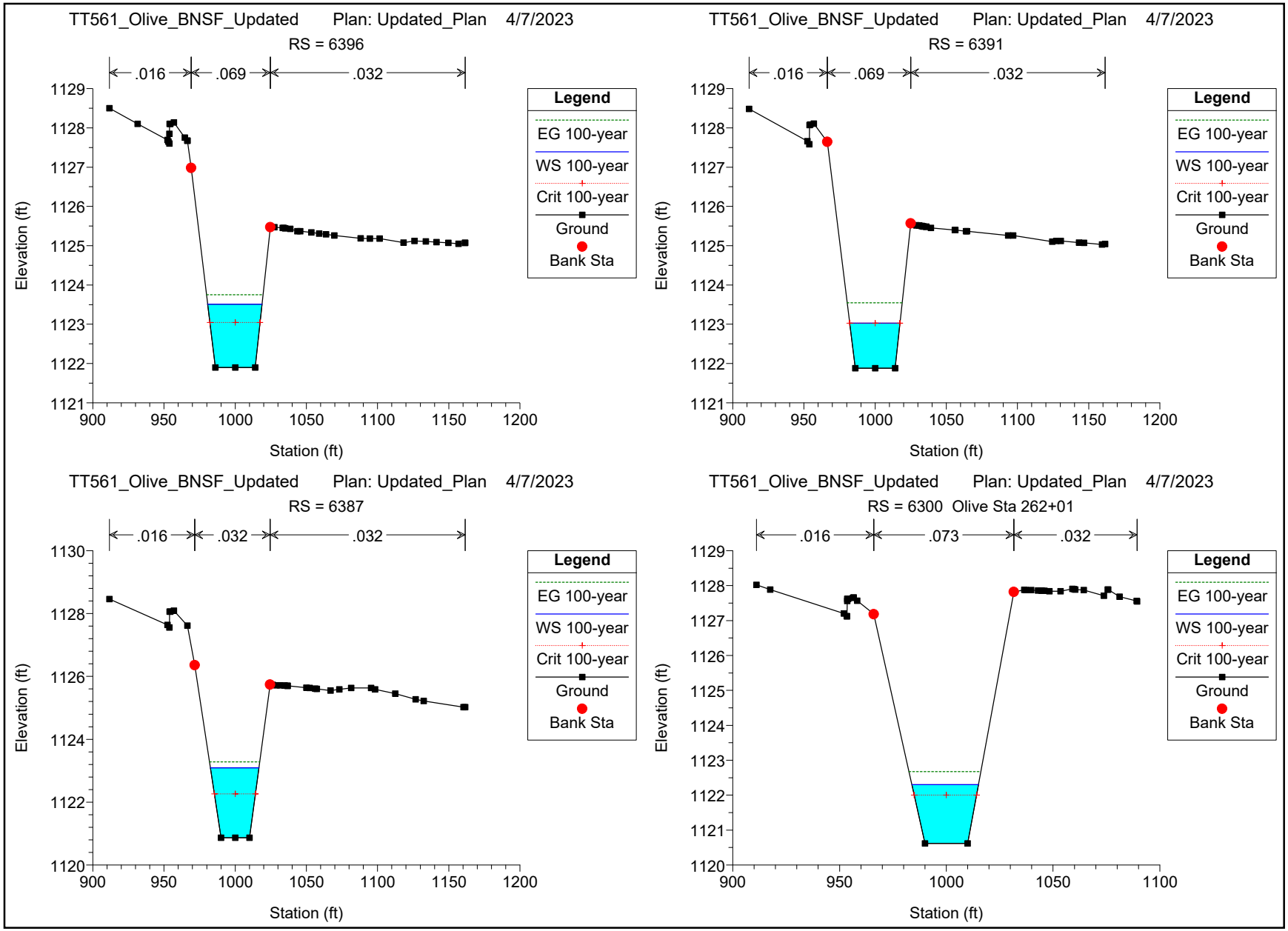

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7359 End Channel Drop
.016
.059
.032
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7339 20' After Drop
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7300 Olive Sta 252+01
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7200 Olive Sta 253+01
.016
.032
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)

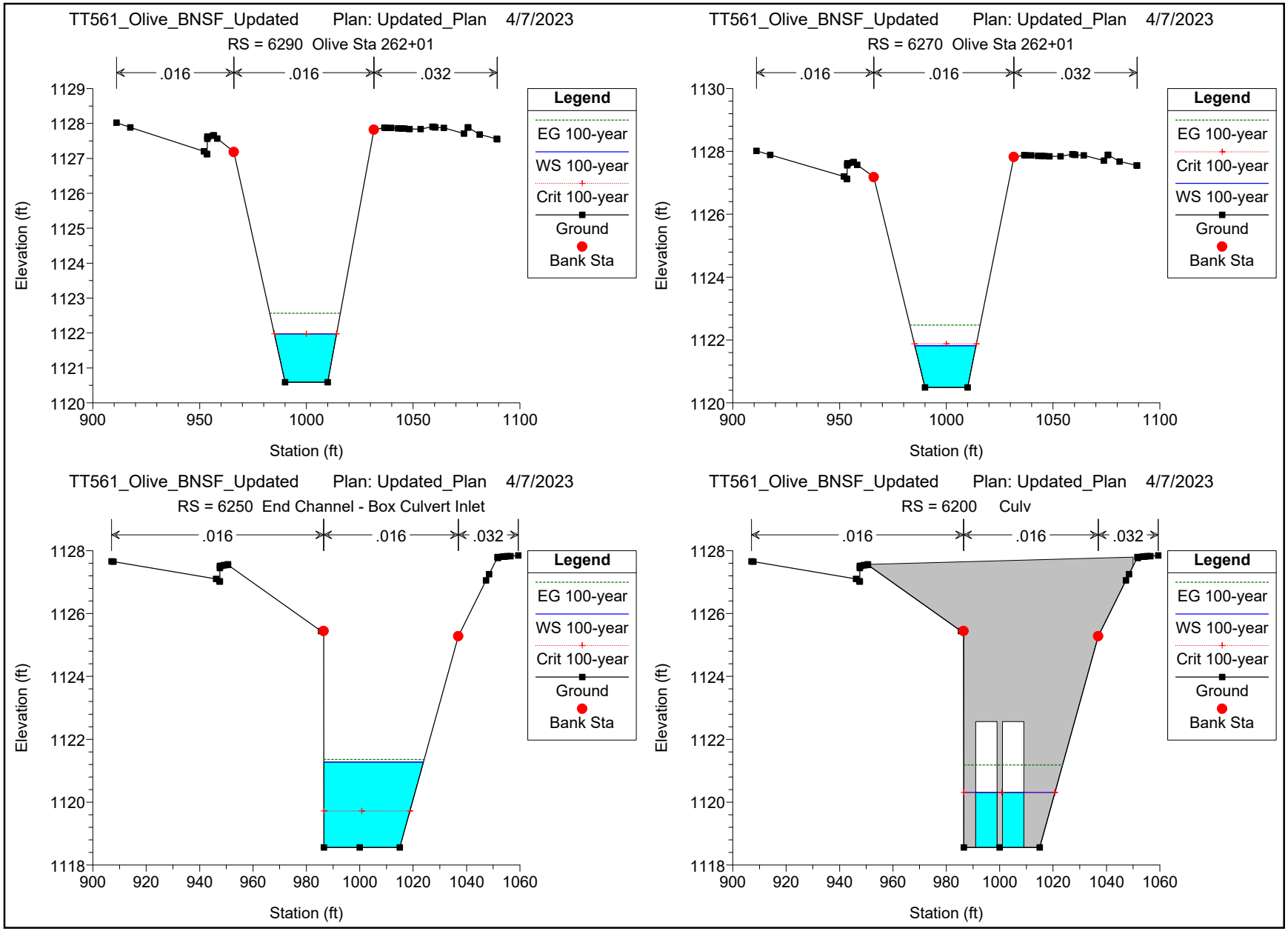

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7100 Olive Sta 254+01
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 7000 Olive Sta 255+01
.016
.054
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6996
.016
.059
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6991
.016
.069
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta

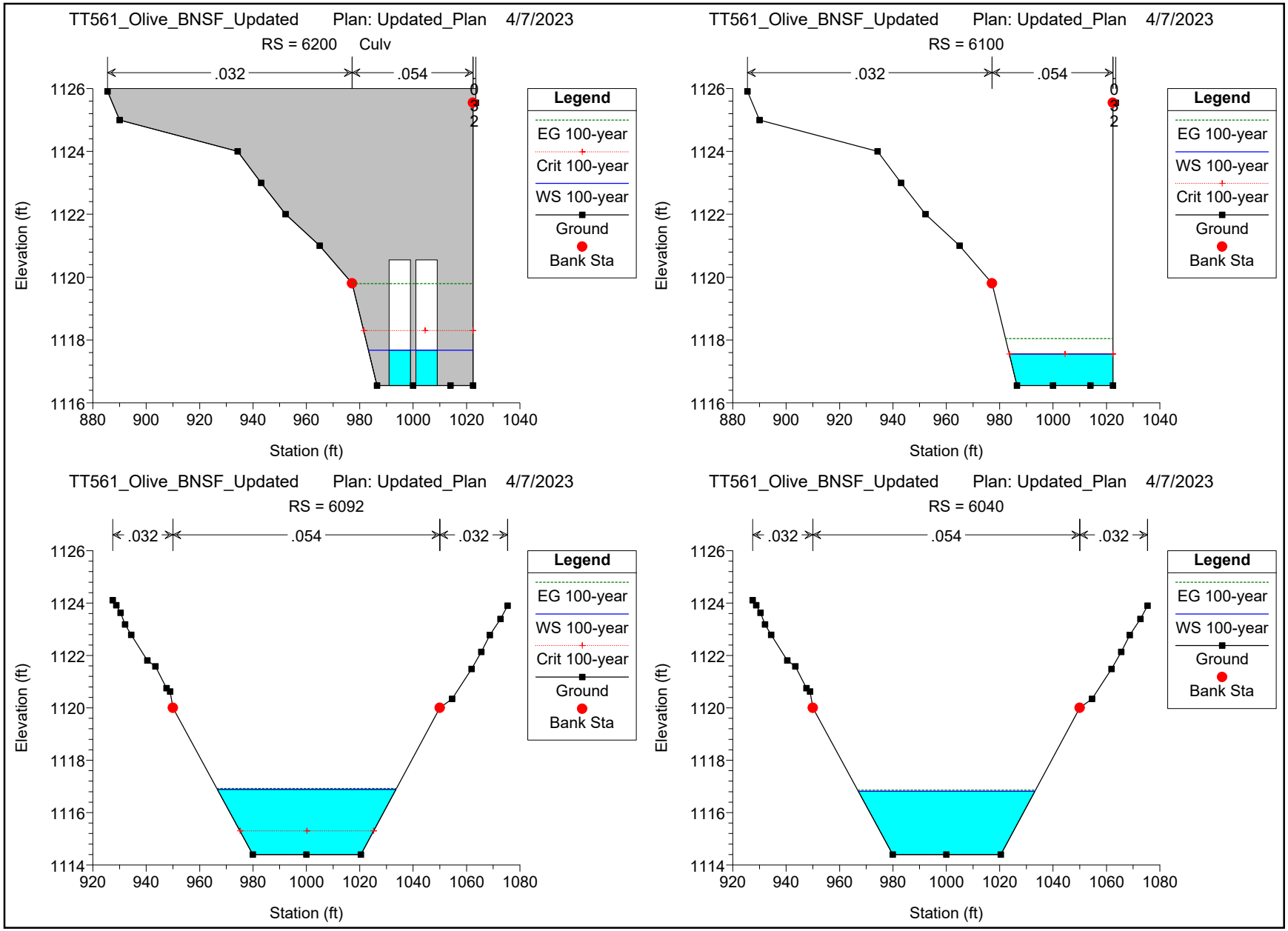

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6987
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6912
.066
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6879
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6873
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta

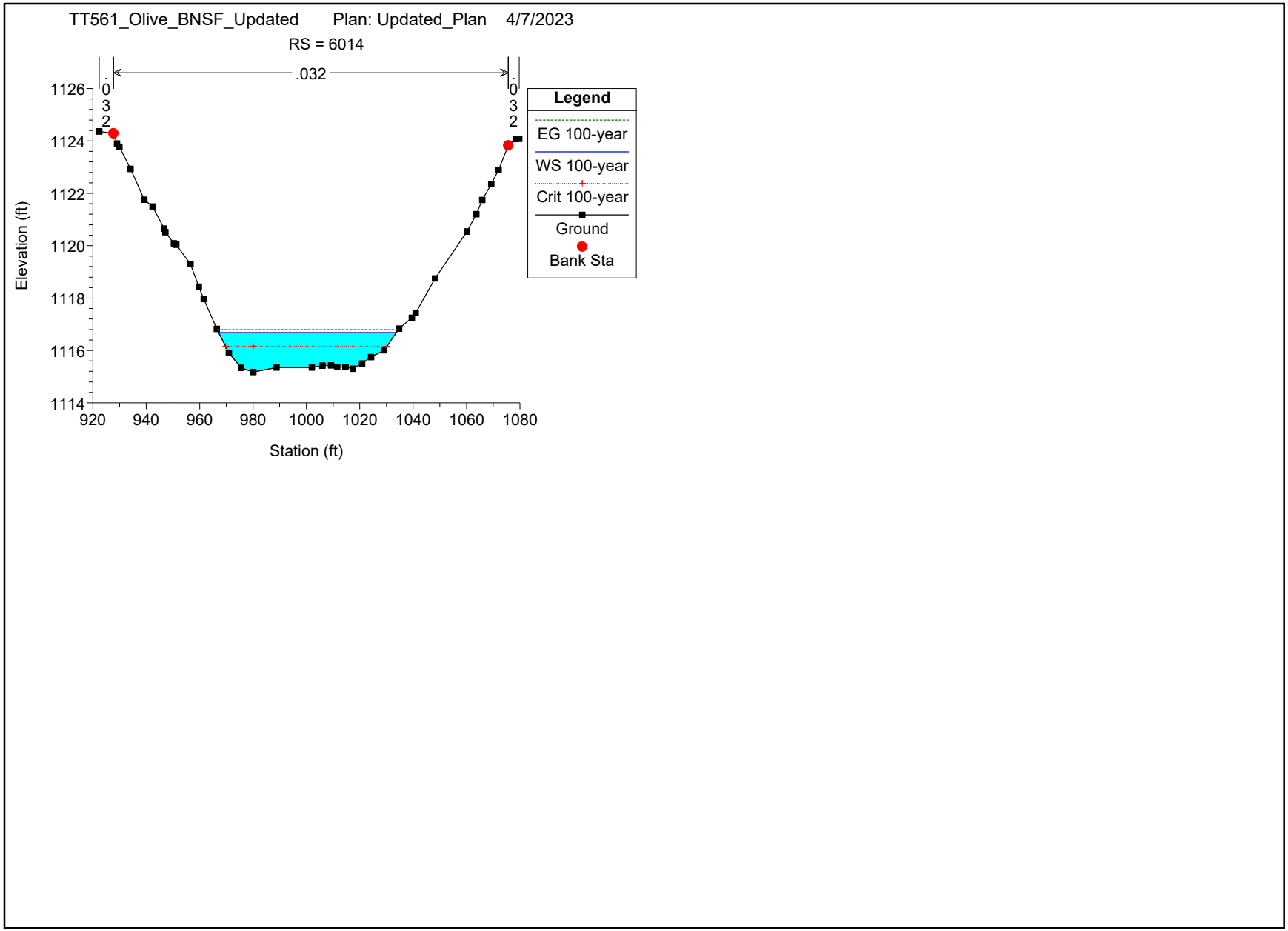

TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6872 Culv
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6872 Culv
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6776
.016
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6765
.073
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta


TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6709
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6600 Olive Sta 259+01
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6500 Olive Sta 260+01
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6400 Olive Sta 261+01
.016
.054
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta


TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6396
.016
.069
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6391
.016
.069
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6387
.016
.032
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6300 Olive Sta 262+01
.016
.073
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta


TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6290 Olive Sta 262+01
.016
.016
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6270 Olive Sta 262+01
.016
.016
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
Crit 100-year
WS 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6250 End Channel - Box Culvert Inlet
.016
.016
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6200 Culv
.016
.016
.032
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta


TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6200 Culv
.032
.054
0
3
2
Legend
EG 100-year
Crit 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6100
.032
.054
0
3
2
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6092
.032
.054
.032
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6040
.032
.054
.032
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)


TT561_Olive_BNSF_Updated Plan: Updated_Plan 4/7/2023
RS = 6014
.032
.032
.032
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
1126
1124
1122
1120
1118
1116
1114
920
940
960
980
1000
1020
1040
1060
1080

Project: TT0561&TT0562 Combined - Olive 303L to Reems Road
Location: Surprise, Arizona
Date: March 22, 2023
Subject: Olive Avenue CombinedChannel Freeboard Table

50-Year Storm Event								
HEC-RAS Station	**Channel Invert Elevation** (ft)	**Water Surface Elevation** (ft)	**Depth Of Flow** (ft)	**Top of Bank Elevation** (ft)	**Provided Freeboard** (ft)	**Channel Velocities** (ft/s)	**Calculated Required Freeboard** (ft)	**Required Freeboard (Min. 1')** (ft)
11537 *	1149.58	1152.77	3.2	1153.18	0.4	3.3	0.06	1
11522 *	1149.45	1151.90	2.5	1153.18	1.3	5.8	0.14	1
11487 *	1149.12	1151.60	2.5	1152.86	1.3	5.3	0.12	1
11437 *	1148.66	1151.14	2.5	1152.46	1.3	5.3	0.12	1
11387 *	1148.21	1150.68	2.5	1152.14	1.5	5.3	0.12	1
11337 *	1147.75	1150.23	2.5	1151.88	1.7	5.3	0.12	1
11287 *	1147.29	1149.83	2.5	1151.55	1.7	5.1	0.11	1
11237 *	1146.83	1149.55	2.7	1151.17	1.6	4.5	0.09	1
11187 *	1146.37	1148.95	2.6	1150.99	2.0	5.0	0.11	1
11167 *	1146.18	1148.50	2.3	1150.99	2.5	6.5	0.17	1
11157 *	1146.01	1147.93	1.9	1150.95	3.0	8.5	0.29	1
11135 *	1143.95	1148.18	4.2	1149.93	1.8	1.7	0.03	1
11119 *	1143.25	1148.16	4.9	1149.26	1.1	2.0	0.04	1
11114	Culvert X-Sections							
11088								
11084	1143.11	1144.83	1.7	1148.16	3.3	9.1	0.33	1
11067	1142.81	1145.60	2.8	1149.72	4.1	3.5	0.06	1
11052	1142.54	1145.59	3.0	1149.19	3.6	3.4	0.06	1
11036	1142.25	1145.61	3.4	1149.47	3.9	3.0	0.05	1
11021	1141.98	1145.05	3.1	1149.00	4.0	6.4	0.17	1
11020	Culvert X-Sections							
10843								
10838								
10837								
10623	1141.09	1142.62	1.5	1147.50	4.9	5.9	0.14	1
10585	1140.71	1142.57	1.9	1146.62	4.0	3.0	0.04	1
10550	1140.58	1142.40	1.8	1146.23	3.8	3.1	0.04	1
10450	1140.23	1142.18	2.0	1146.30	4.1	2.7	0.04	1
10350	1140.11	1141.90	1.8	1144.88	3.0	3.1	0.04	1
10250	1139.85	1141.55	1.7	1144.24	2.7	3.3	0.05	1
10150	1139.53	1141.11	1.6	1143.56	2.5	3.6	0.06	1
10050	1139.01	1140.76	1.8	1142.91	2.2	3.2	0.05	1
10000	1138.85	1140.60	1.8	1142.64	2.0	3.2	0.05	1
9900	1138.50	1140.30	1.8	1142.20	1.9	3.1	0.04	1
9889	1138.46	1140.25	1.8	1142.00	1.8	3.1	0.04	1
9869	1138.39	1139.51	1.1	1141.72	2.2	5.5	0.12	1
9859	1137.39	1139.27	1.9	1141.62	2.3	3.1	0.04	1
9839	1137.32	1139.19	1.9	1141.52	2.3	3.0	0.04	1
9800	1137.19	1139.10	1.9	1141.33	2.2	2.9	0.04	1
9700	1136.84	1138.91	2.1	1140.87	2.0	2.6	0.03	1
9600	1136.49	1138.79	2.3	1140.36	1.6	2.3	0.03	1
9500	1136.14	1138.63	2.5	1139.85	1.2	2.0	0.03	1
9496	1137.12	1138.49	1.4	1139.83	1.3	3.4	0.05	1
9491	1137.11	1138.05	0.9	1139.81	1.8	5.2	0.11	1
9487	1136.09	1137.81	1.7	1139.78	2.0	3.3	0.05	1
9400	1135.79	1137.50	1.7	1139.37	1.9	3.3	0.05	1
9300	1135.44	1137.16	1.7	1138.89	1.7	3.3	0.05	1
9200	1135.09	1136.84	1.8	1138.36	1.5	3.2	0.05	1

50-Year Storm Event (Cont.)								
HEC-RAS Station	**Channel Invert Elevation** (ft)	**Water Surface Elevation** (ft)	**Depth Of Flow** (ft)	**Top of Bank Elevation** (ft)	**Provided Freeboard** (ft)	**Channel Velocities** (ft/s)	**Calculated Required Freeboard** (ft)	**Required Freeboard (Min. 1')** (ft)
9100	1134.74	1136.56	1.8	1138.02	1.5	3.0	0.04	1
9089	1134.70	1136.50	1.8	1137.99	1.5	3.0	0.04	1
9069	1134.63	1135.75	1.1	1137.88	2.1	5.4	0.12	1
9059	1133.13	1134.96	1.8	1137.80	2.8	3.2	0.05	1
9039	1133.06	1134.85	1.8	1137.73	2.9	3.3	0.05	1
9000	1132.92	1134.73	1.8	1137.52	2.8	3.3	0.05	1
8900	1132.57	1134.47	1.9	1137.29	2.8	3.1	0.04	1
8800	1132.22	1134.26	2.0	1136.71	2.5	2.8	0.04	1
8700	1131.87	1134.12	2.3	1135.75	1.6	2.4	0.03	1
8620	1131.56	1133.95	2.4	1135.42	1.5	2.2	0.03	1
8607	1131.47	1133.88	2.4	1136.00	2.1	2.4	0.03	1
8575	1131.42	1133.86	2.4	1134.93	1.1	2.3	0.03	1
8568	1131.42	1133.86	2.4	1135.03	1.2	2.3	0.03	1
8567	Culvert X-Sections							
8440								
8418	1130.90	1132.55	1.6	1133.90	1.4	3.3	0.05	1
8408	1130.40	1132.47	2.1	1133.96	1.5	2.5	0.03	1
8373	1130.26	1132.37	2.1	1133.76	1.4	2.5	0.03	1
8300	1130.02	1132.28	2.3	1133.41	1.1	2.3	0.03	1
8200	1129.66	1132.21	2.5	1133.16	1.0	1.4	0.02	1
8196	1130.67	1132.04	1.4	1133.00	1.0	3.3	0.05	1
8191	1130.67	1131.60	0.9	1132.94	1.3	5.2	0.11	1
8187	1129.62	1131.40	1.8	1132.92	1.5	3.1	0.04	1
8100	1129.32	1131.17	1.9	1132.43	1.3	2.9	0.04	1
8039	1129.09	1130.89	1.8	1132.19	1.3	3.1	0.04	1
8019	1129.02	1130.13	1.1	1132.08	1.9	5.4	0.12	1
8009	1128.02	1129.93	1.9	1132.01	2.1	3.0	0.04	1
8000	1127.99	1129.90	1.9	1131.95	2.0	2.9	0.04	1
7989	1127.95	1129.88	1.9	1131.90	2.0	2.9	0.04	1
7900	1127.64	1129.71	2.1	1131.50	1.8	2.6	0.03	1
7800	1127.29	1129.59	2.3	1131.05	1.5	2.3	0.03	1
7700	1126.94	1129.44	2.5	1130.54	1.1	2.0	0.03	1
7696	1127.93	1129.29	1.4	1130.52	1.2	3.4	0.05	1
7691	1127.91	1128.85	0.9	1130.51	1.7	5.2	0.11	1
7687	1126.90	1128.63	1.7	1130.51	1.9	3.3	0.05	1
7600	1126.59	1128.34	1.8	1130.03	1.7	3.3	0.05	1
7500	1126.24	1128.02	1.8	1129.56	1.5	3.2	0.05	1
7400	1125.89	1127.74	1.8	1129.06	1.3	3.1	0.04	1
7389	1125.85	1127.68	1.8	1129.01	1.3	3.1	0.04	1
7369	1125.78	1126.91	1.1	1128.88	2.0	5.5	0.12	1
7359	1123.78	1125.85	2.1	1128.82	3.0	2.9	0.04	1
7339	1123.72	1125.78	2.1	1128.66	2.9	2.9	0.04	1
7300	1123.61	1125.71	2.1	1128.51	2.8	2.9	0.04	1
7200	1123.31	1125.55	2.2	1128.04	2.5	2.6	0.04	1

50-Year Storm Event (Cont.)								
HEC-RAS Station	**Channel Invert Elevation** (ft)	**Water Surface Elevation** (ft)	**Depth Of Flow** (ft)	**Top of Bank Elevation** (ft)	**Provided Freeboard** (ft)	**Channel Velocities** (ft/s)	**Calculated Required Freeboard** (ft)	**Required Freeboard (Min. 1')** (ft)
7100	1123.01	1125.43	2.4	1127.62	2.2	2.4	0.03	1
7000	1122.74	1125.27	2.5	1127.41	2.1	2.3	0.03	1
6996	1123.70	1125.14	1.4	1127.39	2.3	3.4	0.05	1
6991	1123.68	1125.01	1.3	1127.37	2.4	3.8	0.06	1
6987	1122.67	1125.09	2.4	1127.36	2.3	2.4	0.03	1
6912	1122.47	1124.88	2.4	1127.04	2.2	2.6	0.03	1
6879	1122.37	1124.87	2.5	1126.94	2.1	2.5	0.03	1
6873	1122.35	1124.87	2.5	1126.91	2.0	2.4	0.03	1
6872	Culvert X-Sections							
6776								
6765	1122.02	1124.20	2.2	1126.55	2.3	2.7	0.04	1
6709	1121.87	1124.00	2.1	1126.34	2.3	2.8	0.04	1
6600	1121.51	1123.72	2.2	1125.92	2.2	2.6	0.04	1
6500	1121.21	1123.60	2.4	1125.65	2.1	2.4	0.03	1
6400	1120.94	1123.43	2.5	1125.43	2.0	2.3	0.03	1
6396	1121.90	1123.28	1.4	1125.47	2.2	3.5	0.05	1
6391	1121.88	1122.83	0.9	1125.57	2.7	5.3	0.11	1
6387	1120.87	1122.79	1.9	1125.74	3.0	3.1	0.05	1
6300	1120.62	1122.05	1.4	1127.18	5.1	4.4	0.08	1
6290	1120.59	1121.75	1.2	1127.18	5.4	5.7	0.13	1
6270	1120.49	1121.60	1.1	1127.18	5.6	6.0	0.14	1
6250	Culvert X-Sections							
6200								
6100	1116.55	1117.38	0.8	1119.80	2.4	5.1	0.10	1
6092	1114.40	1116.66	2.3	1120.00	3.3	1.3	0.02	1
6040	1114.40	1116.60	2.2	1120.00	3.4	1.4	0.02	1
6014	1115.18	1116.48	1.3	1123.83	7.3	2.5	0.03	1

* Cross-Sections based on BNSF future ditch plans and track widening/improvements. Design ensures future BNSF Improvemets are accommodated while capturing/conveying flows. The beginning of the channel shows there is not enough freeboard but overall the channel does as you move downstream.

100-Year Storm Event							
HEC-RAS Station	**Channel Invert Elevation** (ft)	**Water Surface Elevation** (ft)	**Depth Of Flow** (ft)	**Top of Bank Elevation** (ft)	**Provided Freeboard** (ft)	**Channel Velocities** (ft/s)	**Calculated Required Freeboard** (ft)
11537*	1149.58	1153.14	3.6	1153.18	0.0	3.6	0.07
11522*	1149.45	1152.20	2.8	1153.18	1.0	6.2	0.16
11487*	1149.12	1151.91	2.8	1152.86	0.9	5.7	0.14
11437*	1148.66	1151.45	2.8	1152.46	1.0	5.7	0.14
11387*	1148.21	1150.99	2.8	1152.14	1.2	5.7	0.14
11337*	1147.75	1150.55	2.8	1151.88	1.3	5.7	0.14
11287*	1147.29	1150.16	2.9	1151.55	1.4	5.4	0.13
11237*	1146.83	1149.89	3.1	1151.17	1.3	4.8	0.10
11187*	1146.37	1149.28	2.9	1150.99	1.7	5.3	0.12
11167*	1146.18	1148.82	2.6	1150.99	2.2	6.8	0.19
11157*	1146.01	1148.20	2.2	1150.95	2.8	8.9	0.32
11135*	1143.95	1148.96	5.0	1149.93	1.0	1.7	0.03
11119*	1143.25	1148.90	5.7	1149.26	0.4	2.4	0.04
11114	Culvert X-Sections						
11088							
11084	1142.81	1146.45	3.6	1148.72	2.3	2.2	0.03
11067	1142.81	1146.45	3.6	1149.72	3.3	3.2	0.05
11052	1142.54	1146.44	3.9	1149.19	2.8	3.2	0.06
11036	1142.25	1146.45	4.2	1149.47	3.0	3.0	0.05
11021	1141.98	1145.77	3.8	1149.00	3.2	6.9	0.20
11020	Culvert X-Sections						
10843							
10838							
10837							
10623	1141.09	1142.87	1.8	1147.50	4.6	6.3	0.16
10585	1140.71	1142.88	2.2	1146.62	3.7	3.3	0.05
10550	1140.58	1142.71	2.1	1146.23	3.5	3.4	0.05
10450	1140.23	1142.49	2.3	1146.30	3.8	3.0	0.04
10350	1140.11	1142.19	2.1	1144.88	2.7	3.4	0.05
10250	1139.85	1141.83	2.0	1144.24	2.4	3.6	0.06
10150	1139.53	1141.39	1.9	1143.56	2.2	3.9	0.07
10050	1139.01	1141.04	2.0	1142.91	1.9	3.5	0.06
10000	1138.85	1140.88	2.0	1142.64	1.8	3.5	0.06
9900	1138.50	1140.57	2.1	1142.20	1.6	3.4	0.05
9889	1138.46	1140.51	2.0	1142.00	1.5	3.5	0.05
9869	1138.39	1139.72	1.3	1141.72	2.0	5.9	0.14
9859	1137.39	1139.58	2.2	1141.62	2.0	3.4	0.05
9839	1137.32	1139.50	2.2	1141.52	2.0	3.3	0.05
9800	1137.19	1139.40	2.2	1141.33	1.9	3.2	0.05
9700	1136.84	1139.21	2.4	1140.87	1.7	2.9	0.04
9600	1136.49	1139.07	2.6	1140.36	1.3	2.6	0.04
9500	1136.14	1138.88	2.7	1139.85	1.0	2.4	0.03
9496	1137.12	1138.72	1.6	1139.83	1.1	3.7	0.06
9491	1137.11	1138.24	1.1	1139.81	1.6	5.6	0.13
9487	1136.09	1138.09	2.0	1139.78	1.7	3.6	0.06
9400	1135.79	1137.79	2.0	1139.37	1.6	3.6	0.06
9300	1135.44	1137.45	2.0	1138.89	1.4	3.6	0.06
9200	1135.09	1137.12	2.0	1138.36	1.2	3.5	0.06

100-Year Storm Event (Cont.)							
HEC-RAS Station	**Channel Invert Elevation** (ft)	**Water Surface Elevation** (ft)	**Depth Of Flow** (ft)	**Top of Bank Elevation** (ft)	**Provided Freeboard** (ft)	**Channel Velocities** (ft/s)	**Calculated Required Freeboard** (ft)
9100	1134.74	1136.83	2.1	1138.02	1.2	3.3	0.05
9089	1134.70	1136.77	2.1	1137.99	1.2	3.4	0.05
9069	1134.63	1135.96	1.3	1137.88	1.9	5.9	0.14
9059	1133.13	1135.31	2.2	1137.80	2.5	3.5	0.06
9039	1133.06	1135.21	2.2	1137.73	2.5	3.5	0.06
9000	1132.92	1135.11	2.2	1137.52	2.4	3.4	0.05
8900	1132.57	1134.88	2.3	1137.29	2.4	3.2	0.05
8800	1132.22	1134.71	2.5	1136.71	2.0	2.9	0.04
8700	1131.87	1134.59	2.7	1135.75	1.2	2.5	0.04
8620	1131.56	1134.44	2.9	1135.42	1.0	2.3	0.03
8607	1131.47	1134.37	2.9	1136.00	1.6	2.5	0.04
8575	1131.42	1134.35	2.9	1134.93	0.6	2.4	0.03
8568	1131.42	1134.36	2.9	1135.03	0.7	2.4	0.03
8567	Culvert X-Sections						
8440							
8418	1130.90	1132.84	1.9	1133.90	1.1	3.6	0.06
8408	1130.40	1132.77	2.4	1133.96	1.2	2.8	0.04
8373	1130.26	1132.65	2.4	1133.76	1.1	2.8	0.04
8300	1130.02	1132.55	2.5	1133.41	0.9	2.6	0.04
8200	1129.66	1132.46	2.8	1133.16	0.7	1.6	0.02
8196	1130.67	1132.26	1.6	1133.00	0.7	3.7	0.06
8191	1130.67	1131.79	1.1	1132.94	1.2	5.6	0.13
8187	1129.62	1131.70	2.1	1132.92	1.2	3.4	0.05
8100	1129.32	1131.46	2.1	1132.43	1.0	3.3	0.05
8039	1129.09	1131.16	2.1	1132.19	1.0	3.4	0.05
8019	1129.02	1130.34	1.3	1132.08	1.7	5.9	0.14
8009	1128.02	1130.24	2.2	1132.01	1.8	3.3	0.05
8000	1127.99	1130.21	2.2	1131.95	1.7	3.2	0.05
7989	1127.95	1130.18	2.2	1131.90	1.7	3.2	0.05
7900	1127.64	1130.01	2.4	1131.50	1.5	2.9	0.04
7800	1127.29	1129.87	2.6	1131.05	1.2	2.6	0.04
7700	1126.94	1129.68	2.7	1130.54	0.9	2.4	0.03
7696	1127.93	1129.51	1.6	1130.52	1.0	3.8	0.06
7691	1127.91	1129.04	1.1	1130.51	1.5	5.6	0.13
7687	1126.90	1128.92	2.0	1130.51	1.6	3.6	0.06
7600	1126.59	1128.63	2.0	1130.03	1.4	3.6	0.06
7500	1126.24	1128.31	2.1	1129.56	1.3	3.5	0.06
7400	1125.89	1128.02	2.1	1129.06	1.0	3.4	0.05
7389	1125.85	1127.96	2.1	1129.01	1.0	3.5	0.06
7369	1125.78	1127.13	1.4	1128.88	1.8	6.0	0.14
7359	1123.78	1126.25	2.5	1128.82	2.6	3.1	0.05
7339	1123.72	1126.19	2.5	1128.66	2.5	3.1	0.05
7300	1123.61	1126.12	2.5	1128.51	2.4	3.1	0.05
7200	1123.31	1125.97	2.7	1128.04	2.1	2.8	0.04

100-Year Storm Event (Cont.)							
HEC-RAS Station	**Channel Invert Elevation** (ft)	**Water Surface Elevation** (ft)	**Depth Of Flow** (ft)	**Top of Bank Elevation** (ft)	**Provided Freeboard** (ft)	**Channel Velocities** (ft/s)	**Calculated Required Freeboard** (ft)
7100	1123.01	1125.85	2.8	1127.62	1.8	2.6	0.04
7000	1122.74	1125.69	3.0	1127.41	1.7	2.5	0.04
6996	1123.70	1125.59	1.9	1127.39	1.8	3.3	0.05
6991	1123.68	1125.51	1.8	1127.37	1.9	3.5	0.05
6987	1122.67	1125.56	2.9	1127.36	1.8	2.5	0.04
6912	1122.47	1125.37	2.9	1127.04	1.7	2.7	0.04
6879	1122.37	1125.35	3.0	1126.94	1.6	2.6	0.04
6873	1122.35	1125.36	3.0	1126.91	1.6	2.5	0.04
6872	Culvert X-Sections						
6776							
6765	1122.02	1124.54	2.5	1126.55	2.0	3.0	0.04
6709	1121.87	1124.33	2.5	1126.34	2.0	3.1	0.05
6600	1121.51	1124.03	2.5	1125.92	1.9	3.0	0.04
6500	1121.21	1123.89	2.7	1125.65	1.8	2.8	0.04
6400	1120.94	1123.68	2.7	1125.43	1.8	2.7	0.04
6396	1121.90	1123.51	1.6	1125.47	2.0	3.9	0.07
6391	1121.88	1123.03	1.1	1125.57	2.5	5.8	0.13
6387	1120.87	1123.09	2.2	1125.74	2.7	3.5	0.06
6300	1120.62	1122.30	1.7	1127.18	4.9	4.9	0.10
6290	1120.59	1121.97	1.4	1127.18	5.2	6.2	0.15
6270	1120.49	1121.82	1.3	1127.18	5.4	6.5	0.17
6250	1118.56	1121.27	2.7	1125.44	4.2	2.4	0.03
6200	Culvert X-Sections						
6100							
6092	1114.4	1116.89	2.5	1120.00	3.1	1.6	0.02
6040	1114.4	1116.81	2.4	1120.00	3.2	1.6	0.02
6014	1115.18	1116.68	1.5	1123.83	7.1	2.8	0.04

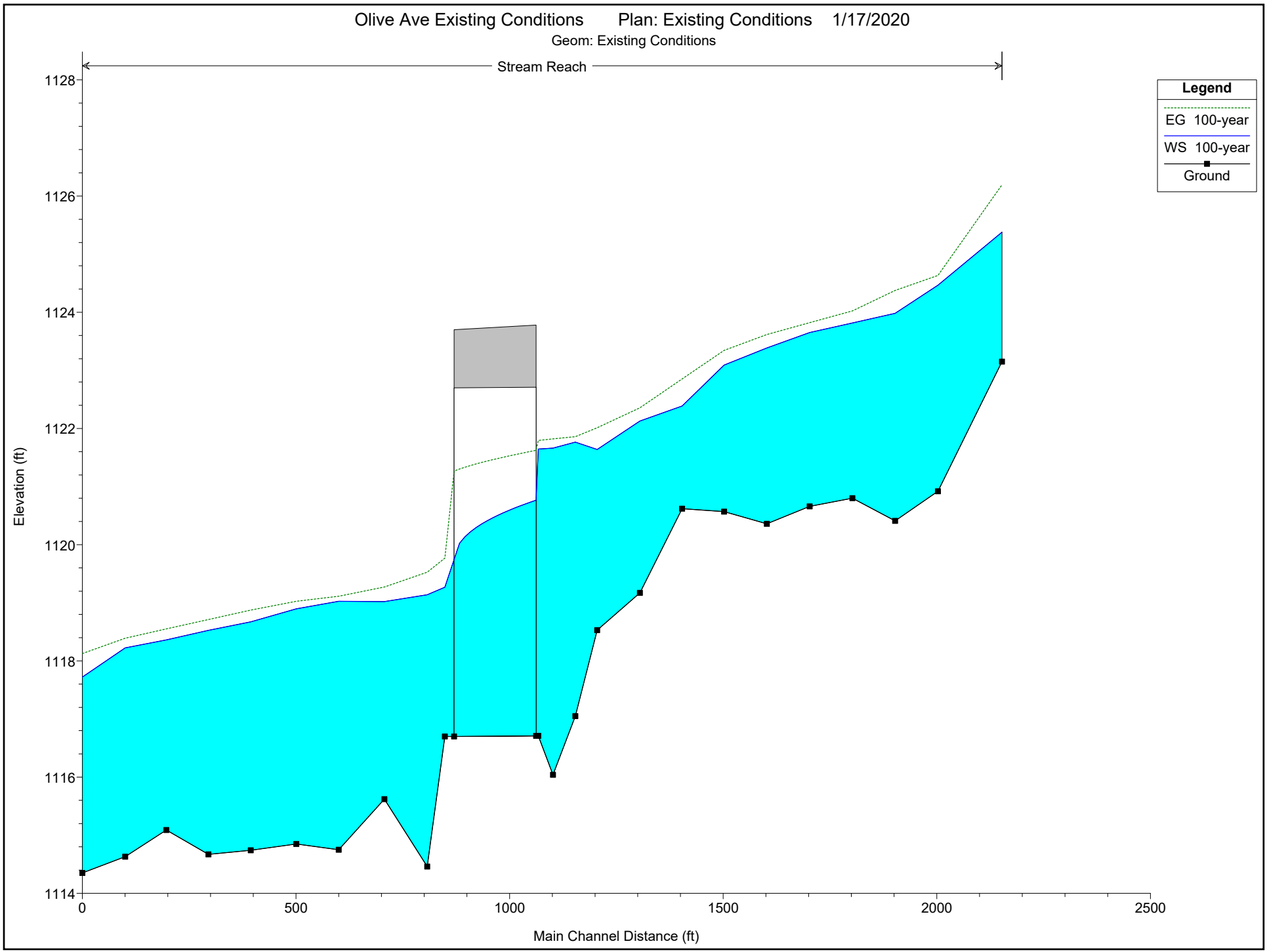
* Cross-Sections based on BNSF future ditch plans and track widening/improvements. Design ensures future BNSF Improvemets are accommodated while capturing/conveying flows.

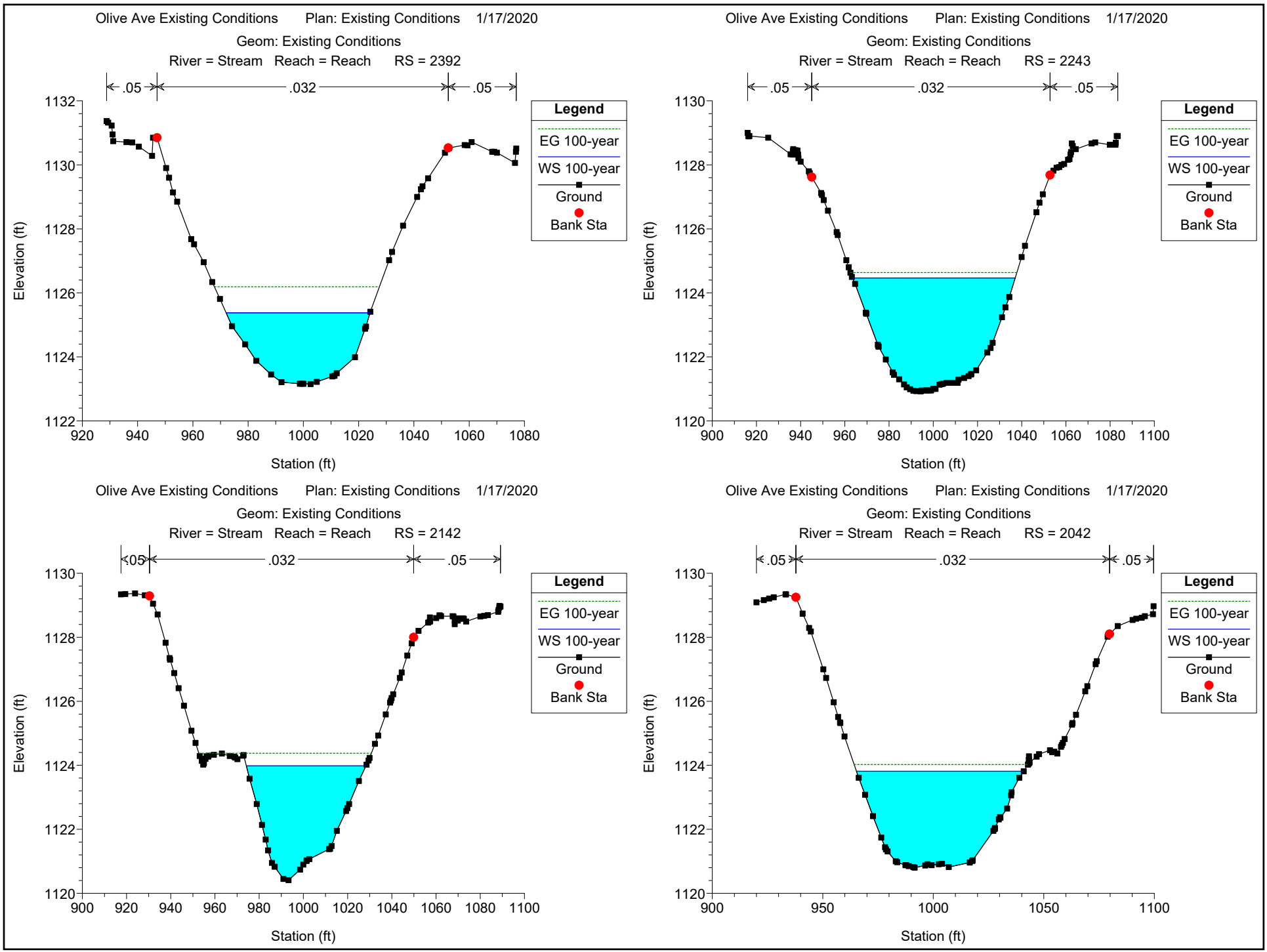
Project: TT0561&TT0562 Combined - Olive 303L to Reems Road
Location: Surprise, Arizona
Date: March 22, 2023
Subject: Olive Avenue Combined Channel Freeboard Table for Superelevation Portions

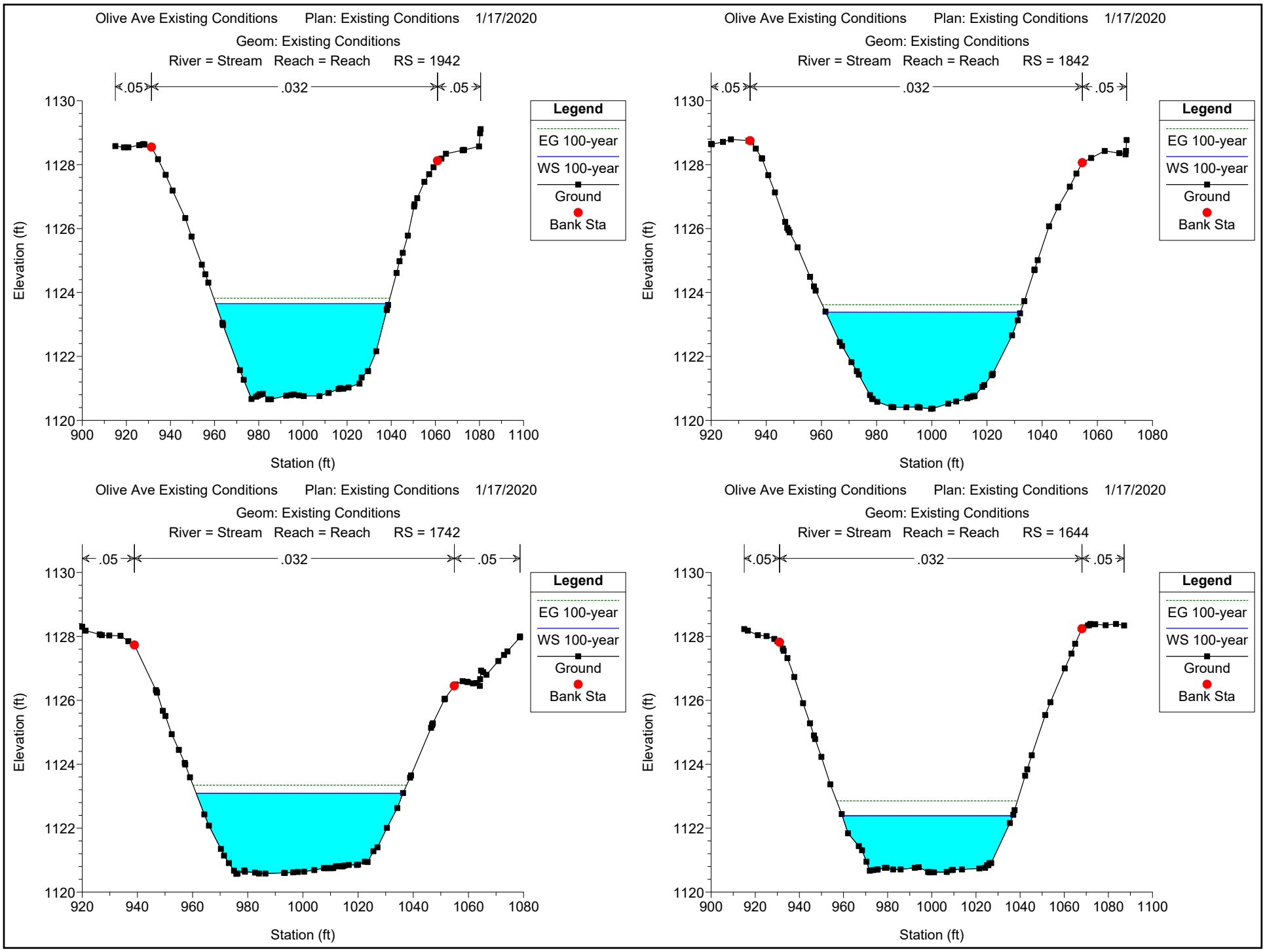
HEC-RAS Station	Channel Invert Elevation (ft)	Water Surface Elevation (ft)	Depth Of Flow (ft)	Top Width (ft)	Top of Bank Elevation (ft)	Channel Velocities (ft/s)	Depth of the Superelevation (ft)	Water Surface Elevation at Superelevation (ft)	Required Freeboard (ft)	Provided Freeboard (ft)
50-Year Storm Event										
11135	1143.95	1148.18	4.23	31.8	1149.93	1.7	0.01	1148.19	1.0	1.7
11119	1143.25	1148.16	4.91	16.4	1149.26	2.0	0.02	1148.18	1.0	1.1
11114	Culvert X-Sections									
11088										
11084	1143.11	1144.83	1.72	10.0	1148.16	9.1	0.43	1145.26	1.4	2.9
11067	1142.81	1145.60	2.79	22.4	1149.72	3.5	0.06	1145.66	1.1	4.1
11052	1142.54	1145.59	3.05	20.4	1149.19	3.4	0.06	1145.65	1.1	3.5
11036	1142.25	1145.61	3.36	21.0	1149.47	3.0	0.05	1145.66	1.0	3.8
11021	1141.98	1145.05	3.07	8.0	1149.00	6.4	0.21	1145.26	1.2	3.7
11020	Culvert X-Sections									
10843										
10838										
10623	1141.09	1142.62	1.53	24.8	1147.50	5.9	0.18	1142.80	1.2	4.7
100-Year Storm Event										
11135	1143.95	1148.96	5.01	35.53	1149.93	1.7	0.01	1148.97	1.0	1.0
11119	1143.25	1148.90	5.65	16.42	1149.26	2.4	0.03	1148.93	1.0	0.3
11114	Culvert X-Sections									
11088										
11084	1142.81	1146.45	3.64	10.01	1148.72	2.2	0.02	1146.47	1.0	2.2
11067	1142.81	1146.45	3.64	26.23	1149.72	3.2	0.05	1146.50	1.1	3.2
11052	1142.54	1146.44	3.9	23.24	1149.19	3.2	0.05	1146.49	1.1	2.7
11036	1142.25	1146.45	4.2	23.8	1149.47	3.0	0.05	1146.50	1.0	3.0
11021	1141.98	1145.77	3.79	8.0	1149.00	6.9	0.25	1146.02	1.2	3.0
11020	Culvert X-Sections									
10843										
10838										
10623	1141.09	1142.87	1.78	27.2	1147.50	6.3	0.21	1143.08	1.2	4.4

Appendix C.1B

HEC-RAS Calculations – Existing Conditions Reems Channel


Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
Stream Reach
Legend
EG 100-year
WS 100-year
Ground
Elevation (ft)
1128
1126
1124
1122
1120
1118
1116
1114
0
500
1000
1500
2000
2500
Main Channel Distance (ft)

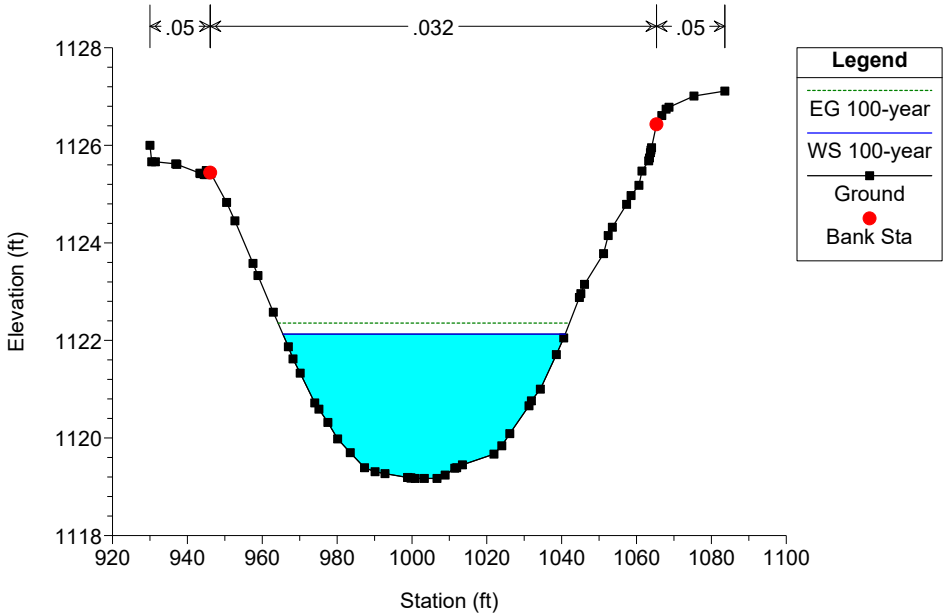

Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 2392
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 2243
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 2142
05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 2042
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 1942
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 1842
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 1742
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 1644
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)

Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020

Geom: Existing Conditions

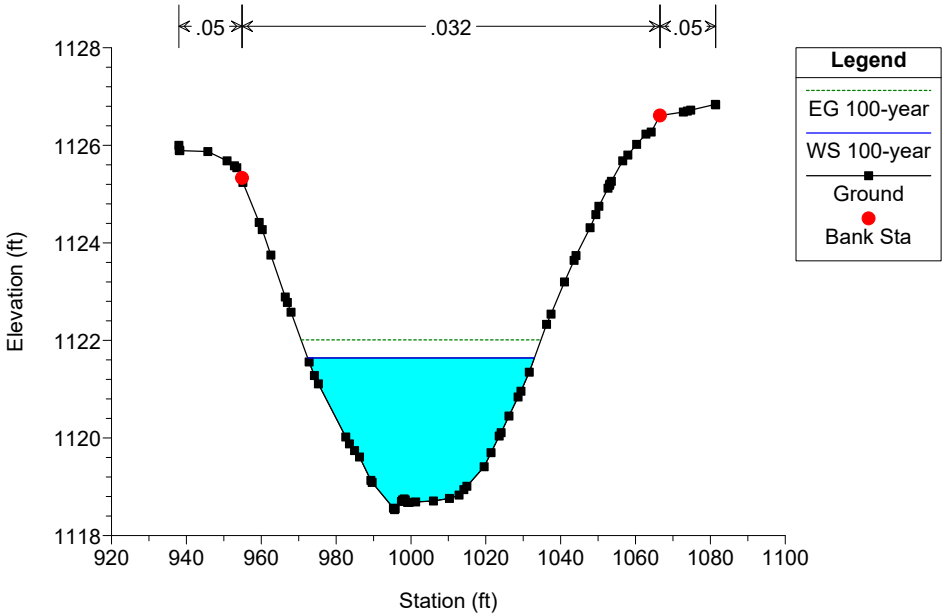
River = Stream Reach = Reach RS = 1545



Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020

Geom: Existing Conditions

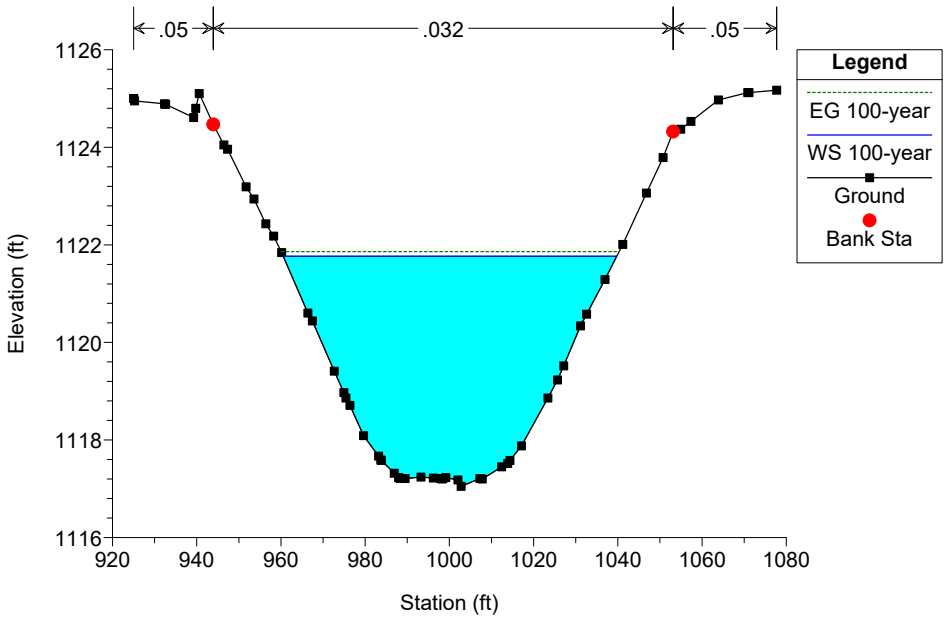
River = Stream Reach = Reach RS = 1445



Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020

Geom: Existing Conditions

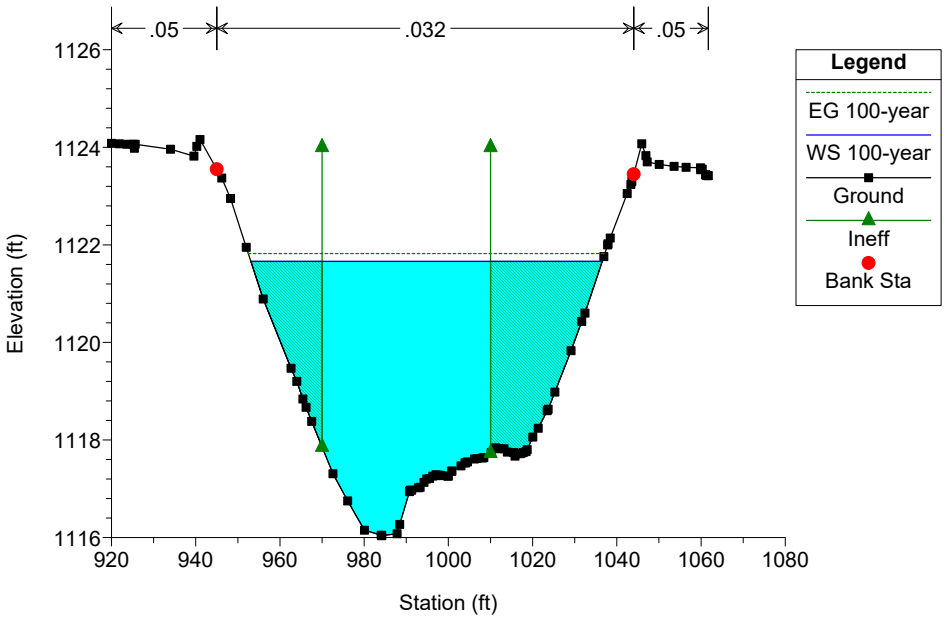
River = Stream Reach = Reach RS = 1394

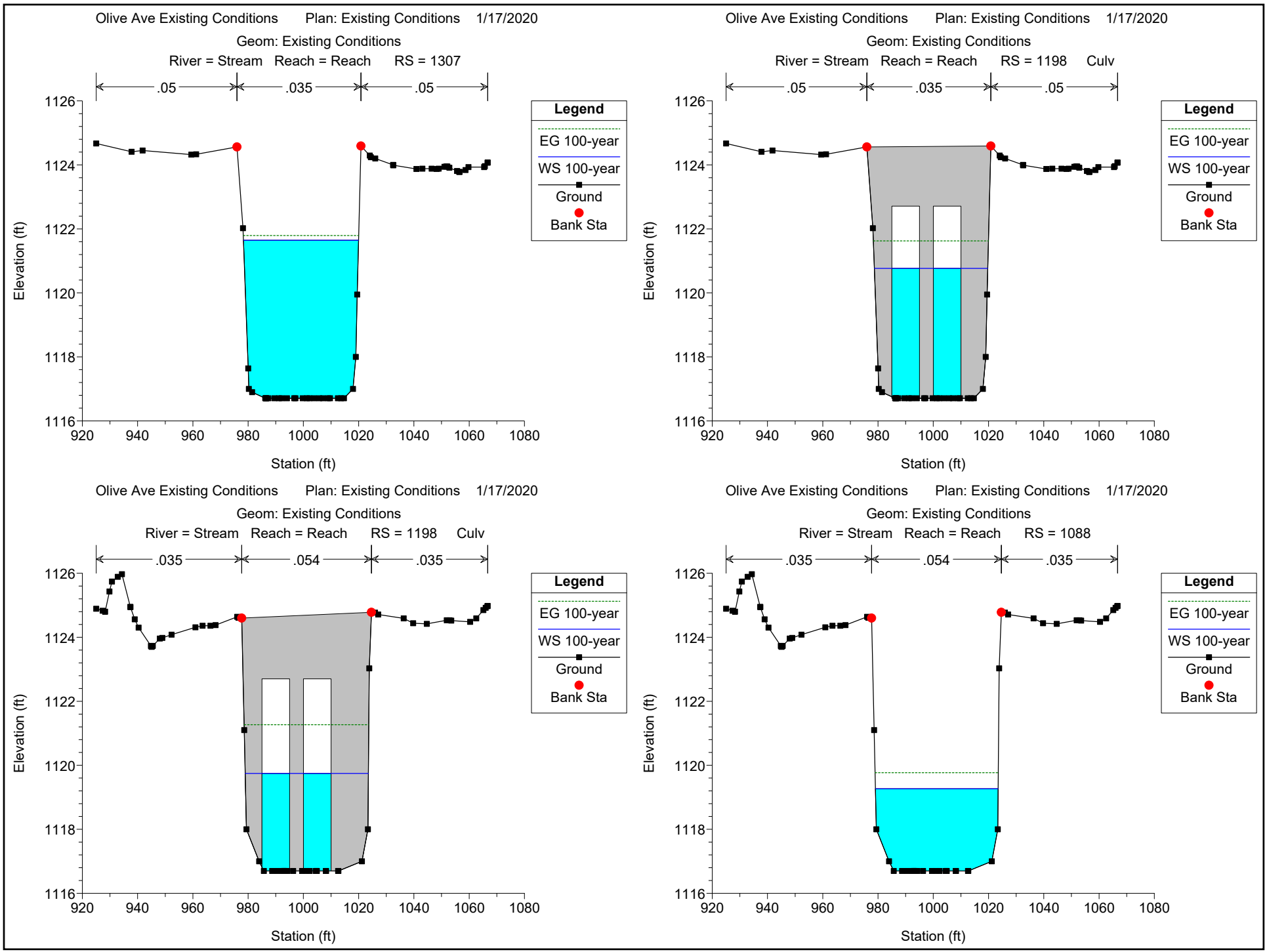


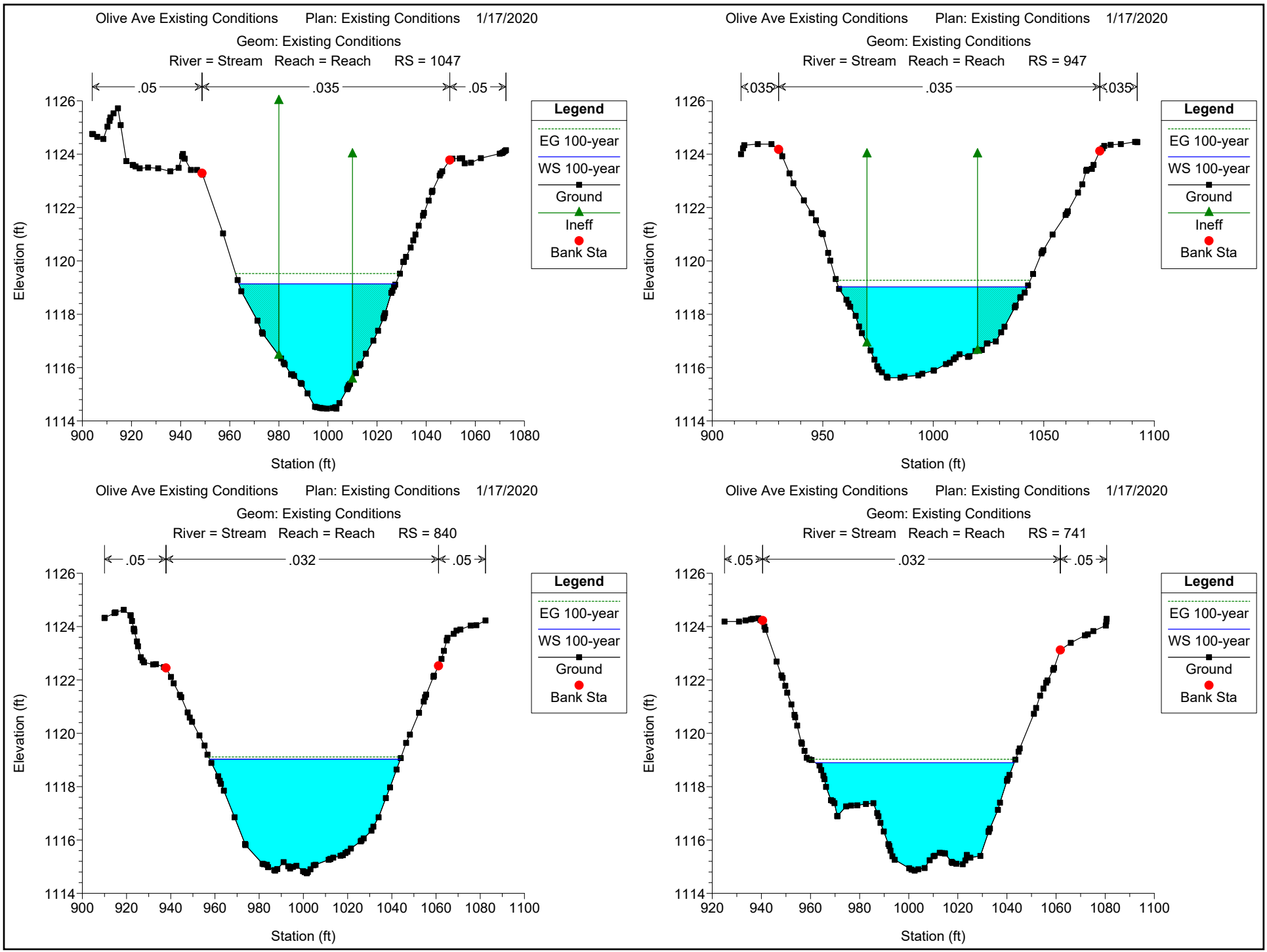
Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020

Geom: Existing Conditions

River = Stream Reach = Reach RS = 1342



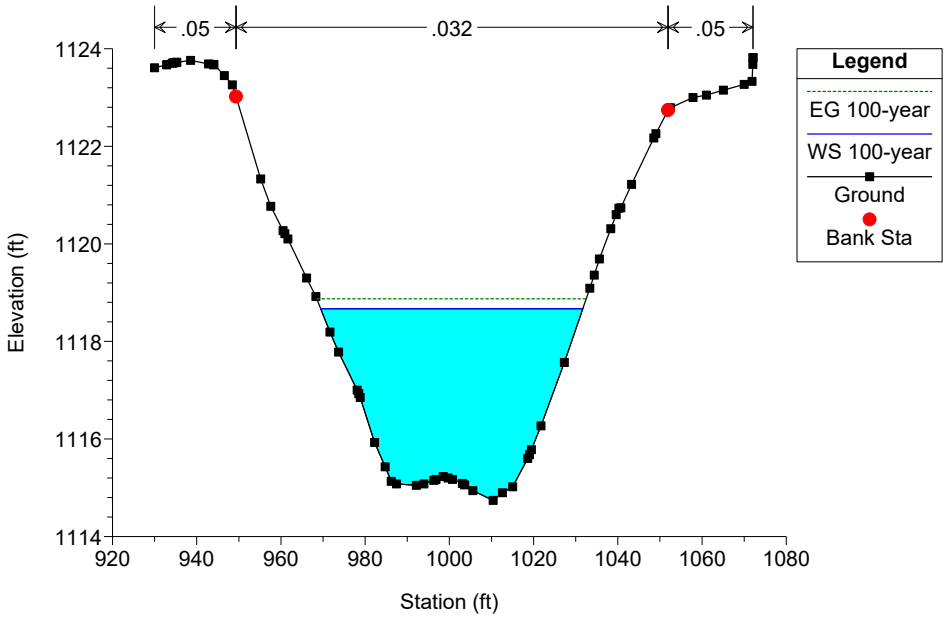

Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 1307
.05
.035
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 1198 Culv
.05
.035
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 1198 Culv
.035
.054
.035
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 1088
.035
.054
.035
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 1047
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Ineff
Bank Sta
Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 947
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Ineff
Bank Sta
Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 840
.05
.032
.05
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 741
.05
.032
.05
Elevation (ft)
Station (ft)
Legend
EG 100-year
WS 100-year
Ground
Bank Sta

Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020

Geom: Existing Conditions

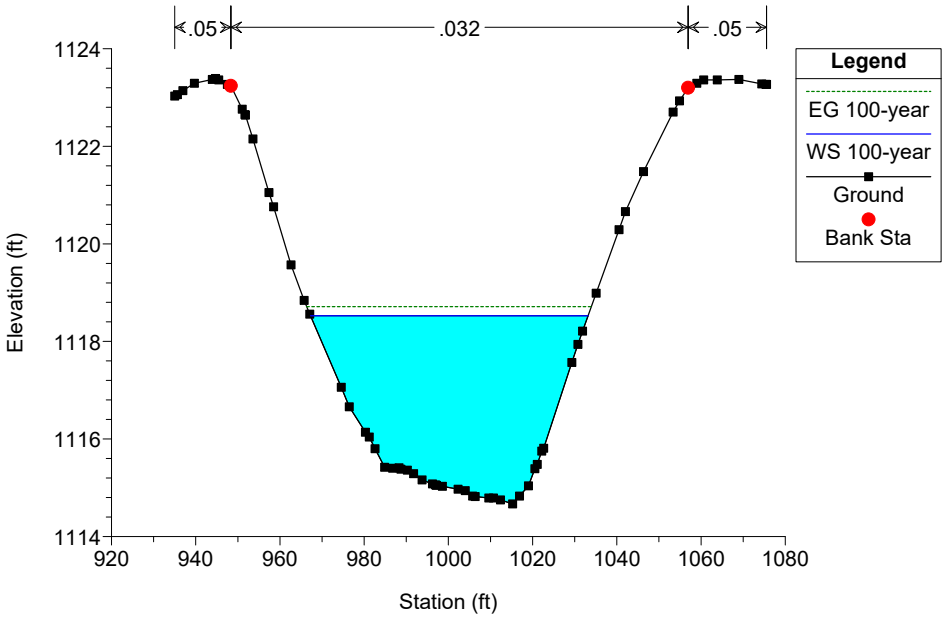
River = Stream Reach = Reach RS = 634



Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020

Geom: Existing Conditions

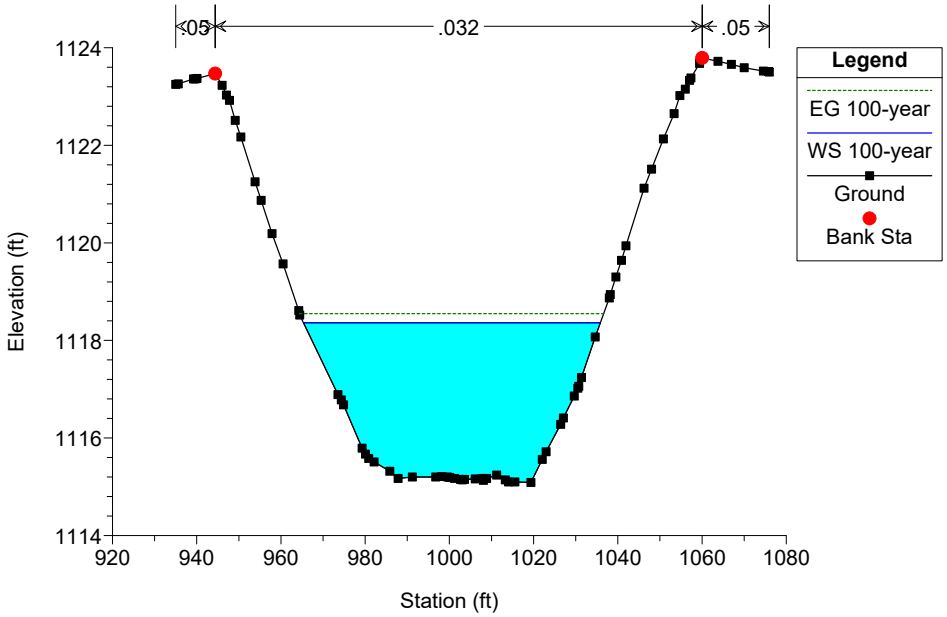
River = Stream Reach = Reach RS = 535



Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020

Geom: Existing Conditions

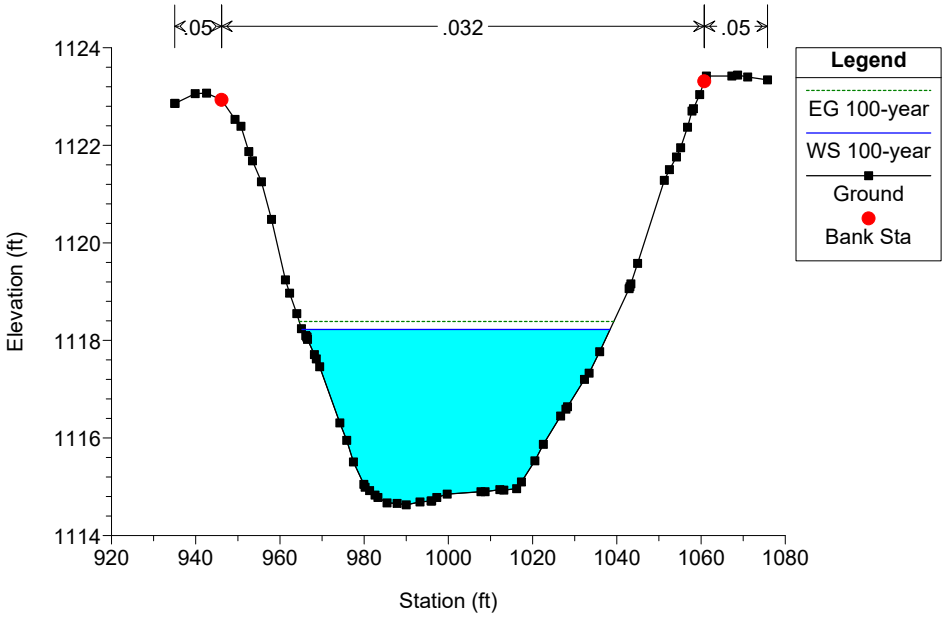
River = Stream Reach = Reach RS = 436

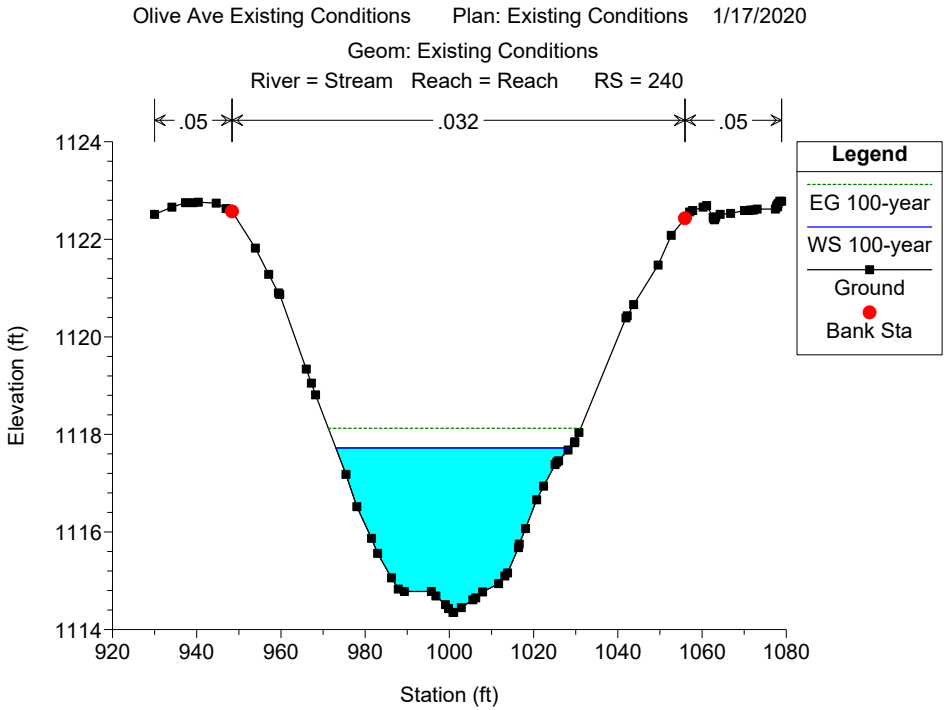


Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020

Geom: Existing Conditions

River = Stream Reach = Reach RS = 340




Olive Ave Existing Conditions Plan: Existing Conditions 1/17/2020
Geom: Existing Conditions
River = Stream Reach = Reach RS = 240
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
1124
1122
1120
1118
1116
1114
920
940
960
980
1000
1020
1040
1060
1080

HEC-RAS Plan: Existing River: Stream Reach: Reach Profile: 100-year

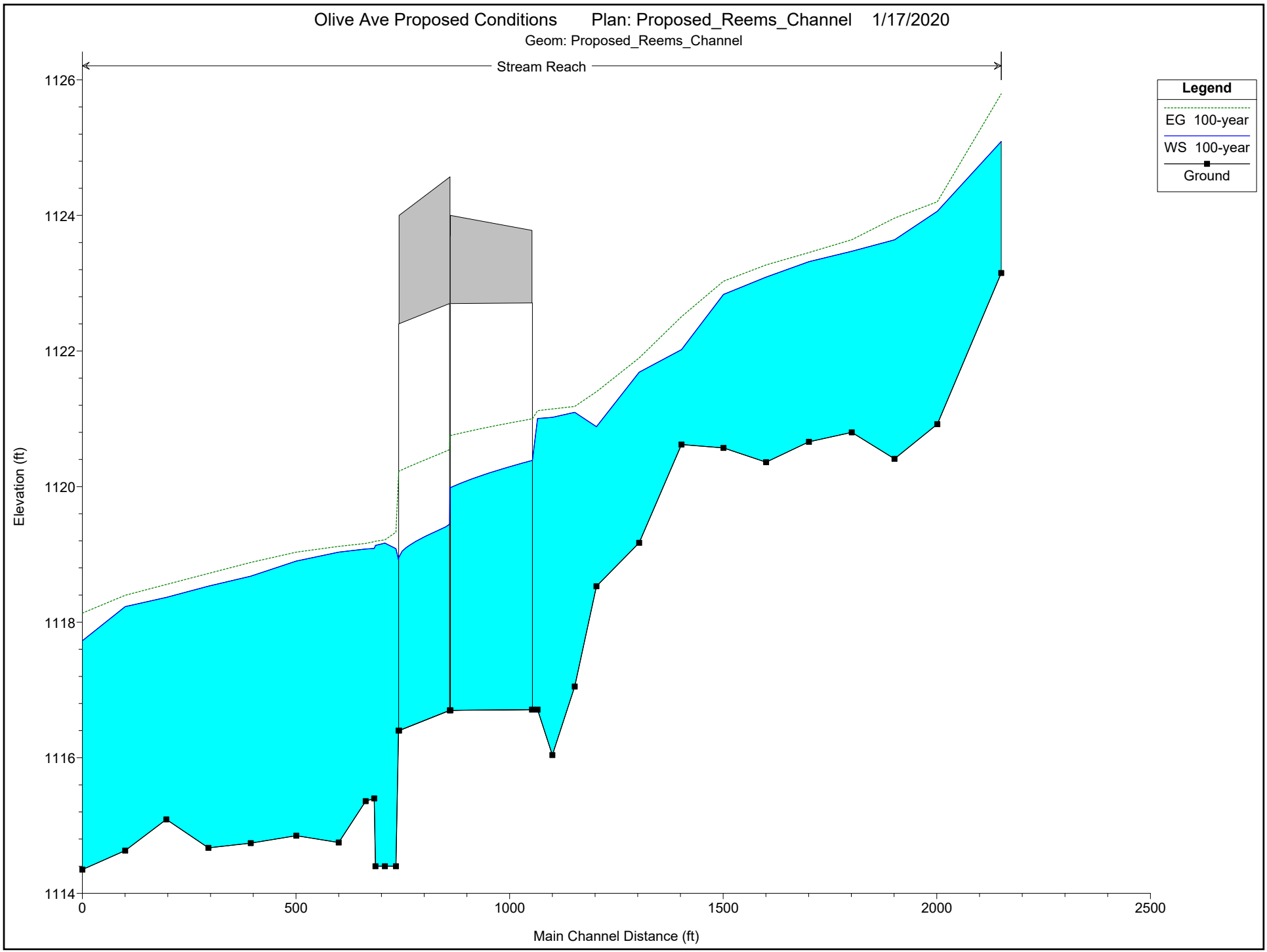
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach	2392	100-year	603.00	1123.15	1125.38	1125.38	1126.19	0.013100	7.24	83.31	52.09	1.01
Reach	2243	100-year	603.00	1120.92	1124.47		1124.64	0.001522	3.30	182.61	73.65	0.37
Reach	2142	100-year	603.00	1120.41	1123.98		1124.38	0.004148	5.04	119.71	54.11	0.60
Reach	2042	100-year	603.00	1120.80	1123.82		1124.02	0.002221	3.66	164.77	75.74	0.44
Reach	1942	100-year	603.00	1120.66	1123.65		1123.82	0.001655	3.31	182.44	78.27	0.38
Reach	1842	100-year	603.00	1120.36	1123.39		1123.62	0.002407	3.85	156.42	70.61	0.46
Reach	1742	100-year	603.00	1120.57	1123.09		1123.35	0.003037	4.04	149.40	74.99	0.50
Reach	1644	100-year	603.00	1120.62	1122.39		1122.85	0.008691	5.47	110.21	77.30	0.81
Reach	1545	100-year	603.00	1119.17	1122.13		1122.36	0.002552	3.82	157.73	75.44	0.47
Reach	1445	100-year	603.00	1118.53	1121.64		1122.01	0.004372	4.90	123.02	60.55	0.61
Reach	1394	100-year	603.00	1117.05	1121.77		1121.86	0.000631	2.46	245.05	79.21	0.25
Reach	1342	100-year	603.00	1116.04	1121.66	1118.86	1121.82	0.000604	3.20	188.73	83.45	0.26
Reach	1307	100-year	603.00	1116.71	1121.65	1118.72	1121.79	0.000815	3.09	195.19	41.66	0.25
Reach	1198		Culvert									
Reach	1088	100-year	603.00	1116.70	1119.27		1119.77	0.014305	5.68	106.23	44.41	0.65
Reach	1047	100-year	603.00	1114.46	1119.14	1117.44	1119.53	0.002187	5.00	120.70	63.79	0.44
Reach	947	100-year	603.00	1115.62	1119.02	1117.68	1119.27	0.002078	4.02	150.03	85.45	0.41
Reach	840	100-year	603.00	1114.75	1119.03		1119.11	0.000611	2.36	255.86	86.27	0.24
Reach	741	100-year	603.00	1114.85	1118.90		1119.03	0.001138	2.91	207.40	80.90	0.32
Reach	634	100-year	603.00	1114.74	1118.67		1118.88	0.001652	3.61	166.96	62.26	0.39
Reach	535	100-year	603.00	1114.67	1118.53		1118.71	0.001540	3.46	174.31	65.91	0.38
Reach	436	100-year	603.00	1115.09	1118.36		1118.55	0.001740	3.50	172.44	70.49	0.39
Reach	340	100-year	603.00	1114.63	1118.22		1118.39	0.001469	3.27	184.13	73.18	0.36
Reach	240	100-year	603.00	1114.35	1117.72	1116.97	1118.13	0.004505	5.11	117.93	55.54	0.62

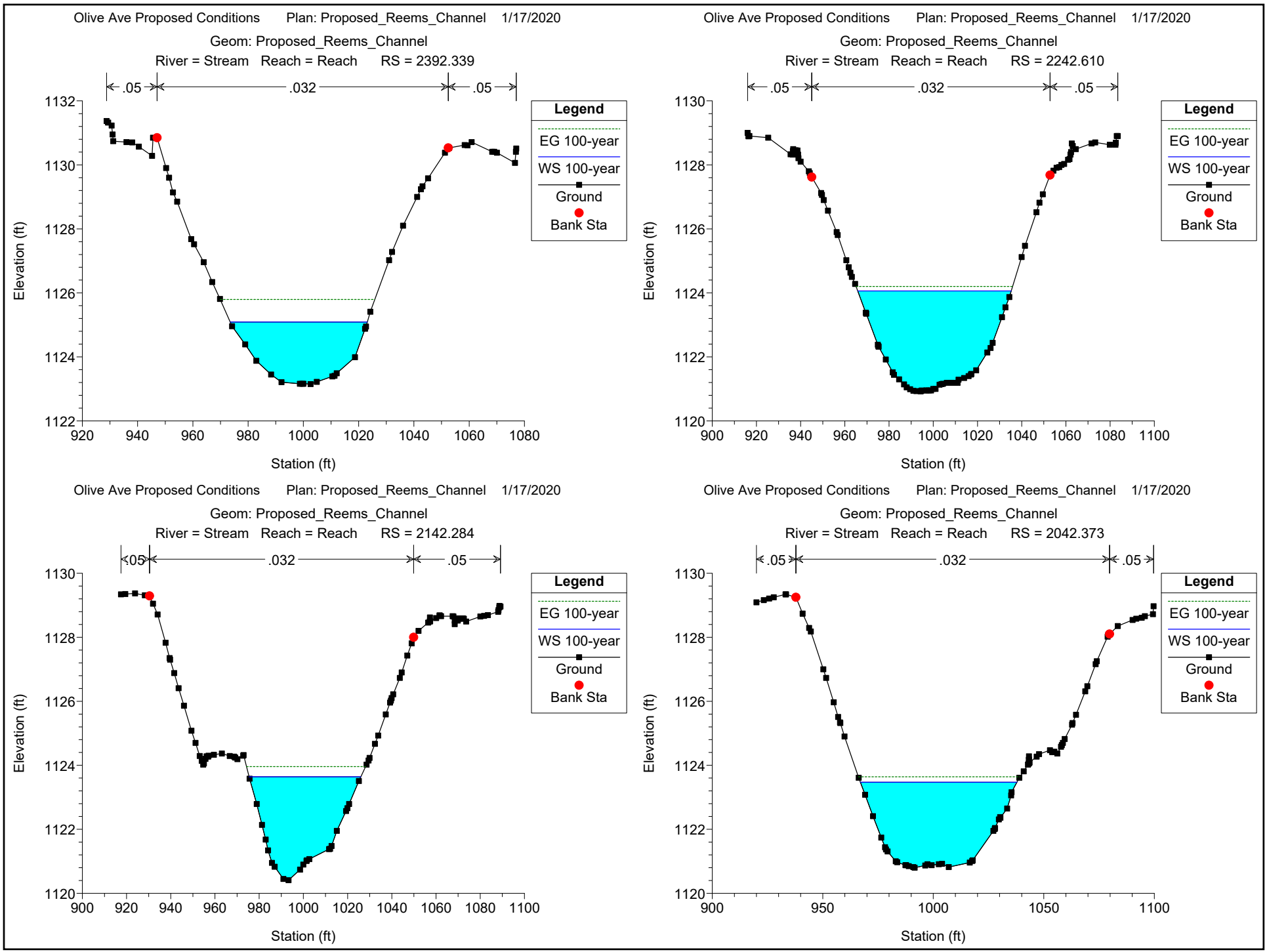
HEC-RAS Plan: Existing River: Stream Reach: Reach Profile: 100-year

Reach	River Sta	Profile	E.G. US.	W.S. US.	E.G. IC	E.G. OC	Min El Weir Flow	Q Culv Group	Q Weir	Delta WS	Culv Vel US	Culv Vel DS
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(ft)	(ft/s)	(ft/s)
Reach	1198 Culvert #1	100-year	1121.80	1121.65	1121.60	1121.80	1123.79	603.00		2.38	7.43	9.90

Appendix C.1C

HEC-RAS Calculations – Proposed Conditions Reems Channel


Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
Stream Reach
Legend
EG 100-year
WS 100-year
Ground
Elevation (ft)
1126
1124
1122
1120
1118
1116
1114
0
500
1000
1500
2000
2500
Main Channel Distance (ft)


Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 2392.339
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 2242.610
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 2142.284
05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 2042.373
.05
.032
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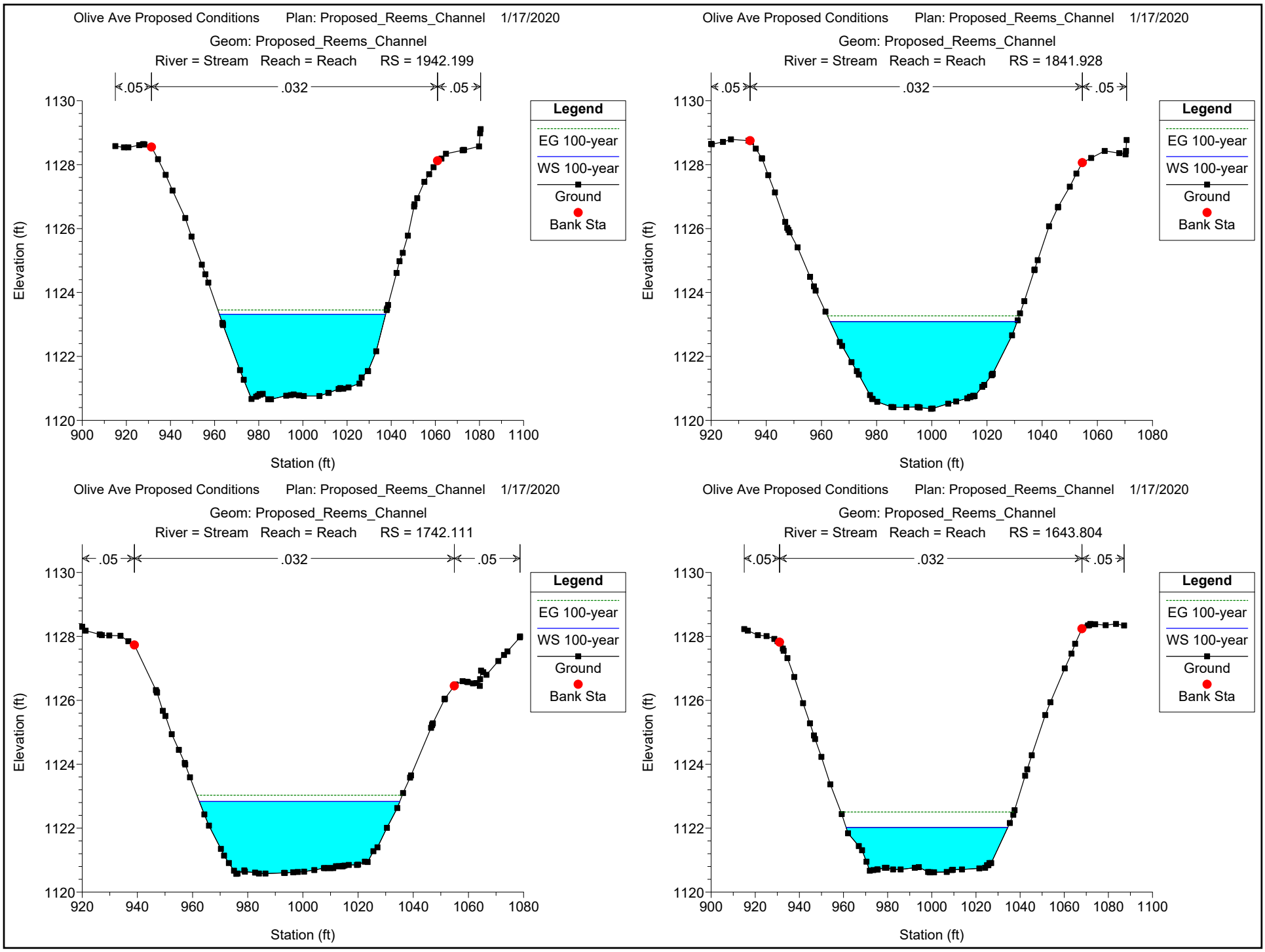
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)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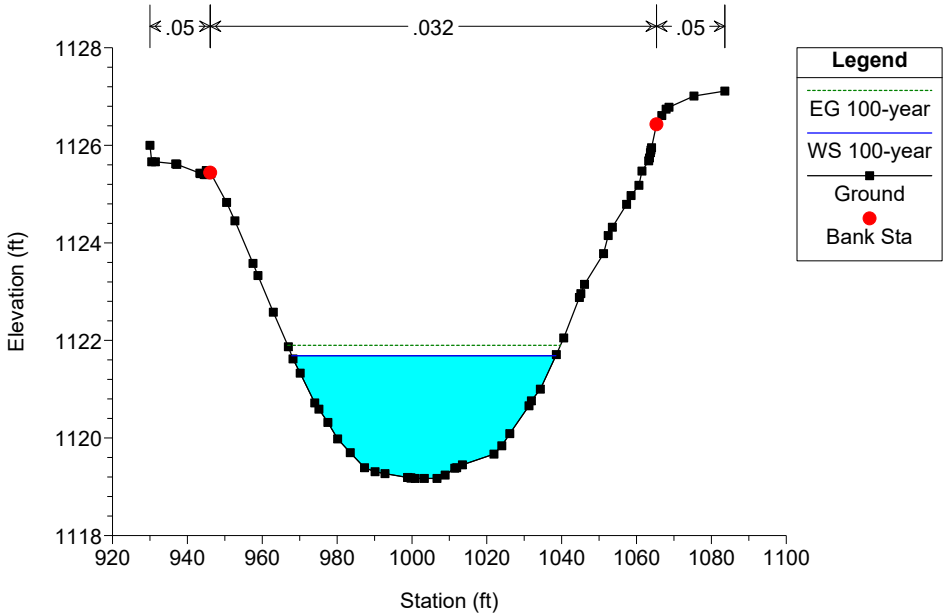
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 1841.928
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 1742.111
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 1643.804
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)

Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020

Geom: Proposed_Reems_Channel

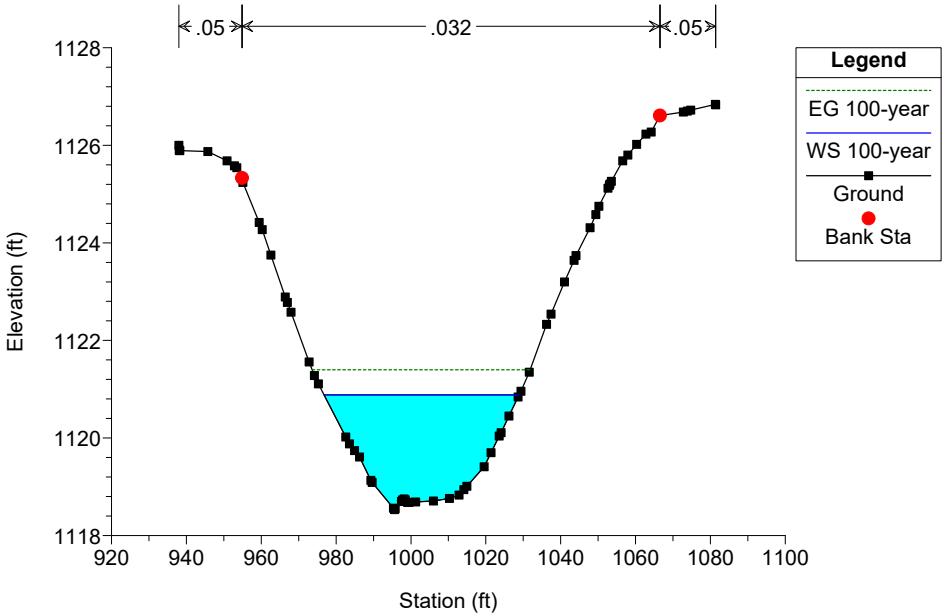
River = Stream Reach = Reach RS = 1544.822



Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020

Geom: Proposed_Reems_Channel

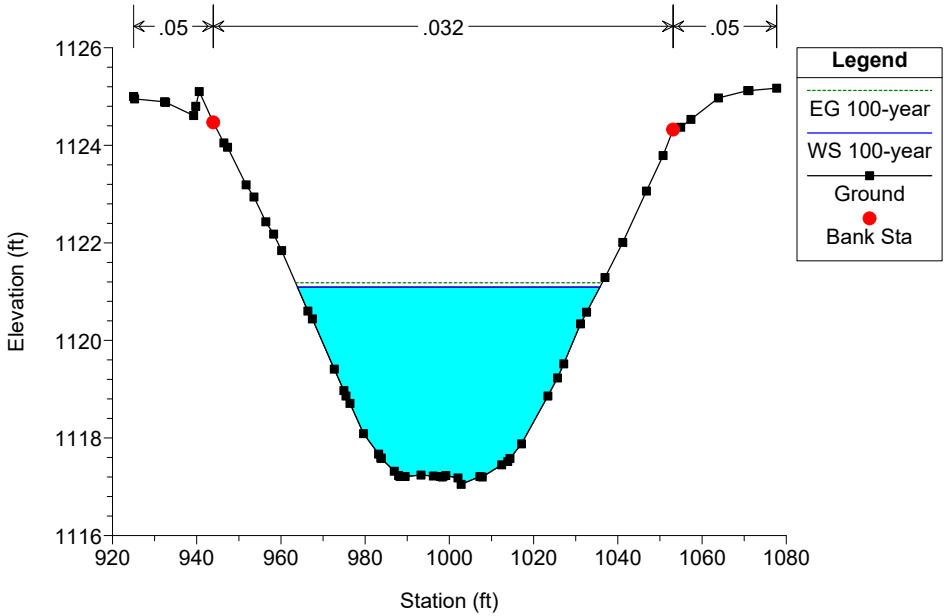
River = Stream Reach = Reach RS = 1444.814



Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020

Geom: Proposed_Reems_Channel

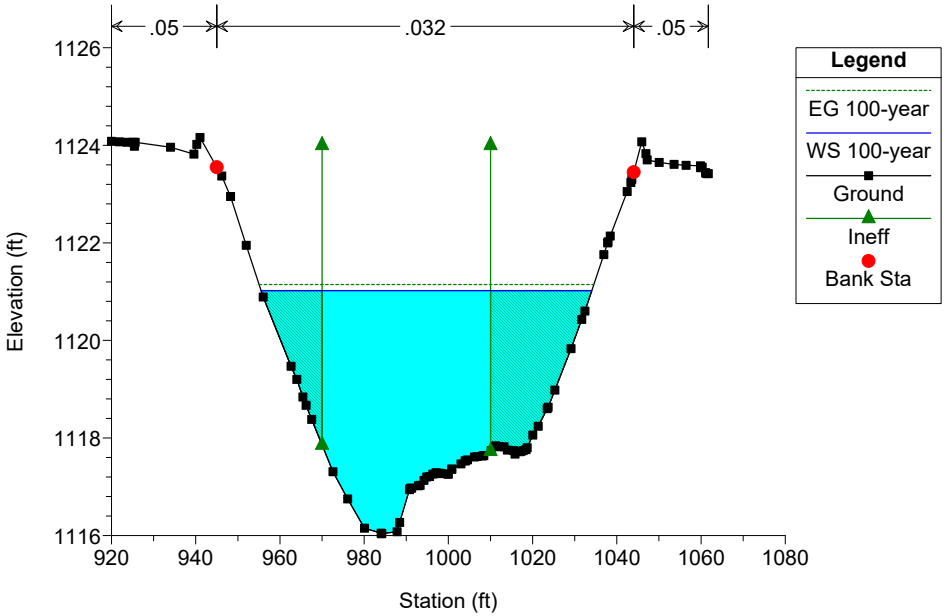
River = Stream Reach = Reach RS = 1393.856

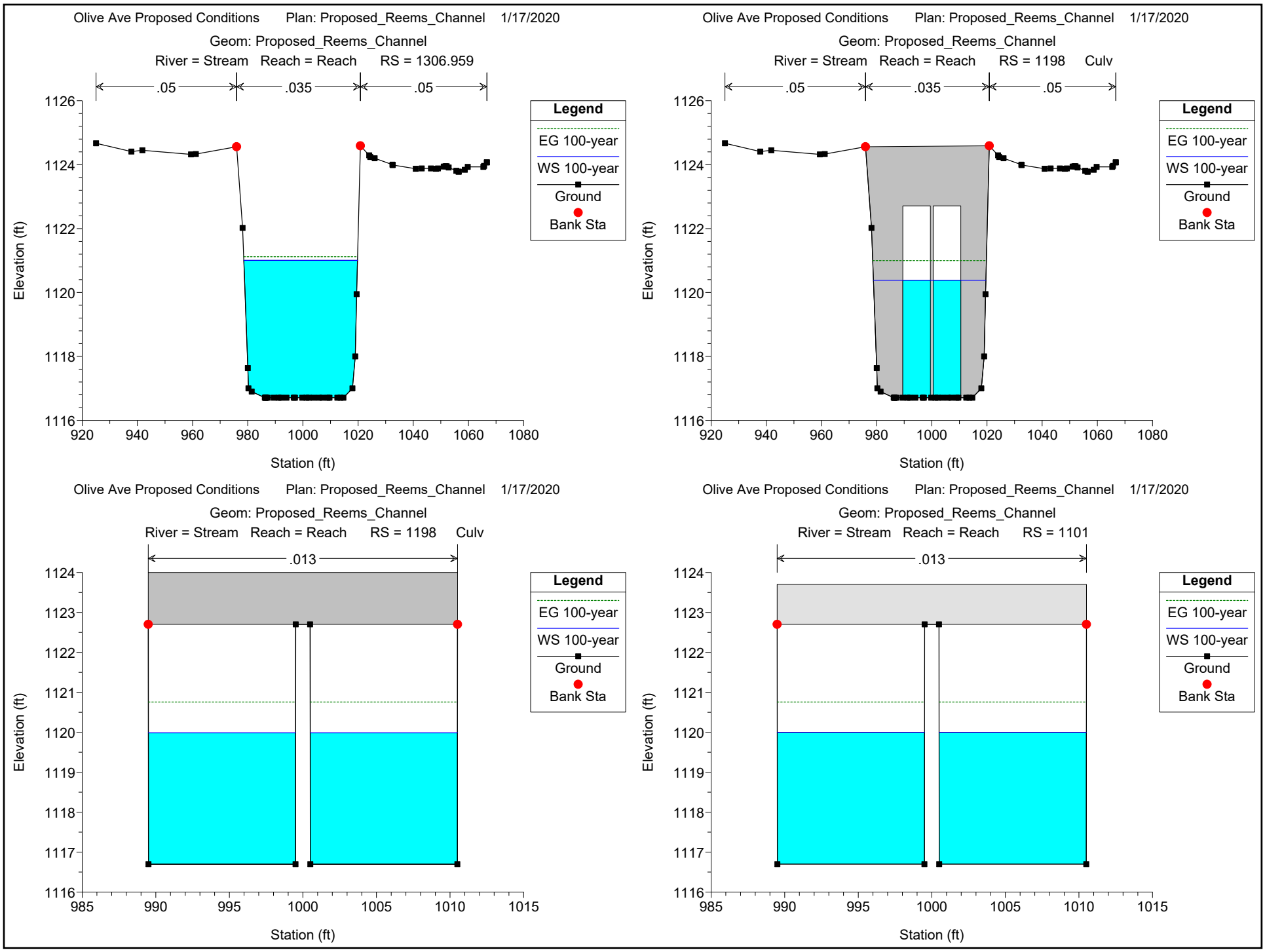


Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020

Geom: Proposed_Reems_Channel

River = Stream Reach = Reach RS = 1341.571

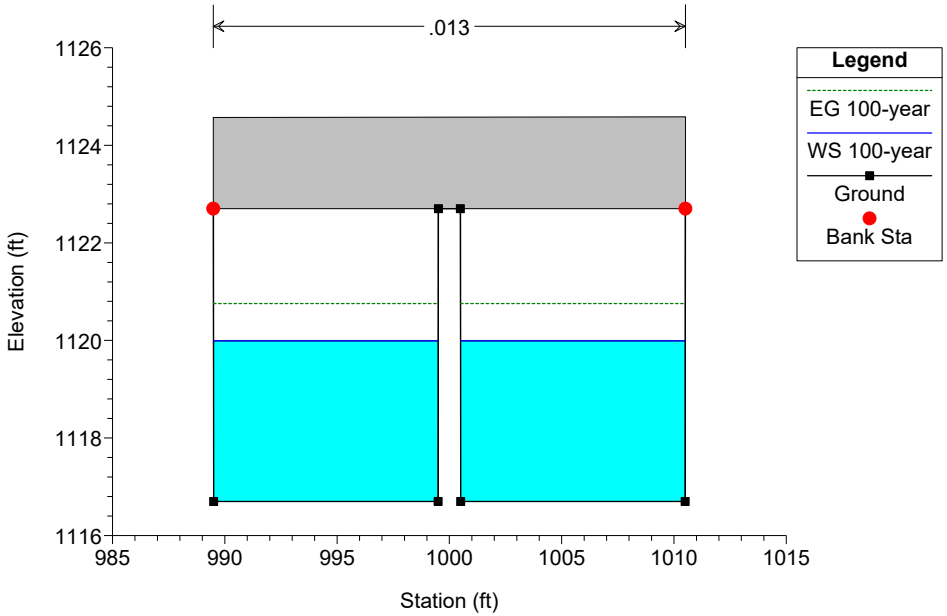



Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 1306.959
.05
.035
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 1198 Culv
.05
.035
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 1198 Culv
.013
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 1101
.013
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)

Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020

Geom: Proposed_Reems_Channel

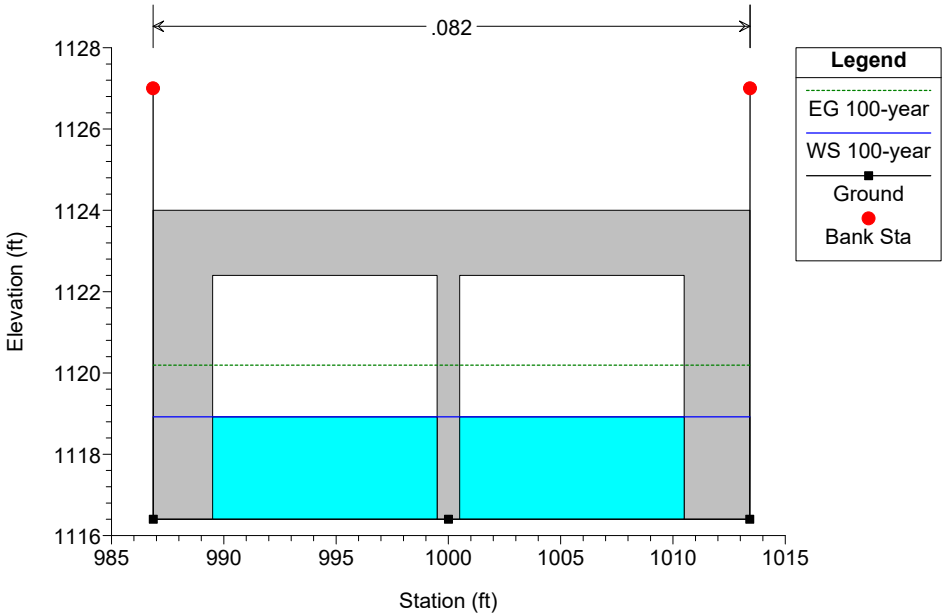
River = Stream Reach = Reach RS = 1100 Culv



Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020

Geom: Proposed_Reems_Channel

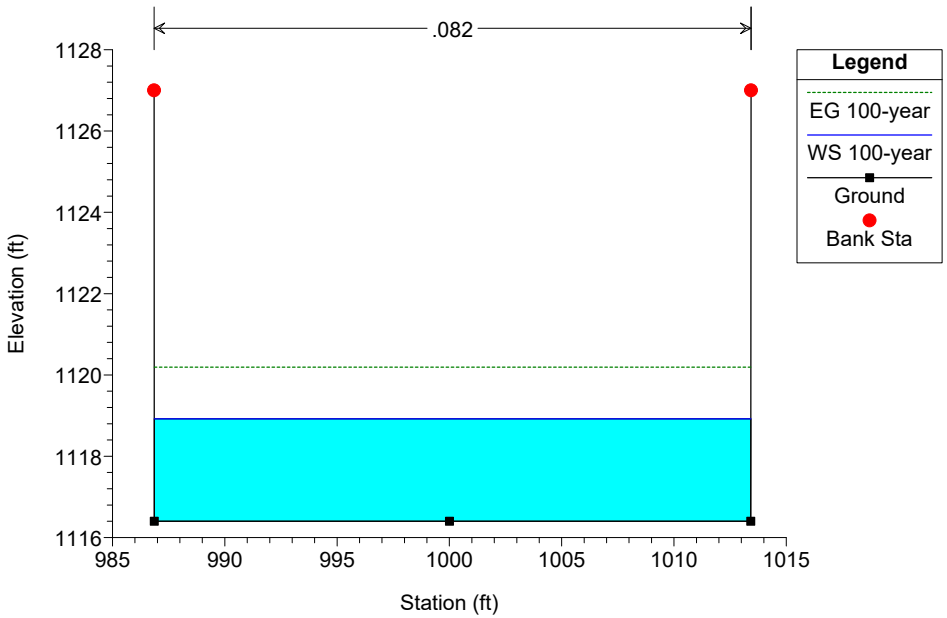
River = Stream Reach = Reach RS = 1100 Culv



Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020

Geom: Proposed_Reems_Channel

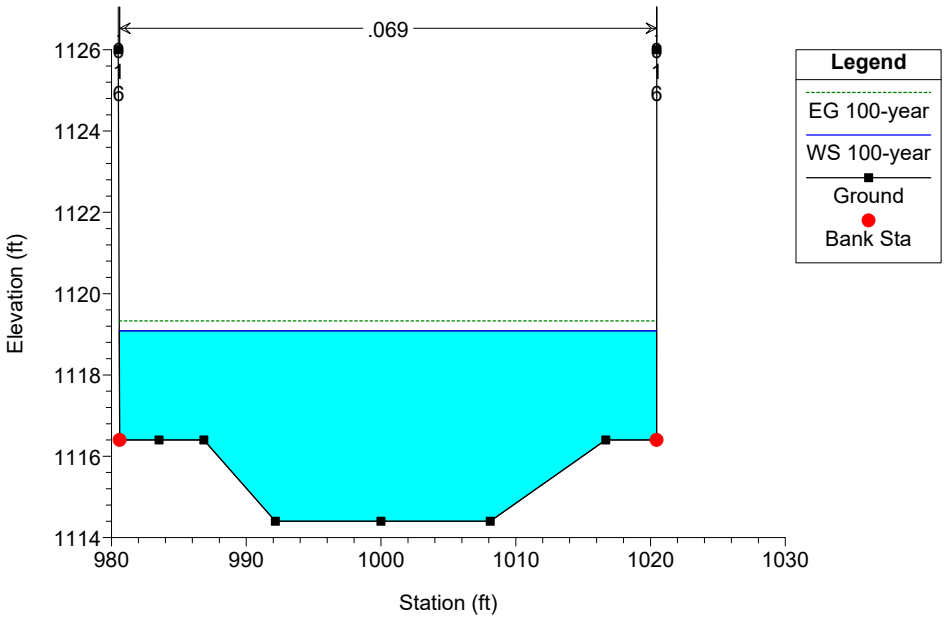
River = Stream Reach = Reach RS = 979.5778

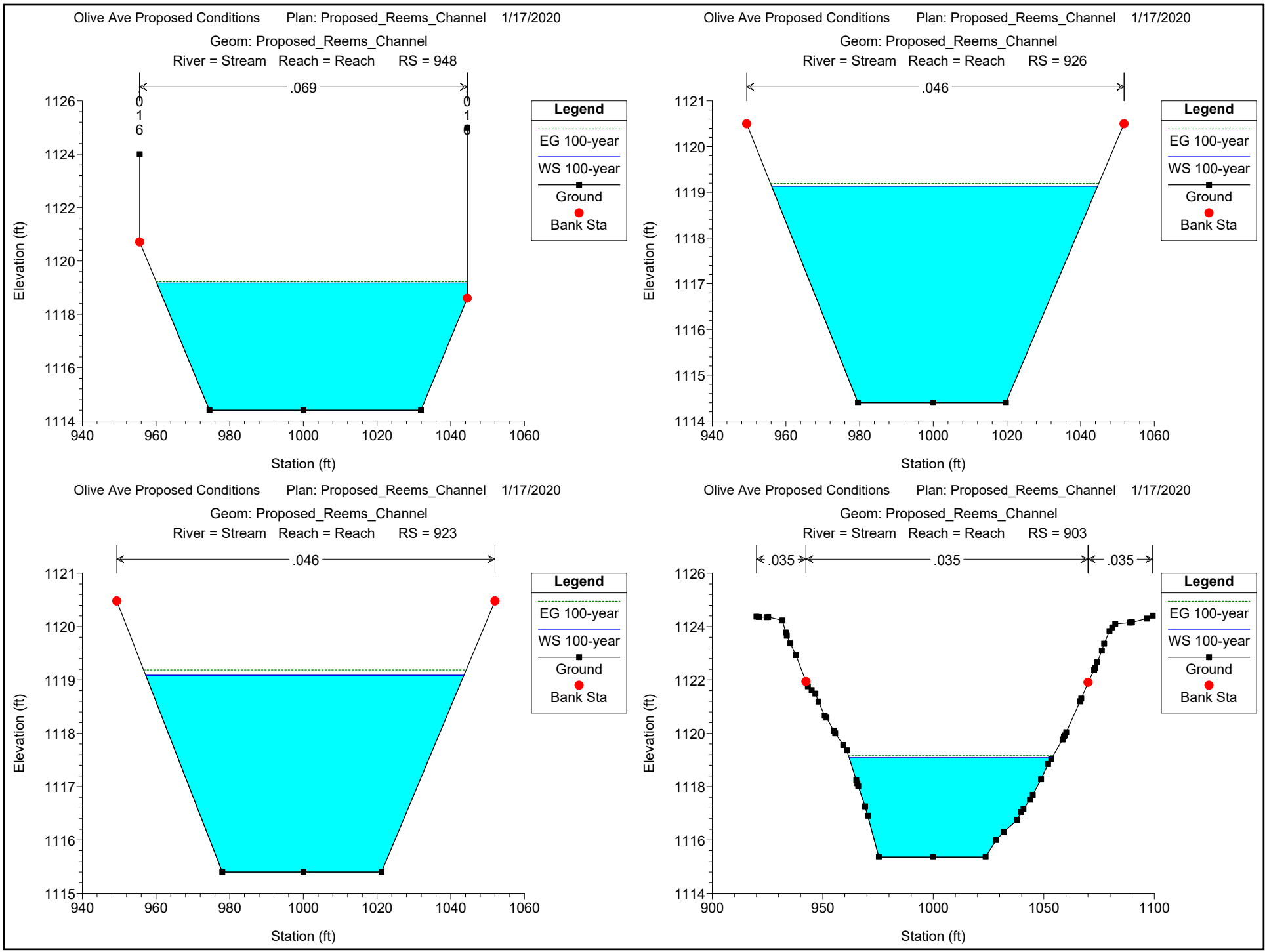


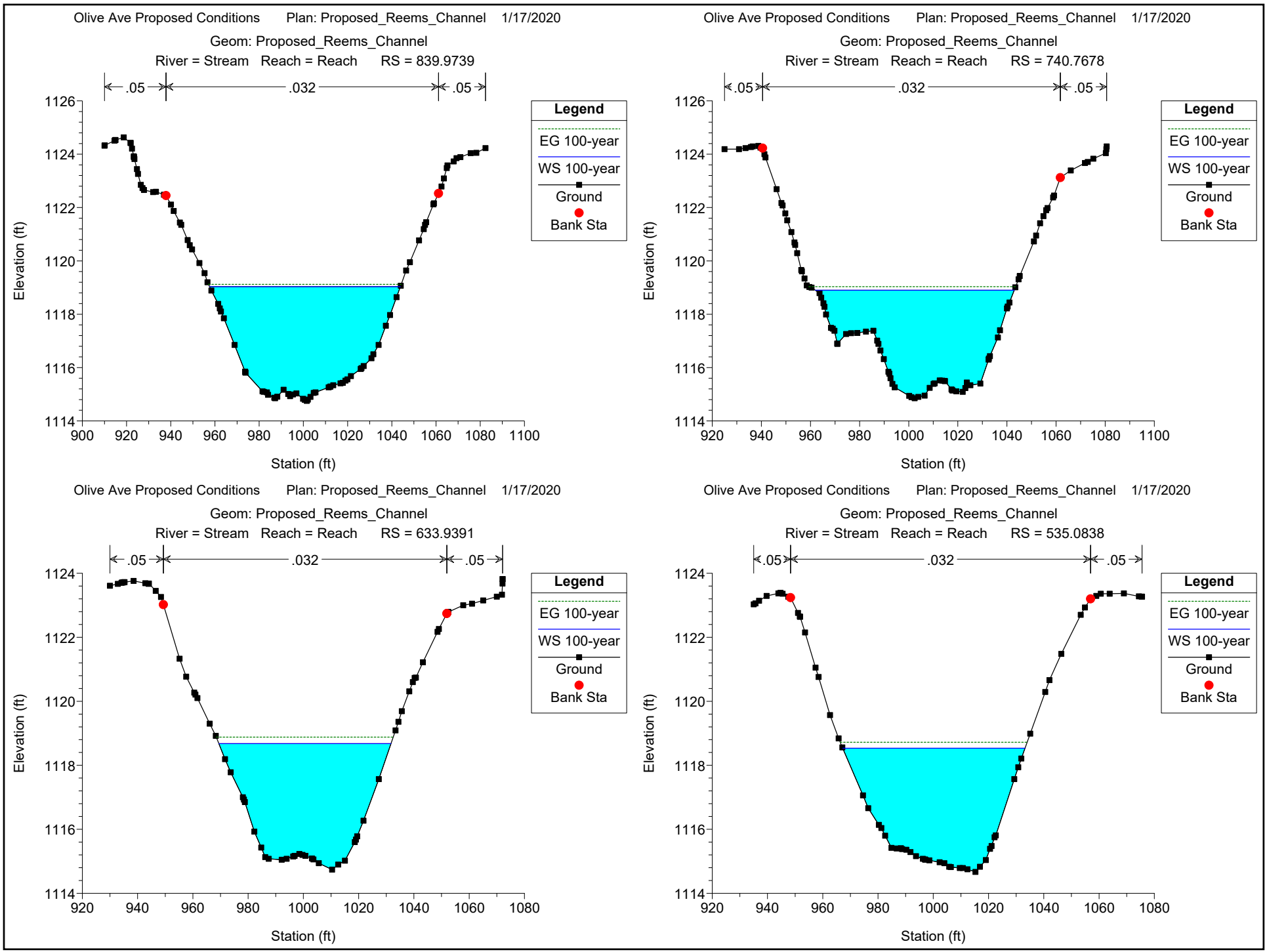
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020

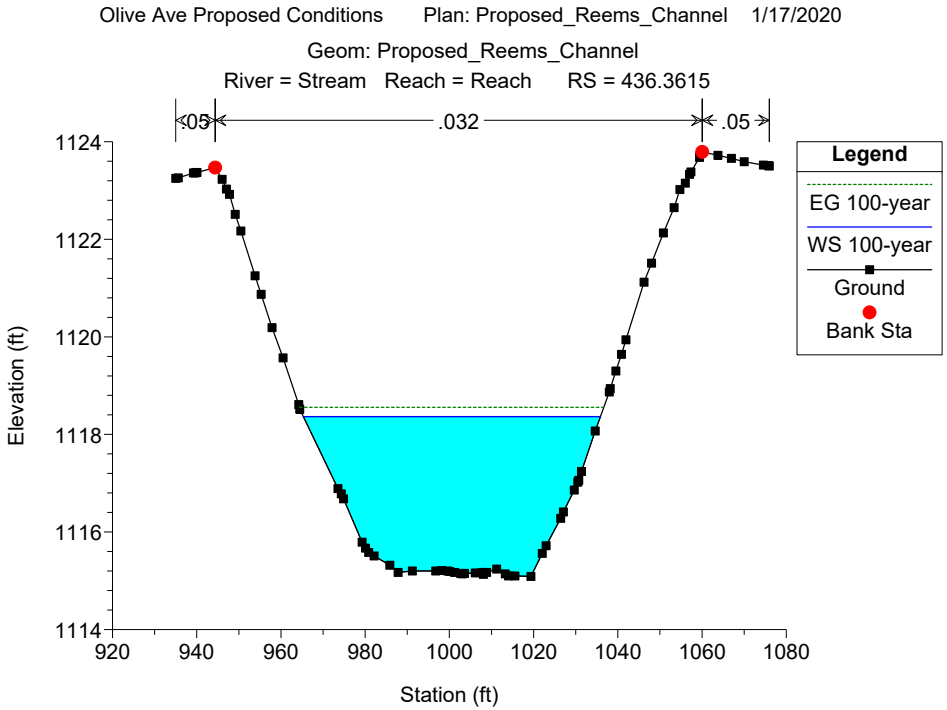
Geom: Proposed_Reems_Channel

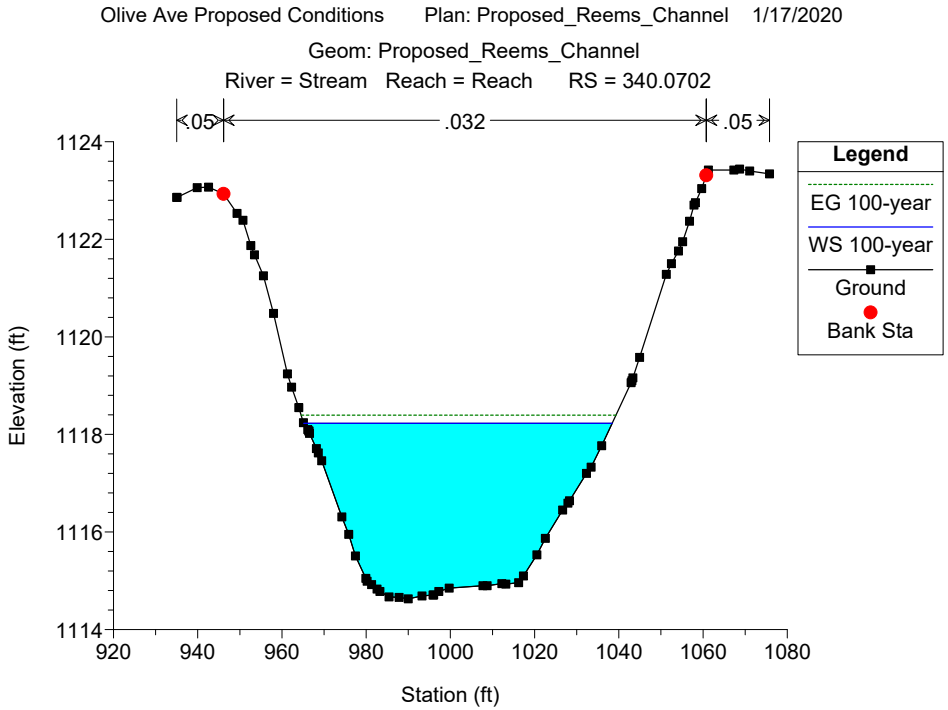
River = Stream Reach = Reach RS = 974

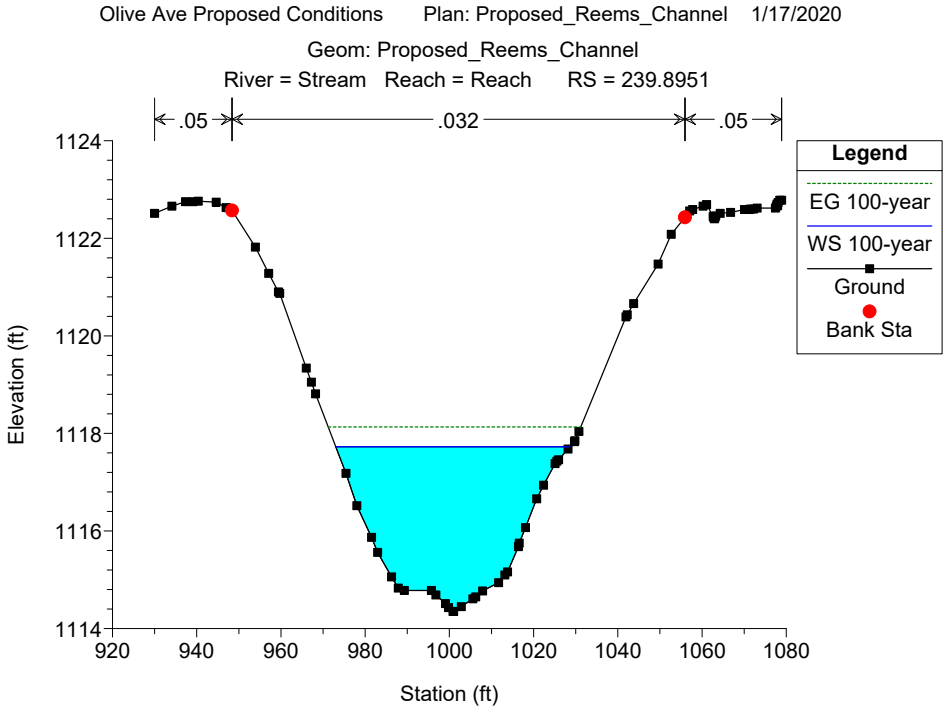



Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 948
.069
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 926
.046
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 923
.046
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 903
.035
.035
.035
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 839.9739
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 740.7678
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 633.9391
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 535.0838
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 436.3615
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
1124
1122
1120
1118
1116
1114
920
940
960
980
1000
1020
1040
1060
1080


Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 340.0702
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
1124
1122
1120
1118
1116
1114
920
940
960
980
1000
1020
1040
1060
1080


Olive Ave Proposed Conditions Plan: Proposed_Reems_Channel 1/17/2020
Geom: Proposed_Reems_Channel
River = Stream Reach = Reach RS = 239.8951
.05
.032
.05
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
1124
1122
1120
1118
1116
1114
920
940
960
980
1000
1020
1040
1060
1080

HEC-RAS Plan: Prop River: Stream Reach: Reach Profile: 100-year

Reach	River Sta	Profile	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)	
Reach	2392.339	100-year	462.00	1123.15	1125.09	1125.09	1125.79	0.013724	6.73	68.64	49.61	1.01
Reach	2242.610	100-year	462.00	1120.92	1124.06		1124.20	0.001464	3.01	153.73	69.43	0.36
Reach	2142.284	100-year	462.00	1120.41	1123.64		1123.96	0.003801	4.53	101.88	50.52	0.56
Reach	2042.373	100-year	462.00	1120.80	1123.47		1123.64	0.002073	3.31	139.56	70.82	0.42
Reach	1942.199	100-year	462.00	1120.66	1123.32		1123.45	0.001524	2.94	156.91	75.33	0.36
Reach	1841.928	100-year	462.00	1120.36	1123.09		1123.27	0.002133	3.40	135.98	67.82	0.42
Reach	1742.111	100-year	462.00	1120.57	1122.83		1123.03	0.002690	3.54	130.38	72.69	0.47
Reach	1643.804	100-year	462.00	1120.62	1122.02	1121.96	1122.51	0.012394	5.59	82.62	73.24	0.93
Reach	1544.822	100-year	462.00	1119.17	1121.69		1121.90	0.002925	3.68	125.59	70.55	0.49
Reach	1444.814	100-year	462.00	1118.53	1120.88		1121.40	0.008703	5.76	80.27	52.10	0.82
Reach	1393.856	100-year	462.00	1117.05	1121.10		1121.18	0.000704	2.38	194.38	71.85	0.25
Reach	1341.571	100-year	462.00	1116.04	1121.02	1118.56	1121.15	0.000577	2.83	163.07	78.53	0.25
Reach	1306.959	100-year	462.00	1116.71	1121.00	1118.40	1121.12	0.000750	2.74	168.62	41.19	0.24
Reach	1198		Culvert									
Reach	1101	100-year	462.00	1116.70	1119.99	1119.26	1120.76	0.001508	7.01	65.88	20.02	0.68
Reach	1100		Culvert									
Reach	979.5778	100-year	605.00	1116.40	1118.92	1118.92	1120.19	0.091462	9.04	66.93	26.56	1.00
Reach	974	100-year	605.00	1114.40	1119.08		1119.33	0.005754	3.96	152.77	39.88	0.36
Reach	948	100-year	605.00	1114.40	1119.17		1119.22	0.001075	1.77	341.23	84.31	0.16
Reach	926	100-year	605.00	1114.40	1119.13		1119.19	0.000739	1.99	304.39	88.48	0.19
Reach	923	100-year	605.00	1115.40	1119.09		1119.19	0.001598	2.53	238.90	86.36	0.27
Reach	903	100-year	605.00	1115.36	1119.08		1119.16	0.000717	2.29	264.21	91.70	0.24
Reach	839.9739	100-year	605.00	1114.75	1119.03		1119.12	0.000612	2.36	256.38	86.34	0.24
Reach	740.7678	100-year	605.00	1114.85	1118.90		1119.03	0.001139	2.91	207.88	81.01	0.32
Reach	633.9391	100-year	605.00	1114.74	1118.68		1118.88	0.001653	3.62	167.32	62.31	0.39
Reach	535.0838	100-year	605.00	1114.67	1118.53		1118.72	0.001541	3.46	174.69	65.96	0.38
Reach	436.3615	100-year	605.00	1115.09	1118.37		1118.56	0.001740	3.50	172.85	70.55	0.39
Reach	340.0702	100-year	605.00	1114.63	1118.23		1118.40	0.001470	3.28	184.54	73.25	0.36
Reach	239.8951	100-year	605.00	1114.35	1117.73	1116.98	1118.13	0.004505	5.12	118.23	55.62	0.62

HEC-RAS Plan: Prop River: Stream Reach: Reach Profile: 100-year

Reach	River Sta	Profile	E.G. US.	W.S. US.	E.G. IC	E.G. OC	Min El Weir Flow	Q Culv Group	Q Weir	Delta WS	Culv Vel US	Culv Vel DS
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(ft)	(ft/s)	(ft/s)
Reach	1198 Culvert #1	100-year	1121.12	1121.00	1120.78	1121.12	1124.01	462.00		1.01	6.28	7.03
Reach	1100 Culvert #1	100-year	1120.76	1119.99	1120.76	1120.55	1124.58	462.00		1.07	8.41	9.06

Appendix C.1D
Culvert Calculations

Project: TT0561 - Olive Avenue Widening
Location: Glendale, AZ
Date: April 17, 2023
Subject: Culvert Analysis Summary

Culvert ID	Road ID	Station	Type	Culvert Size (ft)	# Barrels	Inlet Invert (elev)	Culvert Length (ft)	Culvert Slope (ft/ft)	Outlet Invert (elev)	Design Flow (cfs)	Overtopping Elevation (elev)	Culvert Capacity to Overtopping (cfs)
DW Culvert-1	Olive Ave	186+56	RCP	1.5	1	1167.12	46.0	0.0046	1166.91	5.0	1170.0	12.0
DW Culvert-2	Sarival Ave	37+25	RCP	1.5	1	1151.61	46.0	0.0033	1151.46	5.0	1154.9	13.1
BNSF Box Culvert	Olive Ave	214+99	Box	8'x4'	1	1143.26	33.3	0.0045	1143.11	158.0	1150.50	350
Sarival Box Culvert	Olive Ave	216+40	Box	8'x5'	1	1141.98	177.5	0.0024	1141.56	158.0	1149.74	428

Notes:

1) Culverts are for offsite flows reaching the BNSF railroad and Olive Ave/Sarival Ave intersection.
2) The existing and proposed capacities are calculated based on the overtopping elevation (high point).
3) Driveway culverts are to convey small storm events to first flush/retention basins.
4) BNSF & Sarival Box culvert 100-year flows are 210 cfs each

Tailwater Channel Data - BNSF - Olive & Sarival

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 10.00 ft

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0024

Channel Manning's n: 0.0160

Channel Invert Elevation: 1143.26 ft

Roadway Data for Crossing: BNSF - Olive & Sarival

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 1150.50 ft

Roadway Surface: Gravel

Roadway Top Width: 12.00 ft

Table 2 - Culvert Summary Table: BNSF - Olive & Sarival

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	1143.26	0.000	0.000	0-NF	0.000	0.000	0.150	0.000	0.000	0.000
21.00	21.00	1144.18	0.915	0.627	1-JS1t	0.552	0.598	0.767	0.617	3.422	3.029
42.00	42.00	1144.71	1.453	0.964	1-JS1t	0.859	0.949	1.074	0.924	4.889	3.837
63.00	63.00	1145.16	1.904	1.257	1-S2n	1.120	1.244	1.139	1.166	6.916	4.382
84.00	84.00	1145.58	2.317	1.534	1-S2n	1.355	1.507	1.384	1.373	7.586	4.802
105.00	105.00	1145.95	2.694	1.852	1-S2n	1.574	1.749	1.613	1.556	8.138	5.147
126.00	126.00	1146.30	3.045	2.189	1-S2n	1.782	1.975	1.829	1.722	8.611	5.442
147.00	147.00	1146.64	3.379	2.534	1-S2n	1.981	2.189	2.035	1.875	9.028	5.701
158.00	158.00	1146.81	3.551	2.719	1-S2n	2.083	2.297	2.140	1.951	9.228	5.825
189.00	189.00	1147.30	4.038	3.257	5-S2n	2.361	2.588	2.425	2.152	9.742	6.141
210.00	210.00	1147.64	4.377	3.637	5-S2n	2.544	2.776	2.611	2.278	10.054	6.334

****

Straight Culvert

Inlet Elevation (invert): 1143.26 ft, Outlet Elevation (invert): 1143.11 ft

Culvert Length: 33.30 ft, Culvert Slope: 0.0045

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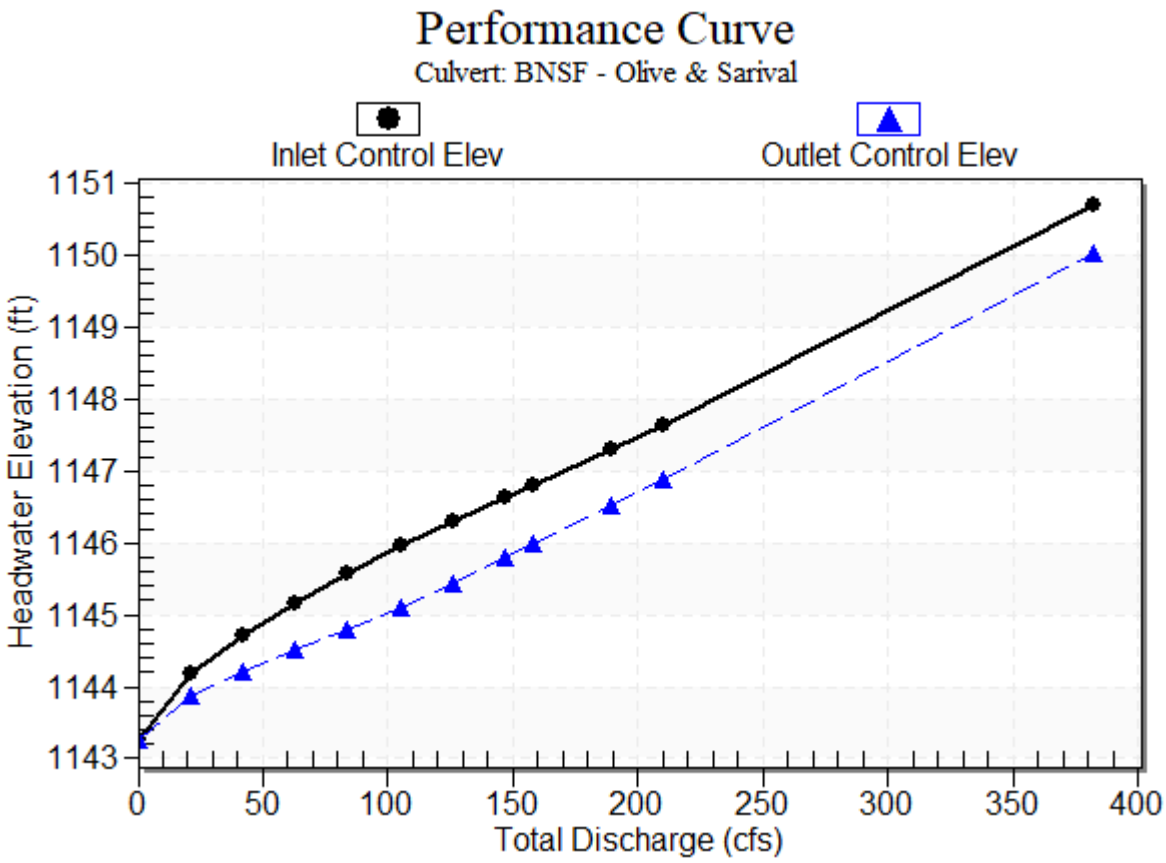
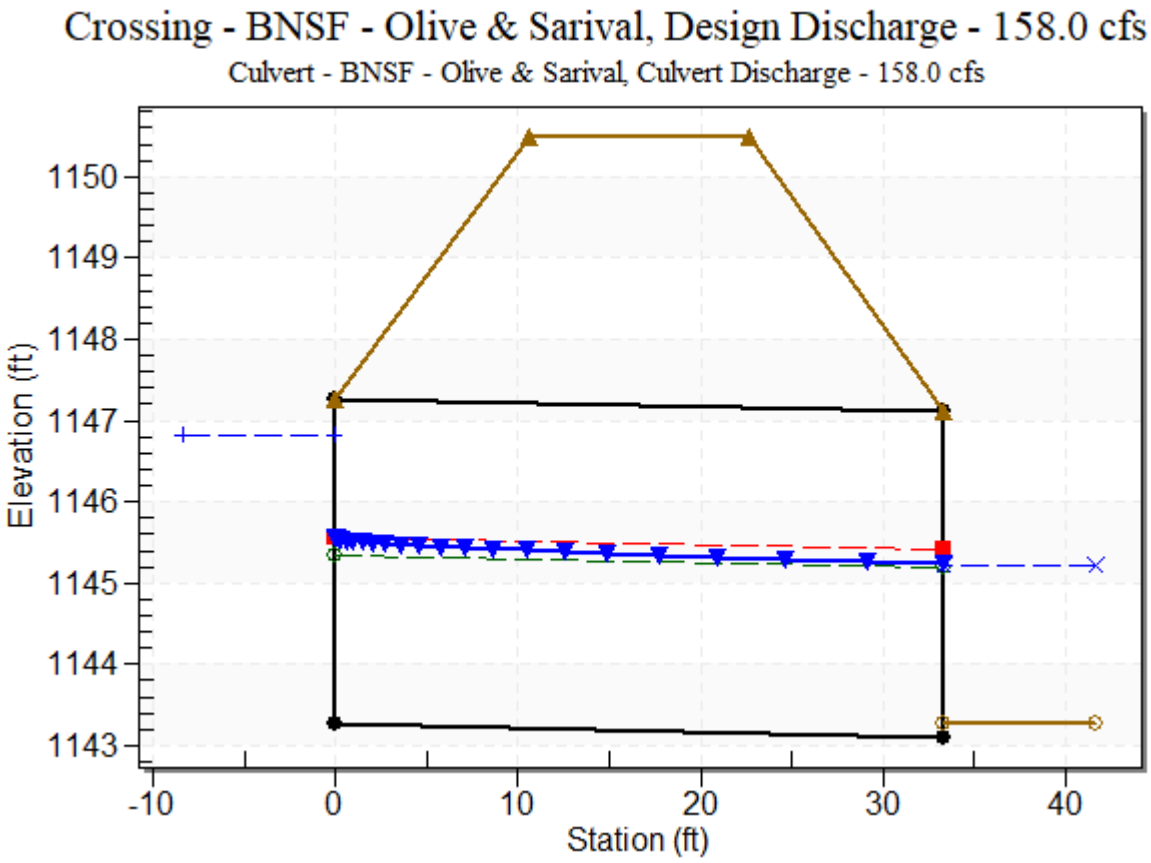
Culvert Performance Curve Plot: BNSF - Olive & Sarival



Water Surface Profile Plot for Culvert: BNSF - Olive & Sarival



Site Data - BNSF - Olive & Sarival

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 1143.26 ft

Outlet Station: 33.30 ft

Outlet Elevation: 1143.11 ft

Number of Barrels: 1

Culvert Data Summary - BNSF - Olive & Sarival

Barrel Shape: Concrete Box

Barrel Span: 8.00 ft

Barrel Rise: 4.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge (30-75º flare) Wingwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: BNSF - Olive & Sarival)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	1143.26	0.00	0.00	0.00	0.00
21.00	1143.88	0.62	3.03	0.09	0.72
42.00	1144.18	0.92	3.84	0.14	0.76
63.00	1144.43	1.17	4.38	0.17	0.78
84.00	1144.63	1.37	4.80	0.21	0.80
105.00	1144.82	1.56	5.15	0.23	0.81
126.00	1144.98	1.72	5.44	0.26	0.82
147.00	1145.14	1.88	5.70	0.28	0.83
158.00	1145.21	1.95	5.83	0.29	0.83
189.00	1145.41	2.15	6.14	0.32	0.84
210.00	1145.54	2.28	6.33	0.34	0.85

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

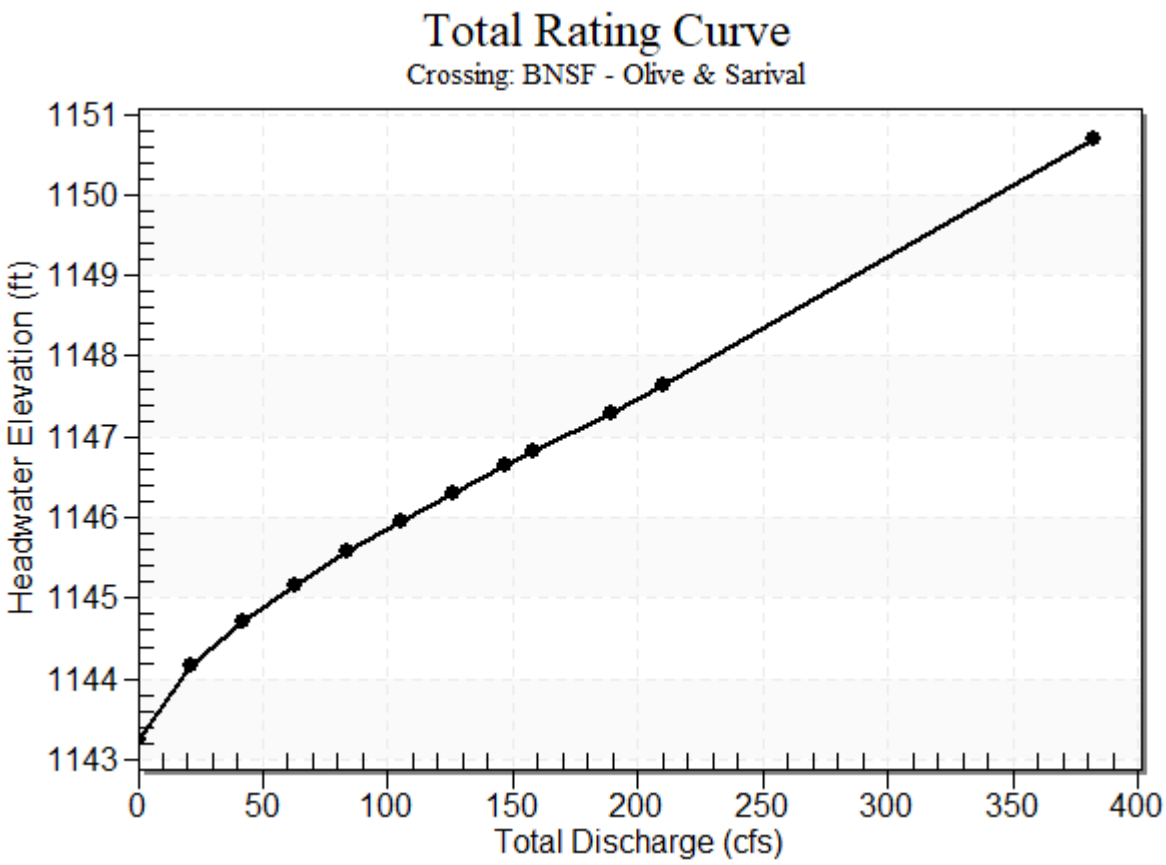
Design Flow: 158 cfs

Maximum Flow: 210 cfs

Table 1 - Summary of Culvert Flows at Crossing: BNSF - Olive & Sarival

Headwater Elevation (ft)	Total Discharge (cfs)	BNSF - Olive & Sarival Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1143.26	0.00	0.00	0.00	1
1144.18	21.00	21.00	0.00	1
1144.71	42.00	42.00	0.00	1
1145.16	63.00	63.00	0.00	1
1145.58	84.00	84.00	0.00	1
1145.95	105.00	105.00	0.00	1
1146.30	126.00	126.00	0.00	1
1146.64	147.00	147.00	0.00	1
1146.81	158.00	158.00	0.00	1
1147.30	189.00	189.00	0.00	1
1147.64	210.00	210.00	0.00	1
1150.50	350.10	350.10	0.00	Overtopping

Rating Curve Plot for Crossing: BNSF - Olive & Sarival



Tailwater Channel Data - Sarival Box Culvert

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 10.00 ft

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0024

Channel Manning's n: 0.0160

Channel Invert Elevation: 1141.98 ft

Roadway Data for Crossing: Sarival Box Culvert

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 50.00 ft

Crest Elevation: 1149.74 ft

Roadway Surface: Paved

Roadway Top Width: 100.00 ft

Table 2 - Culvert Summary Table: Sarival Box Culvert

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	1141.98	0.000	0.000	0-NF	0.000	0.000	0.420	0.000	0.000	0.000
21.00	21.00	1142.99	0.917	1.010	3-M1t	0.677	0.598	1.037	0.617	2.531	3.029
42.00	42.00	1143.58	1.456	1.596	3-M1t	1.059	0.949	1.344	0.924	3.907	3.837
63.00	63.00	1144.07	1.908	2.089	3-M1t	1.386	1.244	1.586	1.166	4.966	4.382
84.00	84.00	1144.51	2.311	2.530	3-M1t	1.683	1.507	1.793	1.373	5.857	4.802
105.00	105.00	1144.92	2.689	2.936	3-M1t	1.961	1.749	1.976	1.556	6.642	5.147
126.00	126.00	1145.30	3.044	3.315	3-M2t	2.226	1.975	2.142	1.722	7.352	5.442
147.00	147.00	1145.65	3.377	3.674	3-M2t	2.482	2.189	2.295	1.875	8.005	5.701
158.00	158.00	1145.84	3.544	3.855	3-M2t	2.612	2.297	2.371	1.951	8.330	5.825
189.00	189.00	1146.32	3.997	4.344	2-M2c	2.971	2.588	2.588	2.152	9.129	6.141
210.00	210.00	1146.64	4.293	4.661	2-M2c	3.208	2.776	2.776	2.278	9.455	6.334

****

Straight Culvert

Inlet Elevation (invert): 1141.98 ft, Outlet Elevation (invert): 1141.56 ft

Culvert Length: 177.50 ft, Culvert Slope: 0.0024

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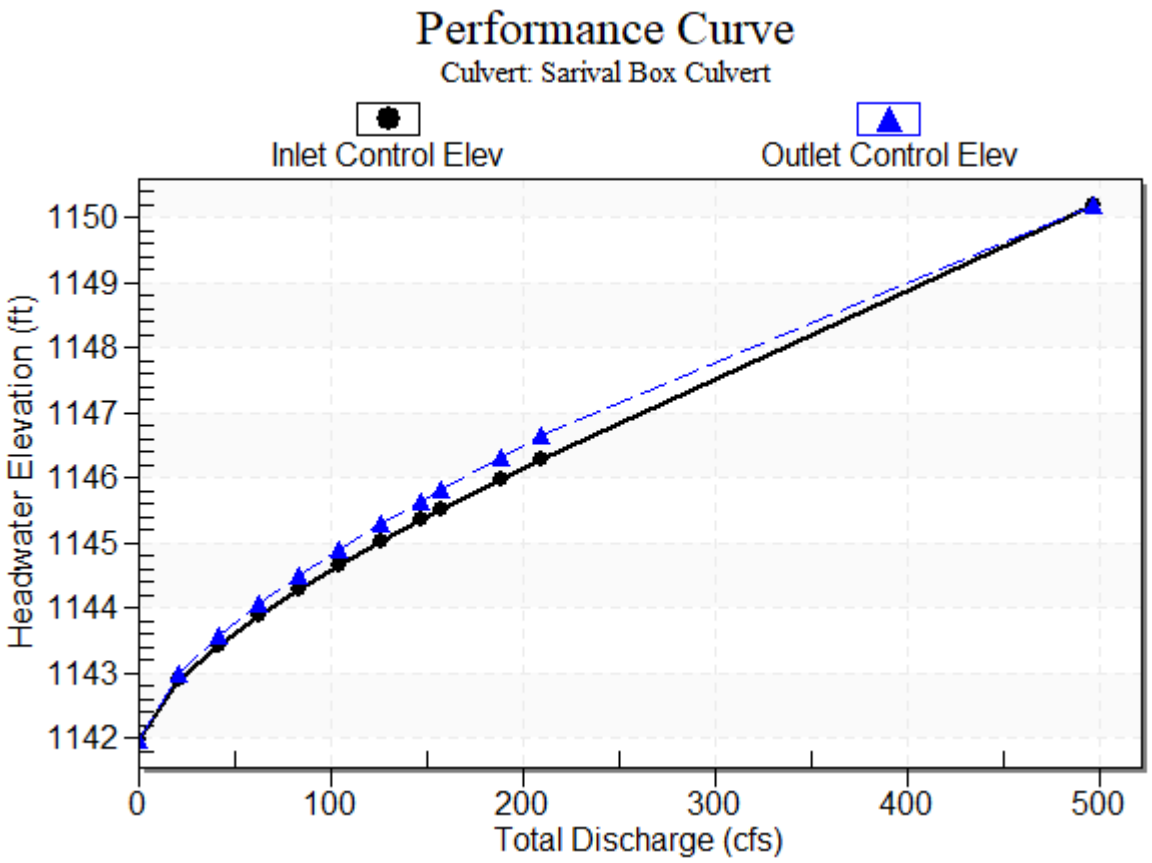
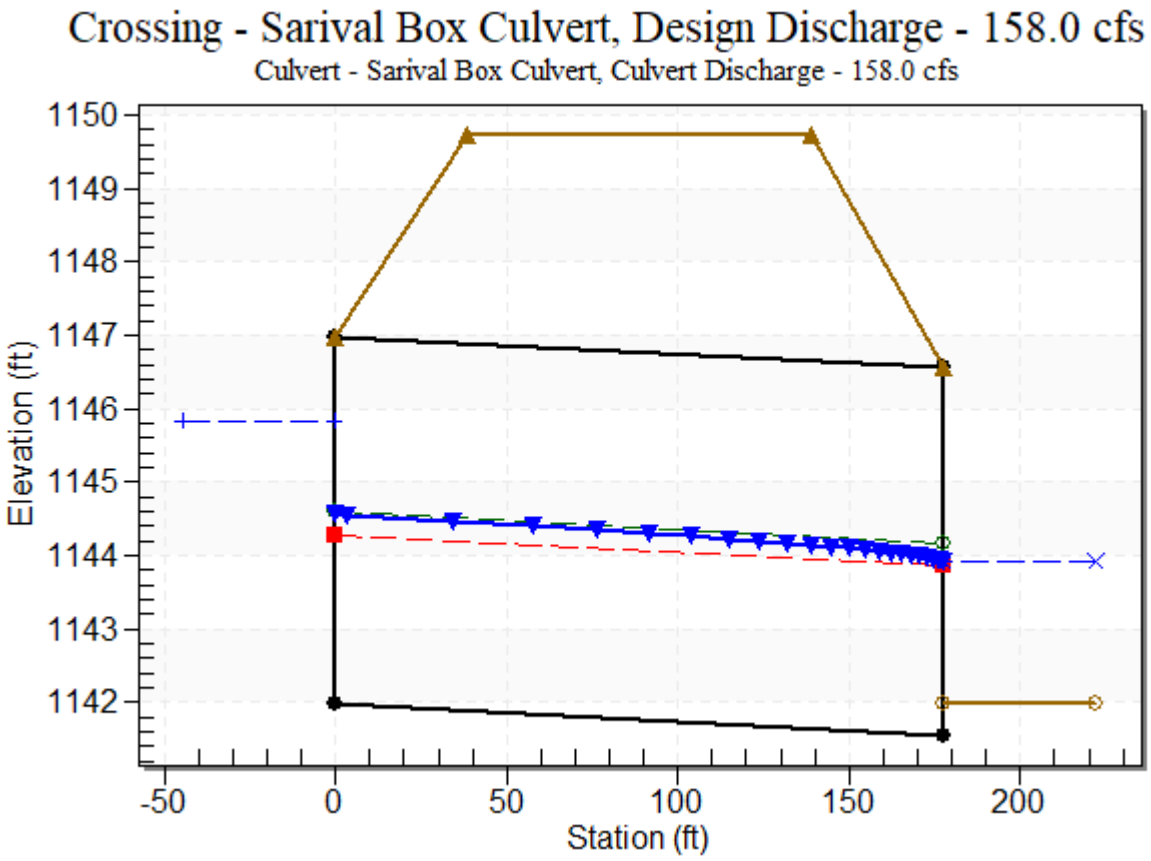
Culvert Performance Curve Plot: Sarival Box Culvert



Water Surface Profile Plot for Culvert: Sarival Box Culvert



Site Data - Sarival Box Culvert

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 1141.98 ft

Outlet Station: 177.50 ft

Outlet Elevation: 1141.56 ft

Number of Barrels: 1

Culvert Data Summary - Sarival Box Culvert

Barrel Shape: Concrete Box

Barrel Span: 8.00 ft

Barrel Rise: 5.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge (30-75º flare) Wingwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Sarival Box Culvert)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	1141.98	0.00	0.00	0.00	0.00
21.00	1142.60	0.62	3.03	0.09	0.72
42.00	1142.90	0.92	3.84	0.14	0.76
63.00	1143.15	1.17	4.38	0.17	0.78
84.00	1143.35	1.37	4.80	0.21	0.80
105.00	1143.54	1.56	5.15	0.23	0.81
126.00	1143.70	1.72	5.44	0.26	0.82
147.00	1143.86	1.88	5.70	0.28	0.83
158.00	1143.93	1.95	5.83	0.29	0.83
189.00	1144.13	2.15	6.14	0.32	0.84
210.00	1144.26	2.28	6.33	0.34	0.85

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

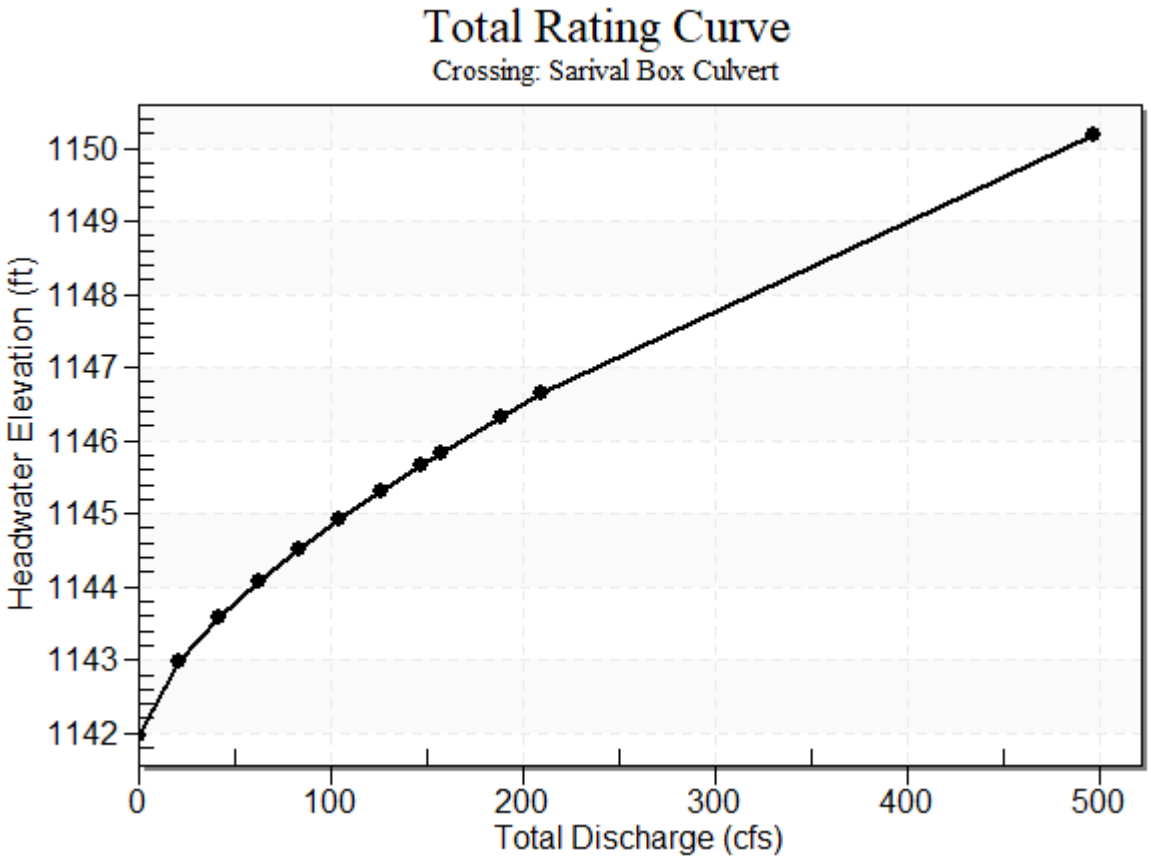
Design Flow: 158 cfs

Maximum Flow: 210 cfs

Table 1 - Summary of Culvert Flows at Crossing: Sarival Box Culvert

Headwater Elevation (ft)	Total Discharge (cfs)	Sarival Box Culvert Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1141.98	0.00	0.00	0.00	1
1142.99	21.00	21.00	0.00	1
1143.58	42.00	42.00	0.00	1
1144.07	63.00	63.00	0.00	1
1144.51	84.00	84.00	0.00	1
1144.92	105.00	105.00	0.00	1
1145.30	126.00	126.00	0.00	1
1145.65	147.00	147.00	0.00	1
1145.84	158.00	158.00	0.00	1
1146.32	189.00	189.00	0.00	1
1146.64	210.00	210.00	0.00	1
1149.74	428.18	428.18	0.00	Overtopping

Rating Curve Plot for Crossing: Sarival Box Culvert



Olive Sta 186+56 – 18” RCP Driveway Culvert-1

Site Data - 18

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 1167.12 ft

Outlet Station: 46.00 ft

Outlet Elevation: 1166.91 ft

Number of Barrels: 1

Culvert Data Summary - 18

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 7 - Culvert Summary Table: 18

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	1167.12	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
1.00	1.00	1167.69	0.509	0.573	3-M1t	0.370	0.369	0.467	0.467	2.129	1.145
2.00	2.00	1167.86	0.735	0.442	1-S2n	0.530	0.530	0.530	0.606	3.462	1.362
3.00	3.00	1168.15	0.947	1.033	3-M1t	0.662	0.658	0.705	0.705	3.673	1.507
4.00	4.00	1168.34	1.130	1.219	3-M1t	0.784	0.765	0.786	0.786	4.268	1.619
5.00	5.00	1168.49	1.297	1.375	2-M2c	0.904	0.856	0.856	0.854	4.801	1.712
6.00	6.00	1168.65	1.462	1.532	7-M2c	1.029	0.942	0.942	0.915	5.138	1.792
7.00	7.00	1168.81	1.635	1.692	7-M2c	1.178	1.021	1.021	0.969	5.461	1.863
8.00	8.00	1168.98	1.823	1.861	7-M2c	1.500	1.092	1.092	1.019	5.805	1.926
9.00	9.00	1169.17	2.033	2.050	7-M2c	1.500	1.156	1.156	1.065	6.158	1.983
10.00	10.00	1169.42	2.267	2.303	7-M2c	1.500	1.218	1.218	1.108	6.508	2.036

****

Straight Culvert

Inlet Elevation (invert): 1167.12 ft, Outlet Elevation (invert): 1166.91 ft

Culvert Length: 46.00 ft, Culvert Slope: 0.0046

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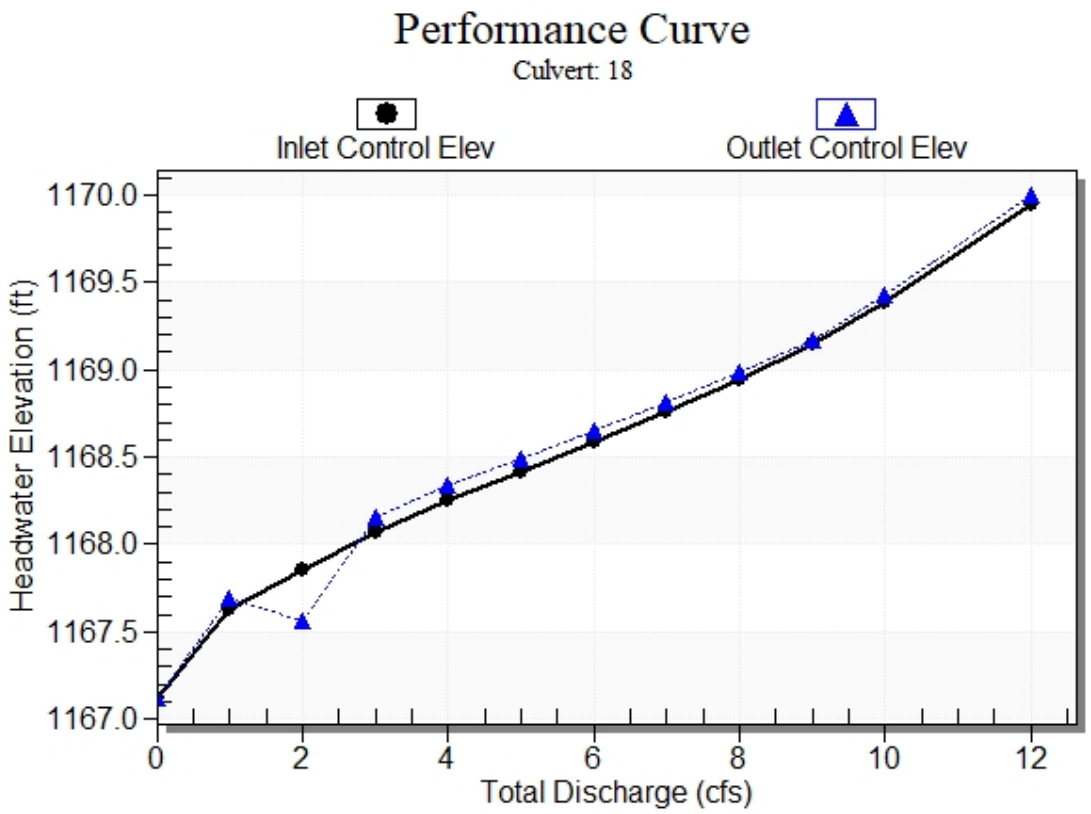
Culvert Performance Curve Plot: 18



Water Surface Profile Plot for Culvert: 18

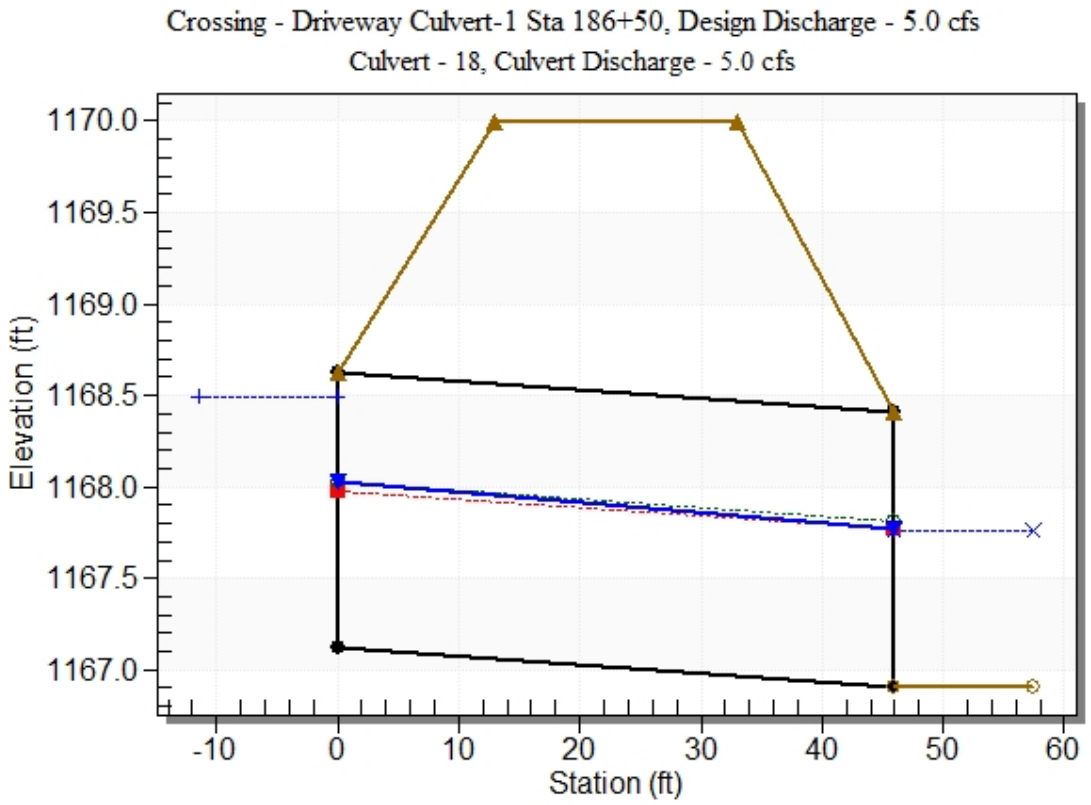


Table 8 - Downstream Channel Rating Curve (Crossing: Driveway Culvert-1 Sta 186+50)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	1166.91	0.00	0.00	0.00	0.00
1.00	1167.38	0.47	1.15	0.13	0.42
2.00	1167.52	0.61	1.36	0.17	0.44
3.00	1167.62	0.71	1.51	0.19	0.45
4.00	1167.70	0.79	1.62	0.22	0.46
5.00	1167.76	0.85	1.71	0.23	0.46
6.00	1167.82	0.91	1.79	0.25	0.47
7.00	1167.88	0.97	1.86	0.27	0.47
8.00	1167.93	1.02	1.93	0.28	0.48
9.00	1167.98	1.07	1.98	0.29	0.48
10.00	1168.02	1.11	2.04	0.30	0.48

Tailwater Channel Data - Driveway Culvert-1 Sta 186+50

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0044

Channel Manning's n: 0.0320

Channel Invert Elevation: 1166.91 ft

Roadway Data for Crossing: Driveway Culvert-1 Sta 186+50

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 20.00 ft

Crest Elevation: 1170.00 ft

Roadway Surface: Paved

Roadway Top Width: 20.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

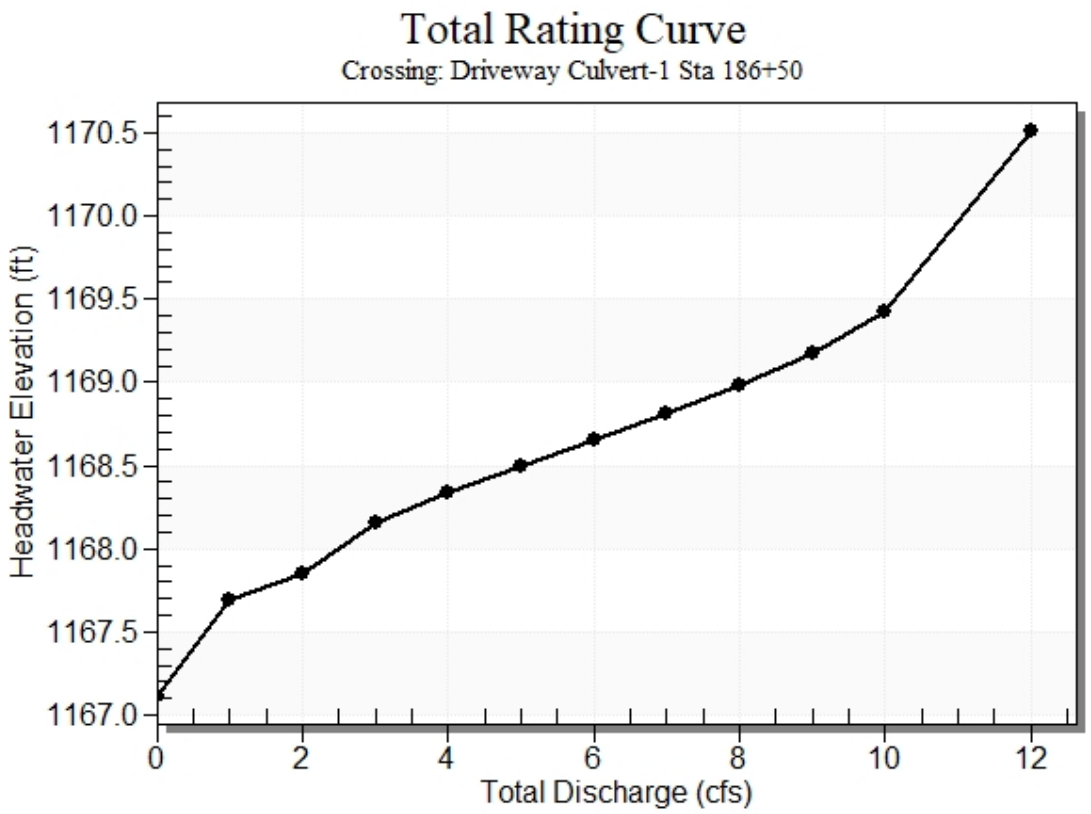
Design Flow: 5 cfs

Maximum Flow: 10 cfs

Table 9 - Summary of Culvert Flows at Crossing: Driveway Culvert-1 Sta 186+50

Headwater Elevation (ft)	Total Discharge (cfs)	18 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1167.12	0.00	0.00	0.00	1
1167.69	1.00	1.00	0.00	1
1167.86	2.00	2.00	0.00	1
1168.15	3.00	3.00	0.00	1
1168.34	4.00	4.00	0.00	1
1168.49	5.00	5.00	0.00	1
1168.65	6.00	6.00	0.00	1
1168.81	7.00	7.00	0.00	1
1168.98	8.00	8.00	0.00	1
1169.17	9.00	9.00	0.00	1
1169.42	10.00	10.00	0.00	1
1170.00	12.01	12.01	0.00	Overtopping

Rating Curve Plot for Crossing: Driveway Culvert-1 Sta 186+50



Sarival Sta 37+25 – 18” RCP Driveway Culvert-2

Site Data - 18

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 1151.61 ft

Outlet Station: 46.00 ft

Outlet Elevation: 1151.46 ft

Number of Barrels: 1

Culvert Data Summary - 18

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 10 - Culvert Summary Table: 18

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	1151.61	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
1.00	1.00	1152.17	0.510	0.565	3-M1t	0.403	0.369	0.542	0.542	1.739	0.852
2.00	2.00	1152.43	0.736	0.817	3-M1t	0.581	0.530	0.702	0.702	2.462	1.013
3.00	3.00	1152.63	0.948	1.021	3-M1t	0.730	0.658	0.818	0.818	3.045	1.121
4.00	4.00	1152.81	1.131	1.205	3-M1t	0.872	0.765	0.911	0.911	3.561	1.205
5.00	5.00	1152.99	1.298	1.376	3-M2t	1.018	0.856	0.991	0.991	4.038	1.274
6.00	6.00	1153.15	1.463	1.545	3-M2t	1.196	0.942	1.061	1.061	4.492	1.333
7.00	7.00	1153.33	1.636	1.715	3-M2t	1.500	1.021	1.124	1.124	4.929	1.386
8.00	8.00	1153.51	1.824	1.896	3-M2t	1.500	1.092	1.181	1.181	5.358	1.433
9.00	9.00	1153.72	2.034	2.108	7-M2t	1.500	1.156	1.235	1.235	5.783	1.476
10.00	10.00	1153.98	2.268	2.373	7-M2t	1.500	1.218	1.285	1.285	6.207	1.515

****

Straight Culvert

Inlet Elevation (invert): 1151.61 ft, Outlet Elevation (invert): 1151.46 ft

Culvert Length: 46.00 ft, Culvert Slope: 0.0033

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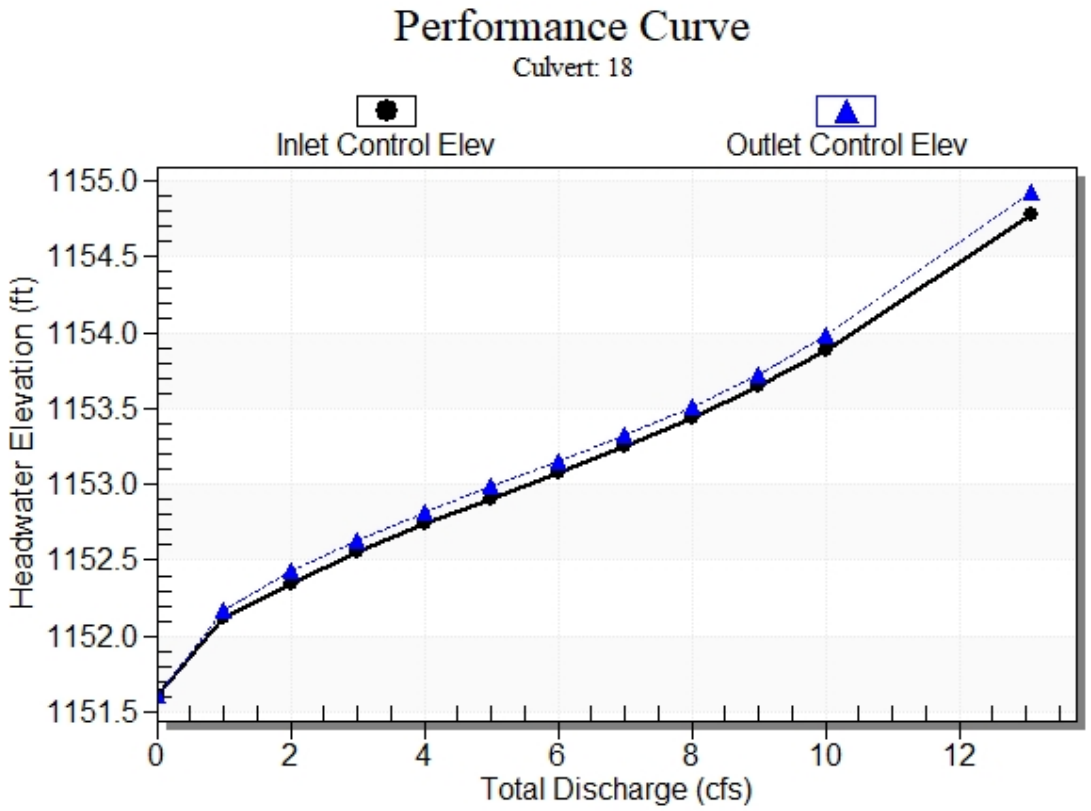
Culvert Performance Curve Plot: 18



Water Surface Profile Plot for Culvert: 18

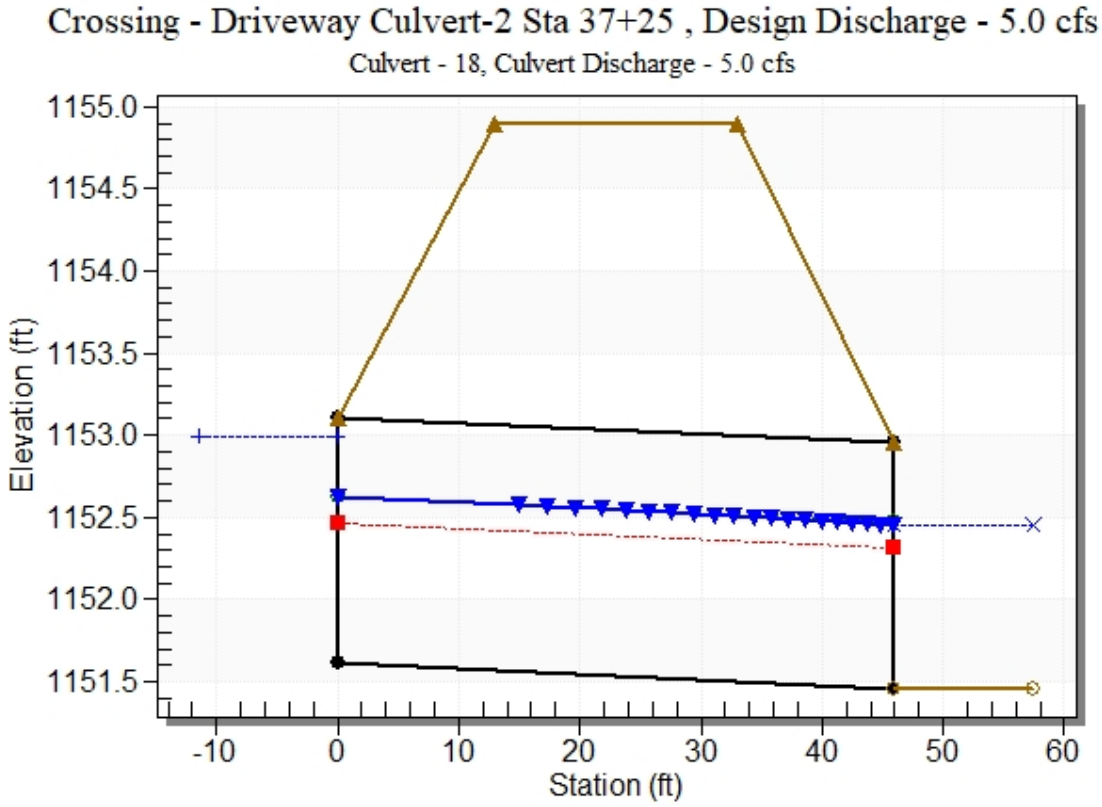


Table 11 - Downstream Channel Rating Curve (Crossing: Driveway Culvert-2 Sta 37+25)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	1151.46	0.00	0.00	0.00	0.00
1.00	1152.00	0.54	0.85	0.07	0.29
2.00	1152.16	0.70	1.01	0.09	0.30
3.00	1152.28	0.82	1.12	0.10	0.31
4.00	1152.37	0.91	1.20	0.11	0.31
5.00	1152.45	0.99	1.27	0.12	0.32
6.00	1152.52	1.06	1.33	0.13	0.32
7.00	1152.58	1.12	1.39	0.14	0.33
8.00	1152.64	1.18	1.43	0.15	0.33
9.00	1152.69	1.23	1.48	0.15	0.33
10.00	1152.74	1.28	1.52	0.16	0.33

Tailwater Channel Data - Driveway Culvert-2 Sta 37+25

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0020

Channel Manning's n: 0.0320

Channel Invert Elevation: 1151.46 ft

Roadway Data for Crossing: Driveway Culvert-2 Sta 37+25

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 20.00 ft

Crest Elevation: 1154.90 ft

Roadway Surface: Paved

Roadway Top Width: 20.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

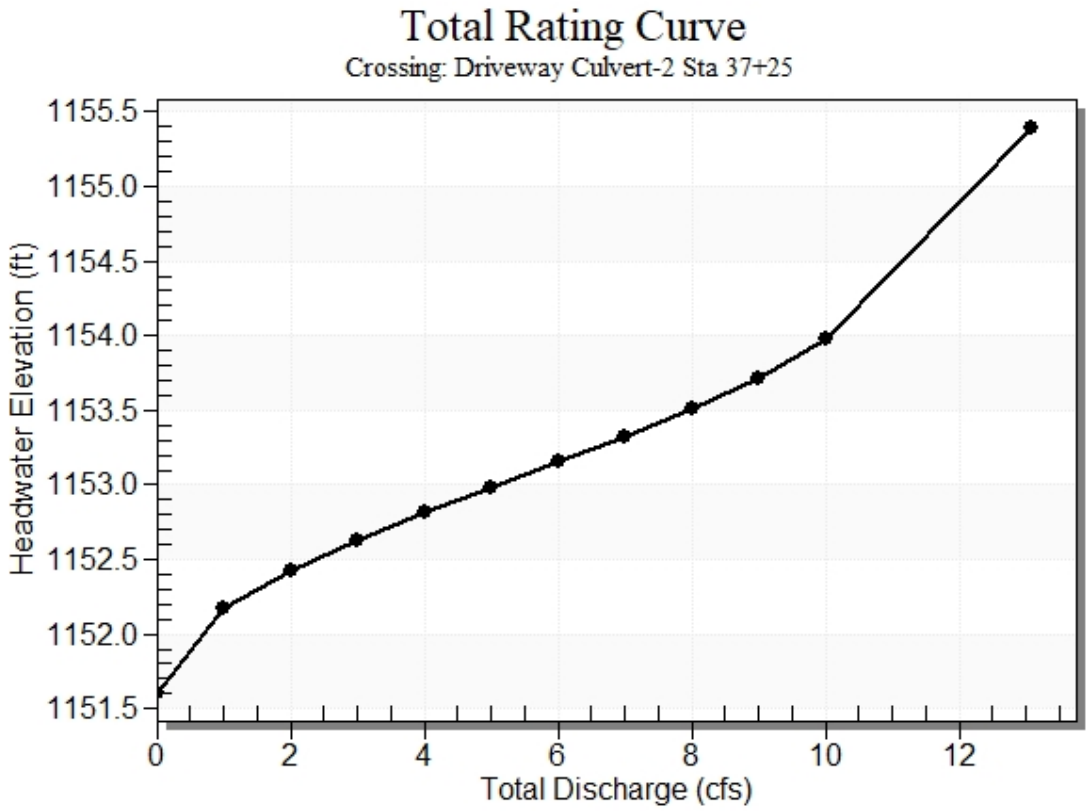
Design Flow: 5 cfs

Maximum Flow: 10 cfs

Table 12 - Summary of Culvert Flows at Crossing: Driveway Culvert-2 Sta 37+25

Headwater Elevation (ft)	Total Discharge (cfs)	18 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1151.61	0.00	0.00	0.00	1
1152.17	1.00	1.00	0.00	1
1152.43	2.00	2.00	0.00	1
1152.63	3.00	3.00	0.00	1
1152.81	4.00	4.00	0.00	1
1152.99	5.00	5.00	0.00	1
1153.15	6.00	6.00	0.00	1
1153.33	7.00	7.00	0.00	1
1153.51	8.00	8.00	0.00	1
1153.72	9.00	9.00	0.00	1
1153.98	10.00	10.00	0.00	1
1154.90	13.09	13.09	0.00	Overtopping

Rating Curve Plot for Crossing: Driveway Culvert-2 Sta 37+25



Project: TT0561 - Olive Avenue Widening - Sarival to Reems Road
Location: Surprise, Arizona
Date: April 26, 2023
Subject: Culvert Analysis Summary

Culvert ID	Road ID	Station	Type	Culvert Size (ft)	# Barrels	Inlet Invert (elev)	Culvert Length (ft)	Culvert Slope (ft/ft)	Outlet Invert (elev)	Design Flow (cfs)	Overtopping Elevation (elev)	Culvert Capacity to Overtopping (cfs)
Box-1[7]	Olive Ave	See HEC-RAS Analyses and Results Tables										
Box-2[7]	Olive Ave											
Box -3[7]	Olive Ave											
Box-4	Olive Ave											
DW-Culv-1	Olive Ave	269+83	RCP	1.5	1	1120.34	75.5	0.0262	1118.36	5.0	1123.98	14
Box Extension-1	Olive Ave	263+83	Box	10'x6'	2	1116.73	310.0	0.0011	1116.39	639.0	1126.18	1343

Notes:

1) Culverts are for offsite flows reaching the BNSF railroad and Olive Ave/Reems Rd intersection.
2) The existing and proposed capacities are calculated based on the overtopping elevation (high point).
3) DW Culvert-3 conveys small storm events to proposed retention basin.
4) Box Culverts 1 thru 3 have 100-year flows are 212 cfs each.
5) The 100-year flow from Reems Detention Basin (north of Olive Ave) to Olive Avenue is 639 cfs. The total flow from Olive Ave south to Falcon Dunes Golf Course is 818 cfs.
6) Reem Channel flows obtained from Reem Road Channel and Basin Final Design Report (December, 2011)
7) Box culverts are embedded 1-foot with compacted soil per MCDOT guidance to increase from a 4-foot high box culvert to 5-feet for maintenance.

HY-8 Culvert Analysis Report

18-Inch RCP Driveway Culvert Station 269+83

Site Data - DW-Culv-1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 1120.34 ft

Outlet Station: 75.50 ft

Outlet Elevation: 1118.36 ft

Number of Barrels: 1

Culvert Data Summary - DW-Culv-1

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: NONE

Table 1 - Culvert Summary Table: DW-Culv-1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	1120.34	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
1.00	1.00	1120.84	0.498	0.0*	1-S2n	0.239	0.369	0.239	0.078	5.397	0.633
2.00	2.00	1121.06	0.722	0.0*	1-S2n	0.341	0.530	0.341	0.118	6.561	0.831
3.00	3.00	1121.27	0.931	0.0*	1-S2n	0.424	0.658	0.431	0.150	7.184	0.972
4.00	4.00	1121.45	1.114	0.0*	1-S2n	0.491	0.765	0.491	0.178	7.925	1.086
5.00	5.00	1121.62	1.281	0.0*	1-S2n	0.556	0.856	0.556	0.203	8.401	1.183
6.00	6.00	1121.79	1.446	0.0*	1-S2n	0.612	0.942	0.622	0.226	8.662	1.268
7.00	7.00	1121.96	1.619	0.0*	5-S2n	0.669	1.021	0.682	0.248	8.954	1.344
8.00	8.00	1122.15	1.807	0.025	5-S2n	0.722	1.092	0.737	0.269	9.264	1.414
9.00	9.00	1122.36	2.016	0.504	5-S2n	0.774	1.156	0.792	0.288	9.513	1.478
10.00	10.00	1122.59	2.251	0.805	5-S2n	0.826	1.218	0.845	0.307	9.751	1.537

* Full Flow Headwater elevation is below inlet invert.

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Straight Culvert

Inlet Elevation (invert): 1120.34 ft, Outlet Elevation (invert): 1118.36 ft

Culvert Length: 75.53 ft, Culvert Slope: 0.0262

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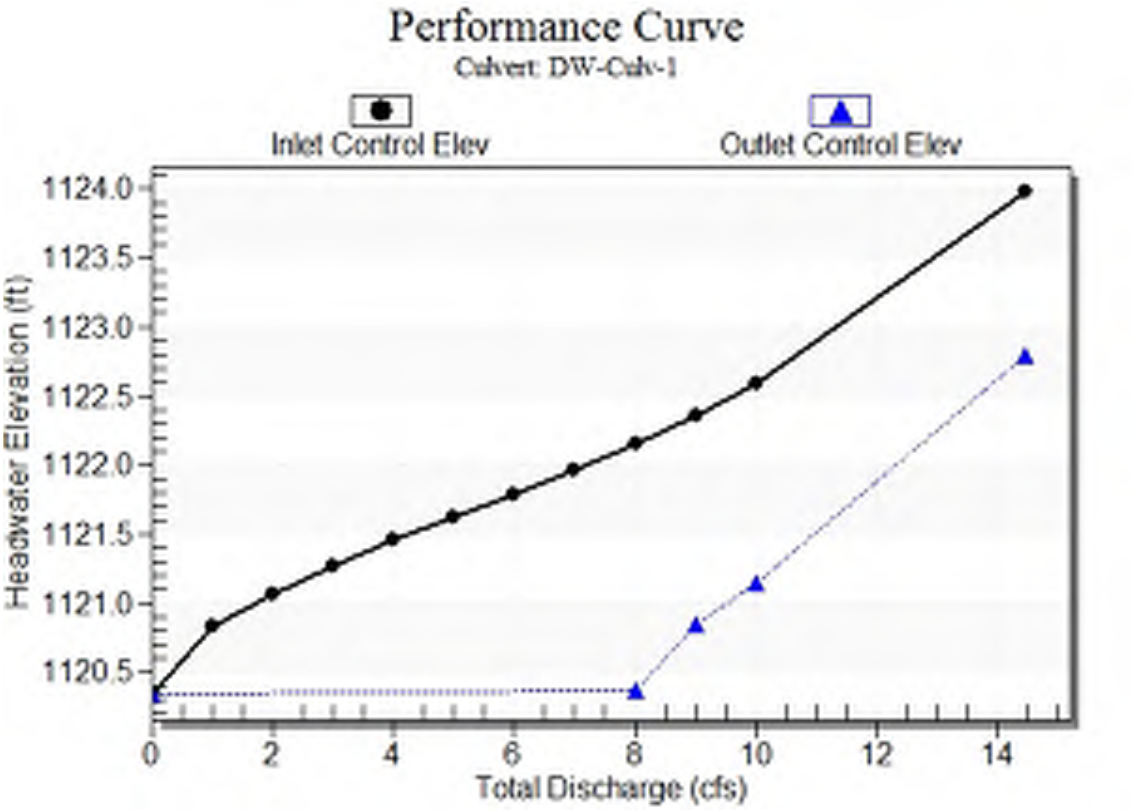
Culvert Performance Curve Plot: DW-Culv-1



Water Surface Profile Plot for Culvert: DW-Culv-1

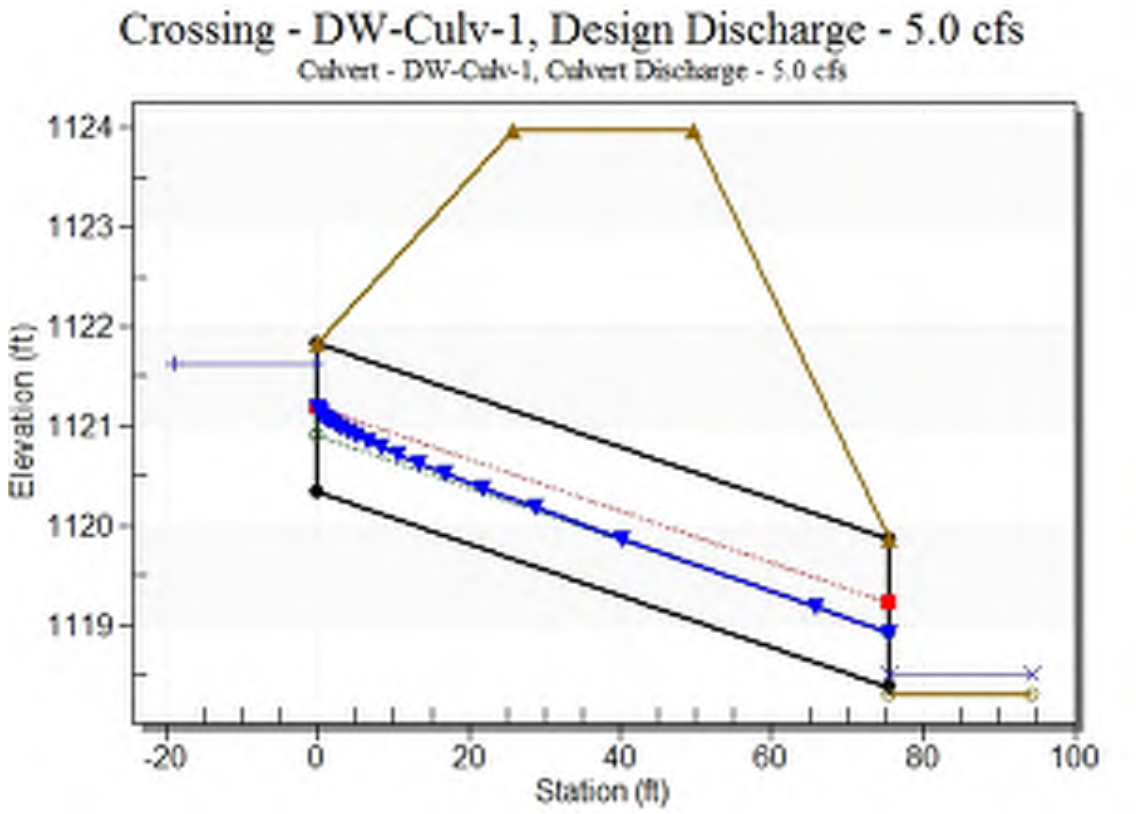


Table 2 - Downstream Channel Rating Curve (Crossing: DW-Culv-1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	1118.30	0.00	0.00	0.00	0.00
1.00	1118.38	0.08	0.63	0.02	0.40
2.00	1118.42	0.12	0.83	0.03	0.43
3.00	1118.45	0.15	0.97	0.03	0.45
4.00	1118.48	0.18	1.09	0.04	0.46
5.00	1118.50	0.20	1.18	0.04	0.47
6.00	1118.53	0.23	1.27	0.05	0.48
7.00	1118.55	0.25	1.34	0.05	0.49
8.00	1118.57	0.27	1.41	0.06	0.49
9.00	1118.59	0.29	1.48	0.06	0.50
10.00	1118.61	0.31	1.54	0.07	0.50

Tailwater Channel Data - DW-Culv-1

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 20.00 ft

Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0035

Channel Manning's n: 0.0250

Channel Invert Elevation: 1118.30 ft

Roadway Data for Crossing: DW-Culv-1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 50.00 ft

Crest Elevation: 1123.98 ft

Roadway Surface: Paved

Roadway Top Width: 24.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

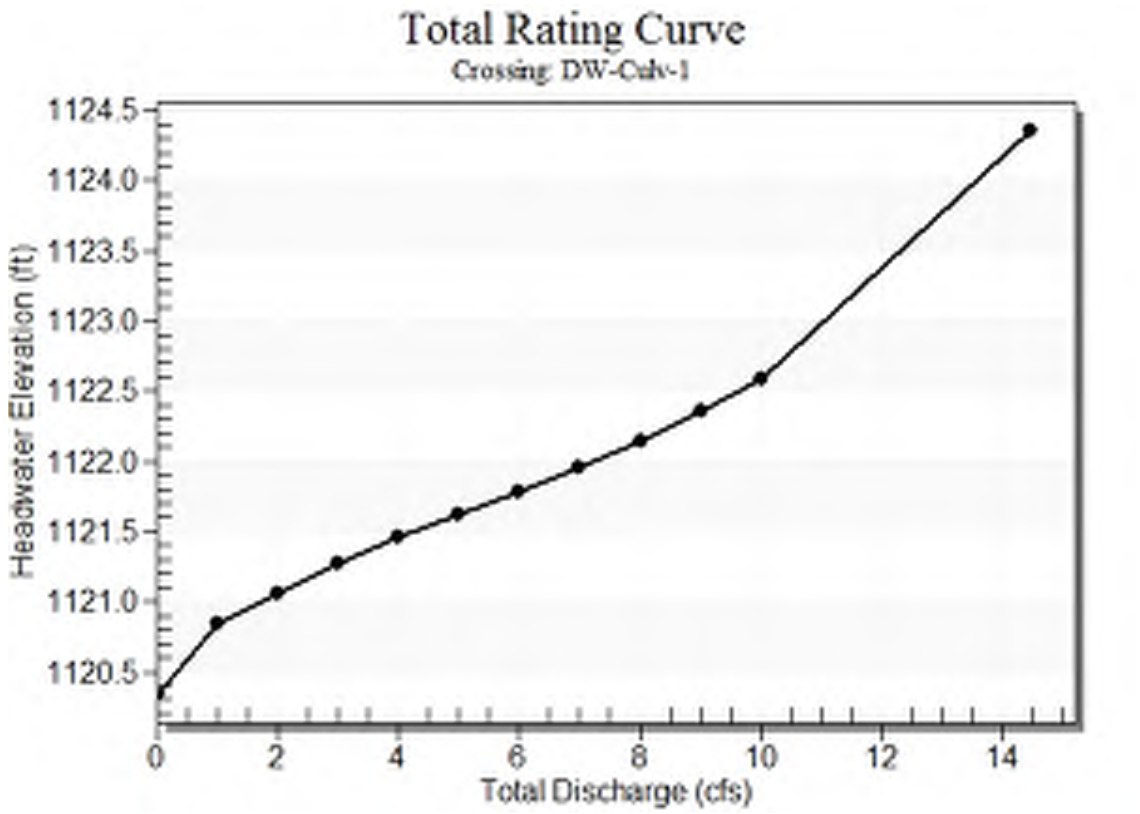
Design Flow: 5 cfs

Maximum Flow: 10 cfs

Table 3 - Summary of Culvert Flows at Crossing: DW-Culv-1

Headwater Elevation (ft)	Total Discharge (cfs)	DW-Culv-1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1120.34	0.00	0.00	0.00	1
1120.84	1.00	1.00	0.00	1
1121.06	2.00	2.00	0.00	1
1121.27	3.00	3.00	0.00	1
1121.45	4.00	4.00	0.00	1
1121.62	5.00	5.00	0.00	1
1121.79	6.00	6.00	0.00	1
1121.96	7.00	7.00	0.00	1
1122.15	8.00	8.00	0.00	1
1122.36	9.00	9.00	0.00	1
1122.59	10.00	10.00	0.00	1
1123.98	14.46	14.46	0.00	Overtopping

Rating Curve Plot for Crossing: DW-Culv-1



Appendix C.2

Channel and Ditch Calculations

Project: TT0561 - Olive Avenue Widening
Location: Glendale, AZ
Date: April 12, 2023
Subject: Ditch/Channel Design Summary

Ditch ID	Road Alignment	Contributing Subbasins	From Station	To Station	Manning's 'n'	Lt Side Slope (ft/ft)	Rt Side Slope (ft/ft)	Channel Slope (ft/ft)	Channel Depth (ft)	Channel 10-Yr Flow (cfs)	Full Channel Capacity (cfs)	Full Channel Capacity Velocity (ft/s)	Notes
Ditch-1E	Olive Ave	DA-35 (TT0497), DA-101A	178+70	179+00	0.032	4/1	4/1	0.0429	1.0	2.5	11.0	2.8	Riprap protection provided
Ditch-1F	Olive Ave	DA-35 (TT0497), DA-101A DA-101B	179+00	181+34	0.032	4/1	4/1	0.0050	1.0	4.3	8.1	2.0	
Ditch-1G	Olive Ave	DA-35 (TT0497), DA-101A DA-101B, DA-101C	181+34	188+85	0.032	4/1	4/1	0.0044	1.0	5.2	7.6	1.9	To Basin-3
Ditch-1H	Olive Ave	DA-107A	217+50	218+40	0.032	4/1	4/1	0.0044	1.0	0.5	7.6	1.2	Channel
Ditch-2A	Sarival Ave	DA-301A	22+62	17+47	0.032	4/1	4/1	0.0061	1.0	0.3	9.0	2.2	
Ditch-2B	Sarival Ave	DA-301, DA-301A	17+47	13+06	0.032	4/1	4/1	0.0051	1.0	2.2	8.2	2.1	To Basin-301
Ditch-2C	Sarival Ave	N/A	10+50	8+30	0.032	4/1	4/1	0.0035	1.0	N/A	6.8	1.7	Ditch to provide positive outfall to an existing area drain discharging to the Northern Parkway Channel, which is the regional outfall.
Ditch-2D	Sarival Ave	N/A	8+30	3+95	0.032	4/1	4/1	0.0029	1.0	N/A	6.2	1.5	Ditch to provide positive outfall to an existing area drain discharging to the Northern Parkway Channel, which is the regional outfall.
Ditch-2E	Sarival Ave	N/A	3+95	1+07	0.032	4/1	4/1	0.0067	1.0	N/A	9.4	2.4	Ditch to provide positive outfall to an existing area drain discharging to the Northern Parkway Channel, which is the regional outfall.
Ditch-3A	Sarival Ave	DA-204	41+64	37+49	0.032	4/1	4/1	0.0068	1.0	1.7	9.5	2.4	
Ditch-3B	Sarival Ave	DA-204, DA-203	37+03	30+82	0.032	4/1	4/1	0.0020	1.0	4.0	5.1	1.3	Half of DA-203 contributes to ditch 3B. Flows toBasin-201

Channel ID		Outfall Structure	From Station	To Station	Manning's 'n'	Lt Side Slope (ft/ft)	Rt Side Slope	Bottom Width (ft)	Channel Depth (ft)	Channel Slope (ft/ft)	Calculated Normal Depth (ft)	Calculated Velocity (ft/s)	Channel 50-Yr Flow (cfs)	Full Channel Capacity (cfs)	Notes
Channel-1[5]	Olive Ave	BNSF Box Culvert	211+00	214+99	0.032	4/1	4/1	10.0	3.1	0.0050	2.03	4.1	157.0	356.0	Earthen Lining
Channel-2[5]	Olive Ave	Sarival Box Culvert	214+99	215+52	0.016	2/1	2/1	10.0	3.7	0.0024	2.70	5.8	157.0	528.0	Concrete Channel Lining
Channel-3[5]	Olive Ave	End of project/Reems Road Channel	218+40	220+00	0.016	4/1	4/1	20.0	3.1	0.0035	2.07	5.4	157.0	707.0	Earthen Lining - See HEC-RAS Results

Notes:

1) Ditches are v-ditches unless otherwise noted to have a bottom width.
2) Normal depth, velocity and channel capacities calculated using Bentley Flowmaster V8i.
3) Channel depths includes 1-foot of freeboard.
4) Full channel capacity is at the channel depth, including 1-foot of freeboard.
5) See HEC-RAS Results for full hydraulic analyses. Flowmaster calculations provided for reference.

Worksheet for Channel 1 - BNSF North Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.032	
Channel Slope	0.00500	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	157.00	ft³/s

Results

Normal Depth	2.08	ft
Flow Area	38.14	ft²
Wetted Perimeter	27.16	ft
Hydraulic Radius	1.40	ft
Top Width	26.65	ft
Critical Depth	1.59	ft
Critical Slope	0.01460	ft/ft
Velocity	4.12	ft/s
Velocity Head	0.26	ft
Specific Energy	2.34	ft
Froude Number	0.61	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.08	ft
Critical Depth	1.59	ft
Channel Slope	0.00500	ft/ft

Worksheet for Channel 1 - BNSF North Channel

GVF Output Data

Critical Slope	0.01460	ft/ft

Worksheet for Channel 2 - BNSF Box to Sarival Box

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.016	
Channel Slope	0.00240	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	157.00	ft³/s

Results

Normal Depth	1.94	ft
Flow Area	27.00	ft²
Wetted Perimeter	18.69	ft
Hydraulic Radius	1.44	ft
Top Width	17.78	ft
Critical Depth	1.74	ft
Critical Slope	0.00356	ft/ft
Velocity	5.81	ft/s
Velocity Head	0.53	ft
Specific Energy	2.47	ft
Froude Number	0.83	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.94	ft
Critical Depth	1.74	ft
Channel Slope	0.00240	ft/ft

Worksheet for Channel 2 - BNSF Box to Sarival Box

GVF Output Data

Critical Slope	0.00356	ft/ft

Worksheet for Channel 3 - Sarival Box to End of Concrete Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.016	
Channel Slope	0.00300	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	15.00	ft
Discharge	157.00	ft³/s

Results

Normal Depth	1.41	ft
Flow Area	29.09	ft²
Wetted Perimeter	26.62	ft
Hydraulic Radius	1.09	ft
Top Width	26.28	ft
Critical Depth	1.33	ft
Critical Slope	0.00373	ft/ft
Velocity	5.40	ft/s
Velocity Head	0.45	ft
Specific Energy	1.86	ft
Froude Number	0.90	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.41	ft
Critical Depth	1.33	ft
Channel Slope	0.00300	ft/ft

Worksheet for Channel 3 - Sarival Box to End of Concrete Channel

GVF Output Data

Critical Slope	0.00373	ft/ft

Worksheet for Channel 4 -Concrete Channel to End of Project

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.032	
Channel Slope	0.00300	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	15.00	ft
Discharge	157.00	ft³/s

Results

Normal Depth	2.04	ft
Flow Area	47.38	ft²
Wetted Perimeter	31.86	ft
Hydraulic Radius	1.49	ft
Top Width	31.35	ft
Critical Depth	1.33	ft
Critical Slope	0.01492	ft/ft
Velocity	3.31	ft/s
Velocity Head	0.17	ft
Specific Energy	2.21	ft
Froude Number	0.48	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.04	ft
Critical Depth	1.33	ft
Channel Slope	0.00300	ft/ft

Worksheet for Channel 4 -Concrete Channel to End of Project

GVF Output Data

Critical Slope	0.01492	ft/ft

Worksheet for Ditch-1E

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.069	
Channel Slope	0.04290	ft/ft
Normal Depth	1.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	11.01	ft^3/s
Flow Area	4.00	ft^2
Wetted Perimeter	8.25	ft
Hydraulic Radius	0.49	ft
Top Width	8.00	ft
Critical Depth	0.86	ft
Critical Slope	0.09569	ft/ft
Velocity	2.75	ft/s
Velocity Head	0.12	ft
Specific Energy	1.12	ft
Froude Number	0.69	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.86	ft
Channel Slope	0.04290	ft/ft
Critical Slope	0.09569	ft/ft

Worksheet for Ditch-1F

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.032	
Channel Slope	0.00500	ft/ft
Normal Depth	1.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	8.11	ft^3/s
Flow Area	4.00	ft^2
Wetted Perimeter	8.25	ft
Hydraulic Radius	0.49	ft
Top Width	8.00	ft
Critical Depth	0.76	ft
Critical Slope	0.02144	ft/ft
Velocity	2.03	ft/s
Velocity Head	0.06	ft
Specific Energy	1.06	ft
Froude Number	0.51	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.76	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.02144	ft/ft

Worksheet for Ditch-1G

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.032	
Channel Slope	0.00440	ft/ft
Normal Depth	1.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	7.61	ft^3/s
Flow Area	4.00	ft^2
Wetted Perimeter	8.25	ft
Hydraulic Radius	0.49	ft
Top Width	8.00	ft
Critical Depth	0.74	ft
Critical Slope	0.02162	ft/ft
Velocity	1.90	ft/s
Velocity Head	0.06	ft
Specific Energy	1.06	ft
Froude Number	0.47	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.74	ft
Channel Slope	0.00440	ft/ft
Critical Slope	0.02162	ft/ft

Worksheet for Ditch-2A

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.032	
Channel Slope	0.00610	ft/ft
Normal Depth	1.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	8.96	ft^3/s
Flow Area	4.00	ft^2
Wetted Perimeter	8.25	ft
Hydraulic Radius	0.49	ft
Top Width	8.00	ft
Critical Depth	0.79	ft
Critical Slope	0.02116	ft/ft
Velocity	2.24	ft/s
Velocity Head	0.08	ft
Specific Energy	1.08	ft
Froude Number	0.56	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.79	ft
Channel Slope	0.00610	ft/ft
Critical Slope	0.02116	ft/ft

Worksheet for Ditch-2B

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.032	
Channel Slope	0.00510	ft/ft
Normal Depth	1.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	8.19	ft^3/s
Flow Area	4.00	ft^2
Wetted Perimeter	8.25	ft
Hydraulic Radius	0.49	ft
Top Width	8.00	ft
Critical Depth	0.76	ft
Critical Slope	0.02141	ft/ft
Velocity	2.05	ft/s
Velocity Head	0.07	ft
Specific Energy	1.07	ft
Froude Number	0.51	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.76	ft
Channel Slope	0.00510	ft/ft
Critical Slope	0.02141	ft/ft

Worksheet for Ditch-2C

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.032	
Channel Slope	0.00350	ft/ft
Normal Depth	1.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	6.78	ft^3/s
Flow Area	4.00	ft^2
Wetted Perimeter	8.25	ft
Hydraulic Radius	0.49	ft
Top Width	8.00	ft
Critical Depth	0.71	ft
Critical Slope	0.02196	ft/ft
Velocity	1.70	ft/s
Velocity Head	0.04	ft
Specific Energy	1.04	ft
Froude Number	0.42	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.71	ft
Channel Slope	0.00350	ft/ft
Critical Slope	0.02196	ft/ft

Worksheet for Ditch-2D

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.032	
Channel Slope	0.00290	ft/ft
Normal Depth	1.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	6.18	ft^3/s
Flow Area	4.00	ft^2
Wetted Perimeter	8.25	ft
Hydraulic Radius	0.49	ft
Top Width	8.00	ft
Critical Depth	0.68	ft
Critical Slope	0.02223	ft/ft
Velocity	1.54	ft/s
Velocity Head	0.04	ft
Specific Energy	1.04	ft
Froude Number	0.38	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.68	ft
Channel Slope	0.00290	ft/ft
Critical Slope	0.02223	ft/ft

Worksheet for Ditch-2E

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.032	
Channel Slope	0.00670	ft/ft
Normal Depth	1.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	9.39	ft^3/s
Flow Area	4.00	ft^2
Wetted Perimeter	8.25	ft
Hydraulic Radius	0.49	ft
Top Width	8.00	ft
Critical Depth	0.81	ft
Critical Slope	0.02103	ft/ft
Velocity	2.35	ft/s
Velocity Head	0.09	ft
Specific Energy	1.09	ft
Froude Number	0.59	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.81	ft
Channel Slope	0.00670	ft/ft
Critical Slope	0.02103	ft/ft

Worksheet for Ditch-3A

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.032	
Channel Slope	0.00680	ft/ft
Normal Depth	1.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	9.46	ft^3/s
Flow Area	4.00	ft^2
Wetted Perimeter	8.25	ft
Hydraulic Radius	0.49	ft
Top Width	8.00	ft
Critical Depth	0.81	ft
Critical Slope	0.02101	ft/ft
Velocity	2.36	ft/s
Velocity Head	0.09	ft
Specific Energy	1.09	ft
Froude Number	0.59	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.81	ft
Channel Slope	0.00680	ft/ft
Critical Slope	0.02101	ft/ft

Worksheet for Ditch-3B

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.032	
Channel Slope	0.00200	ft/ft
Normal Depth	1.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	5.13	ft^3/s
Flow Area	4.00	ft^2
Wetted Perimeter	8.25	ft
Hydraulic Radius	0.49	ft
Top Width	8.00	ft
Critical Depth	0.63	ft
Critical Slope	0.02279	ft/ft
Velocity	1.28	ft/s
Velocity Head	0.03	ft
Specific Energy	1.03	ft
Froude Number	0.32	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.63	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.02279	ft/ft

Appendix D

Onsite Collection and Conveyance Systems

Appendix D.1

Rational Method Calculations

Project: TT0561 - Olive Avenue Widening
Location: Surprise, Arizona
Date: April 12, 2023
Subject: 10-Year Rational Flow Calculations

Proj. Number: 221892
Proj. Engineer: A.Herting
Checker: L.Vick

Source: Effective Maricopa County Drainage Policies and Standards Manual, 2016

Subbasin	C	Tc (min)	L (mi)	m	b	Kb	Elev Start	Elev End	S (ft/mi)	i (in/hr)	Tc (Calc) (hrs)	Tc (Calc) (min)	A (ac)	Q (cfs)	Slope (ft/ft)
Olive Ave Westbound Lanes															
DA-1	0.95	10	0.129	-0.00625	0.04	0.041	1178.95	1174.41	35.3	3.56	0.160	10	0.59	2.00	0.0067
DA-2	0.95	12	0.159	-0.00625	0.04	0.041	1174.41	1169.68	29.7	3.25	0.192	12	0.73	2.26	0.0056
DA-3	0.95	12	0.144	-0.00625	0.04	0.042	1169.68	1165.47	29.2	3.25	0.186	11	0.57	1.75	0.0055
DA-4	0.95	10	0.153	-0.00625	0.04	0.041	1165.47	1160.17	34.7	3.56	0.174	10	0.70	2.37	0.0066
DA-5	0.95	10	0.154	-0.00625	0.04	0.041	1160.17	1154.44	37.1	3.56	0.171	10	0.69	2.34	0.0070
DA-6	0.95	7	0.090	-0.00625	0.04	0.041	1154.44	1150.50	43.8	4.04	0.118	7	0.70	2.68	0.0083
DA-7	0.95	6	0.066	-0.00625	0.04	0.043	1149.66	1146.43	48.7	4.31	0.099	6	0.31	1.26	0.0092
Olive Ave Eastbound Lanes															
DA-101	0.95	10	0.129	-0.00625	0.04	0.041	1178.92	1174.49	34.4	3.56	0.161	10	0.59	1.98	0.0065
DA-102	0.95	11	0.159	-0.00625	0.04	0.041	1174.49	1169.68	30.2	3.39	0.188	11	0.74	2.39	0.0057
DA-103	0.95	12	0.144	-0.00625	0.04	0.042	1169.68	1166.17	24.4	3.25	0.197	12	0.48	1.49	0.0046
DA-104	0.95	11	0.170	-0.00625	0.04	0.041	1166.17	1160.20	35.0	3.39	0.186	11	0.79	2.53	0.0066
DA-105	0.95	10	0.154	-0.00625	0.04	0.041	1160.20	1154.43	37.4	3.56	0.171	10	0.68	2.31	0.0071
DA-106	0.95	7	0.090	-0.00625	0.04	0.041	1154.43	1150.28	46.1	4.04	0.117	7	0.59	2.28	0.0087
DA-107	0.95	7	0.066	-0.00625	0.04	0.043	1149.01	1147.16	27.9	4.04	0.120	7	0.29	1.12	0.0053
DA-101A	0.40	5	0.029	-0.00625	0.04	0.047	1179.00	1178.00	34.5	4.68	0.074	4	0.06	0.12	0.0065
DA-101B	0.40	15	0.159	-0.00625	0.04	0.039	1178.00	1176.00	12.6	2.94	0.256	15	1.24	1.45	0.0024
DA-101C	0.40	7	0.054	-0.00625	0.04	0.042	1176.00	1175.00	18.4	4.04	0.122	7	0.47	0.75	0.0035
DA-102A	0.40	10	0.159	-0.00625	0.04	0.039	1175.00	1168.70	39.6	3.56	0.167	10	1.24	1.76	0.0075
DA-103B	0.40	5	0.054	-0.00625	0.04	0.042	1168.50	1166.00	46.0	4.68	0.087	5	0.47	0.87	0.0087
DA-104A	0.40	11	0.170	-0.00625	0.04	0.039	1166.00	1160.00	35.2	3.39	0.182	11	1.27	1.72	0.0067
DA-105A	1.00	8	0.154	-0.00625	0.04	0.038	1160.00	1150.00	64.8	3.84	0.135	8	1.82	6.99	0.0123
DA-106A	1.00	5	0.090	-0.00625	0.04	0.040	1154.00	1146.00	88.9	4.68	0.089	5	1.07	5.01	0.0168
DA-107A	0.40	9	0.066	-0.00625	0.04	0.043	1149.00	1148.00	15.1	3.68	0.150	9	0.34	0.51	0.0029
DA-3A	0.61	0	0.039	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DA-103A	0.60	0	0.039	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sarival Ave															
DA-201	0.95	10	0.063	-0.00625	0.04	0.042	1150.56	1149.95	9.6	3.56	0.170	10	0.43	1.46	0.0018
DA-202	0.83	15	0.199	-0.00625	0.04	0.039	1153.97	1149.76	21.2	2.94	0.243	15	1.36	3.33	0.0040
DA-203	0.56	11	0.097	-0.00625	0.04	0.038	1151.46	1150.22	12.8	3.39	0.183	11	2.39	4.51	0.0024
DA-204	0.55	7	0.077	-0.00625	0.04	0.041	1154.40	1151.61	36.2	4.04	0.116	7	0.78	1.75	0.0069
DA-301	0.95	11	0.121	-0.00625	0.04	0.041	1149.08	1146.30	22.9	3.39	0.180	11	0.60	1.92	0.0043
DA-301A	0.40	11	0.122	-0.00625	0.04	0.044	1147.00	1143.84	25.9	3.39	0.180	11	0.23	0.31	0.0049
DA-302	0.95	11	0.122	-0.00625	0.04	0.040	1148.90	1146.30	21.3	3.39	0.183	11	0.90	2.90	0.0040
DA-303	0.71	8	0.081	-0.00625	0.04	0.040	1143.84	1141.58	27.8	3.84	0.130	8	1.12	3.04	0.0053

Notes:

1) DA-3A & DA-103A are underneath the L303 bridge and do not contribute to DA-3 & DA-103.
2) DA's 101A, 101B, 101C,102A,103A & 301A calculated for ditch capacity only.
3) Drainage areas with curb and gutter use only the pavement area for calculations if landscape areas do not drain to the roadway. Landscape areas are used to calculate retention volumes and ditch flows, where applicable.

Project: TT0561 - Olive Avenue Widening
Location: Surprise, Arizona
Date: April 12, 2023
Subject: 50-Year Rational Flow Calculations

Proj. Number: 221892
Proj. Engineer: A.Herting
Checker: L.Vick

Source: Effective Maricopa County Drainage Policies and Standards Manual, 2016

Subbasin	C	Tc (min)	L (mi)	m	b	Kb	Elev Start	Elev End	S (ft/mi)	i (in/hr)	Tc (Calc) (hrs)	Tc (Calc) (min)	A (ac)	Q (cfs)	Slope (ft/ft)
Olive Ave Westbound Lanes															
DA-1	0.95	9	0.129	-0.00625	0.04	0.041	1178.95	1174.41	35.3	5.19	0.139	8	0.59	2.91	0.0067
DA-2	0.95	10	0.159	-0.00625	0.04	0.041	1174.41	1169.68	29.7	5.01	0.163	10	0.73	3.48	0.0056
DA-3	0.95	9	0.144	-0.00625	0.04	0.042	1169.68	1165.47	29.2	5.19	0.155	9	0.57	2.79	0.0055
DA-4	0.95	9	0.153	-0.00625	0.04	0.041	1165.47	1160.17	34.7	5.19	0.151	9	0.70	3.45	0.0066
DA-5	0.95	9	0.154	-0.00625	0.04	0.041	1160.17	1154.44	37.1	5.19	0.148	9	0.69	3.41	0.0070
DA-6	0.95	6	0.090	-0.00625	0.04	0.041	1154.44	1150.50	43.8	6.06	0.101	6	0.70	4.03	0.0083
DA-7	0.95	5	0.066	-0.00625	0.04	0.043	1149.66	1146.43	48.7	6.59	0.084	5	0.31	1.93	0.0092
Olive Ave Eastbound Lanes															
DA-101	0.95	8	0.129	-0.00625	0.04	0.041	1178.92	1174.49	34.4	5.40	0.137	8	0.59	3.01	0.0065
DA-102	0.95	10	0.159	-0.00625	0.04	0.041	1174.49	1169.68	30.2	5.01	0.162	10	0.74	3.53	0.0057
DA-103	0.95	10	0.144	-0.00625	0.04	0.042	1169.68	1166.17	24.4	5.01	0.167	10	0.48	2.30	0.0046
DA-104	0.95	10	0.170	-0.00625	0.04	0.041	1166.17	1160.20	35.0	5.01	0.160	10	0.79	3.74	0.0066
DA-105	0.95	9	0.154	-0.00625	0.04	0.041	1160.20	1154.43	37.4	5.19	0.148	9	0.68	3.37	0.0071
DA-106	0.95	6	0.090	-0.00625	0.04	0.041	1154.43	1150.28	46.1	6.06	0.100	6	0.59	3.42	0.0087
DA-107	0.95	6	0.066	-0.00625	0.04	0.043	1149.01	1147.16	27.9	6.06	0.103	6	0.29	1.67	0.0053
DA-101A	0.50	5	0.029	-0.00625	0.04	0.047	1179.00	1178.00	34.5	6.59	0.065	4	0.06	0.21	0.0065
DA-101B	0.50	13	0.159	-0.00625	0.04	0.039	1178.00	1176.00	12.6	4.42	0.219	13	1.24	2.73	0.0024
DA-101C	0.50	6	0.054	-0.00625	0.04	0.042	1176.00	1175.00	18.4	6.06	0.105	6	0.47	1.42	0.0035
DA-102A	0.50	6	0.054	-0.00625	0.04	0.042	1176.00	1175.00	18.4	6.06	0.105	6	0.47	1.42	0.0035
DA-103B	0.50	9	0.170	-0.00625	0.04	0.039	1175.00	1168.70	37.0	5.19	0.153	9	1.27	3.29	0.0070
DA-104A	0.50	11	0.154	-0.00625	0.04	0.038	1168.50	1166.00	16.2	4.78	0.191	11	1.82	4.35	0.0031
DA-105A	1.00	5	0.090	-0.00625	0.04	0.040	1166.00	1160.00	66.7	6.59	0.085	5	1.07	7.06	0.0126
DA-106A	1.00	5	0.066	-0.00625	0.04	0.043	1160.00	1150.00	150.9	6.59	0.059	4	0.34	2.26	0.0286
DA-107A	0.50	5	0.039	-0.00625	0.04	0.042	1154.00	1146.00	205.0	6.59	0.040	2	0.55	1.80	0.0388
DA-3A	0.67	0	0.039	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DA-103A	0.66	0	0.039	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sarival Ave															
DA-201	0.95	9	0.063	-0.00625	0.04	0.042	1150.56	1149.95	9.6	5.19	0.147	9	0.43	2.12	0.0018
DA-202	0.85	12	0.199	-0.00625	0.04	0.039	1153.97	1149.76	21.2	4.59	0.205	12	1.36	5.33	0.0040
DA-203	0.63	9	0.097	-0.00625	0.04	0.038	1151.46	1150.22	12.8	5.19	0.156	9	2.39	7.79	0.0024
DA-204	0.63	6	0.077	-0.00625	0.04	0.041	1154.40	1151.61	36.2	6.06	0.099	6	0.78	2.96	0.0069
DA-301	0.95	9	0.121	-0.00625	0.04	0.041	1149.08	1146.30	22.9	5.19	0.154	9	0.60	2.94	0.0043
DA-301A	0.50	9	0.122	-0.00625	0.04	0.044	1147.00	1143.84	25.9	5.19	0.153	9	0.23	0.60	0.0049
DA-302	0.95	9	0.122	-0.00625	0.04	0.040	1148.90	1146.30	21.3	5.19	0.156	9	0.90	4.43	0.0040
DA-303	0.75	7	0.081	-0.00625	0.04	0.040	1143.84	1141.58	27.8	5.69	0.112	7	1.12	4.79	0.0053

Notes:
1) DA-3A & DA-103A are underneath the L303 bridge and do not contribute to DA-3 & DA-103.
2) DA-301A calculated for ditch capacity only.
3) Drainage areas with curb and gutter use only the pavement area for calculations if landscape areas do not drain to the roadway. Landscape areas are used to calculate retention volumes and ditch flows, where applicable.

Project: TT0561 - Olive Avenue Widening
Location: Surprise, Arizona
Date: April 12, 2023
Subject: 100-Year Rational Flow Calculations

Proj. Number: 221892
Proj. Engineer: A.Herting
Checker: L.Vick

Source: Effective Maricopa County Drainage Policies and Standards Manual, 2016

Subbasin	C	Tc (min)	L (mi)	m	b	Kb	Elev Start	Elev End	S (ft/mi)	i (in/hr)	Tc (Calc) (hrs)	Tc (Calc) (min)	A (ac)	Q (cfs)	Slope (ft/ft)
Olive Ave Westbound Lanes															
DA-1	0.95	8	0.129	-0.00625	0.04	0.041	1178.95	1174.41	35.3	6.12	0.130	8	0.59	3.43	0.0067
DA-2	0.95	9	0.159	-0.00625	0.04	0.041	1174.41	1169.68	29.7	5.87	0.154	9	0.73	4.08	0.0056
DA-3	0.95	9	0.144	-0.00625	0.04	0.042	1169.68	1165.47	29.2	5.87	0.148	9	0.57	3.16	0.0055
DA-4	0.95	9	0.153	-0.00625	0.04	0.041	1165.47	1160.17	34.7	5.87	0.144	9	0.70	3.91	0.0066
DA-5	0.95	8	0.154	-0.00625	0.04	0.041	1160.17	1154.44	37.1	6.12	0.139	8	0.69	4.02	0.0070
DA-6	0.95	6	0.090	-0.00625	0.04	0.041	1154.44	1150.50	43.8	6.86	0.097	6	0.70	4.55	0.0083
DA-7	0.95	5	0.066	-0.00625	0.04	0.043	1149.66	1146.43	48.7	7.45	0.080	5	0.31	2.19	0.0092
Olive Ave Eastbound Lanes															
DA-101	0.95	8	0.129	-0.00625	0.04	0.041	1178.92	1174.49	34.4	6.12	0.131	8	0.59	3.41	0.0065
DA-102	0.95	9	0.159	-0.00625	0.04	0.041	1174.49	1169.68	30.2	5.87	0.153	9	0.74	4.14	0.0057
DA-103	0.95	9	0.144	-0.00625	0.04	0.042	1169.68	1166.17	24.4	5.87	0.158	9	0.48	2.69	0.0046
DA-104	0.95	9	0.170	-0.00625	0.04	0.041	1166.17	1160.20	35.0	5.87	0.151	9	0.79	4.38	0.0066
DA-105	0.95	8	0.154	-0.00625	0.04	0.041	1160.20	1154.43	37.4	6.12	0.139	8	0.68	3.97	0.0071
DA-106	0.95	6	0.090	-0.00625	0.04	0.041	1154.43	1150.28	46.1	6.86	0.096	6	0.59	3.87	0.0087
DA-107	0.95	6	0.066	-0.00625	0.04	0.043	1149.01	1147.16	27.9	6.86	0.098	6	0.29	1.89	0.0053
DA-101A	0.50	5	0.029	-0.00625	0.04	0.047	1179.00	1178.00	34.5	7.45	0.062	4	0.06	0.24	0.0065
DA-101B	0.50	13	0.159	-0.00625	0.04	0.039	1178.00	1176.00	12.6	4.98	0.210	13	1.24	3.08	0.0024
DA-101C	0.50	6	0.054	-0.00625	0.04	0.042	1176.00	1175.00	18.4	6.86	0.100	6	0.47	1.60	0.0035
DA-102A	0.50	5	0.054	-0.00625	0.04	0.042	1175.00	1168.70	115.9	7.45	0.055	3	0.47	1.74	0.0220
DA-103B	0.50	12	0.170	-0.00625	0.04	0.039	1168.50	1166.00	14.7	5.18	0.204	12	1.27	3.28	0.0028
DA-104A	0.50	8	0.154	-0.00625	0.04	0.038	1166.00	1160.00	38.9	6.12	0.133	8	1.82	5.57	0.0074
DA-105A	1.00	5	0.090	-0.00625	0.04	0.040	1160.00	1150.00	111.2	7.45	0.069	4	1.07	7.98	0.0211
DA-106A	1.00	5	0.066	-0.00625	0.04	0.043	1154.00	1146.00	120.7	7.45	0.060	4	0.34	2.56	0.0229
DA-107A	0.50	5	0.039	-0.00625	0.04	0.042	1149.00	1148.00	25.6	7.45	0.074	4	0.55	2.03	0.0049
DA-3A	0.67	0	0.039	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DA-103A	0.66	0	0.039	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sarival Ave															
DA-201	0.95	8	0.063	-0.00625	0.04	0.042	1150.56	1149.95	9.6	6.12	0.138	8	0.43	2.50	0.0018
DA-202	0.85	12	0.199	-0.00625	0.04	0.039	1153.97	1149.76	21.2	5.18	0.196	12	1.36	6.01	0.0040
DA-203	0.63	9	0.097	-0.00625	0.04	0.038	1151.46	1150.22	12.8	5.87	0.149	9	2.39	8.81	0.0024
DA-204	0.63	6	0.077	-0.00625	0.04	0.041	1154.40	1151.61	36.2	6.86	0.095	6	0.78	3.35	0.0069
DA-301	0.95	9	0.121	-0.00625	0.04	0.041	1149.08	1146.30	22.9	5.87	0.146	9	0.60	3.33	0.0043
DA-301A	0.50	9	0.122	-0.00625	0.04	0.044	1147.00	1143.84	25.9	5.87	0.146	9	0.23	0.68	0.0049
DA-302	0.95	9	0.122	-0.00625	0.04	0.040	1148.90	1146.30	21.3	5.87	0.148	9	0.90	5.02	0.0040
DA-303	0.75	6	0.081	-0.00625	0.04	0.040	1143.84	1141.58	27.8	6.86	0.104	6	1.12	5.77	0.0053

Notes:

1) DA-3A & DA-103A are underneath the L303 bridge and do not contribute to DA-3 & DA-103.
2) DA-301A calculated for ditch capacity only.
3) Drainage areas with curb and gutter use only the pavement area for calculations if landscape areas do not drain to the roadway. Landscape areas are used to calculate retention volumes and ditch flows, where applicable.

Project: TT0561 - Olive Avenue Widening
Location: Surprise, Arizona
Date: April 12, 2023
Subject: Rational C-Value Calculations

Proj. Number: 221892
Proj. Engineer: A.Herting
Checker: L.Vick

Source: Effective Maricopa County Drainage Policies and Standards Manual, 2016

Subbasin	Total Area	Length (ft)	Landscaping Area	10-year C-Value	100-year C-Value	Pavement and Sidewalk Area	10-Year C -Value	10-Year Weighted C-Value	100-Year Weighted C-Value
	(sf)		(sf)			(sf)			
Olive Ave Westbound Lanes									
DA-1	77,874	680.0	52,136.0	0.40	0.50	25,738.0	0.95	0.58	0.65
DA-2	98,076	840.0	66,191.0	0.40	0.50	31,885.0	0.95	0.58	0.65
DA-3	76,420	760.0	51,737.0	0.40	0.50	24,683.0	0.95	0.58	0.65
DA-4	84,406	806.0	53,855.0	0.40	0.50	30,551.0	0.95	0.60	0.66
DA-5	50,903	815.0	20,727.0	0.40	0.50	30,176.0	0.95	0.73	0.77
DA-6	41,076	475.0	10,625.0	0.40	0.50	30,451.0	0.95	0.81	0.83
DA-7	17,827	350.0	4,377.0	0.40	0.50	13,450.0	0.95	0.81	0.84
Olive Ave Eastbound Lanes									
DA-101	25,530	680.0	0.0	0.40	0.50	25,530.0	0.95	0.95	0.95
DA-102	32,331	840.0	0.0	0.40	0.50	32,331.0	0.95	0.95	0.95
DA-103	21,047	760.0	0.0	0.40	0.50	21,047.0	0.95	0.95	0.95
DA-104	34,234	900.0	0.0	0.40	0.50	34,234.0	0.95	0.95	0.95
DA-105	29,786	815.0	0.0	0.40	0.50	29,786.0	0.95	0.95	0.95
DA-106	25,858	475.0	0.0	0.40	0.50	25,858.0	0.95	0.95	0.95
DA-107	12,662	350.0	0.0	0.40	0.50	12,662.0	0.95	0.95	0.95
DA-101A	2,805	153.0	2,805.0	0.40	0.50	0.0	0.95	0.40	0.50
DA-101B	5,871	336.0	5,871.0	0.40	0.50	0.0	0.95	0.40	0.50
DA-101C	2,203	129.0	2,203.0	0.40	0.50	0.0	0.95	0.40	0.50
DA-102A	53,836	840.0	53,836.0	0.40	0.50	0.0	0.95	0.40	0.50
DA-103B	20,340	287.0	20,340.0	0.40	0.50	0.0	0.95	0.40	0.50
DA-104A	55,251	900.0	55,251.0	0.40	0.50	0.0	0.95	0.40	0.50
DA-105A	79,331	815.0	79,331.0	1.00	1.00	0.0	0.95	1.00	1.00
DA-106A	46,658	475.0	46,658.0	1.00	1.00	0.0	0.95	1.00	1.00
DA-107A	14,939	350.0	14,939.0	0.40	0.50	0.0	0.95	0.40	0.50
DA-3A	23,776	206.0	14,710.0	0.40	0.50	9,066.0	0.95	0.61	0.67
DA-103A	21,420	206.0	13,580.0	0.40	0.50	7,840.0	0.95	0.60	0.66
Sarival Ave									
DA-201	18,768	335.0	0.0	0.40	0.50	18,768.0	0.95	0.95	0.95
DA-202	59,322	1,050.0	12,803.0	0.40	0.50	46,519.0	0.95	0.83	0.85
DA-203	103,996	510.0	74,148.0	0.40	0.50	29,848.0	0.95	0.56	0.63
DA-204	34,030	407.0	24,497.0	0.40	0.50	9,533.0	0.95	0.55	0.63
DA-301	36,094	640.0	10,064.0	0.40	0.50	26,030.0	0.95	0.80	0.82
DA-301A	10,064.0	640.0	10,064.0	0.40	0.50	0.0	0.95	0.40	0.50
DA-302	67,590	645.0	28,373.0	0.40	0.50	39,217.0	0.95	0.72	0.76
DA-303	48,807	430.0	21,529.0	0.40	0.50	27,278.0	0.95	0.71	0.75

Notes:

1) DA-3A & DA-103A are underneath the L303 bridge and do not contribute to DA-3 & DA-103.

Project: TT0561 - Olive Avenue Widening - Sarival to Reems Road
Location: Surprise, Arizona
Date: April 26, 2023
Subject: 10-Year Rational Flow Calculations

Source: Effective Maricopa County Drainage Policies and Standards Manual, 2016

Subbasin	C	Tc (min)	L (mi)	m	b	Kb	Elev Start	Elev End	S (ft/mi)	i (in/hr)	Tc (Calc) (hrs)	Tc (Calc) (min)	A (ac)	Q (cfs)	Slope (ft/ft)
Olive Ave - End of TT0561 To Reems Rd															
DA-1A	0.95	12	0.163	-0.00625	0.04	0.041	1147.87	1143.55	26.5	3.25	0.202	12	0.72	2.22	0.0050
DA-2A	0.95	11	0.158	-0.00625	0.04	0.041	1144.33	1139.05	33.4	3.39	0.182	11	0.70	2.25	0.0063
DA-3A	0.95	13	0.158	-0.00625	0.04	0.041	1138.80	1135.18	22.9	3.13	0.212	13	0.70	2.07	0.0043
DA-4A	0.95	12	0.158	-0.00625	0.04	0.041	1135.94	1131.94	25.3	3.25	0.202	12	0.71	2.20	0.0048
DA-5A	0.95	11	0.159	-0.00625	0.04	0.041	1132.74	1127.91	30.4	3.39	0.187	11	0.78	2.51	0.0058
DA-6A	0.95	8	0.088	-0.00625	0.04	0.042	1128.78	1125.78	34.0	3.84	0.130	8	0.55	2.00	0.0064
DA-101A	0.95	12	0.162	-0.00625	0.04	0.041	1147.87	1143.55	26.6	3.25	0.201	12	0.71	2.20	0.0050
DA-102A	0.95	11	0.158	-0.00625	0.04	0.041	1144.33	1139.05	33.3	3.39	0.183	11	0.70	2.25	0.0063
DA-103A	0.95	13	0.158	-0.00625	0.04	0.041	1138.80	1135.18	22.9	3.13	0.212	13	0.71	2.12	0.0043
DA-104A	0.95	12	0.158	-0.00625	0.04	0.041	1135.94	1131.97	25.1	3.25	0.203	12	0.70	2.17	0.0047
DA-105A	0.95	11	0.158	-0.00625	0.04	0.041	1132.74	1127.94	30.3	3.39	0.188	11	0.75	2.43	0.0057
DA-106A	0.95	8	0.088	-0.00625	0.04	0.041	1128.78	1125.78	34.1	3.84	0.129	8	0.62	2.27	0.0065
Olive Ave - Reems Rd To End of TT0562															
DA-7A	0.95	10	0.109	-0.00625	0.04	0.041	1126.46	1123.86	23.7	3.56	0.165	10	0.81	2.73	0.0045
DA-107A	0.95	10	0.104	-0.00625	0.04	0.042	1126.26	1123.84	23.2	3.56	0.165	10	0.45	1.53	0.0044
Reems Rd															
DA-201A	0.95	10	0.125	-0.00625	0.04	0.042	1129.15	1125.82	26.7	3.56	0.172	10	0.53	1.80	0.0050
DA-202A	0.95	11	0.125	-0.00625	0.04	0.042	1129.15	1125.89	26.0	3.39	0.179	11	0.41	1.34	0.0049
DA-203A	0.95	6	0.066	-0.00625	0.04	0.044	1126.26	1122.89	50.9	4.31	0.098	6	0.25	1.00	0.0096
DA-204A	0.95	6	0.064	-0.00625	0.04	0.043	1126.26	1122.98	51.5	4.31	0.095	6	0.30	1.23	0.0098

Project: TT0561 - Olive Avenue Widening - Sarival to Reems Road
Location: Surprise, Arizona
Date: April 26, 2023
Subject: 50-Year Rational Flow Calculations
Source: Effective Maricopa County Drainage Policies and Standards Manual, 2016

Subbasin	C	Tc (min)	L (mi)	m	b	Kb	Elev Start	Elev End	S (ft/mi)	i (in/hr)	Tc (Calc) (hrs)	Tc (Calc) (min)	A (ft)	A (ac)	Q (cfs)	Slope (ft/ft)
Olive Ave Westbound Lanes																
DA-1A	0.95	10	0.163	-0.00625	0.04	0.041	1147.87	1143.55	26.5	5.01	0.172	10	31297	0.72	3.42	0.0050
DA-2A	0.95	9	0.158	-0.00625	0.04	0.041	1144.33	1139.05	33.4	5.19	0.155	9	30400	0.70	3.44	0.0063
DA-3A	0.95	11	0.158	-0.00625	0.04	0.041	1138.80	1135.18	22.9	4.78	0.180	11	30390	0.70	3.17	0.0043
DA-4A	0.95	10	0.158	-0.00625	0.04	0.041	1135.94	1131.94	25.3	5.01	0.171	10	31064	0.71	3.39	0.0048
DA-5A	0.95	10	0.159	-0.00625	0.04	0.041	1132.74	1127.91	30.4	5.01	0.162	10	33898	0.78	3.70	0.0058
DA-6A	0.95	7	0.088	-0.00625	0.04	0.042	1128.78	1125.78	34.0	5.69	0.112	7	23938	0.55	2.97	0.0064
DA-7A	0.95	9	0.109	-0.00625	0.04	0.041	1126.46	1123.86	23.7	5.19	0.143	9	35227	0.81	3.98	0.0045
DA-8A	0.95	18	0.271	-0.00625	0.04	0.041	1124.39	1120.40	14.7	3.71	0.297	18	30578	0.70	2.47	0.0028
Olive Ave Eastbound Lanes																
DA-101A	0.95	10	0.162	-0.00625	0.04	0.041	1147.87	1143.55	26.6	5.01	0.171	10	31040	0.71	3.39	0.0050
DA-102A	0.95	9	0.158	-0.00625	0.04	0.041	1144.33	1139.05	33.3	5.19	0.155	9	30400	0.70	3.44	0.0063
DA-103A	0.95	11	0.158	-0.00625	0.04	0.041	1138.80	1135.18	22.9	4.78	0.180	11	31109	0.71	3.24	0.0043
DA-104A	0.95	11	0.158	-0.00625	0.04	0.041	1135.94	1131.97	25.1	4.78	0.175	11	30654	0.70	3.19	0.0047
DA-105A	0.95	10	0.158	-0.00625	0.04	0.041	1132.74	1127.94	30.3	5.01	0.162	10	32849	0.75	3.59	0.0057
DA-106A	0.95	7	0.088	-0.00625	0.04	0.041	1128.78	1125.78	34.1	5.69	0.111	7	27080	0.62	3.36	0.0065
Reems Rd																
DA-201A	0.95	9	0.125	-0.00625	0.04	0.042	1129.15	1125.82	26.7	5.19	0.149	9	23227	0.53	2.63	0.0050
DA-202A	0.95	9	0.125	-0.00625	0.04	0.042	1129.15	1125.89	26.0	5.19	0.152	9	18070	0.41	2.04	0.0049
DA-203A	0.95	5	0.066	-0.00625	0.04	0.044	1126.26	1122.89	50.9	6.59	0.083	5	10680	0.25	1.53	0.0096
DA-204A	0.95	5	0.064	-0.00625	0.04	0.043	1126.26	1122.98	51.5	6.59	0.081	5	13118	0.30	1.88	0.0098

Project: TT0561 - Olive Avenue Widening - Sarival to Reems Road
Location: Surprise, Arizona
Date: April 26, 2023
Subject: 100-Year Rational Flow Calculations
Source: Effective Maricopa County Drainage Policies and Standards Manual, 2016

Subbasin	C	Tc (min)	L (ft)	L (mi)	m	b	Kb	Elev Start	Elev End	S (ft/mi)	i (in/hr)	Tc (Calc) (hrs)	Tc (Calc) (min)	A (ac)	Q (cfs)	Slope (ft/ft)
Olive Ave Westbound Lanes																
DA-1A	0.95	10	862.2	0.163	-0.00625	0.04	0.041	1147.87	1143.55	26.5	5.67	0.164	10	0.72	3.87	0.0050
DA-2A	0.95	9	834.2	0.158	-0.00625	0.04	0.041	1144.33	1139.05	33.4	5.87	0.148	9	0.70	3.89	0.0063
DA-3A	0.95	10	836.0	0.158	-0.00625	0.04	0.041	1138.80	1135.18	22.9	5.67	0.169	10	0.70	3.76	0.0043
DA-4A	0.95	10	836.2	0.158	-0.00625	0.04	0.041	1135.94	1131.94	25.3	5.67	0.164	10	0.71	3.84	0.0048
DA-5A	0.95	9	837.7	0.159	-0.00625	0.04	0.041	1132.74	1127.91	30.4	5.87	0.152	9	0.78	4.34	0.0058
DA-6A	0.95	6	466.4	0.088	-0.00625	0.04	0.042	1128.78	1125.78	34.0	6.86	0.105	6	0.55	3.58	0.0064
DA-7A	0.95	8	578.1	0.109	-0.00625	0.04	0.041	1126.46	1123.86	23.7	6.12	0.134	8	0.81	4.70	0.0045
DA-8A	0.95	16	1430.0	0.271	-0.00625	0.04	0.041	1124.39	1120.40	14.7	4.49	0.276	17	0.70	2.99	0.0028
Olive Ave Eastbound Lanes																
DA-101A	0.95	10	856.4	0.162	-0.00625	0.04	0.041	1147.87	1143.55	26.6	5.67	0.163	10	0.71	3.84	0.0050
DA-102A	0.95	9	836.2	0.158	-0.00625	0.04	0.041	1144.33	1139.05	33.3	5.87	0.148	9	0.70	3.89	0.0063
DA-103A	0.95	10	836.5	0.158	-0.00625	0.04	0.041	1138.80	1135.18	22.9	5.67	0.169	10	0.71	3.85	0.0043
DA-104A	0.95	10	835.9	0.158	-0.00625	0.04	0.041	1135.94	1131.97	25.1	5.67	0.164	10	0.70	3.79	0.0047
DA-105A	0.95	9	836.3	0.158	-0.00625	0.04	0.041	1132.74	1127.94	30.3	5.87	0.152	9	0.75	4.20	0.0057
DA-106A	0.95	6	463.9	0.088	-0.00625	0.04	0.041	1128.78	1125.78	34.1	6.86	0.104	6	0.62	4.05	0.0065
Reems Rd																
DA-201A	0.95	8	659.7	0.125	-0.00625	0.04	0.042	1129.15	1125.82	26.7	6.12	0.140	8	0.53	3.10	0.0050
DA-202A	0.95	9	661.7	0.125	-0.00625	0.04	0.042	1129.15	1125.89	26.0	5.87	0.145	9	0.41	2.31	0.0049
DA-203A	0.95	5	349.3	0.066	-0.00625	0.04	0.044	1126.26	1122.89	50.9	7.45	0.079	5	0.25	1.74	0.0096
DA-204A	0.95	5	336.2	0.064	-0.00625	0.04	0.043	1126.26	1122.98	51.5	7.45	0.077	5	0.30	2.13	0.0098

Project: TT0561 - Olive Avenue Widening - Sarival to Reems Road
Location: Surprise, Arizona
Date: April 26, 2023
Subject: Rational C-Value Calculations
Source: Effective Maricopa County Drainage Policies and Standards Manual, 2016

Subbasin	Total Area	Length (ft)	Landscaping Area	10-year C-Value	100-year C-Value	Pavement and Sidewalk Area	10-Year, 100-Year C -Value	10-Year Weighted C-Value	100-Year Weighted C-Value
	(sf)		(sf)			(sf)			
Olive Ave - End of TT0561 To Reems Rd									
DA-1A	31297	862	0.0	0.40	0.50	31,297	0.95	0.95	0.95
DA-2A	30400	834	0.0	0.40	0.50	30,400	0.95	0.95	0.95
DA-3A	30390	836	0.0	0.40	0.50	30,390	0.95	0.95	0.95
DA-4A	31064	836	0.0	0.40	0.50	31,064	0.95	0.95	0.95
DA-5A	33898	838	0.0	0.40	0.50	33,898	0.95	0.95	0.95
DA-6A	23938	466	0.0	0.40	0.50	23,938	0.95	0.95	0.95
DA-101A	31040	856	0.0	0.40	0.50	31,040	0.95	0.95	0.95
DA-102A	30400	836	0.0	0.40	0.50	30,400	0.95	0.95	0.95
DA-103A	31109	836	0.0	0.40	0.50	31,109	0.95	0.95	0.95
DA-104A	30654	836	0.0	0.40	0.50	30,654	0.95	0.95	0.95
DA-105A	32849	836	0.0	0.40	0.50	32,849	0.95	0.95	0.95
DA-106A	27080	464	0.0	0.40	0.50	27,080	0.95	0.95	0.95
Olive Ave - Reems Rd To End of TT0562									
DA-7A	35227	578	0.0	0.40	0.50	35,227	0.95	0.95	0.95
DA-107A	19658	550	0.0	0.40	0.50	19,658	0.95	0.95	0.95
Reems Rd									
DA-201A	23227	660	0.0	0.40	0.50	23,227	0.95	0.95	0.95
DA-202A	18070	662	0.0	0.40	0.50	18,070	0.95	0.95	0.95
DA-203A	10680	349	0.0	0.40	0.50	10,680	0.95	0.95	0.95
DA-204A	13118	336	0.0	0.40	0.50	13,118	0.95	0.95	0.95

NOAA Atlas 14, Volume 1, Version 5
Location name: Waddell, Arizona, USA*
Latitude: 33.5664°, Longitude: -112.4145°
Elevation: 1171.87 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.183 (0.148-0.230)	0.238 (0.194-0.299)	0.323 (0.261-0.405)	0.390 (0.313-0.486)	0.479 (0.381-0.596)	0.549 (0.429-0.679)	0.621 (0.477-0.767)	0.695 (0.525-0.860)	0.794 (0.584-0.983)	0.868 (0.626-1.07)
10-min	0.278 (0.225-0.349)	0.361 (0.294-0.455)	0.492 (0.398-0.616)	0.593 (0.477-0.739)	0.729 (0.580-0.907)	0.835 (0.654-1.03)	0.945 (0.726-1.17)	1.06 (0.799-1.31)	1.21 (0.889-1.50)	1.32 (0.953-1.64)
15-min	0.344 (0.279-0.433)	0.448 (0.365-0.564)	0.610 (0.493-0.764)	0.735 (0.591-0.916)	0.905 (0.718-1.13)	1.04 (0.810-1.28)	1.17 (0.900-1.45)	1.31 (0.990-1.62)	1.50 (1.10-1.85)	1.64 (1.18-2.03)
30-min	0.464 (0.376-0.583)	0.603 (0.491-0.760)	0.821 (0.664-1.03)	0.990 (0.795-1.23)	1.22 (0.968-1.51)	1.40 (1.09-1.73)	1.58 (1.21-1.95)	1.77 (1.33-2.18)	2.02 (1.49-2.50)	2.21 (1.59-2.73)
60-min	0.574 (0.465-0.721)	0.746 (0.608-0.940)	1.02 (0.822-1.27)	1.23 (0.984-1.53)	1.51 (1.20-1.87)	1.73 (1.35-2.14)	1.95 (1.50-2.41)	2.19 (1.65-2.70)	2.50 (1.84-3.09)	2.73 (1.97-3.38)
2-hr	0.657 (0.544-0.807)	0.846 (0.700-1.04)	1.14 (0.936-1.40)	1.36 (1.11-1.66)	1.66 (1.34-2.03)	1.90 (1.51-2.31)	2.14 (1.67-2.60)	2.39 (1.83-2.89)	2.73 (2.05-3.31)	3.00 (2.19-3.64)
3-hr	0.688 (0.567-0.850)	0.879 (0.730-1.09)	1.16 (0.961-1.44)	1.39 (1.14-1.71)	1.70 (1.37-2.07)	1.95 (1.55-2.37)	2.21 (1.73-2.69)	2.50 (1.91-3.03)	2.89 (2.15-3.51)	3.21 (2.32-3.91)
6-hr	0.791 (0.674-0.954)	1.00 (0.856-1.21)	1.29 (1.10-1.55)	1.53 (1.28-1.83)	1.85 (1.53-2.20)	2.10 (1.71-2.49)	2.36 (1.89-2.81)	2.64 (2.07-3.14)	3.03 (2.31-3.60)	3.34 (2.49-3.98)
12-hr	0.892 (0.769-1.05)	1.12 (0.969-1.32)	1.43 (1.23-1.68)	1.67 (1.42-1.95)	1.99 (1.68-2.32)	2.24 (1.86-2.60)	2.49 (2.05-2.91)	2.75 (2.23-3.22)	3.12 (2.45-3.65)	3.40 (2.63-4.02)
24-hr	1.16 (1.02-1.31)	1.47 (1.30-1.66)	1.90 (1.68-2.15)	2.24 (1.97-2.52)	2.71 (2.37-3.04)	3.08 (2.68-3.45)	3.47 (2.99-3.88)	3.88 (3.31-4.33)	4.43 (3.75-4.96)	4.86 (4.08-5.46)
2-day	1.23 (1.07-1.41)	1.57 (1.37-1.79)	2.05 (1.79-2.34)	2.44 (2.12-2.78)	2.97 (2.57-3.39)	3.40 (2.93-3.86)	3.85 (3.29-4.36)	4.31 (3.67-4.89)	4.96 (4.16-5.64)	5.48 (4.55-6.26)
3-day	1.32 (1.16-1.51)	1.69 (1.48-1.93)	2.21 (1.94-2.53)	2.64 (2.31-3.01)	3.24 (2.81-3.68)	3.72 (3.21-4.22)	4.22 (3.63-4.79)	4.75 (4.05-5.39)	5.50 (4.63-6.25)	6.10 (5.09-6.96)
4-day	1.41 (1.25-1.62)	1.80 (1.59-2.06)	2.38 (2.09-2.71)	2.84 (2.50-3.24)	3.50 (3.06-3.98)	4.03 (3.50-4.57)	4.60 (3.96-5.21)	5.20 (4.44-5.88)	6.04 (5.11-6.85)	6.73 (5.63-7.65)
7-day	1.56 (1.38-1.80)	2.00 (1.76-2.30)	2.64 (2.32-3.02)	3.16 (2.77-3.61)	3.89 (3.39-4.43)	4.48 (3.88-5.09)	5.10 (4.39-5.79)	5.76 (4.92-6.54)	6.70 (5.65-7.61)	7.45 (6.22-8.48)
10-day	1.71 (1.51-1.95)	2.18 (1.93-2.50)	2.88 (2.54-3.29)	3.44 (3.02-3.92)	4.22 (3.69-4.79)	4.85 (4.21-5.50)	5.51 (4.75-6.24)	6.21 (5.32-7.03)	7.19 (6.09-8.15)	7.98 (6.69-9.06)
20-day	2.03 (1.80-2.29)	2.61 (2.32-2.95)	3.44 (3.05-3.88)	4.07 (3.60-4.58)	4.92 (4.33-5.52)	5.57 (4.88-6.24)	6.22 (5.44-6.99)	6.90 (6.00-7.73)	7.79 (6.73-8.75)	8.48 (7.28-9.56)
30-day	2.36 (2.08-2.68)	3.03 (2.67-3.44)	3.99 (3.51-4.52)	4.72 (4.14-5.34)	5.69 (4.97-6.43)	6.45 (5.61-7.27)	7.21 (6.25-8.14)	7.99 (6.89-9.03)	9.03 (7.72-10.2)	9.83 (8.35-11.2)
45-day	2.77 (2.46-3.13)	3.57 (3.16-4.03)	4.69 (4.15-5.29)	5.53 (4.88-6.22)	6.62 (5.82-7.45)	7.44 (6.52-8.38)	8.27 (7.21-9.31)	9.09 (7.89-10.2)	10.2 (8.78-11.5)	11.0 (9.43-12.4)
60-day	3.04 (2.71-3.42)	3.93 (3.50-4.41)	5.16 (4.58-5.78)	6.05 (5.36-6.78)	7.21 (6.38-8.07)	8.07 (7.12-9.04)	8.93 (7.84-10.0)	9.77 (8.54-11.0)	10.9 (9.44-12.2)	11.7 (10.1-13.2)

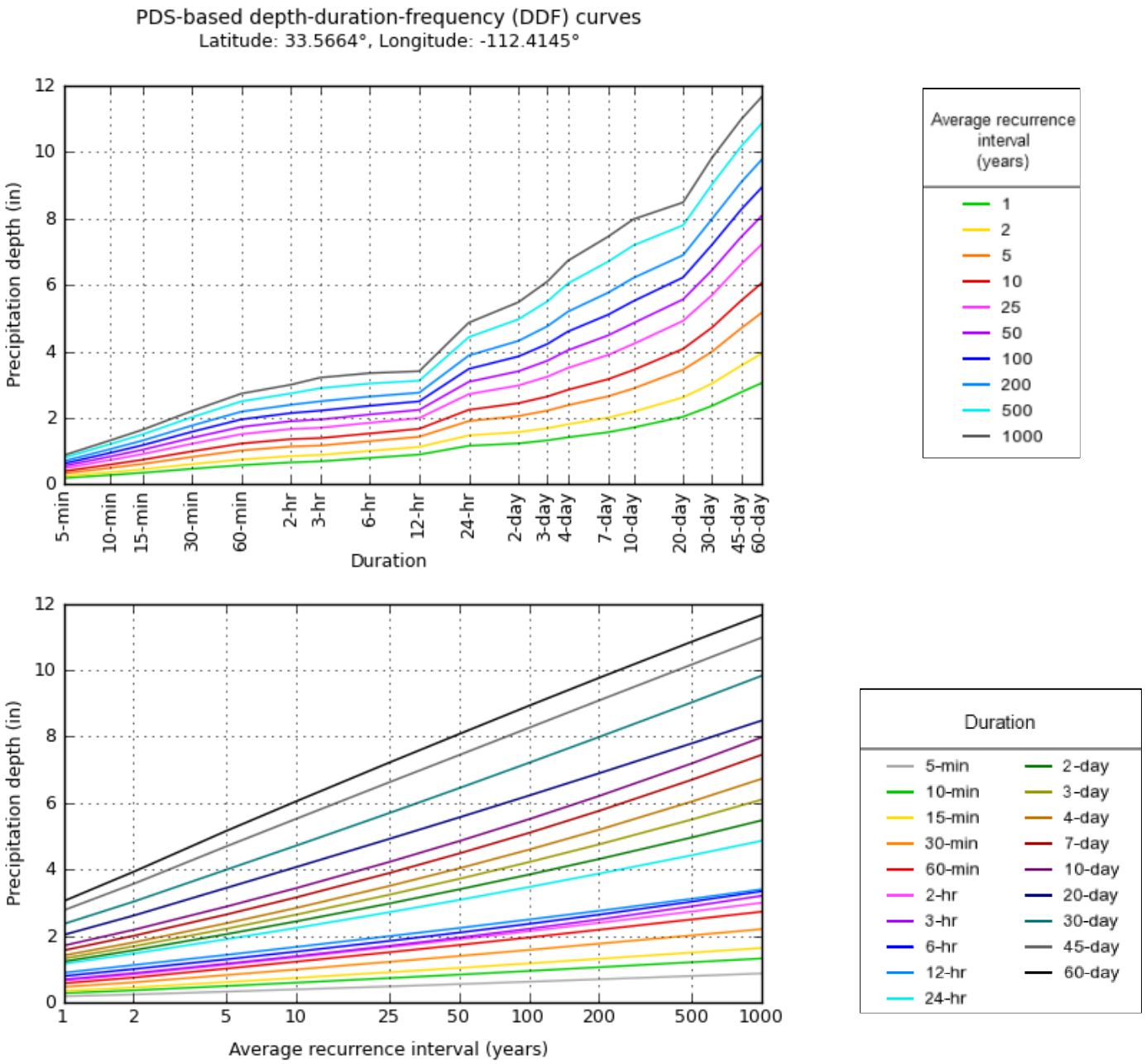
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



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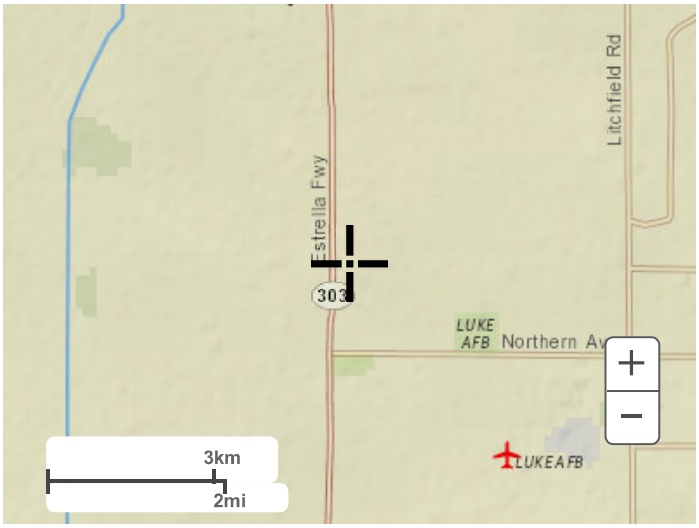
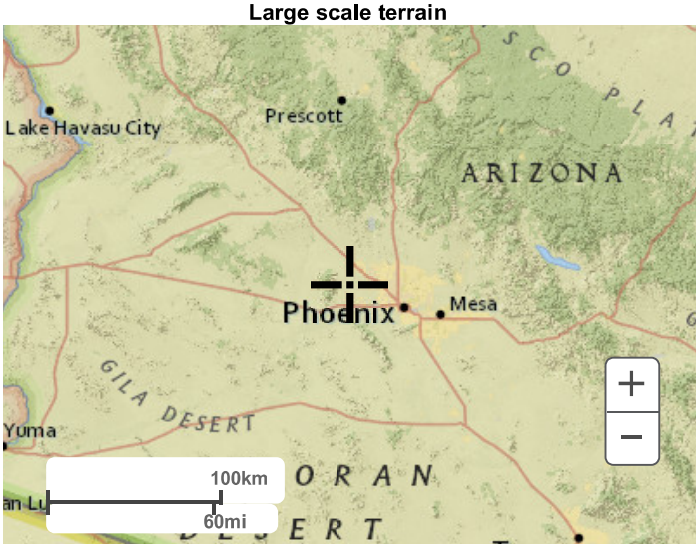
Back to Top

Maps & aerials

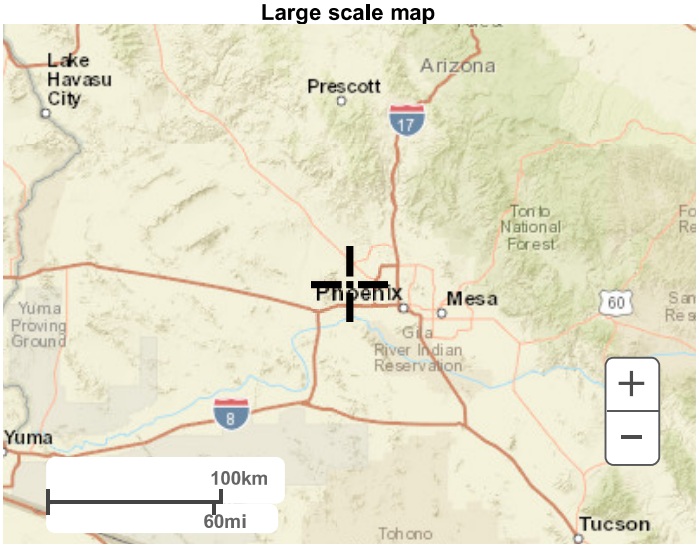
Small scale terrain



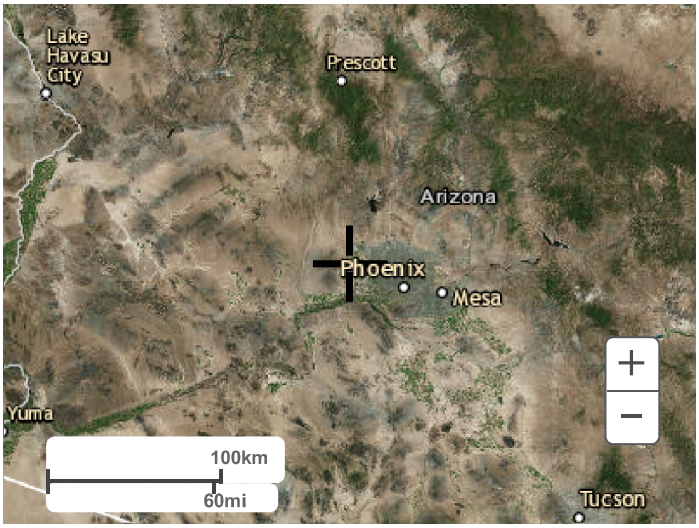
Large scale terrain



Large scale map



Large scale aerial



Back to Top

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NOAA Atlas 14, Volume 1, Version 5
Location name: Waddell, Arizona, USA*
Latitude: 33.5664°, Longitude: -112.4145°
Elevation: 1171.87 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.20 (1.78-2.76)	2.86 (2.33-3.59)	3.88 (3.13-4.86)	4.68 (3.76-5.83)	5.75 (4.57-7.15)	6.59 (5.15-8.15)	7.45 (5.72-9.20)	8.34 (6.30-10.3)	9.53 (7.01-11.8)	10.4 (7.51-12.9)
10-min	1.67 (1.35-2.09)	2.17 (1.76-2.73)	2.95 (2.39-3.70)	3.56 (2.86-4.43)	4.37 (3.48-5.44)	5.01 (3.92-6.20)	5.67 (4.36-7.01)	6.35 (4.79-7.85)	7.25 (5.33-8.98)	7.93 (5.72-9.82)
15-min	1.38 (1.12-1.73)	1.79 (1.46-2.26)	2.44 (1.97-3.06)	2.94 (2.36-3.66)	3.62 (2.87-4.50)	4.14 (3.24-5.13)	4.69 (3.60-5.79)	5.25 (3.96-6.49)	5.99 (4.41-7.42)	6.55 (4.73-8.12)
30-min	0.928 (0.752-1.17)	1.21 (0.982-1.52)	1.64 (1.33-2.06)	1.98 (1.59-2.47)	2.44 (1.94-3.03)	2.79 (2.18-3.45)	3.16 (2.42-3.90)	3.53 (2.67-4.37)	4.03 (2.97-4.99)	4.41 (3.18-5.47)
60-min	0.574 (0.465-0.721)	0.746 (0.608-0.940)	1.02 (0.822-1.27)	1.23 (0.984-1.53)	1.51 (1.20-1.87)	1.73 (1.35-2.14)	1.95 (1.50-2.41)	2.19 (1.65-2.70)	2.50 (1.84-3.09)	2.73 (1.97-3.38)
2-hr	0.328 (0.272-0.404)	0.423 (0.350-0.522)	0.568 (0.468-0.698)	0.679 (0.555-0.832)	0.831 (0.669-1.01)	0.948 (0.753-1.15)	1.07 (0.836-1.30)	1.20 (0.917-1.45)	1.37 (1.02-1.65)	1.50 (1.10-1.82)
3-hr	0.229 (0.189-0.283)	0.293 (0.243-0.363)	0.387 (0.320-0.479)	0.462 (0.379-0.568)	0.566 (0.457-0.689)	0.649 (0.515-0.790)	0.737 (0.576-0.896)	0.831 (0.636-1.01)	0.962 (0.715-1.17)	1.07 (0.773-1.30)
6-hr	0.132 (0.113-0.159)	0.167 (0.143-0.202)	0.216 (0.183-0.260)	0.255 (0.214-0.305)	0.308 (0.255-0.368)	0.351 (0.285-0.416)	0.394 (0.316-0.468)	0.441 (0.346-0.524)	0.506 (0.386-0.602)	0.558 (0.416-0.665)
12-hr	0.074 (0.064-0.087)	0.093 (0.080-0.110)	0.119 (0.102-0.139)	0.138 (0.118-0.162)	0.165 (0.139-0.193)	0.186 (0.155-0.216)	0.207 (0.170-0.241)	0.229 (0.185-0.267)	0.259 (0.204-0.303)	0.282 (0.218-0.334)
24-hr	0.048 (0.043-0.055)	0.061 (0.054-0.069)	0.079 (0.070-0.089)	0.093 (0.082-0.105)	0.113 (0.099-0.127)	0.128 (0.112-0.144)	0.145 (0.125-0.162)	0.161 (0.138-0.180)	0.184 (0.156-0.207)	0.203 (0.170-0.227)
2-day	0.026 (0.022-0.029)	0.033 (0.029-0.037)	0.043 (0.037-0.049)	0.051 (0.044-0.058)	0.062 (0.054-0.071)	0.071 (0.061-0.080)	0.080 (0.068-0.091)	0.090 (0.076-0.102)	0.103 (0.087-0.118)	0.114 (0.095-0.130)
3-day	0.018 (0.016-0.021)	0.023 (0.021-0.027)	0.031 (0.027-0.035)	0.037 (0.032-0.042)	0.045 (0.039-0.051)	0.052 (0.045-0.059)	0.059 (0.050-0.067)	0.066 (0.056-0.075)	0.076 (0.064-0.087)	0.085 (0.071-0.097)
4-day	0.015 (0.013-0.017)	0.019 (0.017-0.022)	0.025 (0.022-0.028)	0.030 (0.026-0.034)	0.036 (0.032-0.041)	0.042 (0.036-0.048)	0.048 (0.041-0.054)	0.054 (0.046-0.061)	0.063 (0.053-0.071)	0.070 (0.059-0.080)
7-day	0.009 (0.008-0.011)	0.012 (0.011-0.014)	0.016 (0.014-0.018)	0.019 (0.016-0.021)	0.023 (0.020-0.026)	0.027 (0.023-0.030)	0.030 (0.026-0.034)	0.034 (0.029-0.039)	0.040 (0.034-0.045)	0.044 (0.037-0.050)
10-day	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.012 (0.011-0.014)	0.014 (0.013-0.016)	0.018 (0.015-0.020)	0.020 (0.018-0.023)	0.023 (0.020-0.026)	0.026 (0.022-0.029)	0.030 (0.025-0.034)	0.033 (0.028-0.038)
20-day	0.004 (0.004-0.005)	0.005 (0.005-0.006)	0.007 (0.006-0.008)	0.008 (0.007-0.010)	0.010 (0.009-0.012)	0.012 (0.010-0.013)	0.013 (0.011-0.015)	0.014 (0.012-0.016)	0.016 (0.014-0.018)	0.018 (0.015-0.020)
30-day	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.006 (0.005-0.006)	0.007 (0.006-0.007)	0.008 (0.007-0.009)	0.009 (0.008-0.010)	0.010 (0.009-0.011)	0.011 (0.010-0.013)	0.013 (0.011-0.014)	0.014 (0.012-0.015)
45-day	0.003 (0.002-0.003)	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.005-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.008 (0.007-0.009)	0.009 (0.008-0.011)	0.010 (0.009-0.012)
60-day	0.002 (0.002-0.002)	0.003 (0.002-0.003)	0.004 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.004-0.006)	0.006 (0.005-0.006)	0.006 (0.005-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.008)	0.008 (0.007-0.009)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

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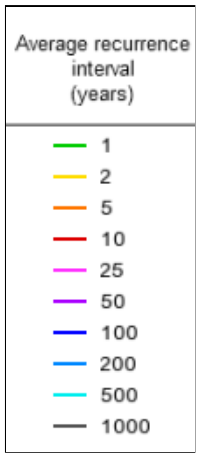
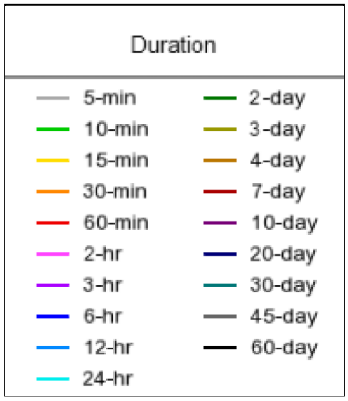
Back to Top

PF graphical

PDS-based intensity-duration-frequency (IDF) curves

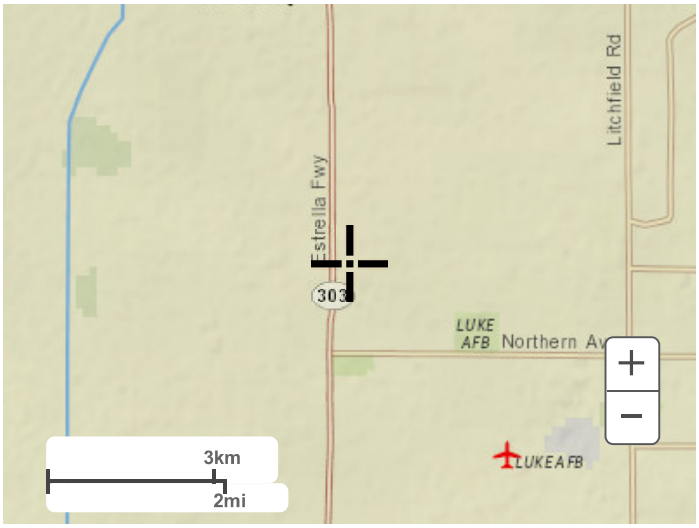




Back to Top

Maps & aerials

Small scale terrain



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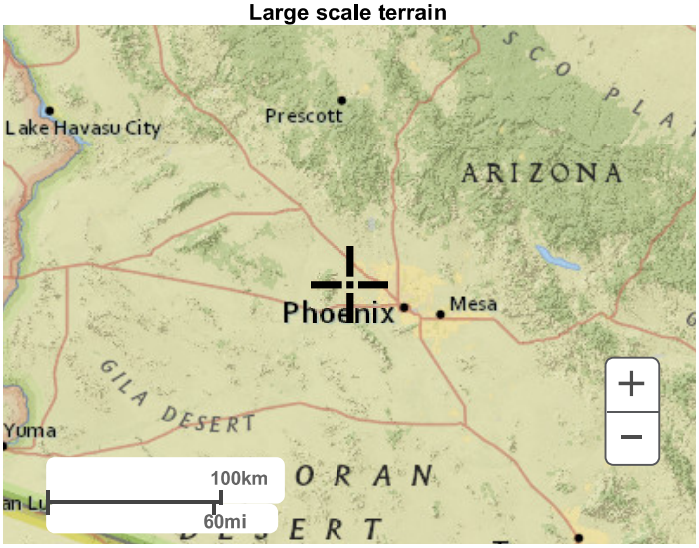
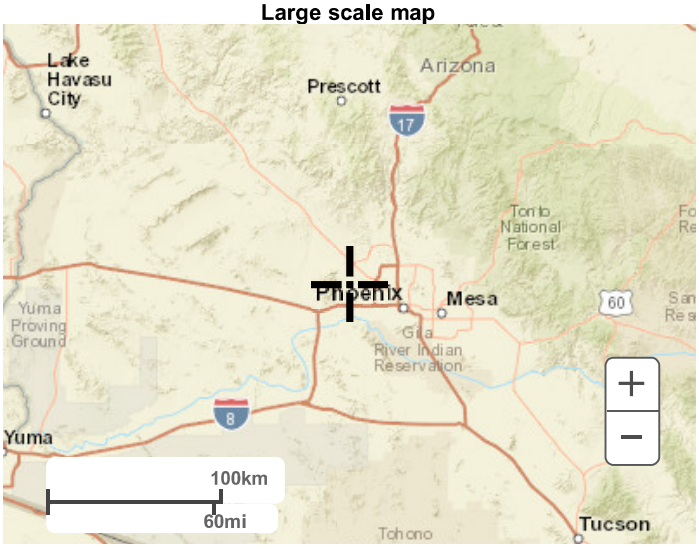
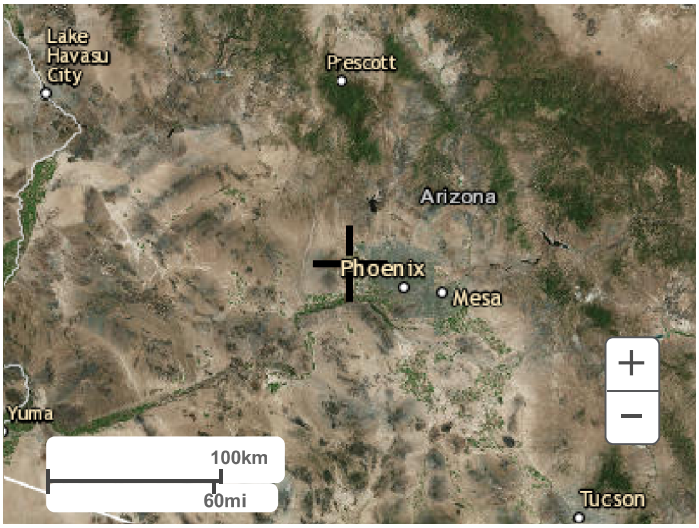


Large scale map



Large scale aerial



Back to Top

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Appendix D.2

First Flush and Retention Basin Calculations

Project: TT0561 - Olive Avenue Widening
Location: Surprise, Arizona
Date: April 12, 2023
Subject: First Flush and 100-Year 2-Hour Retention Requirement Calculations

Source: Effective Maricopa County Drainage Policies and Standards Manual, 2016

Subbasin ID	Basin ID	Subbasin Area (sq.ft.)	Subbasin Area (acres)	First Flush Flow (cfs)	First Flush Volume (acre-ft)	First Flush Volume (ft^3)	100 - Year 2 - Hr Basin Volume (ac-ft)	100 - Year 2 - Hr Basin Volume (ft^3)
From TT0497								
DA-26, DA-33 -DA-35	Basin-1A	326,847	7.50	3.75	0.31	13,619	N/A	N/A
Westbound Olive Ave								
DA-1	Basin-1	77,874	1.79	0.89	0.07	3,245	0.21	9,009
DA-2	Basin-2	98,076	2.25	1.13	0.09	4,087	0.26	11,304
DA-3	ADOT Area Drain	76,420	1.75	0.88	0.07	3,184	0.20	8,795
DA-4	Basin-4	84,406	1.94	0.97	0.08	3,517	0.23	9,978
DA-5	Basin-5	50,903	1.17	0.58	0.05	2,121	0.16	6,960
DA-6	Basin-6	41,076	0.94	0.47	0.04	1,712	0.14	6,106
Eastbound Olive Ave								
DA-101 [1]	Basin-1	25,530	0.59	0.29	0.02	1,064	0.10	4,325
DA-102 [1]	Basin-2	32,331	0.74	0.37	0.03	1,347	0.13	5,477
DA-103	Basin-3	21,047	0.48	0.24	0.02	877	0.08	3,566
DA-104,DA104A	Basin-104	89,485	2.05	1.03	0.09	3,729	0.35	15,160
DA-105,DA105A	Basin-5	109,117	2.50	1.25	0.10	4,547	0.42	18,486
DA-106,DA106A	Basin-6	72,516	1.66	0.83	0.07	3,022	0.28	12,285
DA7,DA-107	Channel	30,489	0.70	0.35	0.03	1,270	0.12	5,165
DA-101A	Adjacent Retention	3,059	0.07	0.04	0.00	127	0.01	273
DA-101B	Adjacent Retention	5,871	0.13	0.07	0.01	245	0.01	523
DA-101C	Basin-3	2,054	0.05	0.02	0.00	86	0.00	183
DA-102A	Basin-3	53,836	1.24	0.62	0.05	2,243	0.11	4,800
DA-103B	Basin-3	20,340	0.47	0.23	0.02	848	0.04	1,814
North Sarival Ave								
DA-201	Basin-201	18,768	0.43	0.22	0.02	782	0.07	3,180
DA-202	Basin-201	59,322	1.36	0.68	0.06	2,472	0.21	9,023
DA-203	Basin-201	103,996	2.39	1.19	0.10	4,333	0.27	11,668
DA-204	Basin-201	34,030	0.78	0.39	0.03	1,418	0.09	3,799
South Sarival Ave								
DA-301	Basin-301	36,094	0.83	0.41	0.03	1,504	0.12	5,307
DA-302	Basin-302	67,590	1.55	0.78	0.06	2,816	0.21	9,174
DA-303	Basin-301	27,278	0.63	0.31	0.03	1,137	0.08	3,656

Notes:

1) DA-101 & 102 are pavement areas only. DA's 101A, 101B ,101C, 102A,103B contribute to Basin-3 as the landscaping area behind the back of curb.
2) Part of DA-101C is in DA-103. The associated DA-101C area in DA-103 has been subtracted from the DA-103 landscaping area.
3) DA-303 is only providing first flush for the additional pavement being added to tie into the project.
4) First flush basin from TT0497 provided for reference above for regraded basin.

Project: TT0561 - Olive Avenue Widening
Location: Surprise, Arizona
Date: April 26, 2023
Subject: First Flush Basin and Retention Basin Summary
Source: Effective Maricopa County Drainage Policies and Standards Manual, 2007

Basin Summary											
Basin ID	**Road**	**Basin Type**	**Station ID**	**Contributing Subbasins**	**Basin Invert (ft)**	**HWE (ft)**	**First Flush Volume Required (ft^3)**	**First Flush Volume Provided (ft^3)**	**100-Year 2-Hour Volume Required (ft^3)**	**100-Year 2-Hour Volume Provided (ft^3)**	**Notes**
Basin -1A[3]	Olive Ave	First Flush	171+00 to 176+50	DA-26, DA-33 -DA-35[3]	1175, 1174 1173	1177, 1176 1174	13,619	15,730	N/A	N/A	Regraded first flush basin with outfall to storm drain. First flush requirement from TT0497
Basin-1	Olive Ave	**First Flush**	177+55	DA-1, DA-101	1170.00	1171.00	4,309	7,267	13,334	N/A	Outfalls to area drain connecting to L303 channel
Basin-2	Olive Ave	**First Flush**	185+99	DA-2, DA-102	1165.50	1166.50	5,434	7,479	16,781	N/A	Outfalls to area drain connecting to L303 channel
Basin-3	Olive Ave	**First Flush**	193+50	DA-103,DA102A	1162.50	1163.50	3,120	3,448	10,453	N/A	In ADOT ROW. Overflow drains along ADOT frontage to the beginning of the Northern Parkway Channel
Basin-4	Olive Ave	**Retention**	202+53	DA-4	1154.50	1157.00	3,517	N/A	9,978	12,959	
Basin-104	Olive Ave	**Retention**	202+48	DA-104,DA104A	1154.00	1157.00	3,729	N/A	15,160	14,005	
Basin-5	Olive Ave	**Retention**	210+64	DA-5, DA-105	1149.00	1151.00	6,668	N/A	25,447	22,772	
Basin-6	Olive Ave	**Retention**	215+39	DA-6, DA-106	1145.50	1148.00	4,733	N/A	18,392	19,931	
Basin-201	Sarival Ave	**Retention**	25+50	DA-201, DA-202 DA-203, DA-204	1144.50	1147.50	9,005	N/A	27,670	36,347	
Basin-301	Sarival Ave	**First Flush**	13+10	DA-301, DA-303	1140.00	1141.00	2,641	2,930	8,963	N/A	1-foot outfall ditch flows to area drain at Northern Parkway
Basin-302	Sarival Ave	**Retention**	18+15	DA-302	1141.00	1144.00	2,816	N/A	9,174	9,258	

Notes:
1) If an outfall was available or adjacent properties would not be impacted, first flush basins were provided. If there was not an outfall or adjacent properties would receive overtopping basin flows, 100-year 2-hour retention was provided.
2) 1-foot of freeboard has been provided for the 100-year 2-hour retention basins.
3) Basin-1A information from TT0497.

Project: TT0561 - Olive Avenue Widening
Location: Glendale, AZ
Date: April 12, 2023
Subject: First Flush and Retention Basin Calculations

Basin-1A (1 of 3)			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1177.0	3,704	2,922	0.0671
1176.0	2,140	1,329	0.0305
1175.0	518		0.0000
	Total at HWE 1177=	**4,251**	**0.098**

Basin-1A (2 of 3)			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1176.0	5,086	4,323	0.0992
1175.0	3,559	2,841	0.0652
1174.0	2,122		0.0000
	Total at HWE 1177=	**7,163**	**0.164**

Basin-1A (3 of 3)			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1175.0		1,651	0.0379
1174.0	3,302	2,665	0.0612
1173.0	2,027		0.0000
	Total at HWE 1177=	**4,316**	**0.099**

Notes: 1) Cascading Basin-1A stores first flush from TT0497.
2) Average End Area Method Utilized for Calculating Volume Provided

Basin-1			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1171.0	8,554	7,267	0.1668
1170.0	5,979		0.0000
	Total at 1208=	**7,267**	**0.167**

Note:

1) Average End Area Method Utilized for Calculating Volume Provided

Basin-2			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1166.5	9,346	7,479	0.1717
1165.5	5,612		0.0000
	Total=	**7,479**	**0.172**

Note:

1) Average End Area Method Utilized for Calculating Volume Provided

Basin-3			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1163.5	5,359	3,448	0.0791
1162.5	1,536		0.0000
	Total=	**3,448**	**0.079**

Note:

1) Average End Area Method Utilized for Calculating Volume Provided

Basin-4			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1158.0	14,811	12,634	0.2900
1157.0	10,457	4,697	0.1078
1156.5	8,330	3,632	0.0834
1156.0	6,199	4,120	0.0946
1155.0	2,041	510	0.0117
1154.5	0		0.0000
	Total at HWE 1157=	**12,959**	**0.298**
	Total at Elev 1157.75	**25,593**	**0.588**

Note:

1) Average End Area Method Utilized for Calculating Volume Provided

Basin-104			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1158.0	9,403	8,410	0.1931
1157.0	7,417	6,473	0.1486
1156.0	5,529	4,635	0.1064
1155.0	3,741	2,897	0.0665
1154.0	2,053		0.0000
	Total at HWE 1157=	**14,005**	**0.322**
	Total at Elev 1158=	**22,415**	**0.515**

Basin-5			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1152.0	19618	17,529	0.4024
1151.0	15,439	13,400	0.3076
1150.0	11,361	9,372	0.2152
1149.0	7,383		0.0000
	Total at HWE 1151=	**22,772**	**0.523**
	Total at Elev 1152=	**40,301**	**0.523**

Basin-6			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1149.0	16,237	13,534	0.3107
1148.0	12,649	9,995	0.2295
1147.0	9,159	7,465	0.1714
1146.0	5,770	2,471	0.0567
1145.5	4,114		0.0000
	Total at HWE 1148=	**19,931**	**0.458**
	Total at Elev 1149=	**33,465**	**0.768**

Note:

1) Average End Area Method Utilized for Calculating Volume Provided

Basin-201			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1148.5	23,132	20,920	0.4802
1147.5	18,707	8,792	0.2018
1147.0	16,459	14,282	0.3279
1146.0	12,105	9,928	0.2279
1145.0	7,751	3,346	0.0768
1144.5	5,631		0.0000
	Total at HWE 1147.50=	**36,347**	**0.8344**
	Total at Elev 1148.5=	**57,267**	**1.315**

Note:

1) Average End Area Method Utilized for Calculating Volume Provided

Basin-301			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1141.0	3,766	2,930	0.0673
1140.0	2,093		0.0000
	Total=	**2,930**	**0.067**

Note:

1) Average End Area Method Utilized for Calculating Volume Provided

Basin-302			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1145.0	6,458	5,740	0.1318
1144.0	5,022	4,347	0.0998
1143.0	3,672	3,052	0.0701
1142.0	2,432	1,859	0.0427
1141.0	1,286		0.0000
	Total at HWE 1144.0=	**9,258**	**0.2125**
	Total at Elev 1145=	**14,998**	**0.344**

Note:

1) Average End Area Method Utilized for Calculating Volume Provided

Basin-401			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1177.0	1,609	1,515	0.0348
1176.0	1,420	969	0.0222
1175.0	518		0.0000
	Total at HWE 1177.0=	**2,484**	**0.0570**
	Total at Elev 1177=	**2,484**	**0.057**

Note:

1) Average End Area Method Utilized for Calculating Volume Provided

Basin-402			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1176.0	5,177	4,392	0.1008
1175.0	3,607	2,865	0.0658
1174.0	2,122		0.0000
	Total at HWE 1176.0=	**7,257**	**0.1666**
	Total at Elev 1176=	**7,257**	**0.167**

Note:

1) Average End Area Method Utilized for Calculating Volume Provided

Basin-403			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1175.0	4,692	4,021	0.0923
1174.0	3,349	2,739	0.0629
1173.0	2,128		0.0000
	Total at HWE 1175.0=	**6,759**	**0.1552**
	Total at Elev 1175=	**6,759**	**0.155**

Note:

1) Average End Area Method Utilized for Calculating Volume Provided

Project: TT0561 - Olive Avenue Widening
Location: Glendale, AZ
Date: April 12, 2023
Subject: Percolation Results Summary

Proj. Number: 221892
Proj. Engineer: R.Halligan
Checker: A.Herting

Percolation Test Results

Test Location	Corresponding Basin ID	Road ID ID	Test Depth (ft)	Soil Type	Testing Method Type	Average Infiltration Rate (in/hr)	De-rated Infiltration Rate (report) (in/hr)	De-rated Infiltration Rate (Calculated) (in/hr)	Final Infiltration Rate (feet in 36 hours)
B1-1	Basin 1	Olive Avenue	4.0	Silty Sand	EPA	3.60	0.60	0.60	1.80
B1-2	Basin 1	Olive Avenue	4.0	Silty Sand	EPA	14.40	2.40	2.40	7.20
B2-1	Basin 2	Olive Avenue	6.0	Sand with Silt and Gravel	EPA	1.40	0.23	0.23	0.69
B2-2	Basin 2	Olive Avenue	5.0	Sandy Clay	EPA	6.00	1.00	1.00	3.00
B4-1	Basin 4	Olive Avenue	6.0	Clayey sand to sandy clay	EPA	46.10	7.70	7.70	23.10
B4-2	Basin 4	Olive Avenue	6.0	Silty Sand	EPA	1.20	0.20	0.20	0.60
B10-1	Basin 201	Sarival Road	6.0	Silty Sand	EPA	11.50	1.90	1.92	5.70
B10-2	Basin 201	Sarival Road	6.0	Silty Sand	EPA	54.70	9.10	9.13	27.30
B3-1	Basin 3	Olive Avenue	6.0	Silty Sand	ASTM	0.58	0.29	0.29	0.87
B3-2	Basin 3	Olive Avenue	5.0	Silty Sand with Gravel	ASTM	1.21	0.61	0.61	1.83
B5-1	Basin 104	Olive Avenue	5.0	Silty Sand	ASTM	0.57	0.29	0.29	0.87
B5-2	Basin 104	Olive Avenue	5.0	Silty Sand	ASTM	0.91	0.46	0.46	1.38
B6-1	Basin 5	Olive Avenue	5.0	Sand with Silt and Gravel	ASTM	0.77	0.39	0.39	1.17
B6-2	Basin 5	Olive Avenue	4.0	Clayey sand to sandy clay	ASTM	0.99	0.50	0.50	1.50
B7-1	Basin 6	Olive Avenue	6.0	Silty Sand	ASTM	3.27	1.60	1.64	4.80
B7-2	Basin 6	Olive Avenue	5.0	Sand with Silt	ASTM	1.97	0.99	0.99	2.97
B8-1	Basin 301	Sarival Road	4.0	Silty, Clayey Sand	ASTM	1.56	0.78	0.78	2.34
B8-2	Basin 301	Sarival Road	4.0	Silty, Clayey Sand	ASTM	0.82	0.41	0.41	1.23
B9-1	Basin 302	Sarival Road	5.0	Silty Sand	ASTM	1.94	0.97	0.97	2.91
B9-2	Basin 302	Sarival Road	5.0	Silty Sand	ASTM	2.20	1.10	1.10	3.30

Notes:
1) Design factors used for each testing method (ASTM or EPA)
a) ASTM Design Factor = 0.5
b) EPA Design Factor = 0.167

Drywell Calculations

Basin ID	Designed TotalBasin Depth (ft)	Corresponding Percolation Test ID	Average Basin Percolation Depth in 36 hours (feet)	Drywell Required (Y/N)	Number of Drywells Required	Notes
Basin-1	1.0	B1-1,B1-2	4.5	**N**	0	
Basin-2	1.0	B2-1,B2-2	1.8	**N**	0	
Basin-3	1.0	B3-1,B3-2	1.4	**N**	0	
Basin-4	3.5	B4-1,B4-2	11.9	**N**	0	
Basin-104	4.0	B5-1,B5-2	1.1	**Y**	2	
Basin-5	3.0	B6-1,B6-2	1.3	**Y**	3	
Basin-6	3.5	B7-1,B7-2	3.9	**N**	0	
Basin-201	4.0	B10-1,B10-2	16.5	**N**	0	
Basin-301	1.0	B8-1,B8-2	1.8	**N**	0	
Basin-302	4.0	B9-1,B9-2	3.1	**Y**	2	
				Total	**7**	

Notes:
1) Prior to construction, drywells assumed to percolate at 0.1 cfs, which is 12,960 cubic feet per 36 hours. Actual tests will determine final percolation rate of drywell.

Project: TT0561 - Olive Avenue Widening - Sarival to Reems Road
Location: Surprise, Arizona
Date: April 26, 2023
Subject: First Flush and 100-Year 2-Hour Retention Requirement Calculations

Source: Effective Maricopa County Drainage Policies and Standards Manual, 2016

Subbasin ID	Basin ID	Subbasin Area (sq.ft.)	Subbasin Area (acres)	First Flush Flow (cfs)	First Flush Volume (acre-ft)	First Flush Volume (ft^3)	100 - Year 2 - Hr Basin Volume (ac-ft)	100 - Year 2 - Hr Basin Volume (ft^3)
Olive Avenue								
DA-1A	Check Dam-1	31,297	0.72	1.80	0.03	1,304	0.12	5,302
DA-2A	Check Dam-2	30,400	0.70	0.35	0.03	1,267	0.12	5,150
DA-3A	Check Dam-3	30,390	0.70	0.35	0.03	1,266	0.12	5,149
DA-4A	Check Dam-4	31,064	0.71	0.36	0.03	1,294	0.12	5,263
DA-5A	Check Dam-5	33,898	0.78	0.39	0.03	1,412	0.13	5,743
DA-6A	FF Basin Reems Channel	23,938	0.55	0.27	0.02	997	0.09	4,055
DA-101A	Check Dam-1	31,040	0.71	0.36	0.03	1,293	0.12	5,259
DA-102A	Check Dam-2	30,400	0.70	0.35	0.03	1,267	0.12	5,150
DA-103A	Check Dam-3	31,109	0.71	0.36	0.03	1,296	0.12	5,270
DA-104A	Check Dam-4	30,654	0.70	0.35	0.03	1,277	0.12	5,193
DA-105A	Check Dam-5	32,849	0.75	0.38	0.03	1,369	0.13	5,565
DA-106A	FF Basin Reems Channel	27,080	0.62	0.31	0.03	1,128	0.11	4,588
DA-7A	Basin-101C	35,227	0.81	0.40	0.03	1,468	0.14	5,968
DA-107A	Basin-101C	19,658	0.45	0.23	0.02	819	0.08	3,330
Reems Road								
DA-201A	FF Basin Reems Channel	23,227	0.53	0.27	0.02	968	0.09	3,935
DA-202A	FF Basin Reems Channel	18,070	0.41	0.21	0.02	753	0.07	3,061
DA-203A	Direct Discharge	10,680	0.25	1.23	0.01	445	0.04	1,809
DA-204A	Direct Discharge	13,118	0.30	1.51	0.01	547	0.05	2,222

Project: TT0561 - Olive Avenue Widening - Sarival to Reems Road
Location: Surprise, Arizona
Date: April 26, 2023
Subject: First Flush Basin and Retention Basin Summary
Source: Effective Maricopa County Drainage Policies and Standards Manual, 2007

Basin Summary

Basin ID	Road	Basin Type	Station ID	Contributing Subbasins	Basin Invert (ft)	HWE (ft)	First Flush Volume Required (ft^3)	First Flush Volume Provided (ft^3)	100-Year 2-Hour Volume Required (ft^3)	100-Year 2-Hour Volume Provided (ft^3)	Notes
Check Dam-1	Olive Ave	**First Flush**	230+00.00	DA-1A, DA-101A	See Plans	See Plans	2,597		10,561	N/A	Depth of check dam is 1-foot. See calcs for details
Check Dam-2	Olive Ave	**First Flush**	243+00.00	DA-2A, DA-102A	See Plans	See Plans	2,533		10,301	N/A	Depth of check dam is 1-foot. See calcs for details
Check Dam-3	Olive Ave	**First Flush**	248+01.22	DA-3A, DA-103A	See Plans	See Plans	2,562		10,419	N/A	Depth of check dam is 1-foot. See calcs for details
Check Dam-4	Olive Ave	**First Flush**	255+01.20	DA-4A, DA-104A	See Plans	See Plans	2,572		10,456	N/A	Depth of check dam is 1-foot. See calcs for details
Check Dam-5	Olive Ave	**First Flush**	261+01.20	DA-5A, DA-105A	See Plans	See Plans	2,781		11,308	N/A	Depth of check dam is 1-foot. See calcs for details
FF Basin Reems Channel	Olive Ave	**First Flush**	263+85.51	DA-6A, DA-106A, DA-201, DA-202	See Plans	See Plans	3,846	6,388	15,640	N/A	Riprap Apron at end of Reems Box Culvert Extension
Basin-101C	Olive Ave	**Retention**	270+75.00	DA-7A, DA-107A	1118.00	1120.00	2,287	N/A	9,298	23,278	1-foot of freeboard provided from elevation 1120 to 1121.

Notes:
1) 1-foot of freeboard has been provided for the 100-year 2-hour retention basins.

Project: TT0561 - Olive Avenue Widening - Sarival to Reems Road
Location: Surprise, Arizona
Date: April 26, 2023
Subject: First Flush and Retention Basin Calculations

Basin-101C			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1121.0	11,638	10,276	0.2359
1120.0	8,913	7,601	0.1745
1119.0	6,289	5,401	0.1240
1118.0	4,512		0.0000
	Total at HWE 1121=	13,002	**0.298**
	Total at HWE 1121=	**23,278**	**0.534**

Note:
1) Average End Area Method Utilized for Calculating Volume Provided

FF Basin Reems Channel			
CONTOUR ELEVATION	AREA	VOLUME PROVIDED (CFT)	VOLUME PROVIDED (Ac-Ft)
1115.4	3,650	6,388	0.1466
1113.4	2,738		0.0000
	Total at HWE 1115.40	**6,388**	**0.147**

Note:
1) Average End Area Method Utilized for Calculating Volume Provided

Project: TT0561 - Olive Avenue Widening - Sarival to Reems Road
Location: Surprise, Arizona
Date: April 26, 2023
Subject: First Flush and Retention Basin Calculations

Check Dam-1 thru Check Dam-4 Volume Retained at 0.0035 ft/ft Slope			
Height (ft)	**Channel Area (sf)**	**Length (ft)**	**Volume Provided (cf)**
1	24.0	0	1,081
0.825	19.2	50	848
0.65	14.7	100	627
0.475	10.4	150	419
0.3	6.4	200	223
0.175	2.6	250	45
0	0.0	285	0
			3,242

Note:
1) Average End Area Method Utilized for Calculating Volume Provided

Check Dam-5 Volume Retained at 0.0030 ft/ft Slope			
Height (ft)	**Area (sf)**	**Length (ft)**	**Volume (cf)**
1	24.0	0	1,097
0.85	19.9	50	896
0.7	16.0	100	704
0.55	12.2	150	521
0.4	8.6	200	347
0.25	5.3	250	182
0.1	2.0	300	34
0	0.0	333	0
			3,782

Note:
1) Average End Area Method Utilized for Calculating Volume Provided

Appendix D.3
Inlet Calculations

Project: TT0561 - Olive Avenue Widening
Location: Surprise, Arizona
Date: April 12, 2023
Subject: Inlet Summary Calculations
Source: Effective Maricopa County Drainage Policies and Standards Manual, 2016

Inlet (ID)	Road	Station	Contributing Subbasins	Inlet Type	Wing/Inlet Opening (ft)	Effective Opening (ft)	Slope (ft/ft)	Subbasin Flow (cfs)	Total Flow (Including Bypass) (cfs)	Captured Flow (cfs)	Captured Flow (%)	Bypass Flow (cfs)	Bypass To (Inlet ID)	Max Spread (ft)	Calculated Spread (ft)	Spread Acceptable? (Yes/No)
Olive Avenue Westbound Lanes																
Inlet-01	Olive Ave	177+55	DA-1	COP P-1569 M-1	6	7.2	0.0067	2.00	2.00	1.86	93%	0.14	DA-2	17.5	9.3	Yes
Inlet-02	Olive Ave	185+99	DA-2	COP P-1569 M-1	6	7.2	0.0056	2.26	2.40	2.16	90%	0.24	DA-3	17.5	10.3	Yes
Inlet-03	Olive Ave	194+50	DA-3	Scupper	8	6.4	0.0055	1.75	1.99	1.81	91%	0.18	DA-4	17.5	9.8	Yes
Inlet-04	Olive Ave	202+53	DA-4	Scupper	12	9.6	0.0066	2.37	2.55	2.50	98%	0.05	DA-5	17.5	10.2	Yes
Inlet-05	Olive Ave	210+63	DA-5	COP P-1569 M-1	6	7.2	0.0070	2.34	2.39	2.09	88%	0.30	DA-6	17.5	9.8	Yes
Inlet-06	Olive Ave	215+39	DA-6	COP P-1569 M-1	10	10.4	0.0083	2.68	2.98	2.88	97%	0.10	DA-7	17.5	10.4	Yes
Inlet-07	Olive Ave	220+00	DA-7	COP P-1569 M-1	10	10.4	0.0092	1.26	1.38	2.28	165%	-0.90	DA-1A	17.5	9.5	Yes
Olive Avenue Eastbount Lanes																
Inlet-101	Olive Ave	177+55	DA-101	COP P-1572 Modified	9	7.2	0.0065	1.98	1.98	1.92	97%	0.06	DA-102	17.5	9.2	Yes
Inlet-102	Olive Ave	185+99	DA-102	COP P-1569 M-1	6	7.2	0.0057	2.39	2.45	2.28	93%	0.17	DA-103	17.5	10.6	Yes
Inlet-103	Olive Ave	193+52	DA-103	Scupper	8	6.4	0.0046	1.49	1.66	1.70	102%	-0.04	DA-104	17.5	9.5	Yes
Inlet-104	Olive Ave	202+48	DA-104	Scupper	12	9.6	0.0066	2.53	2.49	2.54	102%	-0.05	DA-105	17.5	10.2	Yes
Inlet-105	Olive Ave	210+63	DA-105	COP P-1569 M-1	10	10.4	0.0071	2.31	2.26	2.54	112%	-0.28	DA-106	17.5	10.0	Yes
Inlet-106	Olive Ave	215+39	DA-106	COP P-1569 M-1	10	10.4	0.0087	2.28	2.00	2.31	115%	-0.31	Inlet-301	17.5	9.3	Yes
Inlet-107	Olive Ave	220+00	DA-107	COP P-1569 M-1	6	7.2	0.0053	1.12	1.12	1.16	104%	-0.04	DA-107A	17.5	7.6	Yes
Sarival Avenue North of Olive Avenue Intersection																
Inlet-201	Sarival Ave	25+35	DA-201	COP P-1569 M-1	6	7.2	0.0018	1.46	1.46	1.46	100%	0.00	DA-6	17.5	10.6	Yes
Inlet-202	Sarival Ave	25+35	DA-202	COP P-1569 M-1	10	10.4	0.0040	3.33	3.32	3.30	99%	0.02	DA-7	17.5	12.6	Yes
Sarival Avenue South of Olive Avenue Intersection																
Inlet-301	Sarival Ave	17+54	DA-301	Scupper	12	9.6	0.0043	1.92	1.62	1.92	119%	-0.30	End of Project	17.5	9.9	Yes
Inlet-302	Sarival Ave	17+54	DA-302	Scupper	12	9.6	0.0040	2.90	2.90	2.87	99%	0.03	End of Project	17.5	11.9	Yes
Olive Avenue New Area Drains																
AD-1	Olive Ave	180+60	Basin-1	ADOT C-15.80 Flush	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AD-2	Olive Ave	181+40	Basin-2	ADOT C-15.80 Flush	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes:

1) Effective opening for curb inlets is 80%. If a grate is included (Modified COP P-1572, ADOT C-15.80), a 50% clogging factor is appied.
2) Captured flow calculations were performed using Bentley Flowmaster V8i.
3) Scupper openings are multiples of 4-feet.
4) See area drain calculations in Appendix D for outfall area drains in Basin-1 & Basin-2.
5) Existing ADOT area drain calculations were not performed. Existing area drains are to be protected and allowed to continue to drain the landscape area north of Olive Avenue.

Project: TT0561 - Olive Avenue Widening
Location: Surprise, Arizona
Date: June 15, 2017
Subject: Drop Inlet Calculations

Proj. Number: 221892
Proj. Engineer: A.Herting
Checker: L.Vick

Reference: Drainage Design Manual for Maricopa County, AZ - Hydraulics Manual, Effective August 15, 2013

Drop Inlet

Weir

Q	**339.4**	**cfs**	50-Year Discharge	204.4	cfs
C	3.0	coefficient	100-Year Discharge	240.2	cfs
P	40.0	ft	Width	4	feet
d	2.00	ft	length	16	feet
Clogging Factor	1.0				

Notes:
1) Over 1-foot of depth, the discharge would transition from weir flow to orifice flow.
Therefore, orifice flow/equation is the appropriate calculation for capacity.

Orifice

Q	**486.6**	**cfs**			
Co	0.67	coefficient			
Ag	64.00	sq. ft	Drop Inlet Clear Open Area	64	$feet^2$
d	2.00	ft			
g	32.2	ft/sec^2			
Clogging Factor	1.0				

Notes:
1) Assumes WSE height is 1.0 feet above top end of grate/headwall.
2) The depth of flow is averaged to be 2.0 feet at three locations (top of grate=1.0-feet, 2.0 feet at middle of grate and 3.0 feet at beginning of grate).
3) Flows are from the TT0497 Final Drainage Report
4) Both calculations show that the drop inlet will capture the 50 and 100-year flows.

Project: TT0561 - Olive Avenue Widening
Location: Surprise, Arizona
Date: June 15, 2017
Subject: Area Drain Calculations

Proj. Number: 221892
Proj. Engineer: A.Herting
Checker: L.Vick

Reference: Drainage Design Manual for Maricopa County, AZ - Hydraulics Manual, Effective August 15, 2013

Area Drain ID: AD-1

Weir

Q	**42.4**	**cfs**
C	3.0	coefficient
P	10.0	ft
d	2.00	ft
Clogging Factor	0.5	

perimeter 1 grate = 10 feet

Notes:
1) Over 1-foot of depth, the discharge would transition from weir flow to orifice flow.
Therefore, the weir flowequation is the appropriate use for calculating the grated C-15.80 area drain.

Orifice

Q	**15.5**	**cfs**
Co	0.67	coefficient
Ag	4.08	sq. ft
d	2.00	ft
g	32.2	ft/sec^2
Clogging Factor	0.5	

clear Area Opening = 4.08 per grate
grates = 1

Notes:
1) The green block indicates that this inlet would work as weir flow
2) Area drain is provided as an outfall only.

Project: TT0561 - Olive Avenue Widening
Location: Surprise, Arizona
Date: June 15, 2017
Subject: Area Drain Calculations

Proj. Number: 221892
Proj. Engineer: A.Herting
Checker: L.Vick

Reference: Drainage Design Manual for Maricopa County, AZ - Hydraulics Manual, Effective August 15, 2013

Area Drain ID: AD-2

Weir

Q	**77.9**	**cfs**
C	3.0	coefficient
P	10.0	ft
d	3.00	ft
Clogging Factor	0.5	

perimeter 1 grates = 10 feet

Notes:
1) Over 1-foot of depth, the discharge would transition from weir flow to orifice flow.
Therefore, the weir flowequation is the appropriate use for calculating the grated C-15.80 area drain.

Orifice

Q	**19.0**	**cfs**
Co	0.67	coefficient
Ag	4.08	sq. ft
d	3.00	ft
g	32.2	ft/sec^2
Clogging Factor	0.5	

clear Area Opening = 4.08 per grate
grates = 1

Notes:
1) The green block indicates that this inlet would work as weir flow
2) Area drain is provided as an outfall only.

Worksheet for Inlet-01 - Sta 177+55 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.00	ft³/s
Slope	0.00640	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	93.04	%
Intercepted Flow	1.86	ft³/s
Bypass Flow	0.14	ft³/s
Spread	9.25	ft
Depth	0.26	ft
Flow Area	0.93	ft²
Gutter Depression	0.08	ft
Total Depression	0.24	ft
Velocity	2.14	ft/s
Equivalent Cross Slope	0.08960	ft/ft
Length Factor	0.77	
Total Interception Length	9.32	ft

Worksheet for Inlet-02 - Sta 185+99 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.40	ft³/s
Slope	0.00550	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	90.00	%
Intercepted Flow	2.16	ft³/s
Bypass Flow	0.24	ft³/s
Spread	10.31	ft
Depth	0.29	ft
Flow Area	1.14	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.10	ft/s
Equivalent Cross Slope	0.08424	ft/ft
Length Factor	0.72	
Total Interception Length	9.98	ft

Worksheet for Inlet-03 - Sta 194+50 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	1.99	ft³/s
Slope	0.00480	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	6.40	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	91.00	%
Intercepted Flow	1.81	ft³/s
Bypass Flow	0.18	ft³/s
Spread	9.80	ft
Depth	0.28	ft
Flow Area	1.04	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.91	ft/s
Equivalent Cross Slope	0.08710	ft/ft
Length Factor	0.74	
Total Interception Length	8.68	ft

Worksheet for Inlet-04 - Sta 202+53 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.55	ft³/s
Slope	0.00660	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	9.60	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	98.20	%
Intercepted Flow	2.50	ft³/s
Bypass Flow	0.05	ft³/s
Spread	10.18	ft
Depth	0.28	ft
Flow Area	1.12	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.29	ft/s
Equivalent Cross Slope	0.08496	ft/ft
Length Factor	0.89	
Total Interception Length	10.75	ft

Worksheet for Inlet-05 - Sta 210+39 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.39	ft³/s
Slope	0.00700	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	87.62	%
Intercepted Flow	2.09	ft³/s
Bypass Flow	0.30	ft³/s
Spread	9.78	ft
Depth	0.28	ft
Flow Area	1.04	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.31	ft/s
Equivalent Cross Slope	0.08723	ft/ft
Length Factor	0.69	
Total Interception Length	10.48	ft

Worksheet for Inlet-06 - Sta 215+39 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.98	ft³/s
Slope	0.00800	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	10.40	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	96.57	%
Intercepted Flow	2.88	ft³/s
Bypass Flow	0.10	ft³/s
Spread	10.44	ft
Depth	0.29	ft
Flow Area	1.17	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.55	ft/s
Equivalent Cross Slope	0.08355	ft/ft
Length Factor	0.85	
Total Interception Length	12.29	ft

Worksheet for Inlet-07 - Sta 220+00 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.28	ft³/s
Slope	0.00720	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	10.40	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	100.00	%
Intercepted Flow	2.28	ft³/s
Bypass Flow	0.00	ft³/s
Spread	9.52	ft
Depth	0.27	ft
Flow Area	0.99	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.31	ft/s
Equivalent Cross Slope	0.08874	ft/ft
Length Factor	1.01	
Total Interception Length	10.26	ft

Worksheet for Inlet-101 - Sta 177+55 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge		1.99	ft³/s
Slope		0.00630	ft/ft
Gutter Width		2.00	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.015	
Local Depression		2.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		9.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		9.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency		96.66	%
Intercepted Flow		1.92	ft³/s
Bypass Flow		0.07	ft³/s
Spread		9.24	ft
Depth		0.26	ft
Flow Area		0.93	ft²
Gutter Depression		0.08	ft
Total Depression		0.25	ft
Velocity		2.13	ft/s
Splash Over Velocity		12.28	ft/s
Frontal Flow Factor		1.00	
Side Flow Factor		0.52	
Grate Flow Ratio		0.46	
Equivalent Cross Slope		0.09047	ft/ft
Active Grate Length		4.50	ft
Length Factor		0.49	
Total Interception Length		9.20	ft

Worksheet for Inlet-101 - Sta 177+55 Rt

Messages

Messages	Grate Length should be within the defined range of HEC-22's Chart 5 (approx. 0.5-4.5 ft / 0.15-1.35 m).

Worksheet for Inlet-102 - Sta 185+99 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.60	ft³/s
Slope	0.00560	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	87.56	%
Intercepted Flow	2.28	ft³/s
Bypass Flow	0.32	ft³/s
Spread	10.62	ft
Depth	0.29	ft
Flow Area	1.21	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.15	ft/s
Equivalent Cross Slope	0.08258	ft/ft
Length Factor	0.69	
Total Interception Length	10.50	ft

Worksheet for Inlet-103 - Sta 193+52 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	1.81	ft³/s
Slope	0.00460	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	6.40	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	93.82	%
Intercepted Flow	1.70	ft³/s
Bypass Flow	0.11	ft³/s
Spread	9.49	ft
Depth	0.27	ft
Flow Area	0.98	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.84	ft/s
Equivalent Cross Slope	0.08891	ft/ft
Length Factor	0.79	
Total Interception Length	8.13	ft

Worksheet for Inlet-104 - Sta 202+48 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.59	ft³/s
Slope	0.00660	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	9.60	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	97.95	%
Intercepted Flow	2.54	ft³/s
Bypass Flow	0.05	ft³/s
Spread	10.24	ft
Depth	0.28	ft
Flow Area	1.13	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.29	ft/s
Equivalent Cross Slope	0.08459	ft/ft
Length Factor	0.88	
Total Interception Length	10.85	ft

Worksheet for Inlet-105 - Sta 210+63 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.55	ft³/s
Slope	0.00710	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	10.40	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	99.58	%
Intercepted Flow	2.54	ft³/s
Bypass Flow	0.01	ft³/s
Spread	10.02	ft
Depth	0.28	ft
Flow Area	1.08	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.35	ft/s
Equivalent Cross Slope	0.08583	ft/ft
Length Factor	0.95	
Total Interception Length	10.93	ft

Worksheet for Inlet-106 - Sta 215+39 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.31	ft³/s
Slope	0.00840	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	10.40	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	99.85	%
Intercepted Flow	2.31	ft³/s
Bypass Flow	0.00	ft³/s
Spread	9.26	ft
Depth	0.27	ft
Flow Area	0.94	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.46	ft/s
Equivalent Cross Slope	0.09034	ft/ft
Length Factor	0.97	
Total Interception Length	10.69	ft

Worksheet for Inlet-107 - Sta 220+00 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	1.16	ft³/s
Slope	0.00510	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	100.00	%
Intercepted Flow	1.16	ft³/s
Bypass Flow	0.00	ft³/s
Spread	7.61	ft
Depth	0.23	ft
Flow Area	0.66	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.76	ft/s
Equivalent Cross Slope	0.10200	ft/ft
Length Factor	1.12	
Total Interception Length	6.41	ft

Worksheet for Inlet-201 - Station 25+35 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	1.46	ft³/s
Slope	0.00180	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	100.00	%
Intercepted Flow	1.46	ft³/s
Bypass Flow	0.00	ft³/s
Spread	10.58	ft
Depth	0.29	ft
Flow Area	1.20	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.22	ft/s
Equivalent Cross Slope	0.08280	ft/ft
Length Factor	1.23	
Total Interception Length	5.85	ft

Worksheet for Inlet-202 - Station 25+35 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	3.33	ft³/s
Slope	0.00400	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	10.40	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	98.98	%
Intercepted Flow	3.30	ft³/s
Bypass Flow	0.03	ft³/s
Spread	12.61	ft
Depth	0.33	ft
Flow Area	1.67	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.99	ft/s
Equivalent Cross Slope	0.07358	ft/ft
Length Factor	0.92	
Total Interception Length	11.28	ft

Worksheet for Inlet-301 - Station 17+54 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	1.92	ft³/s
Slope	0.00430	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	9.60	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	100.00	%
Intercepted Flow	1.92	ft³/s
Bypass Flow	0.00	ft³/s
Spread	9.88	ft
Depth	0.28	ft
Flow Area	1.06	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.82	ft/s
Equivalent Cross Slope	0.08663	ft/ft
Length Factor	1.16	
Total Interception Length	8.30	ft

Worksheet for Inlet-302 - Station 17+54 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.90	ft³/s
Slope	0.00400	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	9.60	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	99.00	%
Intercepted Flow	2.87	ft³/s
Bypass Flow	0.03	ft³/s
Spread	11.92	ft
Depth	0.32	ft
Flow Area	1.50	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.93	ft/s
Equivalent Cross Slope	0.07644	ft/ft
Length Factor	0.92	
Total Interception Length	10.41	ft

Project: TT0561 - Olive Avenue Widening - Sarival to Reems Road
Location: Surprise, Arizona
Date: April 26, 2023
Subject: Inlet Summary Calculations
Source: Effective Maricopa County Drainage Policies and Standards Manual, 2016

Inlet (ID)	Road	Station	Contributing Subbasins	Inlet Type	Wing/Inlet Opening (ft)	Effective Opening (ft)	Slope (ft/ft)	Subbasin Flow (cfs)	Total Flow (Including Bypass) (cfs)	Captured Flow (cfs)	Captured Flow (%)	Bypass Flow (cfs)	Bypass To (Inlet ID)	Max Spread (ft)	Calculated Spread (ft)	Spread Acceptable? (Yes/No)
Olive Avenue Westbound Lanes																
Inlet-01C	Olive Ave	228+40	DA-1A	COP P-1569 M-1	6	7.2	0.0050	2.22	2.22	2.06	93%	0.16	Inlet-02	17.5	11.1	Yes
Inlet-02C	Olive Ave	236+40	DA-2A	COP P-1569 M-1	6	7.2	0.0063	2.25	2.40	2.13	89%	0.27	Inlet-03	17.5	10.9	Yes
Inlet-03C	Olive Ave	244+40	DA-3A	COP P-1569 M-1	6	7.2	0.0043	2.07	2.35	2.18	93%	0.17	Inlet-04	17.5	11.5	Yes
Inlet-04C	Olive Ave	252+40	DA-4A	COP P-1569 M-1	6	7.2	0.0048	2.20	2.37	2.17	92%	0.20	Inlet-05	17.5	11.7	Yes
Inlet-05C	Olive Ave	260+40	DA-5A	COP P-1569 M-1	6	7.2	0.0058	2.51	2.71	2.33	86%	0.38	Inlet-06	17.5	11.7	Yes
Inlet-06C	Olive Ave	264+68	DA-6A	COP P-1569 M-1	6	7.2	0.0064	2.00	2.42	2.13	88%	0.29	Inlet-07	17.5	10.9	Yes
Inlet-07C	Olive Ave	270+73	DA-7A	COP P-1569 M-1	10	10.4	0.0045	2.73	3.02	2.58	85%	0.44	End of Project	17.5	12.9	Yes
Olive Avenue Eastbound Lanes																
Inlet-101C	Olive Ave	228+40	DA-101A	COP P-1569 M-1	6	7.2	0.0050	2.20	2.20	2.05	93%	0.15	Inlet-102	17.5	11.1	Yes
Inlet-102C	Olive Ave	236+40	DA-102A	COP P-1569 M-1	6	7.2	0.0063	2.25	2.40	2.13	89%	0.27	Inlet-103	17.5	10.9	Yes
Inlet-103C	Olive Ave	244+40	DA-103A	COP P-1569 M-1	6	7.2	0.0043	2.12	2.39	2.21	92%	0.18	Inlet-104	17.5	11.8	Yes
Inlet-104C	Olive Ave	252+40	DA-104A	COP P-1569 M-1	6	7.2	0.0047	2.17	2.35	2.16	92%	0.19	Inlet-105	17.5	11.5	Yes
Inlet-105C	Olive Ave	260+40	DA-105A	COP P-1569 M-1	6	7.2	0.0057	2.43	2.62	2.28	87%	0.34	Inlet-106	17.5	11.6	Yes
Inlet-106C	Olive Ave	264+76	DA-106A	COP P-1569 M-1	6	7.2	0.0065	2.27	2.61	2.24	86%	0.37	Inlet-203	17.5	11.2	Yes
Inlet-107C	Olive Ave	270+73	DA-107A	COP P-1569 M-1	6	7.2	0.0044	1.53	1.53	1.53	100%	0.00	End of Project	17.5	9.7	Yes
Reems Road North of Olive Avenue Intersection																
Inlet-201C	Reems Rd	51+38	DA-201A	COP P-1569 M-1	6	7.2	0.0050	1.80	1.80	1.76	98%	0.04	Inlet-06	12	10.1	Yes
Inlet-202C	Reems Rd	51+38	DA-202A	COP P-1569 M-1	6	7.2	0.0049	1.34	1.34	1.34	100%	0.00	Inlet-07	12	8.9	Yes
Reems Road South of Olive Avenue Intersection																
Inlet-203C	Reems Rd	46+60	DA-203A	COP P-1569 M-1	6	7.2	0.0096	1.00	1.37	1.34	98%	0.03	End of Project	12	7.7	Yes
Inlet-204C	Reems Rd	46+75	DA-204A	COP P-1569 M-1	6	7.2	0.0098	1.23	1.23	1.22	99%	0.01	End of Project	12	7.3	Yes

Notes:
1) Effective opening for curb inlets is 80%. If a grate is included (Modified COP P-1572, ADOT C-15.80), a 50% clogging factor is appied.
2) Captured flow calculations were performed using Bentley Flowmaster V8i.

Inlet-01C - Sta 228+40 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.22	ft³/s
Slope	0.00500	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	92.71	%
Intercepted Flow	2.06	ft³/s
Bypass Flow	0.16	ft³/s
Spread	10.20	ft
Depth	0.28	ft
Flow Area	1.12	ft²
Gutter Depression	0.08	ft
Total Depression	0.24	ft
Velocity	1.99	ft/s
Equivalent Cross Slope	0.08410	ft/ft
Length Factor	0.77	
Total Interception Length	9.39	ft

Worksheet for Inlet-02C-Sta 236+40 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.40	ft³/s
Slope	0.00630	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	88.61	%
Intercepted Flow	2.13	ft³/s
Bypass Flow	0.27	ft³/s
Spread	10.02	ft
Depth	0.28	ft
Flow Area	1.08	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.22	ft/s
Equivalent Cross Slope	0.08585	ft/ft
Length Factor	0.70	
Total Interception Length	10.27	ft

Worksheet for Inlet-03C-Sta 244+40 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.35	ft³/s
Slope	0.00430	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	92.93	%
Intercepted Flow	2.18	ft³/s
Bypass Flow	0.17	ft³/s
Spread	10.76	ft
Depth	0.30	ft
Flow Area	1.24	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.90	ft/s
Equivalent Cross Slope	0.08187	ft/ft
Length Factor	0.77	
Total Interception Length	9.34	ft

Worksheet for Inlet-04C-Sta 252+40 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.37	ft³/s
Slope	0.00480	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	91.68	%
Intercepted Flow	2.17	ft³/s
Bypass Flow	0.20	ft³/s
Spread	10.55	ft
Depth	0.29	ft
Flow Area	1.19	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.99	ft/s
Equivalent Cross Slope	0.08294	ft/ft
Length Factor	0.75	
Total Interception Length	9.62	ft

Worksheet for Inlet-05C-Sta 260+40 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.71	ft³/s
Slope	0.00580	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	85.98	%
Intercepted Flow	2.33	ft³/s
Bypass Flow	0.38	ft³/s
Spread	10.73	ft
Depth	0.29	ft
Flow Area	1.23	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.20	ft/s
Equivalent Cross Slope	0.08203	ft/ft
Length Factor	0.66	
Total Interception Length	10.84	ft

Worksheet for Inlet-06C-Sta 264+71 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.42	ft³/s
Slope	0.00640	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	88.21	%
Intercepted Flow	2.13	ft³/s
Bypass Flow	0.29	ft³/s
Spread	10.02	ft
Depth	0.28	ft
Flow Area	1.08	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.23	ft/s
Equivalent Cross Slope	0.08584	ft/ft
Length Factor	0.70	
Total Interception Length	10.36	ft

Worksheet for Inlet-07C-Sta 270+73 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	3.02	ft³/s
Slope	0.00450	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	85.55	%
Intercepted Flow	2.58	ft³/s
Bypass Flow	0.44	ft³/s
Spread	11.83	ft
Depth	0.32	ft
Flow Area	1.48	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.04	ft/s
Equivalent Cross Slope	0.07683	ft/ft
Length Factor	0.66	
Total Interception Length	10.93	ft

Worksheet for Inlet-101C-Sta 228+40 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.20	ft³/s
Slope	0.00500	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	93.20	%
Intercepted Flow	2.05	ft³/s
Bypass Flow	0.15	ft³/s
Spread	10.14	ft
Depth	0.28	ft
Flow Area	1.11	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.99	ft/s
Equivalent Cross Slope	0.08517	ft/ft
Length Factor	0.78	
Total Interception Length	9.29	ft

Worksheet for Inlet-102C-Sta 236+40 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.40	ft³/s
Slope	0.00630	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	88.61	%
Intercepted Flow	2.13	ft³/s
Bypass Flow	0.27	ft³/s
Spread	10.02	ft
Depth	0.28	ft
Flow Area	1.08	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.22	ft/s
Equivalent Cross Slope	0.08585	ft/ft
Length Factor	0.70	
Total Interception Length	10.27	ft

Worksheet for Inlet-103C-Sta 244+40 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.39	ft³/s
Slope	0.00430	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	92.51	%
Intercepted Flow	2.21	ft³/s
Bypass Flow	0.18	ft³/s
Spread	10.84	ft
Depth	0.30	ft
Flow Area	1.25	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.91	ft/s
Equivalent Cross Slope	0.08148	ft/ft
Length Factor	0.76	
Total Interception Length	9.44	ft

Worksheet for Inlet-104C-Sta 252+40 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.35	ft³/s
Slope	0.00470	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	92.10	%
Intercepted Flow	2.16	ft³/s
Bypass Flow	0.19	ft³/s
Spread	10.56	ft
Depth	0.29	ft
Flow Area	1.20	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.97	ft/s
Equivalent Cross Slope	0.08289	ft/ft
Length Factor	0.76	
Total Interception Length	9.52	ft

Worksheet for Inlet-105C-Sta 260+40 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.62	ft³/s
Slope	0.00570	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	87.15	%
Intercepted Flow	2.28	ft³/s
Bypass Flow	0.34	ft³/s
Spread	10.62	ft
Depth	0.29	ft
Flow Area	1.21	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.17	ft/s
Equivalent Cross Slope	0.08261	ft/ft
Length Factor	0.68	
Total Interception Length	10.59	ft

Worksheet for Inlet-106C-Sta 264+71 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	2.61	ft³/s
Slope	0.00650	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	85.85	%
Intercepted Flow	2.24	ft³/s
Bypass Flow	0.37	ft³/s
Spread	10.31	ft
Depth	0.29	ft
Flow Area	1.14	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.28	ft/s
Equivalent Cross Slope	0.08423	ft/ft
Length Factor	0.66	
Total Interception Length	10.87	ft

Worksheet for Inlet-107C-Sta 270+73 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	1.53	ft³/s
Slope	0.00440	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	99.96	%
Intercepted Flow	1.53	ft³/s
Bypass Flow	0.00	ft³/s
Spread	8.91	ft
Depth	0.26	ft
Flow Area	0.87	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.75	ft/s
Equivalent Cross Slope	0.09260	ft/ft
Length Factor	0.99	
Total Interception Length	7.30	ft

Worksheet for Inlet-201C - Station 51+38 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	1.80	ft³/s
Slope	0.00500	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	97.54	%
Intercepted Flow	1.76	ft³/s
Bypass Flow	0.04	ft³/s
Spread	9.30	ft
Depth	0.27	ft
Flow Area	0.95	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.90	ft/s
Equivalent Cross Slope	0.09009	ft/ft
Length Factor	0.87	
Total Interception Length	8.25	ft

Worksheet for Inlet-202C-Station 51+38 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	1.34	ft³/s
Slope	0.00490	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	100.00	%
Intercepted Flow	1.34	ft³/s
Bypass Flow	0.00	ft³/s
Spread	8.20	ft
Depth	0.24	ft
Flow Area	0.75	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	1.78	ft/s
Equivalent Cross Slope	0.09751	ft/ft
Length Factor	1.04	
Total Interception Length	6.91	ft

Worksheet for Inlet-203C-Station 46+60 Lt

Project Description

Solve For	Efficiency

Input Data

Discharge	1.37	ft³/s
Slope	0.00950	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	98.12	%
Intercepted Flow	1.34	ft³/s
Bypass Flow	0.03	ft³/s
Spread	7.12	ft
Depth	0.22	ft
Flow Area	0.59	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.34	ft/s
Equivalent Cross Slope	0.10604	ft/ft
Length Factor	0.89	
Total Interception Length	8.09	ft

Worksheet for Inlet-204C-Station 46+75 Rt

Project Description

Solve For	Efficiency

Input Data

Discharge	1.23	ft³/s
Slope	0.00940	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	2.00	ft

Results

Efficiency	99.54	%
Intercepted Flow	1.22	ft³/s
Bypass Flow	0.01	ft³/s
Spread	6.78	ft
Depth	0.22	ft
Flow Area	0.54	ft²
Gutter Depression	0.08	ft
Total Depression	0.25	ft
Velocity	2.28	ft/s
Equivalent Cross Slope	0.10895	ft/ft
Length Factor	0.95	
Total Interception Length	7.58	ft

Appendix D.4

StormCAD Hydraulic Calculations and Profiles

Project: TT0561 - Olive Avenue Widening - L303 to Sarival Ave
Location: Surprize, AZ
Date: 4/11/2023
Subject: Inlet Results

Label	Downstream Conduit	Ground Elevation (ft)	Invert Elevation (ft)	Inlet Location	Headloss Coefficient (Standard)	Captured Flow (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
Area Drain-1	Pipe-201	1166.50	1162.74	On Grade	0.5	0.0	1166.17	1166.17	1166.17	1166.17
Area Drain-2	Pipe-202	1171.00	1162.32	On Grade	0.5	0.0	1166.17	1166.17	1166.17	1166.17
Drop Inlet	Pipe-500	1178.47	1170.47	In Sag	0.5	204.4	1175.65	1174.55	1177.86	1176.76
Inlet-1	Pipe-1	1174.47	1170.33	On Grade	0.5	2.0	1171.24	1171.09	1171.31	1171.39
Inlet-2	Pipe-2	1169.67	1165.67	On Grade	0.5	2.3	1166.67	1166.50	1166.74	1166.83
Inlet-5	Pipe-5	1154.42	1150.34	On Grade	0.5	2.3	1151.16	1151.11	1151.26	1151.21
Inlet-6	Pipe-6	1150.50	1146.42	On Grade	0.5	2.7	1148.19	1148.17	1148.23	1148.21
Inlet-7	Pipe-7	1147.14	1143.06	On Grade	0.5	1.3	1145.05	1145.04	1145.06	1145.05
Inlet-101	Pipe-101	1174.47	1170.80	On Grade	0.5	2.0	1171.43	1171.33	1171.62	1171.53
Inlet-102	Pipe-102	1169.67	1166.00	On Grade	0.5	2.4	1166.80	1166.75	1166.92	1166.86
Inlet-105	Pipe-105	1154.42	1149.70	On Grade	0.5	2.3	1151.09	1151.03	1151.14	1151.16
Inlet-106	Pipe-106	1150.26	1145.73	On Grade	0.5	2.3	1148.11	1148.05	1148.15	1148.18
Inlet-107	Pipe-107	1147.14	1142.43	On Grade	0.5	1.1	1145.03	1145.02	1145.04	1145.05
Inlet-201	Pipe-201	1148.95	1144.69	On Grade	0.5	1.5	1147.61	1147.56	1147.67	1147.67
Inlet-202	Pipe-202	1149.68	1145.50	On Grade	0.5	3.3	1147.76	1147.73	1147.81	1147.78

Project: TT0561 - Olive Avenue Widening - L303 to Sarival Ave
Location: Surprize, AZ
Date: 4/11/2023
Subject: Storm Drain Results

Label	Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (ft)	Slope (ft/ft)	Diameter (Inches)	# of Barrels	Manning's n	Velocity (ft/sec)	Flow (cfs) (cfs)	Full Flow Capacity (cfs)	Full Flow Capacity (%)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
Pipe-500	Drop Inlet	MH-1	1170.47	1169.93	80.0	0.007	60	1	0.013	12.4	204.4	214.0	95.5	1178.47	1180.14	1174.55	1174.13	1176.76	1176.22
Pipe-501	MH-1	MH-2	1169.83	1165.48	624.0	0.007	60	1	0.013	12.6	204.4	217.4	94.0	1180.14	1177.07	1173.91	1169.57	1176.12	1171.77
Pipe-503	MH-3	MH-4	1160.99	1156.86	530.0	0.008	60	1	0.013	10.4	204.4	229.9	88.9	1173.75	1170.55	1166.09	1162.82	1167.77	1164.51
Pipe-504	MH-4	Outfall into ADOT Box Culvert	1156.76	1156.45	87.3	0.004	60	1	0.013	10.4	204.4	155.2	131.7	1170.55	1169.25	1162.49	1161.95	1164.17	1163.63
Pipe-101	Inlet-101	Inlet-1	1170.80	1170.43	74.0	0.005	18	1	0.013	3.6	2.0	7.4	26.7	1174.47	1174.47	1171.33	1171.24	1171.53	1171.31
Pipe-1	Inlet-1	Outlet at Basin-1	1170.33	1170.03	22.5	0.013	18	1	0.013	6.2	4.0	12.1	32.8	1174.47	1172.00	1171.09	1171.00	1171.39	1171.17
Pipe-201	Area Drain-1	Area Drain-2	1162.74	1162.50	77.5	0.003	18	1	0.013	0.0	0.0	5.9	0.0	1166.50	1171.00	1166.17	1166.17	1166.17	1166.17
Pipe-202	Area Drain-2	MH-3	1162.32	1162.25	19.5	0.004	18	1	0.013	0.0	0.0	6.3	0.0	1171.00	1173.75	1166.17	1166.17	1166.17	1166.17
Pipe-102	Inlet-102	Inlet-2	1166.00	1165.77	76.0	0.003	18	1	0.013	3.1	2.4	5.8	41.4	1169.67	1169.67	1166.75	1166.67	1166.86	1166.74
Pipe-2	Inlet-2	Outlet at Basin-2	1165.67	1165.52	22.0	0.007	18	1	0.013	5.0	4.7	8.7	53.6	1169.67	1167.50	1166.50	1166.50	1166.83	1166.72
Pipe-5	Inlet-5	Inlet-105	1150.34	1149.95	76.0	0.005	18	1	0.013	3.8	2.3	7.5	31.1	1154.42	1154.42	1151.11	1151.09	1151.21	1151.14
Pipe-105	Inlet-105	Outlet at Basin-5	1149.70	1149.06	25.0	0.026	18	1	0.013	8.1	4.7	16.8	27.7	1154.42	1151.00	1151.03	1151.00	1151.16	1151.11
Pipe-6	Inlet-6	Inlet-106	1146.42	1145.98	88.0	0.005	18	1	0.013	1.5	2.7	7.4	36.1	1150.50	1150.26	1148.17	1148.11	1148.21	1148.15
Pipe-106	Inlet-106	Outlet at Basin-6	1145.73	1145.52	24.0	0.009	18	1	0.013	2.8	5.0	9.8	50.5	1150.26	1147.50	1148.05	1148.00	1148.18	1148.12
Pipe-7	Inlet-7	Inlet-107	1143.06	1142.68	76.0	0.005	18	1	0.013	0.7	1.3	7.4	17.0	1147.14	1147.14	1145.04	1145.03	1145.05	1145.04
Pipe-107	Inlet-107	Outlet at Basin-7	1142.43	1142.04	38.5	0.010	18	1	0.013	1.4	2.4	10.6	22.5	1147.14	1144.00	1145.02	1145.00	1145.05	1145.03
Pipe-202	Inlet-202	Inlet-201	1145.50	1144.94	115.5	0.005	18	1	0.013	1.9	3.3	7.3	45.5	1149.68	1148.95	1147.73	1147.61	1147.78	1147.67
Pipe-201	Inlet-201	Outlet at Basin-201	1144.69	1144.52	27.0	0.006	18	1	0.013	2.7	4.8	8.3	57.5	1148.95	1146.50	1147.56	1147.50	1147.67	1147.61
Pipe 502A	MH-2	MH-2A	1165.38	1163.89	213.0	0.007	60	1	0.013	12.6	204.4	217.8	93.8	1177.07	1176.04	1169.46	1168.28	1171.67	1170.22
Pipe 502B	MH-2A	MH-3	1163.79	1161.09	394.0	0.007	60	1	0.013	12.5	204.4	215.6	94.8	1176.04	1173.75	1168.18	1166.17	1170.13	1167.86

Project: TT0561 - Olive Avenue Widening - L303 to Sarival Ave
Location: Surprize, AZ
Date: 4/11/2023
Subject: Manhole Results

Label	Downstream Conduit	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Headloss Method	Headloss Coefficient	Headloss (ft)	Velocity (ft/sec)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
MH-1	Pipe-501	1180.14	1169.93	204.4	Standard	0.1	0.22	11.92	1173.49	1173.91	1176.22	1176.12
MH-2	Pipe-502A	1177.07	1165.48	204.4	Standard	0.05	0.11	11.92	1169.28	1169.46	1171.77	1171.67
MH-2A	Pipe-502B	1176.04	1163.89	204.4	Standard	0.05	0.10	11.19	0.00	1168.18	1170.22	1170.13
MH-3	Pipe-503	1173.75	1162.25	204.4	Standard	0.05	0.08	10.41	1166.17	1166.09	1167.86	1167.77
MH-4	Pipe-504	1170.55	1156.86	204.4	Standard	0.2	0.34	10.41	1162.82	1162.49	1164.51	1164.17

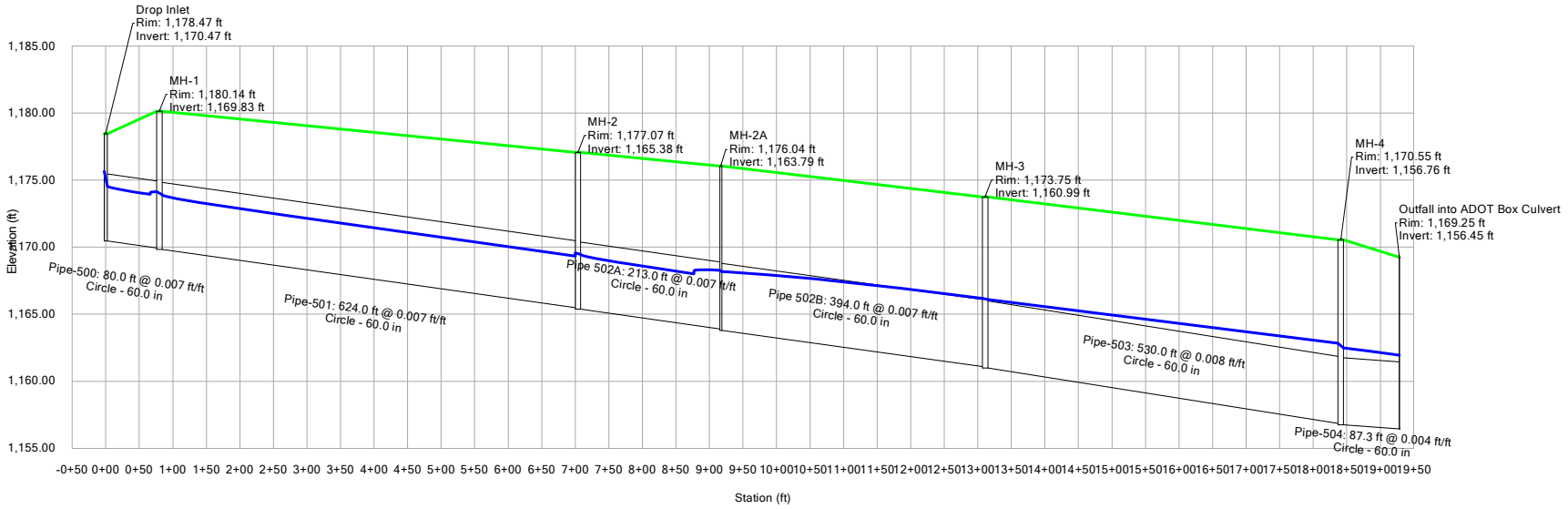
Project: TT0561 - Olive Avenue Widening - L303 to Sarival Ave
Location: Surprize, AZ
Date: 4/11/2023
Subject: Outfall Results

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	User Defined Tailwater (ft)	Hydraulic Grade (ft) (ft)	Total Flow (cfs)	Notes
Outfall into ADOT Box Culvert	1169.25	1156.45	User Defined Tailwater	1161.95	1161.95	204.4	Estimated HGL from HEC-RAS results between Stations 24350.58 & 23856.38
Outlet at Basin-1	1172.00	1170.03	User Defined	1171.00	1171.00	3.8	HWE at Basin-1
Outlet at Basin-2	1167.50	1165.00	User Defined	1166.50	1166.50	4.4	HWE at Basin-2
Outlet at Basin-5	1151.00	1149.00	User Defined	1151.00	1151.00	4.6	HWE at Basin-5
Outlet at Basin-6	1147.50	1145.50	User Defined	1148.00	1148.00	5.2	HWE at Basin-6
Outlet at Basin-7	1144.00	1142.00	User Defined	1145.00	1145.00	3.4	HWE at Basin-7
Outlet at Basin-201	1146.50	1144.50	User Defined	1147.50	1147.50	4.8	HWE at Basin-201

Notes:

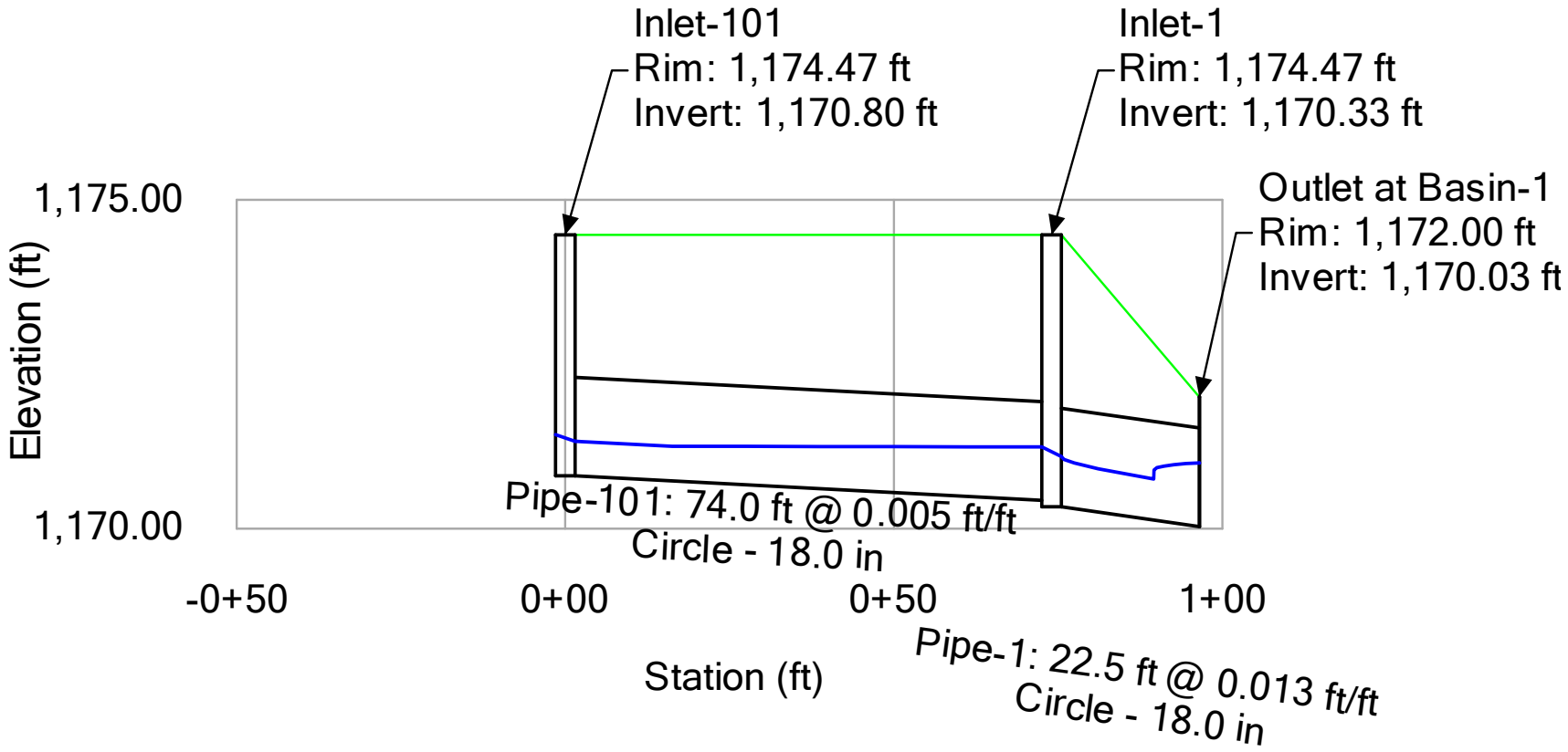
1) HWE at Olive Ave ADOT Box Culvert estimated based on results from the Final Drainage Report for the SR 303L - Glendale Ave to Peoria Ave (TRACS No. H7874 01 C) by Michael Baker Jr, June 2011

Profile Report
Engineering Profile - 60" Mainline Olive Sta 167+25 to Sta 186+75 (TT0561 Storm Drains.stsw)



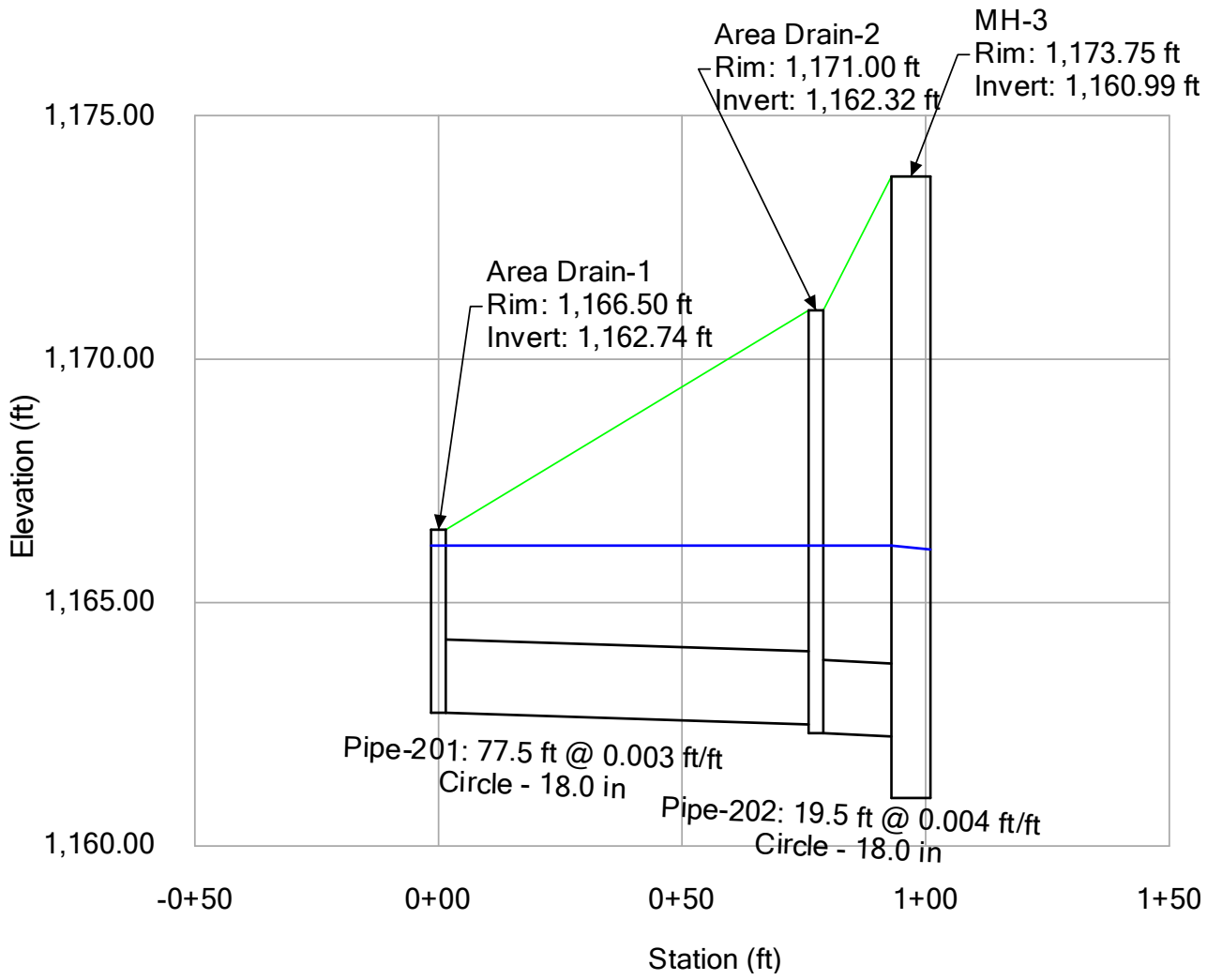
Profile Report

Engineering Profile - Inlet 101 to Basin-1 - Olive Sta 177+55 (TT0561 Storm Drains.stsw)



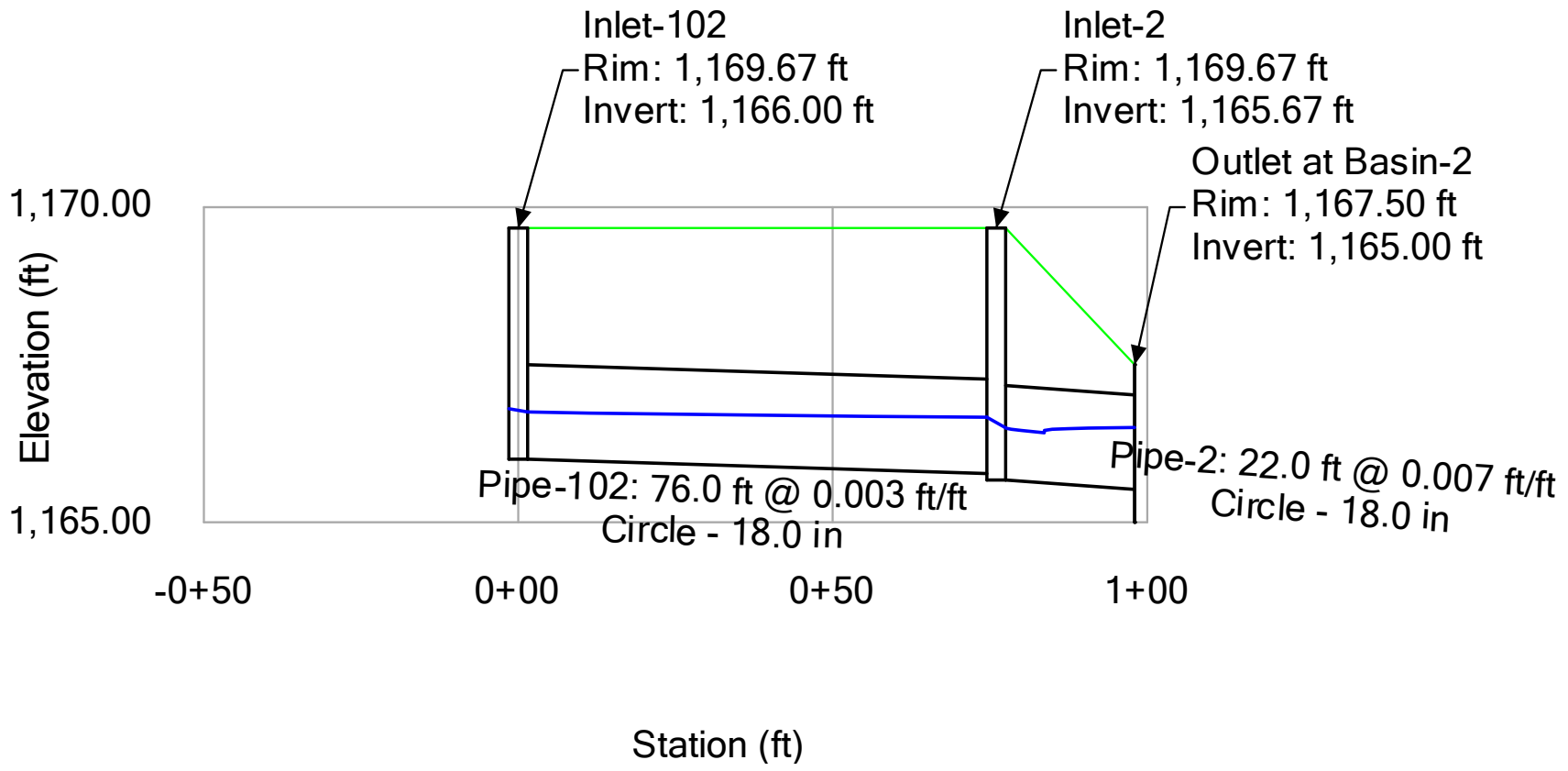
Profile Report

Engineering Profile - Area Drain-1 (Basin-2) to MH-3 - Olive (TT0561 Storm Drains.stsw)



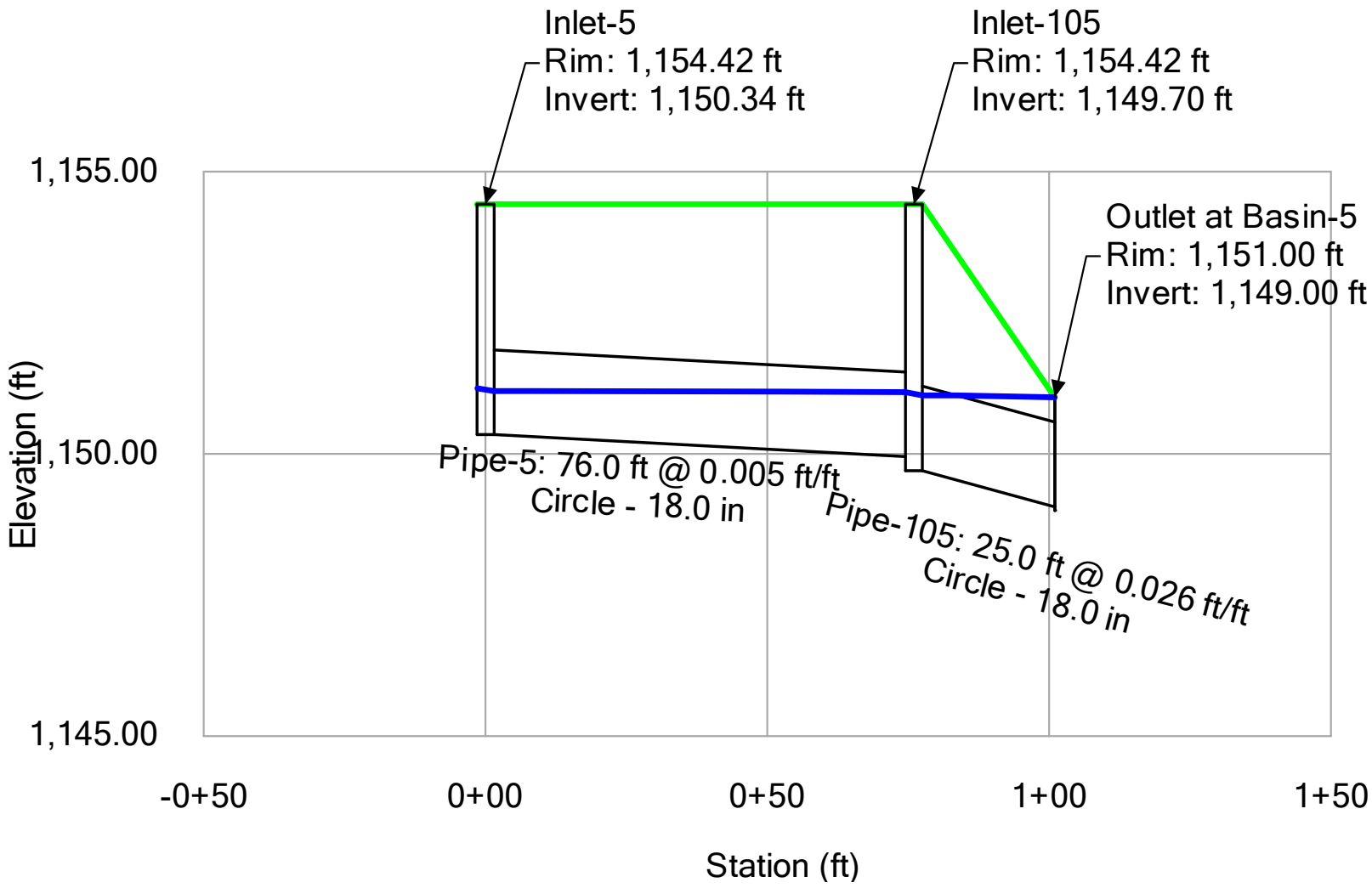
Profile Report

Engineering Profile - Inlet-102 to Basin-2 - Olive Sta 185+99 (TT0561 Storm Drains.stsw)



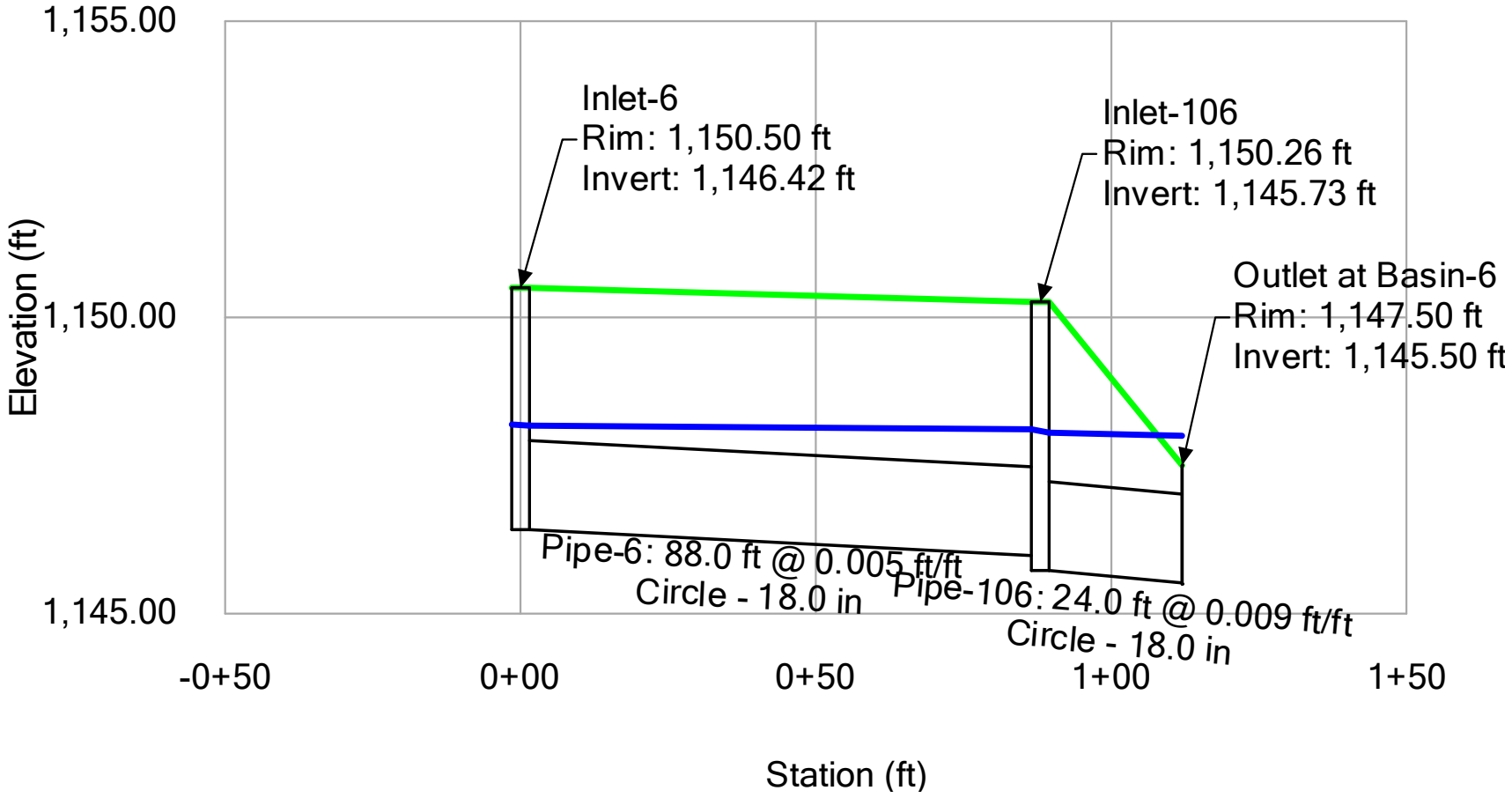
Profile Report

Engineering Profile - Inlet-5 to Basin-5 - Olive Sta 210+63 (TT0561 Storm Drains.stsw)



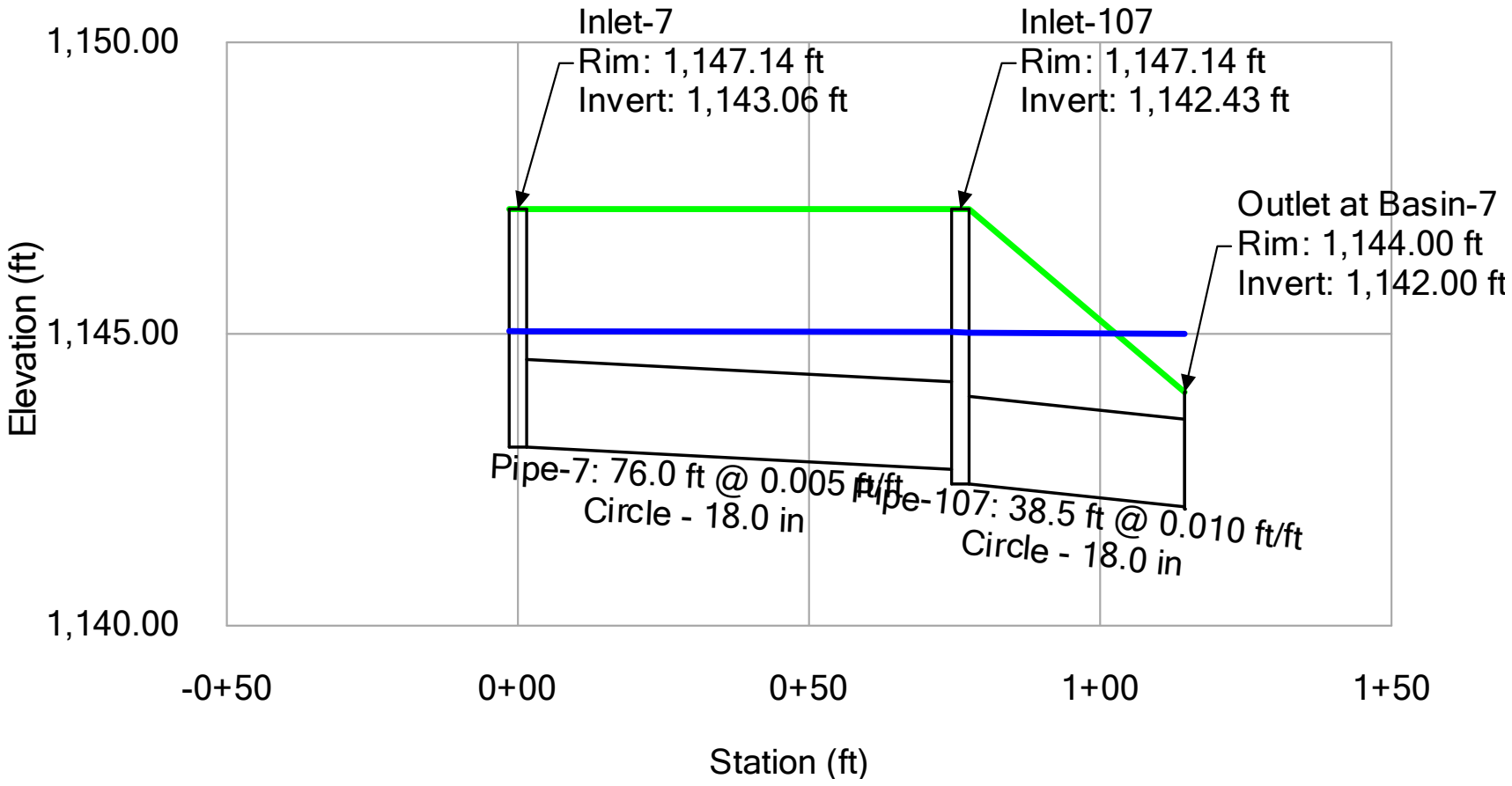
Profile Report

Engineering Profile - Inlet-6 to Basin-6 - Olive Sta 215+39 (TT0561 Storm Drains.stsw)



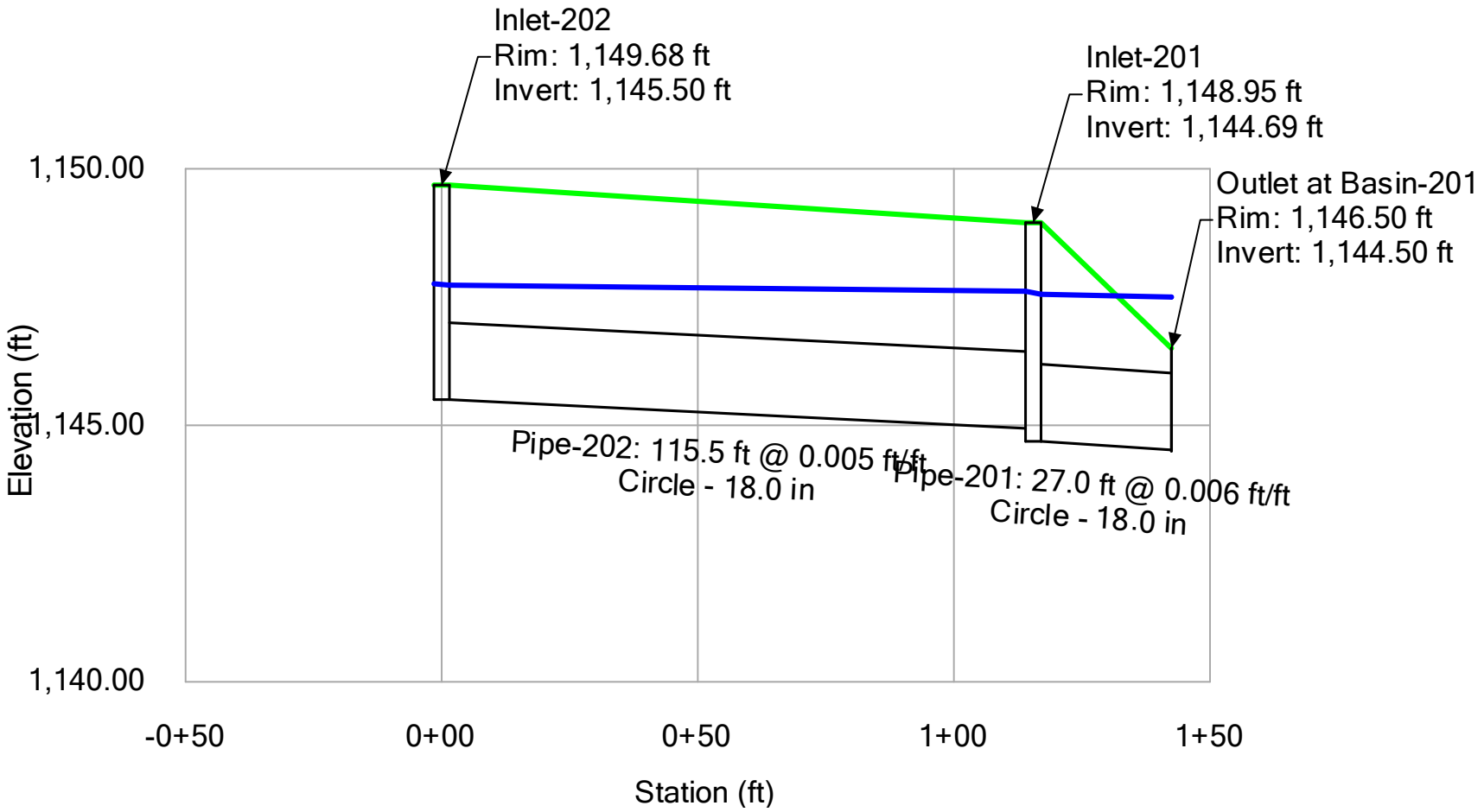
Profile Report

Engineering Profile - Inlet-7 to Basin-7 - Olive Sta 220+00 (TT0561 Storm Drains.stsw)



Profile Report

Engineering Profile - Inlet-202 to Basin-201 - Sarival Sta 25+50 (TT0561 Storm Drains.stsw)



Project: TT0562 - Olive Avenue Widening
Location: Surprise, Arizona
Date: April 26, 2023
Subject StormCAD Inlet Results

Label	Downstream Conduit	Ground Elevation (ft)	Invert Elevation (ft)	Inlet Location	Headloss Coefficient (Standard)	Captured Flow (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
Inlet-01C	Pipe-01C	1143.56	1137.39	On Grade	0.5	Flow	1138.84	1138.83	1138.86	1138.85
Inlet-02C	Pipe-02C	1139.04	1133.62	On Grade	0.5	2.1	1135.08	1135.07	1135.11	1135.09
Inlet-03C	Pipe-03C	1135.17	1129.85	On Grade	0.5	2.1	1131.32	1131.31	1131.35	1131.33
Inlet-04C	Pipe-04C	1131.93	1125.17	On Grade	0.5	2.2	1126.64	1126.63	1126.66	1126.65
Inlet-05C	Pipe-05C	1127.90	1122.79	On Grade	0.5	2.2	1124.26	1124.24	1124.29	1124.27
Inlet-06C	Pipe-06C	1125.74	1119.68	On Grade	0.5	2.3	1120.33	1120.23	1120.54	1120.43
Inlet-07C	Pipe-07C	1123.73	1118.96	On Grade	0.5	2.1	1120.44	1120.43	1120.48	1120.46
Inlet-101C	Pipe-101C	1143.56	1136.91	On Grade	0.5	2.6	1138.80	1138.76	1138.82	1138.85
Inlet-102C	Pipe-102C	1139.54	1133.14	On Grade	0.5	2.1	1135.04	1135.00	1135.06	1135.09
Inlet-103C	Pipe-103C	1135.17	1129.37	On Grade	0.5	2.1	1131.28	1131.23	1131.30	1131.33
Inlet-104C	Pipe-104C	1131.94	1124.67	On Grade	0.5	2.2	1126.60	1126.55	1126.62	1126.64
Inlet-105C	Pipe-105C	1127.93	1122.26	On Grade	0.5	2.2	1124.20	1124.15	1124.23	1124.26
Inlet-106C	Pipe-106C	1125.77	1119.14	On Grade	0.5	2.3	1120.12	1119.97	1120.18	1120.26
Inlet-107C	Pipe-107C	1124.08	1118.42	On Grade	0.5	2.2	1120.38	1120.33	1120.41	1120.42
Inlet-201C	Pipe-201C	1125.78	1119.52	On Grade	0.5	1.5	1120.33	1120.20	1120.37	1120.45
Inlet-202C	Pipe-202C	1125.86	1120.02	On Grade	0.5	1.8	1120.53	1120.45	1120.69	1120.61
Inlet-203C	Pipe-203C	1122.86	1116.17	On Grade	0.5	1.3	1117.67	1117.65	1117.67	1117.68
Inlet-204C	Pipe-204C	1122.98	1116.66	On Grade	0.5	1.3	1117.68	1117.67	1117.69	1117.69

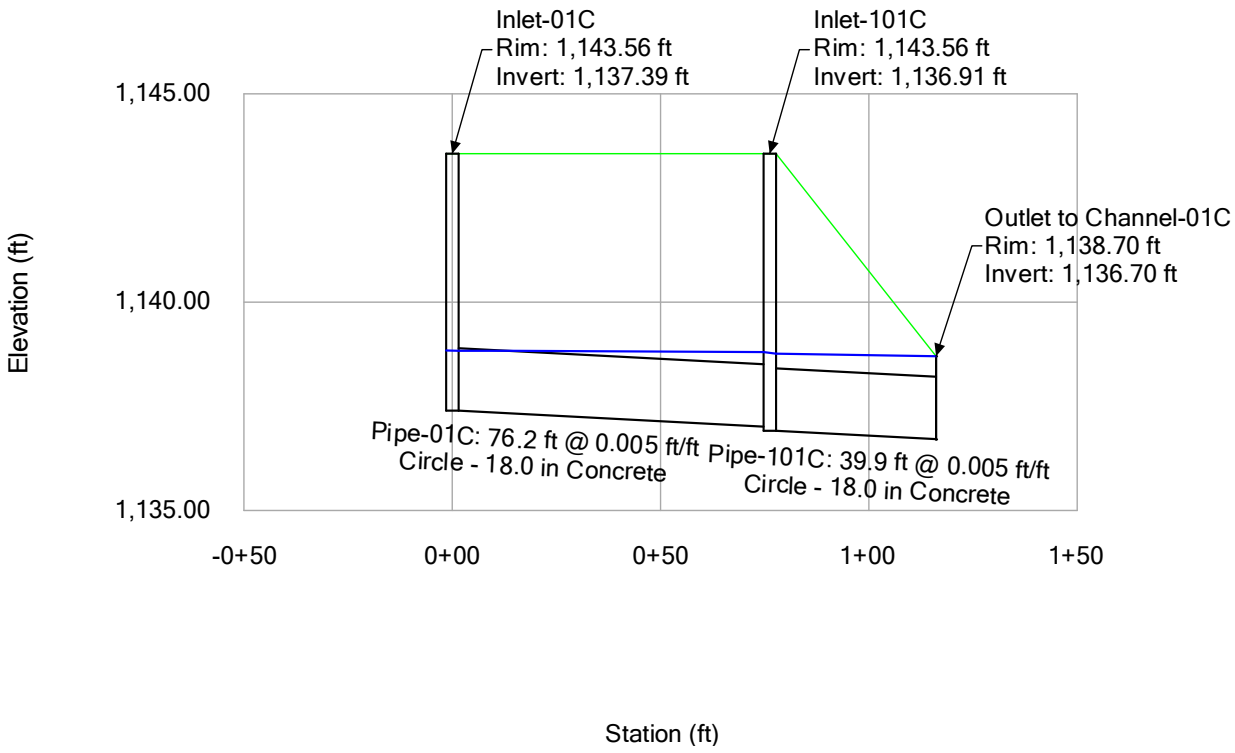
Project: TT0562 - Olive Avenue Widening
Location: Surprise, Arizona
Date: 14/26/2023
Subject StormCAD Storm Drain Results

Label	Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (ft)	Slope (ft/ft)	Diameter (Inches)	# of Barrels	Manning's n	Velocity (ft/sec)	Flow (cfs) (cfs)	Full Flow Capacity (cfs)	Full Flow Capacity (%)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
Pipe-03	Inlet-03C	Inlet-103C	1129.85	1129.47	76.2	0.005	18	1	0.013	3.65	2.18	7.42	29.4	1135.17	1135.17	1131.31	1131.28	1131.33	1131.3
Pipe-04	Inlet-04C	Inlet-104C	1125.17	1124.77	80.1	0.005	18	1	0.013	3.64	2.17	7.42	29.2	1131.93	1131.94	1126.63	1126.6	1126.65	1126.62
Pipe-05	Inlet-05C	Inlet-105C	1122.79	1122.36	87.1	0.005	18	1	0.013	3.7	2.33	7.38	31.6	1127.9	1127.93	1124.24	1124.2	1124.27	1124.23
Pipe-06	Inlet-06C	Inlet-106C	1119.68	1119.24	88.2	0.005	18	1	0.013	3.63	2.13	7.42	28.7	1125.74	1125.77	1120.23	1120.12	1120.43	1120.18
Pipe-07	Inlet-07C	Inlet-107C	1118.96	1118.52	88.2	0.005	18	1	0.013	3.82	2.58	7.42	34.8	1123.73	1124.08	1120.43	1120.38	1120.46	1120.41
Pipe-101	Inlet-101C	Outlet to Channel-01C	1136.91	1136.71	39.9	0.005	18	1	0.013	2.33	4.11	7.44	55.3	1143.56	1138.7	1138.76	1138.7	1138.85	1138.78
Pipe-102	Inlet-102C	Outlet to Channel-02C	1133.14	1132.94	39.9	0.005	18	1	0.013	2.41	4.26	7.44	57.3	1139.54	1134.93	1135	1134.93	1135.09	1135.02
Pipe-103	Inlet-103C	Outlet to Channel-03C	1129.37	1129.17	39.9	0.005	18	1	0.013	2.48	4.39	7.44	59	1135.17	1131.16	1131.23	1131.16	1131.33	1131.26
Pipe-104	Inlet-104C	Outlet to Channel-04C	1124.67	1124.5	34.4	0.005	18	1	0.013	2.45	4.33	7.38	58.6	1131.94	1126.49	1126.55	1126.49	1126.64	1126.58
Pipe-105	Inlet-105C	Outlet to Channel-05C	1122.26	1122.1	30.8	0.005	18	1	0.013	2.61	4.61	7.57	60.9	1127.93	1124.09	1124.15	1124.09	1124.26	1124.2
Pipe-106	Inlet-106C	Outlet to CBC-06	1119.14	1118.76	76.6	0.005	18	1	0.013	4.36	4.37	7.4	59.1	1125.77	1122.51	1119.97	1119.56	1120.26	1119.88
Pipe-107	Inlet-107C	Outlet to Basin-07	1118.42	1118.31	21.5	0.005	18	1	0.013	2.33	4.11	7.51	54.7	1124.08	1120.3	1120.33	1120.3	1120.42	1120.38
Pipe-201	Inlet-201C	Outlet to CBC-201	1119.52	1118.98	109.4	0.005	18	1	0.013	4.01	3.14	7.38	42.5	1125.78	1122.72	1120.2	1119.65	1120.45	1119.91
Pipe-202	Inlet-202C	Inlet-201C	1120.02	1119.62	80.2	0.005	18	1	0.013	3.18	1.34	7.42	18.1	1125.86	1125.78	1120.45	1120.33	1120.61	1120.37
Pipe-203	Inlet-203C	Outlet to Reems Channel	1116.17	1115.6	115.1	0.005	18	1	0.013	3.81	2.57	7.39	34.8	1122.86	1117.58	1117.65	1117.58	1117.68	1117.61
Pipe-204	Inlet-204C	Inlet-203C	1116.66	1116.27	77.6	0.005	18	1	0.013	3.12	1.23	7.45	16.5	1122.98	1122.86	1117.67	1117.67	1117.69	1117.67

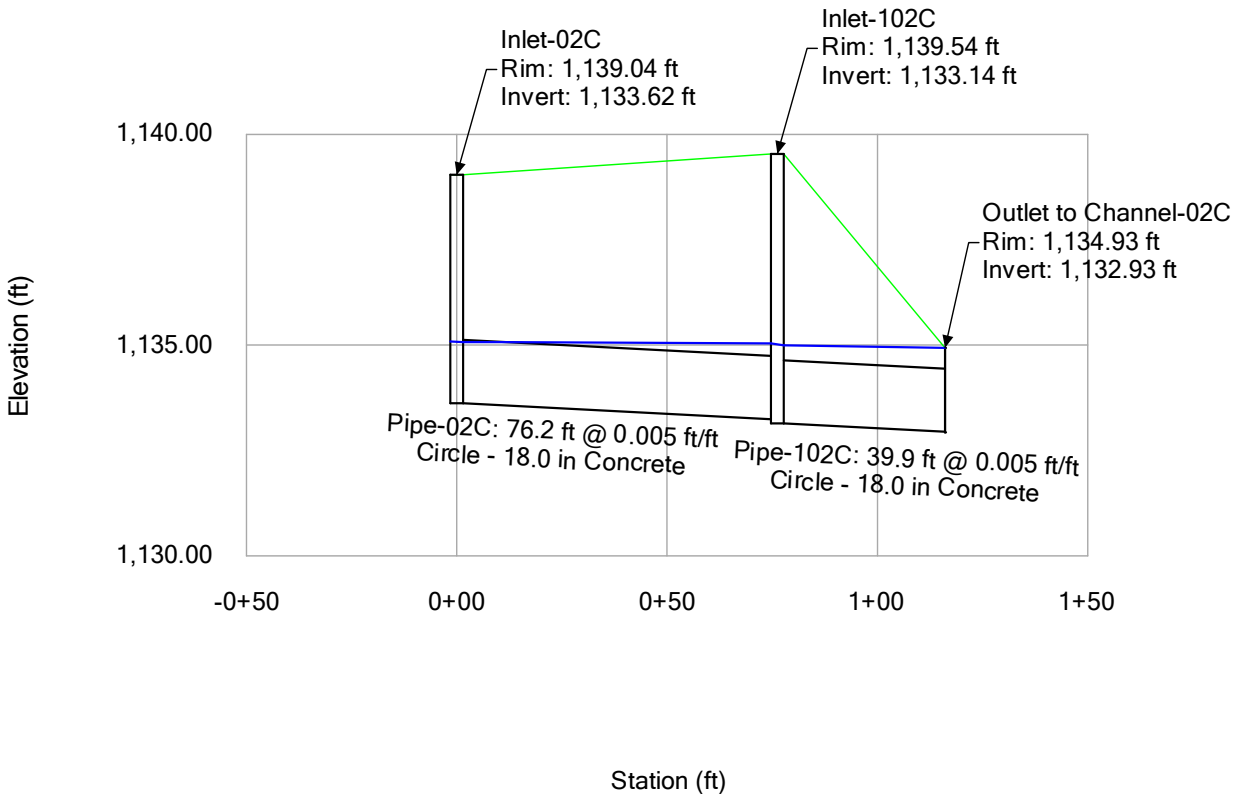
Project: TT0562 - Olive Avenue Widening
Location: Surprise, Arizona
Date: April 26, 2023
Subject StormCAD Outfall Results

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	User Defined Tailwater (ft)	Hydraulic Grade (ft) (ft)	Total Flow (cfs)	Notes
Outlet to Basin-07	1120.3	1118.3	User Defined Tailwater	1120.3	1120.3	4.11	
Outlet to CBC-06	1122.51	1116.51	User Defined Tailwater	1118.51	1119.56	4.37	
Outlet to CBC-201	1122.72	1116.73	User Defined Tailwater	1118.72	1119.65	3.14	
Outlet to Channel-01C	1138.7	1136.7	User Defined Tailwater	1138.7	1138.7	4.11	
Outlet to Channel-02C	1134.93	1132.93	User Defined Tailwater	1134.93	1134.93	4.26	
Outlet to Channel-03C	1131.16	1129.16	User Defined Tailwater	1131.16	1131.16	4.39	
Outlet to Channel-04C	1126.49	1124.49	User Defined Tailwater	1126.49	1126.49	4.33	
Outlet to Channel-05C	1124.09	1122.09	User Defined Tailwater	1124.09	1124.09	4.61	
Outlet to Reems Channel	1117.58	1115.58	User Defined Tailwater	1117.58	1117.58	2.57	

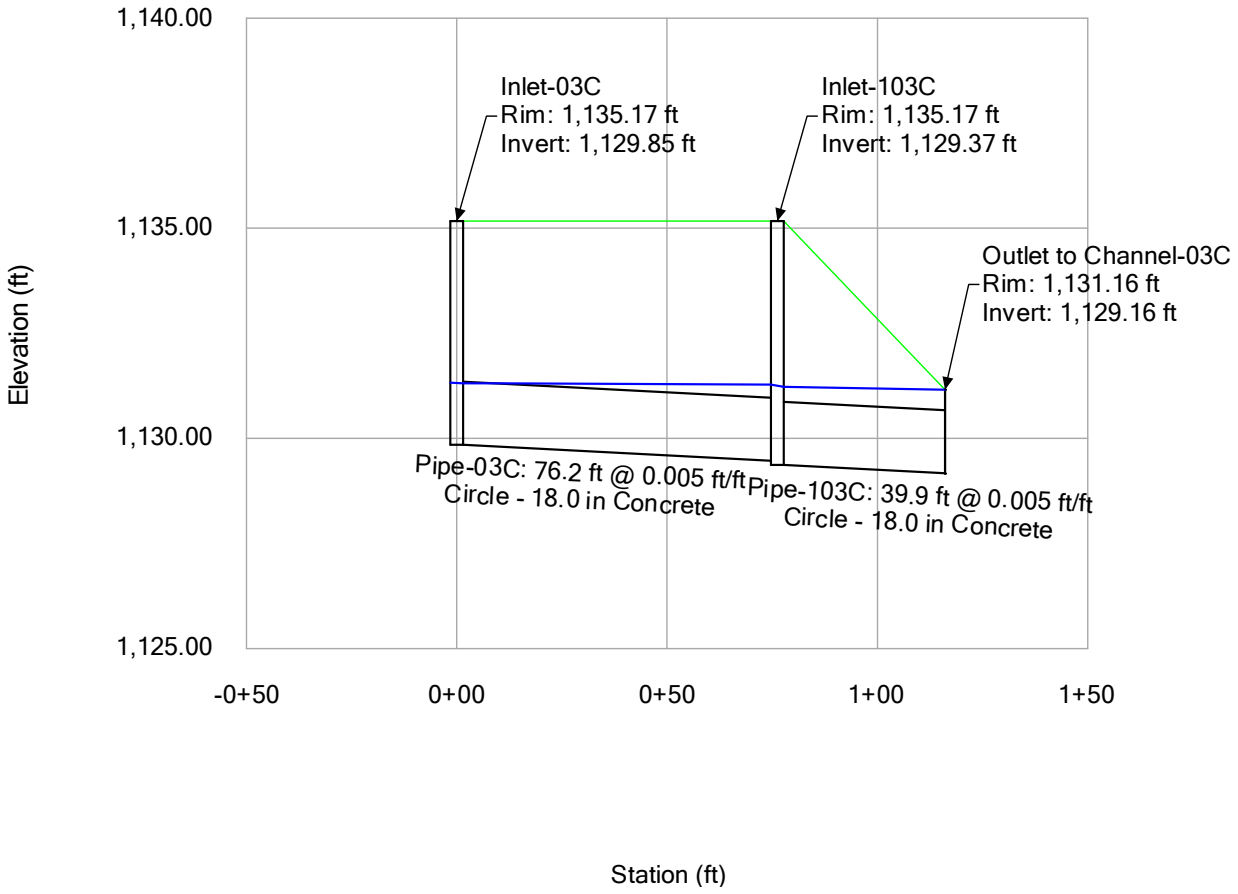
Profile Report
Engineering Profile - Inlet-01C to Outlet to Channel-01C (TT0562 Storm Drains.stsw)



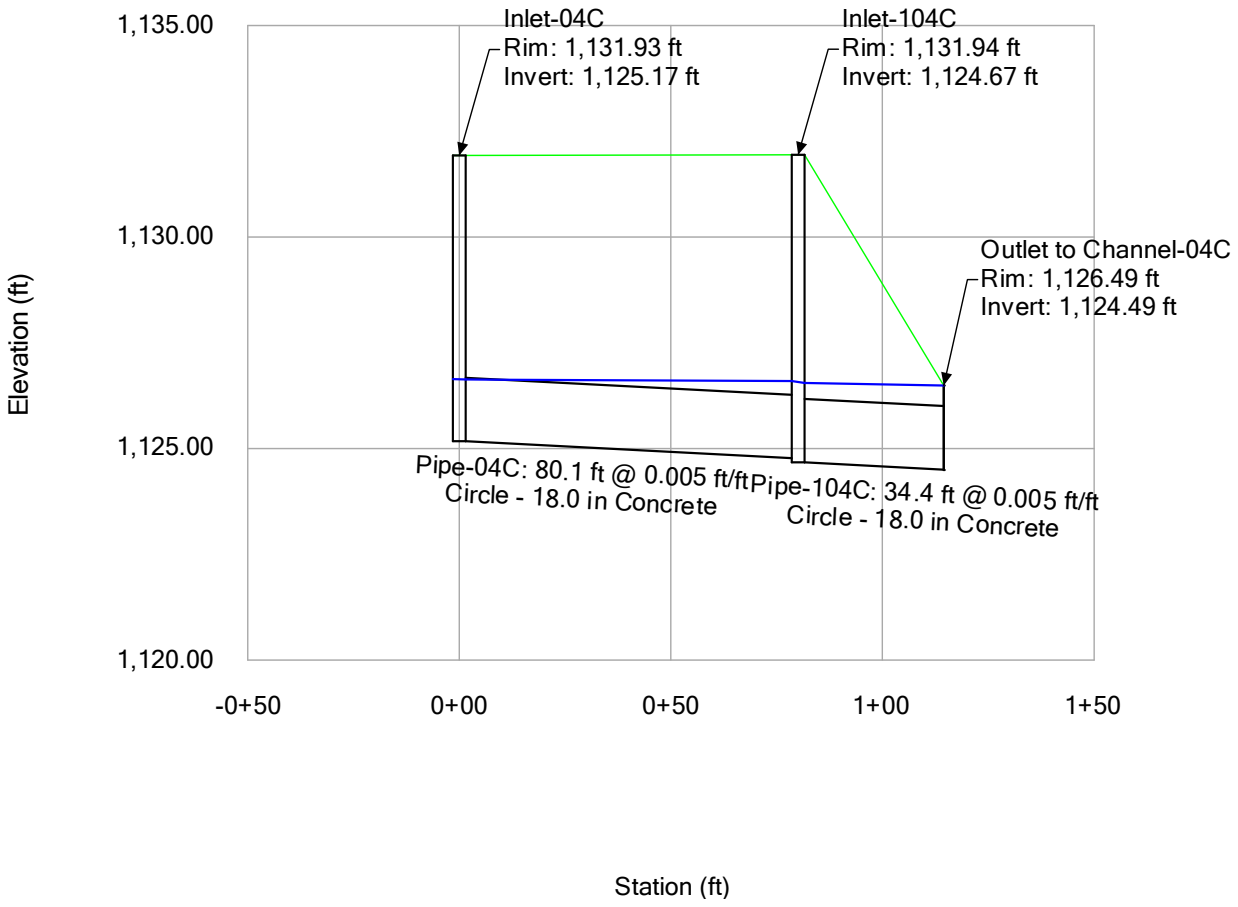
Profile Report
Engineering Profile - Inlet-02C to Outlet to Channel-02C (TT0562 Storm Drains.stsw)



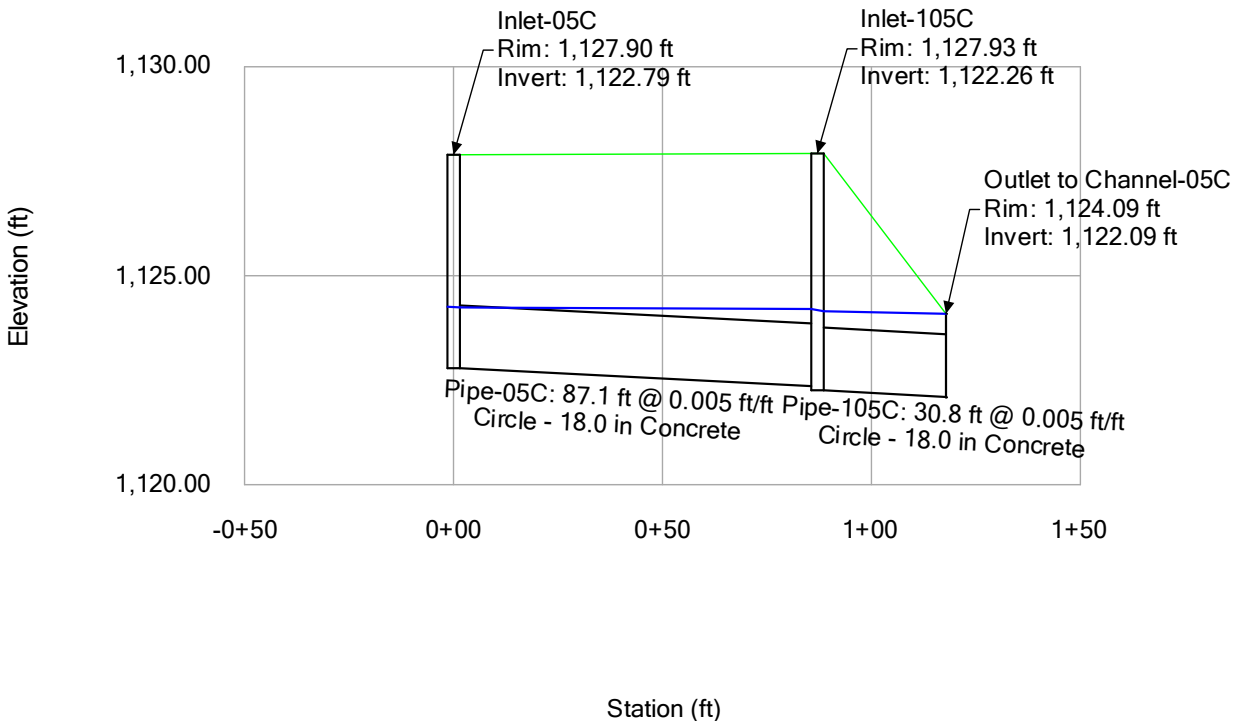
Profile Report
Engineering Profile - Inlet-03C to Outlet to Channel-03C (TT0562 Storm Drains.stsw)



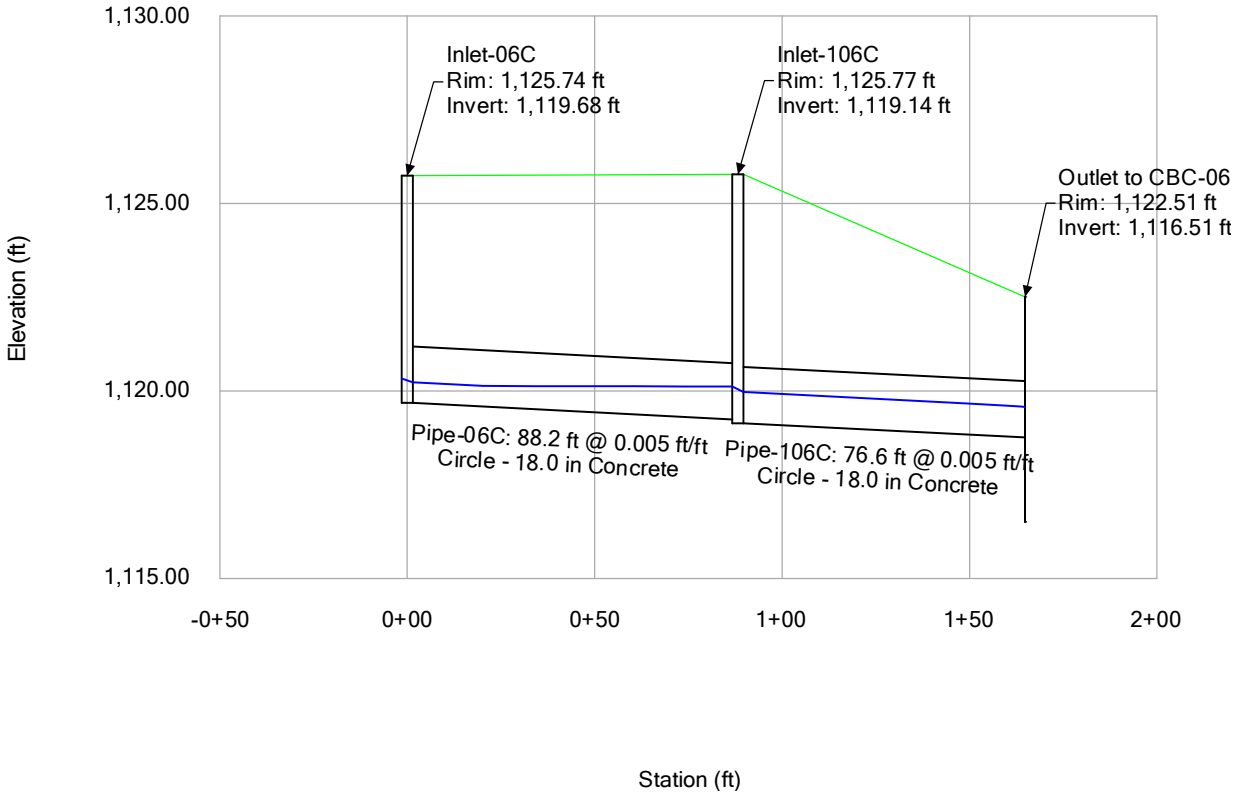
Profile Report
Engineering Profile - Inlet-04C to Outlet to Channel-04C (TT0562 Storm Drains.stsw)



Profile Report
Engineering Profile - Inlet-05C to Outlet to Channel-05C (TT0562 Storm Drains.stsw)



Profile Report
Engineering Profile - Inlet-06C to Outlet to CBC-06 (TT0562 Storm Drains.stsw)



Profile Report
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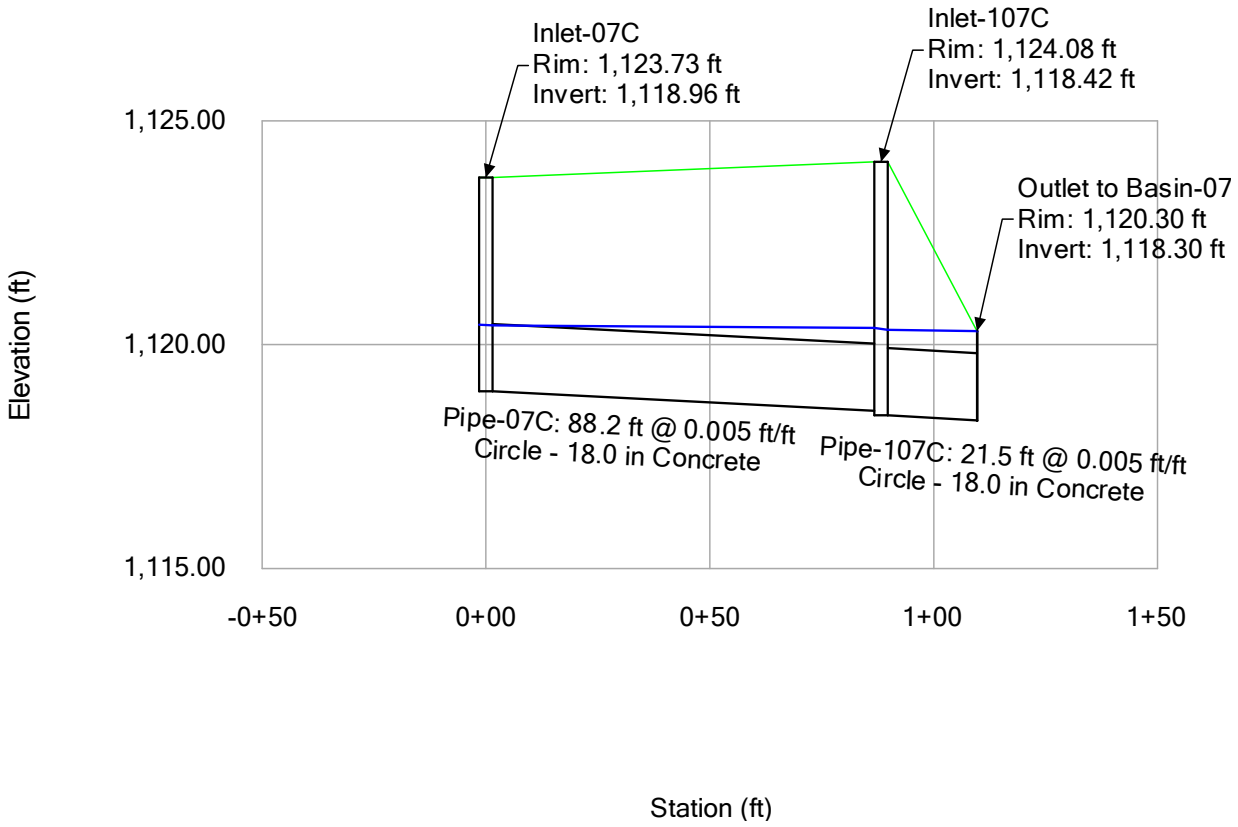

Profile Report
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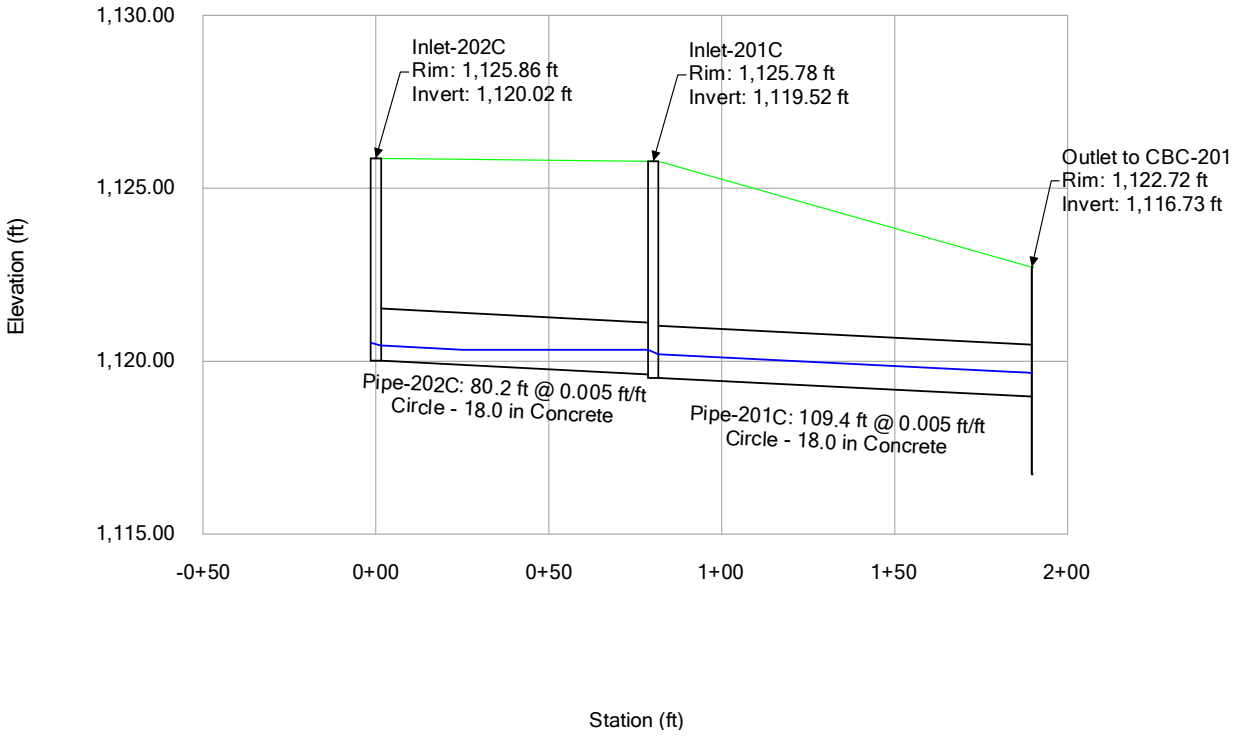
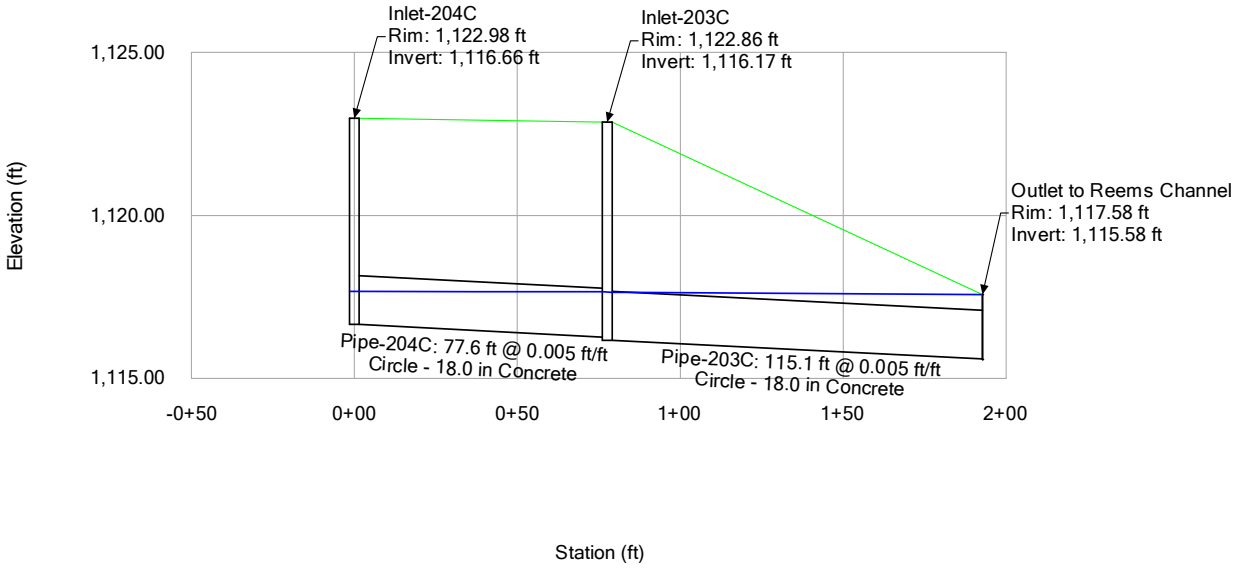


Profile Report
Engineering Profile - Inlet-204C to Outlet to Channel-203 (TT0562 Storm Drains.stsw)



Appendix D.5

Erosion Protection Summary

Project: TT0561 - Olive Avenue Widening
Location: Glendale, AZ
Date: April 13, 2023
Subject: Erosion Protection Summary

Source: Drainage Design Manual for Maricopa County, Arizona : Hydraulics 2013

Inlet and Outlet Riprap Calculations								
Inlet/Culvert/Ditch ID	**Road ID**	**Station**	**Scupper Size/ Culvert Diameter (ft)**	**Flow (cfs)**	**Calculated D_{50}**	**Design D_{50} (ft)**	**Apron Length (ft)**	**Apron Thickness (ft)**
Basin-1A (1 of 2)	Olive Ave	177+55	Weir Overflow	14	N/A	0.5	38	1.0
Basin-1A (2 of 2)	Olive Ave	174+80	Weir Overflow	42	N/A	0.5	38	1.0
Outlet at Basin-1	Olive Ave	177+55	1.5	4.0	0.13	0.5	8.0	1.0
Outlet at Basin-2	Olive Ave	185+99	1.5	4.7	0.18	0.5	8.0	1.0
Outlet at Basin-5	Olive Ave	210+63	1.5	4.7	0.09	0.5	8.0	1.0
Outlet at Basin-6	Olive Ave	215+39	1.5	5.0	0.11	0.5	8.0	1.0
Outlet at Channel 1	Olive Ave	220+00	1.5	2.4	0.05	0.5	8.0	1.0
Outlet at Basin-201	Sarival Ave	25+35	1.5	4.8	0.1	0.5	8.0	1.0
Inlet-03	Olive Ave	194+50	8	1.8	0.3	0.5	10.0	1.0
Inlet-04	Olive Ave	202+53	12	2.5	0.3	0.5	10.0	1.0
Inlet-103	Olive Ave	193+52	8	1.7	0.3	0.5	10.0	1.0
Inlet-104	Olive Ave	202+48	12	2.5	2.9	0.5	10.0	1.0
Inlet-301	Sarival Ave	17+54	12	1.9	0.2	0.5	10.0	1.0
Inlet-302	Sarival Ave	17+54	12	2.9	0.3	0.5	10.0	1.0
Culverts								
DW Culvert-1	Olive Ave	186+56	1.5	5.0	0.3	0.5	8.0	1.0
DW Culvert-2	Sarival Ave	37+25	1.5	5.0	0.3	0.5	8.0	1.0
Ditch/Channel Riprap								
Ditch-1G	Olive Ave	188+85	V-Ditch	4.4	0.2	0.5	24.0	1.0
Channel-4	Olive Ave	220+50 to 220+70	Offsite Channel	157.0	0.4	0.5	20.0	1.0
Ditch-2C	Sarival Ave	11+05	Weir Overflow	6.2	0.1	0.5	8.0	1.0
Ditch-2C	Sarival Ave	11+00 to 10+50	V-Ditch	6.2	0.1	0.5	50.0	1.0
Inlet-302	Sarival Ave	18+02	V-Ditch	2.9	0.2	0.5	24.0	1.0
Ditch-3B	Sarival Ave	30+82	V-Ditch	4.0	0.1	0.5	45	1.0

Notes:

1) Minimum D_{50} is 6-inches at outlets. D_{50} of 3-inches was used at the end of curb & gutter to protect the roadway section.

ID	Type	Section ID	Design Q (cfs)	Slope (ft/ft)	Width (ft)	Average Velocity (ft/s)	Specific Weight Stone (lb/cu ft)	Specific Weight Water (lb/cu ft)	Bank Slope (H:V)	Safety Factor	D50 (ft)	Thickness (ft)
CHANNEL-4	Channel Bed on Straight Reach		-	-	-	5.40	150.00	62.43		1.00	0.40	0.60
DITCH-1G	Channel Bed on Straight Reach		-	-	-	4.24	150.00	62.43		1.00	0.24	0.00
DITCH-2C	Channel Bed on Straight Reach		-	-	-	2.20	150.00	62.43		1.00	0.07	0.00
DITCH-3B	Channel Bed on Straight Reach		-	-	-	1.30	150.00	62.43		1.00	0.02	0.00
DW CULVERTS	Channel Bed on Straight Reach		-	-	-	4.80	150.00	62.43		1.00	0.31	0.00
INLET-03	Channel Bed on Straight Reach		-	-	-	4.70	150.00	62.43		1.00	0.30	0.00
INLET-04	Channel Bed on Straight Reach		-	-	-	4.60	150.00	62.43		1.00	0.29	0.00
INLET-103	Channel Bed on Straight Reach		-	-	-	4.60	150.00	62.43		1.00	0.29	0.00
INLET-104	Channel Bed on Straight Reach		-	-	-	4.60	150.00	62.43		1.00	0.29	0.00
INLET-301	Channel Bed on Straight Reach		-	-	-	4.10	150.00	62.43		1.00	0.23	0.00
INLET-302	Channel Bed on Straight Reach		-	-	-	4.90	150.00	62.43		1.00	0.33	0.00
OUT BASIN-201	Channel Bed on Straight Reach		-	-	-	2.70	150.00	62.43		1.00	0.10	0.00
OUTFALL BASIN-1	Channel Bed on Straight Reach		-	-	-	3.10	150.00	62.43		1.00	0.13	0.00
OUTFALL BASIN-2	Channel Bed on Straight Reach		-	-	-	3.60	150.00	62.43		1.00	0.18	0.00
OUTFALL BASIN-5	Channel Bed on Straight Reach		-	-	-	2.60	150.00	62.43		1.00	0.09	0.00
OUTFALL BASIN-6	Channel Bed on Straight Reach		-	-	-	2.90	150.00	62.43		1.00	0.11	0.00
OUTFALL BASIN-7	Channel Bed on Straight Reach		-	-	-	2.00	150.00	62.43		1.00	0.05	0.00

Project: TT0561 - Olive Avenue Widening - Sarival to Reems Road
Location: Surprise, Arizona
Date: April 26, 2023
Subject: Erosion Protection Summary
Source: Drainage Design Manual for Maricopa County, Arizona : Hydraulics 2013

Storm Drain Pipe Crossings									
Inlet/Box ID	Road ID	Station	Culvert Diameter (ft)	Design Flow (cfs)	Calculated D_{50}	Design D_{50} (ft)	Apron Length (ft)	Apron Thickness (ft)	Notes
Pipe Outlet-1	Sarival Ave	228+40	1.5	2.1	0.1	0.5	8.0	1.0	
Pipe Outlet-2	Olive Ave	244+40	1.5	2.2	0.1	0.5	8.0	1.0	
Pipe Outlet-3	Olive Ave	252+40	1.5	2.2	0.1	0.5	8.0	1.0	
Pipe Outlet-4	Olive Ave	244+40	1.5	2.2	0.1	0.5	8.0	1.0	
Pipe Outlet-5	Olive Ave	252+40	1.5	2.2	0.1	0.5	8.0	1.0	
Pipe Outlet-6	Olive Ave	46+60	1.5	1.3	0.1	0.5	8.0	1.0	
Pipe Outlet-7	Reems Rd	46+75	1.5	1.2	0.2	0.5	8.0	1.0	
Culverts									
Box-1	Olive Ave	See HEC-RAS Analyses and Results Tables	2-8'x5' (1' embedment)	158.0	0.3	0.75	80.0	1.5	9-inch D50
Box-2	Olive Ave		2-8'x5' (1' embedment)	158.0	0.3	0.75	33, 56	1.5	9-inch D50
Box-3	Olive Ave		2-8'x5' (1' embedment)	158.0	0.3	0.75	33, 56	1.5	9-inch D50
Box-4	Olive Ave		2 - 8'x4'	0.0	0.3	0.75	12.0	1.5	Upstream only. 9-inch D50
Box Extension-1	Olive Ave	263+83	2 - 10'x6'	639.0	0.9	1.50	80.0	3.0	Matched FCDMC existing riprap size. See Riprap basin design for additional details.
DW-Culv-1	Olive Ave	269+83	1.5	5.0	0.4	0.5	8.0	1.0	

Channel Riprap									
Channel ID	Road ID	Station	Channel Bottom Width (ft)	Design Flow (cfs)	Calculated D_{50}	Design D_{50} (ft)	Apron Length (ft)	Apron Thickness (ft)	Notes
Olive Channel-1	Olive Ave	226+20 Rt	20	158	0.4	0.5	20.0	1.0	Design flow is 50-year storm, 158 cfs. 100-year flow is 212 cfs Apron is 20-feet upstream and downstream of drop.
Olive Channel-2	Olive Ave	234+20 Rt	20	158	0.5	0.5	20.0	1.0	Design flow is 50-year storm, 158 cfs. 100-year flow is 212 cfs Apron is 20-feet upstream and downstream of drop.
Olive Channel-3	Olive Ave	244+70 Rt	20	158	0.3	0.5	20.0	1.0	Design flow is 50-year storm, 158 cfs. 100-year flow is 212 cfs Apron is 20-feet upstream and downstream of drop.
Olive Channel-4	Olive Ave	251+21 Rt	20	158	0.4	0.5	20.0	1.0	Design flow is 50-year storm, 158 cfs. 100-year flow is 212 cfs Apron is 20-feet upstream and downstream of drop.

Notes:

1) Minimum D_{50} is 6-inches at outlets. D_{50} of 3-inches was used at the end of curb & gutter to protect the roadway section.
2) Riprap basin calculations are provided separately for discharges into Reems Channel.
3) Per HEC-RAS results, all apron lengths along Olive Ave Channel are abck to average velocities (not greater than 1.3) per District Hydraulics Manual for riprap apron lengths.

Project: TT0561 - Olive Avenue Widening - Sarival to Reems Road
Location: Surprise, Arizona
Date: April 26, 2023
Subject: Riprap Basin Design Calculations

Source: Drainage Design Manual for Maricopa County, Arizona : Hydraulics 2013

	Depth of Plunge at Outlet (Hs)						Dissipator Pool Length (Ls)				Dissipator Apron Length (L_A)			Overall Length (L_B)			
Culvert ID	*h_s* (feet)	*D_{50}* (feet)	*ye* (feet)	*Vo* (ft/sec)	*TW/ye*	*C_0*	*Width* (feet)	*10*Hs* (feet)	*3*Width* (feet)	*Ls (Largest Value)* (feet)	*5*Hs* (feet)	*Width* (feet)	*LA (Largest Value)* (feet)	*15*Hs* (feet)	*4*Width* (feet)	*L_B (Largest Value)* (feet)	*Notes*
Box Extension-1	0.8	0.5	3.78	10.96	1.79	2.4	20	7.5	60.0	60.0	3.8	20.0	20.0	11.3	80.0	80.0	HY-8 calculation for riprap sizing

Notes:

1) Riprap at the box extension in the Reems Channel is sized to be a D50 of 18-inches for the first 30-feet due to the existing riprap apron being sized as 18-inches per the Reems Road Design Report. The dissipator pool is designed to have a D50 of 18-inch riprap while the apron is designed to have a D50 of 6-inches.

Project: TT0562 - Olive Avenue Widening
Subject: Total Scour
Date: 7/28/2021
Source: *Flood Control District of Maricopa County Hydraulics Drainage Design Manual, December 2018, Section 11.8*

Location	Factor of Safety	Long-Term Scour (feet)	General Scour (feet)	Bend Scour[1] (feet)	Bedform Scour (feet)	Low-Flow Scour (feet)	Local Scour (feet)	Total Scour (feet)
Reems Channel @ Olive Avenue	1.3	0.9	1.4	0	0.6	2	0.0	**6.3**

Notes:

1) Bend scour components are included in the General Scour equations.
2) Local scour for guide banks, piers, abutments, etc. is not applicable in this situation.
3) HEC-RAS cross-section at end of riprap basin is XS-903

Total scour, Z_t, is the sum of each of these individual components, Z_i, of scour. Total scour can be expressed as:

$$Z_t = FS(Z_{long\text{-}term} + Z_{general} + Z_{bend} + Z_{bedform} + Z_{low\text{-}flow}) + FS_{local} * Z_{local} \qquad (11.41)$$

where:

FS = the factor of safety (safety factor) for the long-term, general, bend, bedform, and low-flow incisement scour components, and

FS_{local} = the factor of safety for local scour such as pier scour, downstream scour for drop structure/grade control structures and other local scour components.

Project: TT0562 - Olive Avenue Widening
Subject: Long-Term Scour
Date: 7/28/2021
Source: *Flood Control District of Maricopa County Hydraulics Drainage Design Manual, December 2018, Section 11.8*

Location	100-Year Flow (cfs)	Long-Term Scour (feet)
Reems Channel @ Olive Avenue	605.0	**0.9**

Level I Analysis from Arizona State Standard 5-96

The equilibrium slope method requires locating an appropriate downstream pivotal point. When such a pivotal point does not exist, a simplified method based on ADWR (1996) may be used to estimate the long-term degradation as the last resort. The long-term degradation by ADWR (1996) Level I analysis is $0.02{Q_{100}}^{0.6}$ where Q_{100} is the 100-year peak flow in cubic feet per second. The long-term degradation is in feet. This equation should only be used when no downstream control structures exist.

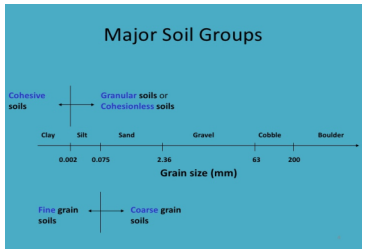
Project: TT0562 - Olive Avenue Widening
Subject: General Scour
Date: 7/28/2021
Source: *Flood Control District of Maricopa County Hydraulics Drainage Design Manual, December 2018, Section 11.8*

	Neill Equation								Lacey Equation					
Location	**Z Factor**	**100-Year Flow (cfs)**	**Flow Area (sf)**	**d_i (feet)**	**q_f (cfs/feet)**	**q_i (cfs/feet)**	**m**	**Neill Scour (feet)**	**Z Factor**	**100-Year Flow (cfs)**	**D_m (mm)**	***f***	**Lacey Scour (feet)**	**Highest Scour Calculation (feet)**
Reems Channel @ Olive Avenue	0.5	605	264	3.7	8.5	71.1	0.67	**0.4**	0.25	605	0.050	0.4	**1.4**	**1.4**

In general, each equation should be applied as follows:

Neill Equation. Neill's equation is applicable to areas of channel constriction, such as bridges or contraction structures. This approach also accounts for scour where bends are present in the contracted zone.

Lacey Equation. This method is more applicable to a natural river system where there is not an upstream structure that captures sediment.



The Neill equation is applicable to channel constriction cases where there is a bridge or contraction structure (Neill, 1973). Neill's equation is as follows:

$$Z_{general} = Z d_i \left[\frac{q_f}{q_i}\right]^m \quad (11.47)$$

where:

$Z_{general}$ = general scour depth, ft;

d_i = average depth at bankfull discharge in incised reach, ft (= hydraulic depth for bankfull discharge or dominant discharge);

q_f = design flood discharge per unit width (width can be defined as wetted cross sectional area divided by flow depth where flow depth can be the Manning's equation-based normal depth or maximum flow depth from HEC-RAS), cfs/ft;

q_i = bankfull discharge in incised reach per unit width (bankfull discharge can be from HEC-RAS main channel flow discharge between appropriate bank stations or taken as the 10-year event with the same definition as dominant discharge (Simons, Li and Associates, 1985); width can be defined as wetted cross section area divided by depth where flow depth can be the Manning's equation-based normal depth maximum flow depth from HEC-RAS, cfs/ft;

m = exponent varying from 0.67 for sand to 0.85 for coarse gravel; and

Z = multiplying factor (0.5 for a straight reach, 0.6 for a moderate bend, and 0.7 for a severe bend).

$$Z_{general} = Z\left(0.47\left[\frac{Q}{f}\right]^{1/3}\right) \quad (11.66)$$

where:

$Z_{general}$ = general scour depth, ft;

Q = design discharge, cfs;

f = Lacey's silt factor = $1.76(D_m)^{1/2}$;

D_m = mean grain size, which may be approximated by D_{50}, (diameter where 50% is finer by dry weight) mm; and

Z = multiplying factor (0.25 for a straight reach, 0.5 for a moderate bend, 0.75 for a severe bend, 1.0 for right angle bends, and 1.25 for a vertical rock bank or wall).

Project: TT0562 - Olive Avenue Widening
Subject: Bendform Scour
Date: 7/28/2021
Source: *Flood Control District of Maricopa County Hydraulics Drainage Design Manual, December 2018, Section 11.8*

	Dune Scour Fr<0.7		Anti-dune Scour Fr >0.7		
Location	**Dune Scour** (feet)	**y_h** (feet)	**Velocity** **(ft/sec)**	**Anti-Dune Scour** **(feet)**	**Highest Scour Calculation (feet)**
Reems Channel @ Olive Avenue	**0.58**	2.88	---	---	**0.58**

Notes:

1) Anti-dune scour forms during higher regime flows where the Froude Number is greater than 0.7, which does not occur in this situation.

$$0.15 < \frac{d_h}{y_h} < 0.3 \qquad (11.72)$$

where:

d_h = dune measured from mound top to trough bottom, ft;

y_h = hydraulic depth of flow, ft.

$$d_h = 0.027 V_a^2 \qquad (11.73)$$

where:

d_h = antidune height measured from mound top to trough bottom, ft;

V_a = average channel velocity, ft/s.

When $1.0 \geq F_r \geq 0.7$, the higher value between the dune height equation and anti-dune height equation should be used.

Appendix E

Drainage Plans (Half Size)

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	1	199	

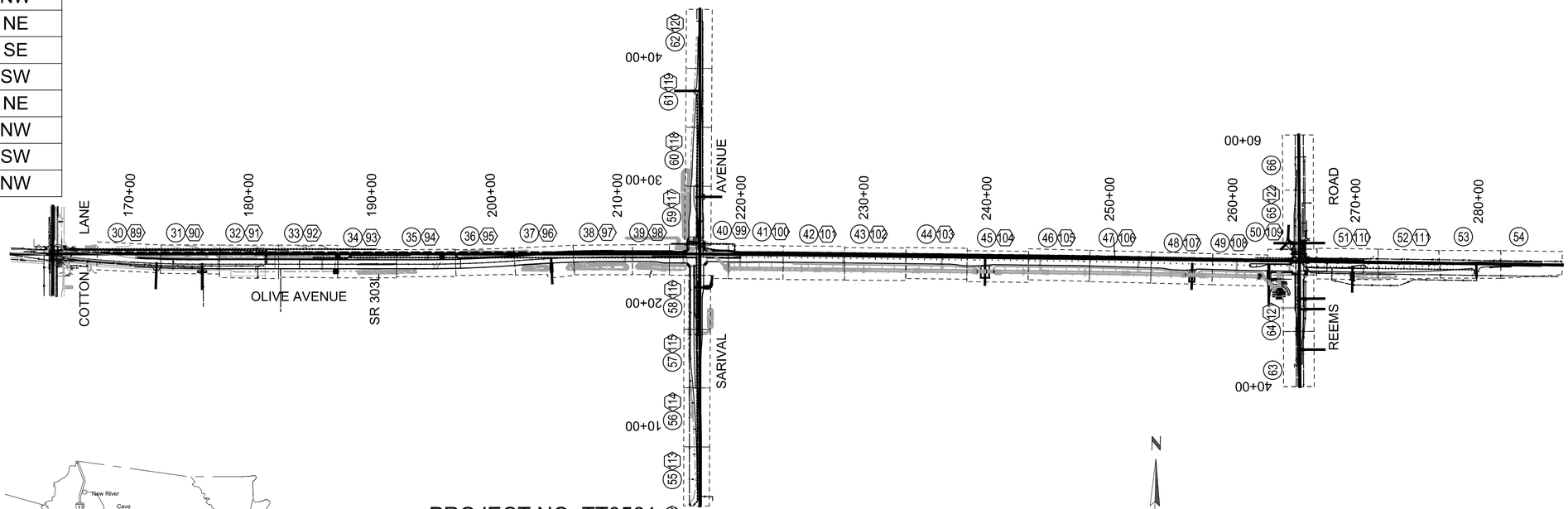
MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION

PLANS FOR THE CONSTRUCTION OF
OLIVE AVENUE - SR303L TO REEMS ROAD

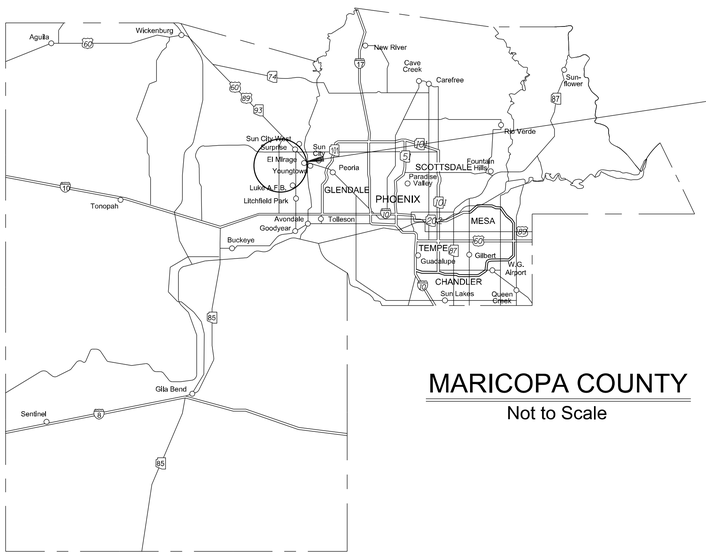
PROJECT NO. TT0561

LOCATIONS FOR AS-BUILT INDEXING

Township	Range	Section	Quarter
3N	2W	25	SW
3N	2W	25	SE
3N	2W	36	NW
3N	2W	36	NE
3N	1W	30	SE
3N	1W	30	SW
3N	1W	31	NE
3N	1W	31	NW
3N	1W	29	SW
3N	1W	32	NW



PROJECT NO. TT0561



MARICOPA COUNTY
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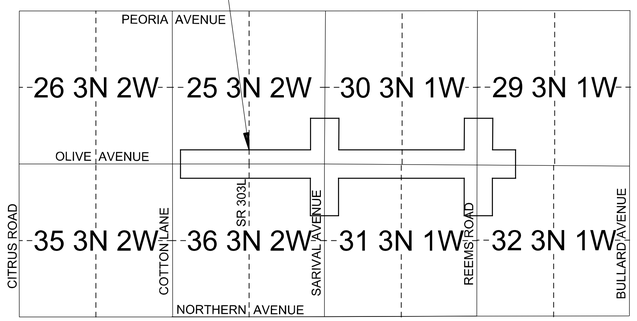

VICINITY MAP
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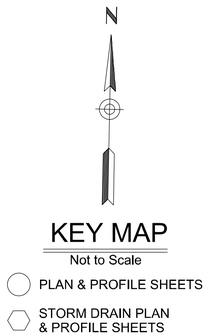

KEY MAP
Not to Scale

- PLAN & PROFILE SHEETS
- STORM DRAIN PLAN & PROFILE SHEETS

IN COOPERATION WITH:
CITY OF GLENDALE

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION

RECOMMENDED FOR CONSTRUCTION:

LYDIA WARNICK, P.E.
PROJECT MANAGER — DATE

ISSUED FOR CONSTRUCTION:

JESSE GUTIERREZ, P.E.
INTERIM TRANSPORTATION DIRECTOR — DATE

COUNTY BOARD OF SUPERVISORS

CLINT HICKMAN - CHAIRMAN

DISTRICT 1	JACK SELLERS
DISTRICT 2	THOMAS GALVIN
DISTRICT 3	BILL GATES
DISTRICT 4	CLINT HICKMAN
DISTRICT 5	STEVE GALLARDO

100% PLANS
PRELIMINARY
NOT FOR CONSTRUCTION

T.Y. LIN INTERNATIONAL
engineers | planners | scientists

4/21/2023 9:54:25 AM
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ABBREVIATIONS *

AASHTO	American Association of State Highway and Transportation Officials	CP	Concrete Pipe	LC	Long Chord	Reloc	Relocate
AB	Aggregate Base	CR	Crown	LS	Lump Sum	Rem	Remove
AC	Asphaltic Concrete	CSP	Corrugated Steel Pipe	Lt	Left	Ret	Retain(ing)
AC	Aluminum Cap	CSPA	Corrugated Steel Pipe Arch			RGRCP	Rubber Gasket Reinforced Concrete Pipe
ACBC	Asphaltic Concrete Base Course	CTB	Concrete Treated Base	MAG	Maricopa Association of Governments	RR	Railroad
ACFC	Asphalt Concrete Friction Course	DA	Drainage Area	Matl	Material	Rt	Right
ACI	American Concrete Institute	DE	Drainage Easement	MC	Maricopa County	R/W	Right of Way
ACP	Asbestos Cement Pipe	Def	Deflection	MCDOT	Maricopa County Department of Transportation		
ACSC	Asphalt Concrete Surface Course	Det	Detail			S	Slope
ADOT	Arizona Department of Transportation	DIP	Ductile Iron Pipe	MH	Manhole	STID	San Tan Irrigation District
		Drn	Drain(age)	Min	Minimum	Sch	Schedule
Ahd		D/W	Driveway	Mod	Modify	SCS	Soil Conservation Service
AISC	American Institute of Steel Construction	Dwg	Drawing	Mon	Monument	SD	Sight Distance
		E	Electric(ity)	MWD	Maricopa Water District	SD	Storm Drain
APS	Arizona Public Service Company	e	External			SE	Slope Easement
Asph	Asphalt	ECR	End Curb Return	NC	Normal Crown	Sec	Section
ASTM	American Society for Testing Materials	EFS	End Full Super	NPI	Non-Pay Item	SG	Subgrade
		ER/W	Existing Right of Way	NPDES	National Pollutant Discharge Elimination System	Shldr	Shoulder
AWS	American Welding Society	El	Elevation	NTS	Not to Scale	Shr	Shrinkage
		Emb	Embankment			Sht	Sheet
B/C	Back of Curb	EP	Edge of Pavement	OC	On Center	Sk	Skew
BC	Brass Cap	Esmt	Easement	OD	Outside Diameter	Specs	Specifications
BCR	Begin Curb Return	Exc	Excavation			SP	Steel Pipe
BCT	Breakaway Cable Terminal	Exist	Existing	P	Pavement (Surface Elevation)	SRP	Salt River Project
Bdy	Boundary	Exp Jt	Expansion Joint	Ped	Pedestal	SS	Sanitary Sewer
Bev	Bevel(ed)			PC	Point of Curvature	Sta	Station
BFS	Begin Full Super	F/C	Face of Curb	PCC	Point of Compound Curvature	Std	Standard
Bit	Bituminous	FCDMC	Flood Control District of Maricopa County	PCC	Portland Cement Concrete	Struc	Structural
Bkfl	Backfill			PCCP	Portland Cement Concrete	Subdiv	Subdivision
BLM	Bureau of Land Management	FF	Finished Floor (Elevation)	Pvmt	Pavement	Super	Superelevation
BM	Bench Mark	FH	Fire Hydrant	PI	Point of Intersection	Sw	Swell
BNSF	Burlington Northern Santa Fe	Fnd	Found	POB	Point of Beginning	S/W	Sidewalk
		Fwy	Freeway	POC	Point on Curve	SWG	Southwest Gas Corporation
		G	Gutter (Flow Line Elevation)	POE	Point of End	T	Tangent Length
C&G	Curb and Gutter	ga	Gauge	POT	Point on Tangent	T	Township
Cab	Cabinet	GB	Grade Break	PP	Power Pole	TC	Top of Curb
CAP	Corrugated Aluminum Pipe	GFL	Gutter Flow Line	PRC	Point of Reverse Curvature	TCE	Temporary Construction Easement
CAPA	Corrugated Aluminum Pipe Arch	GLO	General Land Office	Prel	Preliminary		
		GM	Gas Meter	Proj	Project	Trans	Transition
CB	Catch Basin	Gnd	Ground	Prop	Proposed	TrRk	Trash Rack
CBC	Concrete Box Culvert	GP	Guy Pole	PRVC	Point of Reverse Vertical Curvature	TS	Traffic Signal Pole
CG	Cattle Guard	Gr	Grade			Typ	Typical
CIP	Cast Iron Pipe	GR	Guardrail	PT	Point of Tangency		
CIPP	Cast-in-Place Pipe	GV	Gas Valve	PVC	Point of Vertical Curvature	VC	Vertical Curve
Clr	Clear(ance)			PVC	Poly Vinyl Chloride	VCP	Vitrified Clay Pipe
CLD	Concrete Lined Ditch	HDPE	High Density Polyethylene	PVI	Point of Vertical Intersection	VG	Valley Gutter
CMP	Corrugated Metal Pipe	Hdwl	Headwall	Pvmt	Pavement		
CMPA	Corrugated Metal Pipe Arch	HH	Hand Hole	Pvt	Private	w/	with
CO	Clean Out	HI	High	PVT	Point of Vertical Tangency	w/o	without
Conc	Concrete	HW	High Water			WM	Water Meter
Conn	Connection			Q	Quantity of Drainage Runoff	WV	Water Valve
Const	Construction	ID	Inside Diameter	Qtr	Quarter	WWF	Welded Wire Fabric
Cont	Continuous	Inv	Invert	QW	Qwest Communications		
Cor	Corner	Irr	Irrigation			◆	Grade Break Symbol
Corr	Correction (VPI to VC)			R	Radius		
		JDP	Joint Distribution Project	R	Range		
				RCP	Reinforced Concrete Pipe		
		L	Length of Curve	Rdwy	Roadway		
				Rebar	Reinforcing Bar		
				Reinf	Reinforced(ing)		

* Standard dictionary abbreviations not included.

SYMBOLS

Exist Rdwy Conc Items		New Irrigation Line (By Others)	30" IRR (RGRCP)	Angle Point		Tree or Hedge Line	
Exist Edge of Pvmt		New Buried Cable TV Line (By Others)	TV	Bench Mark	▲	Palm Tree	
Exist R/W Line		New Buried Telephone Line (By Others)	T	Center Line	℄	Deciduous Tree	
ADOT Access Control		New Fiber Optic Tel Line (By Others)	FOT FOT	Flow Line	℄	Euclayptus Tree	
Property Line	℄ ℄	New Water Line (By Others)	W	Monument Line	M	Citrus Tree	
Railroad Tracks		New Gas Line (By Others)	G	Property Line or Plate	ℙ	Mesquite Tree	
Top of Embankment Cut	C C	Utility Removal (By Others)		Section Line	S	Ocotillo Cactus	
Toe of Filled Slope	F F	New Cable TV Vault (By Others)	TV	Exist Manhole	MH	Saguaro Cactus	
Exist Barb Wire Fence		New Cable TV Pedestal (By Others)	TV	Exist US Mail Box		Exist Sign (1 Post)	
Exist Chain Link & Gate		New Pipe		Exist Water Valve	⊗	Exist Sign (2 Posts)	
Exist Block Wall & Gate		Easement		Exist Meter	M	Ground Surface	
Exist Wood Fence		Flow Line		Exist Gas Regulator		New Bit Pvmt (Section)	
Exist Guardrail		New Guardrail		Exist Utility Ped		New ABC (Section)	
Exist Water Line	6"W (TYPE)	New Chain Link Fence		Exist Stand Pipe		New ABC (Plan)	
Exist Sanitary Sewer Line	8"SS (TYPE)	New Barb Wire Fence		Exist Fire Hydrant		Riprap (Plan)	
Exist Buried Electric Line	E	Overhead Power	OP OP	Exist Traffic Control Cab		New Bit Pvmt (Plan)	
Exist Gas Line (Typ)	2" G	Overhead Telephone	OT OT	Exist Traffic Pull Box		New Conc Pvmt (Plan)	
Exist Irrigation Line (Typ)	12" IRR (PVC)	Sawcut, Tack & Match	S	Exist Traffic Signal Pole		Remove Pvmt (Plan)	
Exist Storm Drain Line (Typ)	24" SD (CP)	Exist Electric Vault	EV	Exist Comm Manhole	C	New Conc (Section)	
Exist Buried Cable TV Line	TV	Exist Electric Meter	E	Exist Telco Pedestal	T	New Fire Hydrant	
Exist Buried Telephone Line	T	Exist Electric Pull Box	EPB	Exist Cable TV Junction Box	CATV MH	New Gas Regulator Station	R
Exist Hydro Pipe		Exist Pole Service	PS	Exist Cable TV Pedestal	TV	New Gas Valve	
Exist Channel-Canal		Exist Transformer	TSFM	Exist Sign CATV Undergrd	CATV	New Electric Equipment	S
Exist Wash		Exist Irrigation Pull Box	IPB	Exist Sign Telco Undergrd	TELE	Exist Sign Gas Undergrd	GAS
		Exist Electric Junction Box	EJB	Exist Gas Vent Pipe		Exist Hose Bib	HB
		Exist Electric Manhole	E	Exist Gas Valve	⊗	Exist Street Light	
		Exist Wood Power Pole		Exist Sanitary Sewer MH	SS	Exist Guy Wire	
		Exist Steel Power Pole					

Exist Irrigation Manhole	IRR	Exist Pipe Conc Inside Top	PCIT
Exist Pipe CMP Inside Top	CMPIT	Exist Headgate	
Exist Pipe PVC Inside Top	PVCIT	Exist Water Meter	WM
Exist Pipe PVC Invert	PVCI	Exist Well Pump	WP
Exist Pipe CMP Invert	CMPI		
Exist Pipe Conc Invert	PCI		

Striping and traffic signal symbols are on sheets 154, 180, & 183 of the plans

GENERAL NOTES

1 All work shall conform with the 2023 Revision to the 2020 Edition of the Uniform Standard Specifications for Public Works Construction published by the Maricopa Association of Governments (MAG) as modified by the MCDOT Supplement to the MAG Standard Specifications dated January, 2023 and the project Special Provisions.

2 Standard Details refer to the MAG Uniform Standard Specifications and Details for Public Works Construction unless noted otherwise.

3 All existing utility lines shown on the plans are from available utility records. The Contractor shall verify the actual location before starting construction. The Contractor shall contact "Arizona811" at 811 or (602) 263-1100 two days prior to beginning construction.

4 Utilities interfering with construction shall be reset or relocated by the utility company concerned unless noted otherwise.

5 Disposal of all waste material, broken concrete, etc. will be the responsibility of the Contractor, subject to the approval of the Engineer.

6 All stations and call out distances left and right refer to the construction centerline unless noted otherwise.

7 All trees, bushes and obstacles inside the existing right-of-way which interfere with construction, shall be removed by the Contractor unless noted otherwise. Any fences damaged during construction shall be restored by the Contractor at no additional cost to the County.

8 All paved turnouts shall have the same asphalt and base requirements as the adjacent roadway unless noted otherwise.

9 The Contractor shall obtain all the necessary permits from local governments for work within their jurisdiction.

10 Construction activities shall not interfere with mail delivery. The Contractor shall temporarily relocate mailboxes as necessary to provide uninterrupted mail service. This is a non-pay item.

MARICOPA WATER DISTRICT NOTES

1 Contractor shall notify Maricopa Water District in writing at least 72 hours in advance of any construction.

2 The contractor is responsible for contacting and coordinating with MWD for the inspection of all construction work within MWD's easement and/or right-of-way. Notice must be given to MWD a minimum of 48 hours prior to the start of any construction that will require field inspection or approval. Please contact MWD's Engineering Department at (623) 546-8266.

3 All construction work within MWD's easement and/or right-of-way is subject to inspection and approval by MWD. Construction work concealed without inspection by MWD shall be subject to exposure at the contractor's expense.

4 As-built plans shall be provided to MWD upon completion of this project.

5 All MWD facillity relocation design to be done by MWD.

6 Asphalitic concrete millings may be provided to MWD. See special provisions.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY NOTES

1 All Construction within Flood Control District (District) rights-of-way jurisdiction shall conform to the latest District Standards and Specifications as published on the District's web site.

2 Contractor must obtain necessary District Permit prior to commencement of construction within District right-of-way and maintain a copy of the permit on the project site at all times.

3 Notify the District's Permits Inspector at 602-525-7913 or if working at a District Dam call 602-506-4722 at least 48 hrs prior to any work being performed in the District's rights-of-way.

4 Contractor performing excavation operations is responsible for locating and protecting all underground utilities.

5 Any damage to District's structures, equipment, materials, vegetation, and/or property shall be replaced and/or repaired in-kind to the satisfaction of the District.

6 In the event the terms and conditions in the District's permit are not consistent with the District-approved plans, the District's permit will have priority.

7 In order to close the District's permit and release bonds, the work on the project site will have to be complete as determined by the District's inspector, certified as-built plans along with required quality assurance tests will have to be provided and accepted by the District, and all easements required by the project recorded.

▲ BENCH MARK

Found 1,535' West of Citrus Road Section Line and 75' North of Olive Avenue Center Line 2" Alum Cap on 1/2" Rebar Stamped C.P. 102
Northing=384014.638, Easting=537750.101
Elev = 1226.12 feet NAVD 88 Datum

Found 4,067' East of Cotton Lane Section Line and 322' South of Existing Olive Right of Way 2" Alum Cap on 1/2" Rebar stamped C.P. 103
Northing=383555.933, Easting=548649.536
Elev = 1156.27 feet NAVD 88 Datum

Found 2,760' East of Reems Road Section Line and 1,308' South of Olive Avenue Section Line 2" Alum Cap on 1/2" Rebar stamped C.P. 104
Northing=382461.495 Easting=557483.141
Elev = 1111.23 feet NAVD 88 Datum

LENGTH OF PROJECT

OLIVE AVENUE STA 170+75.66 TO STA 285+17.64=11,441.98 ft

SARIVAL AVENUE STA 4+99.82 TO STA 41+64.28=3,664.46 ft

REEMS ROAD STA 42+01.46 TO STA 57+77.07=1,575.61 ft

TOTAL=16,682.05 ft

16682.05/5280=3.16 miles

PROJECT DISTURBED AREA

1,029,255 ft² = 53.18 Acres
UUA = 0 Acres

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	2	199	

DESIGN DATA

OLIVE AVENUE
CLASSIFICATION.....URBAN MINOR ARTERIAL
TERRAIN.....LEVEL
DESIGN SPEED.....55 MPH
(2012) AVERAGE DAILY TRAFFIC.....6,200/VPD
(2032) AVERAGE DAILY TRAFFIC.....22,500/VPD

SARIVAL AVENUE
CLASSIFICATION.....URBAN MINOR ARTERIAL
TERRAIN.....LEVEL
DESIGN SPEED.....55 MPH
(2012) AVERAGE DAILY TRAFFIC.....2,700/VPD
(2032) AVERAGE DAILY TRAFFIC.....11,000/VPD

INDEX

1..... FACE SHEET
2..... GENERAL NOTES SHEET
3-15..... TYPICAL SECTIONS
16-19..... QUANTITY SUMMARY
20..... GEOMETRIC CONTROL
21-29..... GEOMETRY SHEETS
30-66..... PAVING PLAN AND PROFILE SHEETS
67-74..... DRIVEWAY PROFILES
75-79..... SARIVAL AVENUE STAKING AND BNSF SHEET
80..... SR 303L MEDIAN STAKING SHEET
81-83..... REEMS ROAD STAKING AND BNSF SHEET
84-88..... STORM DRAIN PLAN AND PROFILE SHEETS
89-122.... DRAINAGE PLAN AND PROFILE SHEETS
123-124.. CHANNEL PLAN AND PROFILE SHEETS
125-130.. CULVERT PLAN AND PROFILE SHEETS
131-142.. CONNECTOR PIPE PROFILE SHEETS
143..... CHANNEL DETAIL SHEET
144-152.. DRAINAGE DETAIL SHEETS
153-179.. STRIPING AND SIGNING SHEETS
180-183.. TRAFFIC SIGNAL SHEETS
184-195.. CONSTRUCTION SEQUENCING SHEETS
196-198.. POT HOLE SUMMARY SHEET
199..... FISSURE MITIGATION

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
3			
2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

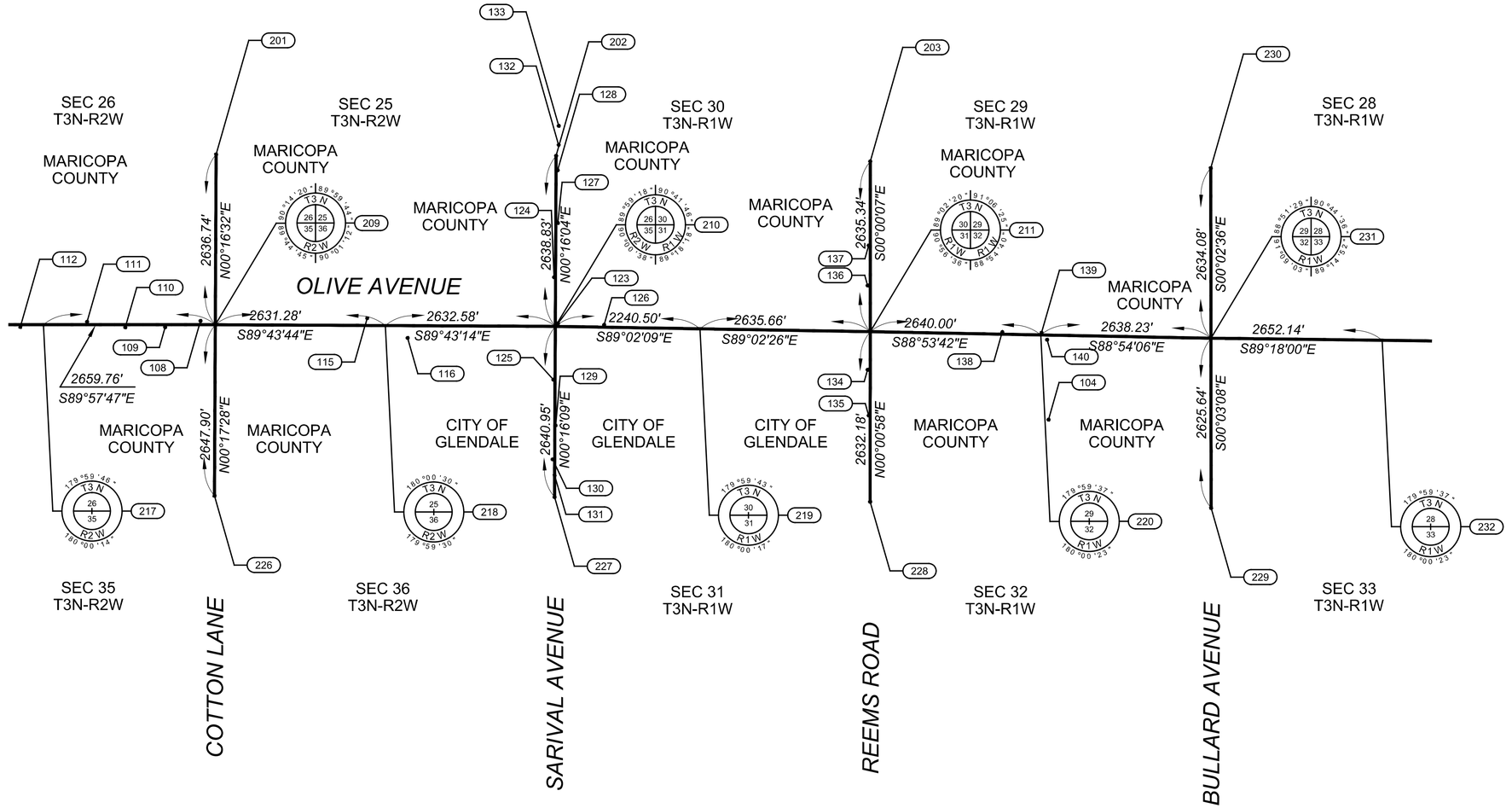
	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

TY LIN INTERNATIONAL
engineers | planners | scientists

GENERAL NOTES

SHEET 2 OF 199

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	20	199	



NOTES:

1. *THIS PROJECT IS IN A GROUND COORDINATE SYSTEM, HOWEVER, IT IS BASED ON THE ARIZONA COORDINATE SYSTEM, 1983 CENTRAL ZONE. OTHERWISE KNOWN AS THE ARIZONA STATE PLANE CENTRAL ZONE (ASPCZ) WHICH IS UTILIZING THE NORTH AMERICAN DATUM OF 1983 (NAD83) AS REALIZED IN THE 1992 ADJUSTMENT.*
2. *IN ORDER TO OBTAIN ASPCZ COORDINATES, TRANSLATE THE NORTHING VALUE BY ADDING 550,000 unit ft. THEN SCALE BOTH THE NORTHING AND EASTING VALUE BY 0.99987465 FROM NORTHING 933772.663, EASTING 557362.696.*
3. *UNITS=INTERNATIONAL FEET*
   1 FOOT = 0.3048 METER EXACTLY
4. *ALL BEARINGS ARE GRID BEARINGS. DISTANCES ARE GROUND DISTANCES AND COORDINATES ARE GROUND COORDINATES.*
5. *THE FIELD PORTION OF THIS SURVEY WAS PERFORMED DURING THE MONTH OF MARCH 2012.*
6. *ALL ELEVATIONS ARE NAVD88.*

LEGEND:

AC	*Aluminum Cap*
BC	*Brass Cap*
BCFL	*Brass Cap Flush*
BCHH	*Brass Cap in Handhole*
COEM	*City of El Mirage*
MC HD	*Maricopa County Highway Department*
MCDOT	*Maricopa County Department of Transportation*
MC ED	*Maricopa County Engineering Department*

No.	Northing	Easting	Elevation	Description
104	382461.49	557483.14	1111.23	MACS
108	383990.38	544354.50	1186.31	MACS--2 MC .15D S_2014 CP108 MACS--2 MC .15D S_20 MACS--2 M
109	383893.15	543807.08	1186.04	MACS--2 MC .15D S_2014 CP109 MACS--2 MC .15D S_20 MACS--2 M
110	383890.83	543191.22	1188.07	MACS--2 MC .15D S_2014 CP110 MACS--2 MC .15D S_20 MACS--2 M
111	383977.14	542599.41	1191.14	MACS--2 MC .15D S_2014 CP111 MACS--2 MC .15D S_20 MACS--2 M
112	383894.76	541564.44	1203.36	MBCF--3MDOT 1/2SRod 0.0F S_112 2014
115	384033.63	546935.57	1168.48	2MDOT 5/8R 0.0F S_CP115 TT497 2015 MACS--2MDOT 5/8R
116	383727.57	547561.77	1163.10	2MDOT 5/8R 0.0F S_CP116 TT497 2015 MACS--2MDOT 5/8R 0.0
123	383951.57	549889.38	1149.88	2 MC F 5/8IN SR S_CP123 2017 MACS--2 MACS--2 MC F 5/8IN S
124	384666.27	549828.41	1152.57	2 MC F 5/8IN SR S_CP124 2017 MACS--2 MC F 5/8IN S
125	383080.57	549816.05	1144.53	2 MC F 5/8IN SR S_CP125 2017 MACS--2 MACS--2 MC F 5
126	383928.93	550603.23	1143.45	2 MC F 5/8IN SR S_CP126 2017 MACS--2 MACS--2 MC F 5 MACS--2 MC F 5/8IN S
127	385505.13	549886.14	1155.42	2 MC F 5/8IN SR S_CP127 2017 MACS--2 MC F 5/8IN S
128	386320.75	549885.24	1157.29	2 MC F 5/8IN SR S_CP128 2017 MACS--2 MC F 5/8IN S
129	382372.10	549852.11	1141.33	MCXS--NOID F EAST SIDE OF WATER VALVE CONCRETE MCXS--NOID F
130	381848.62	549806.52	1138.44	MPKS 1
131	381602.13	549837.44	1138.43	MPKS 1
132	386713.45	549899.20	1158.08	MPKS 1
133	387008.04	549900.58	1158.52	MPKS 1
134	383234.96	554683.25	1123.79	MACS--2 MC F 5/8IN SR S_CP 134 2017
135	382525.41	554699.20	1119.86	MPKS 1

No.	Northing	Easting	Elevation	Description
136	384537.25	554683.25	1130.81	MACS--2 MC F 5/8IN SR S_CP136 2017
137	385156.45	554698.65	1131.26	MPKS 1
138	383818.14	556767.80	1118.75	MACS--2 MC F 5/8IN SR S_CP138 2017
139	383805.83	557374.50	1116.89	MACS--2 MC F 5/8IN SR S_CP139 2017
140	383699.24	557460.44	1116.93	MCXF--NOID F N_ON SPILLWAY CURB
201	386567.41	544596.60	1190.56	Fdn 3" MCDOT BC
202	386544.21	549860.05	1158.13	Fdn 4" MC ED BCHH
203	386458.92	554723.10	1134.65	Fdn 3" MC ED BCHH
209	383930.70	544583.91	1184.00	Fdn 3" MCDOT BCHH
210	383905.40	549847.71	1150.08	Fnd 3" MCDOT BC Stamped "T3NR2W S25 S36 T3NR1W S30 S31 2003 29891"
211	383823.58	554723.19	1125.80	Fdn 3" MCDOT BCHH
217	383932.41	541924.15	1197.33	Fnd 2" MCDOT AC Stamped "T3NR2W 1/4 S26 S35 2003 29891"
218	383918.25	547215.16	1168.13	Fnd 3" MCDOT BC Stamped "T3NR2W 1/4 S25 S36 2003 29891"
219	383867.70	552087.89	1136.39	Fnd 2" MCDOT AC Stamped "T3NR1W 1/4 S30 S31 RLS 36563 2003"
220	383772.66	557362.70	1118.34	Fnd 2" MCDOT AC Stamped "T3NR1W 1/4 S29 S32 RLS 36563"
226	381282.84	544570.46	1112.96	Fnd 3" MCDOT BC Flush
227	381264.48	549835.31	1136.68	Fnd 2" MCDOT AC Stamped "T3N R2W S36 1/4 T3N R1W S31 2003 29891"
228	381191.40	554722.45	1113.41	Fnd 3" MC HD BCHH Stamped "EL 1111.90 19"
229	381096.48	560000.33	1103.99	Fnd 2" MCDOT AC Stamped "T3NR1W 1/4 S32 S33 RLS 36563 2003"
230	386356.21	559995.95	1124.97	Fnd 2" AC Flush "RLS 25393"
231	383722.13	559997.94	1112.30	Fnd 2" MCDOT BCHH Stamped "T3NR1W 29 28 32 33 2009 RLS 26411"
232	383689.73	562649.89	1111.24	Fnd 3" MCDOT BCHH Stamped "T3NR1W 28 33 RLS 26411"

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
1			
2			
3			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY
NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C. MILNER, A. HERTING	02/2021
DRAWN	A. SADOW, L. THIELE	02/2021
CHECKED	J. BARR	02/2021

T.Y. LIN INTERNATIONAL
engineers | planners | scientists

GEOMETRIC CONTROL

SHEET 20 OF 199

4/21/2023 9:54:41 AM
T:\Tempe\Projects\221892.00\500_DSGN\dgn\TT0561_SC_Geo00.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	77	199	

Note: Points to Center of Foundation
A: Sta 9+33.68, 19.55' Lt

C: Sta 9+33.70, 13.55' Lt
D: Sta 9+84.20, 13.63' Lt
E: Sta 10+18.81, 13.66' Lt
F: Sta 10+18.81, 18.04' Rt
G: Sta 10+58.84, 23.97' Rt
H: Sta 10+18.84, 24.03' Rt

NOTES:
FOR GEOMETRIC CONTROL SEE SHEET 20

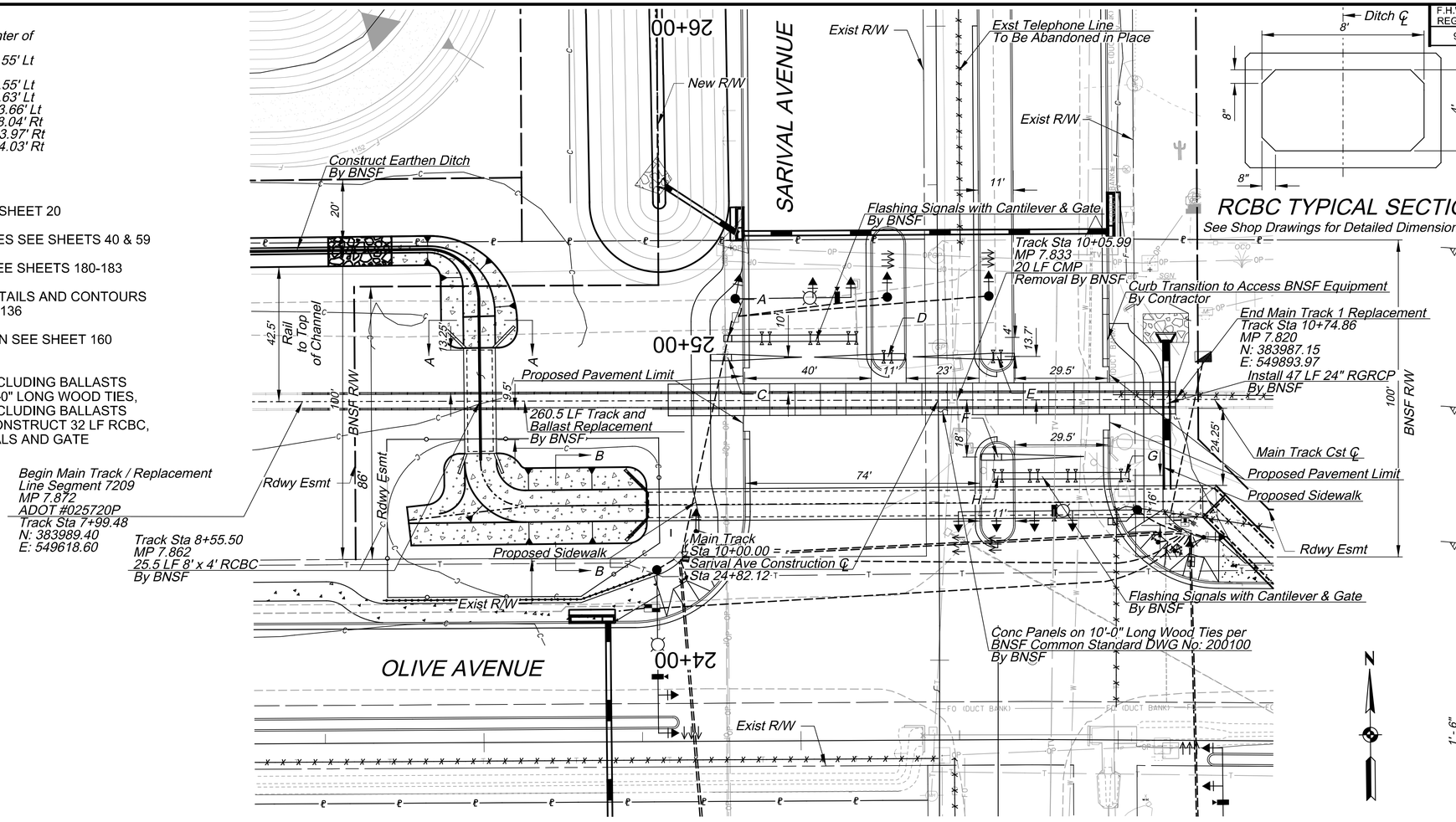
FOR PAVING PLANS AND PROFILES SEE SHEETS 40 & 59

FOR TRAFFIC SIGNAL DETAILS SEE SHEETS 180-183

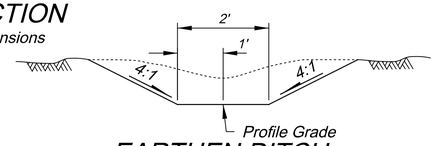
FOR CHANNEL AND CULVERT DETAILS AND CONTOURS SEE SHEETS 78-79, 123-124, AND 136

FOR SIGNING AND STRIPING PLAN SEE SHEET 160

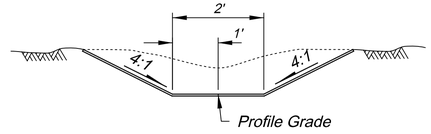
BNSF SUMMARY:
CONSTRUCT 160 TRACK FEET INCLUDING BALLASTS ON CONCRETE PANELS WITH 10'-0" LONG WOOD TIES, CONSTRUCT 115 TRACK FEET INCLUDING BALLASTS WITH 10'-0" LONG WOOD TIES, CONSTRUCT 32 LF RCBC, AND INSTALL CANTILEVER SIGNALS AND GATE



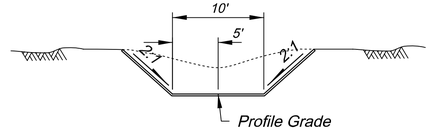
RCBC TYPICAL SECTION
See Shop Drawings for Detailed Dimensions



EARTHEN DITCH TYPICAL SECTION



SECTION A-A



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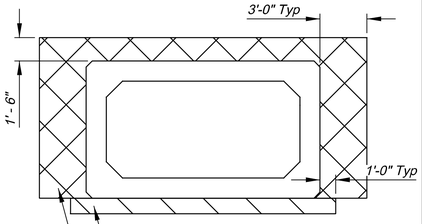

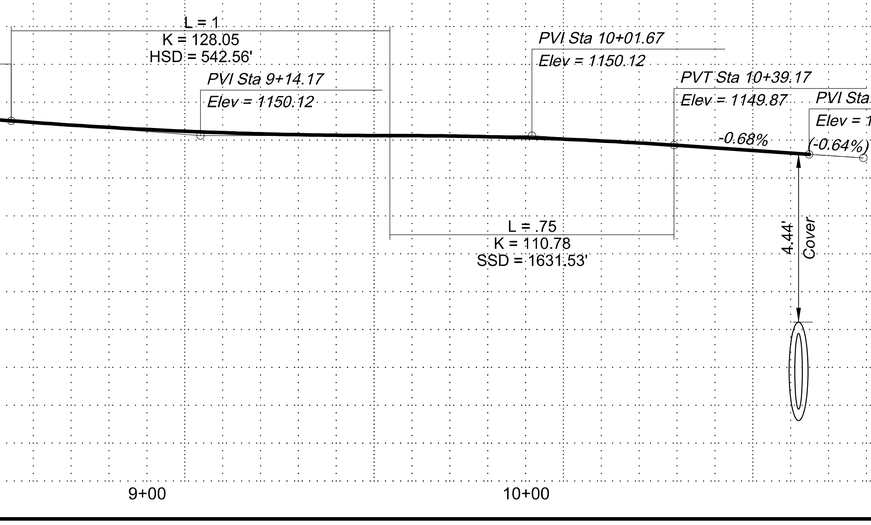

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
1			
2			
3			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

T.Y. LIN INTERNATIONAL
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SARIVAL AVENUE BNSF, LS 7209, MP 7.872
TRACK CROSSING LAYOUT PLAN

SHEET 77 OF 199

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F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	78	199	

GENERAL NOTES:

GENERAL: ALL MATERIAL AND WORKMANSHIP SHALL BE PER THE CURRENT AREMA MANUAL FOR RAILWAY ENGINEERING: CHAPTER 8. THE CONSTRUCTION SPECIFICATIONS SUPPLEMENT THE ABOVE AREMA MANUAL AND SHALL GOVERN.

STRUCTURE STATIONING AND ELEVATIONS ARE BASED ON SURVEY DATED 12/17/2014 BY MCDOT.

VERIFY ALL DIMENSIONS, STATIONS, AND ELEVATIONS PRIOR TO THE START OF CONSTRUCTION.

ALL CHANGES TO THE REQUIREMENTS BELOW SHALL BE SUBJECT TO APPROVAL OF THE ENGINEER.

DESIGN DATA: LOADING: COOPER E-80, 2-4 FEET OF FILL.

STREAM FLOW DIVERSION: IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DIVERT THE STREAM FLOW DURING CONSTRUCTION IN ORDER TO KEEP THE CONSTRUCTION AREA FREE OF WATER. THE METHOD OF DIVERSION SHALL BE APPROVED BY THE ENGINEER AND THE COST SHALL BE INCLUDED IN THE INSTALLATION OF THE CULVERT. CONTRACTOR SHALL ATTEMPT TO UTILIZE EXISTING CULVERT TO MAXIMUM EXTENT POSSIBLE TO DIVERT STREAM FLOW.

PRECAST CULVERT: THE CULVERT SHALL BE DESIGNED BY THE PRECAST SUPPLIER. INSTALLATION SHALL FOLLOW BNSF CULVERT SPECIFICATION 05100.

SWIFT LIFT CAVITY SHALL BE GROUTED AFTER SETTING PRECAST CULVERT USING EPOXY GROUT CONSISTING OF EQUAL PARTS BY VOLUME OF CLASS B EPOXY AND DRY SILICA SAND, MIXED IN ACCORDANCE WITH MANUFACTURER'S DIRECTIONS.

CONCRETE: ALL CONCRETE WORK AND PLACEMENT OF REINFORCEMENT SHALL BE IN ACCORDANCE WITH THE BNSF RAILWAY STANDARD CONSTRUCTION SPECIFICATIONS. THE PORTLAND CEMENT USED IN ALL CONCRETE SHALL BE AIR ENTRAINED CONTAINING NOT LESS THAN 5 PERCENT NOR MORE THAN 7 PERCENT AIR BY VOLUME. THE CAST-IN-PLACE CONCRETE SHALL HAVE AN ULTIMATE COMPRESSIVE STRENGTH OF NOT LESS THAN 4,000 PSI IN 28 DAYS. THE PRECAST CONCRETE SHALL HAVE AN ULTIMATE COMPRESSIVE STRENGTH NOT LESS THAN 5,00 PSI IN 28 DAYS. MAXIMUM SIZE OF COURSE AGGREGATE SHALL BE ONE INCH. THE MINIMUM CONCRETE COVER ON REINFORCEMENT SHALL BE TWO INCHES UNLESS INDICATED OTHERWISE. THE EXPOSED EDGES OF CONCRETE SHALL BE CHAMFERED 3/4", EXCEPT AS NOTED.

REINFORCEMENT: STEEL BARS FOR REINFORCEMENT SHALL BE DEFORMED BILLET STEEL BARS CONFORMING TO THE REQUIREMENTS OF THE ASTM A615. GRADE 60 OR ASTM A706. WELDED WIRE FABRIC SHALL MEET THE REQUIREMENTS OF ASTM A185. ALL REINFORCEMENT BAR DIMENSIONS ARE OUT TO OUT. FABRICATION OF REINFORCEING STEEL SHALL BE IN ACCORDANCE WITH CHAPTER 7 OF THE CURRENT CRS MANUAL OF STANDARD PRACTICE.

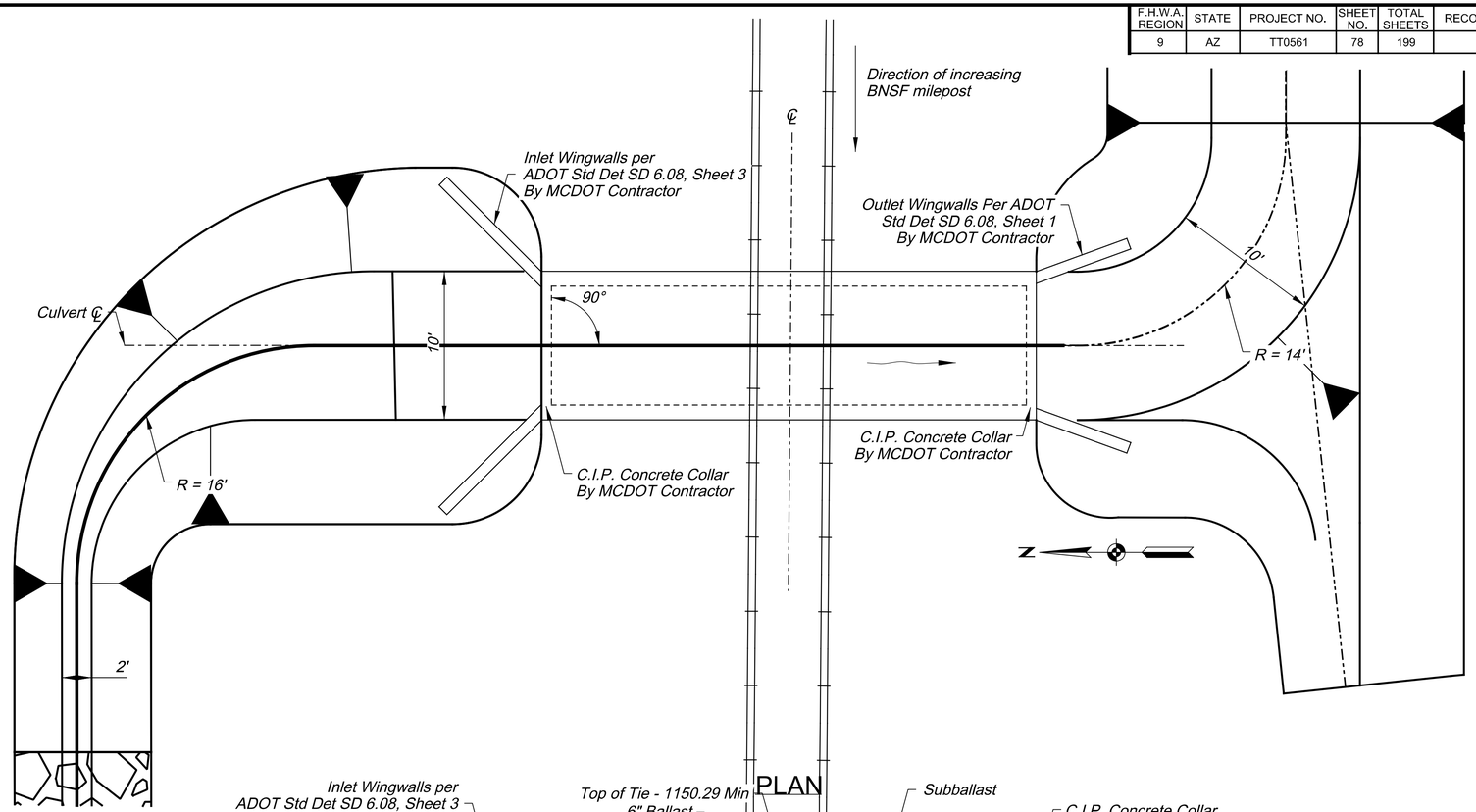
CONSTRUCTION: INSTALLATION, BACKFILL, AND EMBANKMENT SHALL BE IN ACCORDANCE WITH SECTION 5100 OF THE BNSF RAILWAY STANDARD CONSTRUCTION SPECIFICATIONS.

REFER TO THE STANDARD CONSTRUCTION SPECIFICATION SECTION 3200 AND SECTION 4100 FOR FILL PLACEMENT AND BACKFILL REQUIREMENTS.

BEDDING: PROVIDE WELL COMPACTED BEDDING AS REQUIRED TO ESTABLISH THE GRADE OF THE CULVERT. BEDDING SHALL CONSIST OF 12" OF BEDDING BENEATH THE CULVERT. BEDDING MATERIAL SHALL BE GRANULAR MATERIAL, SUCH AS AGGREGATES ORDINARILY SPECIFIED AND USED IN THE CONSTRUCTION OF NATURAL OR MANUFACTURED SANDS, CRUSHED SLAG, OR HOMOGENEOUS MIXTURE OF THESE MATERIALS. RECOMMENDED GRADATION IS AS FOLLOWS:

SCREEN SIZE	% PASSING (BY WEIGHT)
1 INCH	100
1/2 INCH	60-90
3/8 INCH	20-40
NO. 4	10-20
NO. 200	LESS THAN 5%

RIPRAP: CLASS OF RIPRAP SHALL BE SPECIFIED BY THE ENGINEER. RIPRAP SHALL BE PLACED ON GEOTEXTILE FABRIC IN SUCH A MANNER AS TO AVOID SEGREGATION OF VARIOUS SIZES OF ROCK, AND DISTRIBUTED SO THAT THE ENTIRE MASS OF RIPRAP IS WELL-DISTRUBUTED WITHIN THE LIMITS SPECIFIED. RIPRAP SHALL BE PLACED OVER THE GEOTEXTILE FABRIC BY METHODS THAT DO NOT STRETCH, TEAR, PUNCTURE, OR REPOSITION THE FABRIC. A MAXIMUM DROP HEIGHT OF 3 FEET IS RECOMMENDED. THE FINISHED SURFACE OF THE RIPRAP SHALL PRESENT AN APPEARANCE FREE OF SEGREGATION AND WITH A PROPORTIONATE QUANTITY OF THE LARGER PIECES SHOWING.



SUMMARY OF ESTIMATED QUANTITIES

QUANT.	UNIT	ITEM
33.3	LF	8'x4' PRECAST RBCB
266	CY	WELL COMPACTED GRANULAR BEDDING

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
1			
2			
3			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

	BY	DATE
DESIGNED	A. SADOW	06/2022
DRAWN	A. SADOW	06/2022
CHECKED	C. MILNER	06/2022

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

TY LIN INTERNATIONAL
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SARIVAL AVENUE, LS 7209, MP 7.872
BNSF R/W CULVERT DETAILS

SHEET 78 OF 199

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	79	199	

GENERAL NOTES:

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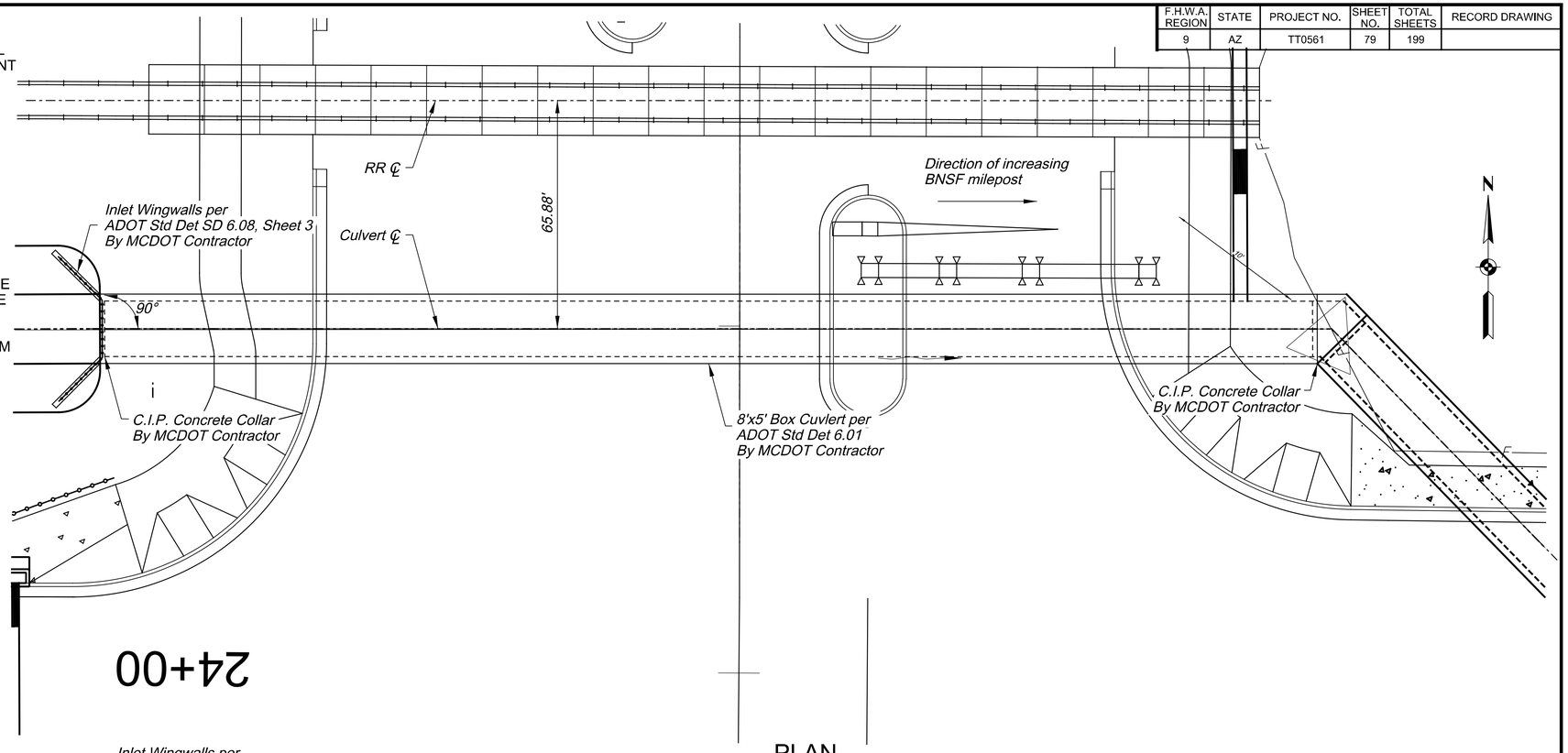
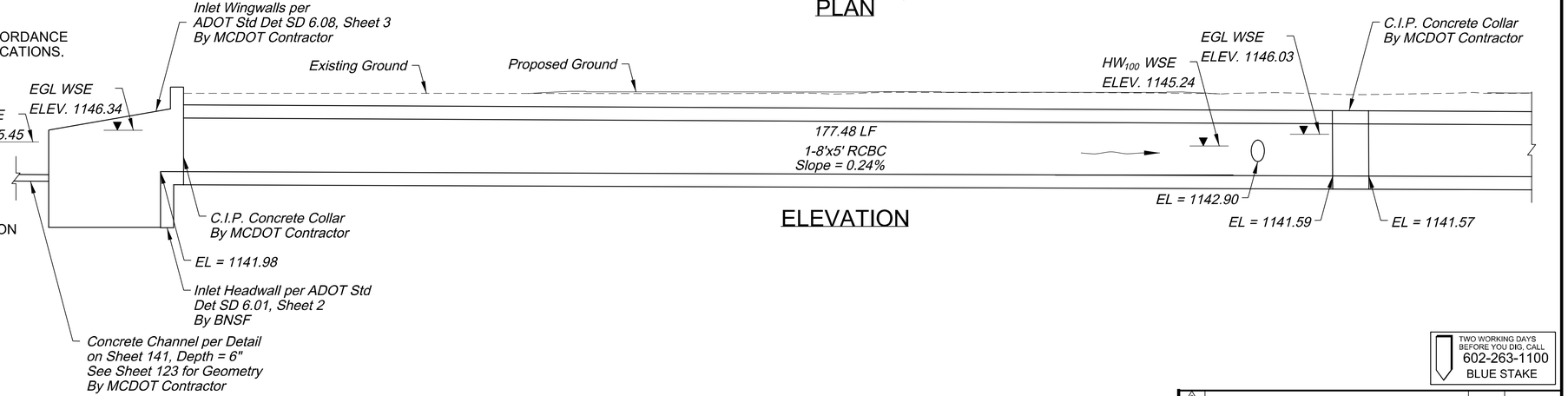


PLAN



ELEVATION

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
1			
2			
3			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY
NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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SARIVAL AVENUE
BNSF R/W CULVERT DETAILS

SHEET 79 OF 199

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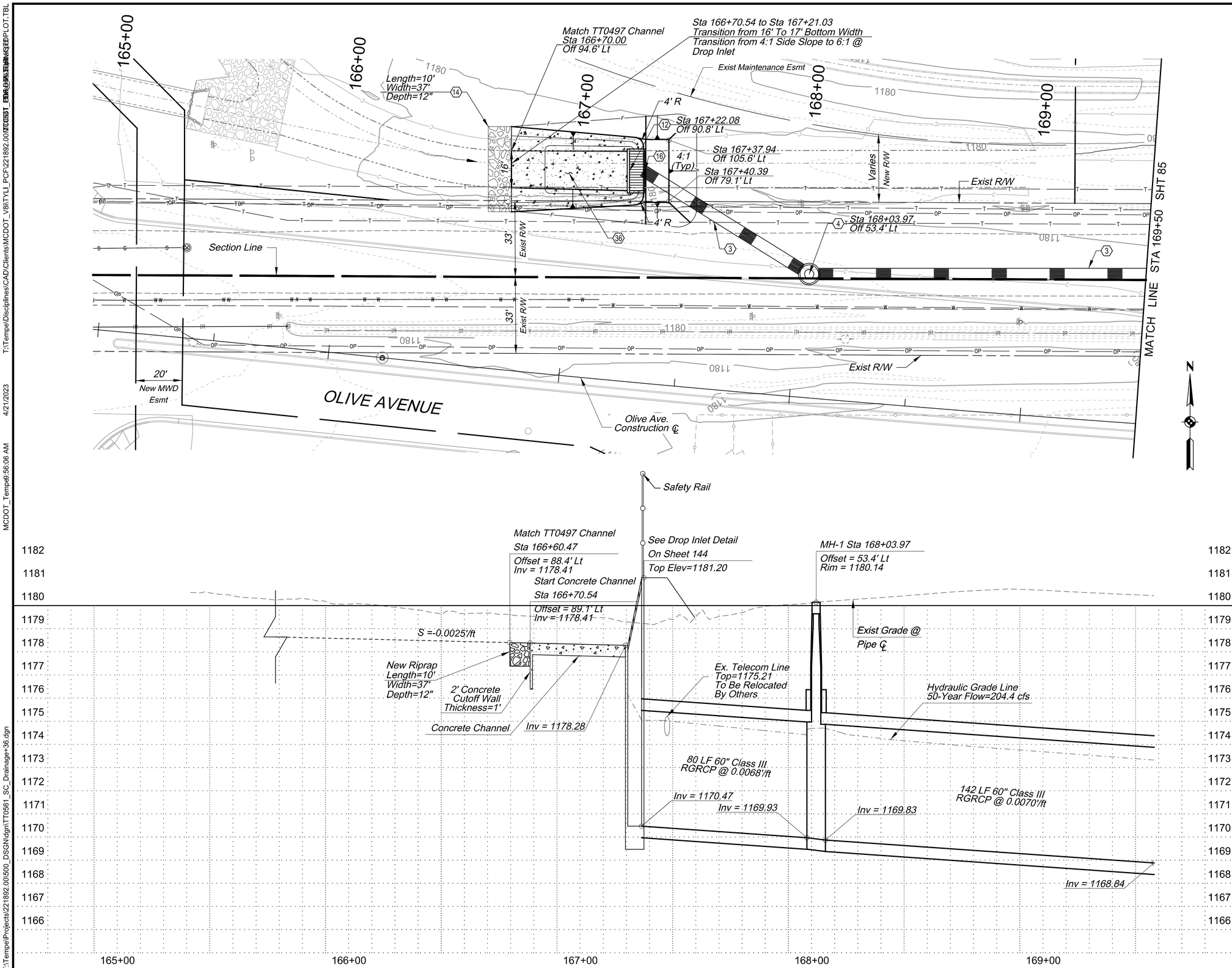

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	84	199	

CONSTRUCTION

3	Furnish and Install 60" RGRCP Storm Drain Class III	222 LF
4	Construct 4' Concrete Manhole Per MAG Std Det 521 & 522	1 EA
12	Install Headwall Drop Inlet Per Detail on Sheet 144	1 EA
14	Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan	14 CY
16	Install Safety Rail (Height 4'8") Per MAG Std Det 145	18 LF
36	Install Concrete Channel Per Detail on Sheet 143, Depth=6".	96 SY

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

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602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
3			
2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
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100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

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DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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STORM DRAIN PLAN & PROFILE SHEET

SHEET 84 OF 199

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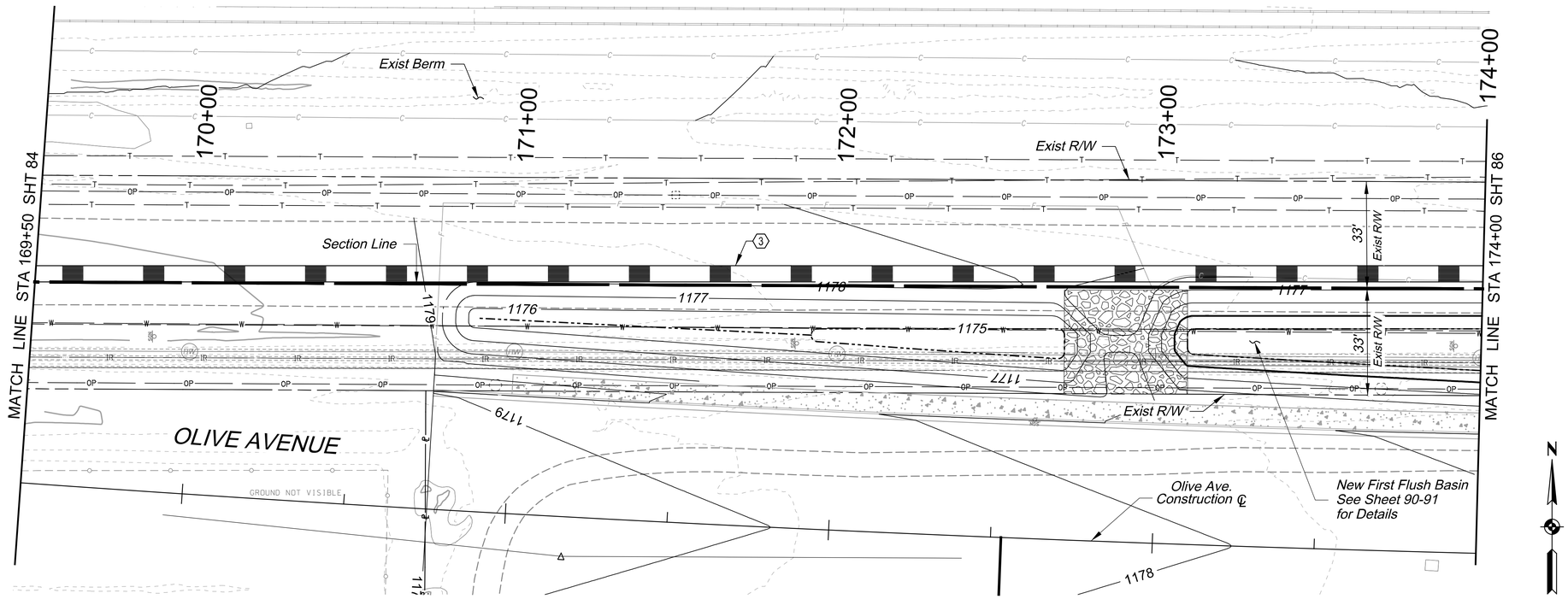

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	85	199	

CONSTRUCTION

3 Furnish and Install 60" RGRCP Storm Drain Class III — 447 LF

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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STORM DRAIN PLAN & PROFILE SHEET

SHEET 85 OF 199

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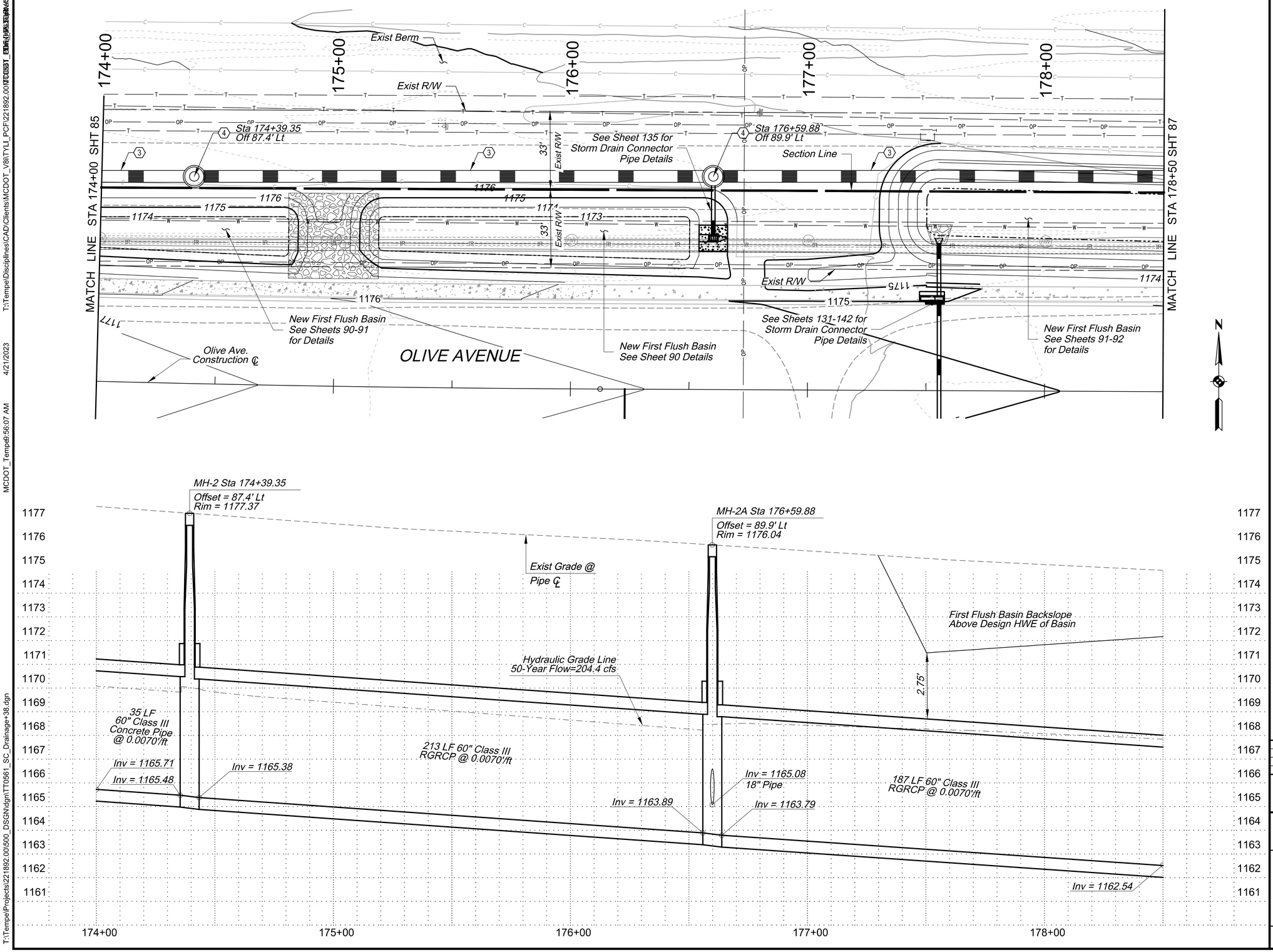

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	86	199	

CONSTRUCTION

3	Furnish and Install 60" RGRCP Storm Drain Class III	433 LF
4	Construct 4' Concrete Manhole Per MAG Std Det 521 & 522	2 EA

SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

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602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
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CHECKED	J.BARR	04/2023

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STORM DRAIN PLAN & PROFILE SHEET

SHEET 86 OF 199

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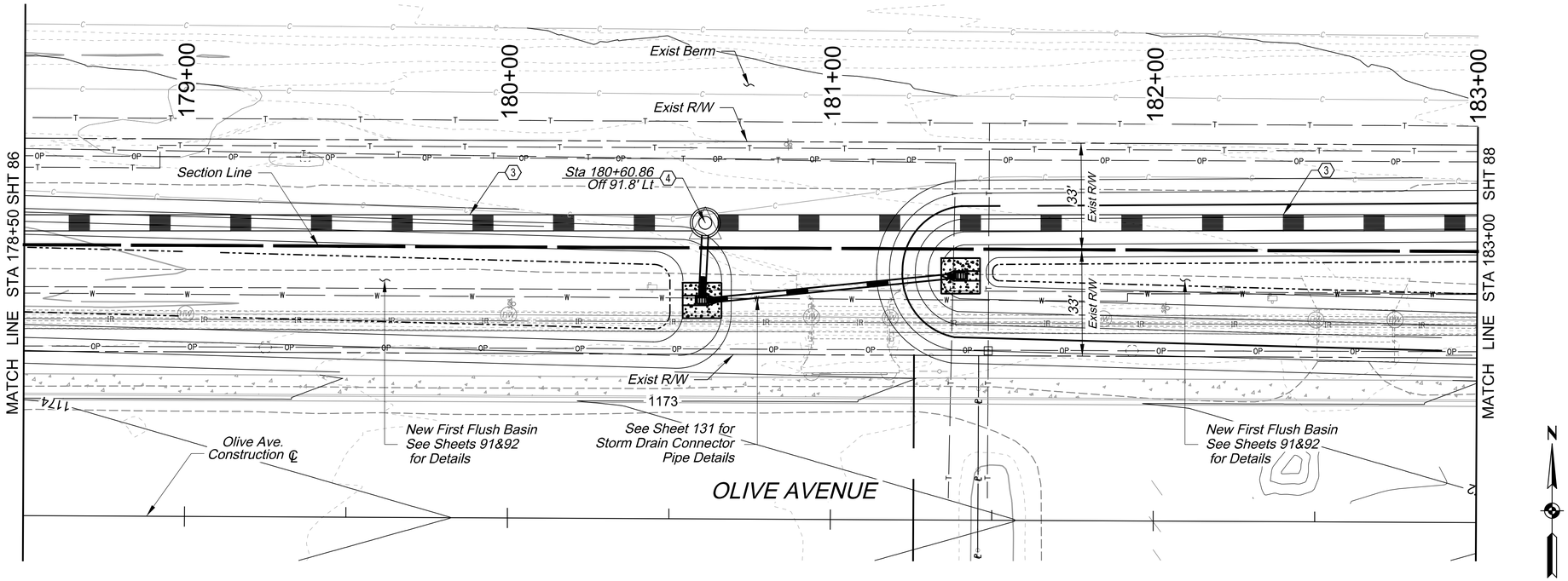
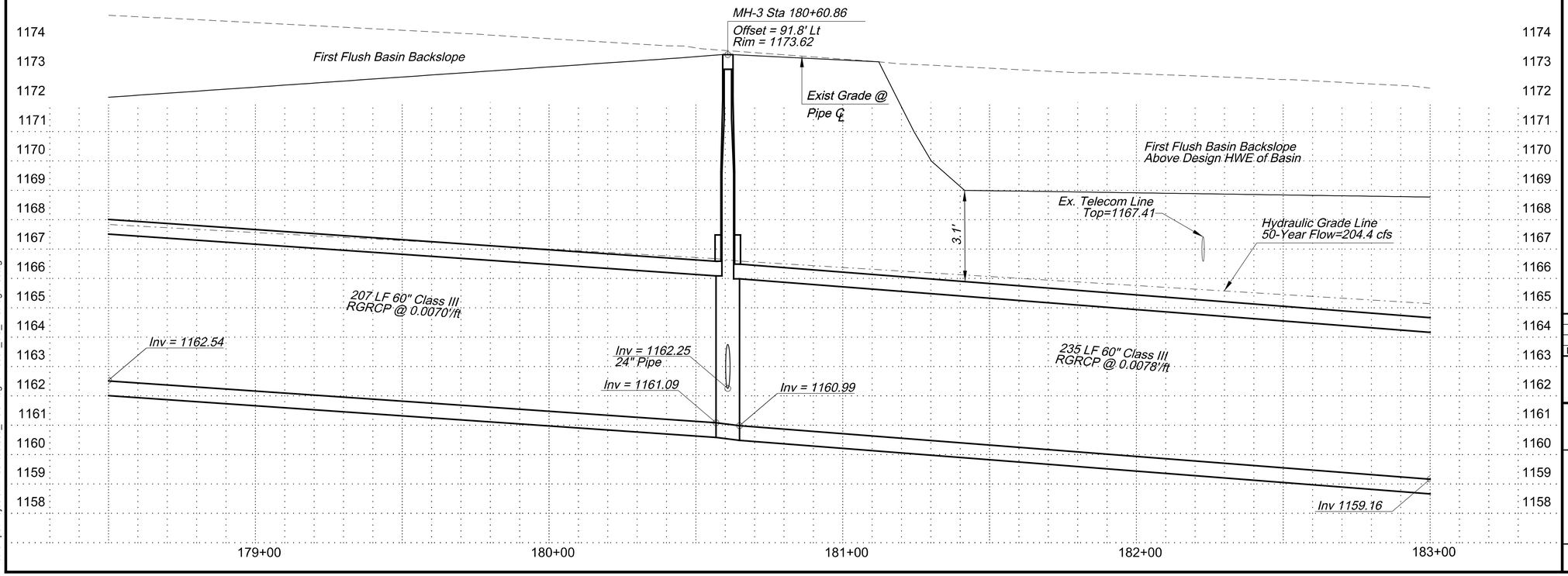
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	87	199	

CONSTRUCTION

3 Furnish and Install 60" RGRCP Storm Drain Class III — 442 LF

4 Construct 4' Concrete Manhole Per MAG Std Det 521 & 522 — 1 EA





SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

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BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
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OLIVE AVENUE
SR 303L TO REEMS ROAD
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STORM DRAIN PLAN & PROFILE SHEET

SHEET 87 OF 199

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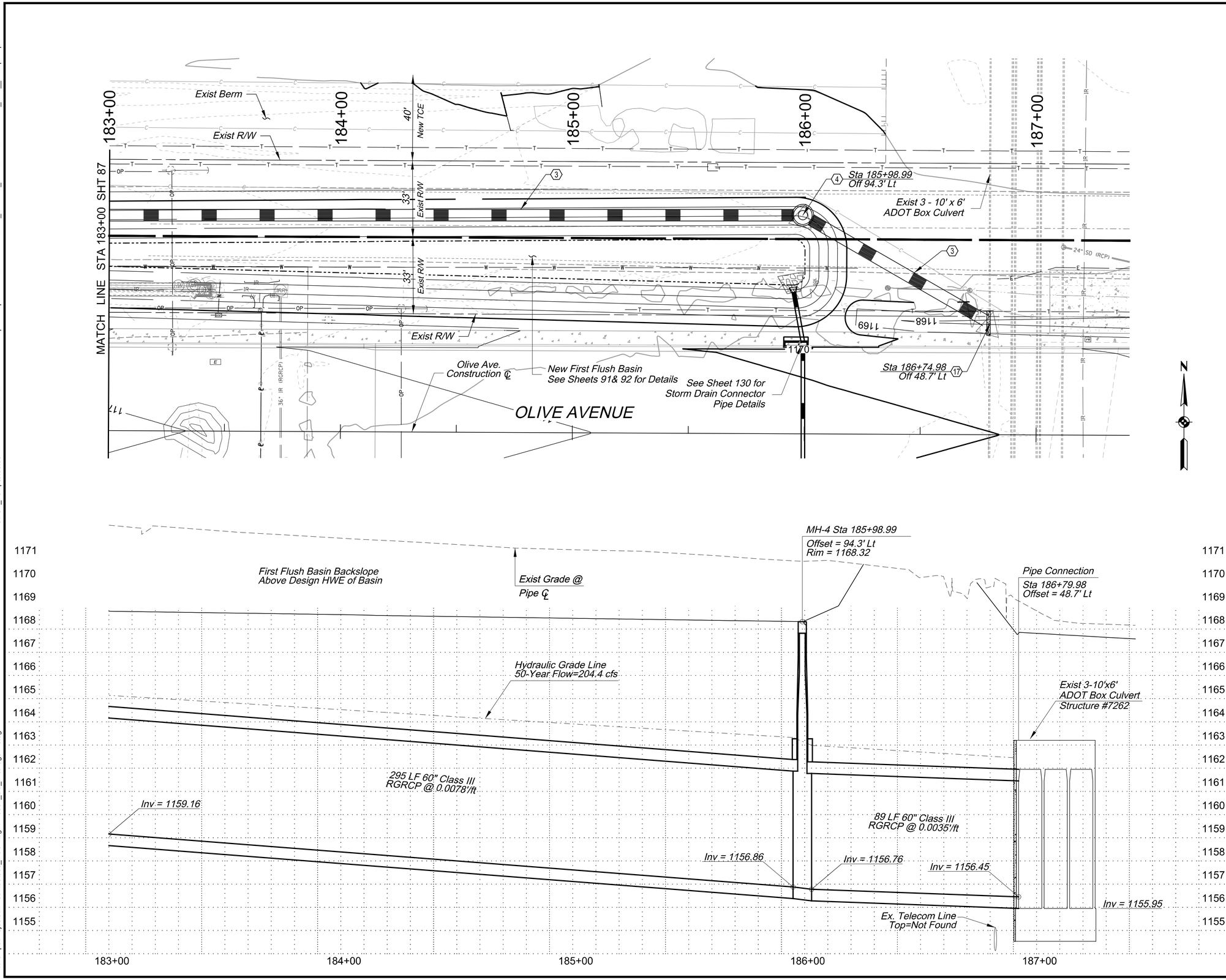

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	88	199	

CONSTRUCTION

3	Furnish and Install 60" RGRCP Storm Drain Class III	384 LF
4	Construct 4' Concrete Manhole Per MAG Std Det 521 & 522	1 EA
17	Construct Pipe Penetration Into Existing RCBC Box Culvert Per Detail on Sheet 145	1 EA

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

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STORM DRAIN PLAN & PROFILE SHEET

SHEET 88 OF 199

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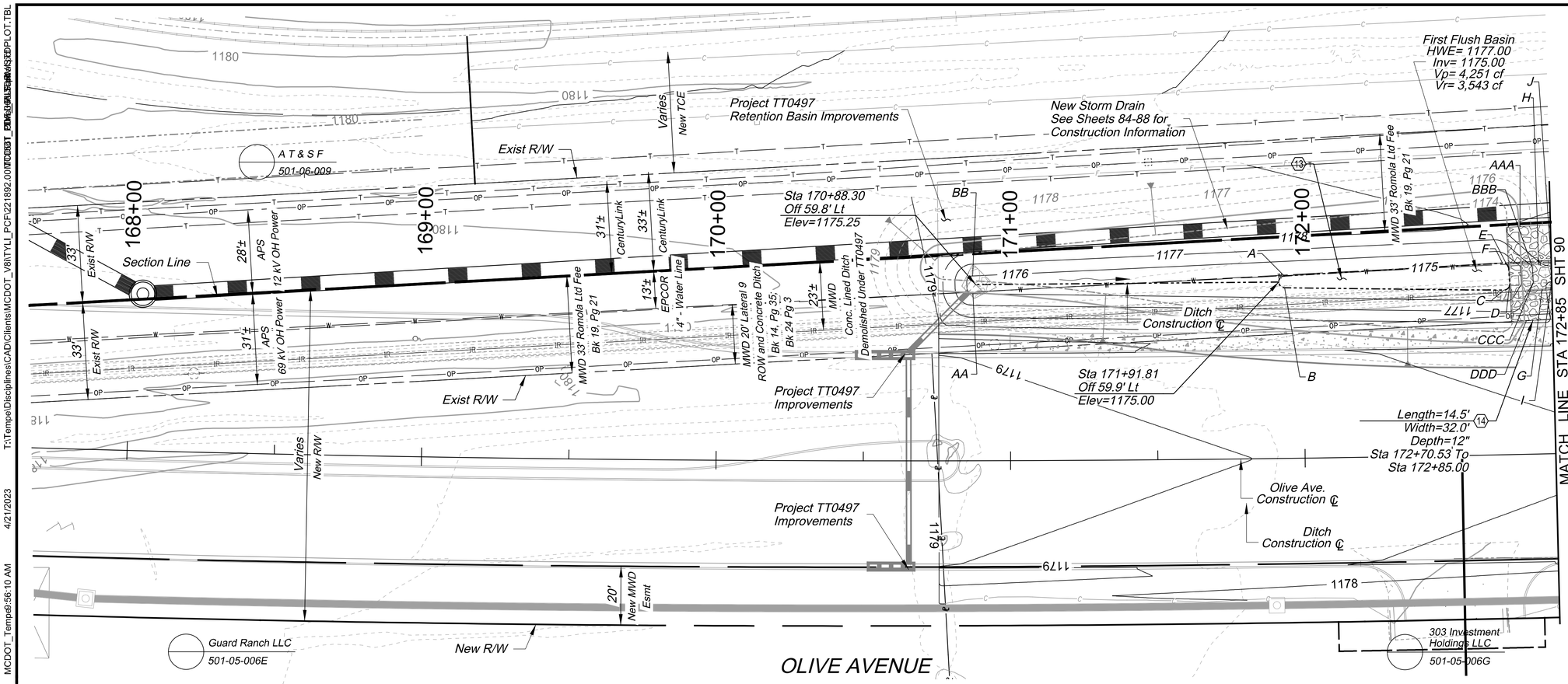
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	89	199	

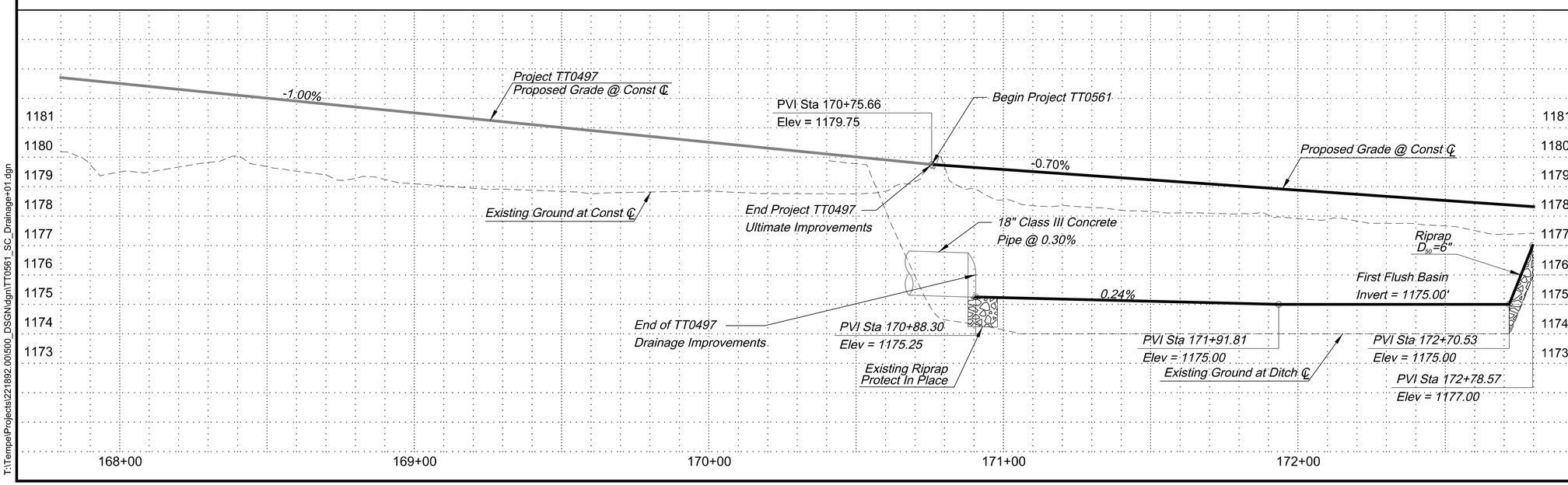
CONSTRUCTION

(13) Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510

(14) Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan — 17.2 CY



Basin Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
A	171+93.72, 62.0' Lt	1175.00
B	171+93.76, 58.0' Lt	1175.00
C	172+68.55, 55.9' Lt	1175.00
D	172+70.63, 58.0' Lt	1175.00
E	172+70.43, 63.2' Lt	1175.00
F	172+63.34, 63.2' Lt	1175.00
G	172+81.67, 56.2' Lt	1178.00
H	172+80.65, 65.4' Lt	1178.00
I	172+85.21, 58.6' Lt	1178.00
J	172+85.00, 63.8' Lt	1178.00
AA	170+87.31, 56.8' Lt	1176.00
BB	170+87.25, 62.8' Lt	1176.00
AAA	172+74.65, 77.4' Lt	1178.00
BBB	172+78.44, 63.7' Lt	1177.00
CCC	172+78.66, 58.2' Lt	1177.00
DDD	172+76.04, 45.6' Lt	1178.00



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Vert: 1"=2'

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SCALE IN FEET

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BLUE STAKE

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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

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PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
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DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 89 OF 199

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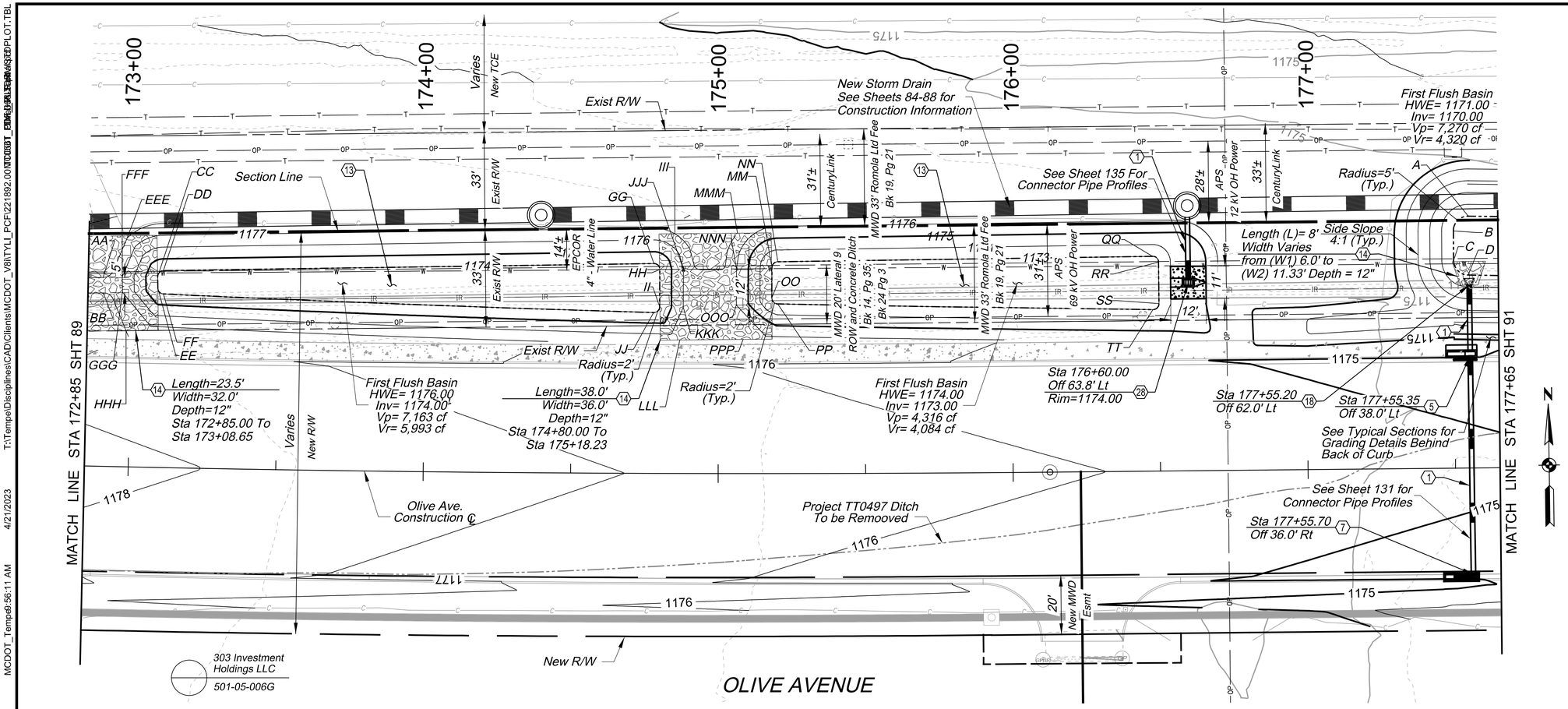
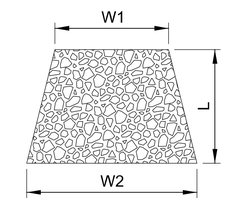
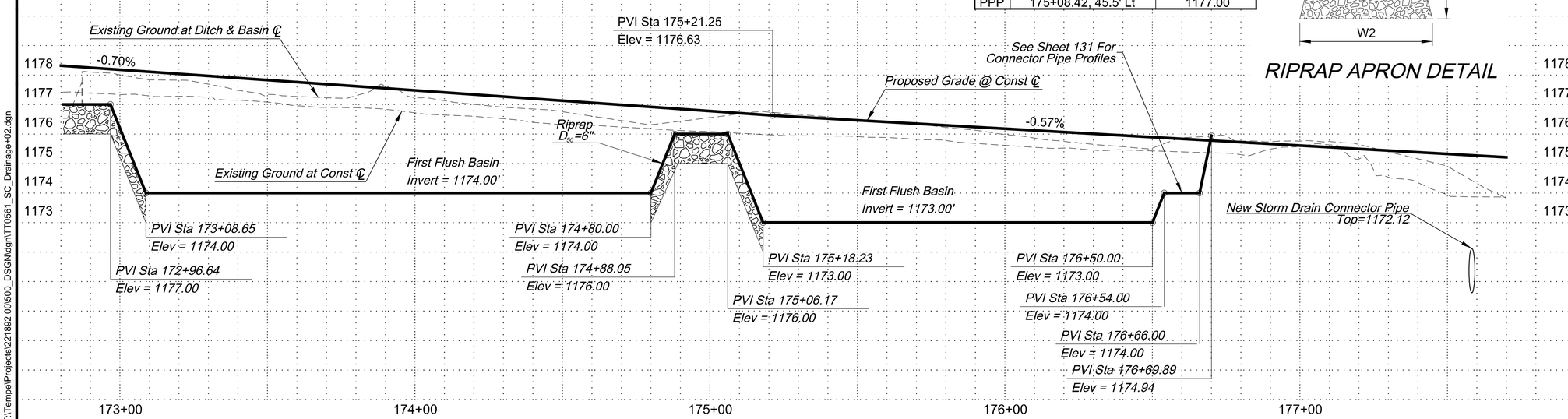


Basin Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
MMM	175+06.51, 81.5' Lt	1177.00
NNN	175+06.18, 69.3' Lt	1176.00
OOO	175+06.15, 57.2' Lt	1176.00
PPP	175+08.42, 45.5' Lt	1177.00



RIPRAP APRON DETAIL



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	90	199	

CONSTRUCTION

1. Furnish and Install 18" RGRCP Storm Drain. Class III — 118 LF
5. Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6' — 1 EA
7. Construct Concrete Catch Basin Per Modified COP Std Det P-1572 for Multiple Inlets and P-1573, Type R, Curb Opening Width=9' — 1 EA
13. Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510
14. Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan — 81.2 CY
18. Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18". — 1 EA
28. Install Area Drain Flush Catch Basin Per ADOT Std Det C-15.80 — 1 EA

Basin Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
A	177+55.11, 85.4' Lt	1170.00
B	177+50.00, 80.4' Lt	1170.00
C	177+50.00, 70.4' Lt	1170.00
D	177+54.89, 65.4' Lt	1170.00

Basin Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
AA	172+90.04, 64.0' Lt	1178.00
BB	172+90.23, 58.8' Lt	1178.00
CC	173+08.65, 64.6' Lt	1174.00
DD	173+10.59, 66.7' Lt	1174.00
EE	173+08.78, 60.8' Lt	1174.00
FF	173+10.74, 58.8' Lt	1174.00
GG	174+77.95, 71.1' Lt	1174.00
HH	174+80.00, 69.1' Lt	1174.00
II	174+80.00, 56.5' Lt	1174.00
JJ	174+77.94, 54.4' Lt	1174.00
EEE	172+98.79, 77.6' Lt	1178.00
FFF	172+96.58, 64.3' Lt	1177.00
GGG	172+96.76, 59.3' Lt	1177.00
HHH	172+98.26, 46.1' Lt	1178.00
III	174+85.08, 81.2' Lt	1177.00
JJJ	174+88.05, 69.2' Lt	1176.00
KKK	174+88.03, 56.4' Lt	1176.00
LLL	174+86.90, 45.2' Lt	1177.00

Basin Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
MM	175+18.27, 69.8' Lt	1173.00
NN	175+20.25, 71.8' Lt	1173.00
OO	175+18.23, 59.5' Lt	1173.00
PP	175+20.20, 57.5' Lt	1173.00
QQ	176+48.00, 72.8' Lt	1173.00
RR	176+50.00, 70.8' Lt	1173.00
SS	176+50.00, 56.8' Lt	1173.00
TT	176+47.95, 54.8' Lt	1173.00

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
3			
2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 90 OF 199

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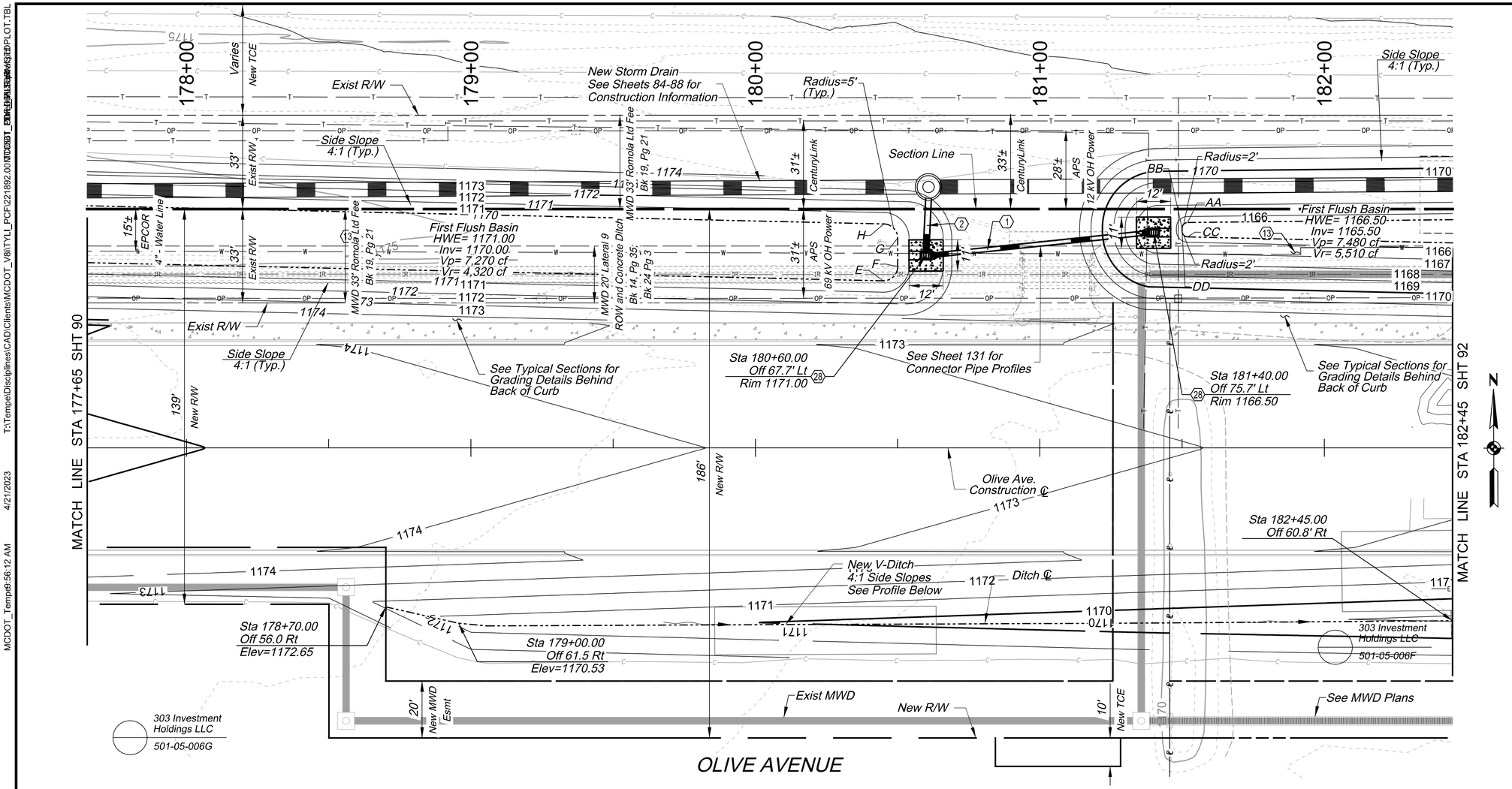

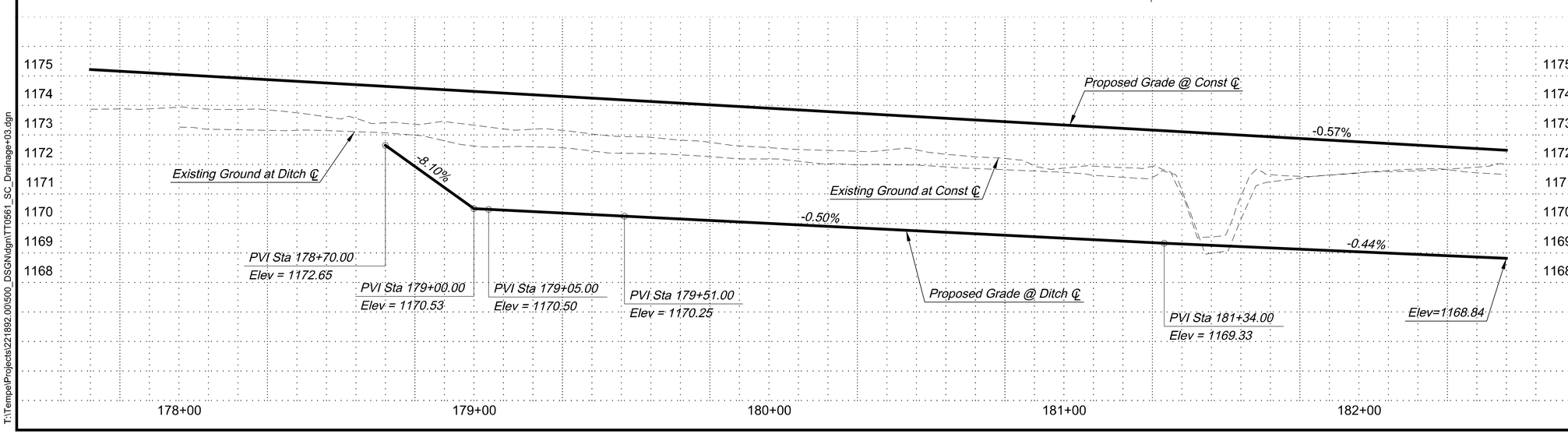

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	91	199	

CONSTRUCTION

1. Furnish and Install 18" RGRCP Storm Drain. Class III — 78 LF
2. Furnish and Install 24" RGRCP Storm Drain Class III — 20 LF
13. Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510
28. Install Area Drain Flush Catch Basin Per ADOT Std Det C-15.80 — 2 EA

Basin Control Points

ID	Olive Ave Const ℄ Station, Offset	Elevation
E	180+44.91, 58.8' Lt	1170.00
F	180+50.00, 63.8' Lt	1170.00
G	180+50.03, 73.8' Lt	1170.00
H	180+45.14, 78.9' Lt	1170.00
AA	181+51.97, 79.3' Lt	1165.50
BB	181+50.00, 77.3' Lt	1165.50
CC	181+51.94, 74.2' Lt	1165.50
DD	181+50.00, 76.2' Lt	1165.50

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

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NO.	REVISION	BY	DATE
3			
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

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DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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DRAINAGE DITCH PLAN AND PROFILE SHEET

SHEET 91 OF 199

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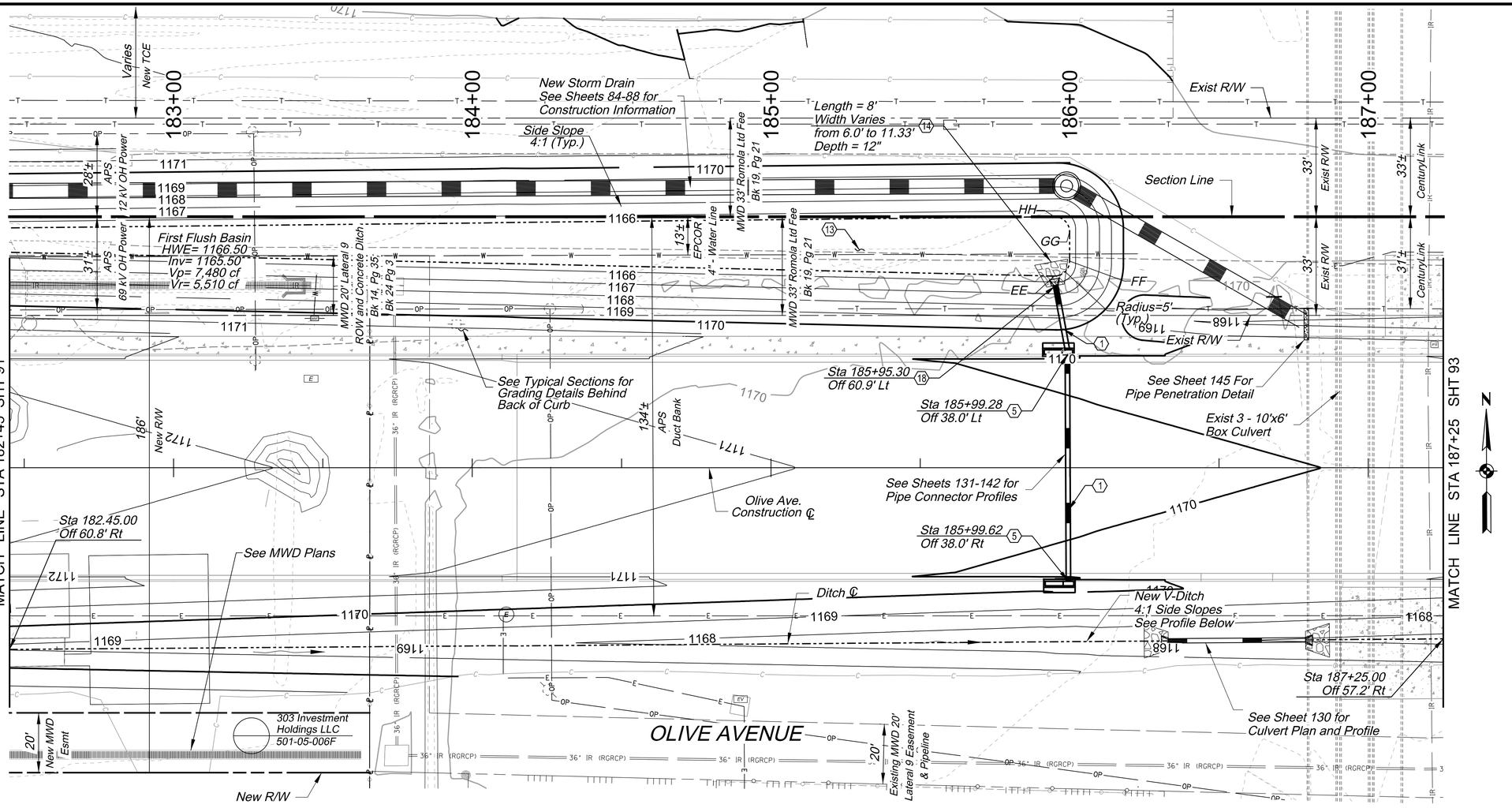
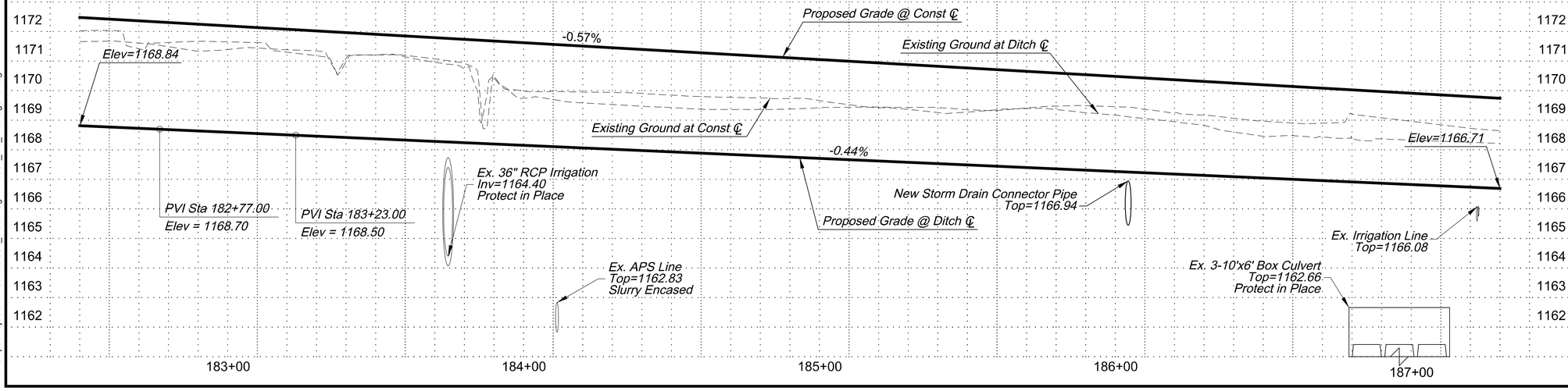


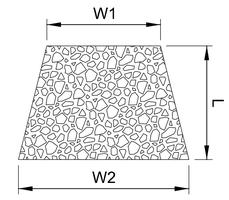


F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	92	199	

CONSTRUCTION

1. Furnish and Install 18" RGRCP Storm Drain. Class III — 98 LF
5. Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6' — 2 EA
13. Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510
14. Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan — 2.6 CY
18. Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18". — 1 EA

Basin Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
EE	185+94.89, 64.2' Lt	1165.50
FF	186+00.00, 68.2' Lt	1165.50
GG	186+00.00, 79.0' Lt	1165.50
HH	185+94.95, 84.0' Lt	1165.50



RIPRAP APRON DETAIL

SCALE: Hor: 1"=20'
Vert: 1"=2'
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SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
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SHEET 92 OF 199

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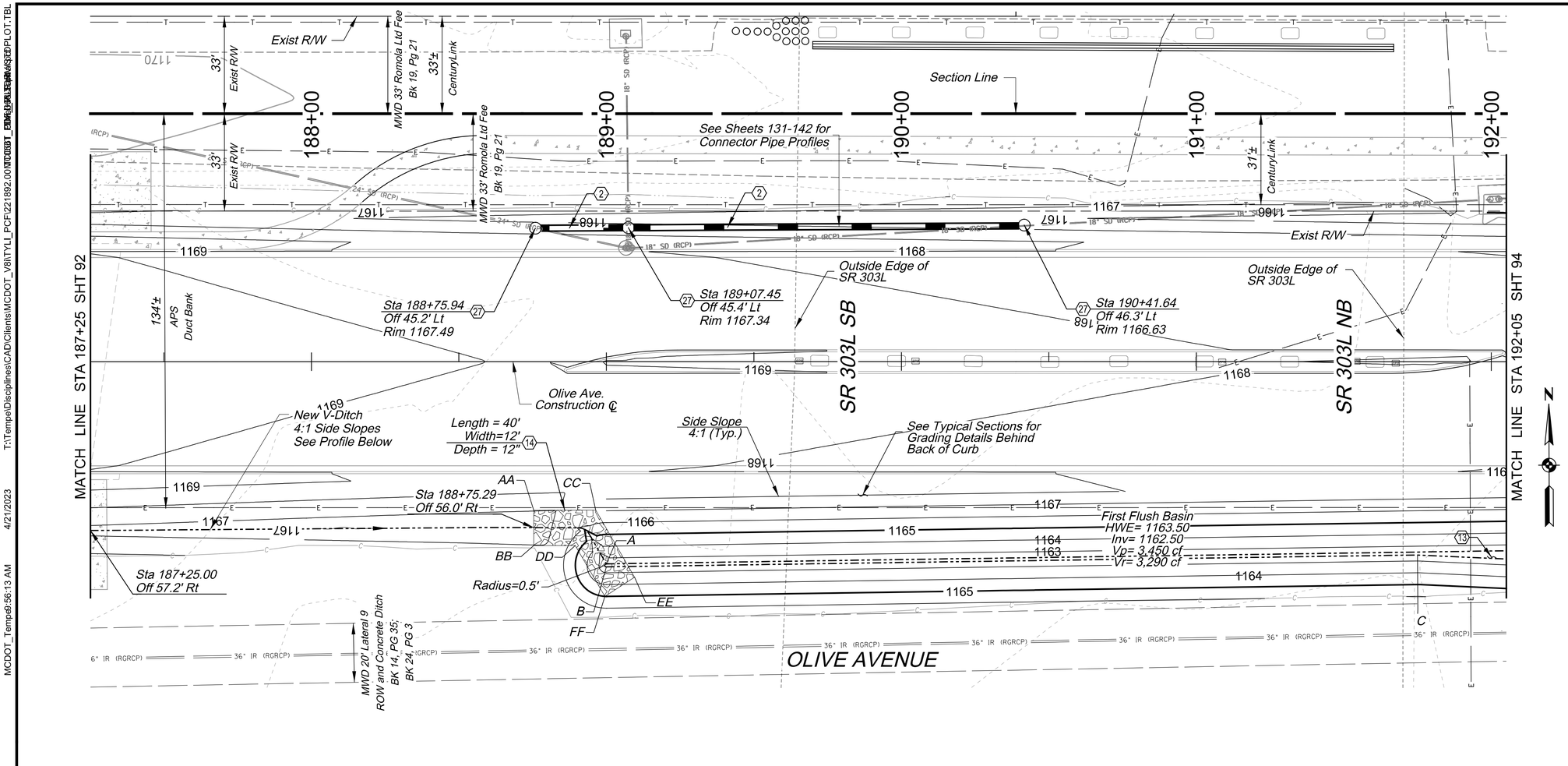

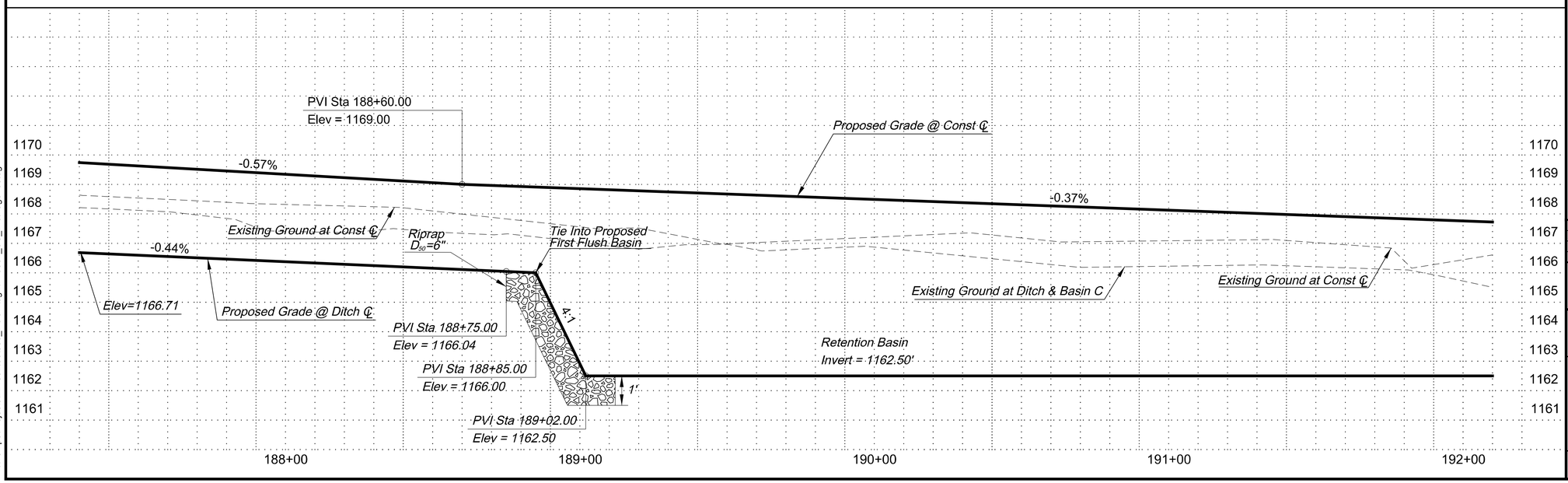

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	93	199	

CONSTRUCTION

(2) Furnish and Install 24" RGRCP Storm Drain Class III — 158 LF

(13) Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510

(14) Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan — 18 CY

(27) Install Manhole Per ADOT Std Det C-18.10, Sheets 1-3 — 3 EA

Basin Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
A	189+00.00, 68.5' Rt	1162.50
B	189+00.00, 69.6' Rt	1162.50
C	191+74.99, 65.5' Rt	1162.50

RipRap Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
AA	188+75.38, 50.3' Rt	1167.00
BB	188+75.38, 62.3' Rt	1167.00
CC	188+96.40, 50.3' Rt	1167.00
DD	188+89.45, 62.3' Rt	1165.50
EE	189+09.52, 73.1' Rt	1163.50
FF	188+99.50, 79.6' Rt	1165.00

SCALE: Hor: 1"=20' Vert: 1"=2'

20 0 20 40 SCALE IN FEET

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NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
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DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 93 OF 199

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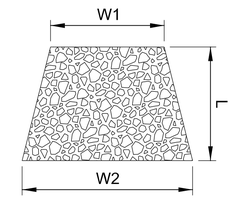
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	94	199	

CONSTRUCTION

(8)	Install Concrete Scupper Per MAG Std Det 206-1 thru 206-3, Inlet Width=8'	3 EA
(13)	Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510	
(14)	Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan	18 CY
(33)	Install Concrete Spillway Per MAG Std Det 206-1 thru 206-3, Width=8'	61.1 LF

Basin Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
D	193+60.00, 72.8' Rt	1162.50
E	193+60.00, 60.8' Rt	1162.50

Grading Riprap Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
AA	194+36.52, 61.2' Lt	1164.50
BB	194+60098, 51.3' Lt	1164.50
CC	194+72.00, 115.9' Lt	1163.26
DD	194+83.03, 106.2' Lt	1164.08
EE	194+82.94, 59.9' Lt	1163.81
FF	194+80.23, 89.5' Lt	1164.08
GG	194+71.86, 106.4' Lt	1163.26
HH	194+60.78, 97.9' Lt	1163.81



RIPRAP APRON DETAIL

SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

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DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 94 OF 199

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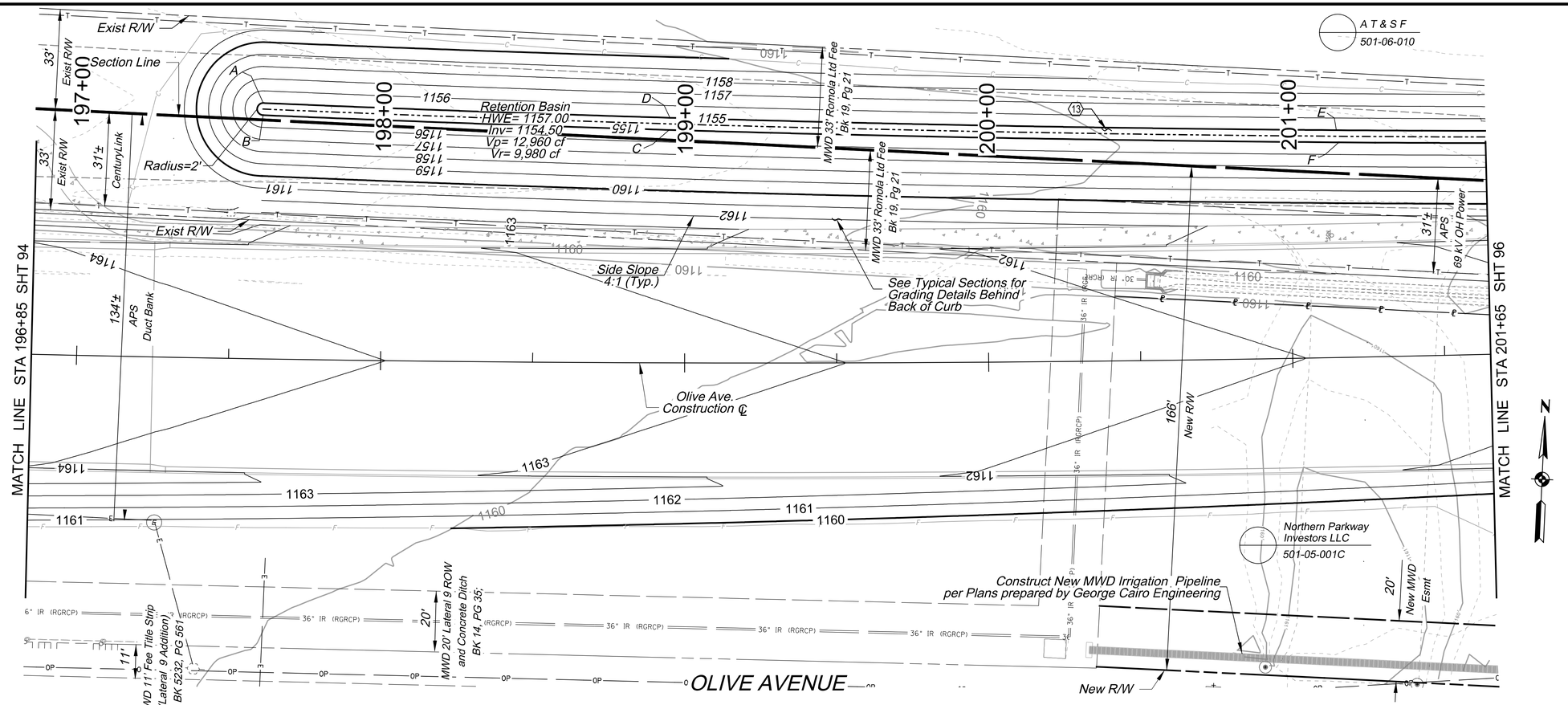
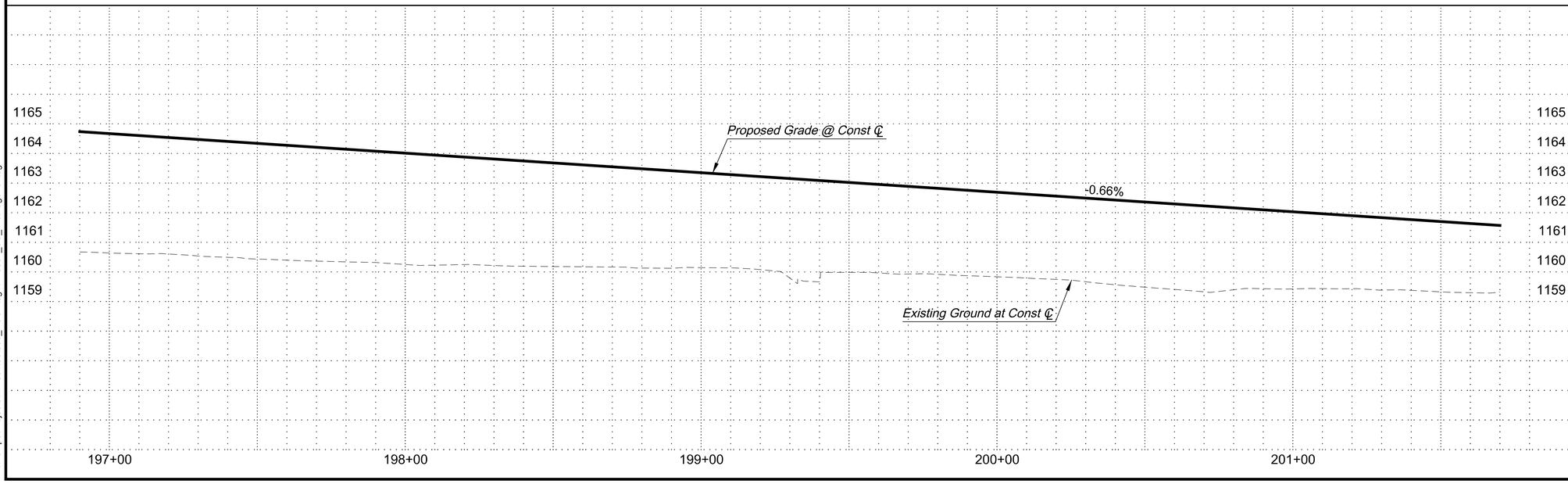


Basin Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
A	197+60.00, 84.2' Lt	1154.50
B	197+60.00, 80.2' Lt	1154.50
C	198+94.64, 76.6' Lt	1154.50
D	198+94.89, 80.6' Lt	1154.50
E	201+15.78, 74.8' Lt	1154.50
F	201+16.48, 70.7' Lt	1154.50



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	95	199	

CONSTRUCTION

SCALE: Hor: 1"=20'
Vert: 1"=2'
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SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 95 OF 199

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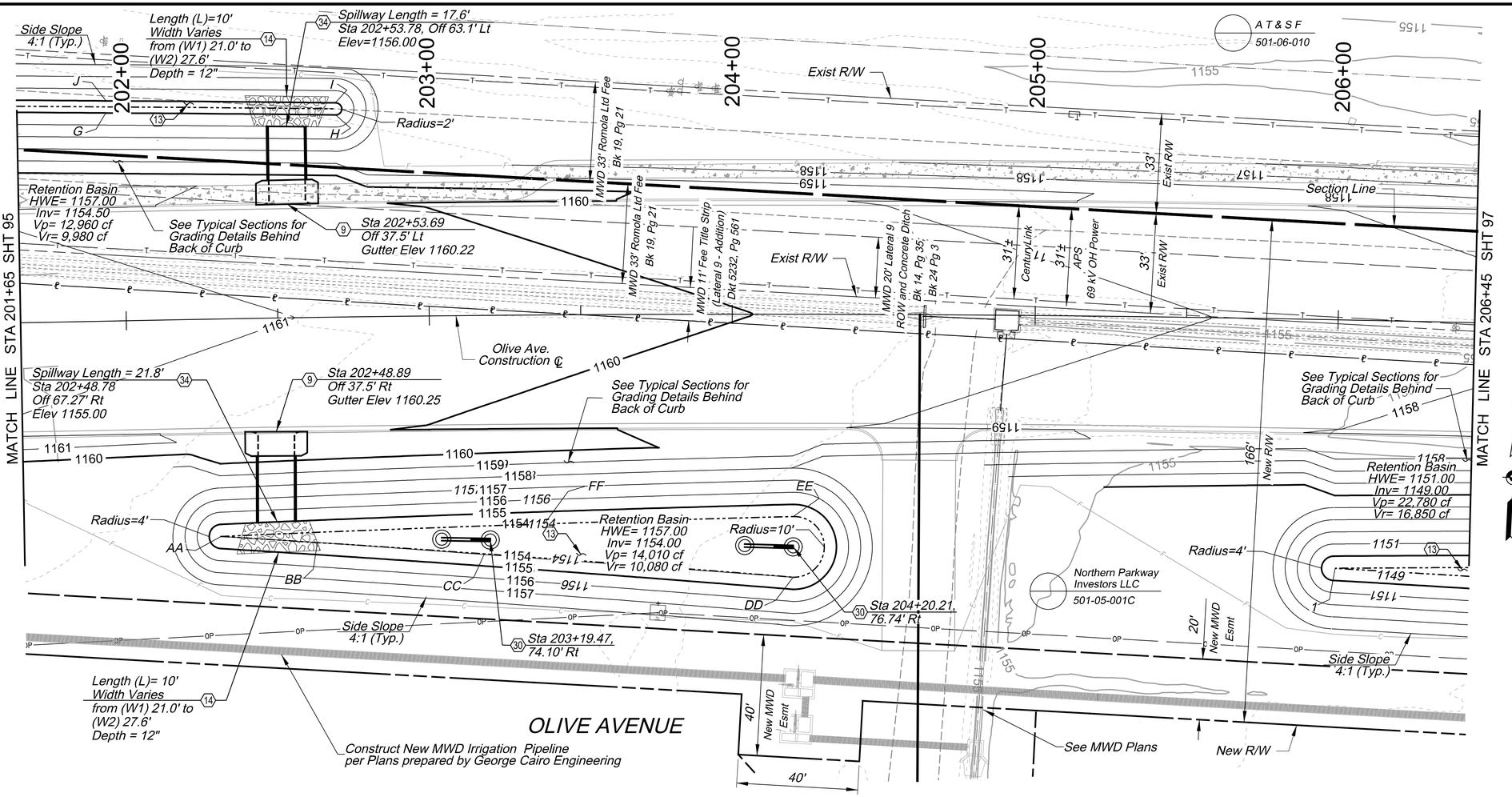
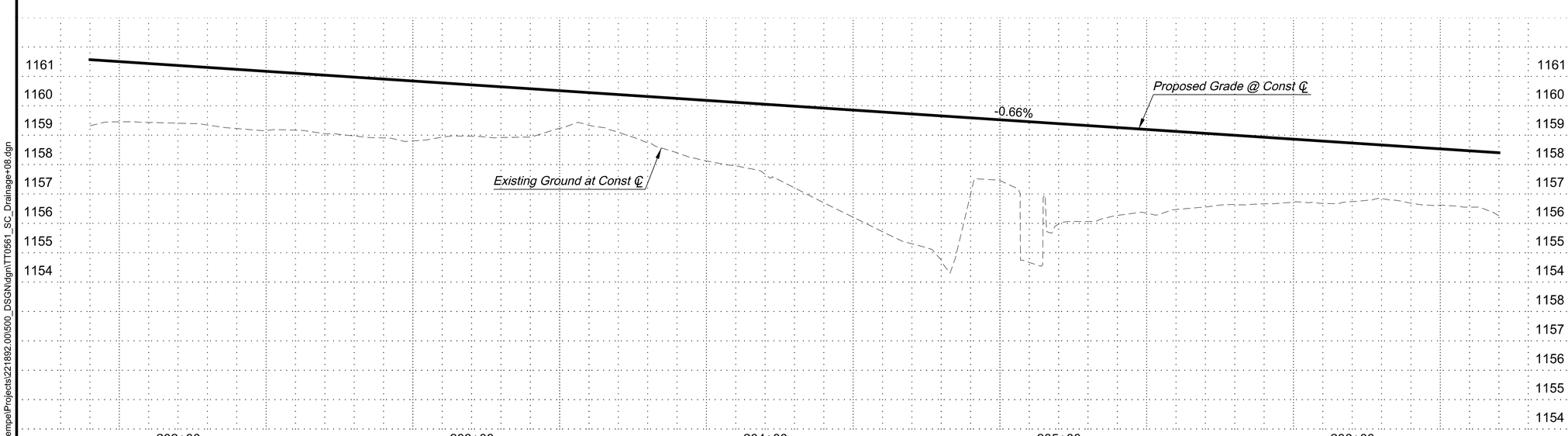




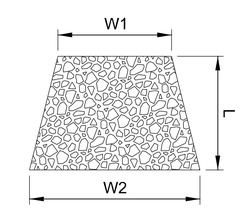
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	96	199	

CONSTRUCTION

- (9) Install Concrete Scupper Per MAG Std Det 206-1 thru 206-3, Inlet Width=12' — 2 EA
- (13) Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510
- (14) Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan — 18 CY
- (30) Install Drywell Per Drywell Detail Sheet, See Sheet 146 — 2 EA
- (34) Install Concrete Spillway Per MAG Std Det 206-1 thru 206-3, Width=12' — 39.4 LF

Basin Control Points

ID	Olive Ave Const ℄ Station, Offset	Elevation
G	201+94.59, 68.69' Lt	1154.50
H	202+70.15, 66.7' Lt	1154.50
I	202+70.12, 70.8' Lt	1154.50
J	201+94.77, 72.7' Lt	1154.50
AA	202+29.94, 71.8' Rt	1154.00
BB	202+61.99, 74.3' Rt	1154.00
CC	203+17.50, 78.7' Rt	1154.00
DD	204+20.21, 86.7' Rt	1154.00
EE	204+20.21, 66.7' Lt	1154.00
FF	203+37.58, 68.9' Rt	1154.00
1	206+00.70, 82.0' Rt	1149.00



RIPRAP APRON DETAIL

SCALE: Hor: 1"=20' Vert: 1"=2'

20 0 20 40 SCALE IN FEET

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MARICOPA COUNTY
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ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 96 OF 199

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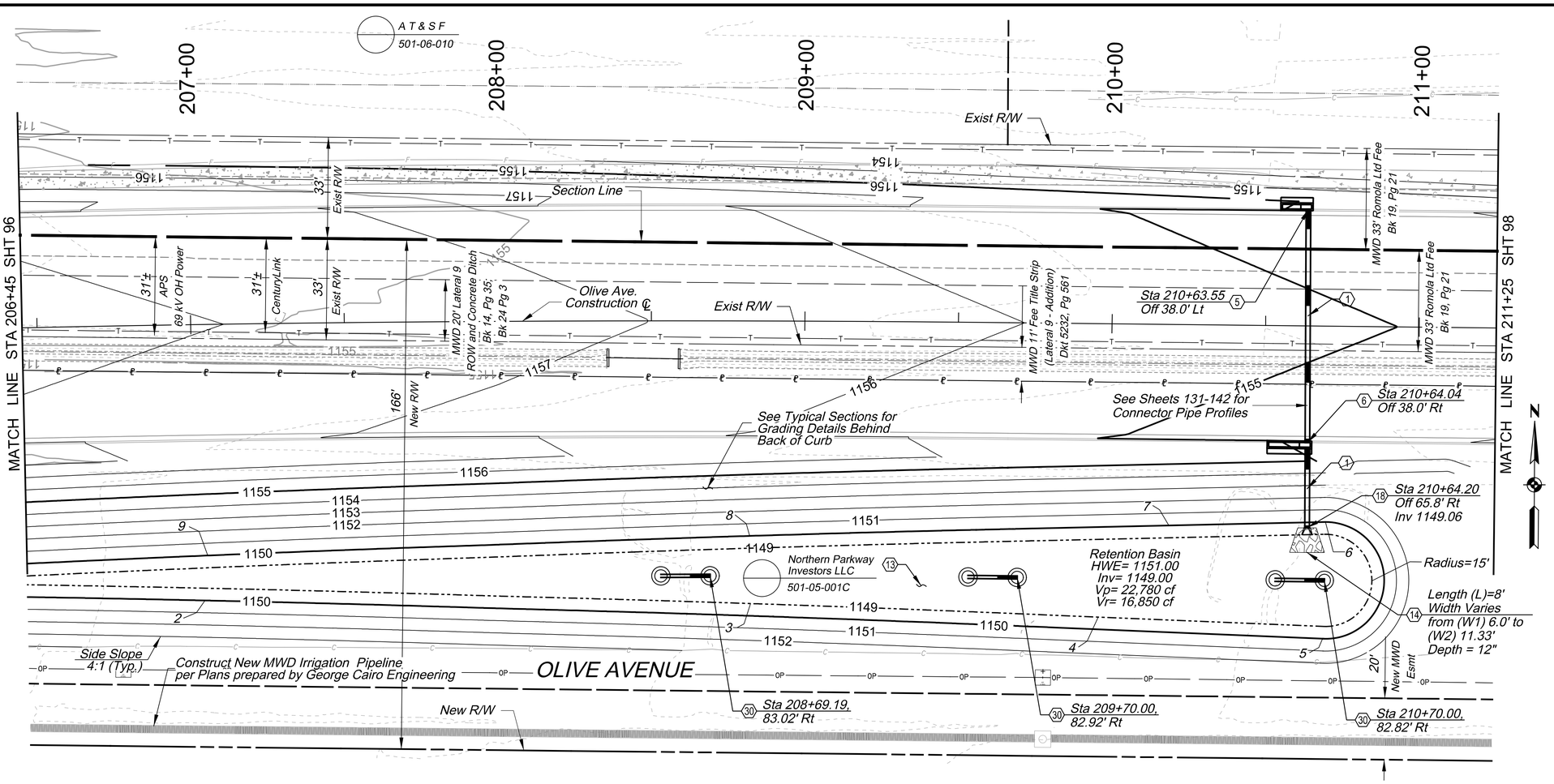
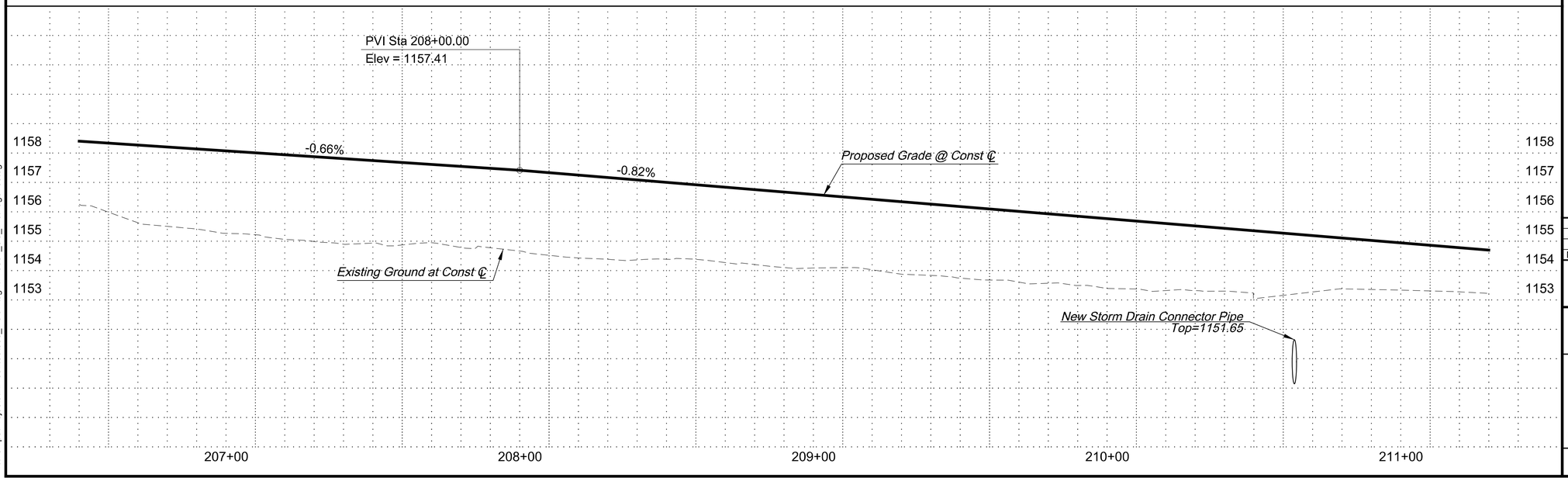




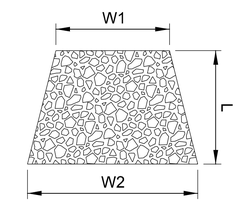
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	97	199	

CONSTRUCTION

1	Furnish and Install 18" RGRCP Storm Drain. Class III	102 LF
5	Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6'	1 EA
6	Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=10'	1 EA
13	Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510	
14	Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan	3 CY
18	Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18".	1 EA
30	Install Drywell Per Drywell Detail Sheet, See Sheet 146	3 EA

Basin Control Points

ID	Olive Ave Const ℄ Station, Offset	Elevation
2	207+03.32, 89.9' Rt	1149.00
3	208+82.50, 92.0' Rt	1149.00
4	209+96.52, 95.6' Rt	1149.00
5	210+69.90, 101.8' Rt	1149.00
6	210+70.14, 63.8' Rt	1149.00
7	210+19.23, 65.5' Rt	1149.00
8	208+82.13, 70.0' Rt	1149.00
9	207+04.29, 75.2' Rt	1149.00



RIPRAP APRON DETAIL

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
3			
2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 97 OF 199

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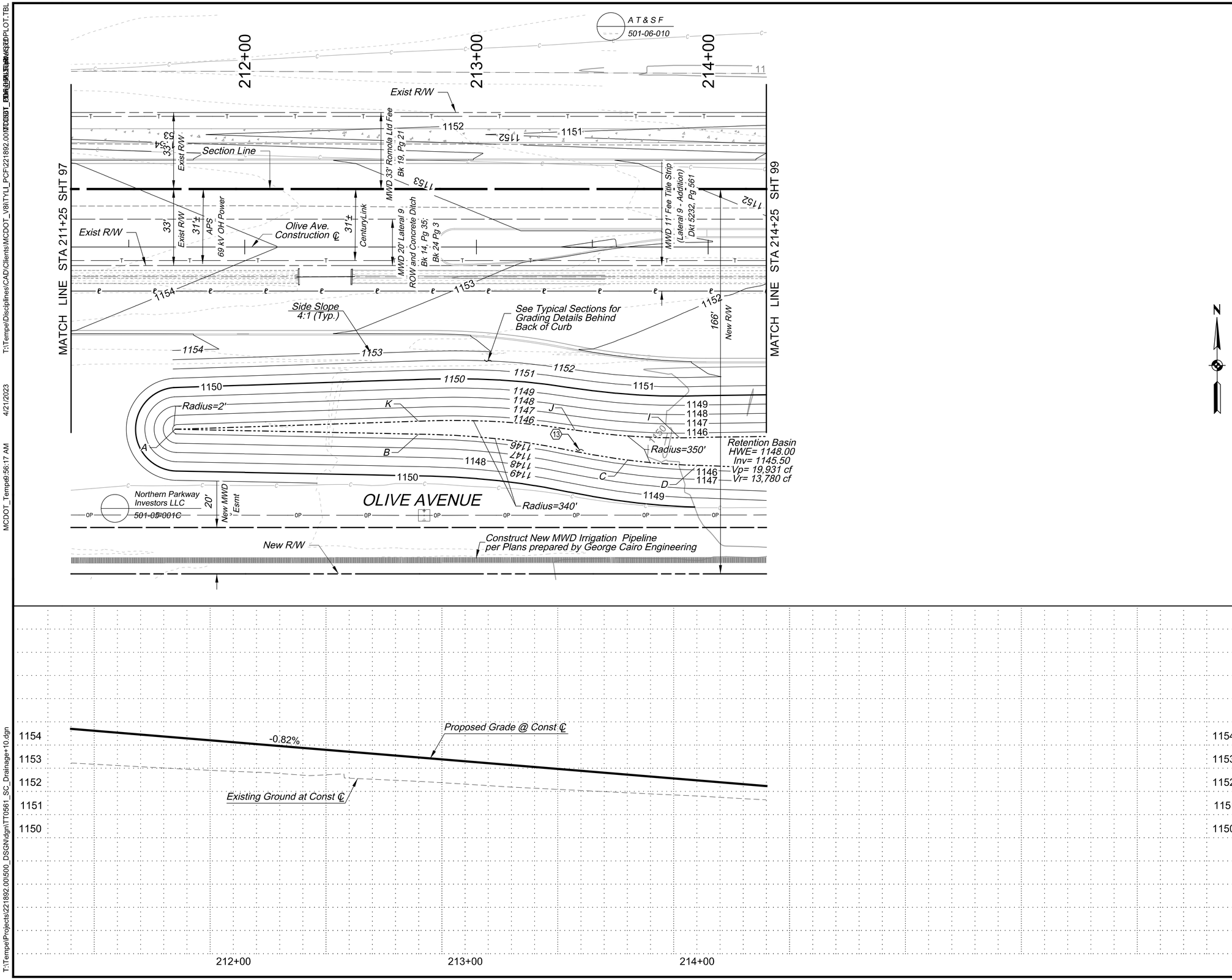
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	98	199	

CONSTRUCTION

(13) Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510



Basin Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
A	211+70.00, 78.6' Rt	1145.50
B	212+75.00, 80.7' Rt	1145.50
C	213+64.99, 92.2' Rt	1145.50
D	213+94.94, 94.5' Rt	1145.50
I	213+87.52, 82.2' Rt	1145.50
J	213+42.50, 78.9' Rt	1145.50
K	212+75.00, 75.1' Rt	1145.50

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
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DRAINAGE PLAN AND PROFILE SHEET

SHEET 98 OF 199

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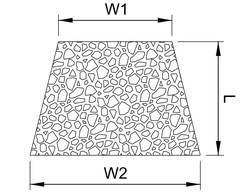
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	99	199	

CONSTRUCTION

1. Furnish and Install 18" RGRCP Storm Drain. Class III — 112 LF
6. Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=10' — 2 EA
13. Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510
14. Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan — 3 CY
18. Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18". — 1 EA

Basin Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
E	214+87.50, 97.4' Rt	1145.50
F	215+45.00, 99.2' Rt	1145.50
G	215+45.00, 79.2' Rt	1145.50
H	214+87.61, 80.5' Rt	1145.50



RIPRAP APRON DETAIL

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL
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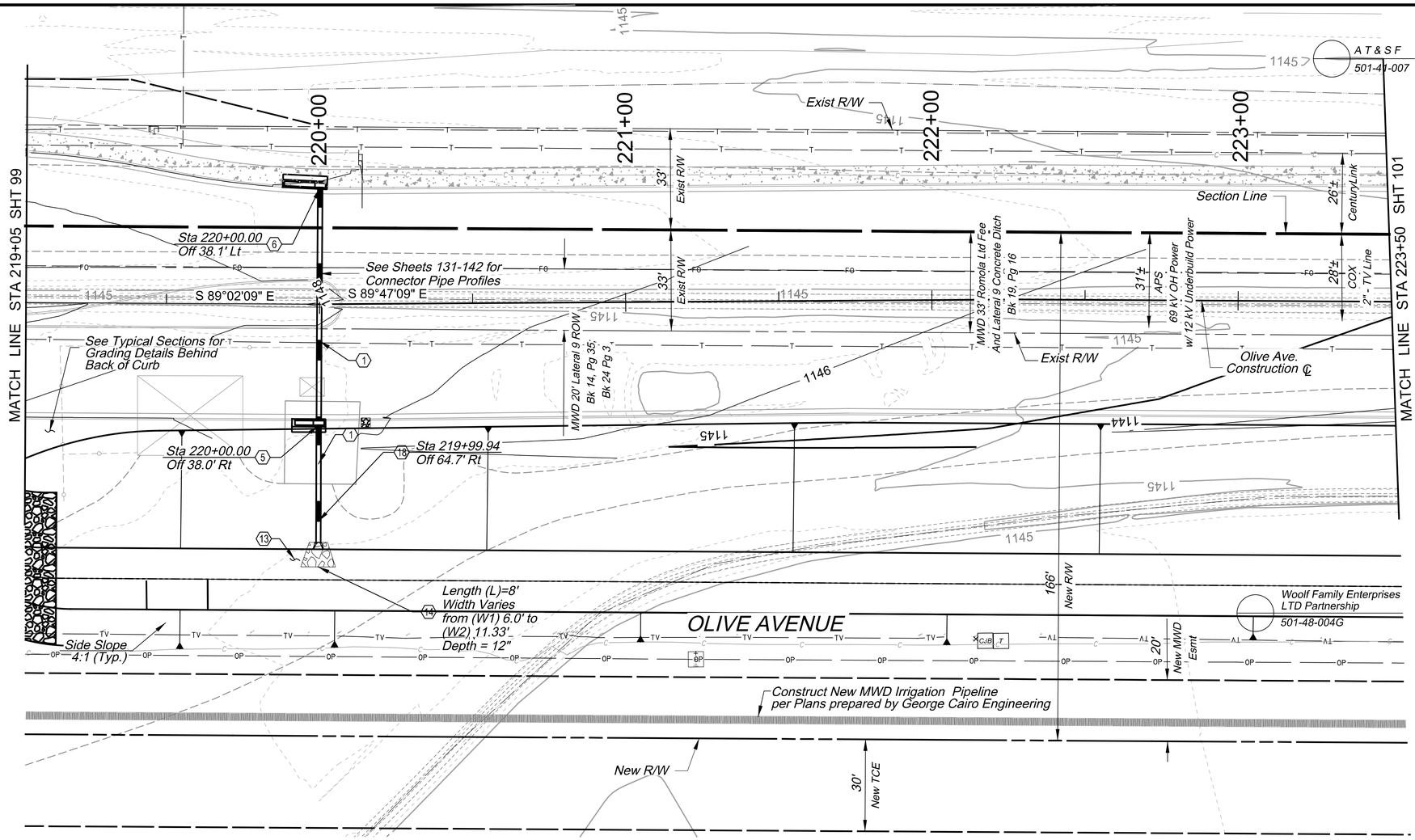

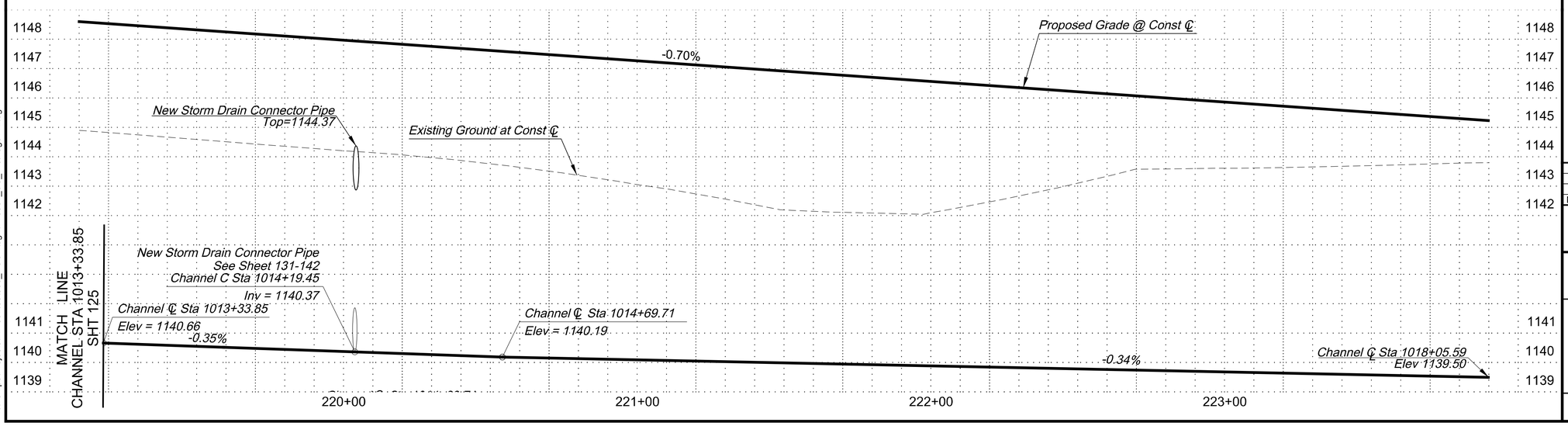

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	100	199	

CONSTRUCTION

1	Furnish and Install 18" RGRCP Storm Drain. Class III	102 LF
5	Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6'	1 EA
6	Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=10'	1 EA
13	Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510	
14	Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan	3 CY
18	Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18".	1 EA
20	Install First Flush Berm Per Detail on Sheet 148.	1 EA

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL
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MARICOPA COUNTY
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DRAINAGE PLAN AND PROFILE SHEET

SHEET 100 OF 199

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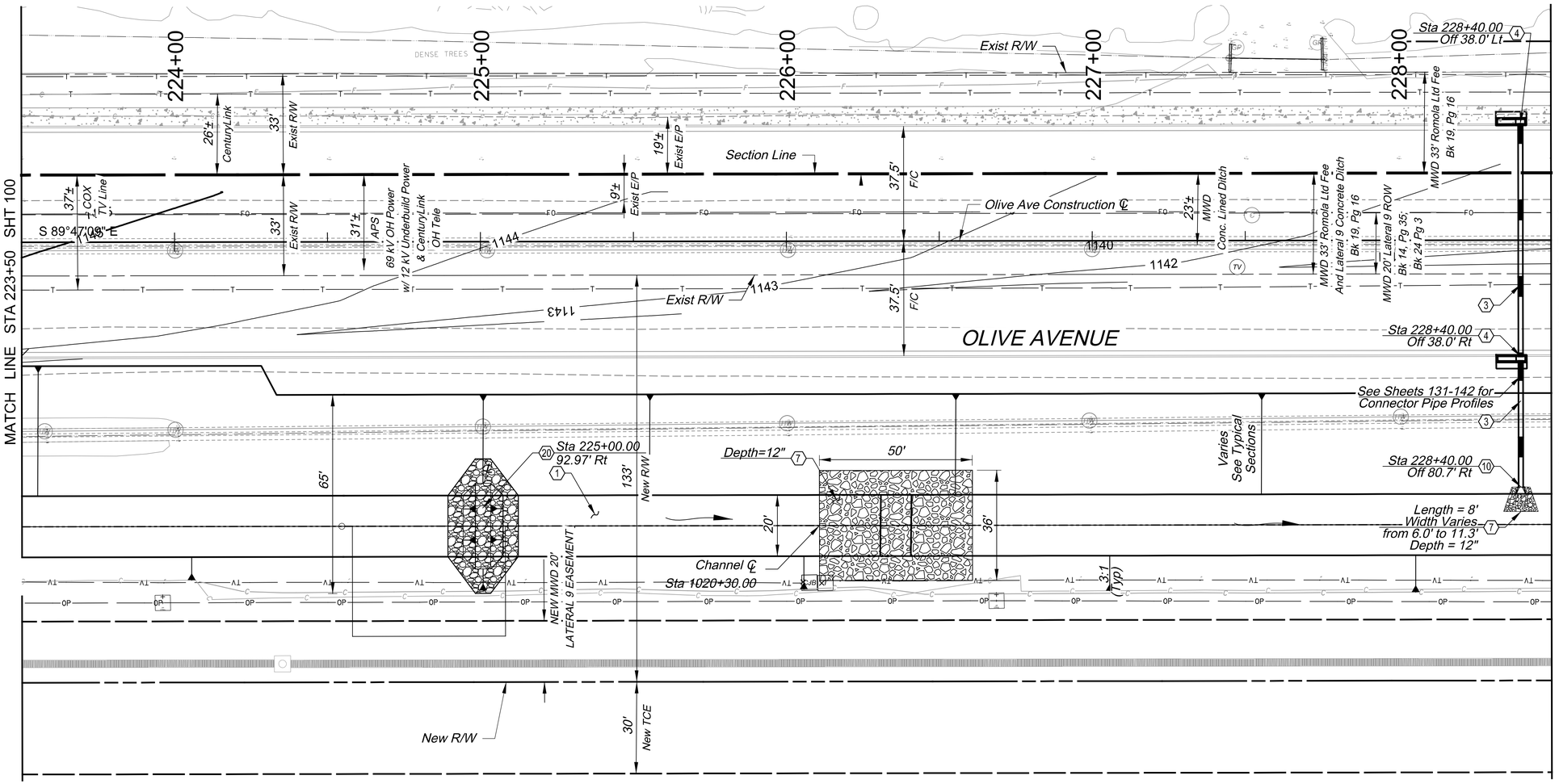

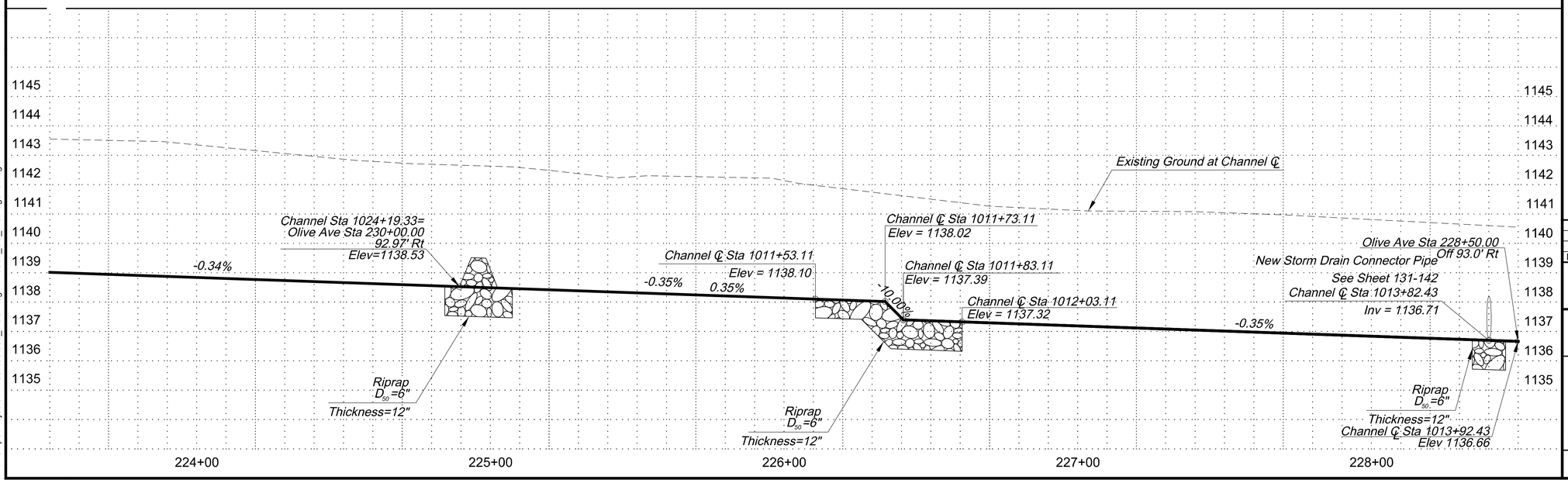

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	101	199	

CONSTRUCTION

1. Drainage Excavation Paid For Under Channel Excavation #215.01100
3. Furnish and Install 18" RGRCP Storm Drain. Class III — 116 LF
4. Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6' — 2 EA
7. Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan — 67 CY
10. Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18". — 1 EA
20. Install First Flush Berm Per Detail on sheet 148 — 1 EA

N

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
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OLIVE AVENUE
SR 303L TO REEMS ROAD
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CHANNEL PLAN AND PROFILE SHEET

SHEET 101 OF 199

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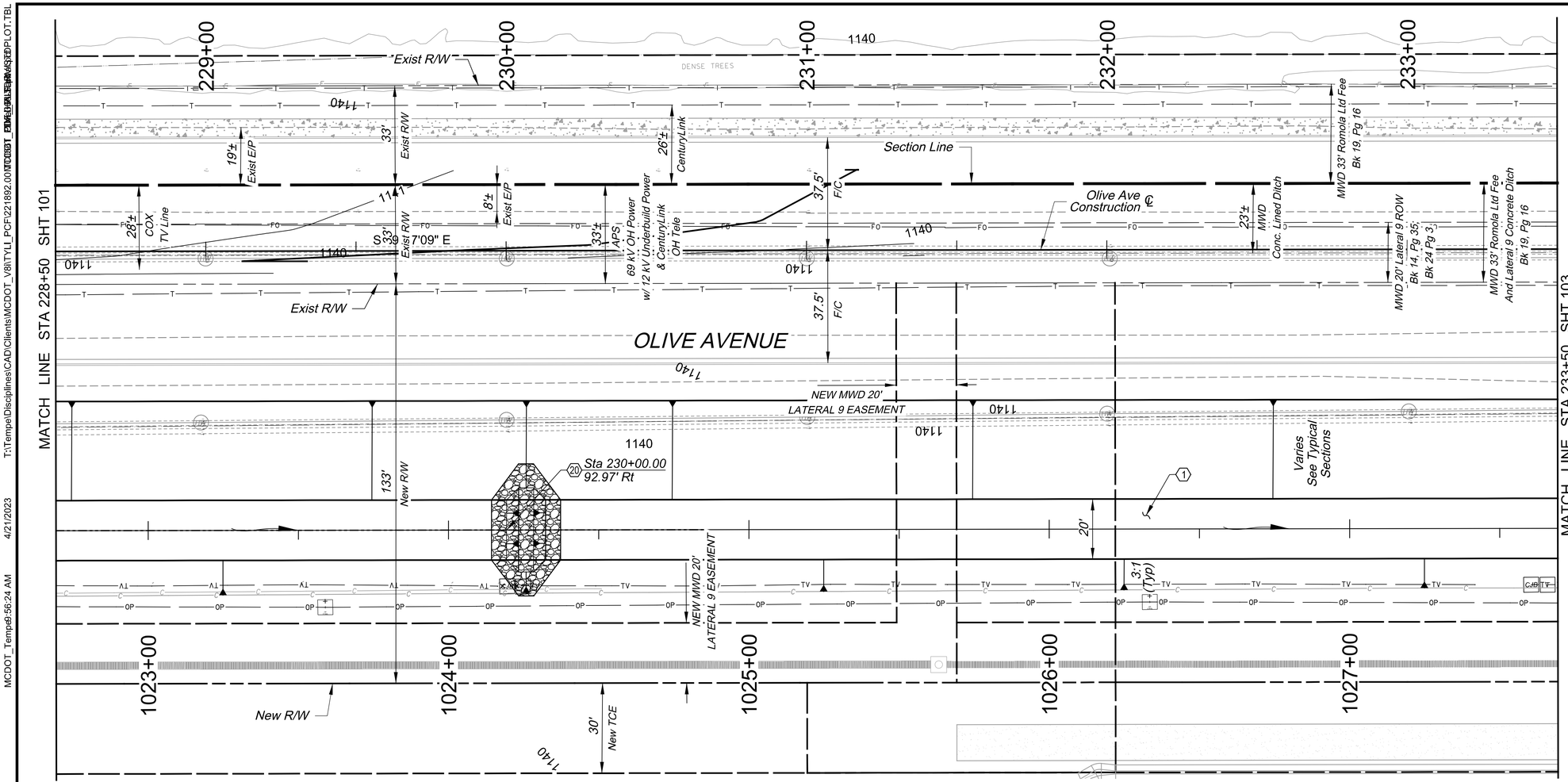
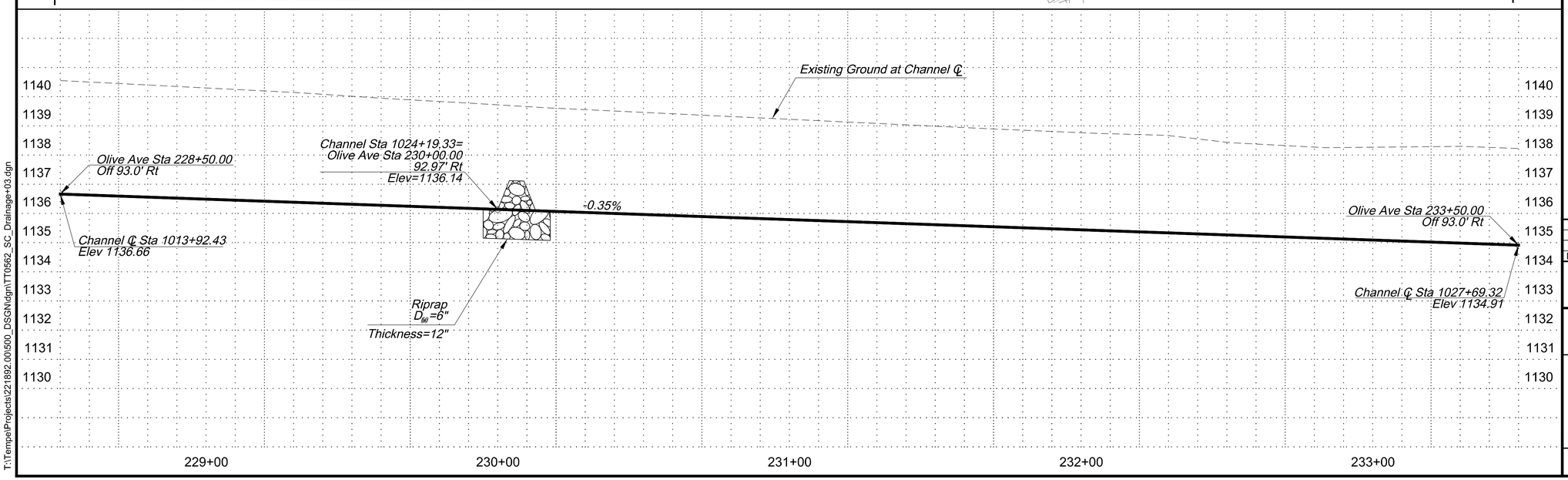
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	102	199	

CONSTRUCTION

(1) *Drainage Excavation Paid For Under Channel Excavation #215.01100*

(20) *Install First Flush Berm Per Detail on Sheet 148* — 1 EA





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SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

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NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
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OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

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CHANNEL PLAN AND PROFILE SHEET

SHEET 102 OF 199

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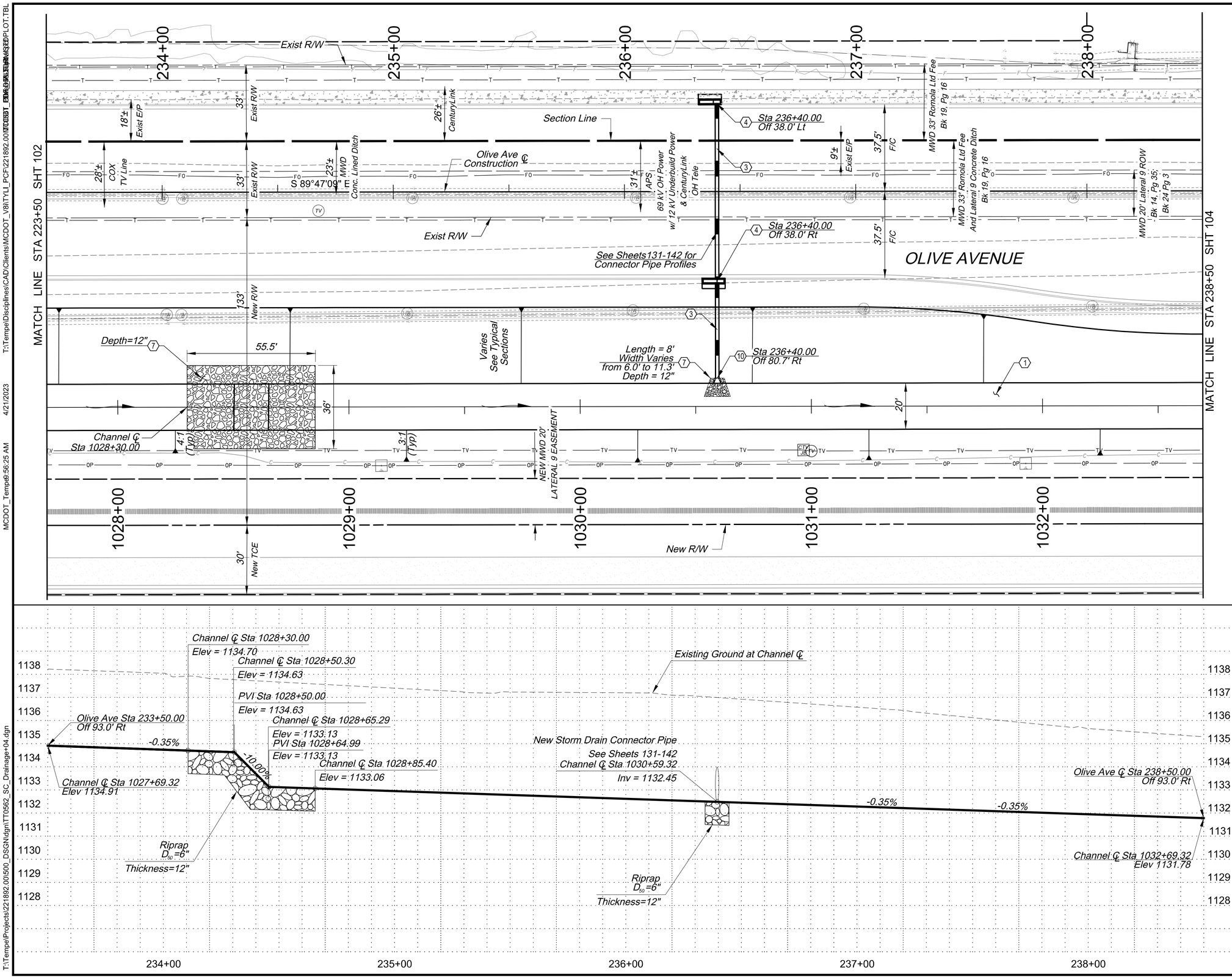

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	103	199	

CONSTRUCTION

1. Drainage Excavation Paid For Under Channel Excavation #215.01100
3. Furnish and Install 18" RGRCP Storm Drain. Class III — 116 LF
4. Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6' — 2 EA
7. Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan — 77 CY
10. Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18". — 1 EA

SCALE: Hor: 1"=20' Vert: 1"=2'

20 0 20 40 SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

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OLIVE AVENUE PLAN & PROFILE SHEET
STA 233+50 TO STA 238+50

SHEET 103 OF 199

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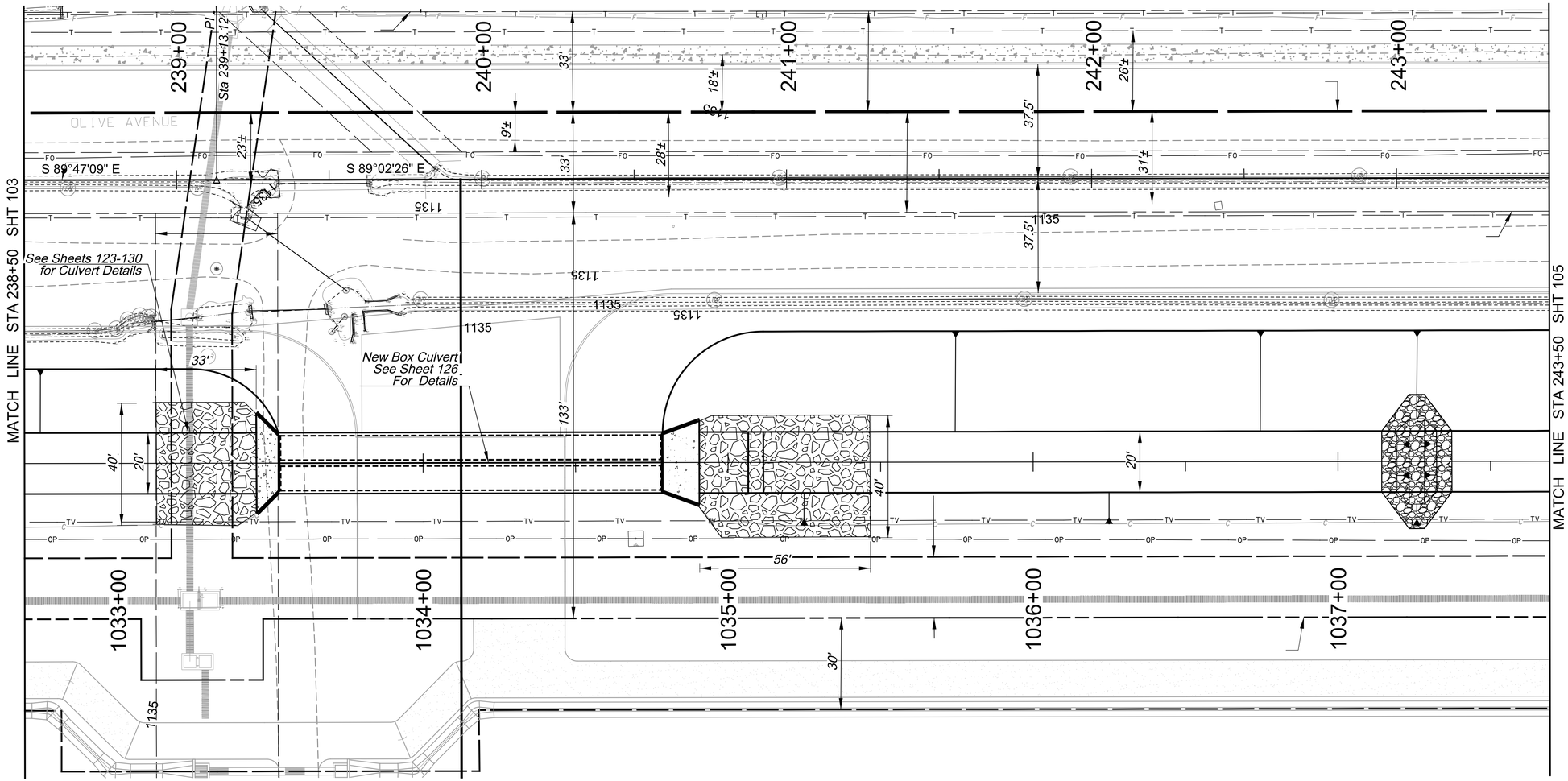

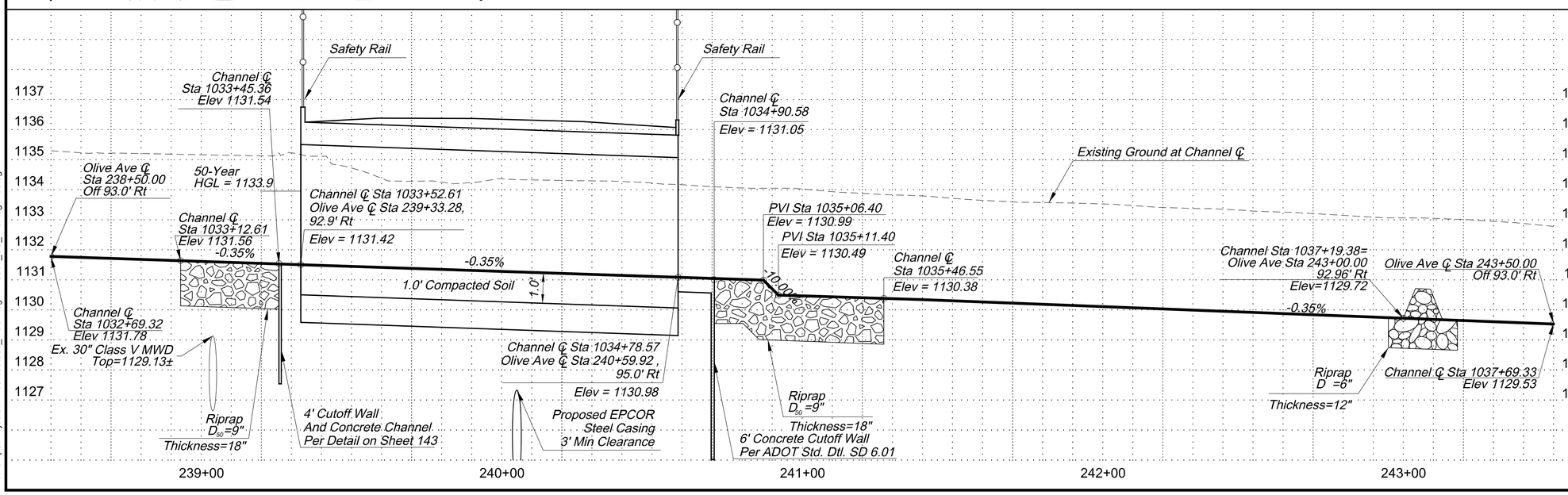

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	104	199	

CONSTRUCTION

(1) *Drainage Excavation Paid For Under Channel Excavation #215.01100*

(8) *Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=9", Dimensions Per Plan* — 198 CY

(20) *Install First Flush Berm Per Detail On Sheet 148* — 1 EA

N

SCALE: Hor: 1"=20'
Vert: 1"=2'
20 0 20 40
SCALE IN FEET

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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

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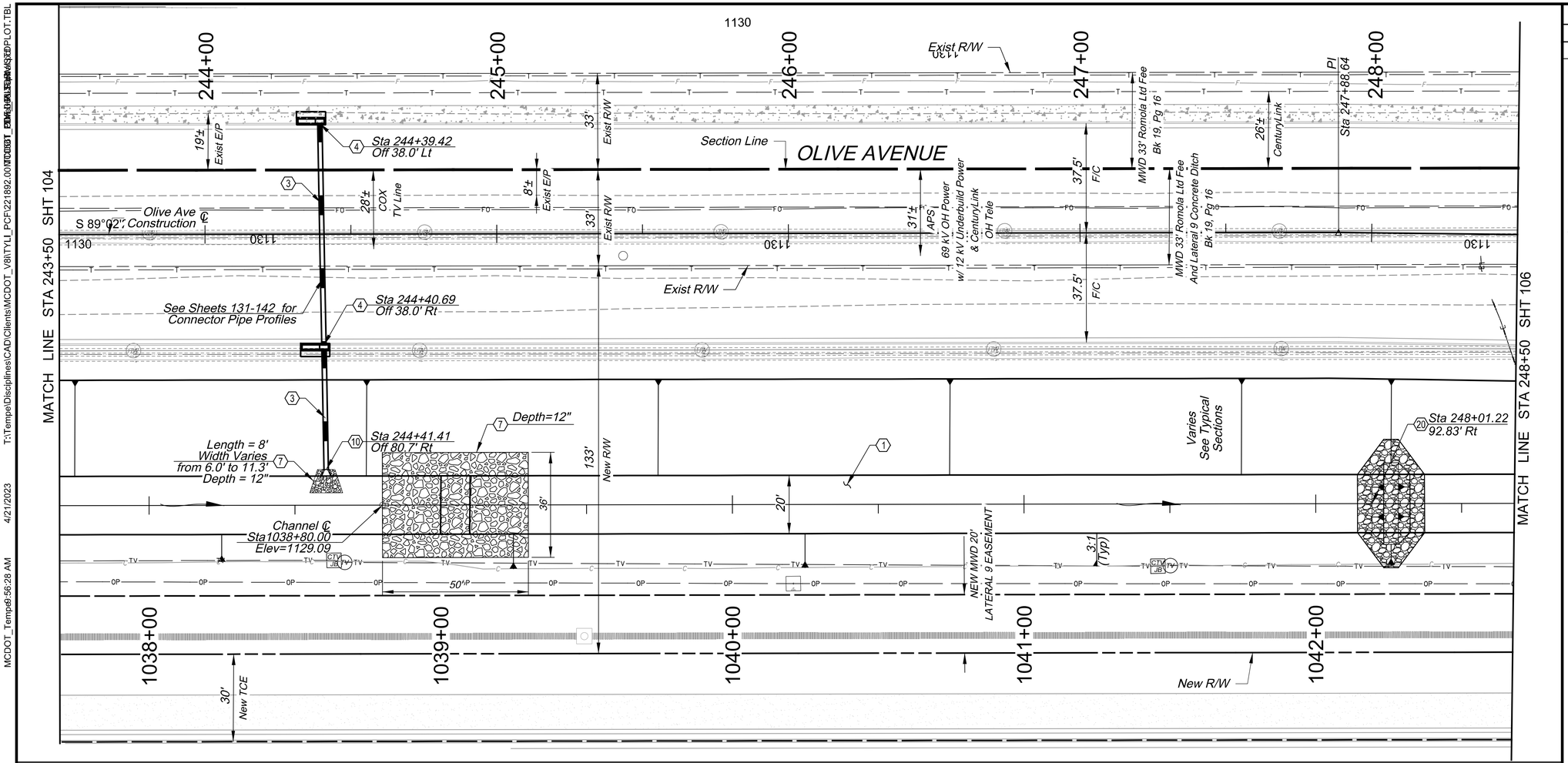
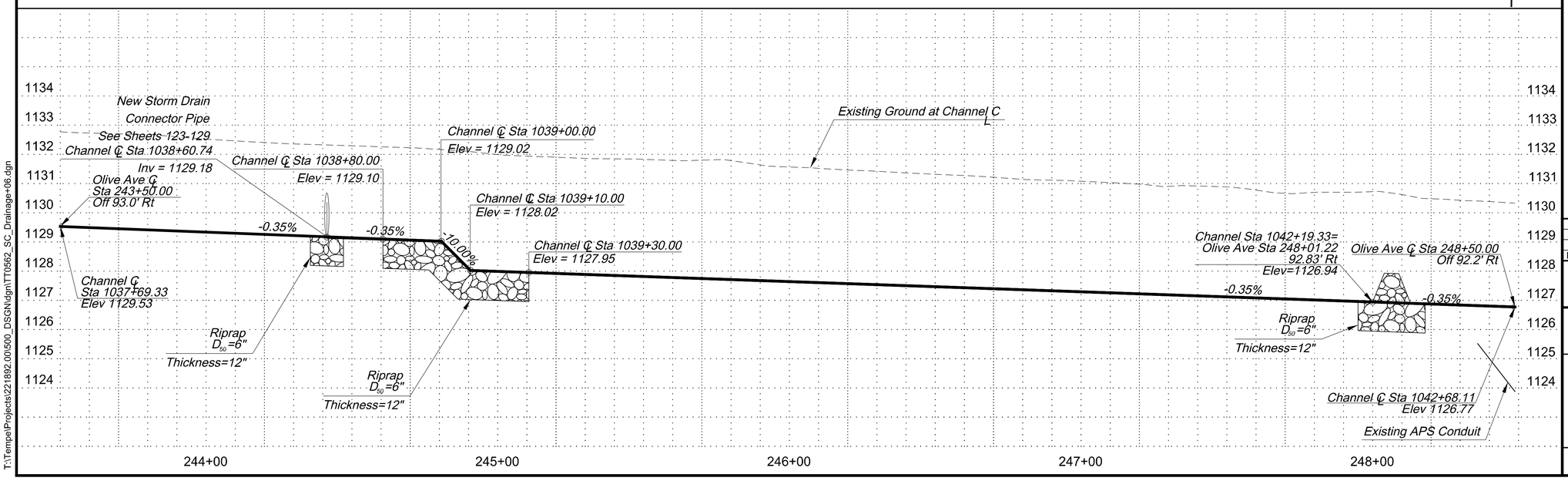
CHANNEL PLAN AND PROFILE SHEET

SHEET 104 OF 199





F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	105	199	

CONSTRUCTION

1	Drainage Excavation Paid For Under Channel Excavation #215.01100	
3	Furnish and Install 18" RGRCP Storm Drain. Class III	116 LF
4	Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6'	2 EA
7	Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan	111 CY
10	Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18".	1 EA
20	Install First Flush Berm Per Detail On Sheet 148	1 EA

N

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

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CHANNEL PLAN AND PROFILE SHEET

SHEET 105 OF 199

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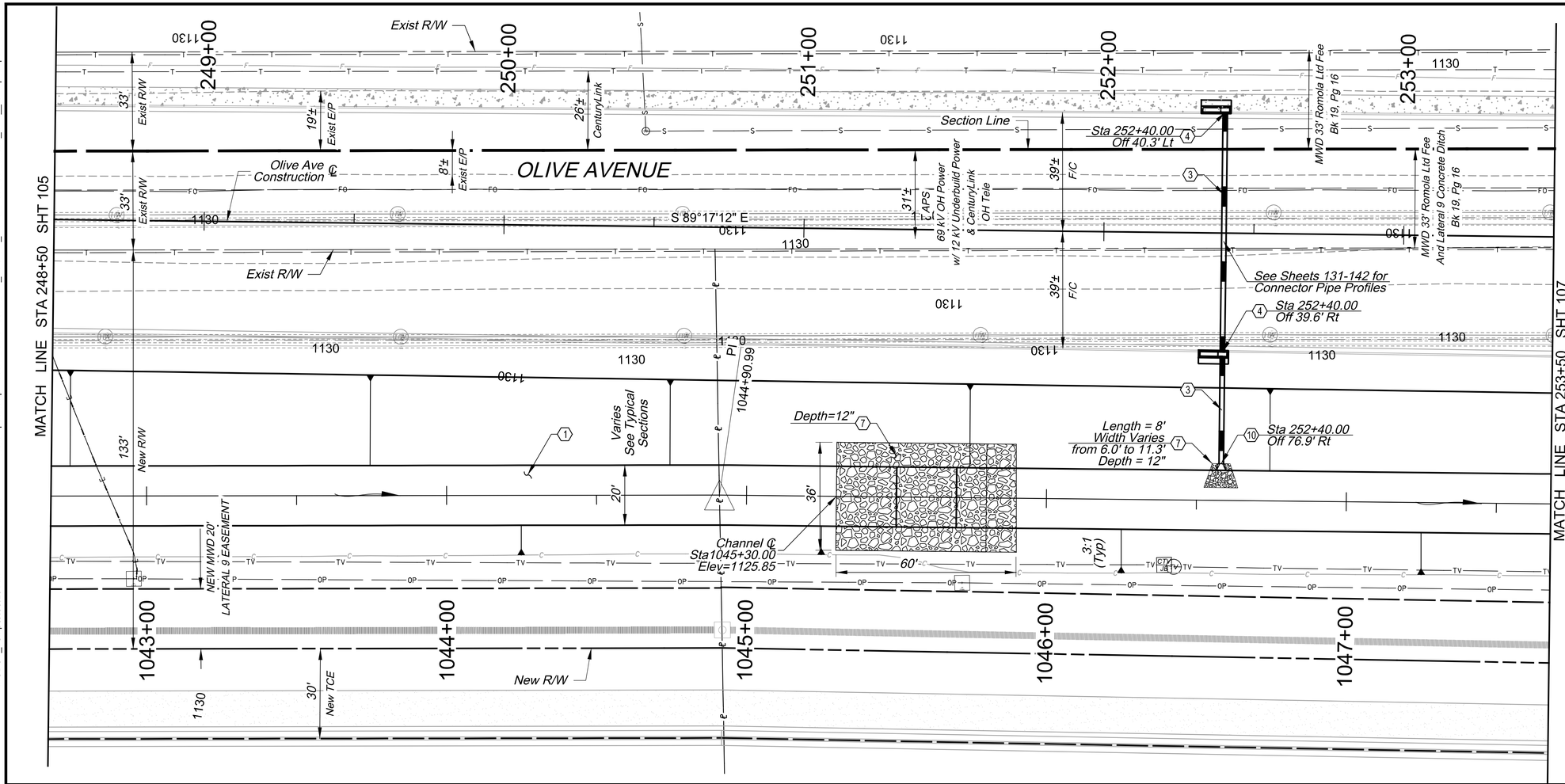

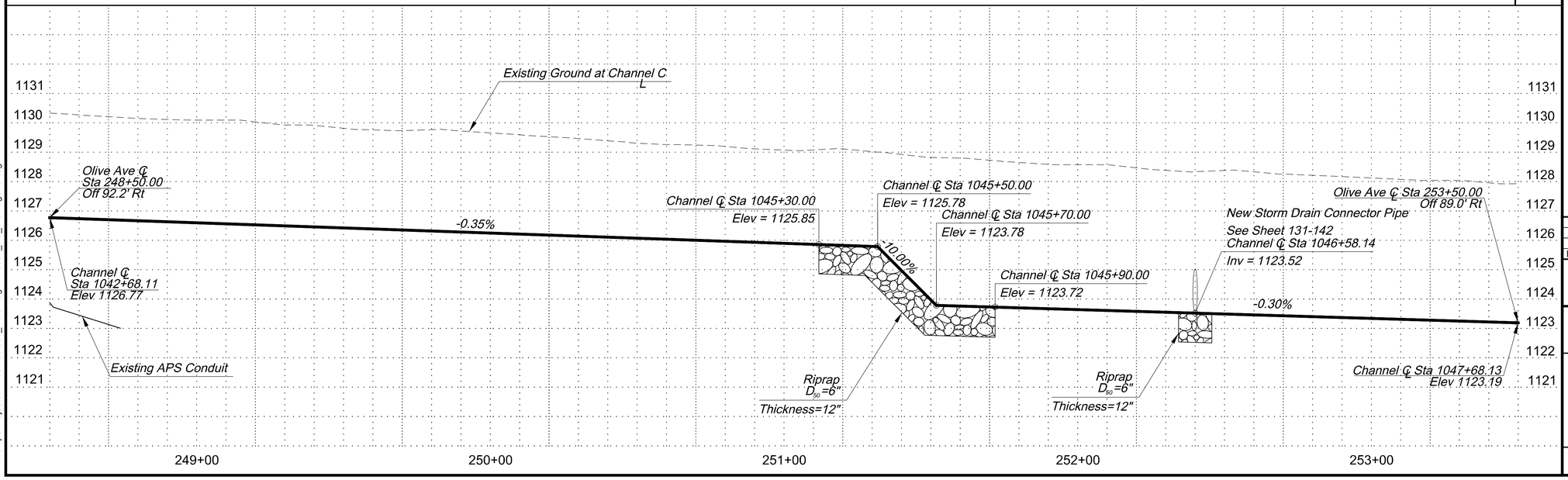

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	106	199	

CONSTRUCTION

1. Drainage Excavation Paid For Under Channel Excavation #215.01100
3. Furnish and Install 18" RGRCP Storm Drain. Class III — 116 LF
4. Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6' — 2 EA
7. Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan — 83 CY
10. Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18". — 1 EA

N

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

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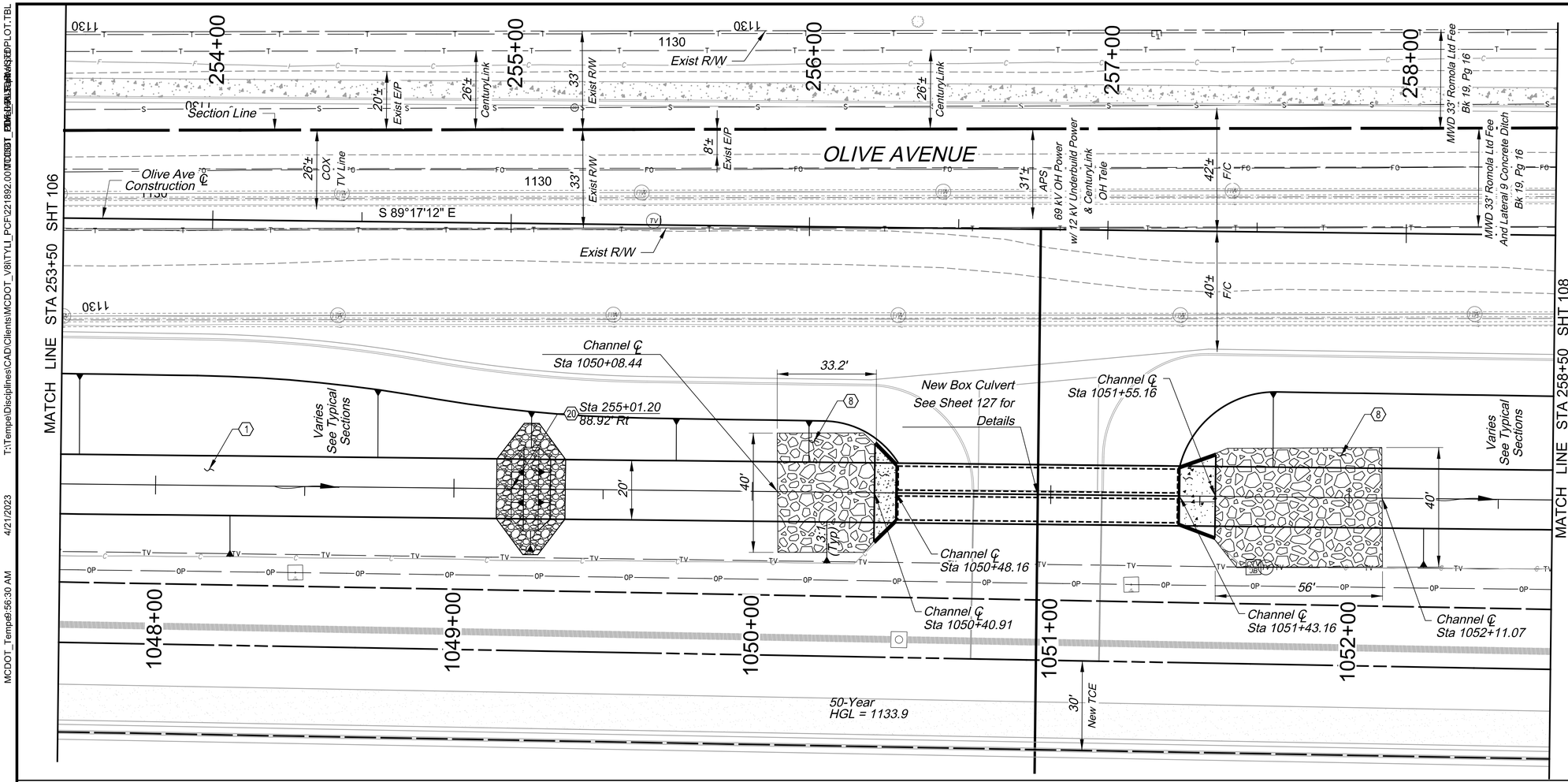

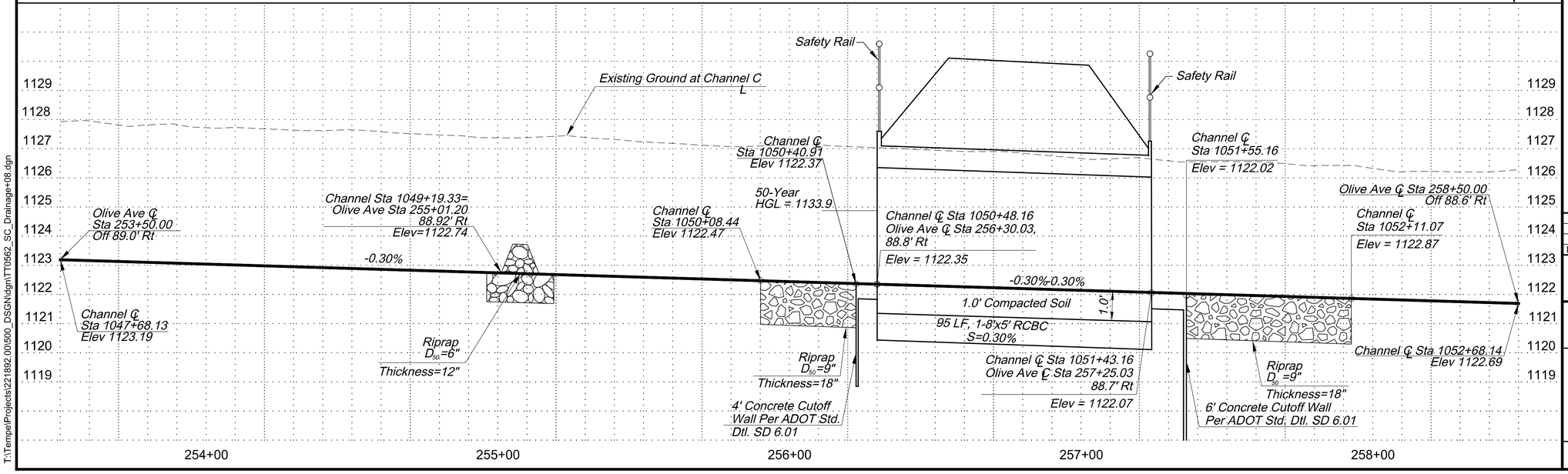

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	107	199	

CONSTRUCTION

1. Drainage Excavation Paid For Under Channel Excavation #215.01100
20. Install First Flush Berm Per First Flush Berm Detail, Sheet 148 — 1 EA
8. Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=9", Dimensions Per Plan — 194 CY

SCALE: Hor: 1"=20' Vert: 1"=2'

20 0 20 40 SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
3			
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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CHANNEL PLAN AND PROFILE SHEET

SHEET 107 OF 199

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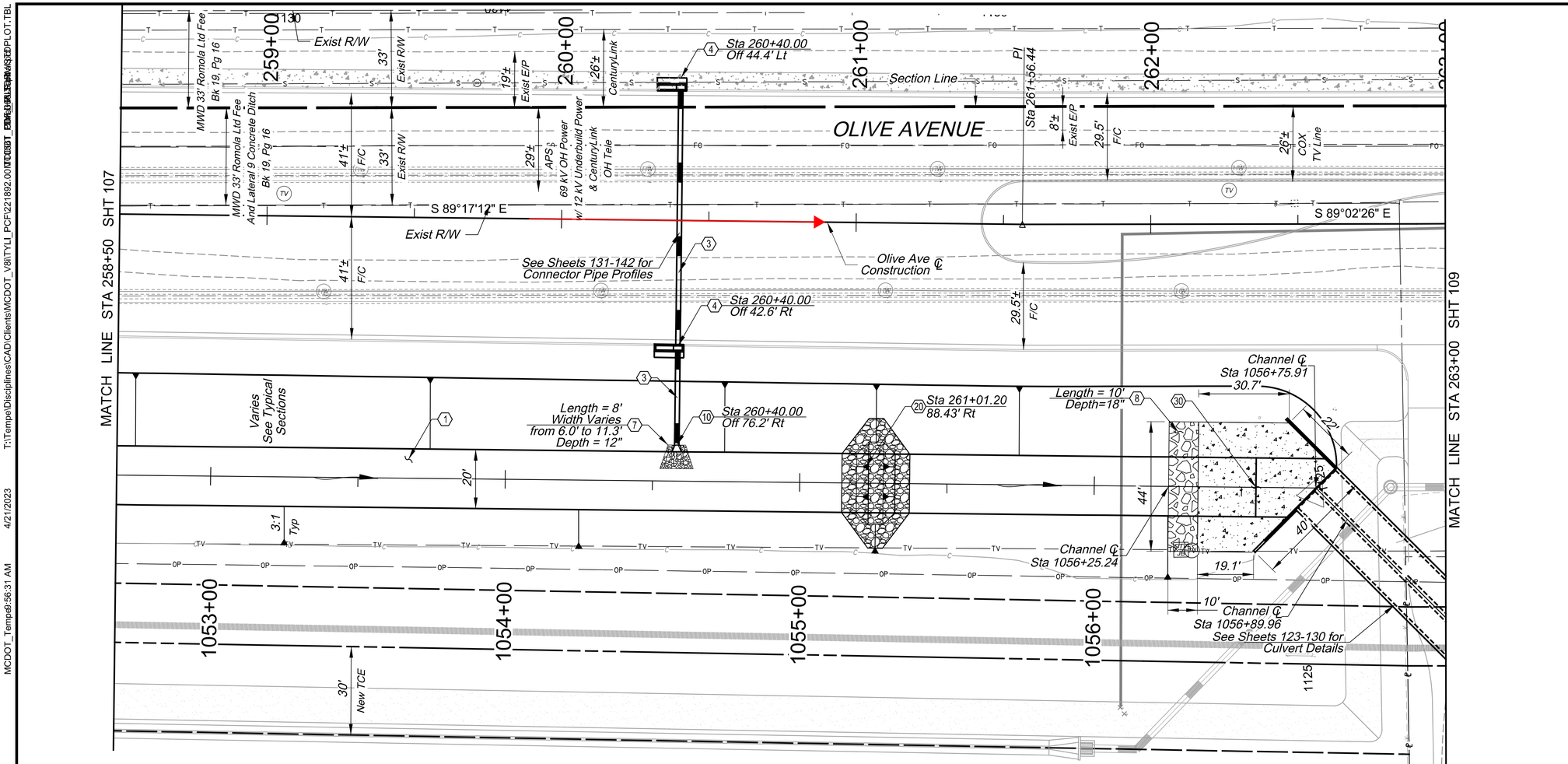

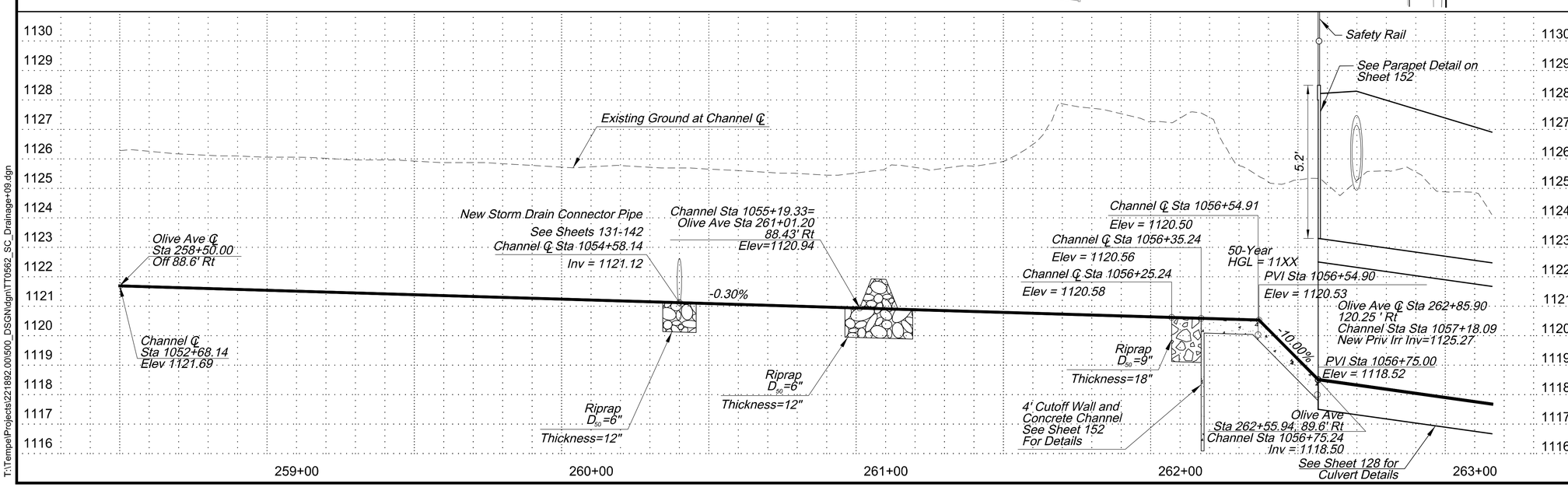

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	108	199	

CONSTRUCTION

1	Drainage Excavation Paid For Under Channel Excavation #215.01100	
3	Furnish and Install 18" RGRCP Storm Drain. Class III	118 LF
4	Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6'	2 EA
7	Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan	3 CY
8	Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=9", Dimensions Per Plan	19 CY
10	Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18".	1 EA
20	Install First Flush Berm Per Detail On Sheet 148	1 EA
30	Install Concrete Channel Per Detail on Sheet 143, Depth=6"	170 SY

N

SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
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CHECKED	J.BARR	04/2023

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CHANNEL PLAN AND PROFILE SHEET

SHEET 108 OF 199

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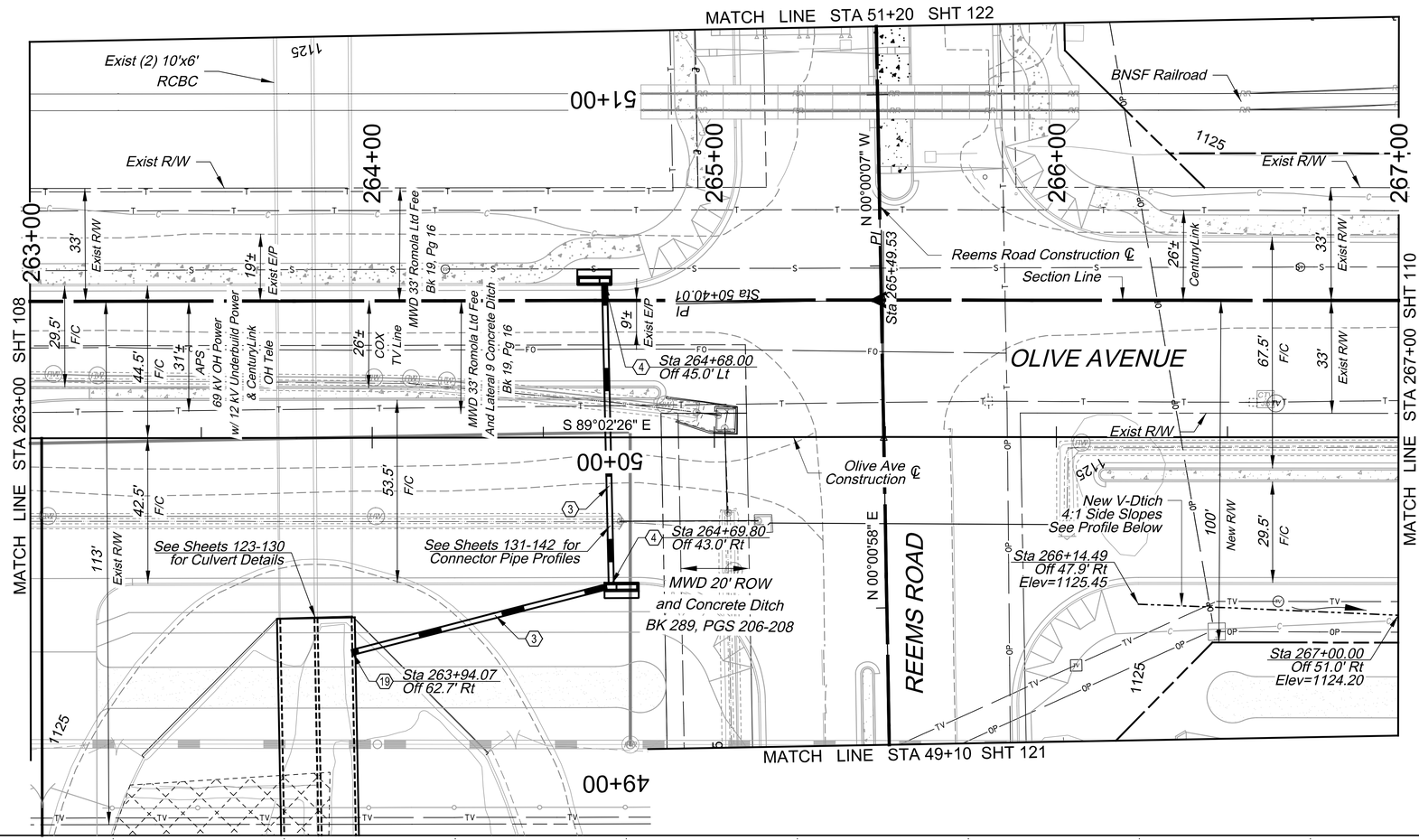
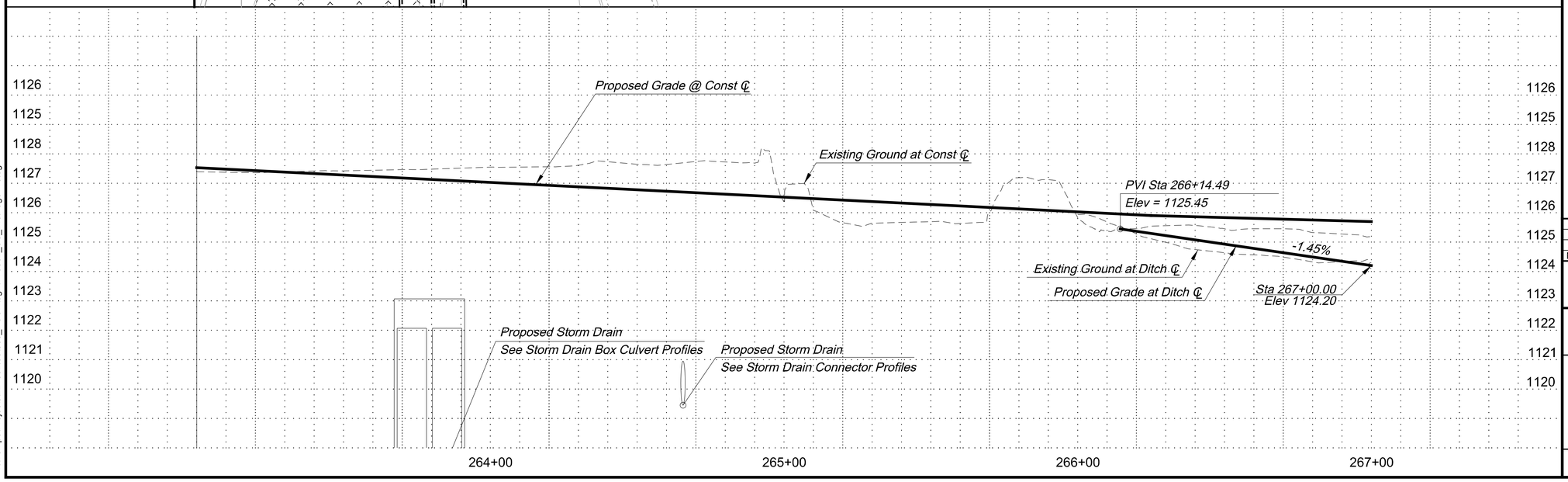
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	109	199	

CONSTRUCTION

(3)	Furnish and Install 18" RGRCP Storm Drain. Class III	165 LF
(4)	Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6'	2 EA
(19)	Construct Pipe Penetration Into New RCBC Box Culvert Per Detail on Sheet 151	1 EA





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SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

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CHECKED	J.BARR	04/2023

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DRAINAGE DITCH PLAN AND PROFILE SHEET

SHEET 109 OF 199

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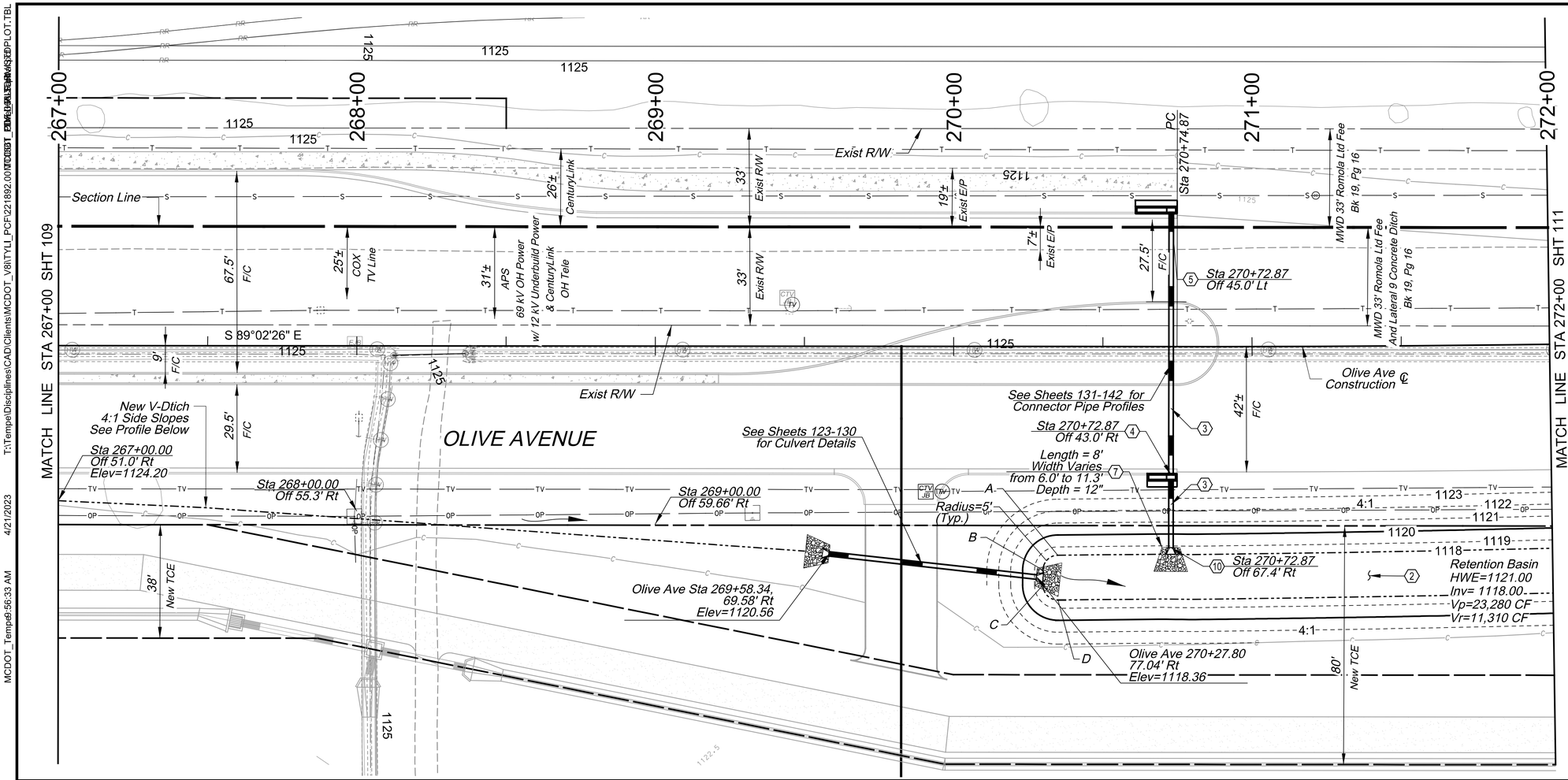

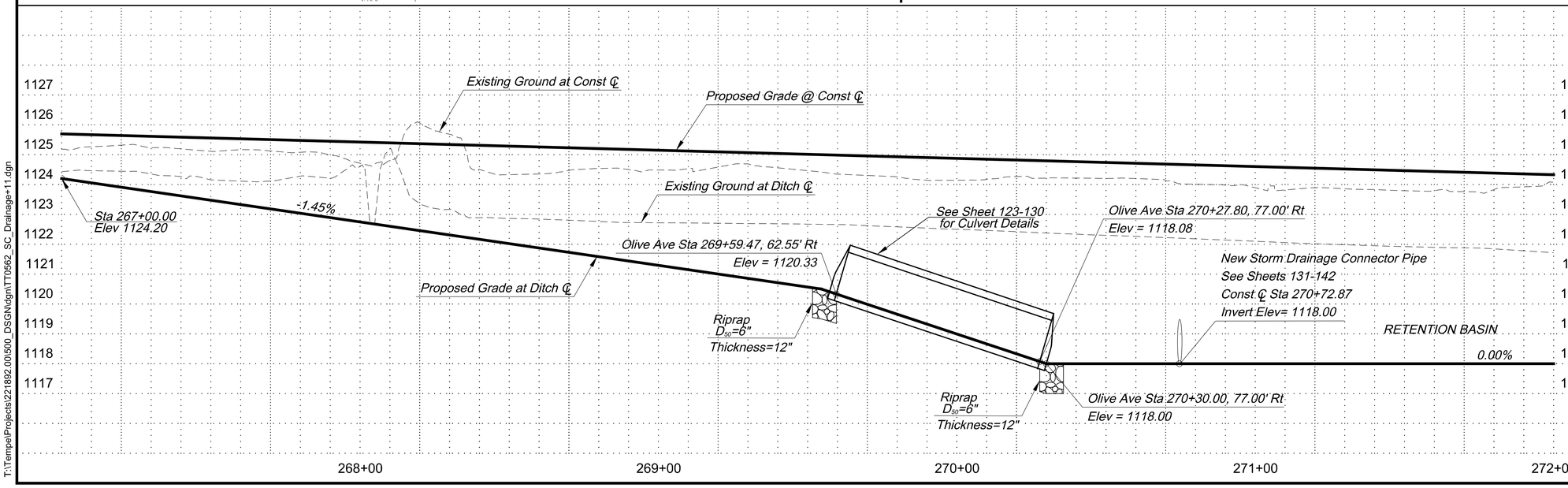

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	110	199	

CONSTRUCTION

2. Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510
3. Furnish and Install 18" RGRCP Storm Drain. Class III — 110 LF
4. Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6' — 1 EA
5. Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=10' — 1 EA
7. Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan — 3 CY
10. Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18". — 1 EA

Retention Basin Control Points

ID	Olive Ave Const ℄ Station, Offset	Elevation
A	270+34.95, 68.0' Rt	1118.00
B	270+30.00, 75.0' Rt	1118.00
C	270+30.00, 80.0' Rt	1118.00
D	270+35.05, 85.0' Rt	1118.00

N

SCALE: Hor: 1"=20'
Vert: 1"=2'
20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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DRAINAGE DITCH PLAN AND PROFILE

SHEET 110 OF 199

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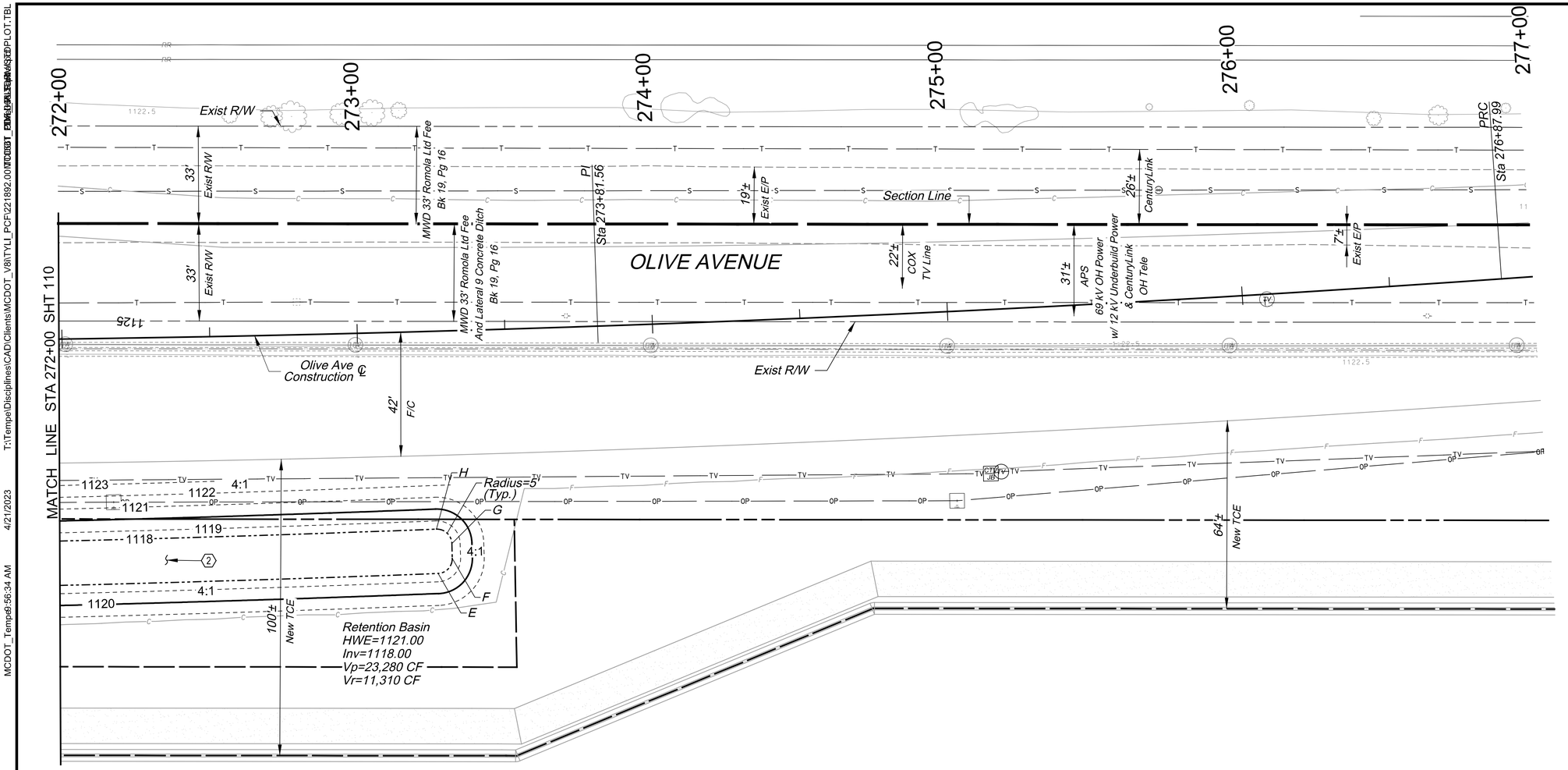

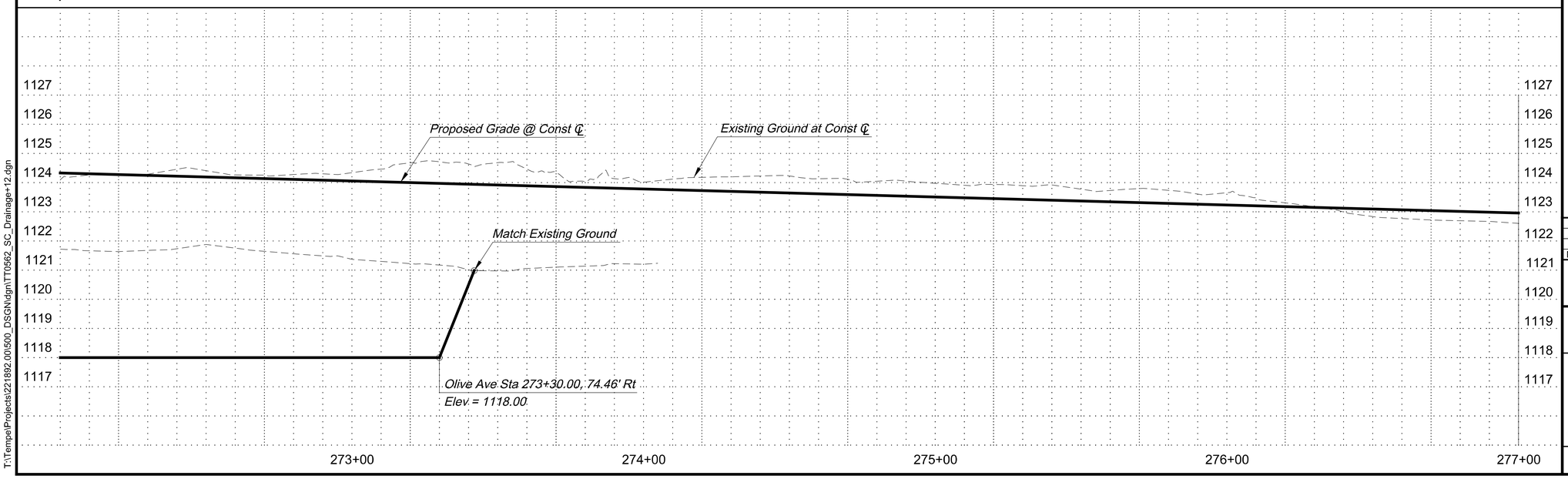

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	111	199	

CONSTRUCTION

(2) *Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510*

Retention Basin Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
E	273+25.10, 82.0' Rt	1118.00
F	273+30.00, 77.0' Rt	1118.00
G	273+30.00, 72.0' Rt	1118.00
H	273+25.00, 67.0' Rt	1118.00

N

SCALE: Hor: 1"=20'
Vert: 1"=2'
20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
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NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY
NOT FOR CONSTRUCTION

	BY	DATE
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DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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SHEET 111 OF 199

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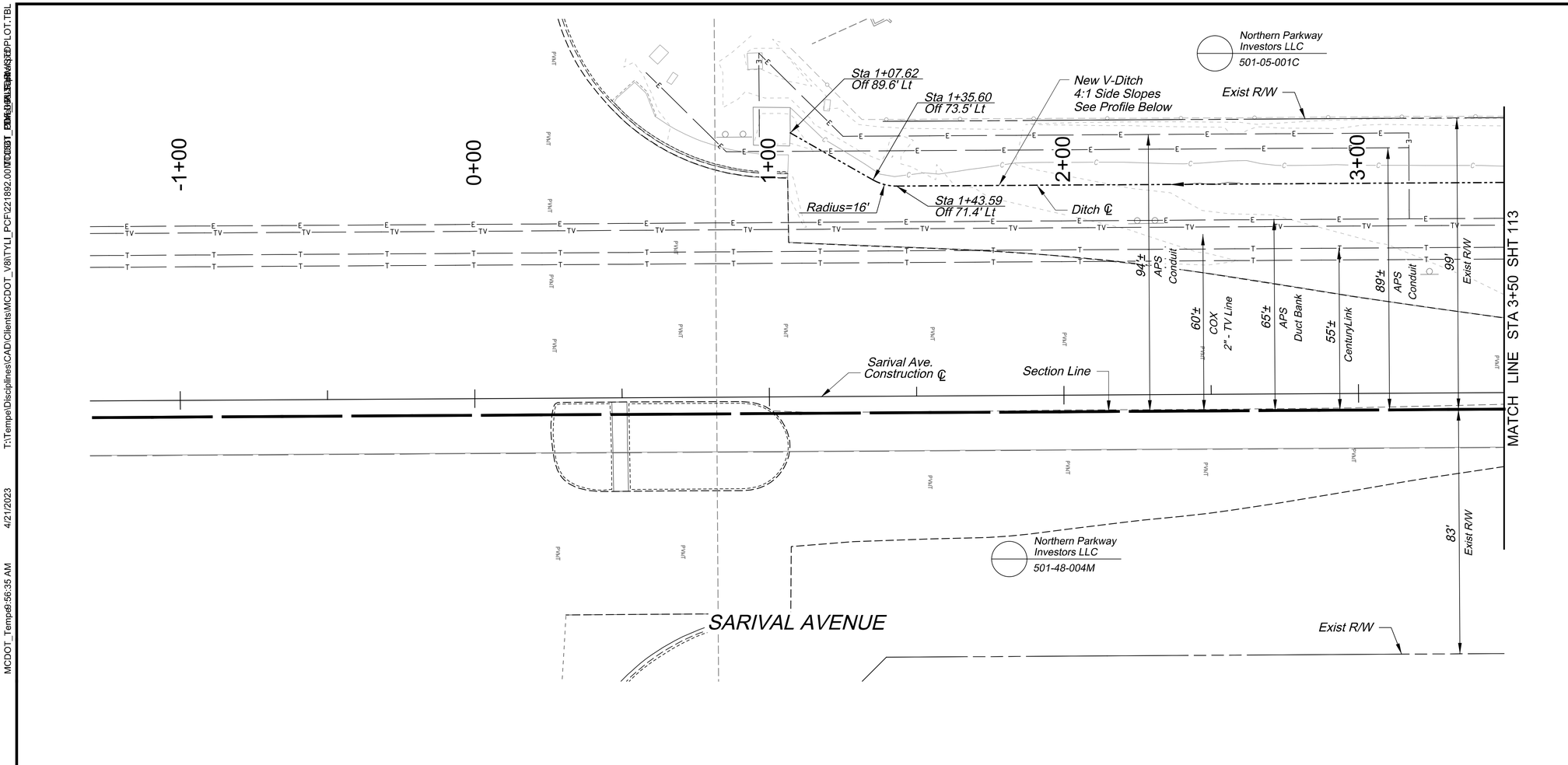
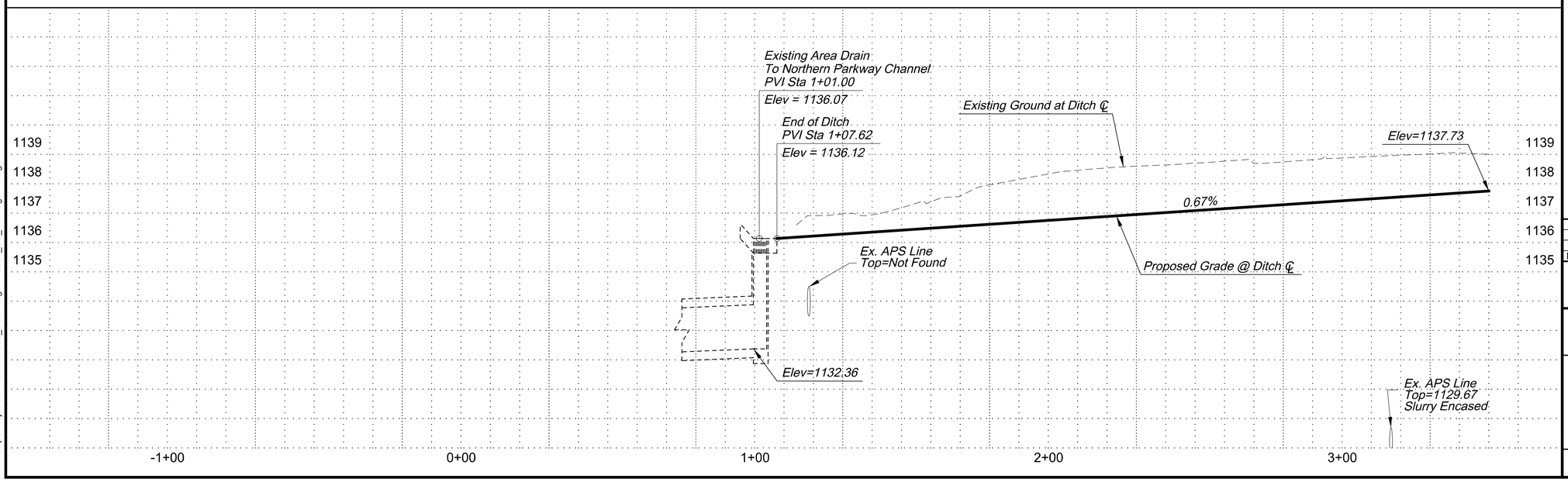
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	112	199	

CONSTRUCTION





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Vert: 1"=2'

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SCALE IN FEET

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602-263-1100
BLUE STAKE

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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 112 OF 199

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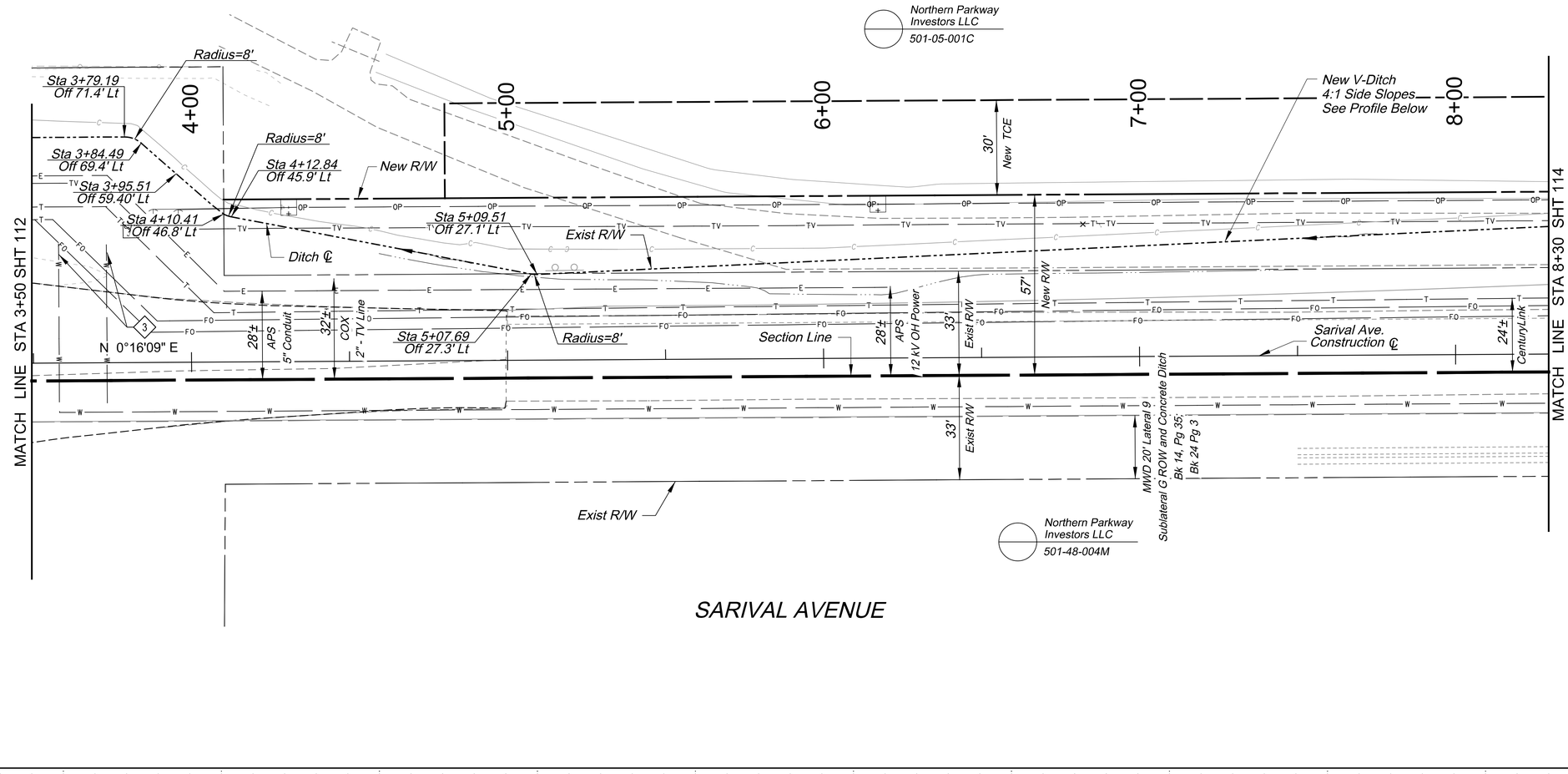

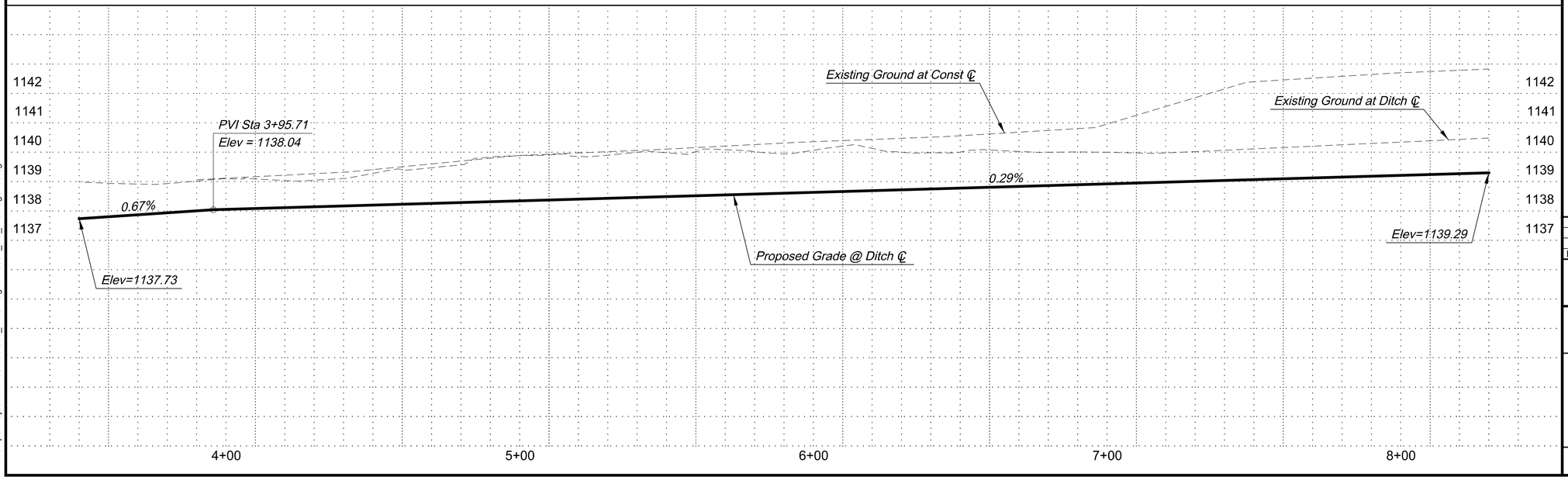

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	113	199	

CONSTRUCTION

REMOVAL / RELOCATE BY OTHERS

3 *Water Meter to Be Adjusted to Grade By Others* — 2 EA

SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

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NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
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DRAINAGE PLAN AND PROFILE SHEET

SHEET 113 OF 199

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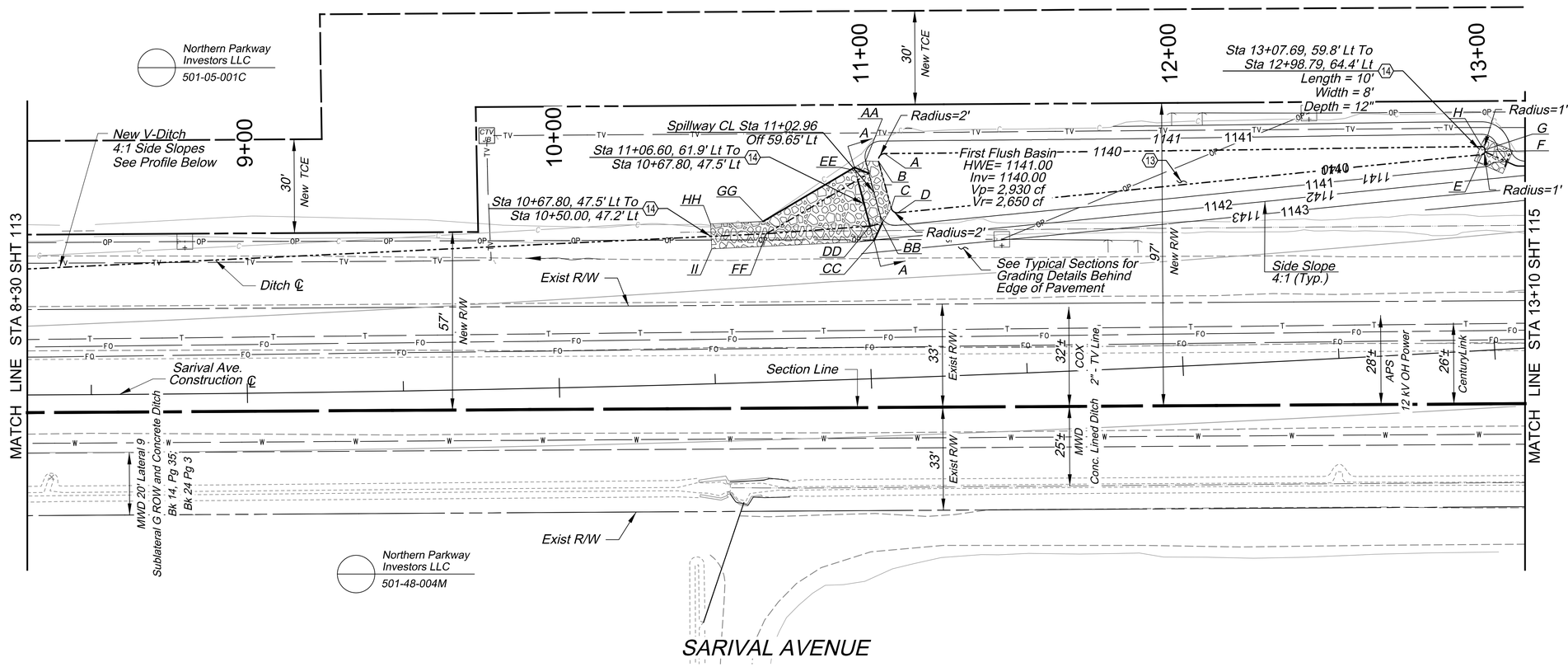
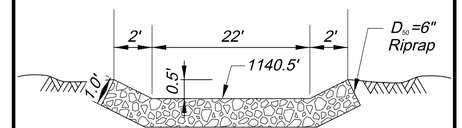


F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	114	199	

CONSTRUCTION

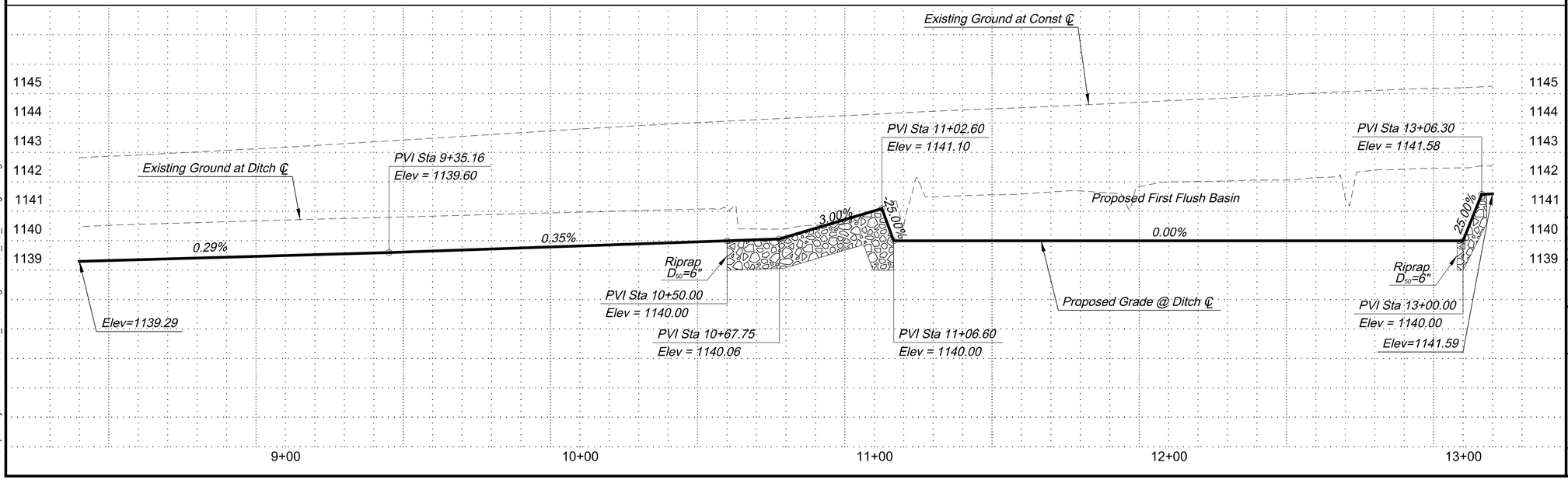
(13) *Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510*

(14) *Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan* — 28 CY



WEIR SECTION A-A

Retention Basin / Wier Control Points		
ID	Sarival Ave Const ℄ Station, Offset	Elevation
A	11+05.67, 74.7' Lt	1140.00
B	11+03.70, 72.3' Lt	1140.00
C	11+07.49, 57.3' Lt	1140.00
D	11+09.60, 55.7' Lt	1140.00
E	12+98.50, 69.4' Lt	1140.00
F	12+99.45, 70.4' Lt	1140.00
G	13+00.62, 64.1' Lt	1140.00
H	12+98.49, 71.9' Lt	1140.00
AA	10+99.48, 72.5' Lt	1141.10
BB	11+04.53, 52.5' Lt	1140.50
CC	11+01.78, 47.0' Lt	1142.00
DD	11+00.61, 51.6' Lt	1140.49
EE	11+00.50, 68.5' Lt	1140.50
FF	10+67.15, 49.6' Lt	1140.00
GG	10+66.14, 53.6' Lt	1140.00
HH	10+49.20, 53.0' Lt	1140.00
II	10+49.50, 45.0' Lt	1140.00



SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 114 OF 199

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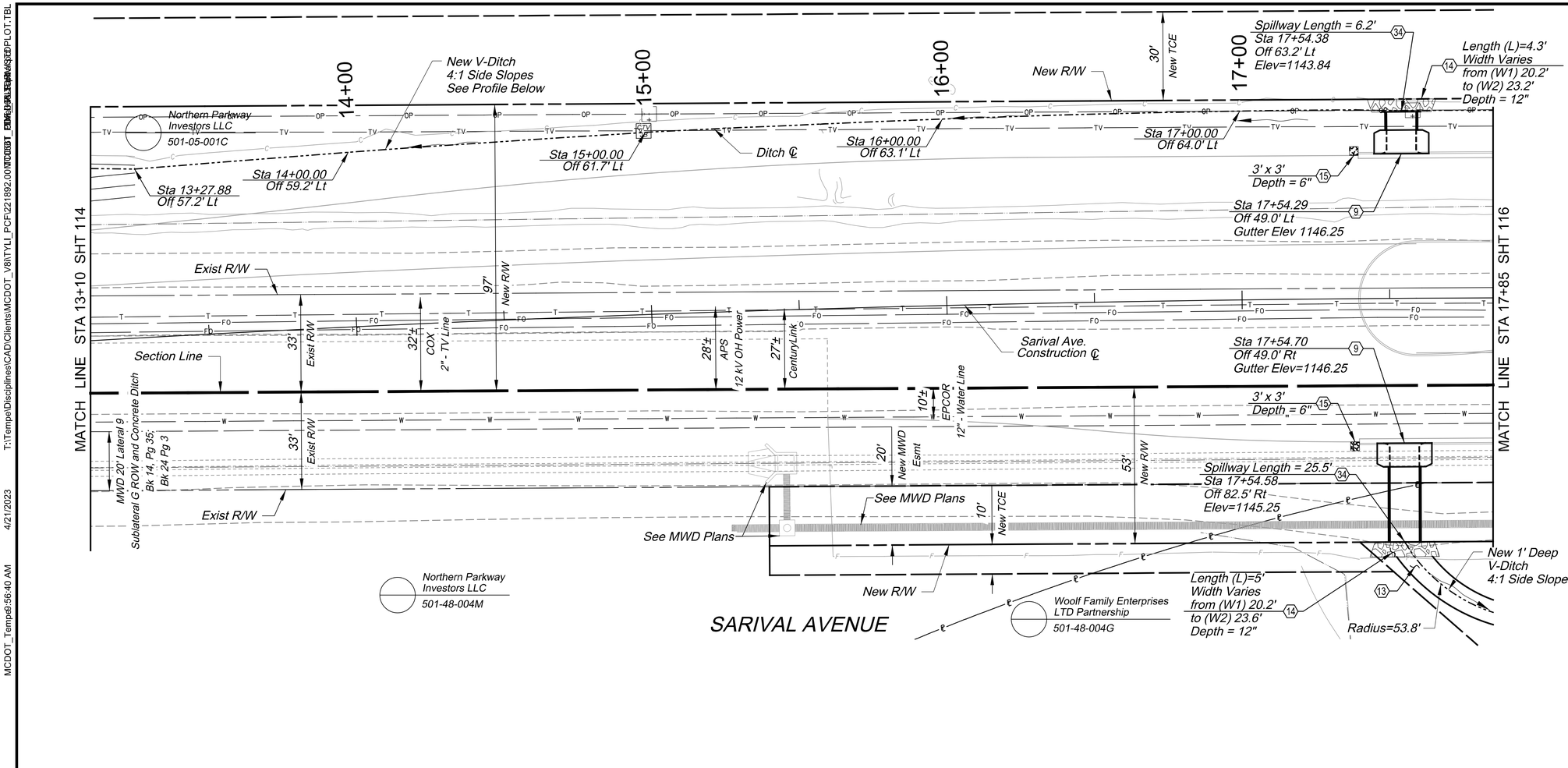
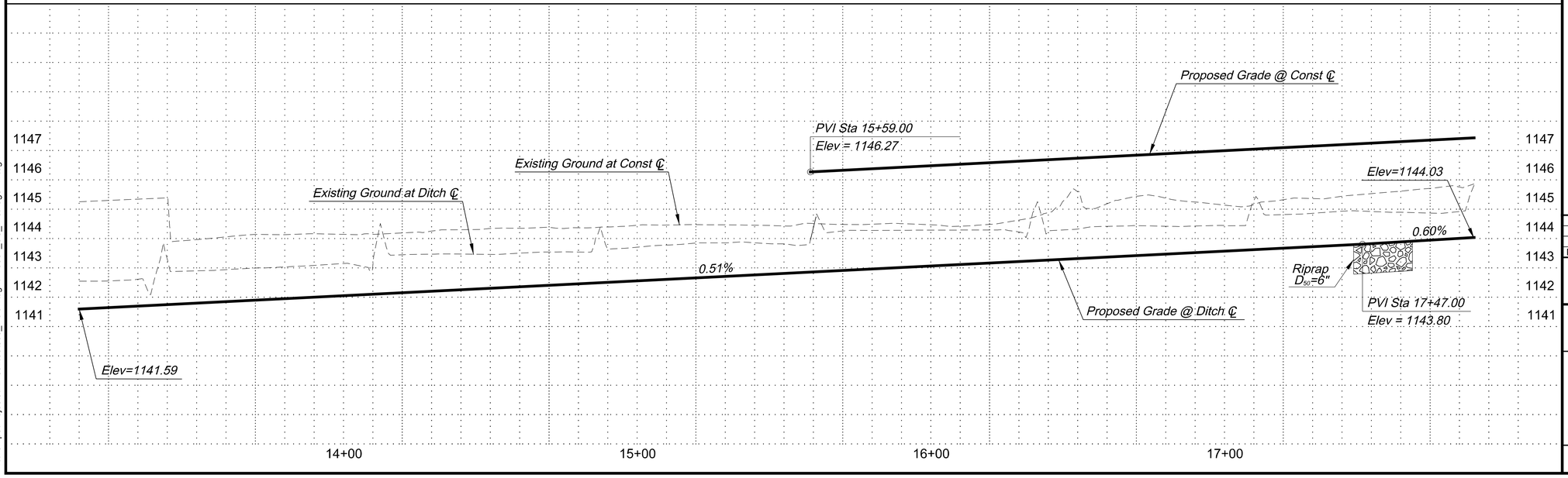
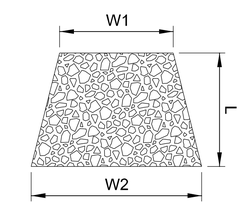




F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	115	199	

CONSTRUCTION

9	Install Concrete Scupper Per MAG Std Det 206-1 thru 206-3, Inlet Width=12'	2 EA
13	Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510	
14	Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan	9 CY
15	Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=3", Dimensions Per Plan	0.4 CY
34	Install Concrete Spillway Per MAG Std Det 206-1 thru 206-3, Width=12'	31.7 LF



RIPRAP APRON DETAIL

SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

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SHEET 115 OF 199

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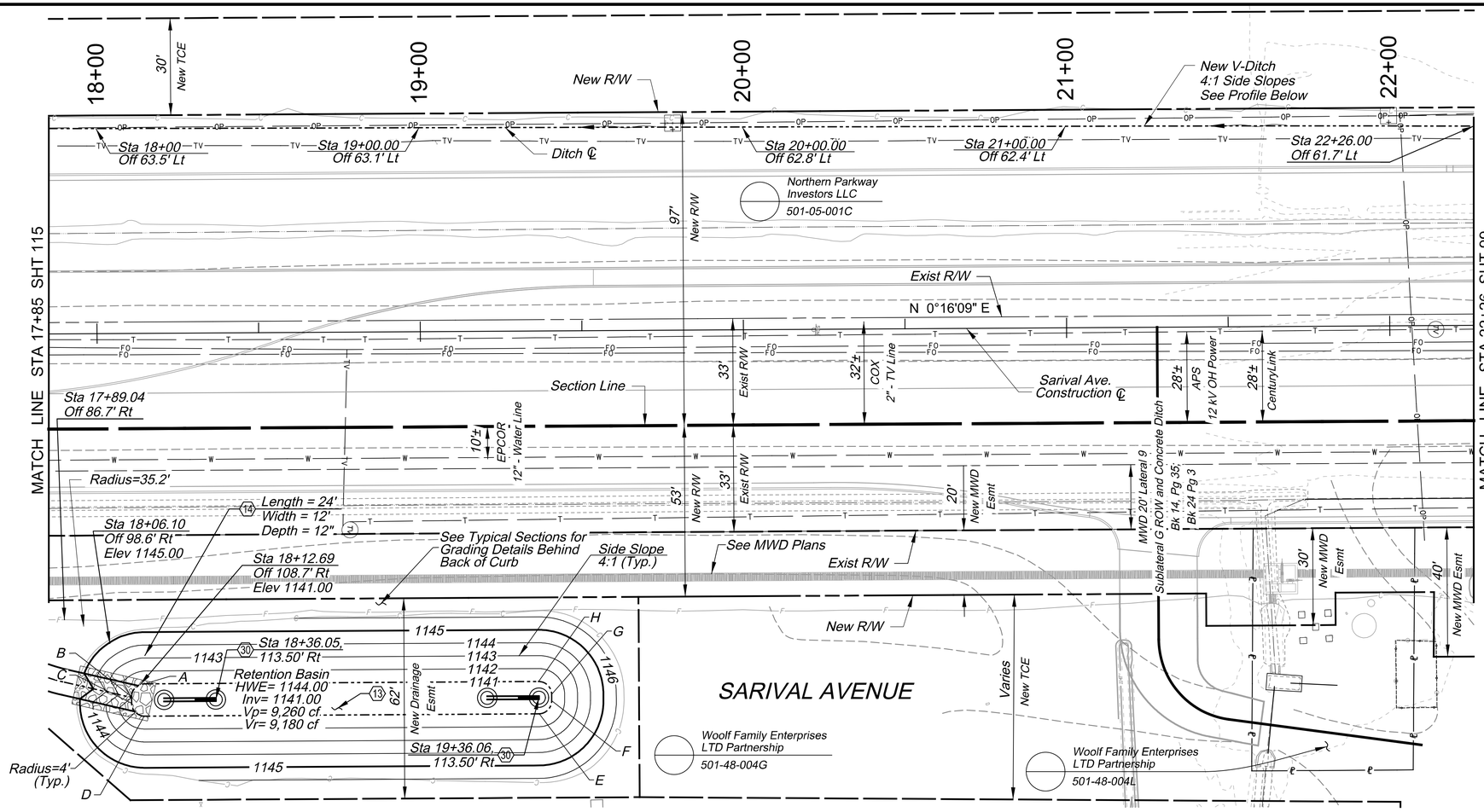

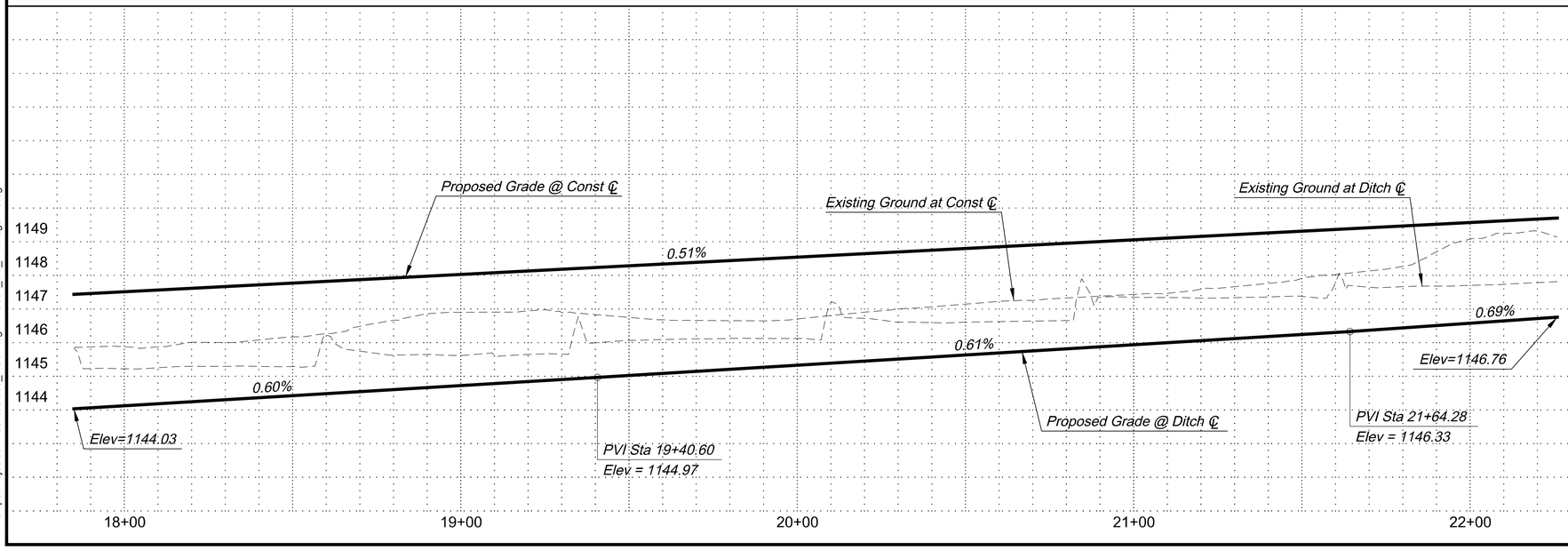

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	116	199	

CONSTRUCTION

13 *Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510*

14 *Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan* — 10.7 CY

30 *Install Drywell Per Drywell Detail Sheet, See Sheet 146* — 2 EA

Retention Basin Control Points		
ID	Sarival Ave Const ℄ Station, Offset	Elevation
A	18+14.01, 101.0' Rt	1141.00
B	18+10.01, 105.0' Rt	1141.00
C	18+10.02, 107.0' Rt	1141.00
D	18+13.86, 111.0' Rt	1141.00
E	19+36.16, 118.5' Rt	1141.00
F	19+39.97, 107.0' Rt	1141.00
G	19+39.97, 105.00' Rt	1141.00
H	19+35.97, 101.0' Rt	1141.00

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 116 OF 199

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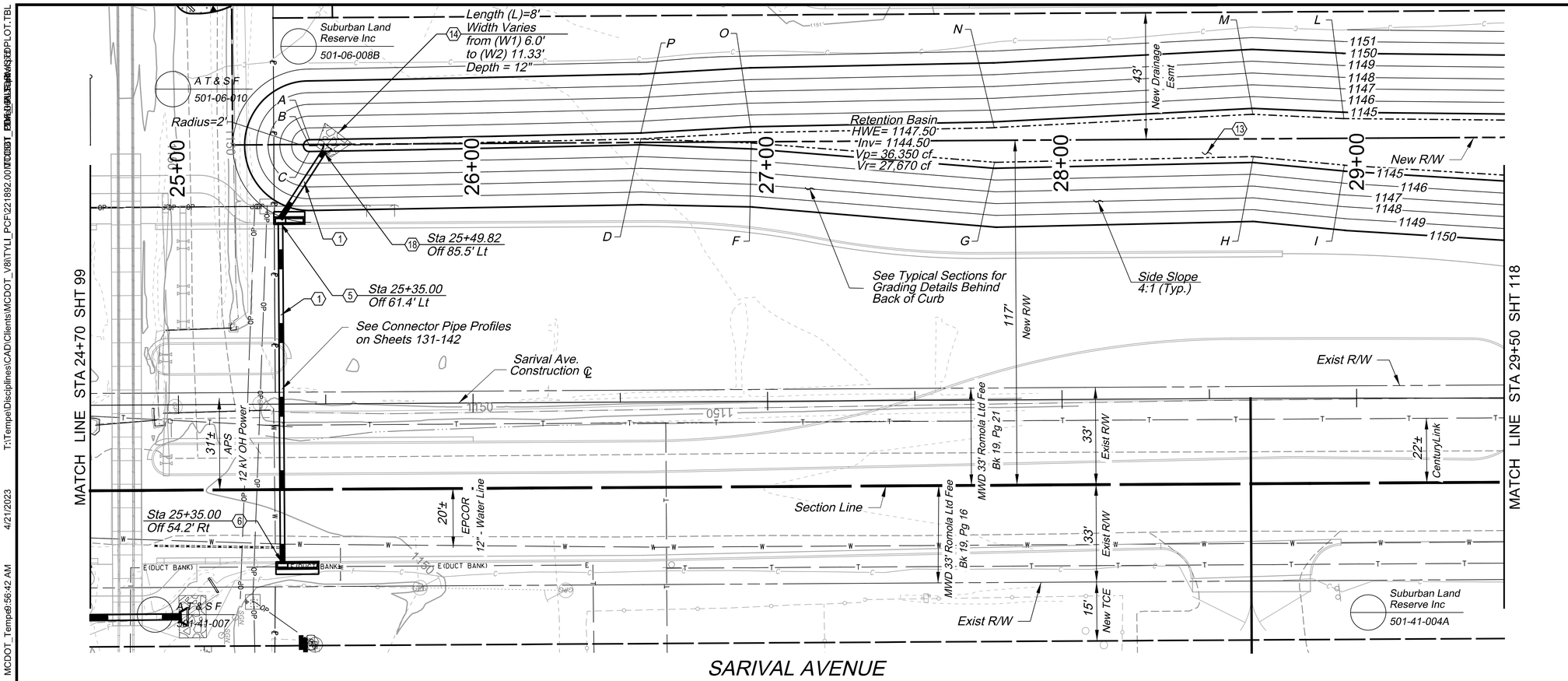
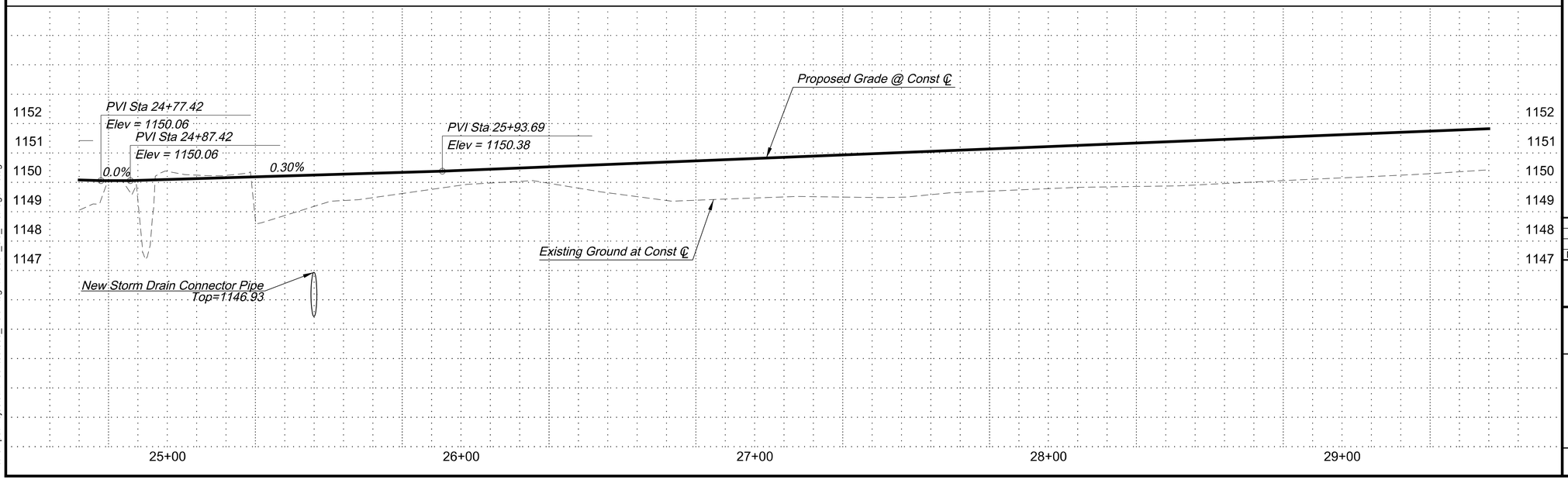




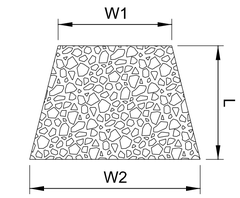
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	117	199	

CONSTRUCTION

1	Furnish and Install 18" RGRCP Storm Drain. Class III	142.5 LF
5	Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6'	1 EA
6	Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=10'	1 EA
13	Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510	
14	Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan	2.6 CY
18	Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18".	1 EA

Retention Basin Control Points

ID	Sarival Ave Const ℄ Station, Offset	Elevation
A	25+45.00, 96.6' Lt	1145.00
B	25+45.00, 94.6' Lt	1144.50
C	25+45.00, 92.6' Lt	1145.00
D	26+57.50, 96.2' Lt	1144.50
F	26+95.02, 94.6' Lt	1144.50
G	27+77.56, 87.6' Lt	1144.50
H	28+64.64, 89.3' Lt	1144.50
I	28+95.26, 86.6' Lt	1144.50
L	28+95.02, 102.4' Lt	1144.50
M	28+64.44, 103.7' Lt	1144.50
N	27+77.50, 99.3' Lt	1144.50
O	26+95.00, 98.1' Lt	1144.50
P	26+57.49, 98.2' Lt	1145.00



RIPRAP APRON DETAIL

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
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	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 117 OF 199

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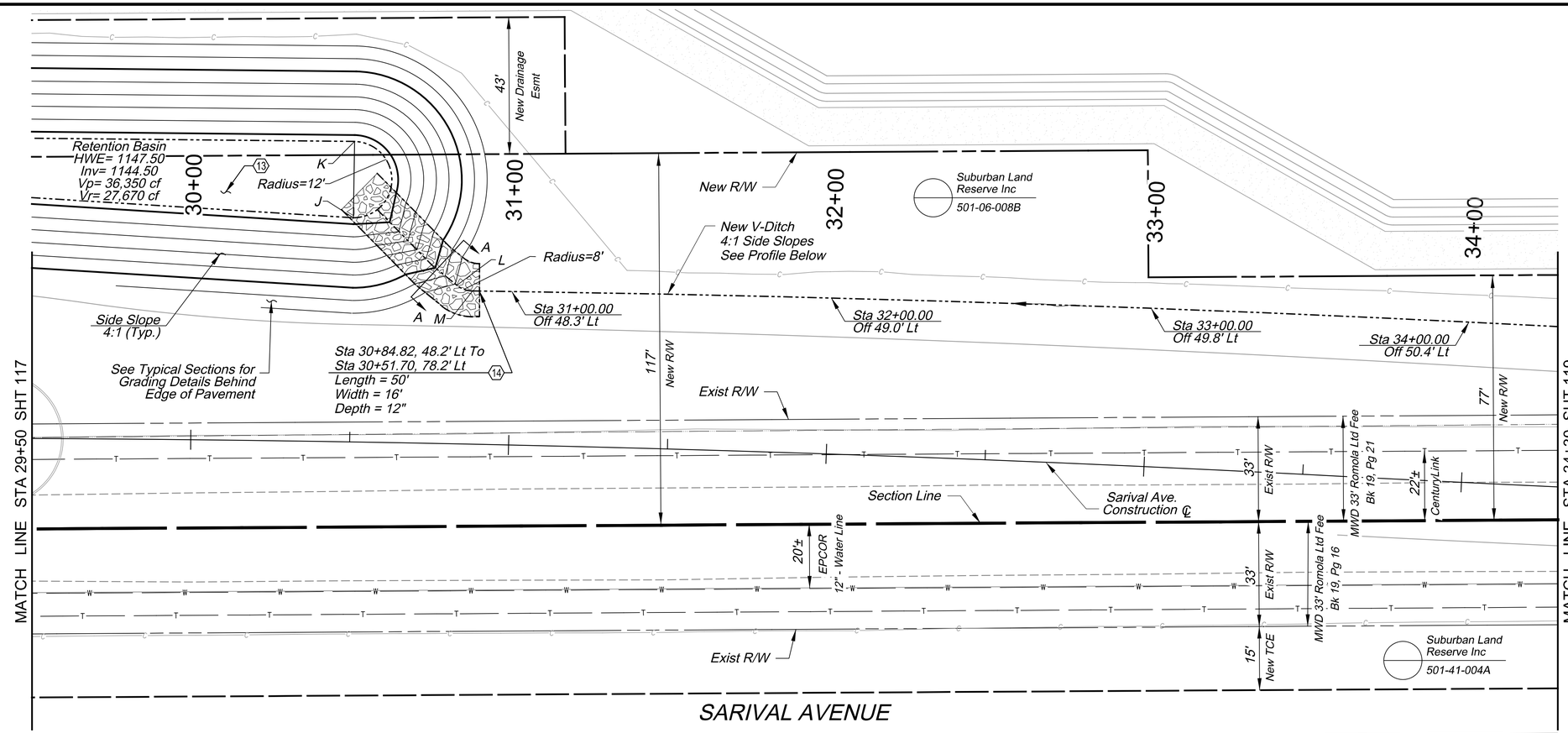
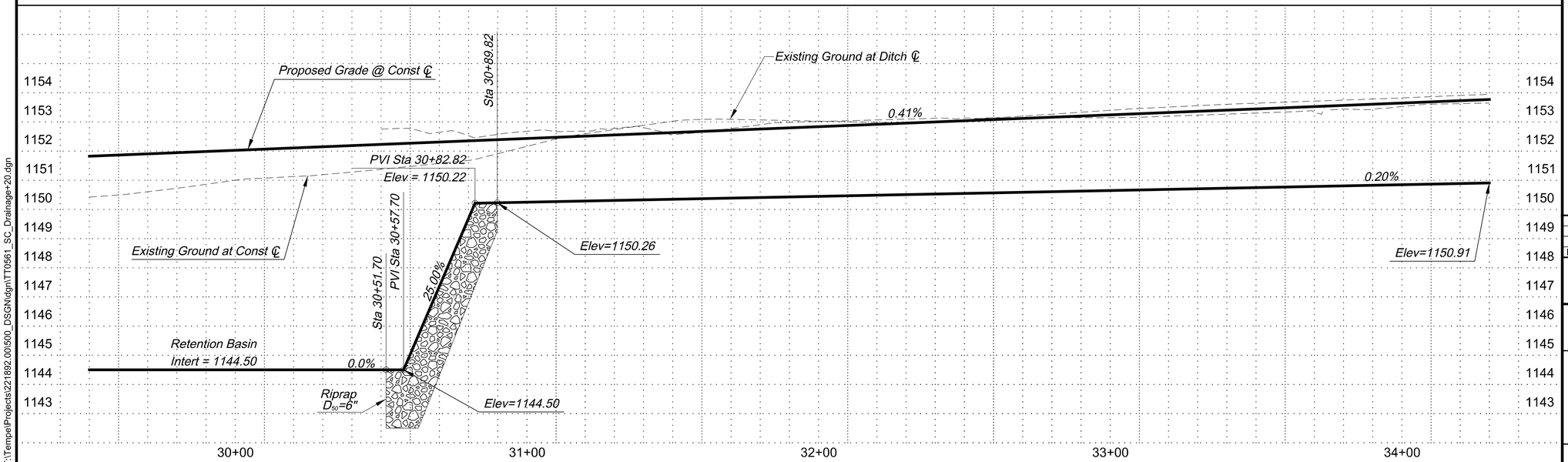




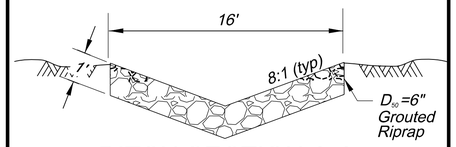
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	118	199	

CONSTRUCTION

(13) Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510

(14) Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan — 30 CY

Retention Basin Control Points		
ID	Sarival Ave Const ℄ Station, Offset	Elevation
J	30+50.00, 79.0' Lt	1144.50
K	30+50.00, 103.0' Lt	1144.50
L	30+82.30, 58.5' Lt	1152.00
M	30+87.23, 58.8' Lt	1152.51



DITCH SECTION A-A

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 118 OF 199

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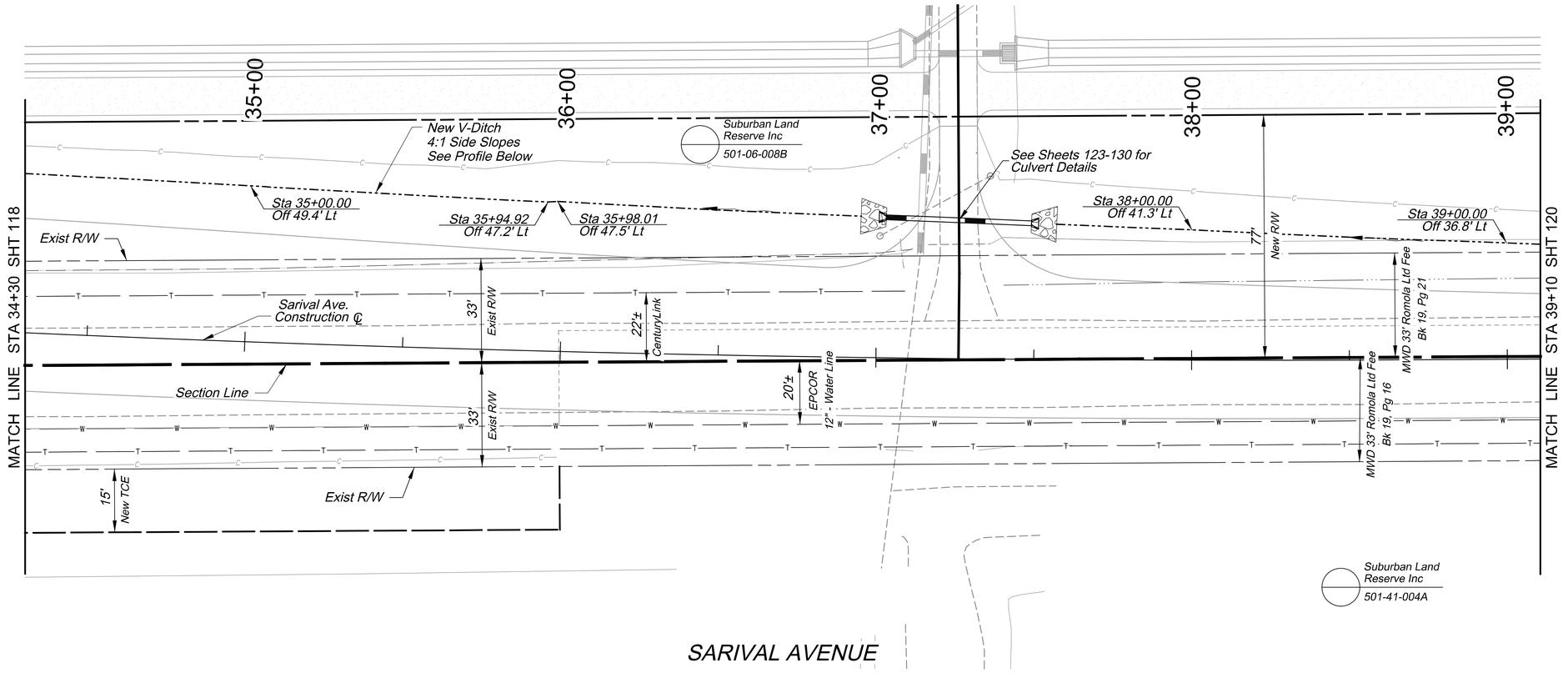

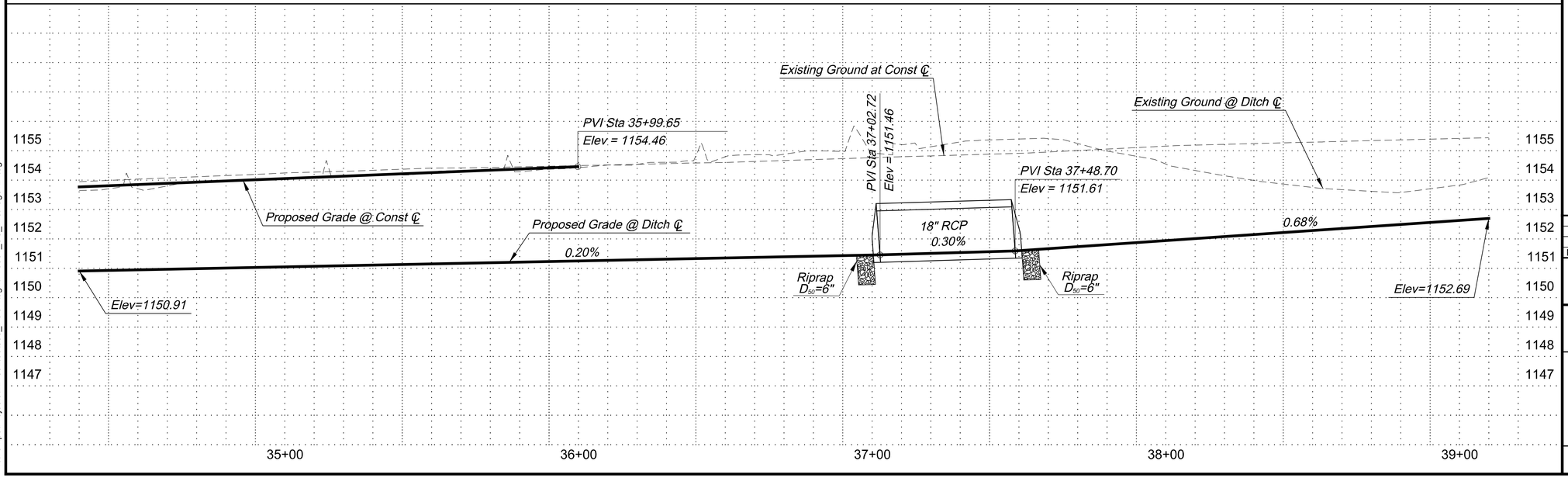

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	119	199	

CONSTRUCTION

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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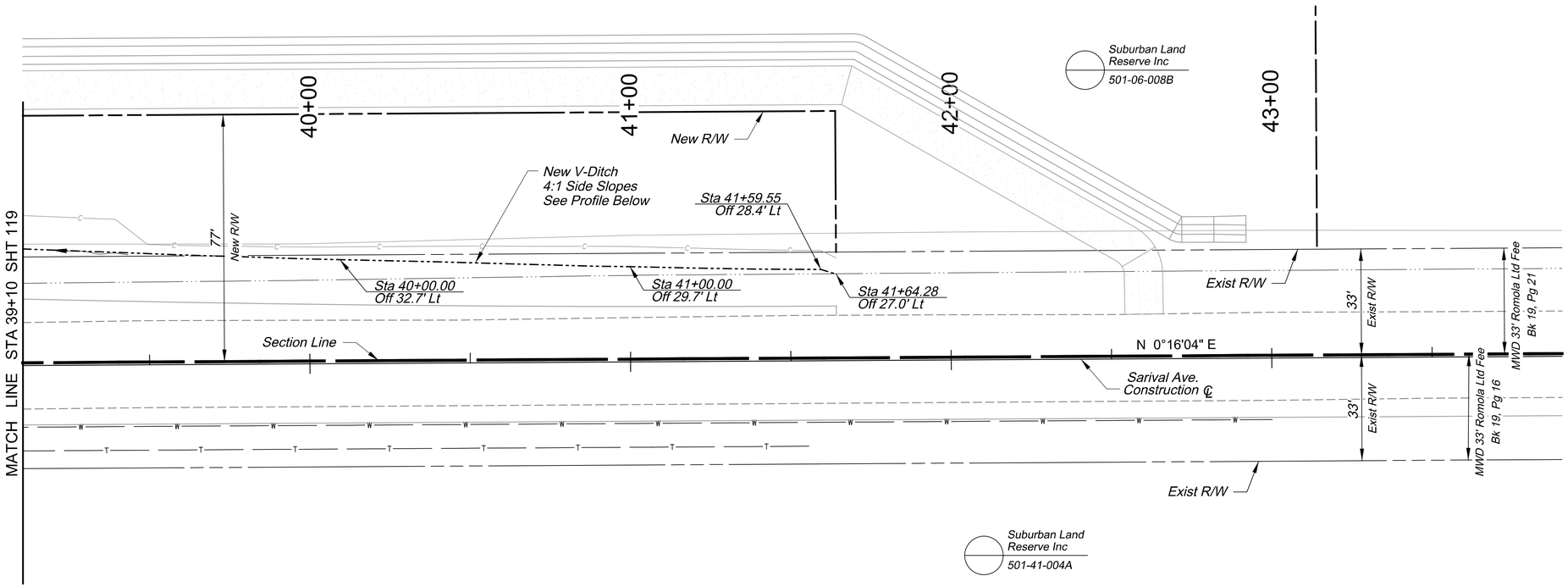
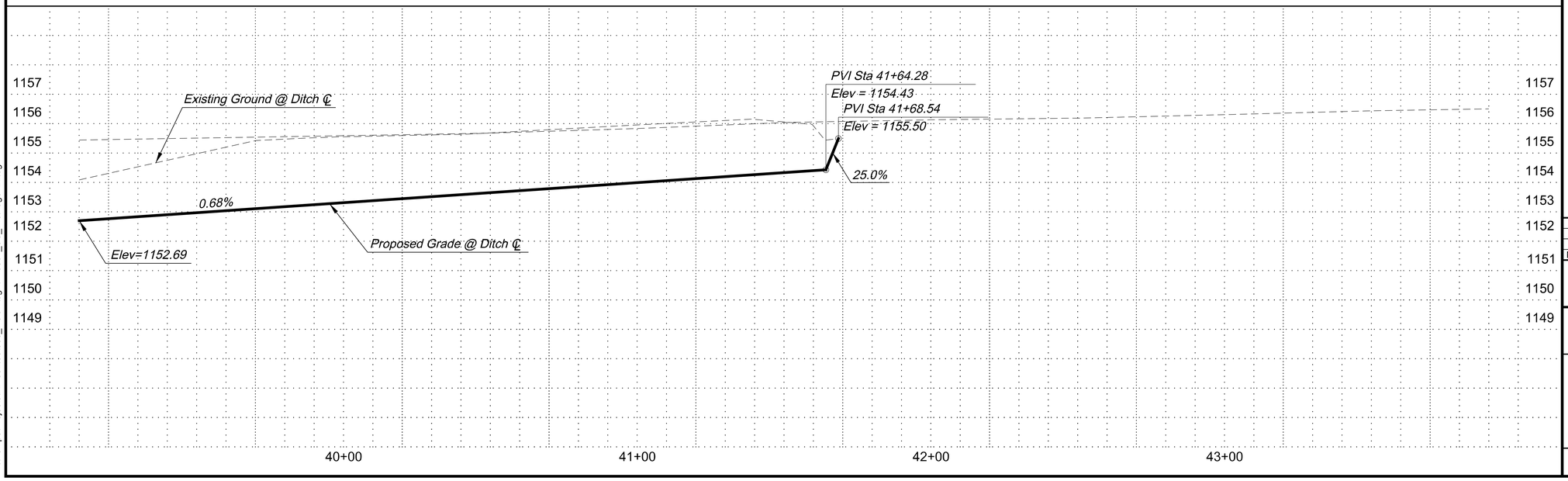
SHEET 119 OF 199

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	120	199	

CONSTRUCTION



SARIVAL AVENUE



SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL
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MARICOPA COUNTY
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SR 303L TO REEMS ROAD
PROJECT NO. TT0561

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DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 120 OF 199

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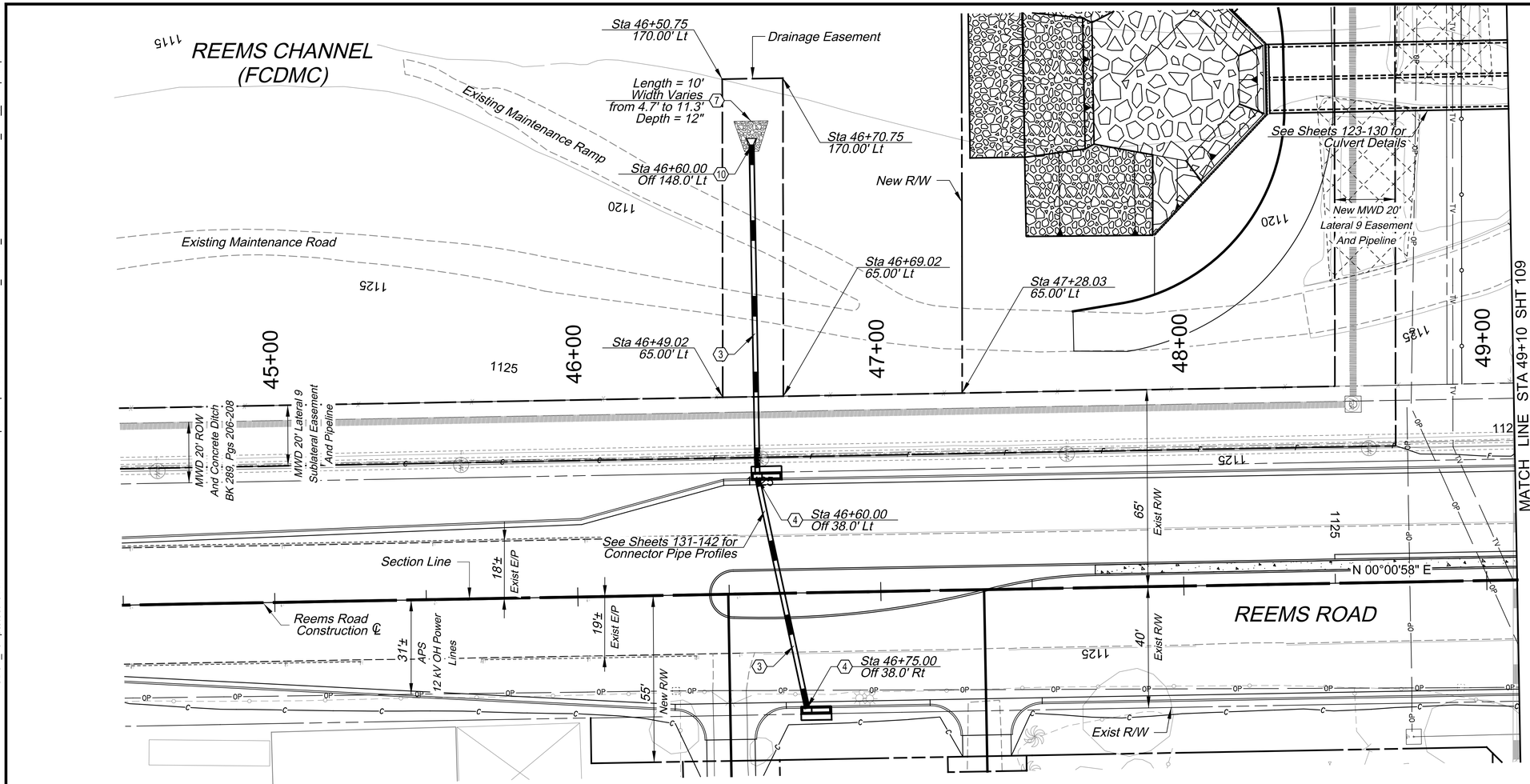

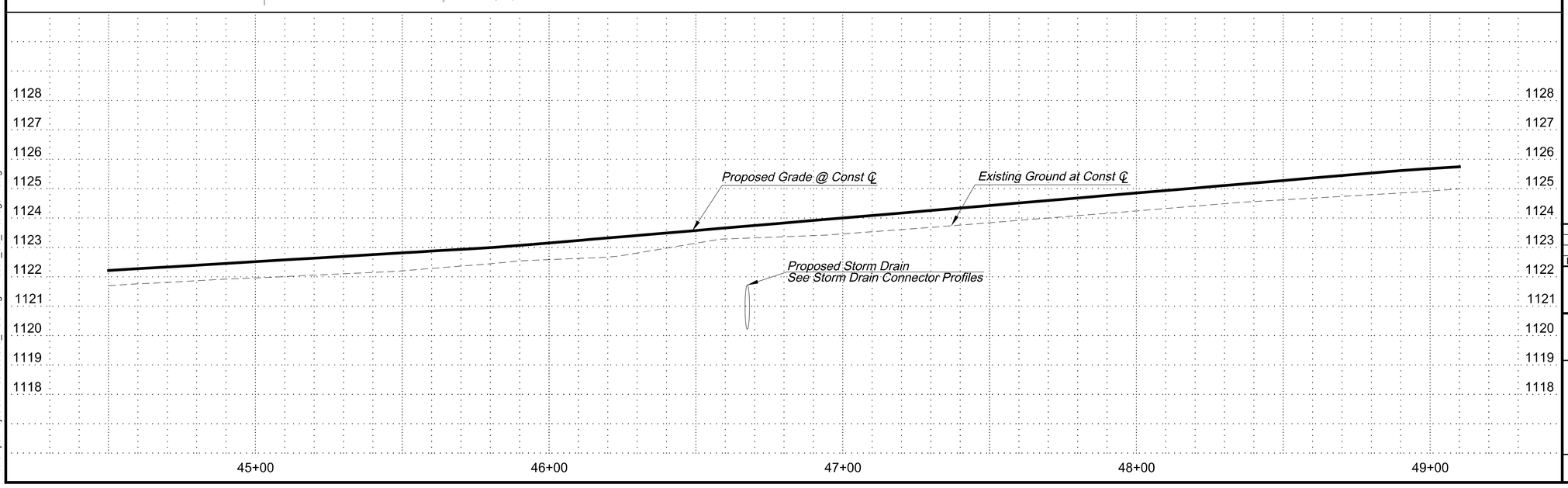

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	121	199	

CONSTRUCTION

3	Furnish and Install 18" RGRCP Storm Drain. Class III	186 LF
4	Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6'	2 EA
7	Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan	3 CY
10	Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18".	1 EA

N

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 121 OF 199

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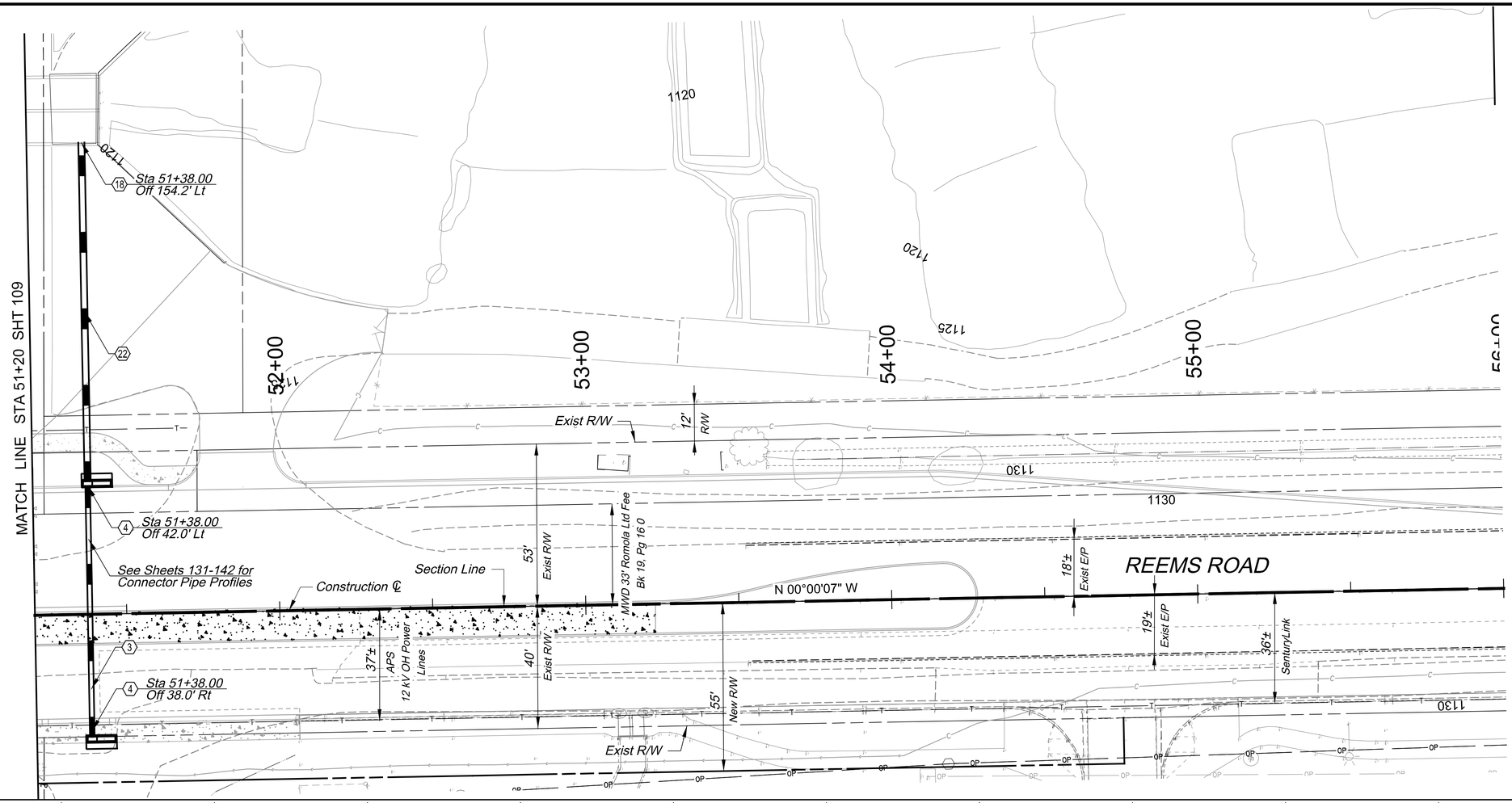

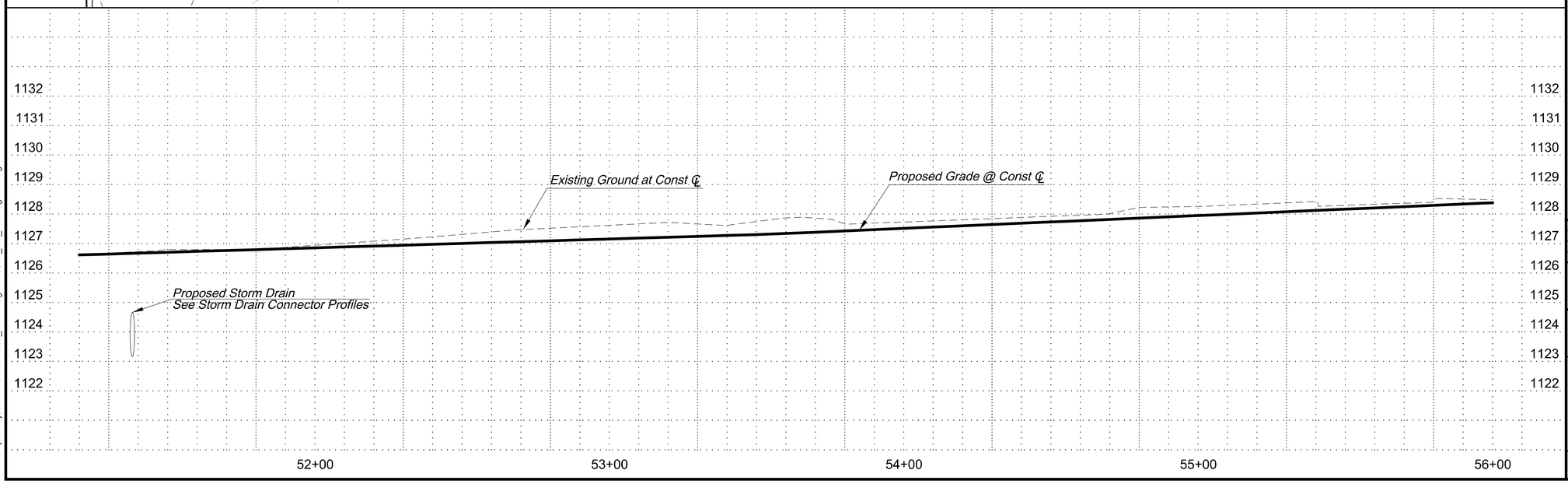

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	122	199	

CONSTRUCTION

3	Furnish and Install 18" RGRCP Storm Drain. Class III	80 LF
4	Construct Concrete Catch Basin Per COP Std Det P-1569-1 Type M-1, L=6'	2 EA
18	Construct Pipe Penetration Into Existing RCBC Box Culvert Per Detail on Sheet 151	1 EA
22	Furnish and Install 24" RGRCP Storm Drain. Class III	111 LF

SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
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OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

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DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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DRAINAGE PLAN AND PROFILE SHEET

SHEET 122 OF 199

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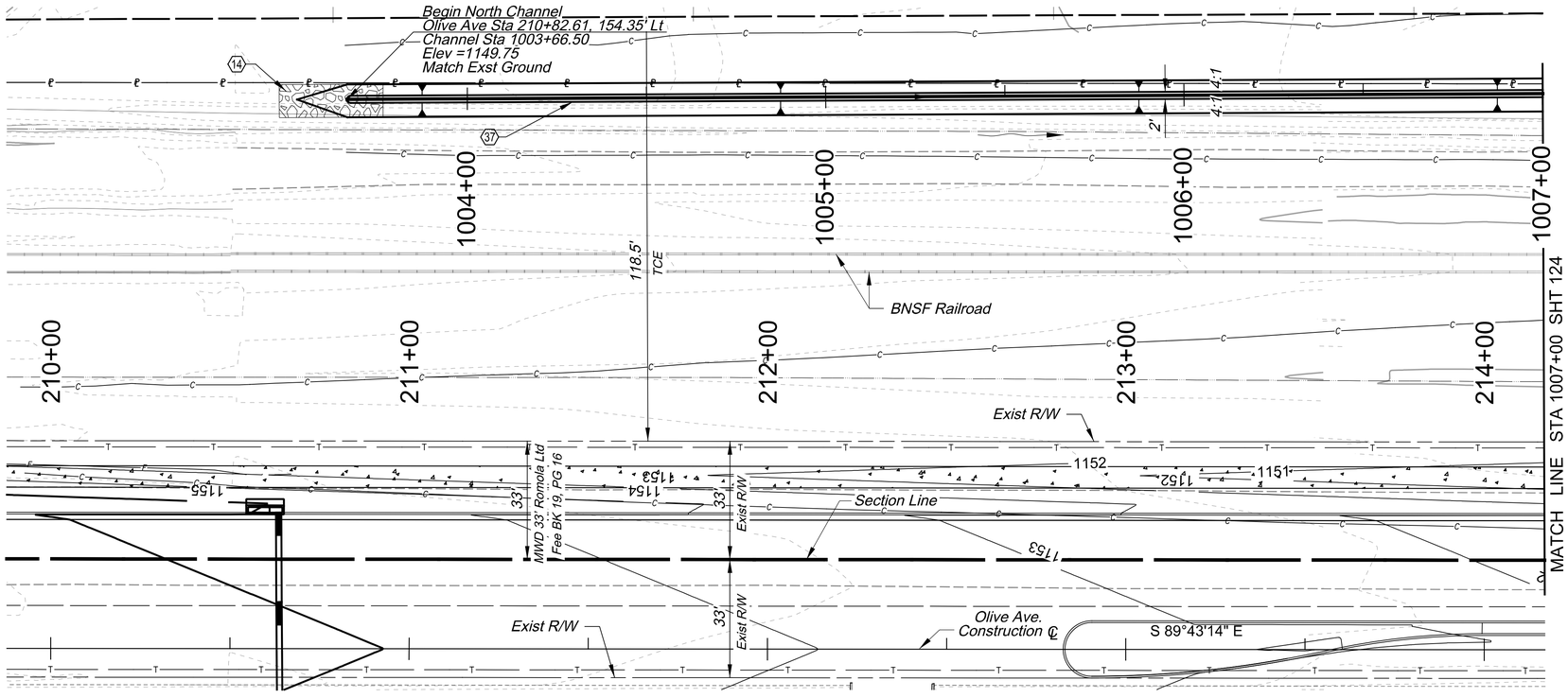
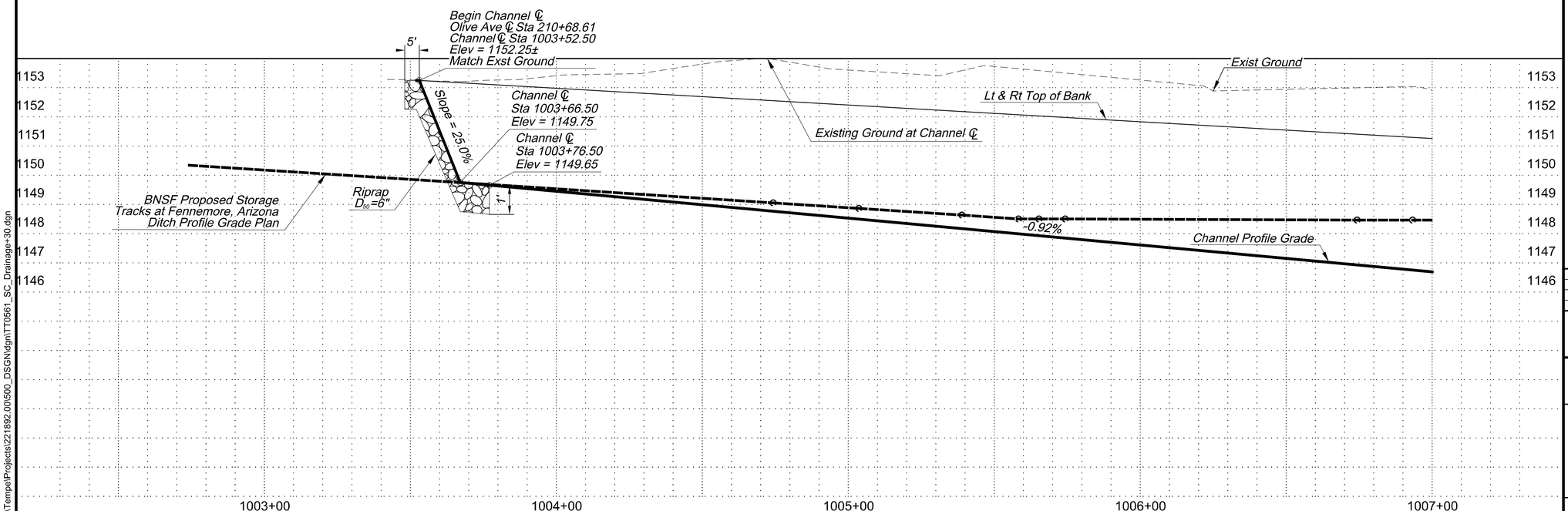


OLIVE AVENUE



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	123	199	

CONSTRUCTION

13 *Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510*

14 *Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan* — 2 CY

37 *Install Earthen Ditch Per Detail on Sheet 77, By MCDOT Contractor* — 311 LF

N

SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG. CALL
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BLUE STAKE

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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
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DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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CHANNEL PLAN & PROFILE SHEET

SHEET 123 OF 199

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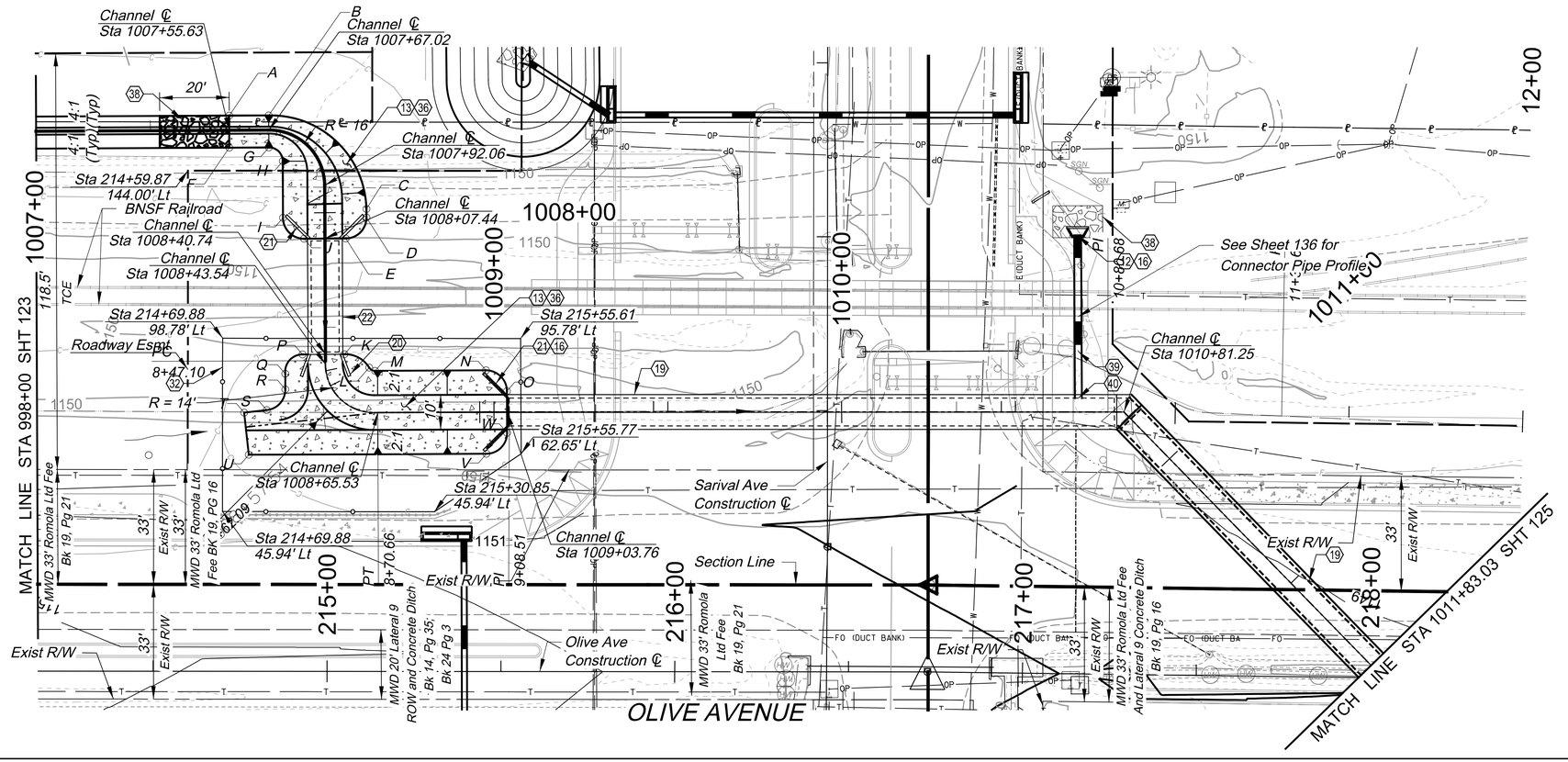

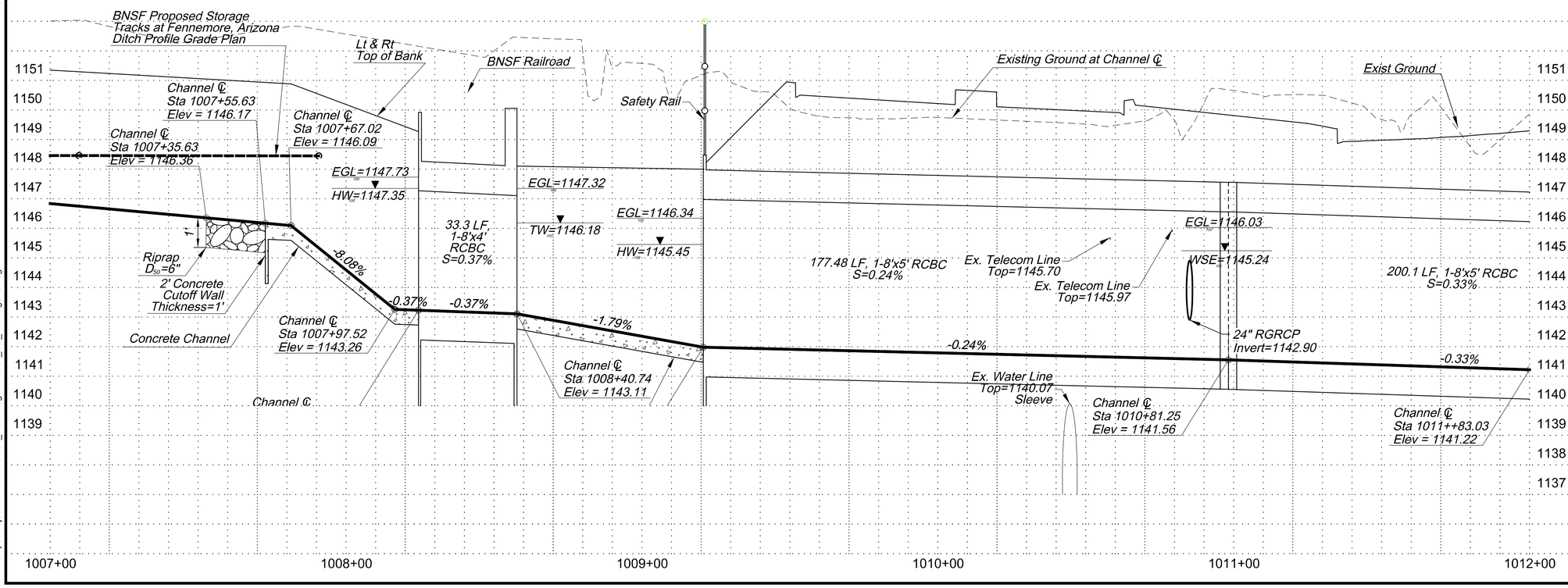

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	124	199	

CONSTRUCTION

12	Install Headwall Drop Inlet Per MAG Std Det 501-5	1 EA
13	Drainage Excavation Paid For Under Earthwork for Retention Basins #215.01510	
16	Install Safety Rail (Height 4'8") Per MAG Std Det 145	56 LF
19	Install 8'x5' RCBC Per ADOT STD SD 6.01 Sheets 1 thru 5	121.9 CY 15,144 LBS
20	Install Outlet Wingwalls Per ADOT Std SD 6.08, Sheet 1	8.3 CY 620 LBS
21	Install Inlet Wingwalls Per ADOT STD SD 6.08, Sheet 3	6.1 CY 450 LBS
22	Install 8'x4' RCBC By BNSF	
32	Install Chainlink Fence Per MAG Std Det 160	276 LF
36	Install Concrete Channel Per Detail on Sheet 143 Depth=6".	287 SY
38	Install Riprap, D50=6", 1' deep	2 CY
39	Furnish and Install 24" RGRCP Storm Drain. Class V	47 LF
40	Construct Pipe Penetration Into Proposed RCBC Box Culvert Per Detail on Sheet 150	1 EA

ID	Olive Ave Const ℄ Station, Offset
A	214+71.72, 159.82' Lt
B	214+83.08, 159.89' Lt
C	215+11.21, 133.03' Lt
D	215+11.22, 130.55' Lt
E	215+05.25, 124.52' Lt
F	214+71.76, 150.62' Lt
G	214+83.12, 150.69' Lt
H	214+87.14, 146.71' Lt
I	214+87.22, 130.43' Lt
J	214+93.25, 124.46' Lt
K	214+04.93, 91.21' Lt
L	215+12.05, 87.41' Lt
M	215+13.76, 86.46' Lt
N	215+45.65, 86.62' Lt
O	215+51.68, 80.65' Lt
P	214+92.86, 91.15' Lt
Q	214+87.91, 85.60' Lt
R	214+87.93, 81.11' Lt
S	214+82.59, 75.12' Lt
T	214+76.11, 74.40' Lt
U	214+77.45, 62.28' Lt
V	215+45.77, 62.62' Lt
W	215+51.74, 68.65' Lt

N

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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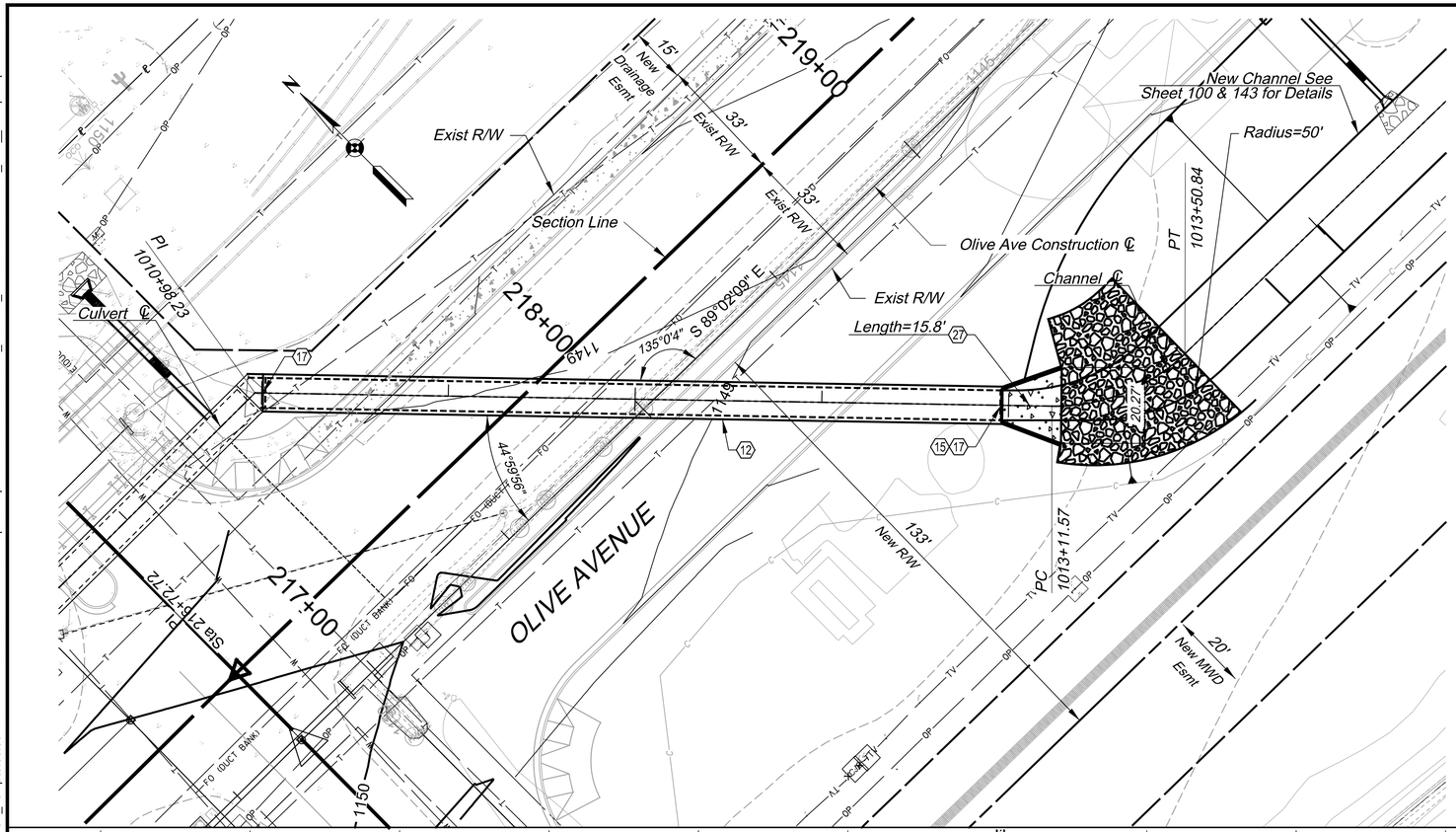
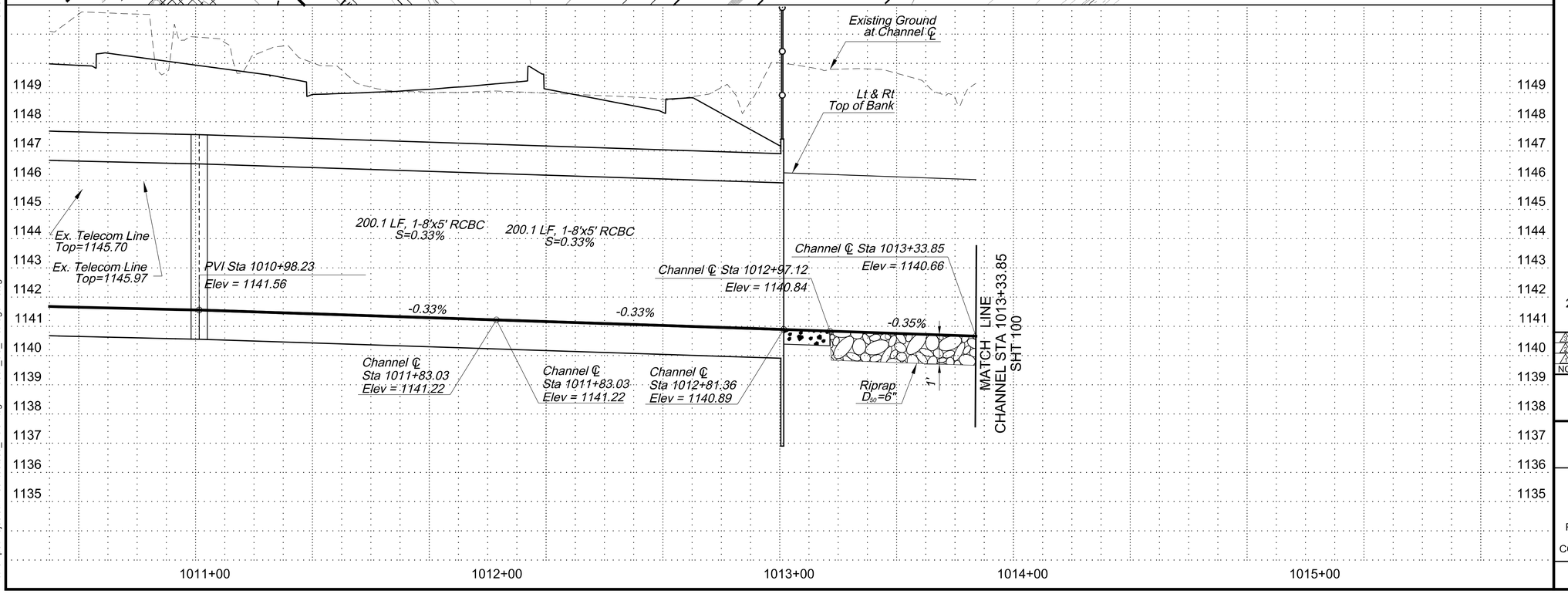
CHANNEL PLAN & PROFILE SHEET

SHEET 124 OF 199





F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	125	199	

CONSTRUCTION

12 Install Dual 8'x4' RCBC Per ADOT STD SD 6.01 Sheets 1 thru 4 And STD SD 6.02 Sheets 1 thru 2	304 CY 56,220 LBS
15 Install Outlet Wingwalls Per ADOT Std SD 6.08, Sheet 5	17 CY 1,290 LBS
17 Install Safety Rail (Height 4'8") Per MAG Std Det 145	43 LF
27 Install Concrete Apron Per ADOT Std Det SD 6.11, 4:1 Slope, 45 Degree Skew, As Modified: i) Dimensions Per Plan ii) Omit 6"x6" Rise Above Grade At Top Of Cutoff Wall	14 CY 1119 LBS

SCALE: Hor: 1"=20'
Vert: 1"=2'
20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
3			
2			
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C.MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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CULVERT PLAN AND PROFILE SHEET

SHEET 125 OF 199

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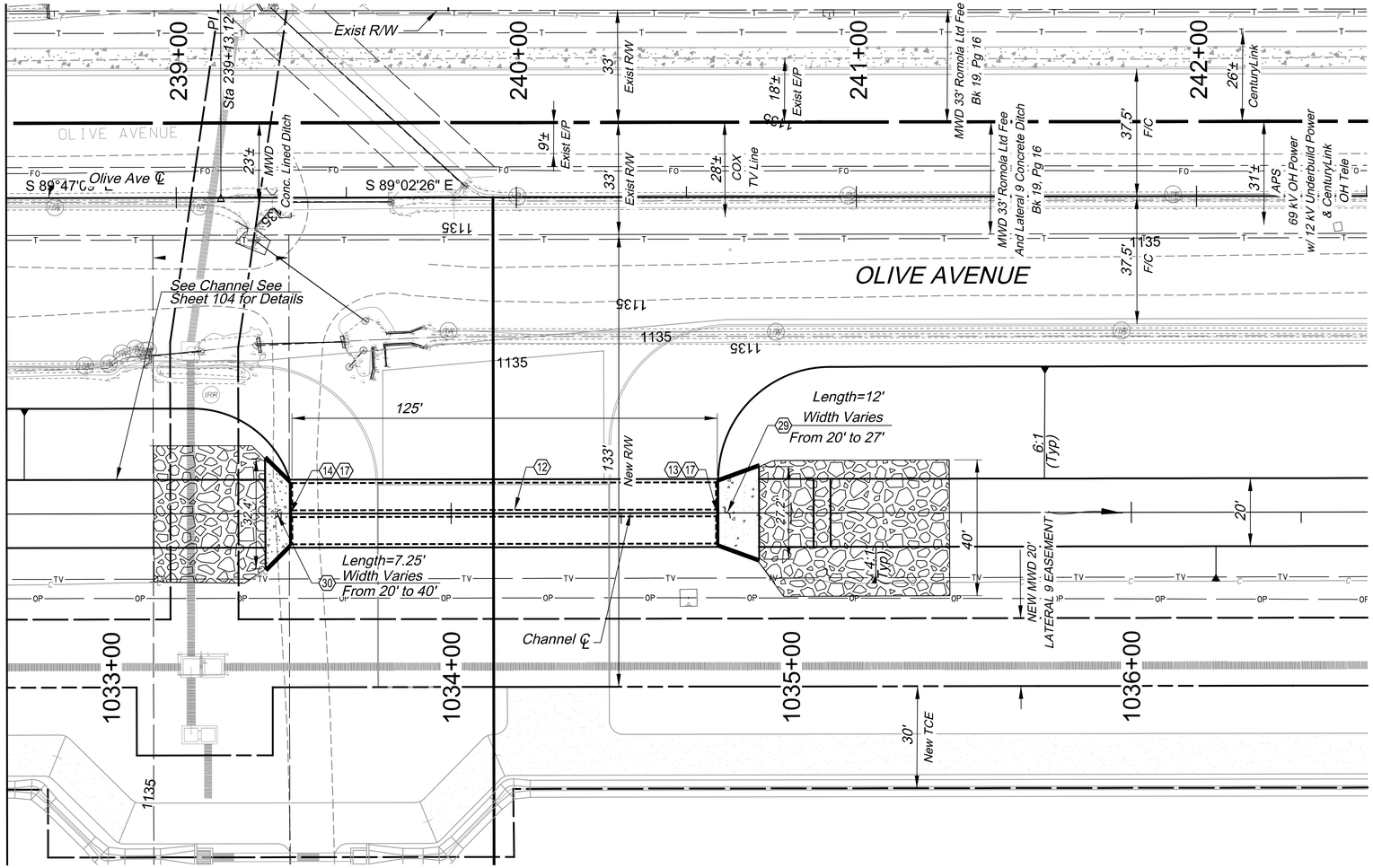

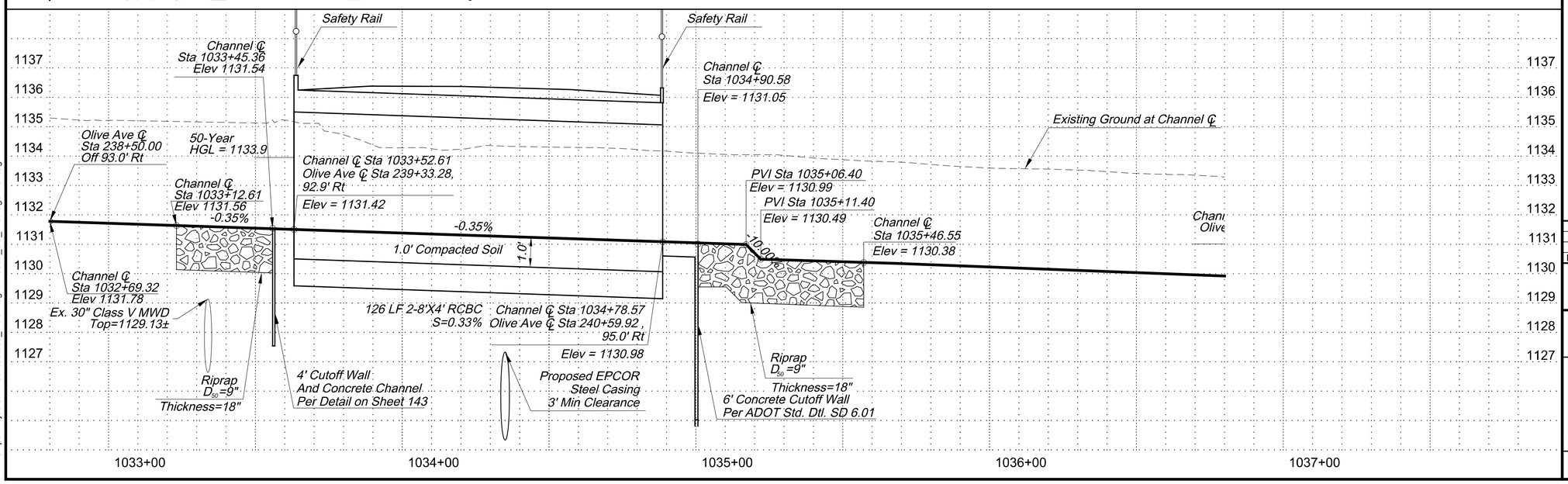

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	126	199	

CONSTRUCTION

(12) Install Dual 8'x4' RCBC Per ADOT STD SD 6.01 Sheets 1 thru 4 And STD SD 6.02 Sheets 1 thru 2	190 CY 35,280 LBS
(13) Install Outlet Wingwalls Per ADOT Std SD 6.08, Sheet 1	14 CY 1,050 LBS
(14) Install Inlet Wingwalls Per ADOT STD SD 6.08, Sheet 3	9 CY 650 LBS
(17) Install Safety Rail (Height 4'8") Per MAG Std Det 145	82 LF
(29) Install Concrete Apron Per ADOT Std Det SD 6.11, 4:1 Slope, 0 Degree Skew, As Modified: i) Omit 6"x6" Rise Above Grade At Top Of Cutoff Wall	11 CY 912 LBS
(30) Install Concrete Channel Per Detail on Sheet 143, Depth=6"	37 SY

N

SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
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CULVERT PLAN AND PROFILE SHEET

SHEET 126 OF 199

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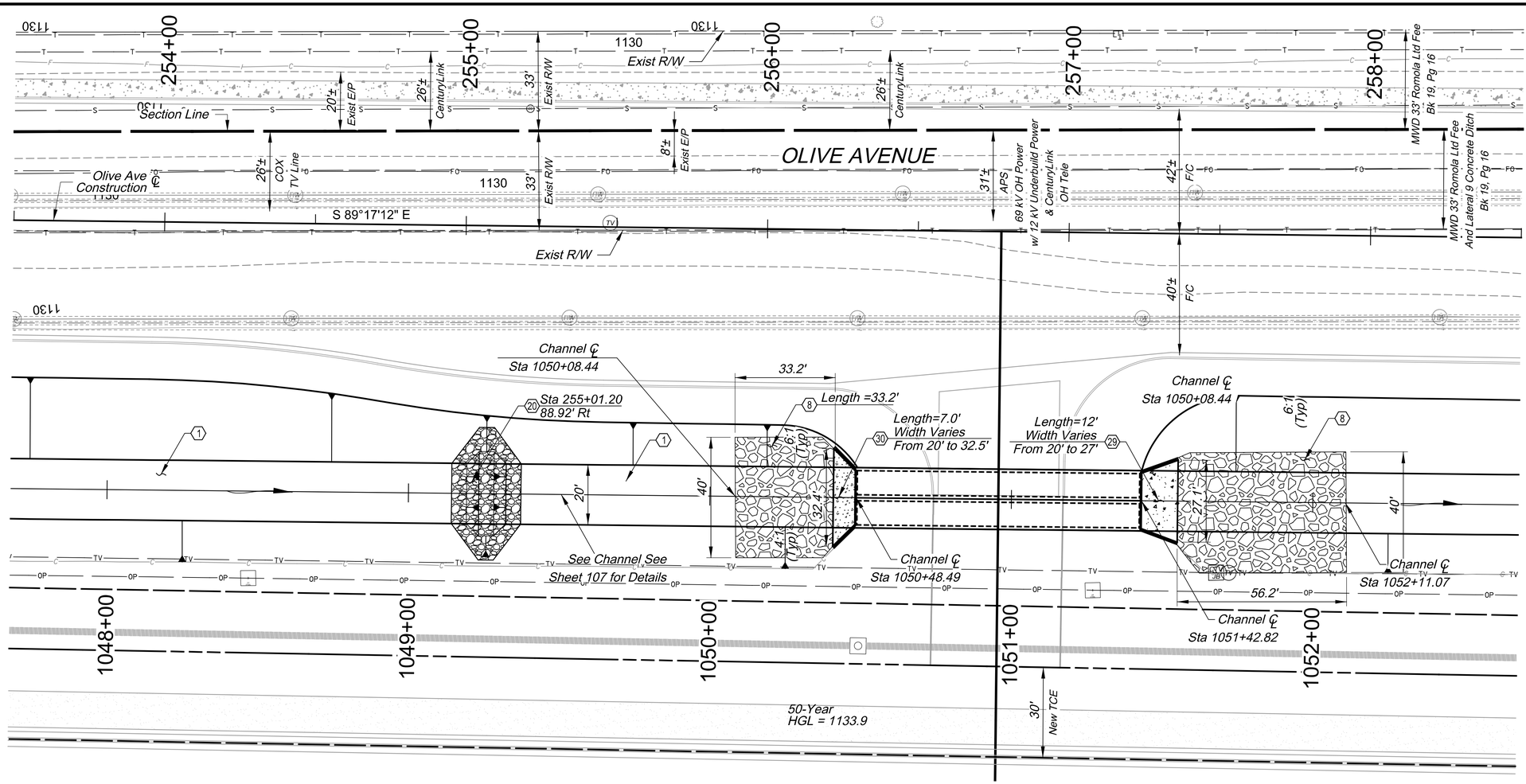

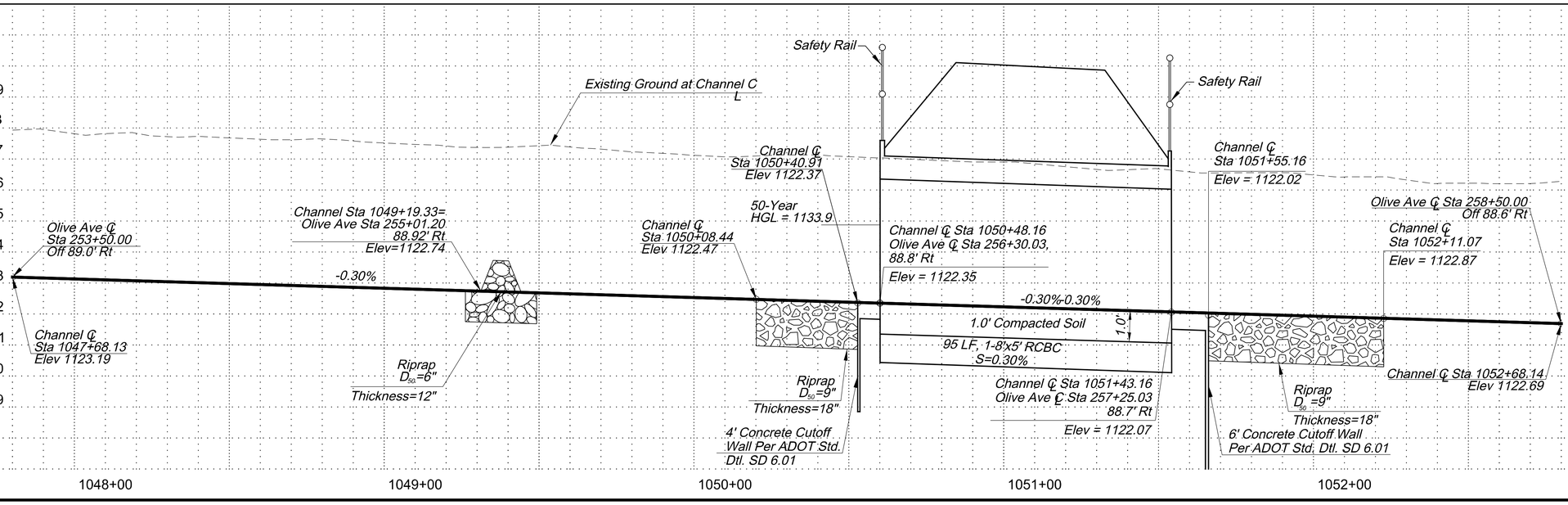

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	127	199	

CONSTRUCTION

1. Drainage Excavation Paid For Under Channel Excavation #215.01100
20. Install First Flush Berm Per First Flush Berm Detail, Sheet 148 — 1 EA
8. Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=9", Dimensions Per Plan — 205 CY
29. Install Concrete Apron Per ADOT Std Det SD 6.11, 4:1 Slope, 0 Degree Skew, As Modified: — 11 CY, 915 LBS
   i) Omit 6"x6" Rise Above Grade At Top Of Cutoff Wall
30. Install Concrete Channel Per Detail on Sheet 143, Depth=6" — 34 SY

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SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

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MARICOPA COUNTY
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CULVERT PLAN AND PROFILE SHEET

SHEET 127 OF 199

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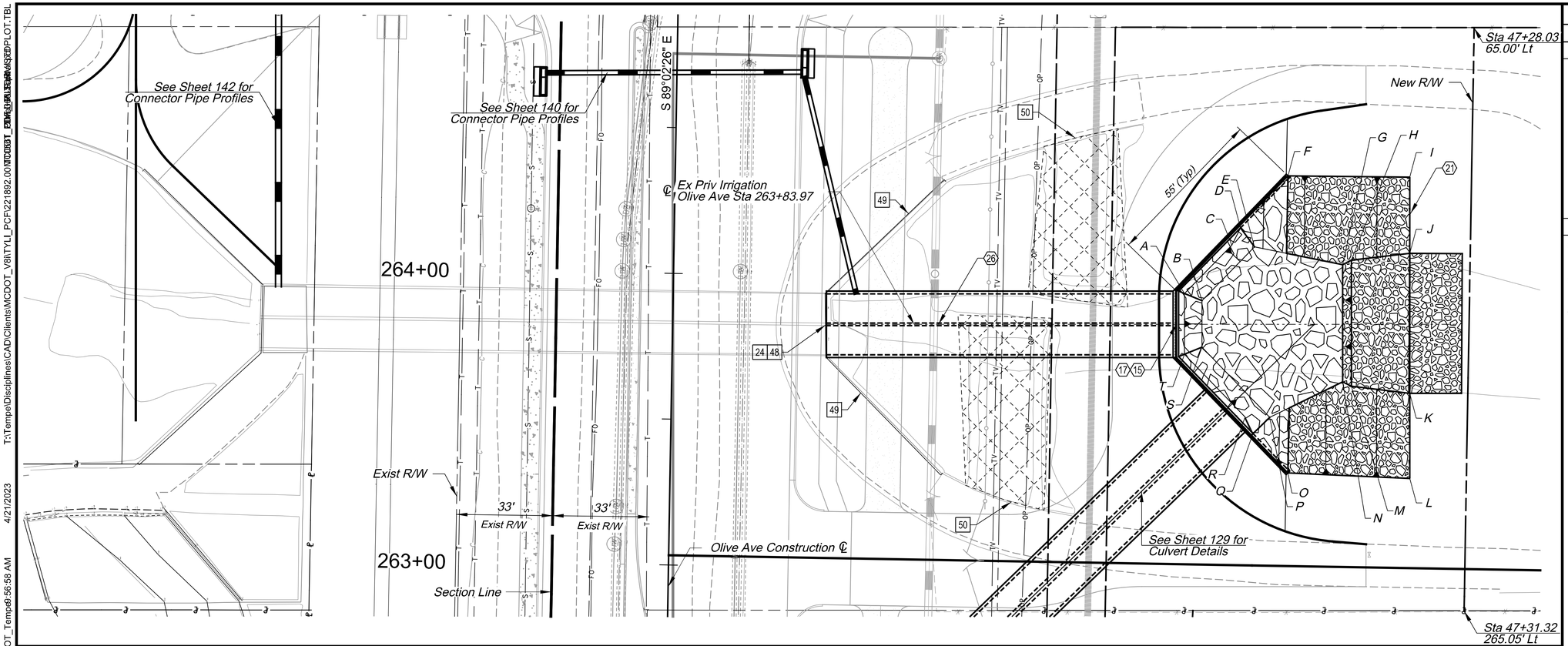

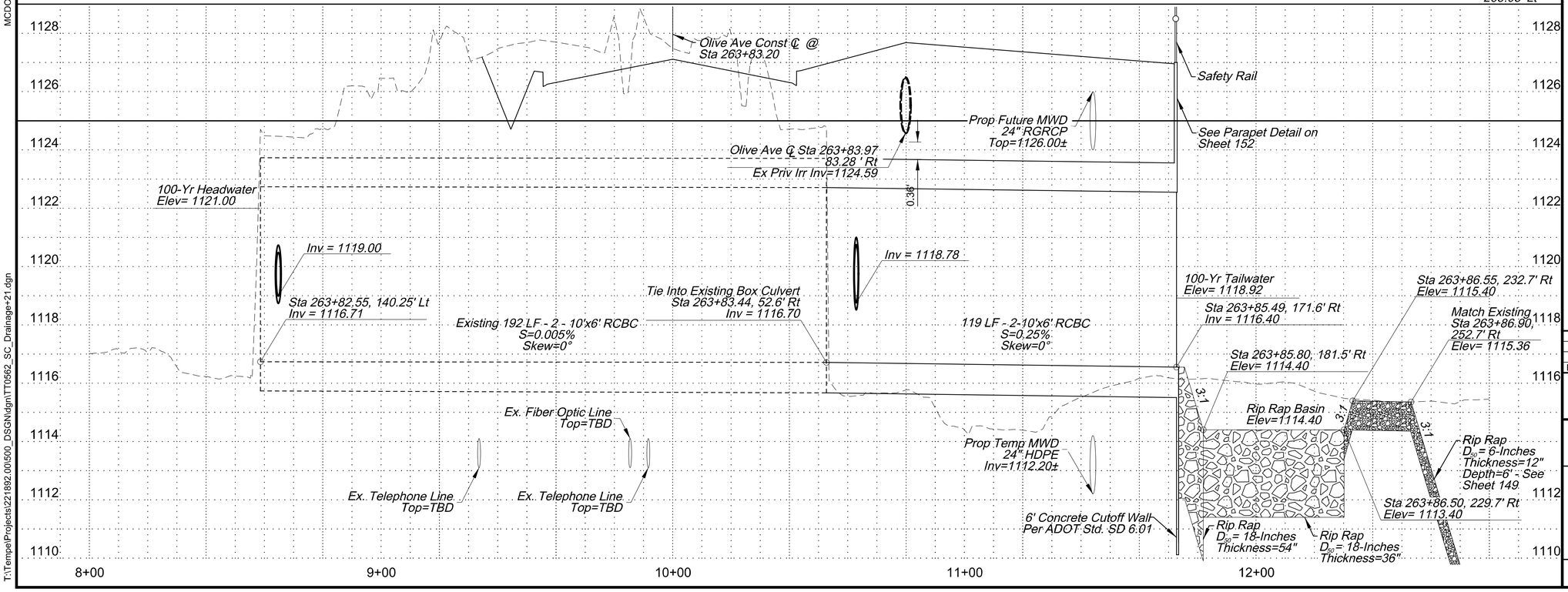

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	128	199	

☐ REMOVAL / RELOCATE ☐

24	Remove & Relocate Existing Safety Rail	135 LF
48	Remove Existing Concrete Box Culvert Headwall	1 EA
49	Remove Existing Concrete Box Culvert Outlet Wing Walls	2 EA
50	Salvage Existing Riprap	130 CY

⬡ CONSTRUCTION ⬡

⟨15⟩	Install Outlet Wingwalls and Headwall Per Detail on Sheet 152	80 CY 11,640 LBS
⟨17⟩	Install Safety Rail (Height 4'8") Per MAG Std Det 145	113 LF
⟨21⟩	Install Riprap Basin Per Detail on Sheet 149	1 EA
⟨26⟩	Construct New Dual 10'x6' Reinforced Box Culvert Extension Per ADOT STD SD 6.01 Sheets 1 thru 4 And STD SD 6.02 Sheets 1 thru 2	258 CY 44,900 LBS

Retention Basin Control Points		
ID	Olive Ave Const ℄ Station, Offset	Elevation
A	263+96.12, 175.3' Rt	1116.40
B	263+93.78, 181.3' Rt	1114.40
C	264+13.00, 191.2' Rt	1116.40
D	264+18.96, 194.1' Rt	1116.40
E	264+12.52, 199.0' Rt	1114.40
F	264+37.06, 210.1' Rt	1121.00
G	264+06.96, 229.34' Rt	1114.40
H	264+08.56, 232.3' Rt	1115.40
I	264+37.36, 251.81' Rt	1120.00
J	264+11.23, 252.3' Rt	1115.37
K	263+63.24, 253.1' Rt	1115.37
L	263+34.04, 253.6' Rt	1120.00
M	263+65.34, 233.1' Rt	1115.40
N	263+66.80, 230.0' Rt	1114.40
O	263+35.25, 211.8' Rt	1121.00
P	263+54.17, 205.2' Rt	1114.40
Q	263+48.52, 199.6' Rt	1116.40
R	263+54.17, 196.8' Rt	1116.40
S	263+77.83, 181.6' Rt	1114.40
T	263+75.30, 175.6' Rt	1116.40

SCALE: Hor: 1"=20'
Vert: 1"=2'
20 0 20 40
SCALE IN FEET

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MARICOPA COUNTY
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ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
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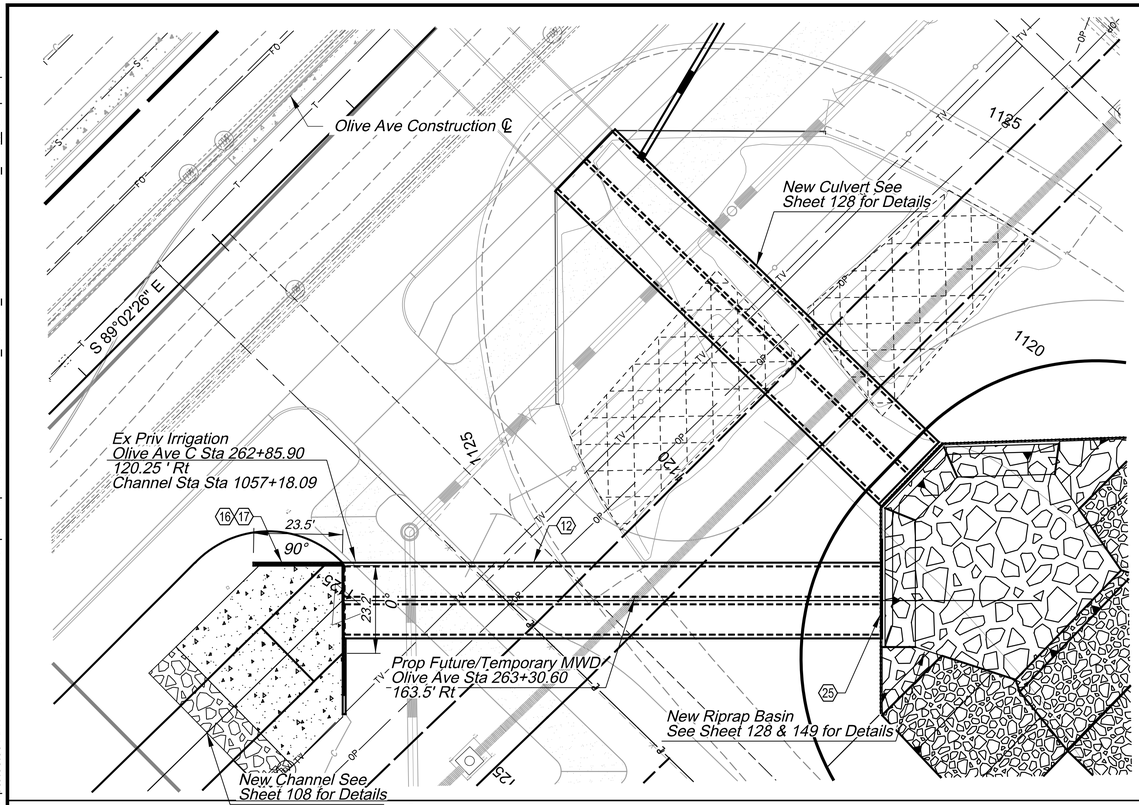
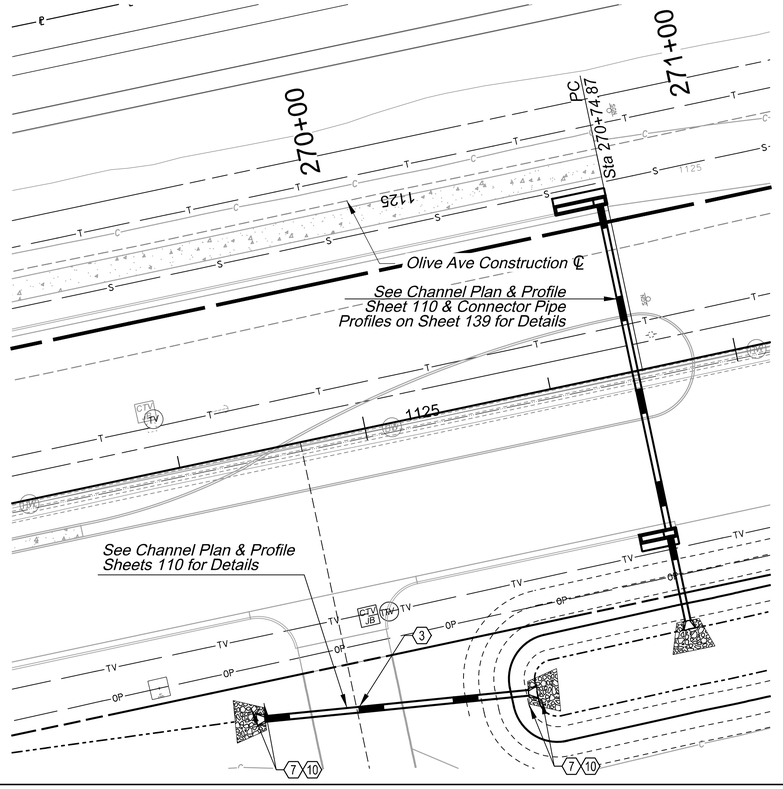
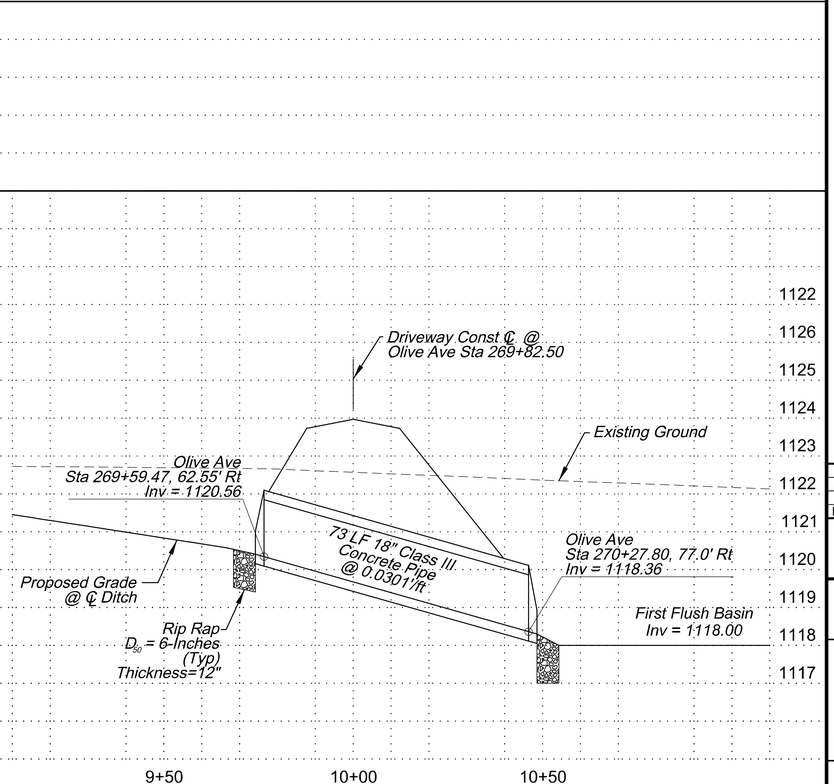
CULVERT PLAN AND PROFILE SHEET

SHEET 128 OF 199







F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	129	199	

CONSTRUCTION

3	Furnish and Install 18" RGRCP Storm Drain Class III	73 LF
7	Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan	210 CY
10	Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18".	2 EA
12	Install Dual 8'x4' RCBC Per ADOT STD SD 6.01 Sheets 1 thru 4 And STD SD 6.02 Sheets 1 thru 2	218 CY 40,740 LBS
16	Install Inlet Wingwalls Per ADOT STD SD 6.08, Sheet 7	12 CY 910 LBS
17	Install Safety Rail (Height 4'8") Per MAG Std Det 145	113 LF
25	Construct New Box Culvert Penetration Into New Retaining Wall Per Detail on Sheet 151	1 EA

SCALE: Hor: 1"=20'
Vert: 1"=2'
20 0 20 40
SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

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100% PLANS
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CULVERT PLAN AND PROFILE SHEET

SHEET 129 OF 199

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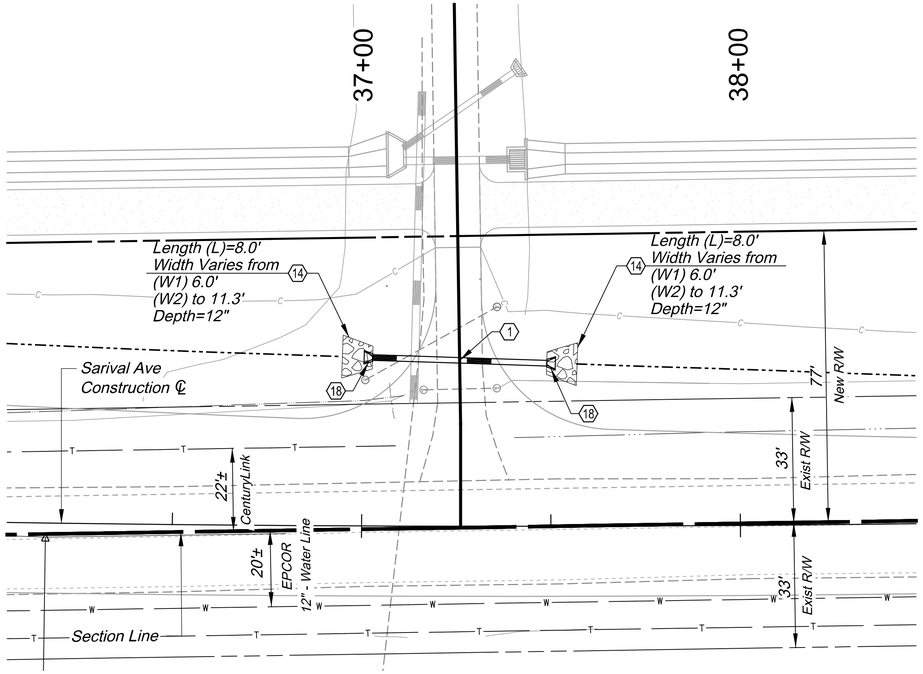
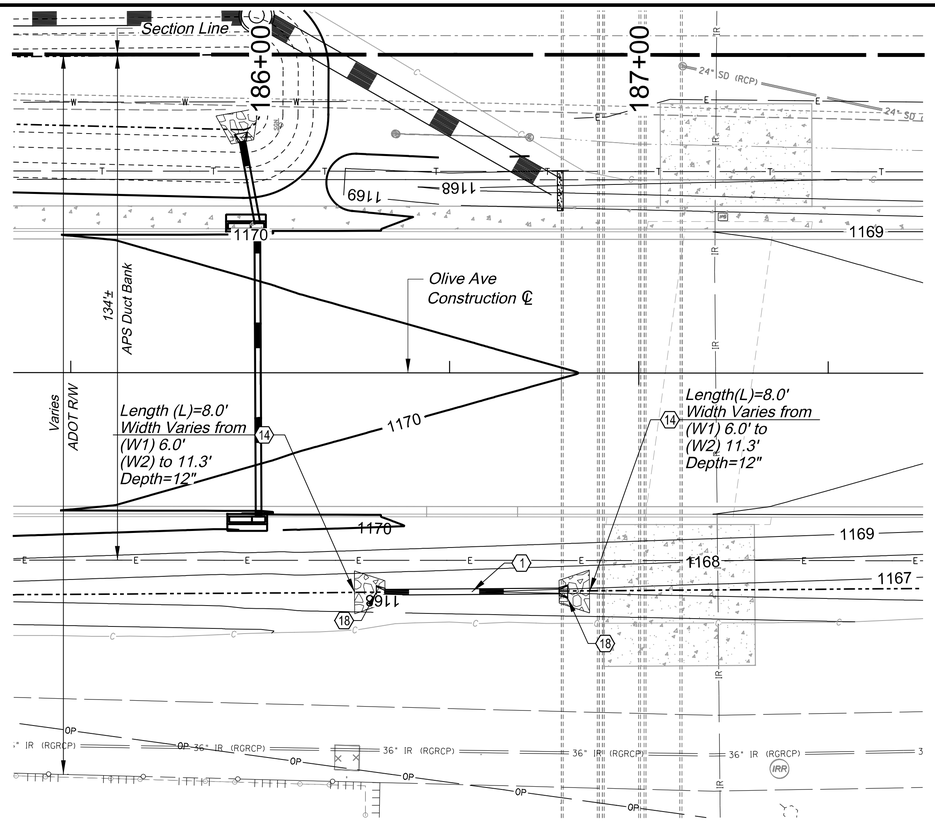
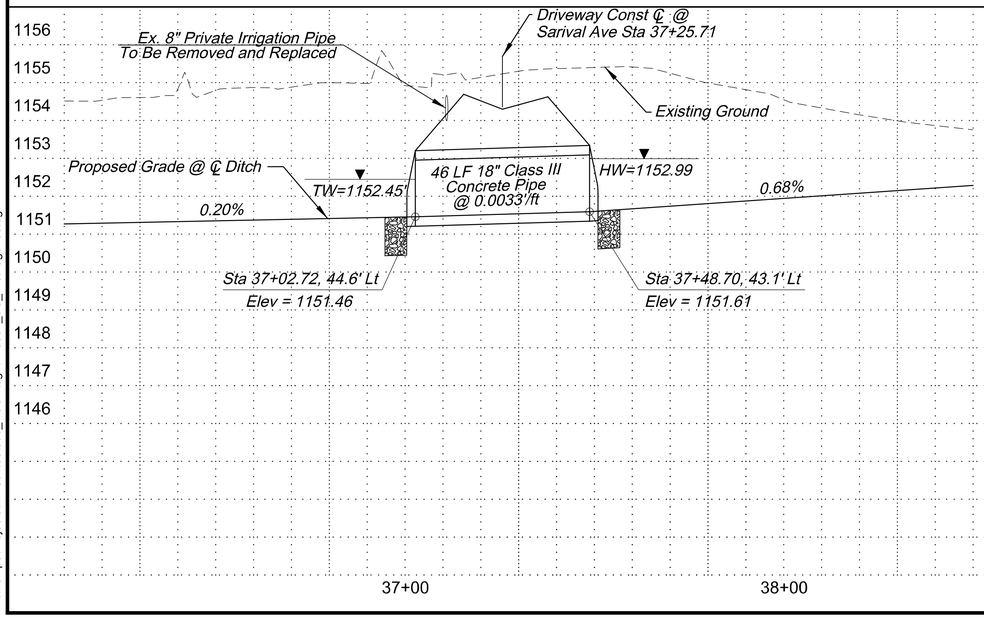
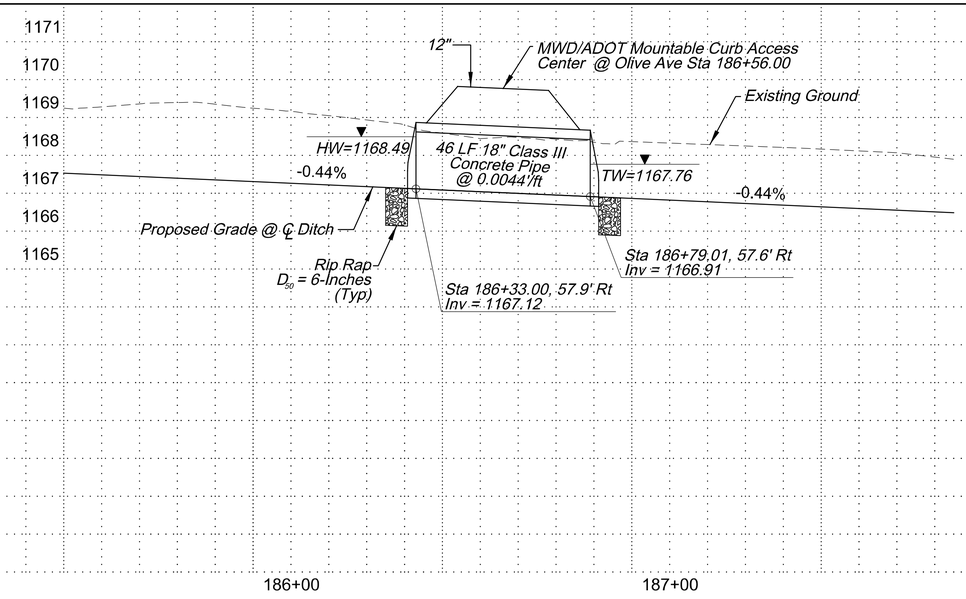




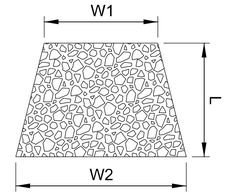




F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	130	199	

CONSTRUCTION

1	Furnish and Install 18" RGRCP Storm Drain. Class III	92 LF
14	Install Riprap Erosion Protection With Geosynthetic Filter Fabric, D50=6", Dimensions Per Plan	11 CY
18	Install Concrete End Section Per MAG Std Det 545, Pipe Diameter 18".	4 EA



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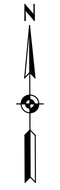

SCALE: Hor: 1"=20'
Vert: 1"=2'

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SCALE IN FEET

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

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MARICOPA COUNTY
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OLIVE AVENUE
SR 303L TO REEMS ROAD
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SHEET 130 OF 199

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F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
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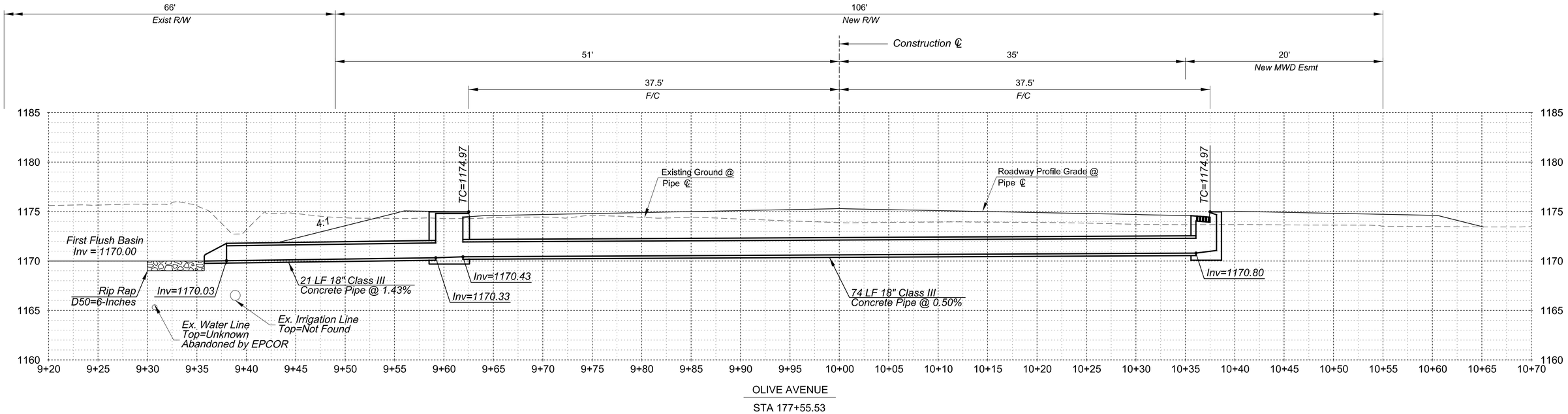
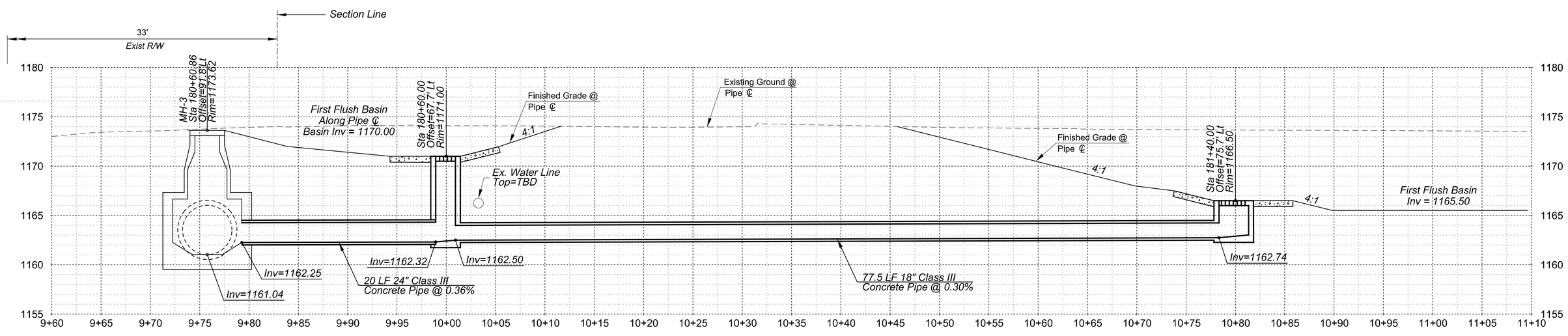


OLIVE AVENUE

STA 177+55.53



OLIVE AVENUE

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NO.	REVISION	BY	DATE
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STORM DRAIN CONNECTOR PIPE PROFILES

SHEET 131 OF 199

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4/21/2023
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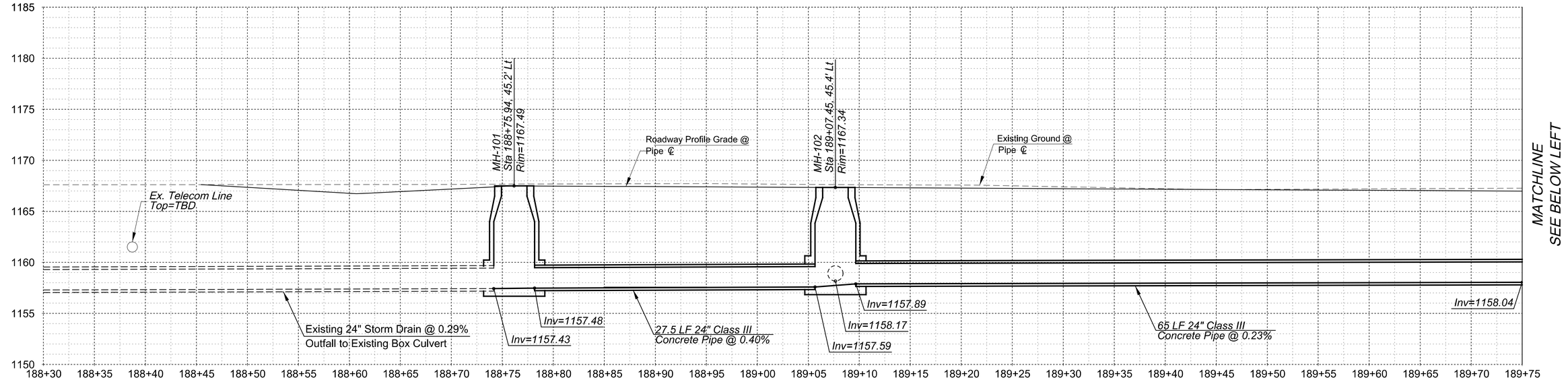
9	AZ	TT0561	132	199	



OLIVE AVENUE

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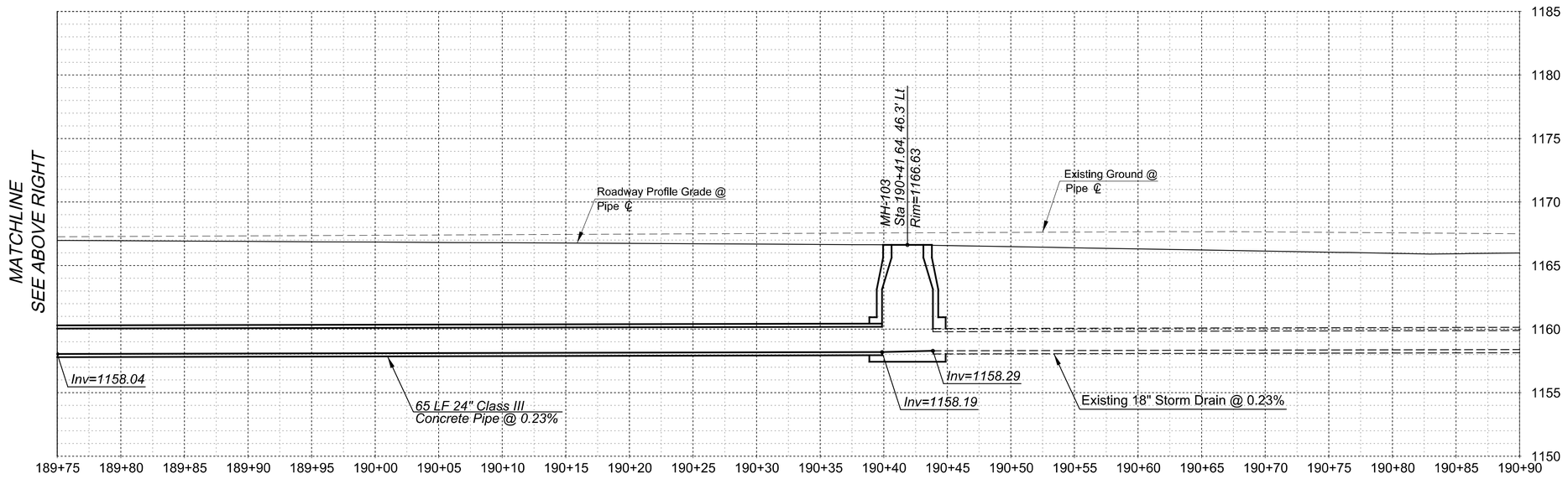

OLIVE AVENUE

STA 189+75.00 to STA 190+41.64

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STORM DRAIN CONNECTOR PROFILES

SHEET 132 OF 199

4/21/2023 9:57:02 AM

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F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
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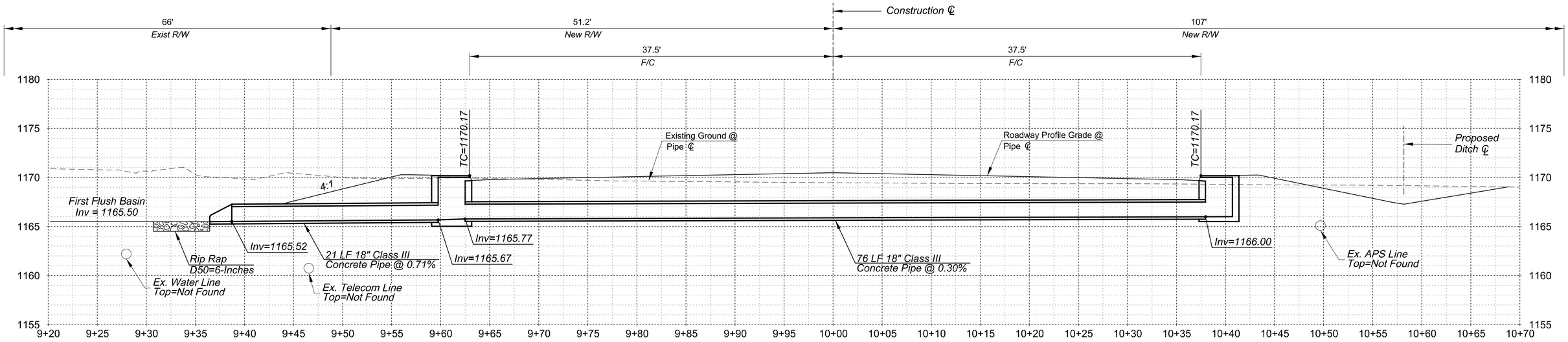
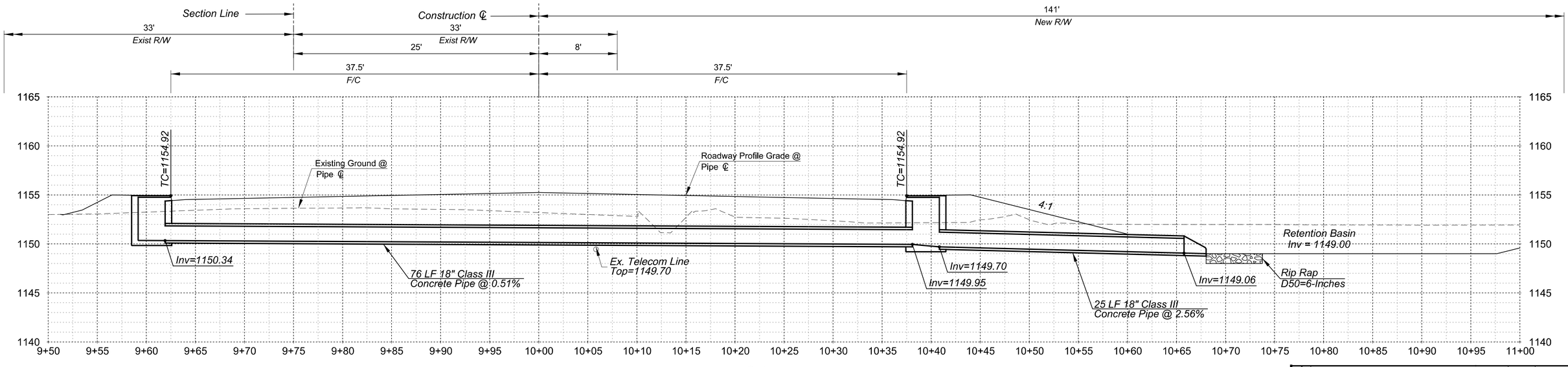


OLIVE AVENUE

STA 185+99.44



OLIVE AVENUE

STA 210+63.79

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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C. MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J. BARR	04/2023

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STORM DRAIN CONNECTOR PIPE PROFILES

SHEET 133 OF 199

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4/21/2023

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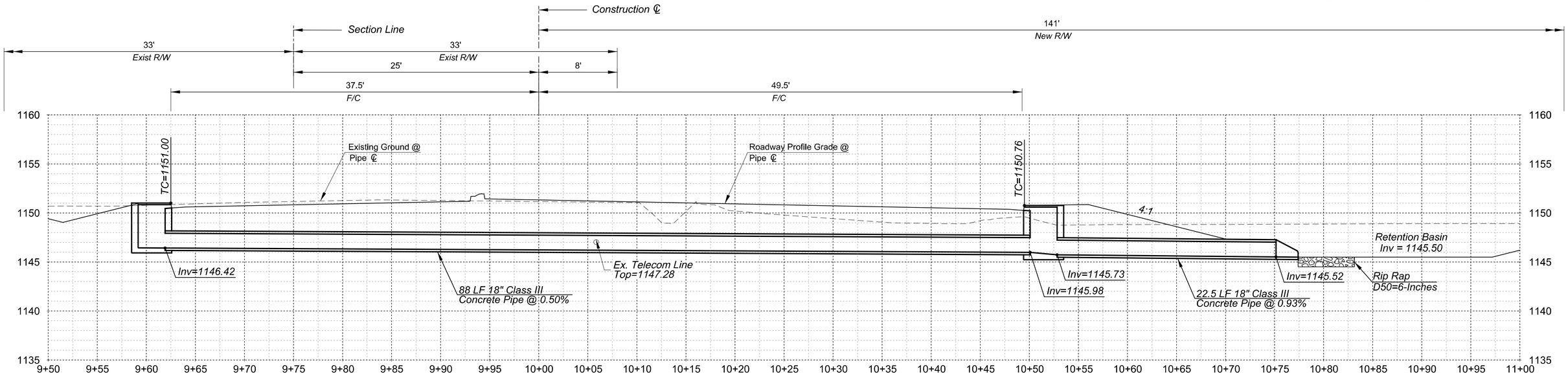
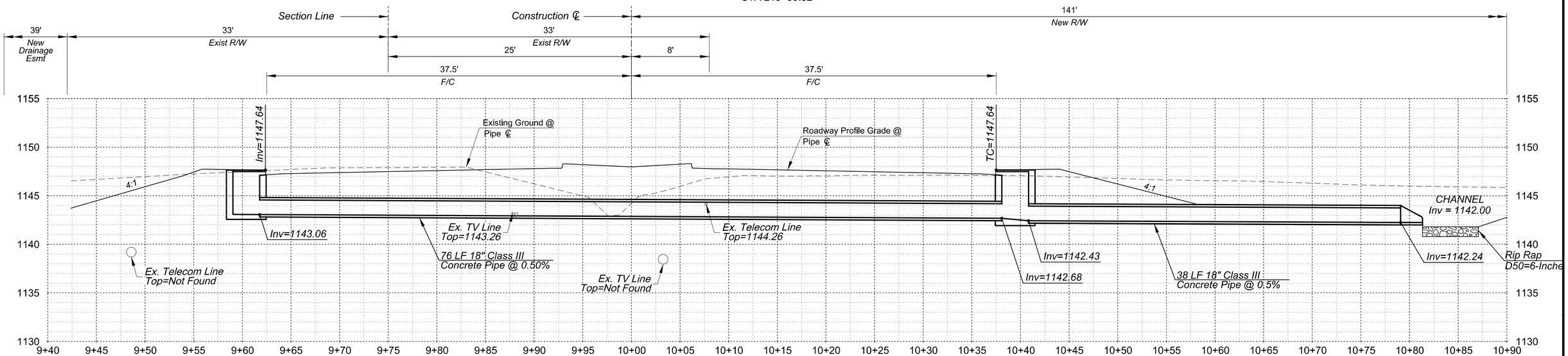


OLIVE AVENUE

STA 215+39.52



OLIVE AVENUE

STA 220+00.00

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MARICOPA COUNTY
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OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

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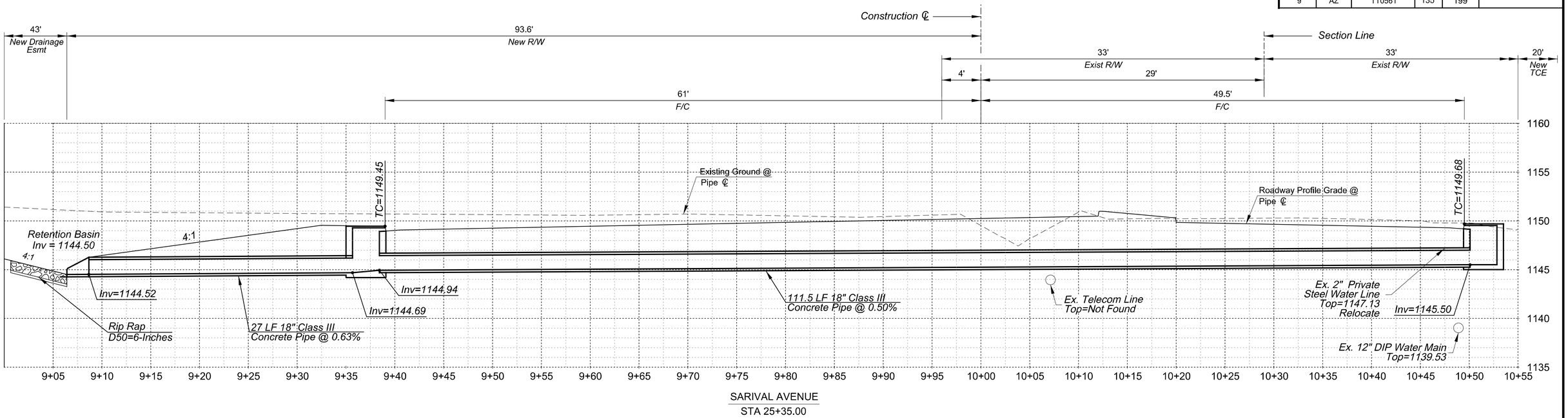
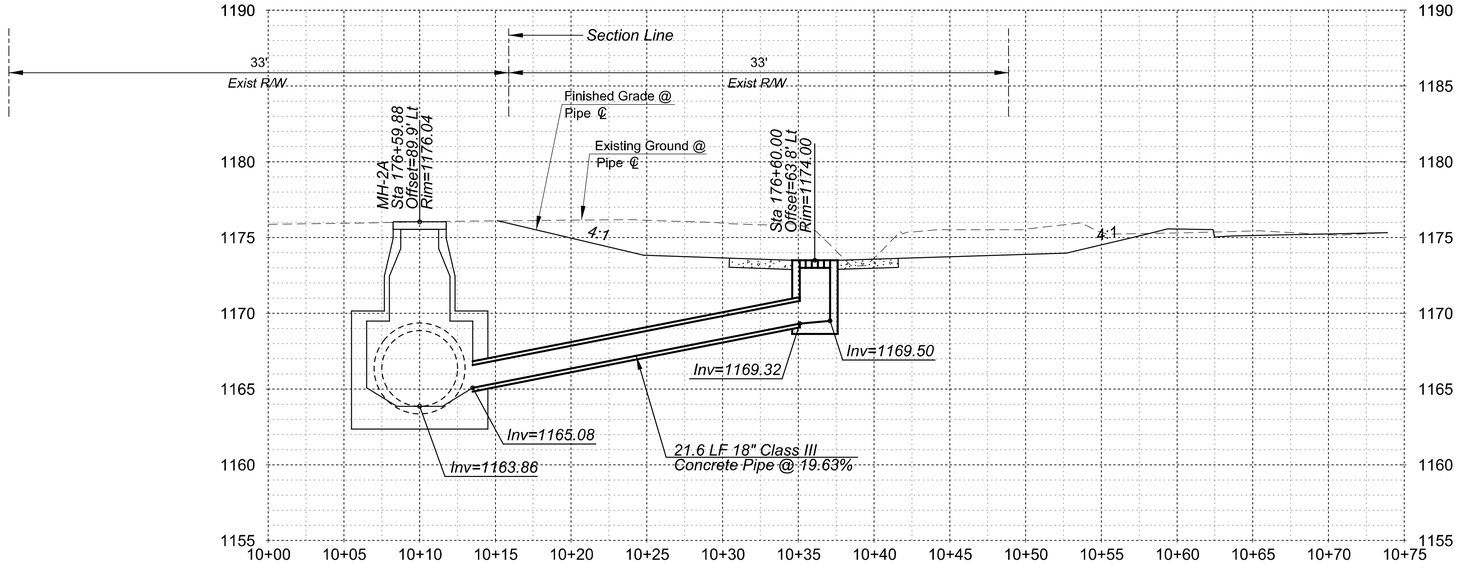


SARIVAL AVENUE
STA 25+35.00



OLIVE AVENUE
STA 176+60.00

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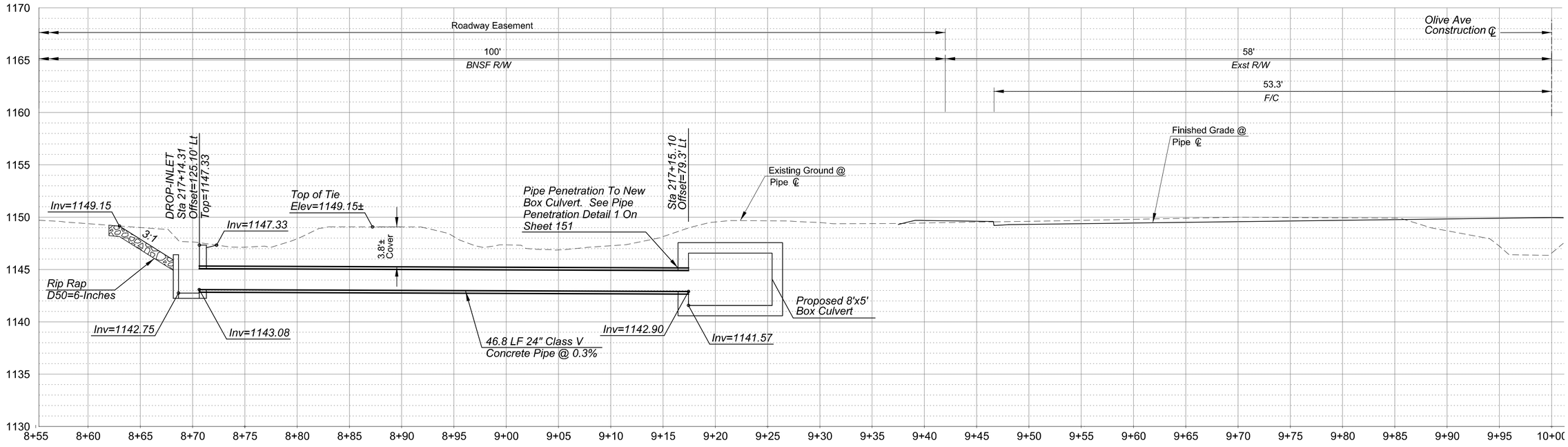

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STA 217+16.43

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SHEET
136 OF 199

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
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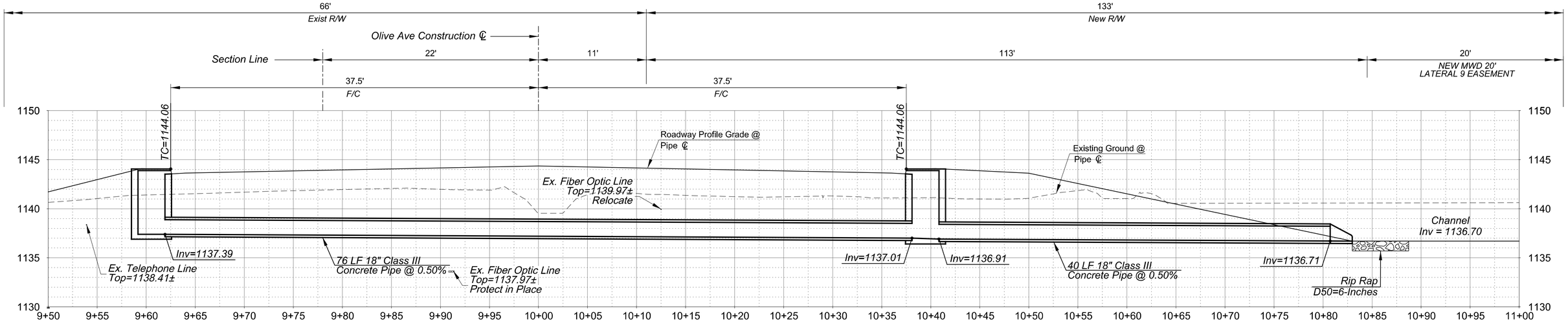
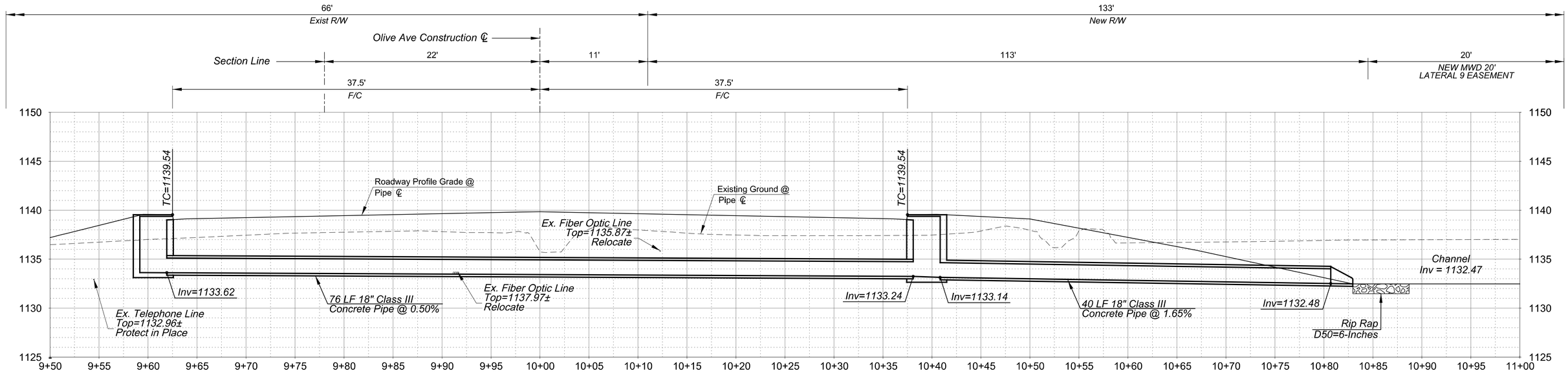


OLIVE AVENUE

STA 228+40.00



OLIVE AVENUE

STA 236+40.00

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MARICOPA COUNTY
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OLIVE AVENUE
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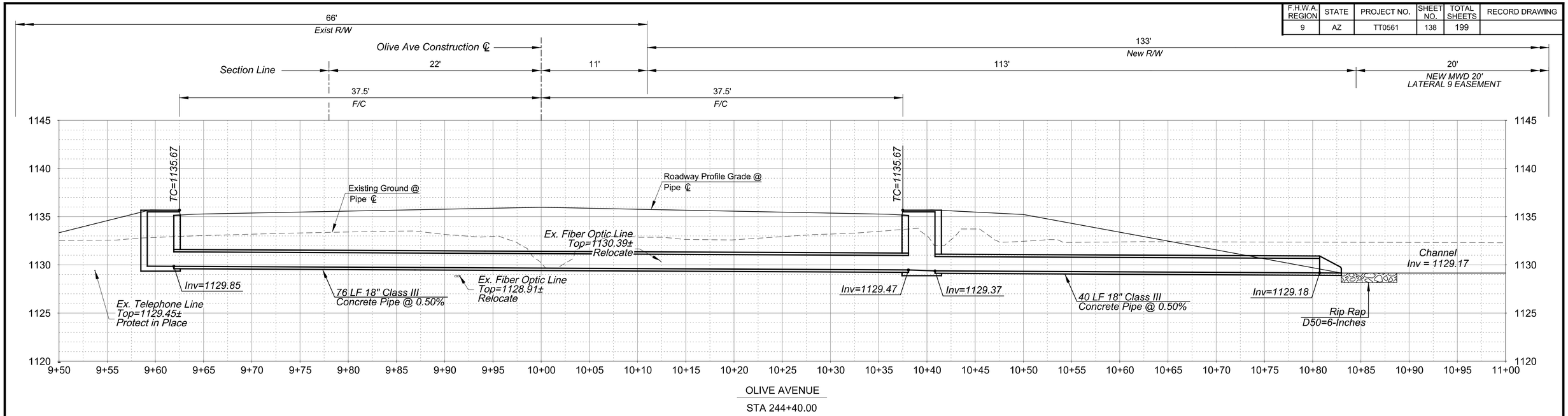
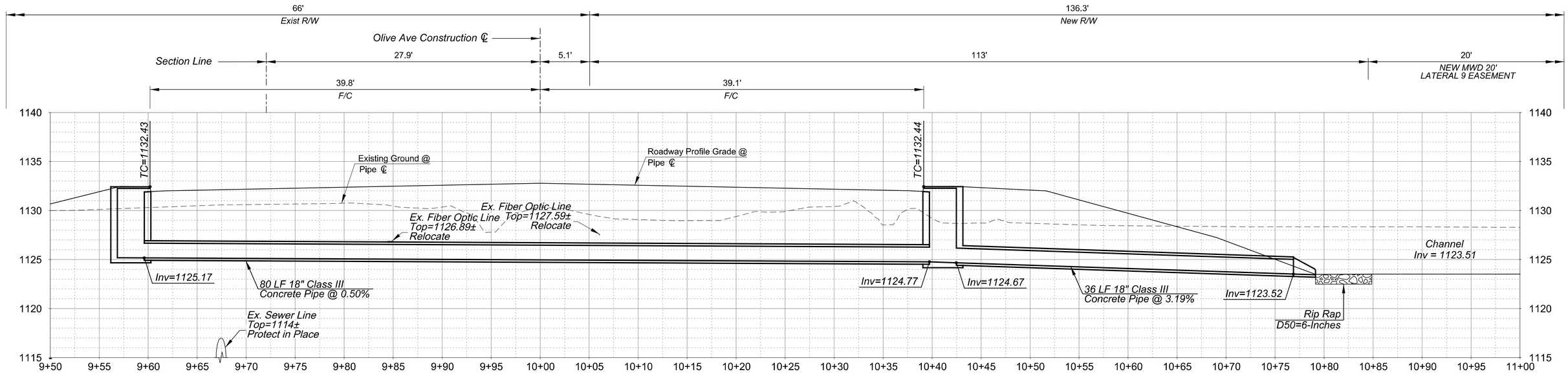


OLIVE AVENUE

STA 244+40.00



OLIVE AVENUE

STA 252+40.00

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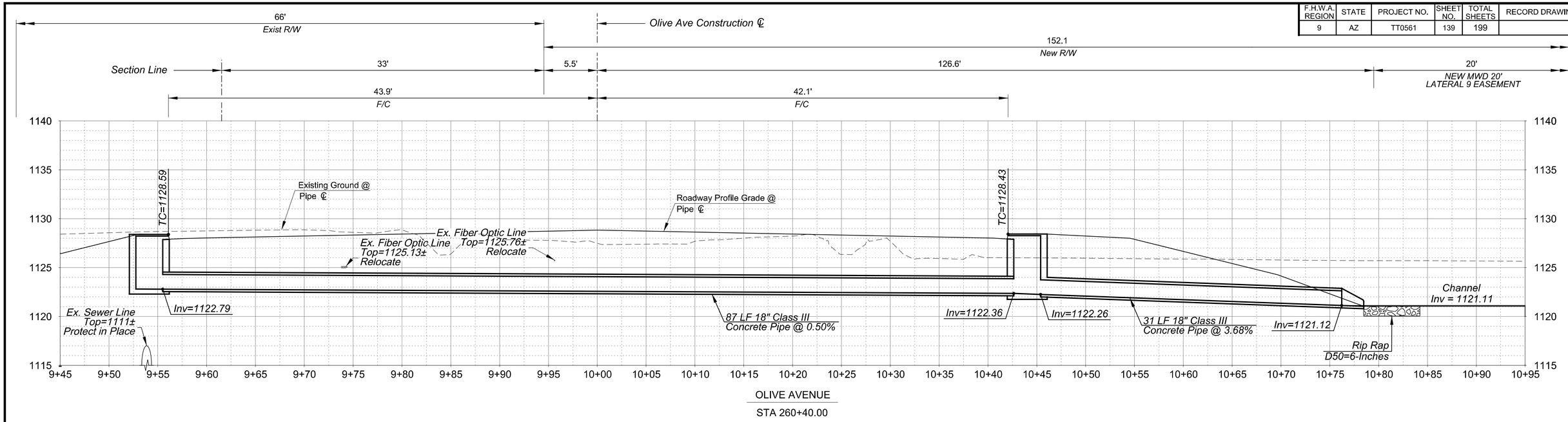
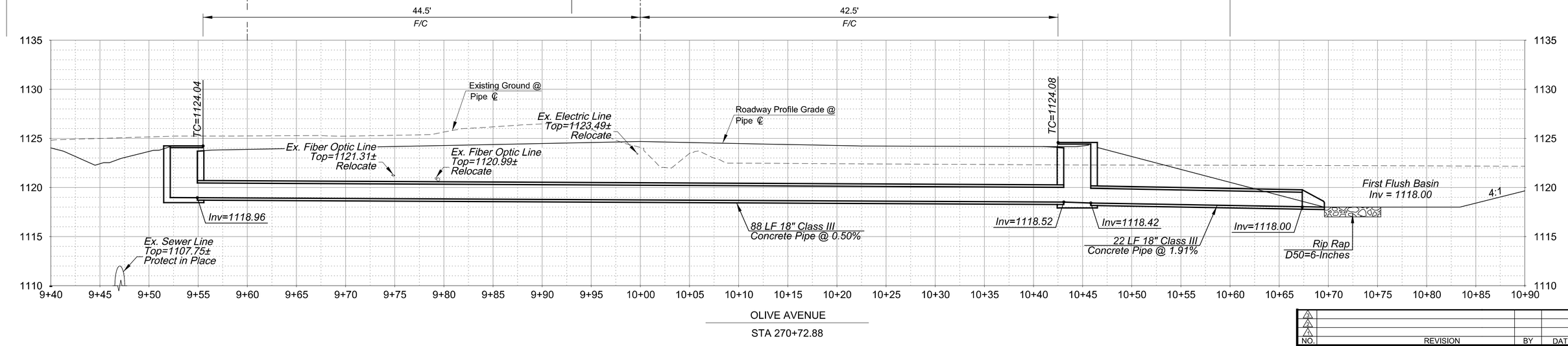


OLIVE AVENUE

STA 260+40.00



OLIVE AVENUE

STA 270+72.88

NO.	REVISION	BY	DATE
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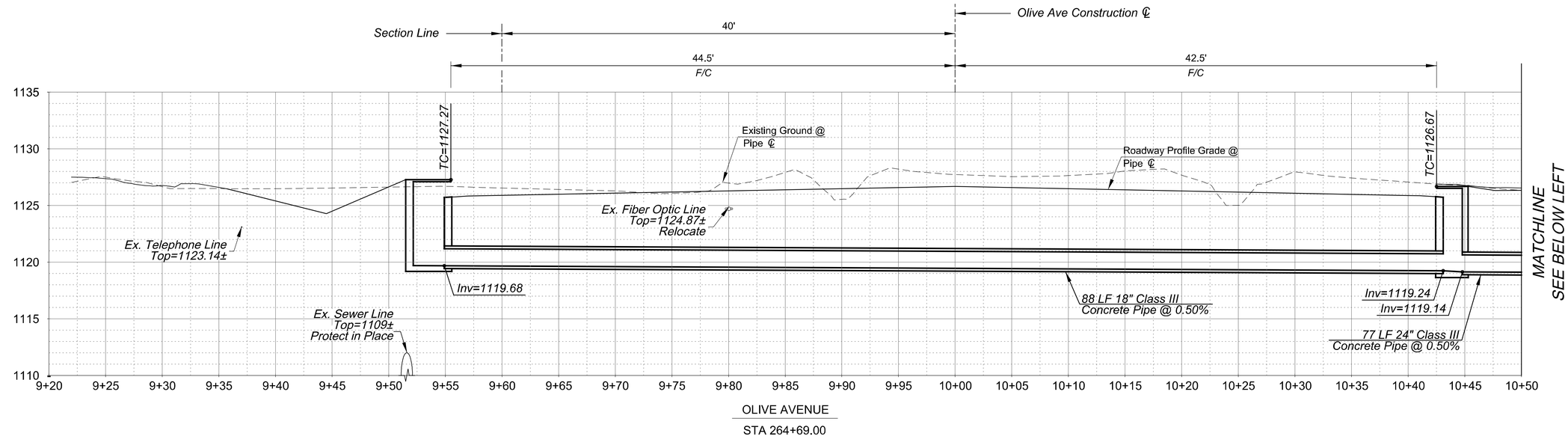
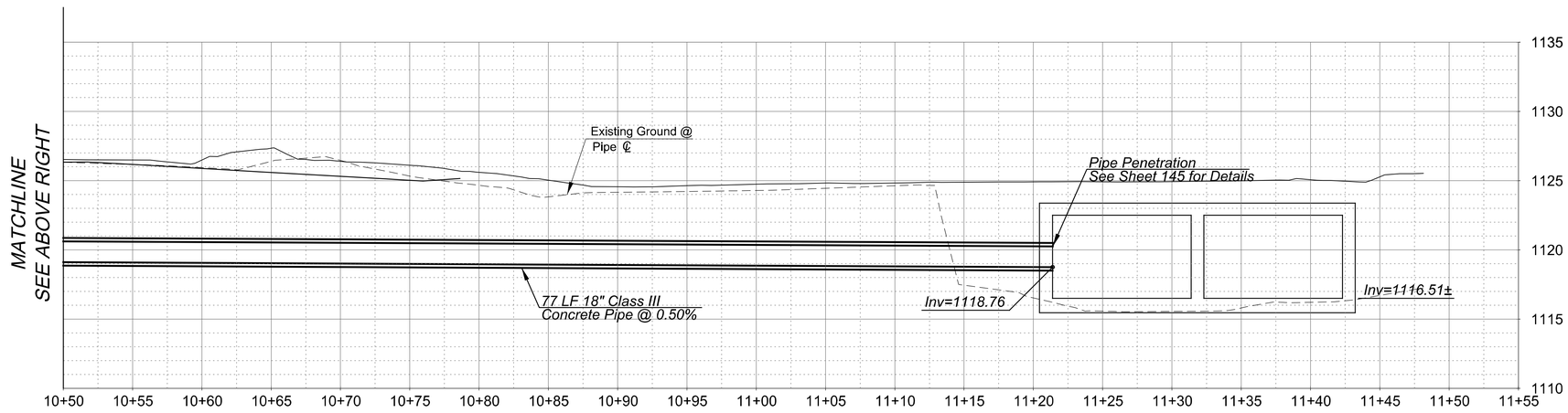


OLIVE AVENUE

STA 264+69.00



OLIVE AVENUE

STA 264+69.00

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MARICOPA COUNTY
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SR 303L TO REEMS ROAD
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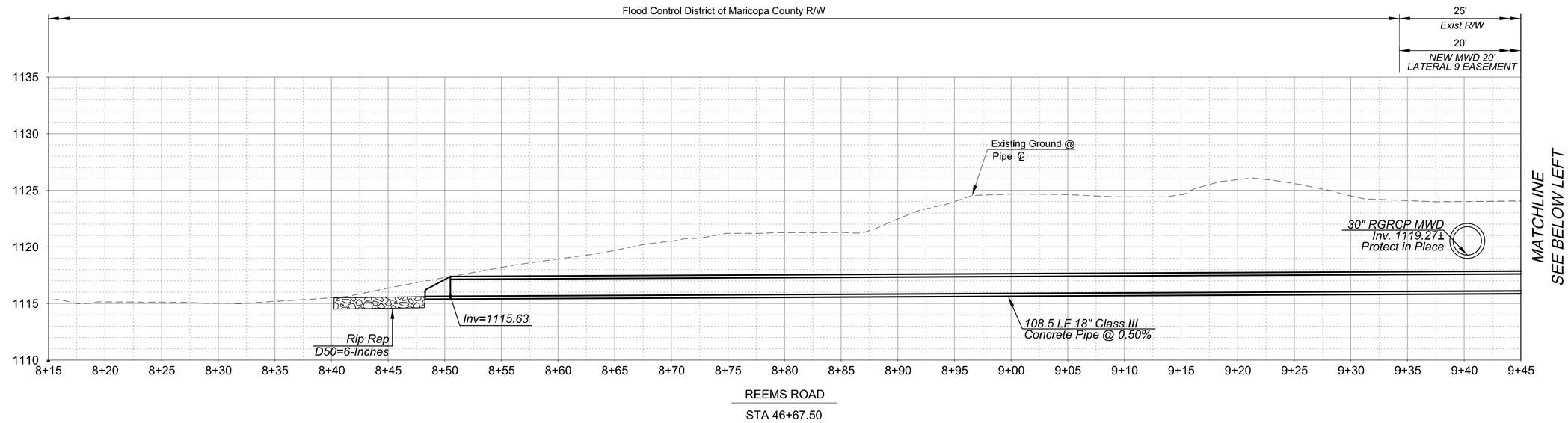

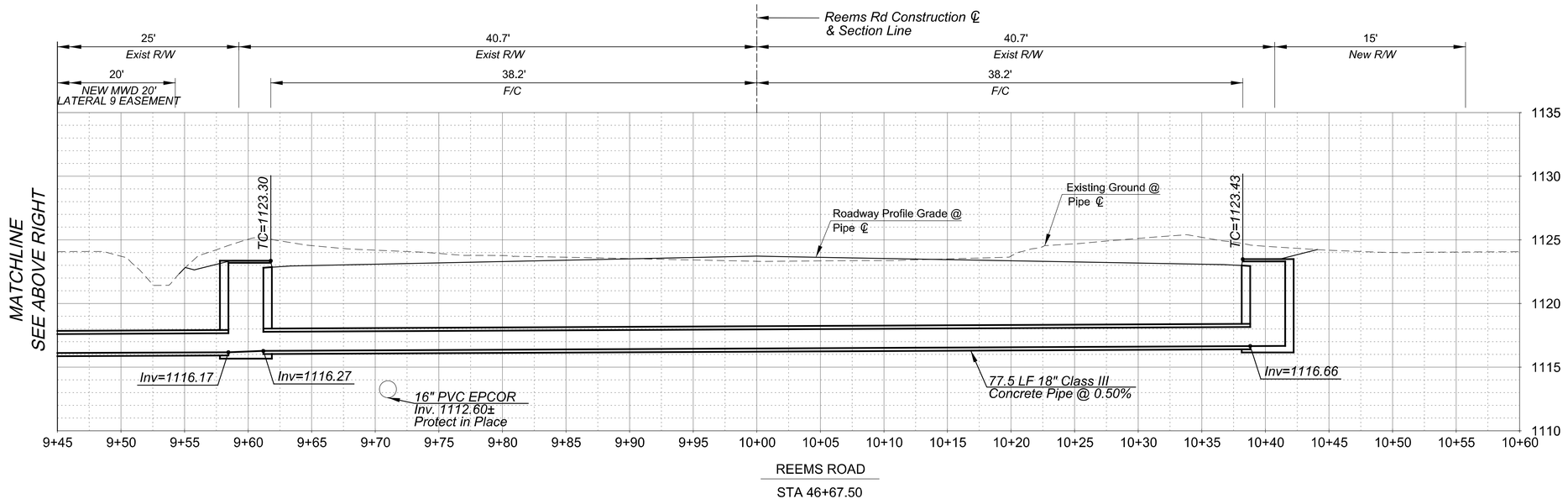

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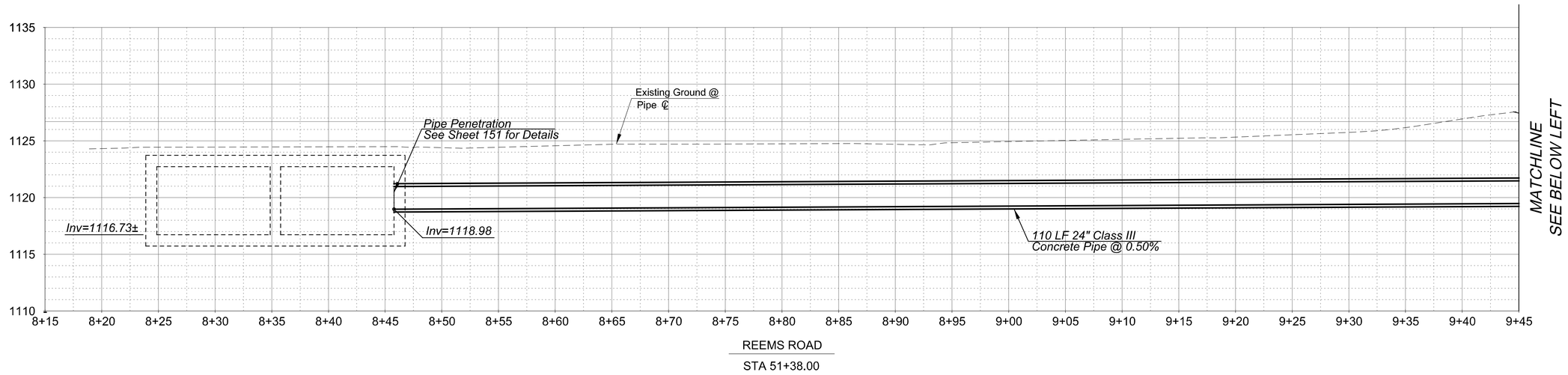

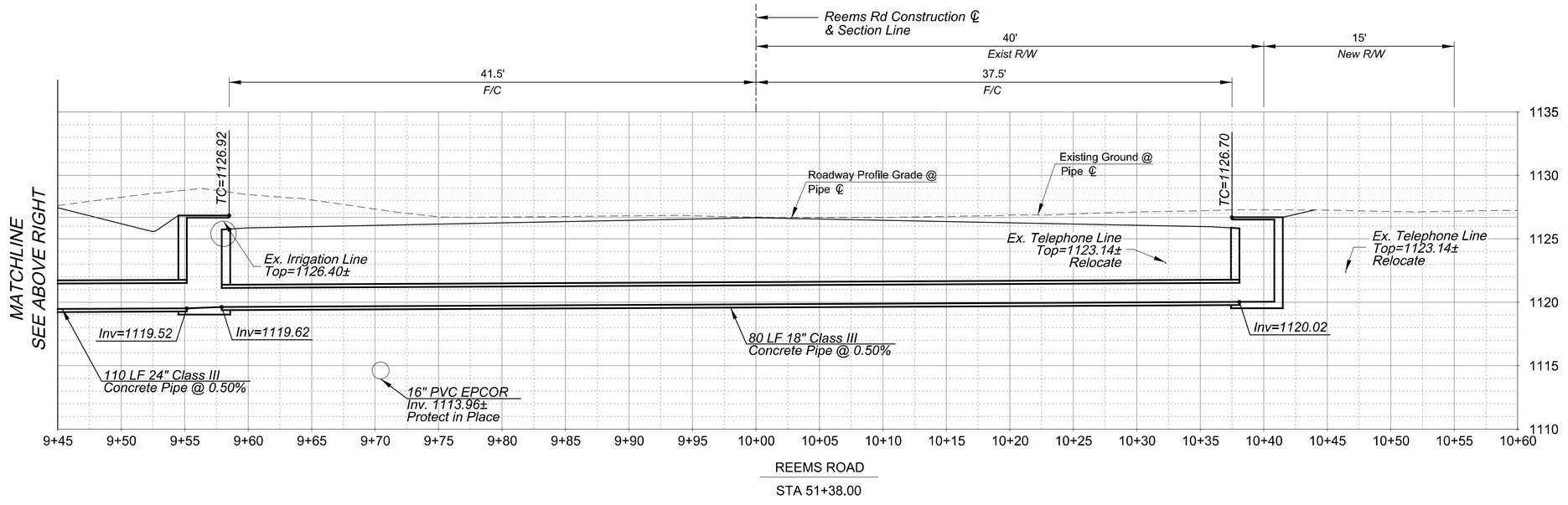

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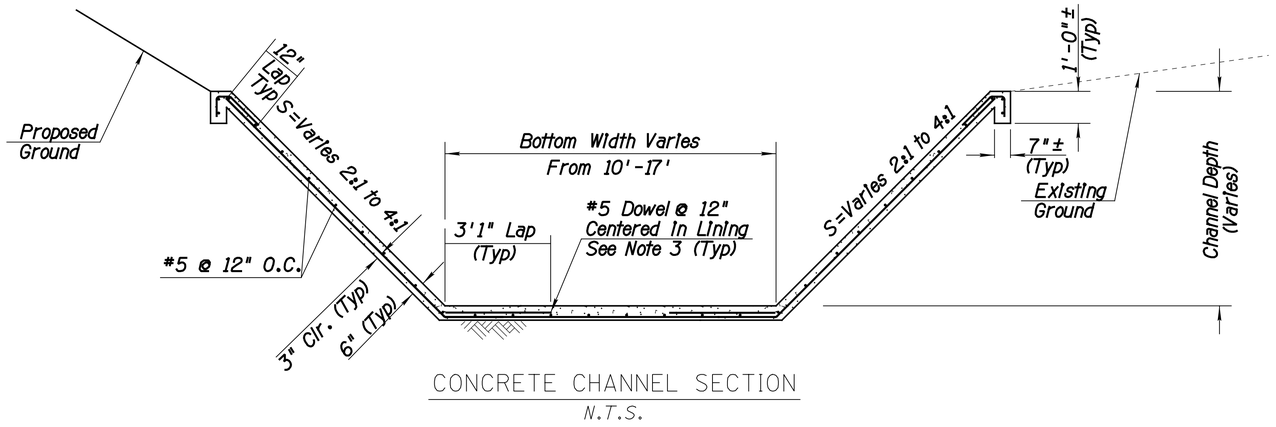
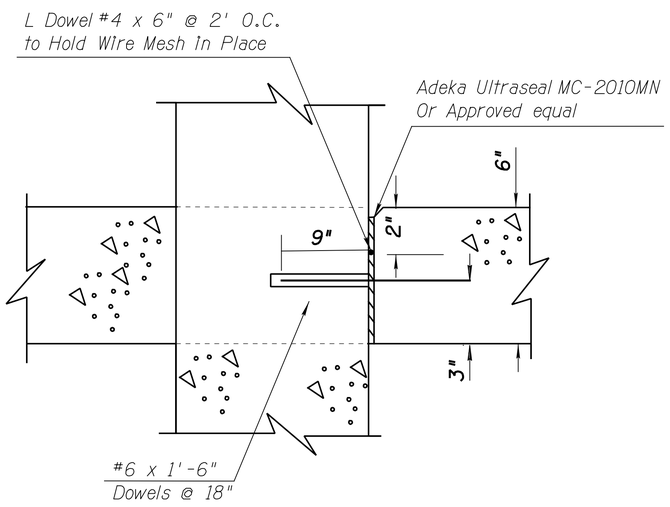


CONCRETE CHANNEL SECTION

N.T.S.

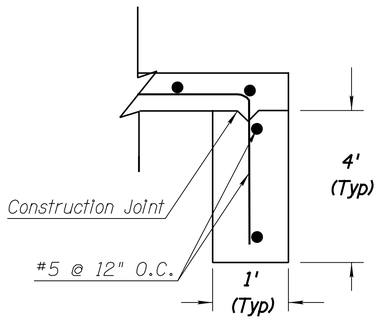
Olive Ave Offsite Channel Depths		
From Channel Const ℄ Station	To Channel Const C Station	Depth
166+70.55	167+20.77	3.0'±

BNSF Offsite Channel Depths		
From Channel Const ℄ Station	To Channel Const ℄ Station	Depth
1007+55.64	1008+07.44	3.3'± to 4'±
1008+40.75	1009+03.76	6'± to 8'±



BOX CULVERT CONNECTION TO CONCRETE CHANNEL

N.T.S.



CONCRETE CUTOFF WALL

N.T.S.

NOTES:

1) All construction shall conform to MAG Standard Details and Specifications, Dated 2020, including all revisions thru 2023.

2) Design specification IBC 2009, ACI 318-14, ASCE 7-10.

3) All reinforcing steel placement dimensions shall be to the center of bars unless otherwise noted.

4) All reinforcing steel shall have 2" clear cover minimum unless otherwise noted.

5) Chamfer all exposed corners 3/4".

6) Concrete compressive strength shall be 3,000 PSI MAG Class A.

7) Reinforcement shall conform to ASTM Specification A615. All reinforcement shall be furnished as Grade 60 (Fy=60 KSI).

8) Stresses: Concrete - f'c=3000 PSI minimum
Steel Reinforcement - fy=60000 PSI

9) Surface of construction concrete shall have a Class I finish in accordance with MAG Standard Specification 505 with a broom finish.

10) Structural backfill and over-excavated areas under the concrete channel shall be compacted to 95% of standard proctor.

11) Embed #6 dowel in a drilled hole with an approved epoxy adhesive. Epoxy anchorage shall develop a min. tensile pullout strength of 13 kips.

12) Construction joints shall be 20' max with expansion joints every 50' max. Before construction, submit to engineer locations of joints 1 week prior to construction.

13) Inlet cutoff walls are to be 4-feet deep per ADOT SD 6.01 (Sheet 2 of 5) as shown on plans.

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
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CONSTRUCTION



SCALE: Hor: 1"=20'
Vert: 1"=2'

20 0 20 40
SCALE IN FEET

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OLIVE AVENUE
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DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J.BARR	04/2023

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CHANNEL DETAIL SHEET

SHEET 143 OF 199

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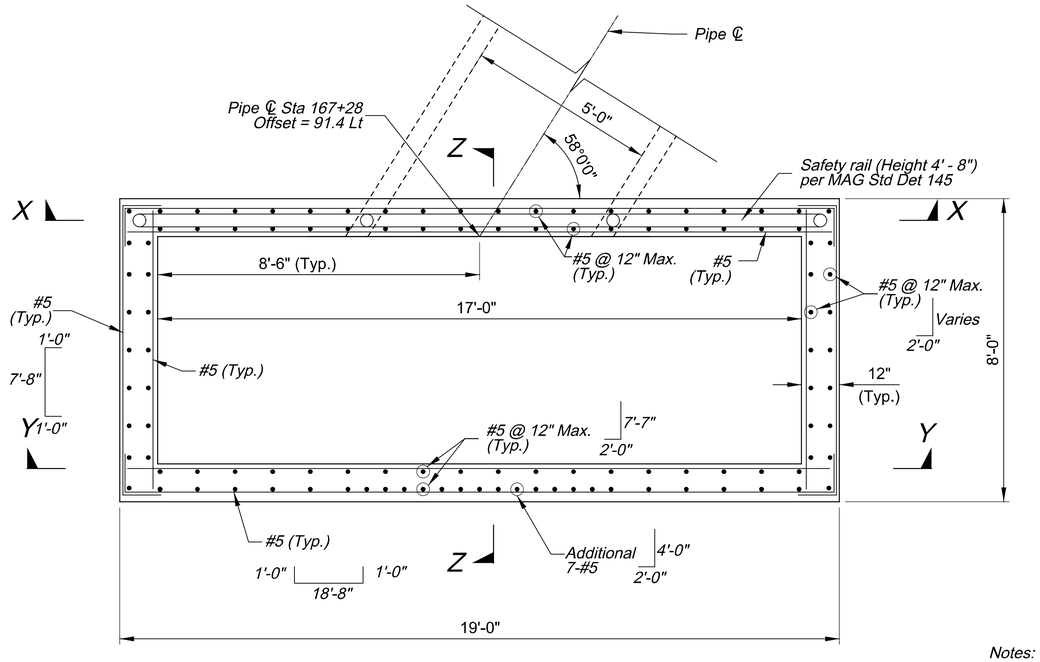
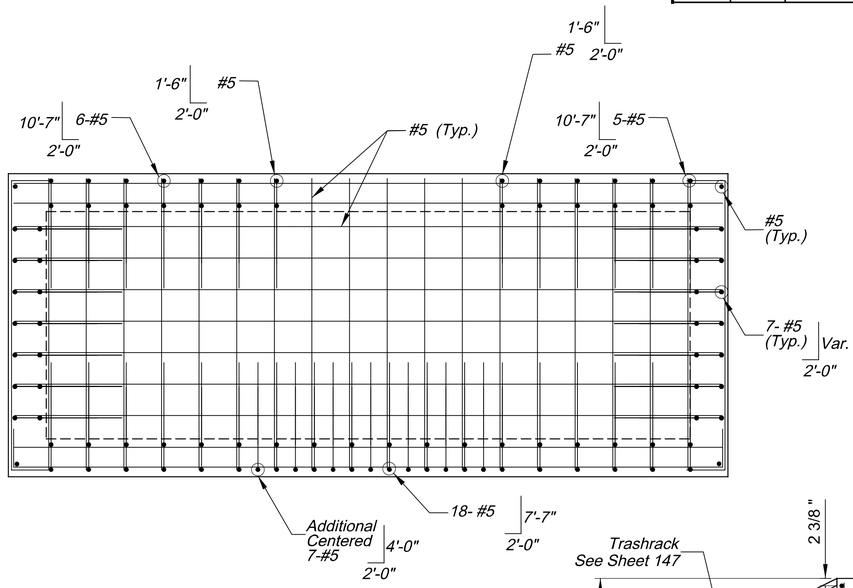


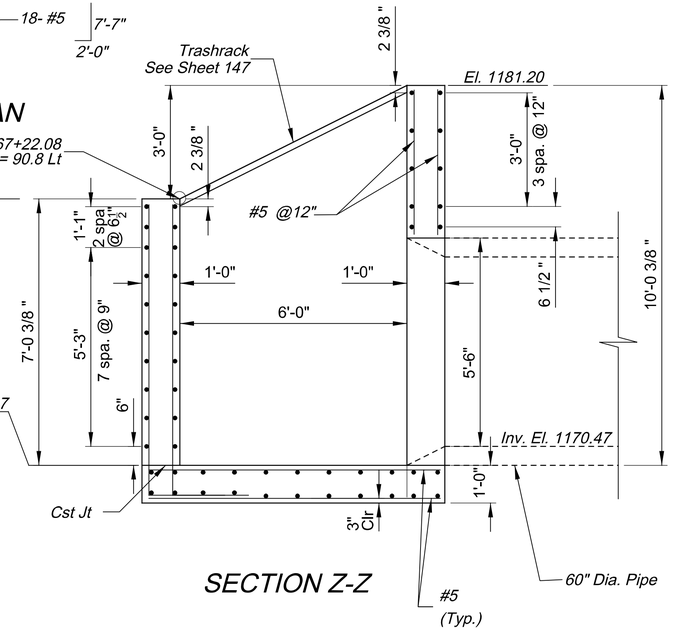
DROP INLET DETAIL
STA 167+22.08



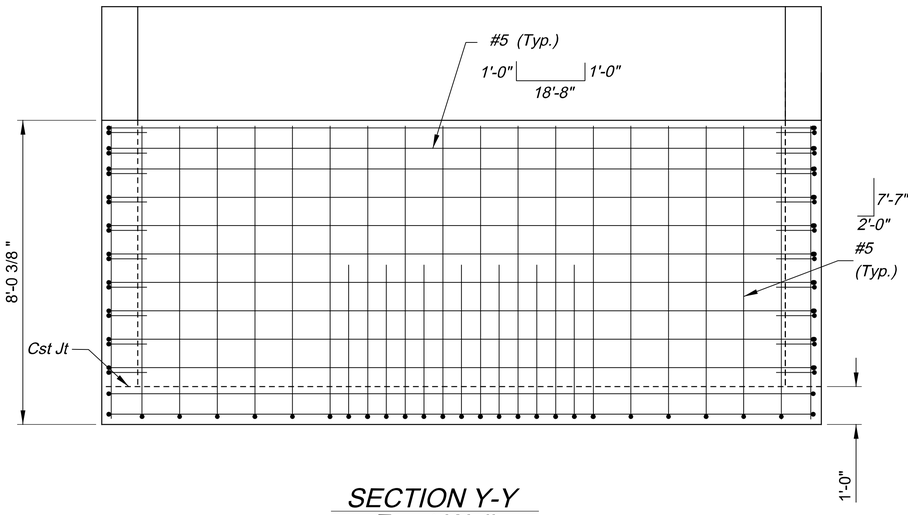
FOOTING PLAN

Notes:

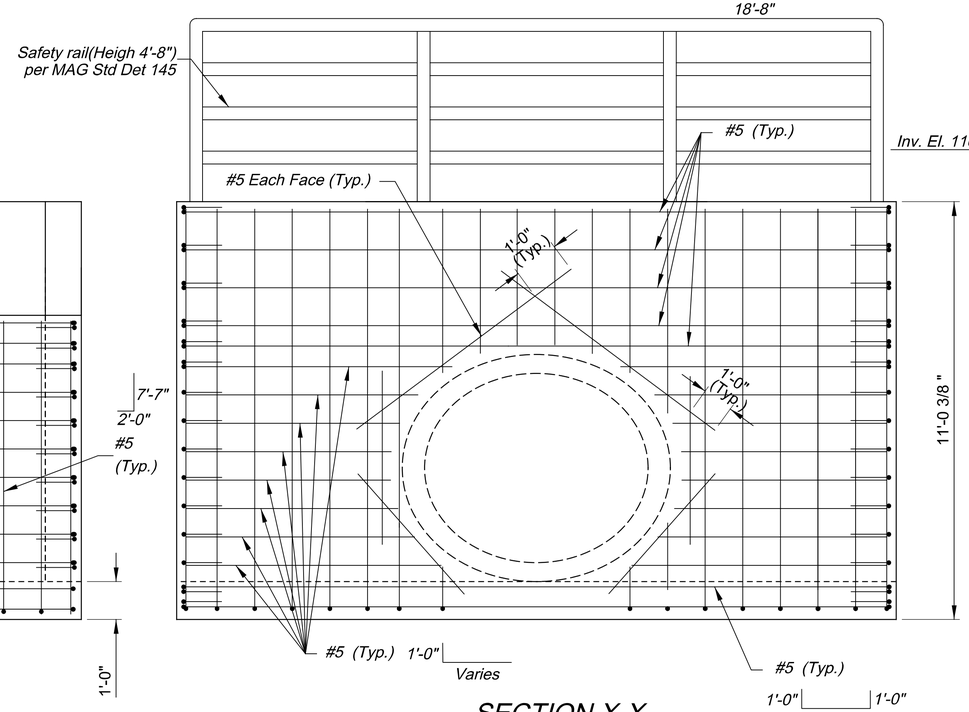
1. All concrete shall be Class 'A' per Sect. 725. f`c =3,000 psi (min)
2. All reinforcing bars shall be ASTM Specification A615, Grade 60.
No. 5, 12" C to C and 2" clear unless otherwise noted.



SECTION Z-Z



SECTION Y-Y
Front Wall



SECTION X-X
Back Wall

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CHECKED	Z. UMICEVIC	04/2023

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DRAINAGE DETAIL SHEET

SHEET
144 OF 199

4/21/2023 9:57:11 AM
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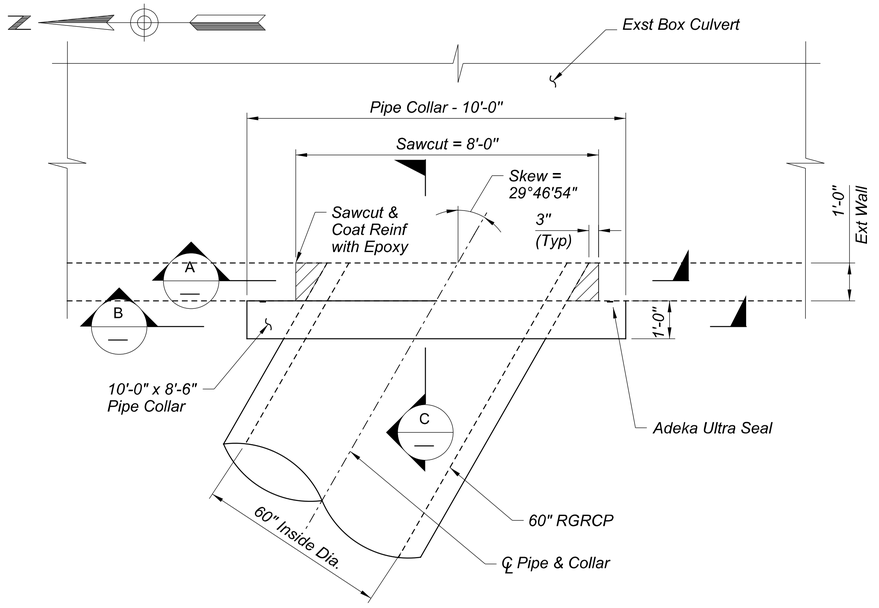
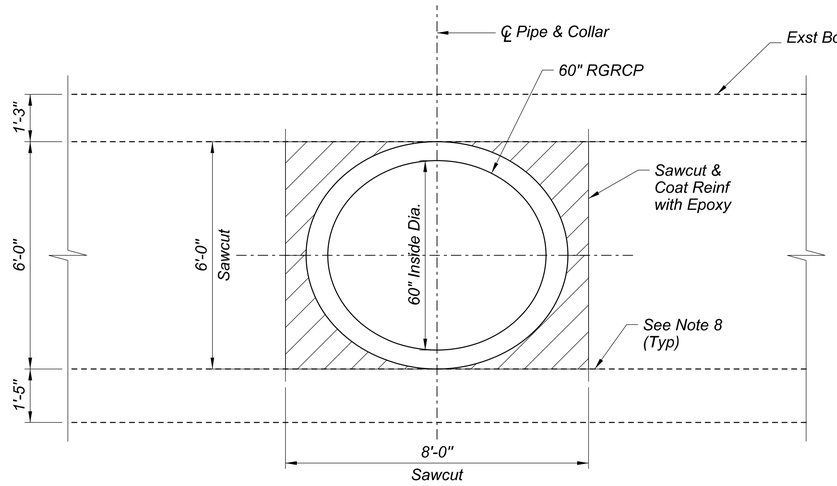
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	145	199	



OLIVE AVENUE STA 186+74.98 ON SHEET 88

60" RGRCP CONNECTION TO EXISTING BOX CULVERT PLAN

SCALE: 1/2" = 1'-0"
Note: Box reinforcing not shown for clarity



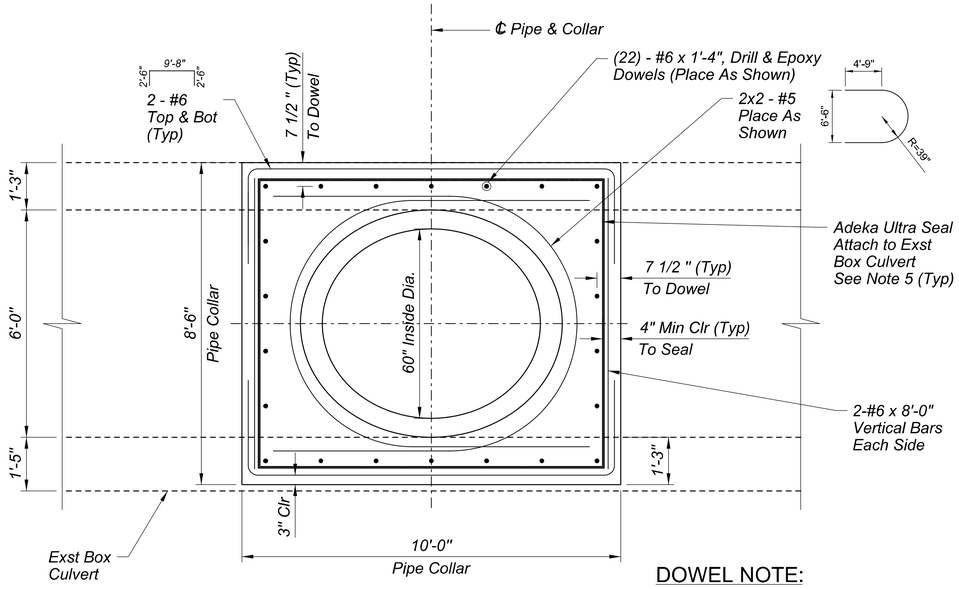
SECTION A

SCALE: 1/2" = 1'-0"

Indicates new fill concrete for sawcut opening between new pipe and existing wall.

GENERAL NOTES:

1. *Design Specification - AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020.*
2. *Design Load: Dead Load = 8 feet Vertical Soil. Unit Weight = 125PCF Live Load = None*
3. *All concrete for pipe collar /connection to existing reinforced concrete box culvert shall be Class "A", f'c = 3000psi, minimum.*
4. *All reinforcing steel shall be ASTM A615, Grade 60.*
5. *Adeka Ultra Seal MC - 2010 MN Waterstop (or approval equal) shall be installed per manufacture requirements. Adeka P-201 (or approval equal) may be required to fill gaps in existing concrete.*
6. *Chamfer all exposed concrete corners 3/4", unless noted otherwise.*
7. *All reinforcing shall have 2" clear cover, unless noted otherwise.*
8. *Seal sawcut overturns with an approval epoxy.*

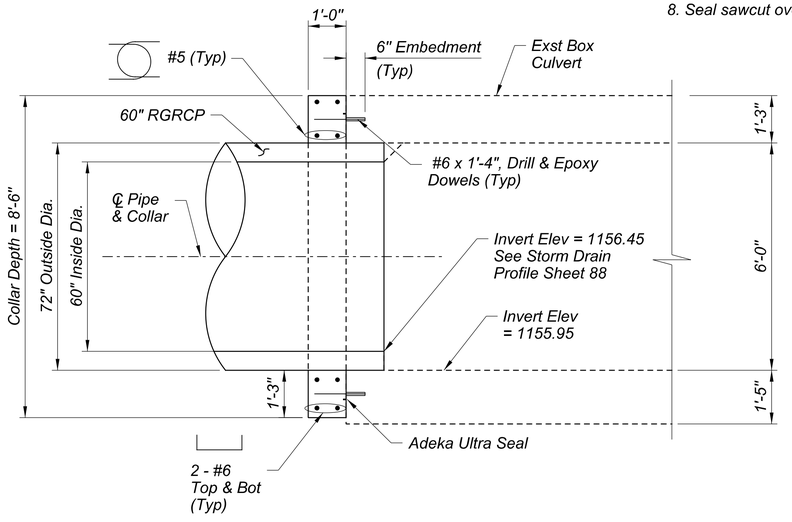


SECTION B

SCALE: 1/2" = 1'-0"

DOWEL NOTE:

#6 dowel shall have minimun 6 inch effective embedment with approved epoxy adhesive. The epoxy adhesive shall have minimun 1,450 psi cracked bond strength. The drilled hole diameter and installation shall be based on manufacturer's requirements. Details of the anchorage system shall be submitted to the Engineer for approval prior to instllation.



SECTION C

SCALE: 1/2" = 1'-0"

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
1			
2			
3			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	A. OUYANG	04/2023
DRAWN	A. OUYANG	04/2023
CHECKED	J. PYNE	04/2023

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DRAINAGE DETAIL SHEET

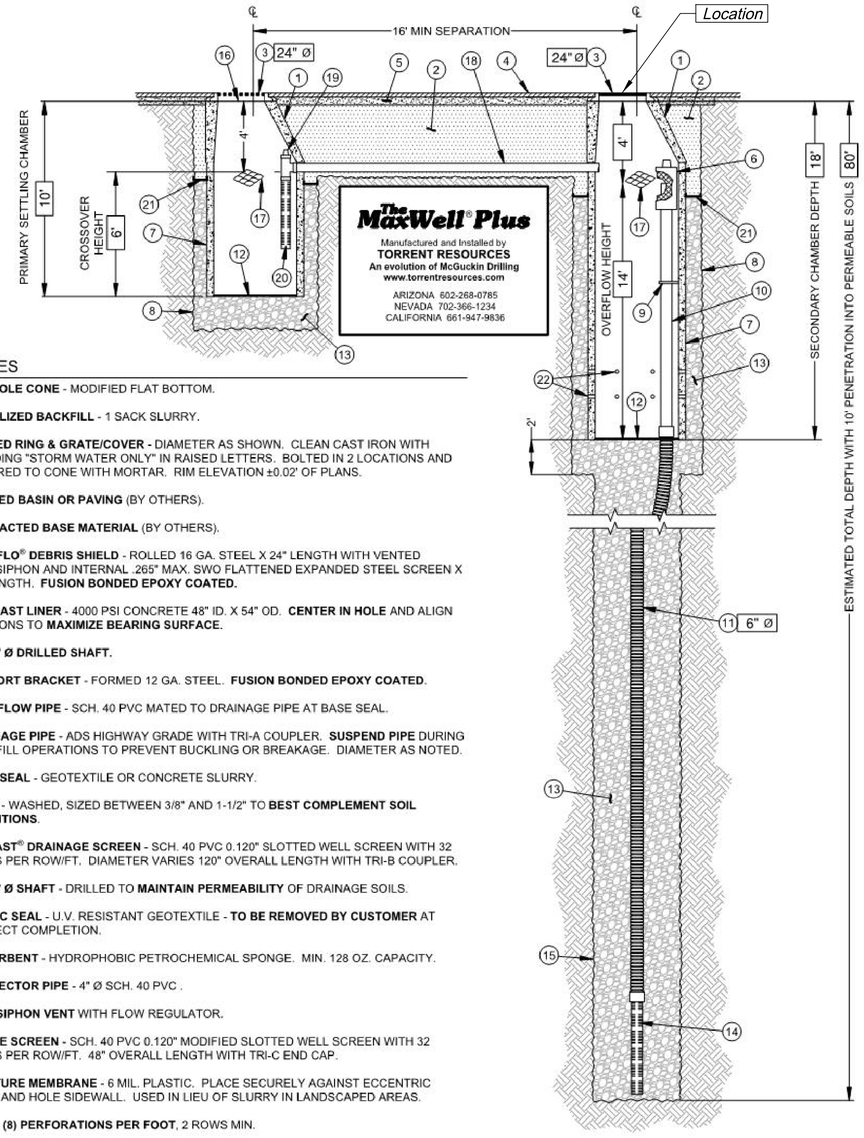
SHEET 145 OF 199

4/21/2023 9:57:12 AM T:\Tempe\Projects\221892.00\500_DSGN\dgn\TT0561_SC_Drainage_Detail+02.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	146	199	

Olive Avenue Project - Maricopa County, AZ

The MaxWell® Plus Drainage System Detail And Specifications



NOTES

1. **MANHOLE CONE** - MODIFIED FLAT BOTTOM.
2. **STABILIZED BACKFILL** - 1 SACK SLURRY.
3. **BOLTED RING & GRATE/COVER -** DIAMETER AS SHOWN. CLEAN CAST IRON WITH WORDING "STORM WATER ONLY" IN RAISED LETTERS. BOLTED IN 2 LOCATIONS AND SECURED TO CONE WITH MORTAR. RIM ELEVATION ±0.02' OF PLANS.
4. **GRADED BASIN OR PAVING** (BY OTHERS).
5. **COMPACTED BASE MATERIAL** (BY OTHERS).
6. **PUREFLO® DEBRIS SHIELD** - ROLLED 16 GA. STEEL X 24" LENGTH WITH VENTED ANTI-SIPHON AND INTERNAL .265" MAX. SWO FLATTENED EXPANDED STEEL SCREEN X 12" LENGTH. **FUSION BONDED EPOXY COATED.**
7. **PRE-CAST LINER** - 4000 PSI CONCRETE 48" ID. X 54" OD. **CENTER IN HOLE** AND ALIGN SECTIONS TO **MAXIMIZE BEARING SURFACE**.
8. **MIN. 6' Ø DRILLED SHAFT.**
9. **SUPPORT BRACKET** - FORMED 12 GA. STEEL. **FUSION BONDED EPOXY COATED**.
10. **OVERFLOW PIPE** - SCH. 40 PVC MATED TO DRAINAGE PIPE AT BASE SEAL.
11. **DRAINAGE PIPE** - ADS HIGHWAY GRADE WITH TRI-A COUPLER. **SUSPEND PIPE** DURING BACKFILL OPERATIONS TO PREVENT BUCKLING OR BREAKAGE. DIAMETER AS NOTED.
12. **BASE SEAL** - GEOTEXTILE OR CONCRETE SLURRY.
13. **ROCK** - WASHED, SIZED BETWEEN 3/8" AND 1-1/2" TO **BEST COMPLEMENT SOIL CONDITIONS**.
14. **FLOFAST® DRAINAGE SCREEN** - SCH. 40 PVC 0.120" SLOTTED WELL SCREEN WITH 32 SLOTS PER ROW/FT. DIAMETER VARIES 120" OVERALL LENGTH WITH TRI-B COUPLER.
15. **MIN. 4' Ø SHAFT** - DRILLED TO **MAINTAIN PERMEABILITY** OF DRAINAGE SOILS.
16. **FABRIC SEAL** - U.V. RESISTANT GEOTEXTILE - **TO BE REMOVED BY CUSTOMER** AT PROJECT COMPLETION.
17. **ABSORBENT** - HYDROPHOBIC PETROCHEMICAL SPONGE. MIN. 128 OZ. CAPACITY.
18. **CONNECTOR PIPE** - 4" Ø SCH. 40 PVC .
19. **ANTI-SIPHON VENT** WITH FLOW REGULATOR.
20. **INTAKE SCREEN -** SCH. 40 PVC 0.120" MODIFIED SLOTTED WELL SCREEN WITH 32 SLOTS PER ROW/FT. 48" OVERALL LENGTH WITH TRI-C END CAP.
21. **MOISTURE MEMBRANE** - 6 MIL. PLASTIC. PLACE SECURELY AGAINST ECCENTRIC CONE AND HOLE SIDEWALL. USED IN LIEU OF SLURRY IN LANDSCAPED AREAS.
22. **EIGHT (8) PERFORATIONS PER FOOT**, 2 ROWS MIN.

AZ Lic. ROC070485 A, ROC047067 B-4, ADWR 363
CA Lic. 528080, C-42, HAZ,
NV Lic. 0035350 A - NM Lic. 90504 GF04
U.S. Patent No. 4,923,330 - ™ Trademark 1974, 1990, 2004

AZ MAXWELL PLUS

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NO.	REVISION	BY	DATE
3			
2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	Z. UMICEVIC	04/2023
DRAWN	T.JENSEN	04/2023
CHECKED	Z. UMICEVIC	04/2023

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DRYWELL DETAIL SHEET

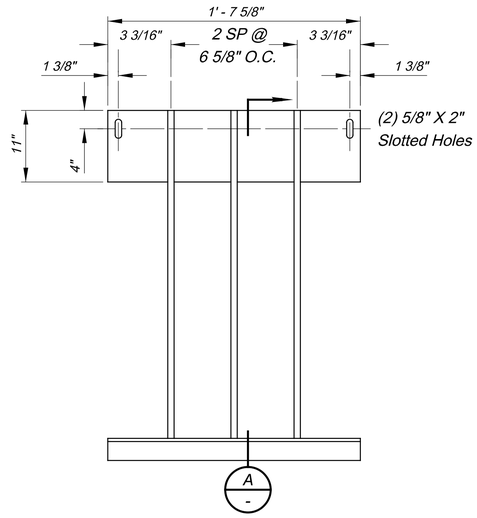
SHEET 146 OF 199

4/21/2023 9:57:13 AM T:\Tempe\Projects\221892.000500_DSGN\dgn\TT0561_SC_Drainage_Detail+03.dgn

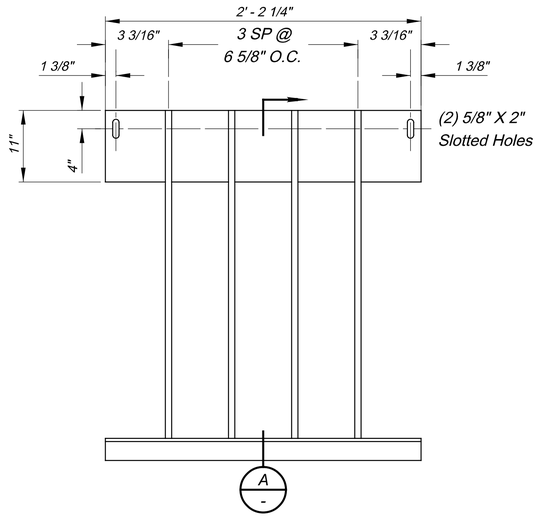
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	147	199	

Trashrack Schedule

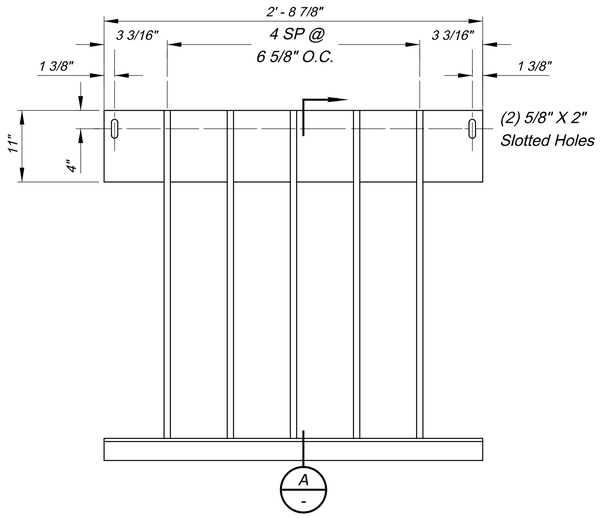
Station	Ref Sheet No.	B	Bar Length	Number Of Panels Required		
				Type 1	Type 2	Type 3
167+25.00	84	6.00'	6.745'	2	--	5



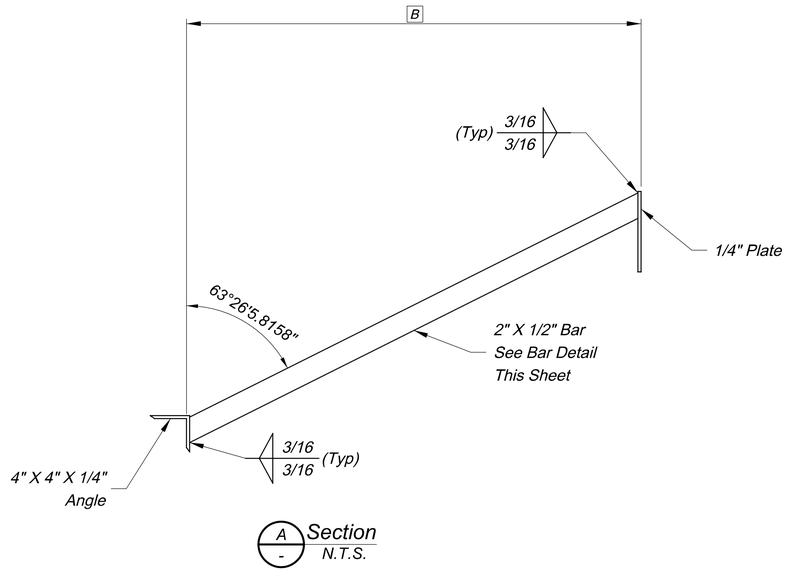
Trashrack Type 1
N.T.S.



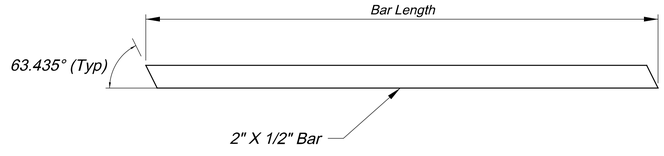
Trashrack Type 2
N.T.S.



Trashrack Type 3
N.T.S.



A - Section
N.T.S.



Bar Detail
N.T.S.

Note:

1) Remove all scale from rock bars. Metal Spray or paint with one coat zinc chrome or red lead primer (industrial quality). Overcoat with grey industrial enamel per MAG Spec. 790.

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602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
3			
2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	J. GRANDY	06/2019
DRAWN	J. GRANDY	06/2019
CHECKED	J .BARR	06/2019

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DROP INLET HEADWALL TRASHRACK

SHEET 147 OF 199

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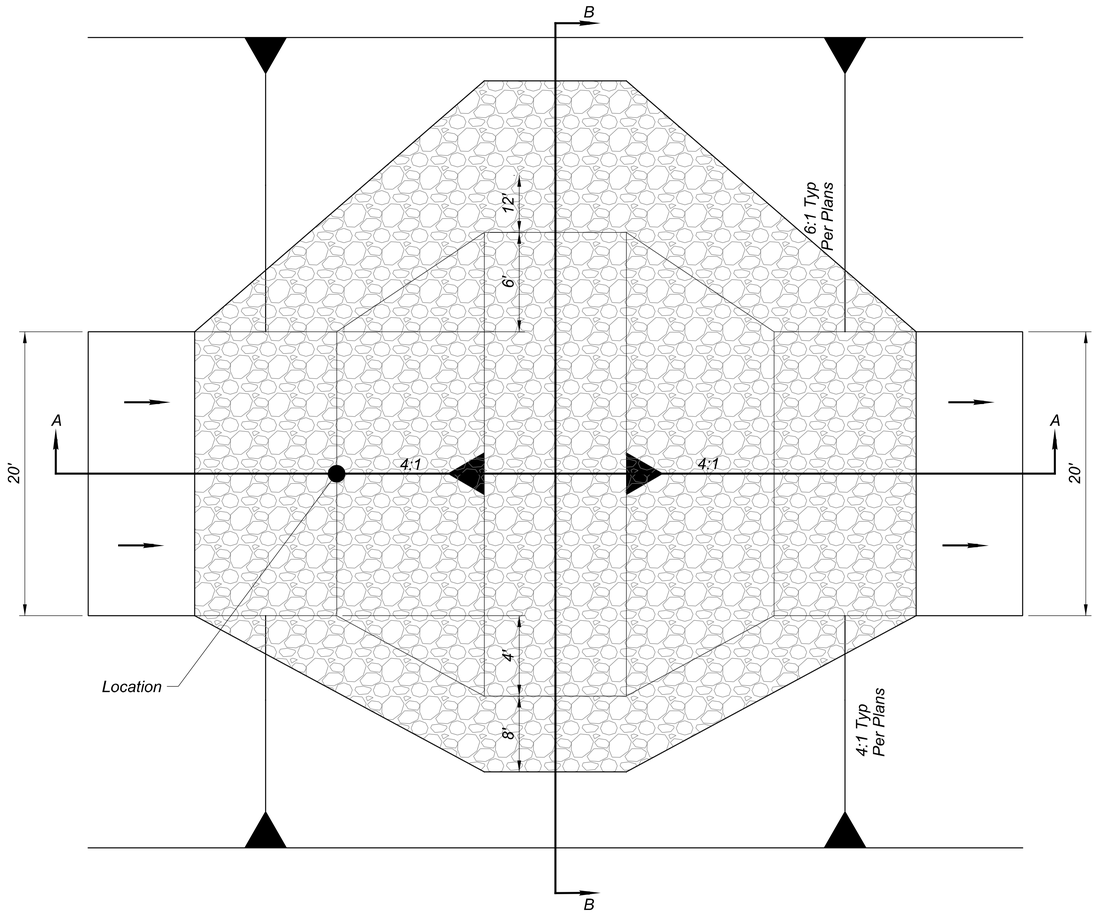
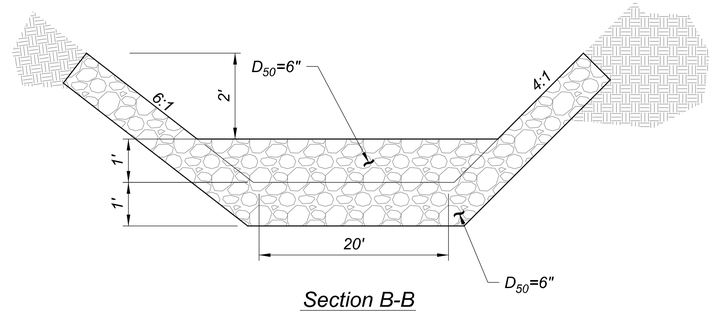
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	148	199	



Plan View
N.T.S.



Section B-B
N.T.S.

Note: Berm Provides Retention For The Required First Flush Volume For The Adjacent Half-street Runoff.

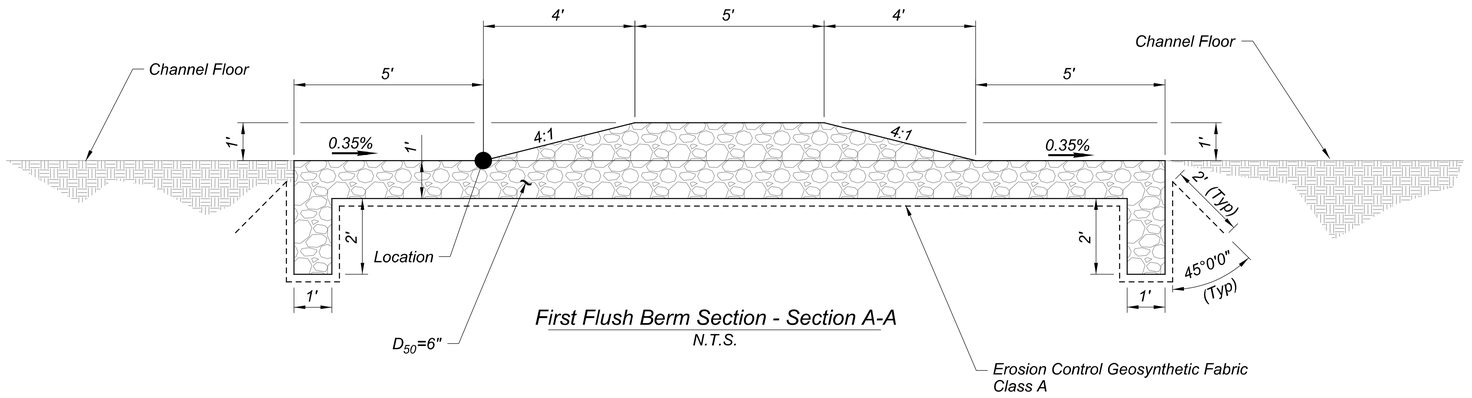
Berm Location Schedule

Berm No	Station (Olive Ave/Channel ℄)	Offset (Olive Ave)	Offset Side	Elev	Quantity (CY)
1A	225+00.00 / 1019+20.00	93.00'	Rt	1139.00'	42
1B	230+06.58 / 1024+25.83	92.96'	Rt	1136.28'	42
2	243+06.58 / 1037+25.83	92.76'	Rt	1129.80'	42
3	248+07.44 / 1042+25.83	92.73'	Rt	1127.09'	42
4	255+07.68 / 1049+25.83	88.96'	Rt	1122.86'	42
5	261+07.70 / 1055+25.83	88.47'	Rt	1121.06'	42

Recommended Riprap Gradation

% Smaller By Weight	Stone Size Range Ratio Of D_{50}	Stone Size Range Ratio For D_{50}=6" (IN)
100	1.5 * D_{50}	9.0
85	1.2 * D_{50}	7.2
50	1.0 * D_{50}	6.0
15	0.4 * D_{50}	2.4

Note: Minimum Specific Weight=156 lb/cf
Note: Minimum Specific Gravity= 2.5



First Flush Berm Section - Section A-A
N.T.S.

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
3			
2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY
NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C. MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J. BARR	04/2023

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FIRST FLUSH BERM DETAIL SHEET

SHEET 148 OF 199

4/21/2023
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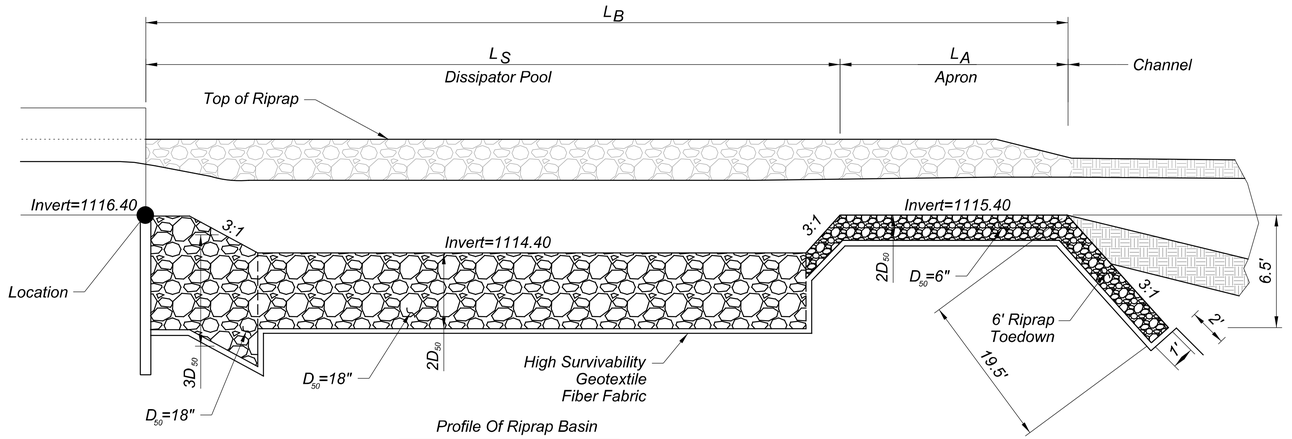
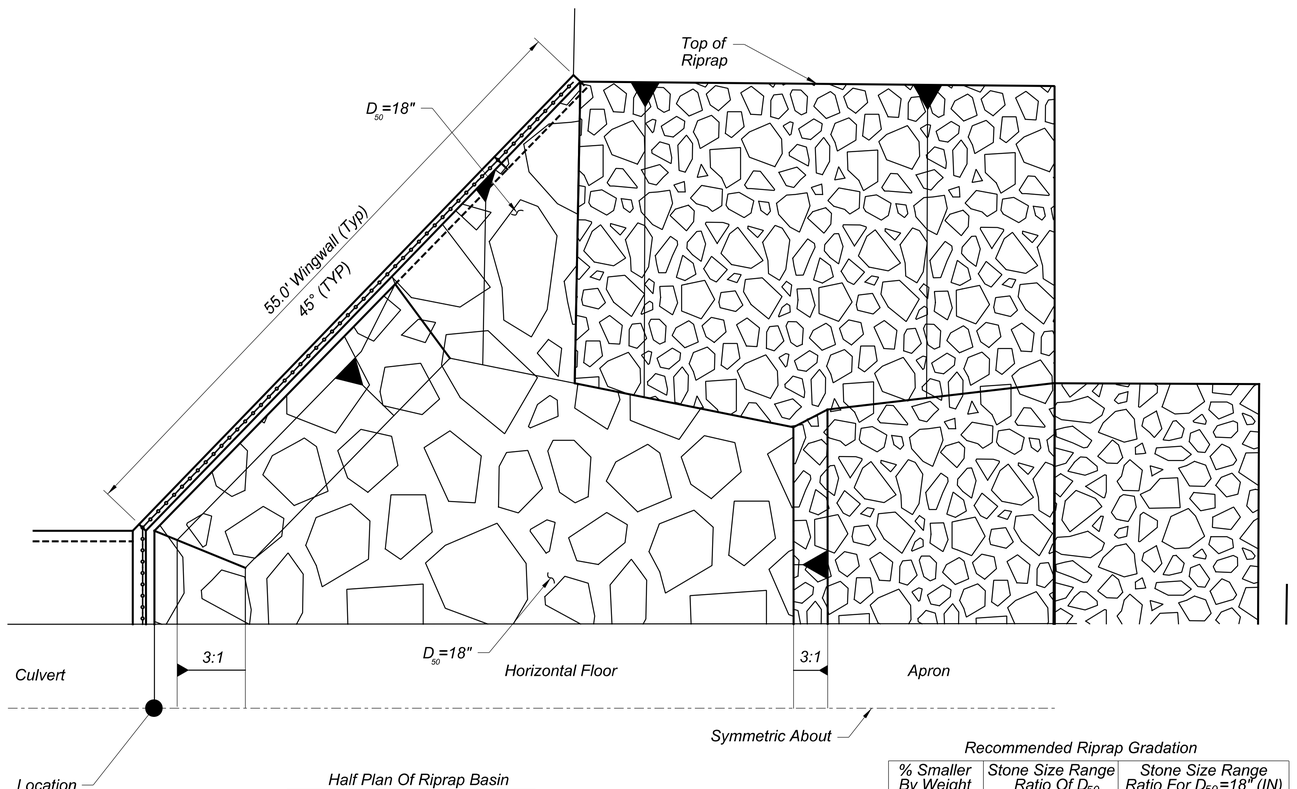
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	149	199	



Profile Of Riprap Basin

N.T.S.



Half Plan Of Riprap Basin

N.T.S.

Riprap Basin Schedule

Apron No	Olive Ave Station	Offset (ft)	Offset Side	L_S (ft)	L_A (ft)	L_B (ft)	Riprap Quantity D_{50}=6" (CY)	Riprap Quantity D_{50}=18" (CY)
1	263+85.49	171.6'	Rt	60'	20'	80'	147	394

Recommended Riprap Gradation

% Smaller By Weight	Stone Size Range Ratio Of D_{50}	Stone Size Range Ratio For D_{50}=18" (IN)
100	1.5 * D_{50}	27.0
85	1.2 * D_{50}	21.6
50	1.0 * D_{50}	18.0
15	0.4 * D_{50}	7.2

Note: Minimum Specific Weight=156 lb/cf
Note: Minimum Specific Gravity= 2.5

Note

1) See sheet 148 for additional riprap basin design and construction details.
2) See sheet 148 for 6" Riprap Gradation.

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
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2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY
NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	C. MILNER, A. HERTING	04/2023
DRAWN	A. SADOW, L. THIELE	04/2023
CHECKED	J. BARR	04/2023

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RIPRAP BASIN DETAIL SHEET

SHEET 149 OF 199

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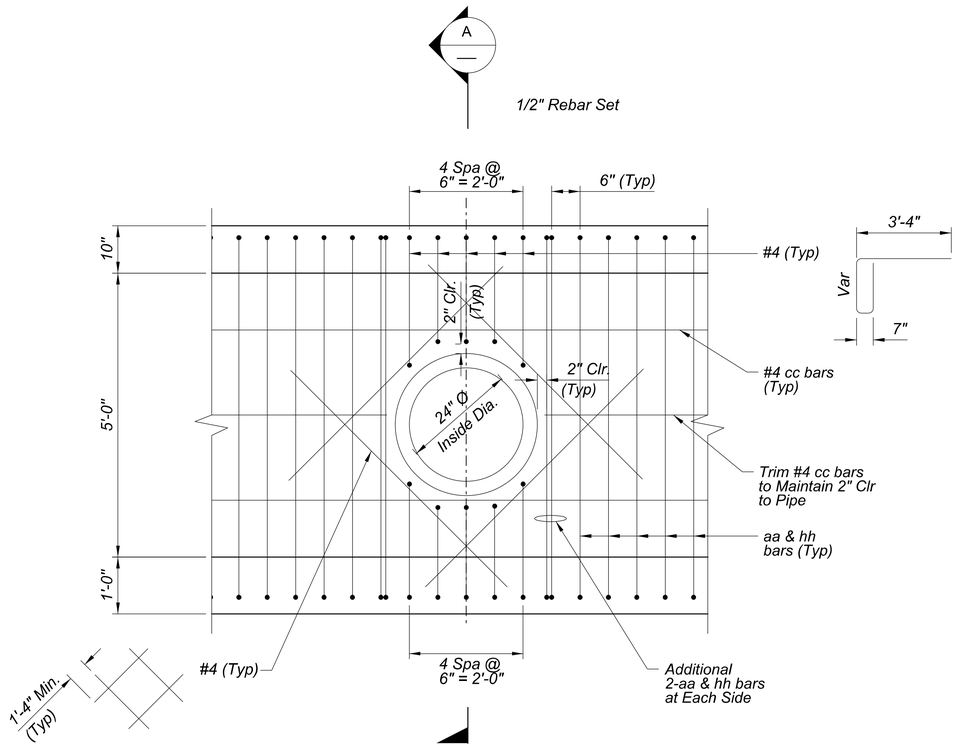
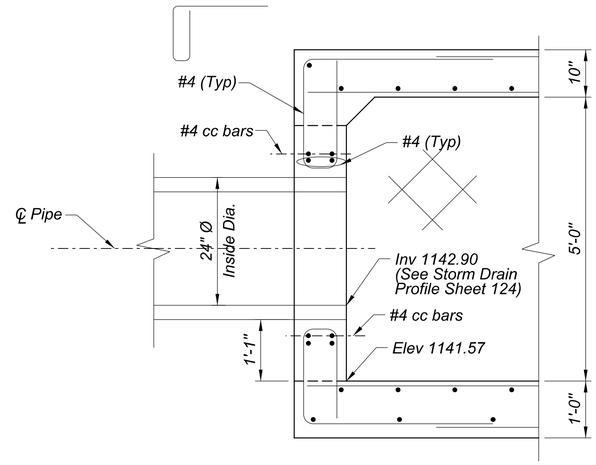
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	151	199	



OLIVE AVENUE STA 217+16.43 ON SHEET 124
24" RGRCP CONNECTION TO NEW BOX CULVERT ELEVATION

SCALE: Not To Scale



SECTION A

SCALE: Not To Scale

NOTE:
See ADOT SD6.02 for more box reinforcing details.

TWO WORKING DAYS BEFORE YOU DIG, CALL
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BLUE STAKE

NO.	REVISION	BY	DATE
3			
2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	A. OUYANG	04/2023
DRAWN	A. OUYANG	04/2023
CHECKED	K. LIM-HOE	04/2023

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PIPE PENETRATION DETAIL 1

SHEET 150 OF 199

4/21/2023 9:57:30 AM
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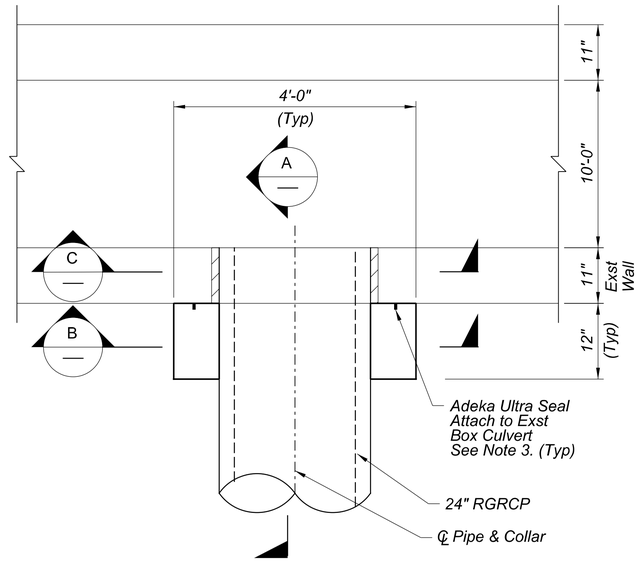
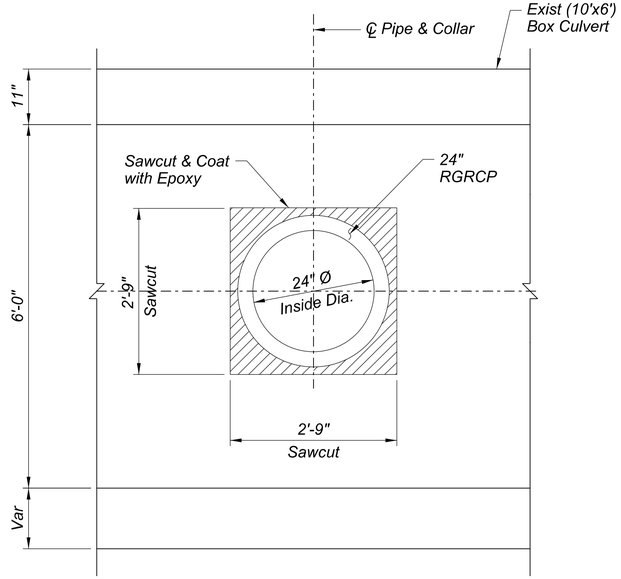
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	151	199	



REEMS ROAD STA 51+38.00 ON SHEET 122
24" RGRCP CONNECTION TO EXISTING BOX CULVERT

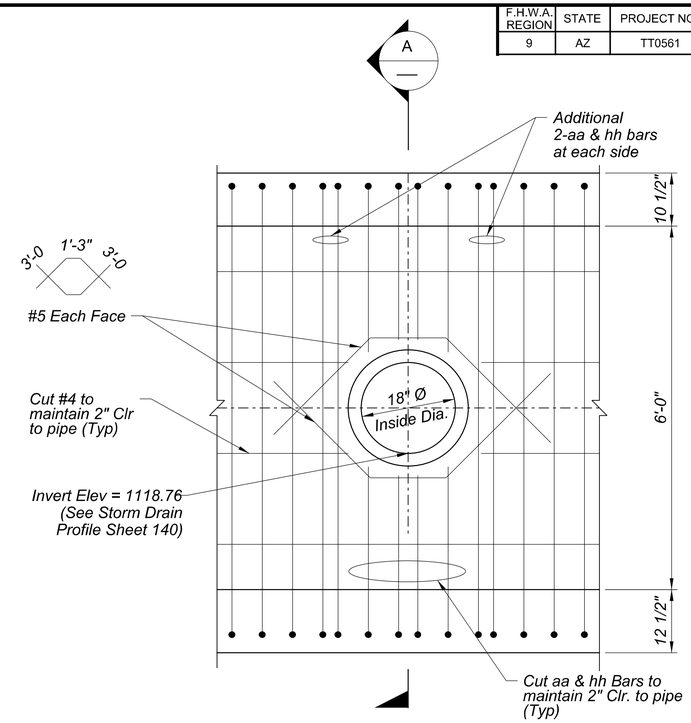
SCALE: Not To Scale

Note: Box reinforcing not shown for clarity.



Indicates new fill concrete for sawcut opening between new pipe and existing wall.

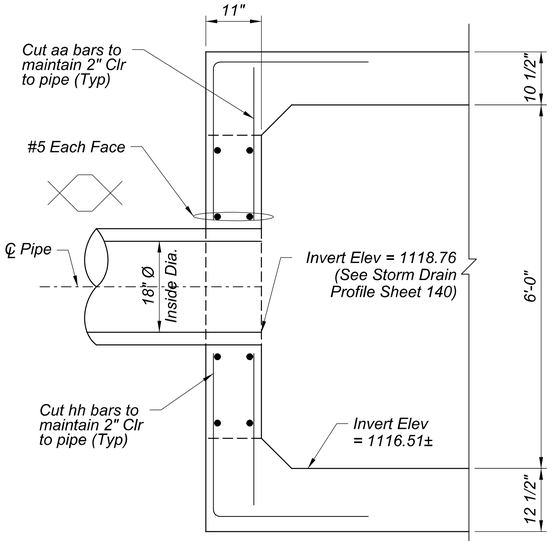
SECTION C
SCALE: Not To Scale



OLIVE AVENUE STA 263+94.07 ON SHEET 109
18" RGRCP CONNECTION TO NEW BOX CULVERT ELEVATION

SCALE: Not To Scale

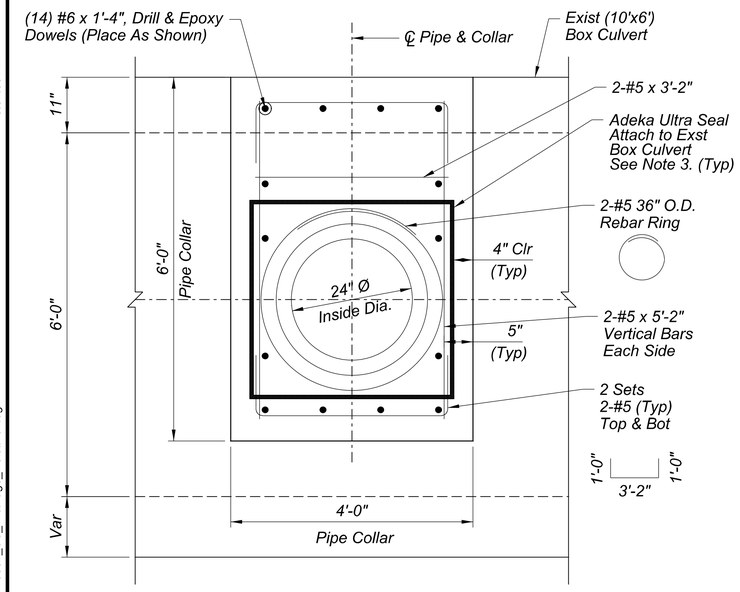
Note: See ADOT SD 6.02 for more box reinforcing details



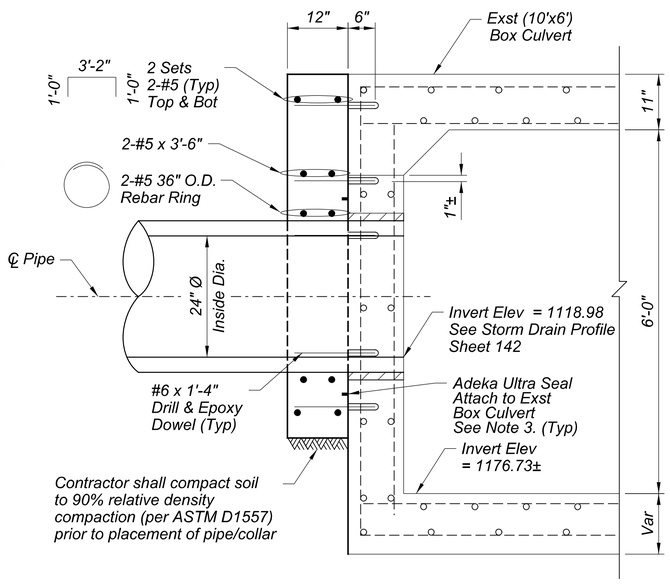
SECTION A
SCALE: Not To Scale

NOTES:

A line (—) in place of the Drawing Number indicates that the SECTION or DETAIL is located on the same Drawing that the SECTION or DETAIL is cut.



SECTION B
SCALE: Not To Scale



SECTION A
SCALE: Not To Scale

DOWEL NOTES:

#6 dowel shall have minimun 6 inch effective embedment with approved epoxy adhesive. The epoxy adhesive shall have minimun 1,450 psi cracked bond strength. The drilled hole diameter and installation shall be based on manufacturer's requirements. Details of the anchorage system shall be submitted to the Engineer for approval prior to instllation.

GENERAL NOTES:

1. *All concrete for pipe collar/connection to existing RCBC Shall be Class "A", f'c=3000 psi, minimum.*
2. *All reinforcing steel shall be ASTM A615, Grade 60.*
3. *Adeka Ultra Seal MC - 2010 MN Waterstop (or approval equal) shall be installed. Per manufacture requirements, Adeka P-201 (or approval equal) may be required to fill gaps in existing concrete.*

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE
1			
2			
3			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

	BY	DATE
DESIGNED	A. OUYANG	04/2023
DRAWN	A. OUYANG	04/2023
CHECKED	K. LIM-HOE	04/2023

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

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PIPE PENETRATION DETAIL 2

SHEET 151 OF 199

4/21/2023

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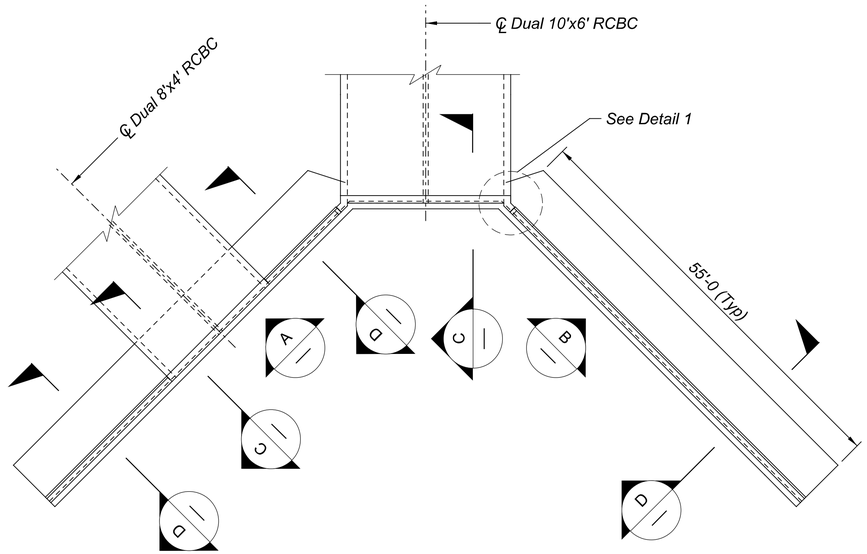
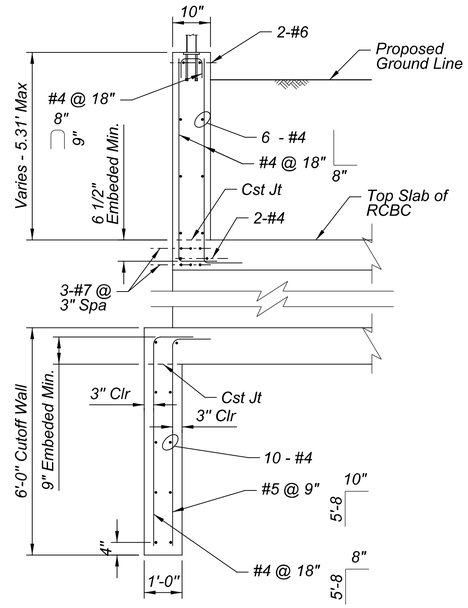
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT0561	152	199	



OLIVE AVENUE STA 263+85.49 ON SHEET 128

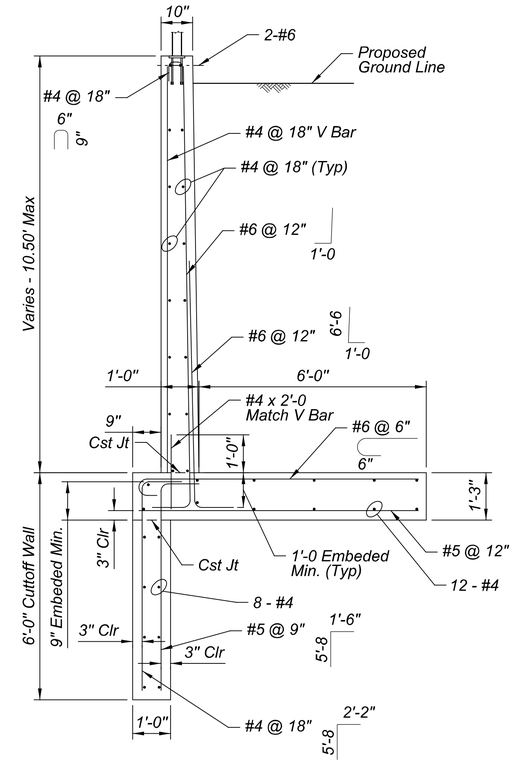
FLUSH BASIN OUTLET PLAN

SCALE: 1"=10'-0"



SECTION C

SCALE: 1/2"=1'-0"

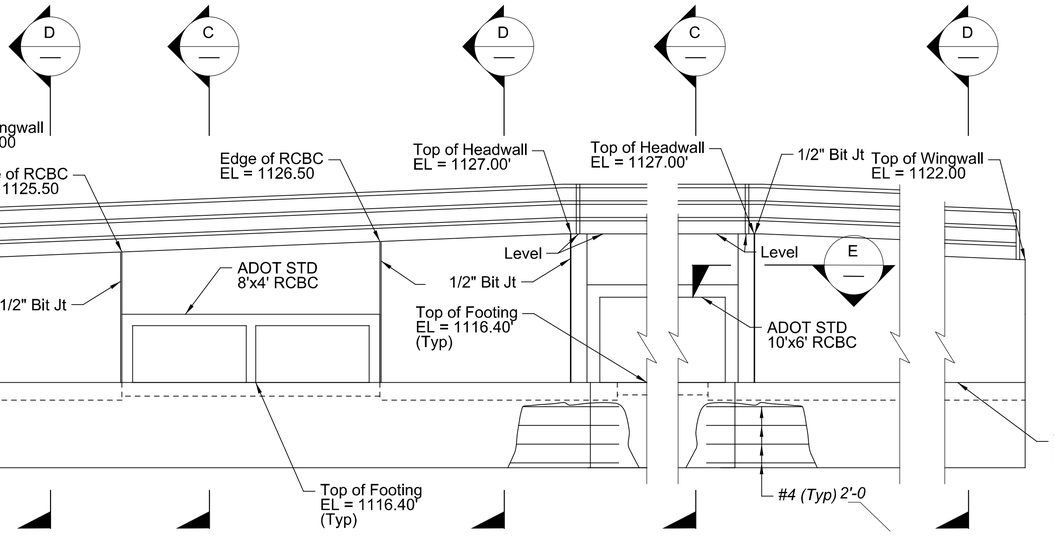


SECTION D

SCALE: 1/2"=1'-0"

SECTION E

SCALE: 1/2"=1'-0"

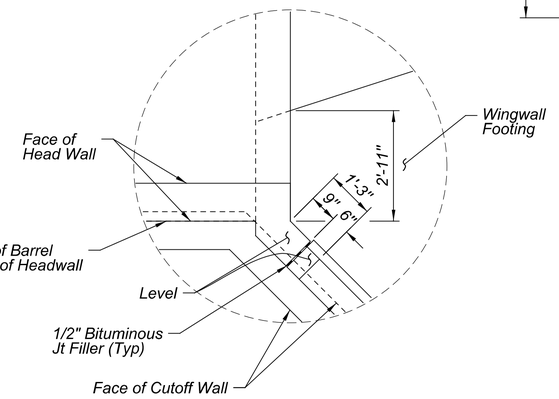


ELEVATION VIEW A

SCALE: 3/16"=1'-0"

ELEVATION VIEW B

SCALE: 3/16"=1'-0"



DETAIL 1

SCALE: 1/2"=1'-0"

NOTES:

All concrete shall be Class "S" (f'c = 3,000 psi).

Reinforcing steel shall conform to ASTM Specification A615. All reinforcing shall be furnished as Grade 60.

All reinforcing steel shall have 2 inch clear cover unless noted otherwise.

Chamfer all exposed corners 3/4" unless noted otherwise.

All bends and hooks shall meet the requirements of AASHTO LRFD Article 5.10.
All bend dimensions for reinforcing steel shall be out-to-out of bars.
All placement dimensions for reinforcing steel shall be to center of bars unless noted otherwise.

Wingwall footing and cutoff wall shall be contiuous with no joint.

Reinforced steel of concrete box culvert are not shown, see ADOT SD 6.01 through SD 6.02 for details.

Dimension shall not be scaled from drawings.

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NO.	REVISION	BY	DATE
3			
2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR 303L TO REEMS ROAD
PROJECT NO. TT0561

100% PLANS
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	A. OUYANG	04/2023
DRAWN	A. OUYANG	04/2023
CHECKED	K. LIM-HOE	04/2023

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WINGWALL BOX CONNECTION DETAIL SHEET

SHEET 152 OF 199

4/21/2023 9:57:31 AM

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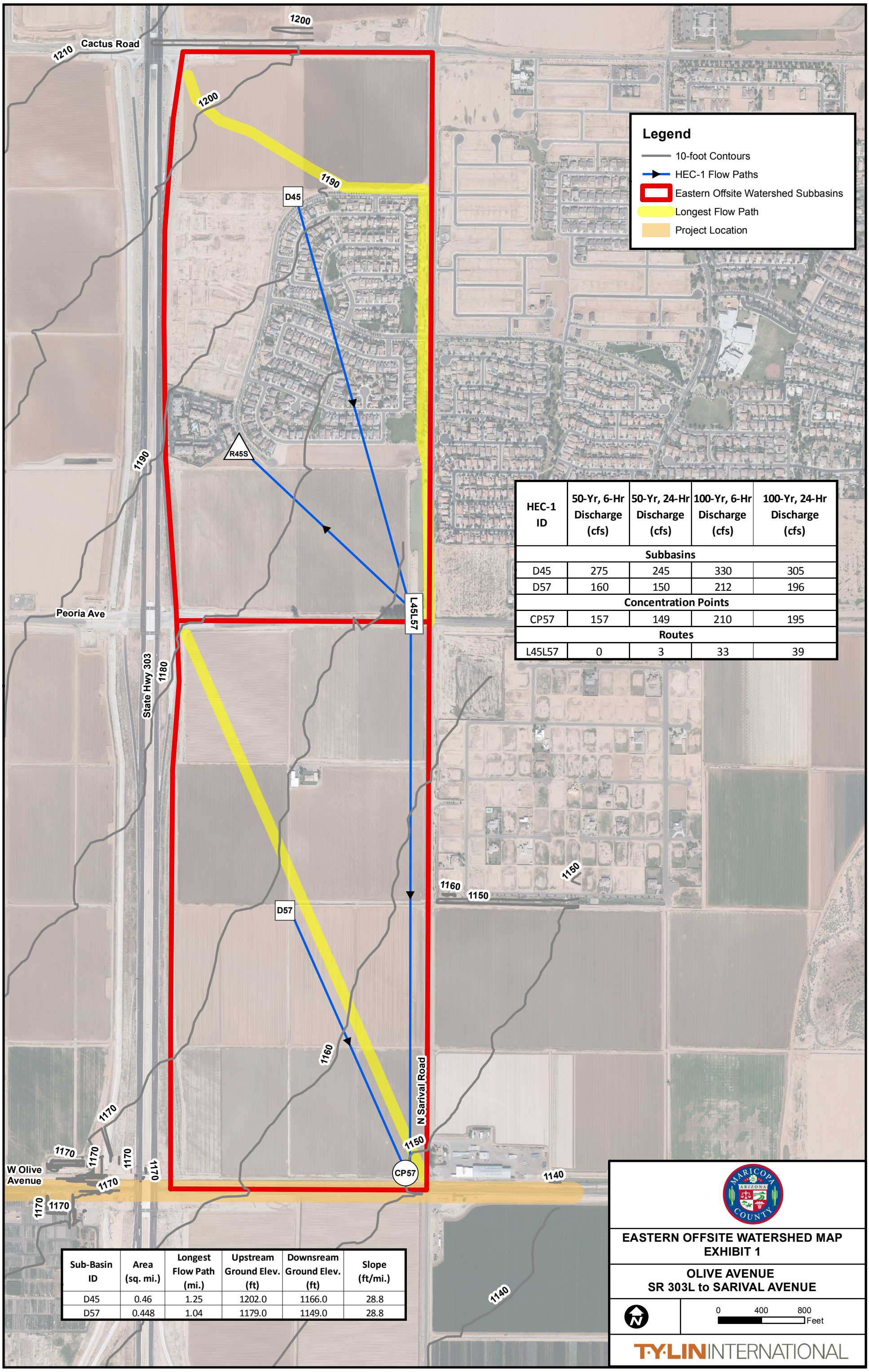
Appendix F
Drainage Exhibits



HEC-1 ID	50-Yr, 6-Hr Discharge (cfs)	50-Yr, 24-Hr Discharge (cfs)	100-Yr, 6-Hr Discharge (cfs)	100-Yr, 24-Hr Discharge (cfs)
Subbasins				
D45	275	245	330	305
D57	160	150	212	196
Concentration Points				
CP57	157	149	210	195
Routes				
L45L57	0	3	33	39

Sub-Basin ID	Area (sq. mi.)	Longest Flow Path (mi.)	Upstream Ground Elev. (ft)	Downsream Ground Elev. (ft)	Slope (ft/mi.)
D45	0.46	1.25	1202.0	1166.0	28.8
D57	0.448	1.04	1179.0	1149.0	28.8

MARICOPA COUNTY ARIZONA

EASTERN OFFSITE WATERSHED MAP
EXHIBIT 1

OLIVE AVENUE
SR 303L to SARIVAL AVENUE

0 400 800 Feet

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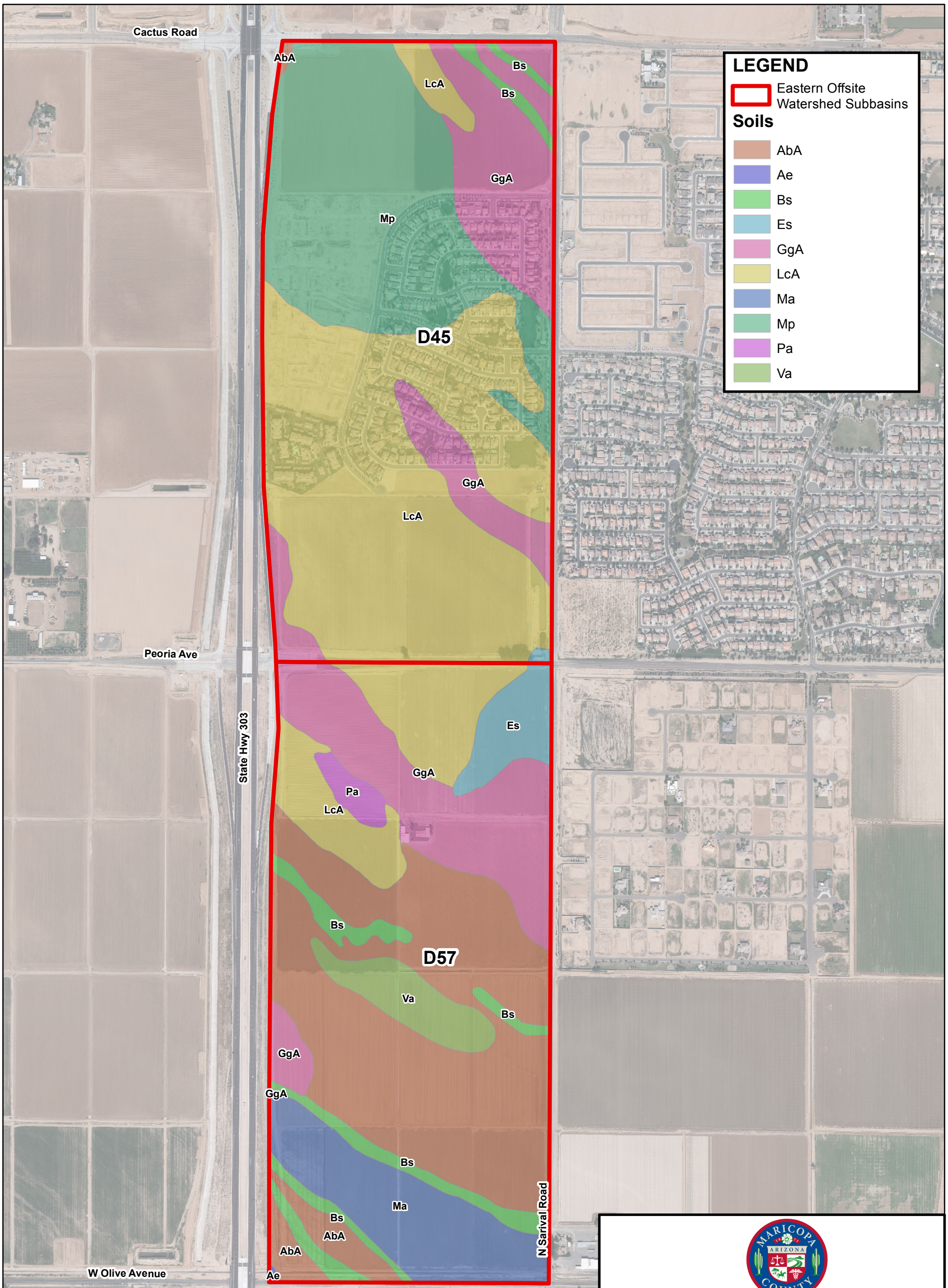

Soil Type	XKSAT (in/hr)	Percent Rock (%)	Soil Type Description
AbA	0.38	0	Antho Sandy Loam 0 to 1 Percent Slope
Ae	0.39	0	Antho-Brios Sandy Loam
Bs	0.39	0	Brios Sandy Loam
Es	0.25	0	Estrella Loam
GgA	0.25	0	Gilman Loam 0 to 1 Percent Slopes
LcA	0.25	0	Laveen Loam 0 to 1 Percent Slopes
Ma	0.4	0	Maripo Sandy Loam
Mp	0.25	0	Mohall Loam
Pa	0.44	0	Perryville Sandy Loam
Va	0.39	0	Valencia Sandy Loam

EASTERN OFFSITE SOILS MAP
EXHIBIT 2

OLIVE AVENUE
SR 303L to SARIVAL AVENUE

0 800 1,600 Feet

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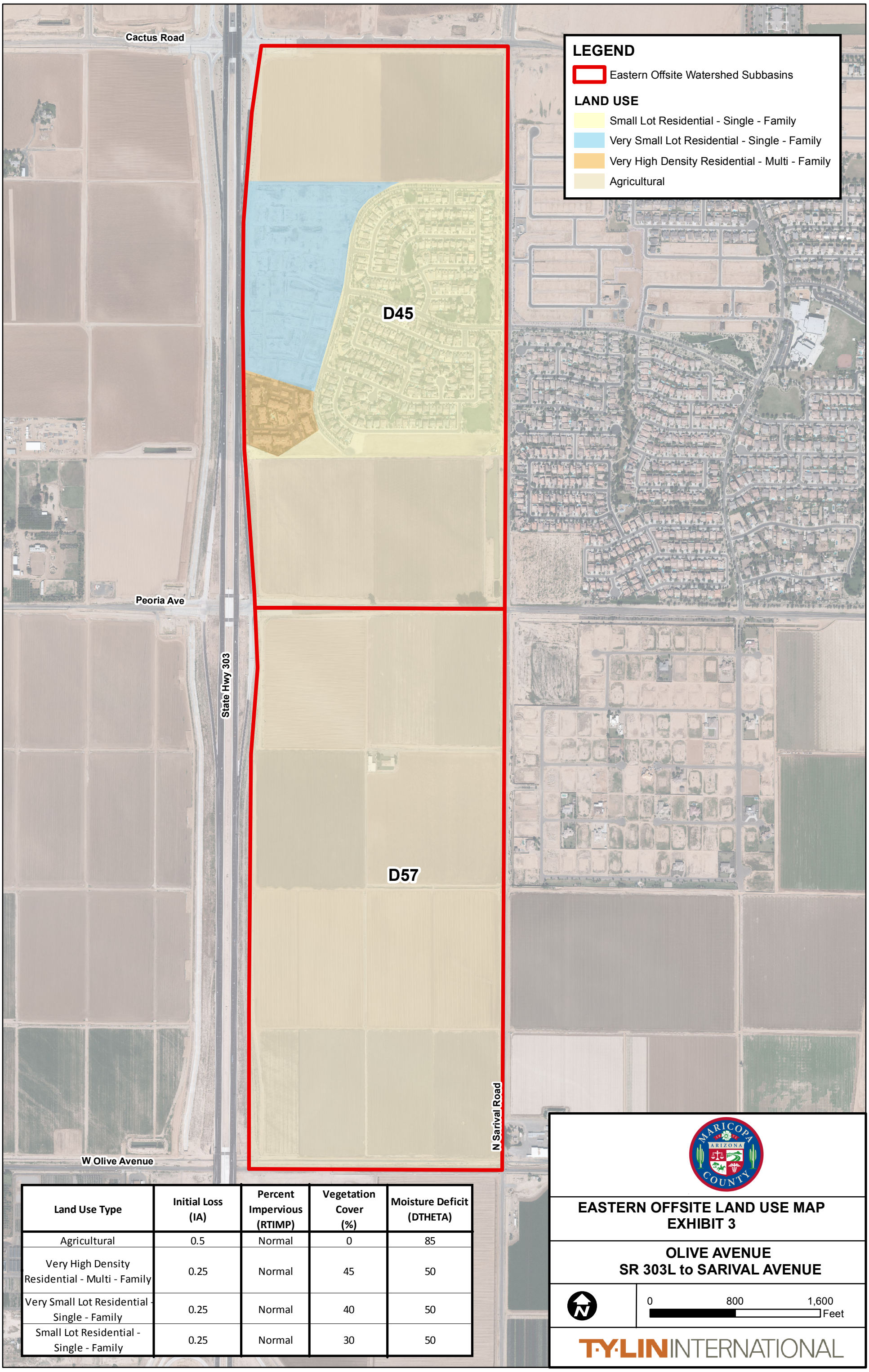

Land Use Type	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetation Cover (%)	Moisture Deficit (DTHETA)
Agricultural	0.5	Normal	0	85
Very High Density Residential - Multi - Family	0.25	Normal	45	50
Very Small Lot Residential - Single - Family	0.25	Normal	40	50
Small Lot Residential - Single - Family	0.25	Normal	30	50

MARICOPA COUNTY ARIZONA

EASTERN OFFSITE LAND USE MAP
EXHIBIT 3

OLIVE AVENUE
SR 303L to SARIVAL AVENUE

0 800 1,600 Feet

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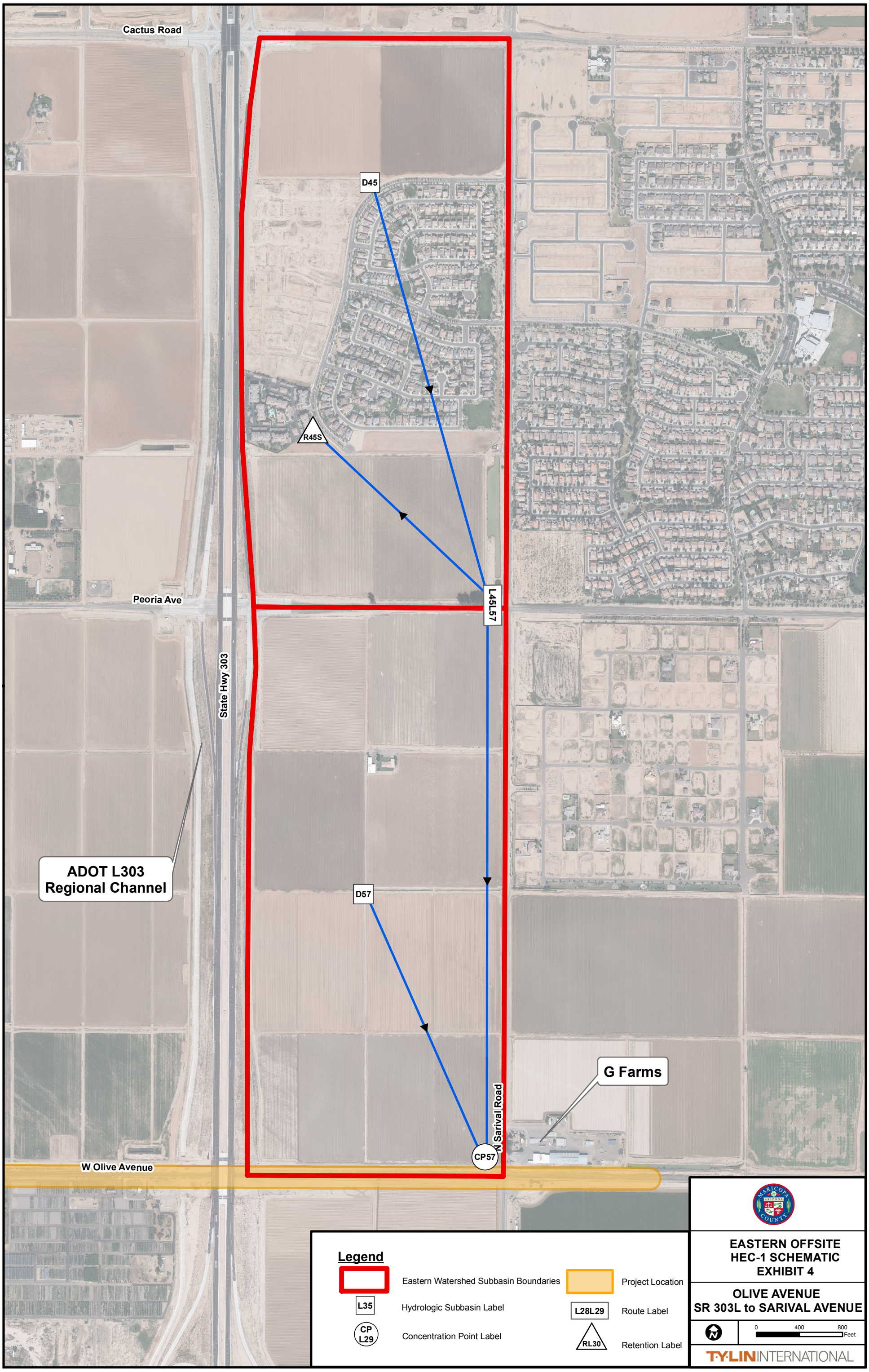
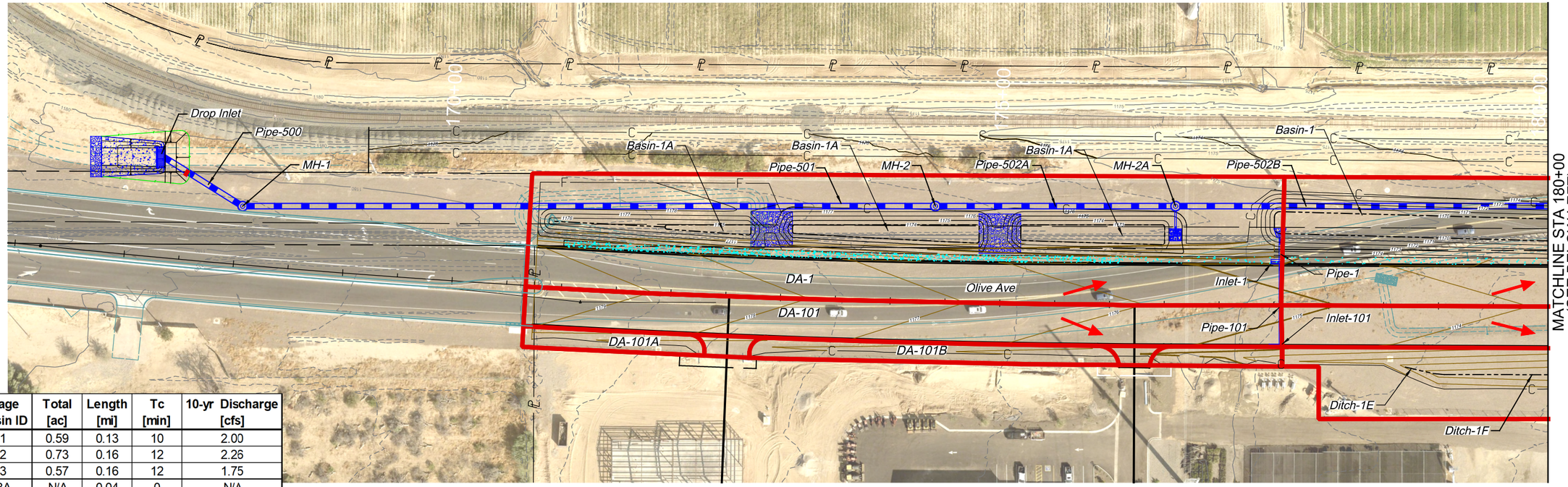
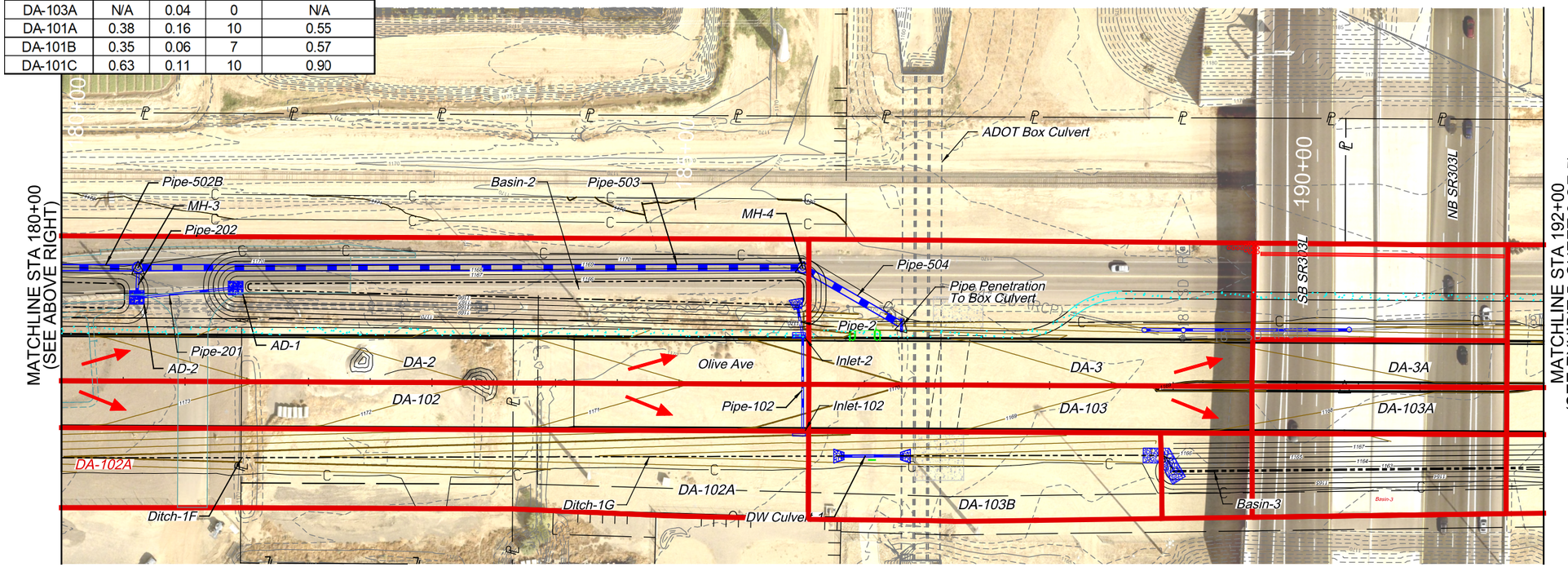

Cactus Road
D45
R45S
L45L57
Peoria Ave
State Hwy 303
ADOT L303
Regional Channel
D57
G Farms
N Sarival Road
CP57
W Olive Avenue
Legend
Eastern Watershed Subbasin Boundaries
Project Location
L35
Hydrologic Subbasin Label
L28L29
Route Label
CP
L29
Concentration Point Label
RL30
Retention Label
EASTERN OFFSITE
HEC-1 SCHEMATIC
EXHIBIT 4
OLIVE AVENUE
SR 303L to SARIVAL AVENUE
0
400
800
Feet
TYLIN INTERNATIONAL



Drainage Subbasin ID	Total [ac]	Length [mi]	Tc [min]	10-yr Discharge [cfs]
DA-1	0.59	0.13	10	2.00
DA-2	0.73	0.16	12	2.26
DA-3	0.57	0.16	12	1.75
DA-3A	N/A	0.04	0	N/A
DA-101	0.59	0.13	10	1.99
DA-102	0.78	0.16	11	2.52
DA-103	0.48	0.15	12	1.49
DA-103A	N/A	0.04	0	N/A
DA-101A	0.38	0.16	10	0.55
DA-101B	0.35	0.06	7	0.57
DA-101C	0.63	0.11	10	0.90



Legend

- Basin Area
- Drainage Flow Arrow
- Ditch/Basin Bottom
- Riprap
- Inlets
- Manholes
- SD Pipes/ Culverts
- Proposed Contours
- Existing Contours
- Project TT497 Design

Sheet Cut Map



N

50 0 50 100

SCALE IN FEET

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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR303L TO SARIVAL AVENUE
PROJECT NO. TT561

EXHIBIT 5

NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	A.HERTING	06/2019
DRAWN	C.COOPER	06/2019
CHECKED	A.HERTING	06/2019

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DRAINAGE AREAS AND INFRASTRUCTURE

SHEET 1 OF 5

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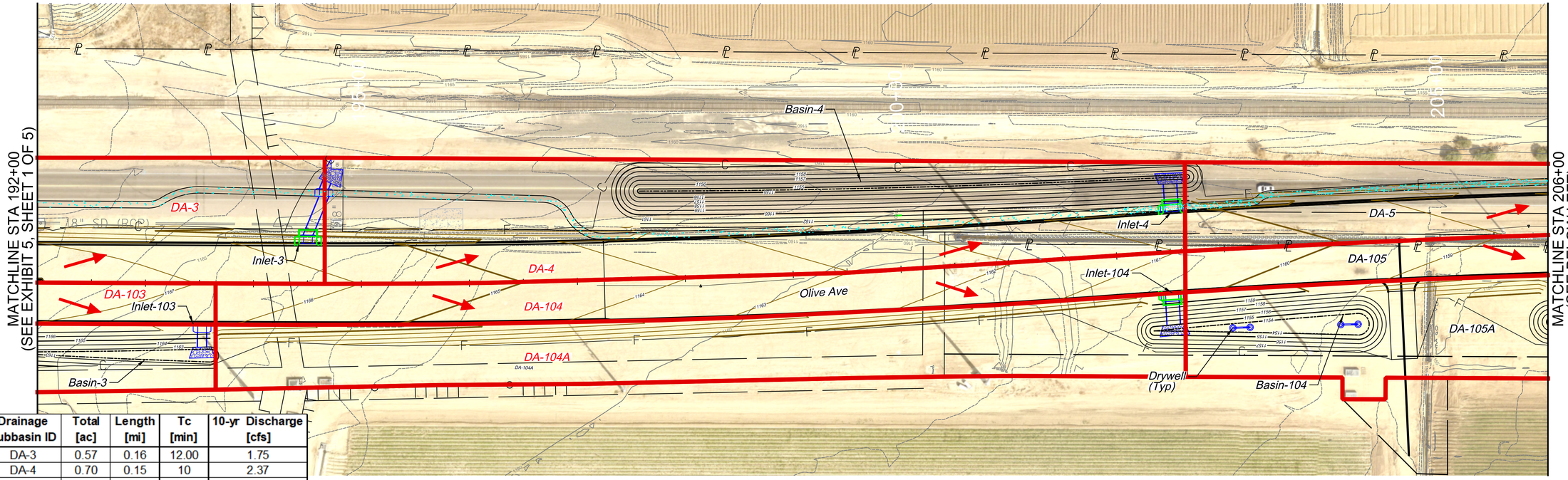
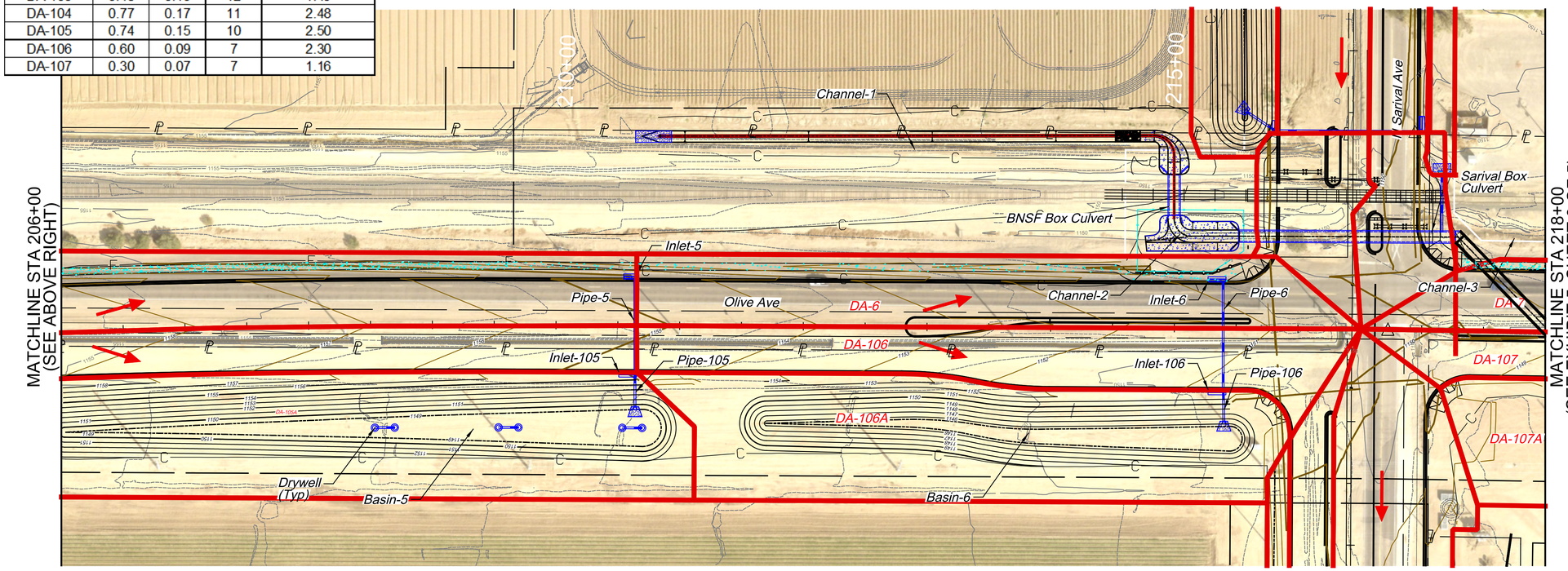


Drainage Subbasin ID	Total [ac]	Length [mi]	Tc [min]	10-yr Discharge [cfs]
DA-3	0.57	0.16	12.00	1.75
DA-4	0.70	0.15	10	2.37
DA-5	0.69	0.15	10	2.34
DA-6	0.70	0.09	7	2.68
DA-7	0.56	0.09	7	2.16
DA-103	0.48	0.15	12	1.49
DA-104	0.77	0.17	11	2.48
DA-105	0.74	0.15	10	2.50
DA-106	0.60	0.09	7	2.30
DA-107	0.30	0.07	7	1.16



Legend

- Basin Area
- Drainage Flow Arrow
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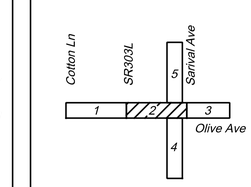
Sheet Cut Map



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SCALE IN FEET

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DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR303L TO SARIVAL AVENUE
PROJECT NO. TT561

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DRAWN	C.COOPER	06/2019
CHECKED	A.HERTING	06/2019

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DRAINAGE AREAS AND INFRASTRUCTURE

SHEET 2 OF 5

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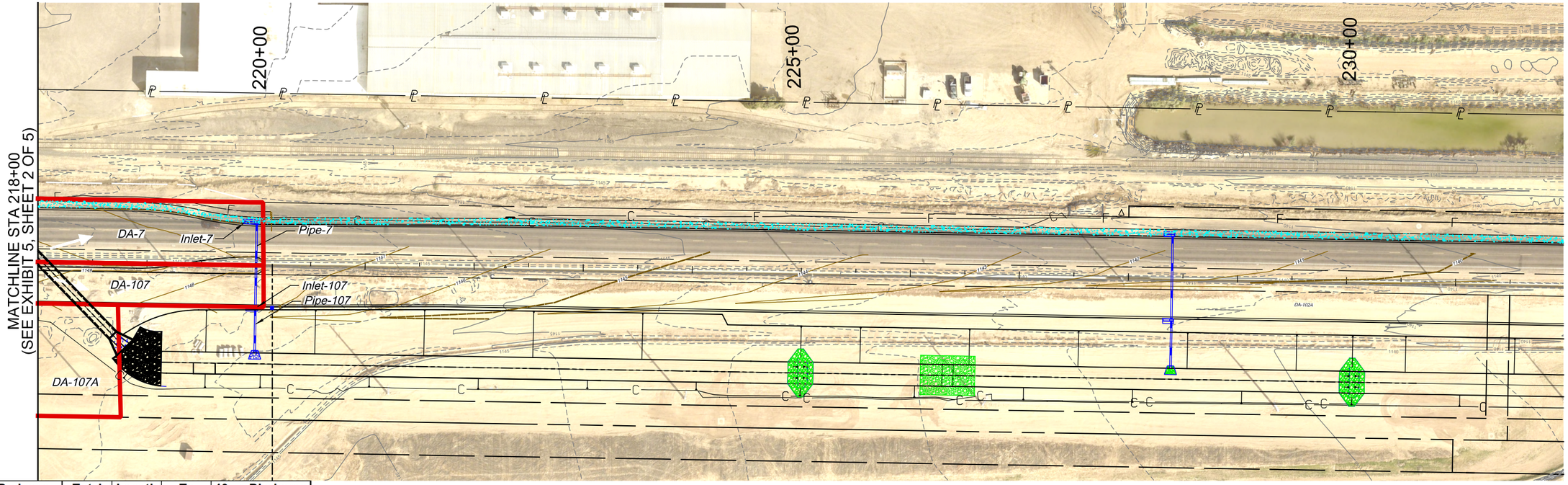
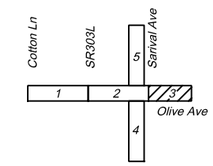


Drainage Subbasin ID	Total [ac]	Length [mi]	Tc [min]	10-yr Discharge [cfs]
DA-7	0.56	0.09	7	2.16
DA-107	0.30	0.07	7	1.16

Legend

- Basin Area
- Drainage Flow Arrow
- Ditch/Basin Bottom
- Riprap
- Inlets
- Manholes
- SD Pipes/ Culverts
- Proposed Contours
- Existing Contours

Sheet Cut Map



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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR303L TO SARIVAL AVENUE
PROJECT NO. TT561

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DRAINAGE AREAS AND INFRASTRUCTURE

SHEET 3 OF 5

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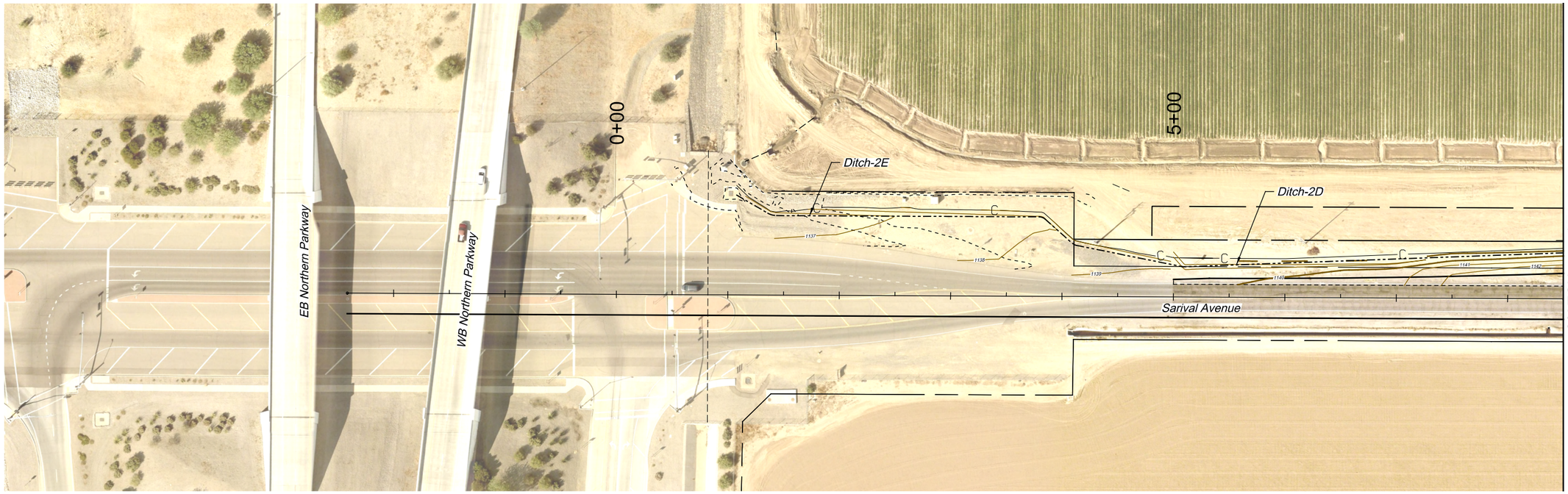

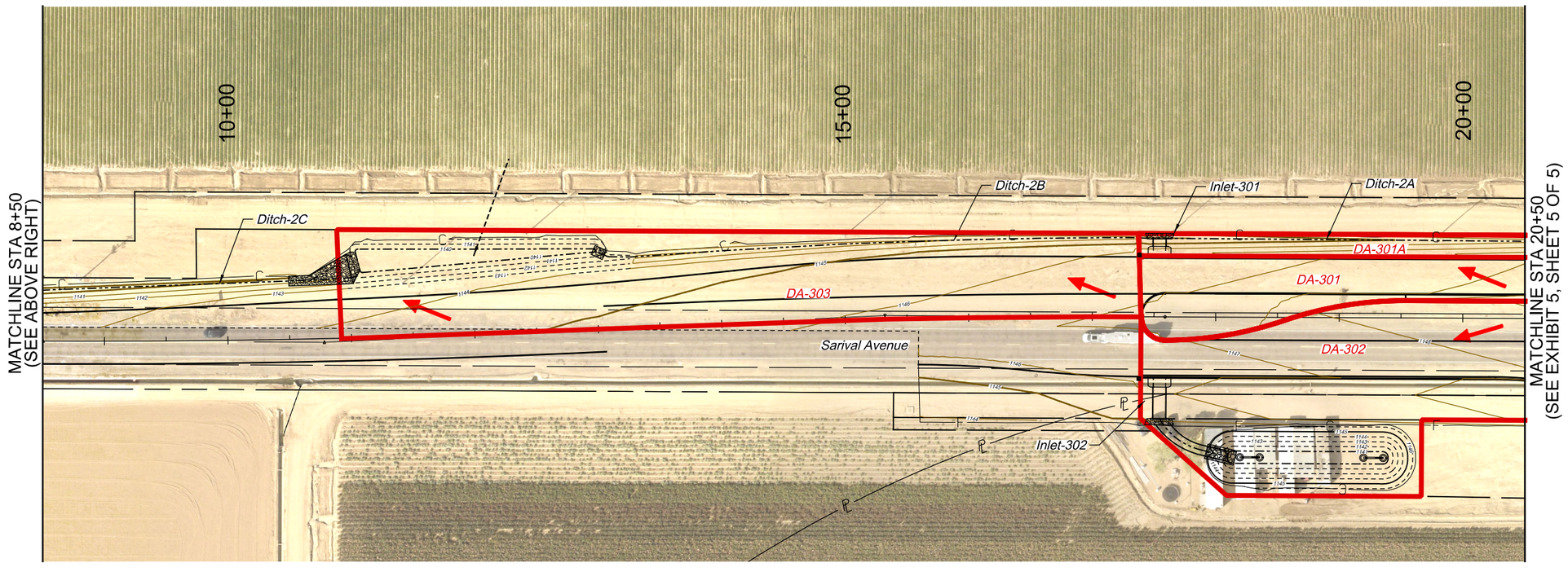

Legend

- Basin Area
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- Riprap
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- SD Pipes/ Culverts
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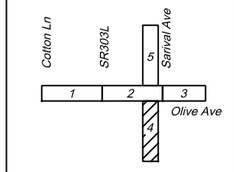
- Existing Contours

Sheet Cut Map



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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR303L TO SARIVAL AVENUE
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EXHIBIT 5

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CHECKED	A.HERTING	06/2019

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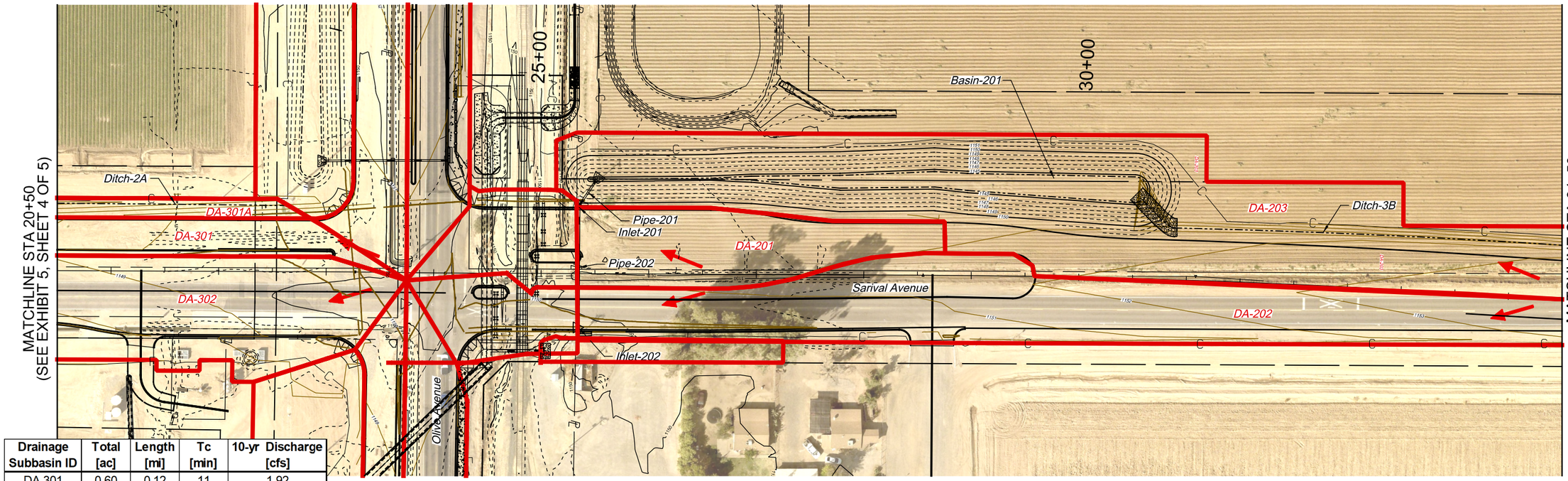
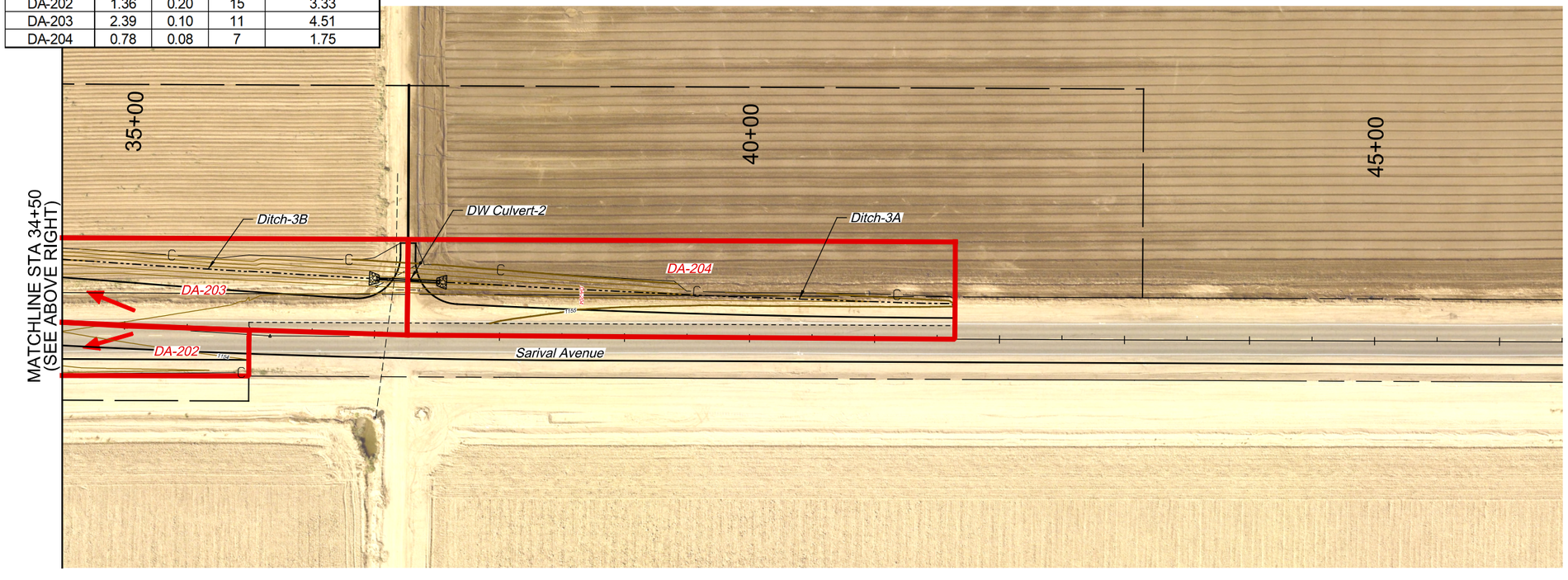
DRAINAGE AREAS AND INFRASTRUCTURE

SHEET 4 OF 5



Drainage Subbasin ID	Total [ac]	Length [mi]	Tc [min]	10-yr Discharge [cfs]
DA-301	0.60	0.12	11	1.92
DA-301A	0.23	0.12	11	0.31
DA-302	0.90	0.12	11	2.90
DA-201	0.43	0.06	10	1.46
DA-202	1.36	0.20	15	3.33
DA-203	2.39	0.10	11	4.51
DA-204	0.78	0.08	7	1.75



Legend

- Basin Area
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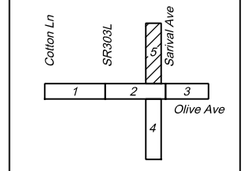
Sheet Cut Map



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DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

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SR303L TO SARIVAL AVENUE
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DRAINAGE AREAS AND INFRASTRUCTURE

SHEET 5 OF 5

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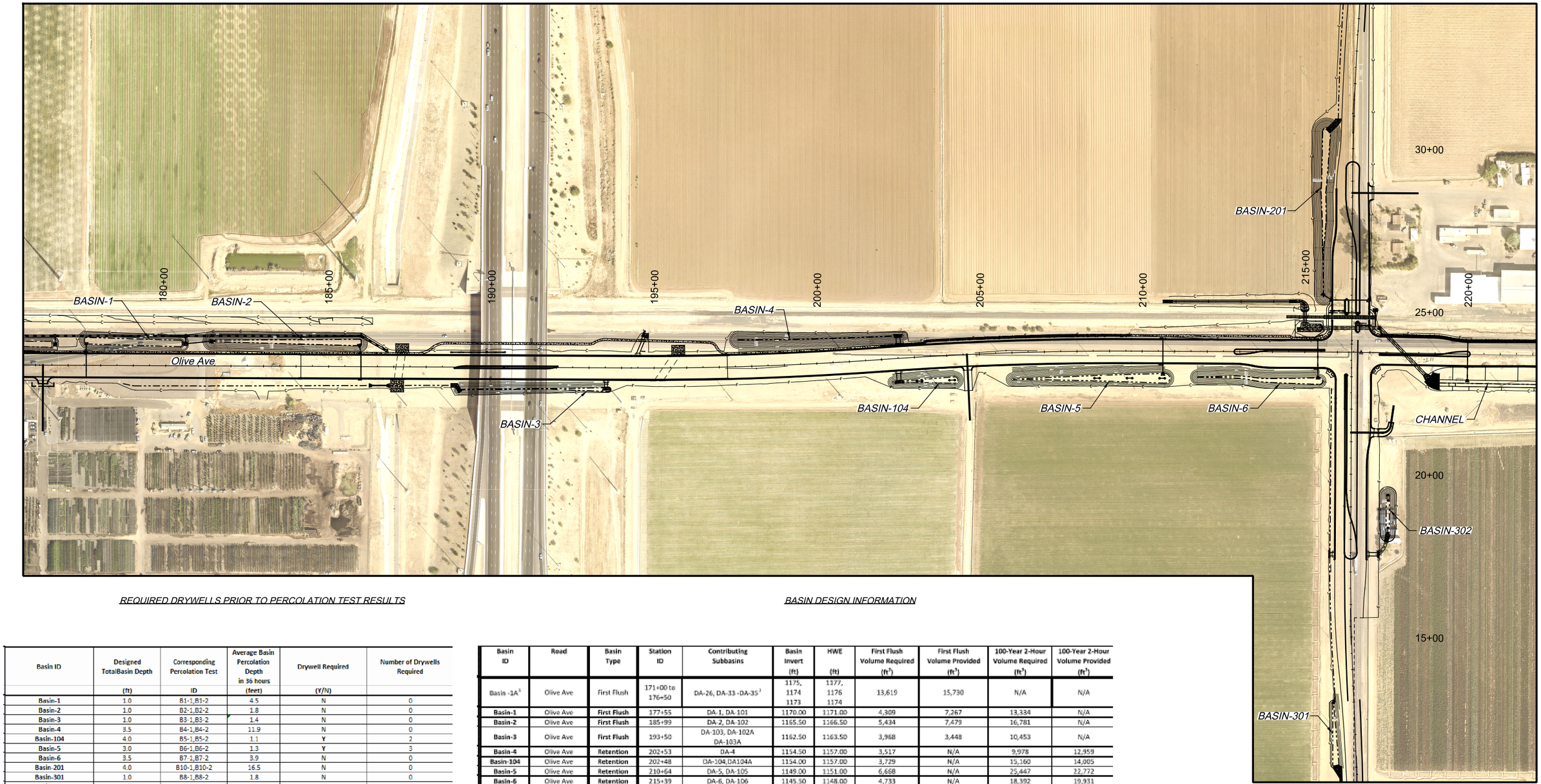


REQUIRED DRYWELLS PRIOR TO PERCOLATION TEST RESULTS

Basin ID	Designed TotalBasin Depth	Corresponding Percolation Test	Average Basin Percolation Depth in 36 hours	Drywell Required	Number of Drywells Required
	(ft)	ID	(feet)	(Y/N)	
Basin-1	1.0	B1-1,B1-2	4.5	N	0
Basin-2	1.0	B2-1,B2-2	1.8	N	0
Basin-3	1.0	B3-1,B3-2	1.4	N	0
Basin-4	3.5	B4-1,B4-2	11.9	N	0
Basin-104	4.0	B5-1,B5-2	1.1	Y	2
Basin-5	3.0	B6-1,B6-2	1.3	Y	3
Basin-6	3.5	B7-1,B7-2	3.9	N	0
Basin-201	4.0	B10-1,B10-2	16.5	N	0
Basin-301	1.0	B8-1,B8-2	1.8	N	0
Basin-302	4.0	B9-1,B9-2	3.1	Y	2

BASIN DESIGN INFORMATION

Basin ID	Road	Basin Type	Station ID	Contributing Subbasins	Basin Invert (ft)	HWE (ft)	First Flush Volume Required (ft^3)	First Flush Volume Provided (ft^3)	100-Year 2-Hour Volume Required (ft^3)	100-Year 2-Hour Volume Provided (ft^3)
Basin -3A[1]	Olive Ave	First Flush	171+00 to 176+50	DA-26, DA-33 -DA-35[1]	1175, 1174 1173	1177, 1176 1174	13,619	15,730	N/A	N/A
Basin-1	Olive Ave	First Flush	177+55	DA-1, DA-101	1170.00	1171.00	4,309	7,267	13,334	N/A
Basin-2	Olive Ave	First Flush	185+93	DA-2, DA-102	1165.50	1166.50	5,434	7,479	16,781	N/A
Basin-3	Olive Ave	First Flush	193+50	DA-103, DA-102A DA-103A	1162.50	1163.50	3,968	3,448	10,453	N/A
Basin-4	Olive Ave	Retention	202+53	DA-4	1154.50	1157.00	3,517	N/A	9,978	12,959
Basin-104	Olive Ave	Retention	202+48	DA-104,DA104A	1154.00	1157.00	3,729	N/A	15,160	14,005
Basin-5	Olive Ave	Retention	210+64	DA-5, DA-105	1149.00	1151.00	6,668	N/A	25,447	22,772
Basin-6	Olive Ave	Retention	215+39	DA-6, DA-106	1145.50	1148.00	4,733	N/A	18,392	19,931
Basin-201	Sarival Ave	Retention	25+50	DA-201, DA-202 DA-203, DA-204	1144.50	1147.50	9,005	N/A	27,670	36,347
Basin-301	Sarival Ave	First Flush	13+10	DA-301, DA-303	1140.00	1141.00	2,641	2,930	8,963	N/A
Basin-302	Sarival Ave	Retention	18+15	DA-302	1141.00	1144.00	2,816	N/A	9,174	9,258

N

150 0 150 300
SCALE IN FEET

NOTES:

1) Prior to construction, drywells assumed to percolate at 0.1 cfs, which is 12,960 cubic feet per 36 hours. Actual drywell tests after installation will determine final percolation rate of drywell.

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

OLIVE AVENUE
SR303L TO SARIVAL AVENUE
PROJECT NO. TT0561

EXHIBIT 6

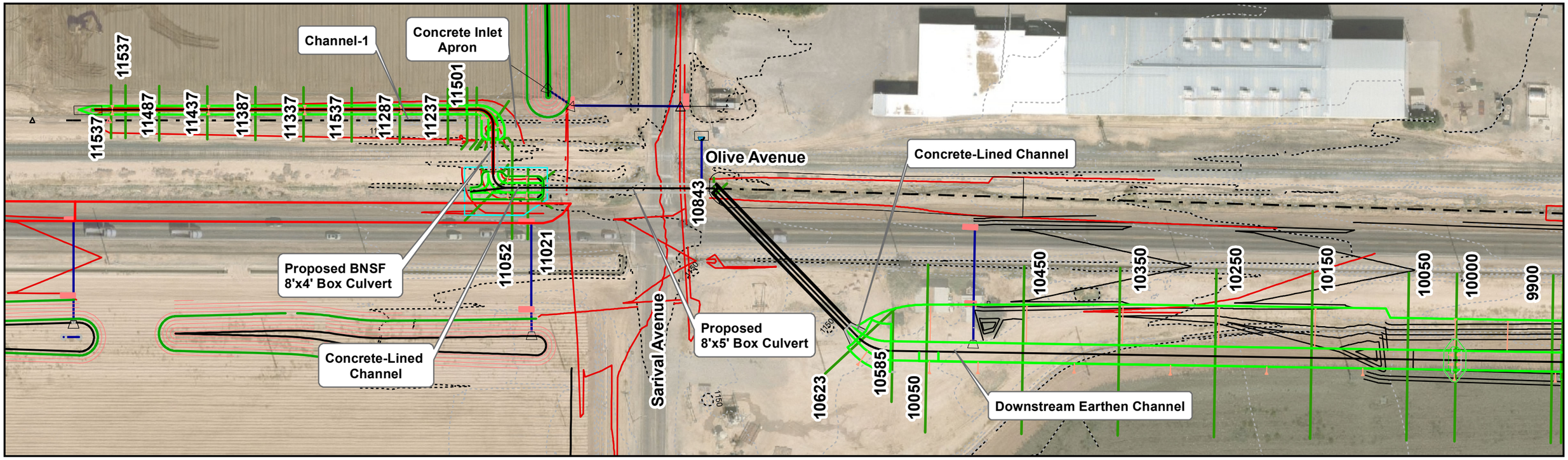
NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	A.HERTING	04/2023
DRAWN	C.COOPER	04/2023
CHECKED	A.HERTING	04/2023

T·Y· LIN INTERNATIONAL
engineers | planners | scientists

DRYWELL EXHIBIT

SHEET 1 OF 1



Legend

- HEC RAS Cross Sections
- HEC-RAS Centerline
- Proposed Major Contours
- Proposed Minor Contour
- Existing Major Contour
- Existing Minor Contour

0 50 100 200 300 Feet

Exhibit 7
Olive Avenue Channel
HEC-RAS Map
1 of 4

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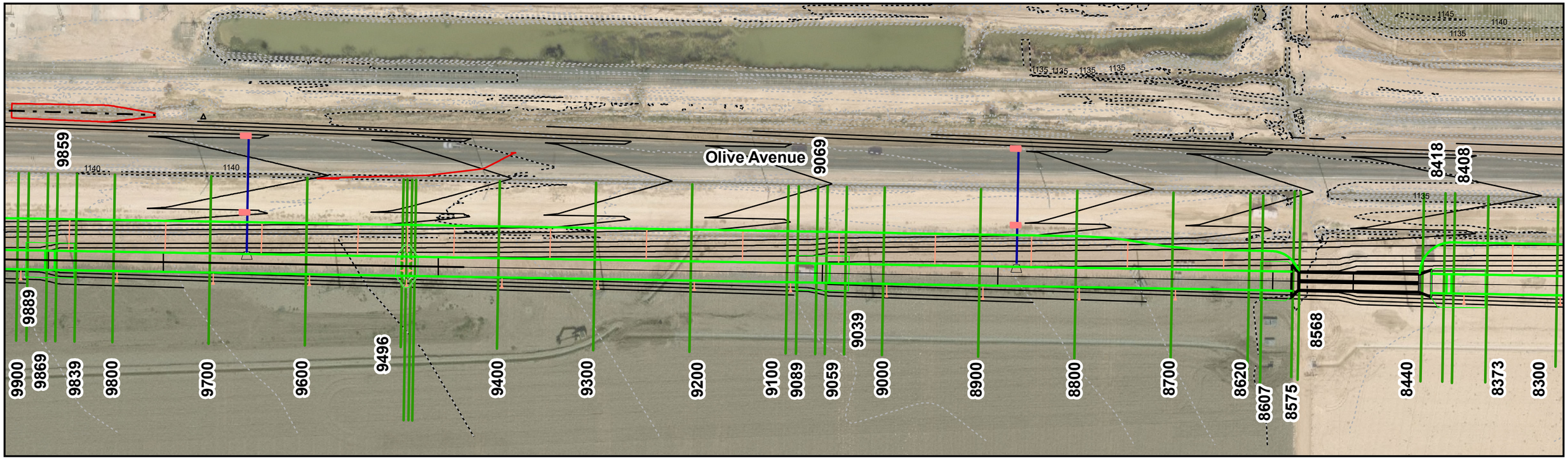


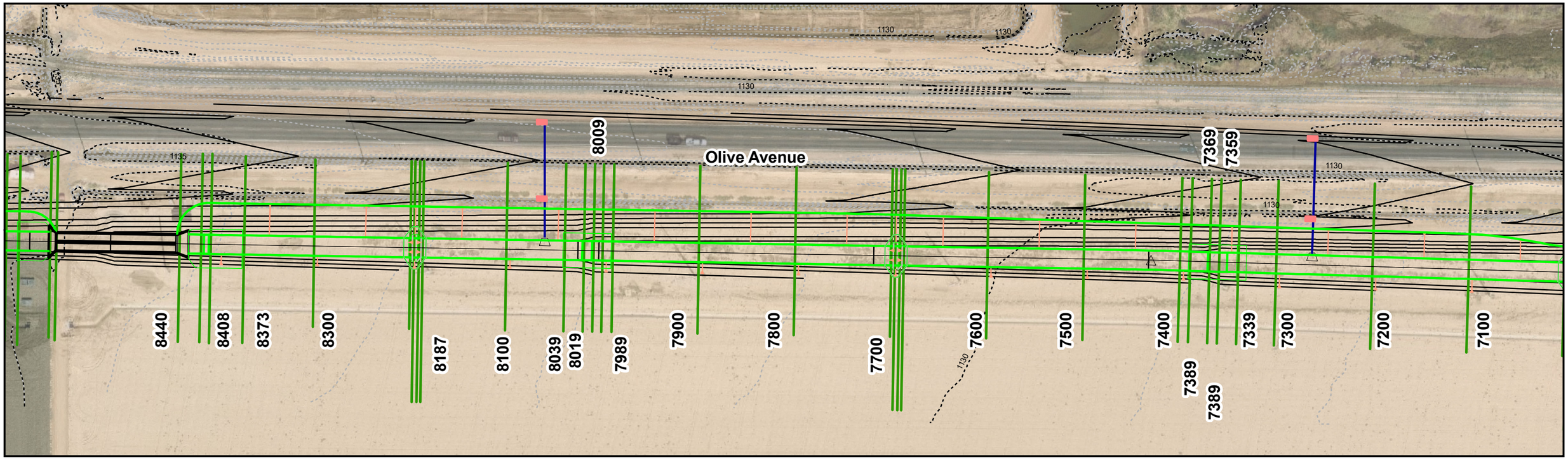
Legend

- HEC RAS Cross Sections
- HEC-RAS Centerline
- Proposed Major Contours
- Proposed Minor Contour
- Existing Major Contour
- Existing Minor Contour

0 50 100 200 300 Feet

Exhibit 7
Olive Avenue Channel
HEC-RAS Map
2 of 4

T·Y·LIN INTERNATIONAL



Legend

- HEC RAS Cross Sections
- HEC-RAS Centerline
- Proposed Major Contours
- Proposed Minor Contour
- Existing Major Contour
- Existing Minor Contour

0 50 100 200 300 Feet

Exhibit 7
Olive Avenue Channel
HEC-RAS Map
3 of 4

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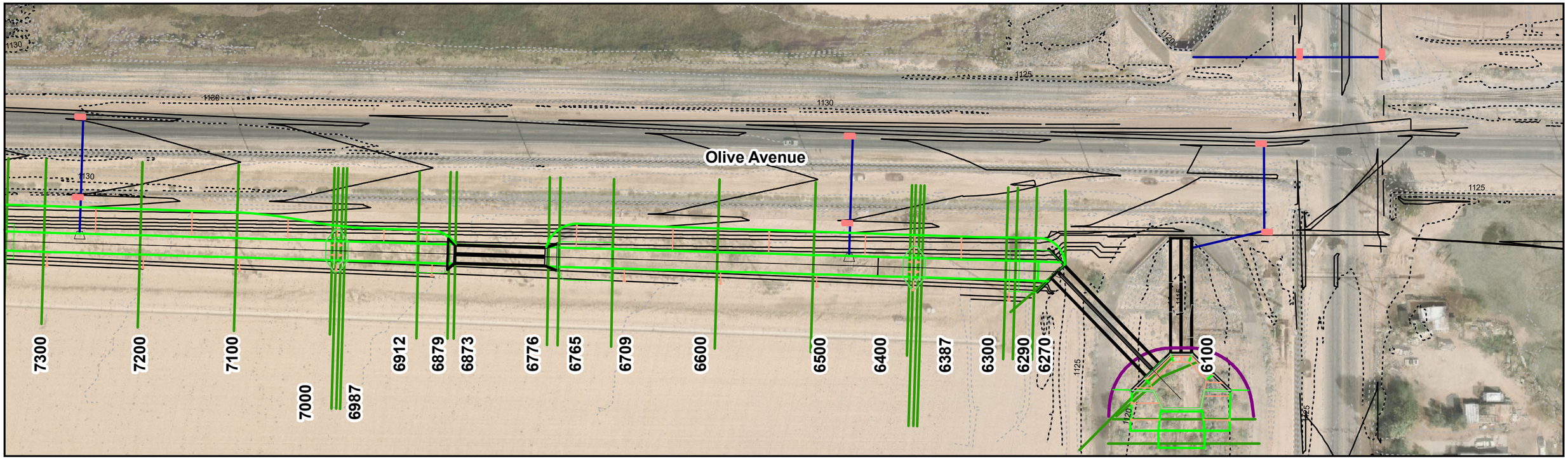

Legend

- HEC RAS Cross Sections
- HEC-RAS Centerline
- Proposed Major Contours
- Proposed Minor Contour
- Existing Major Contour
- Existing Minor Contour

0 50 100 200 300 Feet

Exhibit 7
Olive Avenue Channel
HEC-RAS Map
4 of 4

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Box-1
Inlet-07
Pipe-07
Inlet-107
Pipe-107
220+00
DA-1A
DA-101A
225+00
Olive Avenue
Inlet-01C
Pipe-01C
Inlet-101C
Pipe-101C
230+00
DA-2A
DA-102A
1140
1145
Olive Offsite Channel
Outlet to Channel
Check-Dam-1A
Volume Provided=1,820 cf
Volume Required=1,270 cf
Outlet to Channel
Check-Dam-1B
Volume Provided=3,240 cf
Volume Required=2,733 cf

235+00
Inlet-02C
Pipe-02C
Inlet-102C
Pipe-102C
DA-2A
DA-102A
240+00
DA-3A
DA-103A
Olive Avenue
Inlet-03C
Pipe-03C
Inlet-103C
Pipe-103C
245+00
DA-4A
DA-104A
1130
1135
Outlet to Channel
Olive Offsite Channel
Check-Dam-2
Volume Provided=3,240 cf
Volume Required=2,733 cf
Outlet to Channel
Check-Dam-3
Volume Provided=3,240 cf
Volume Required=2,846 cf

Legend

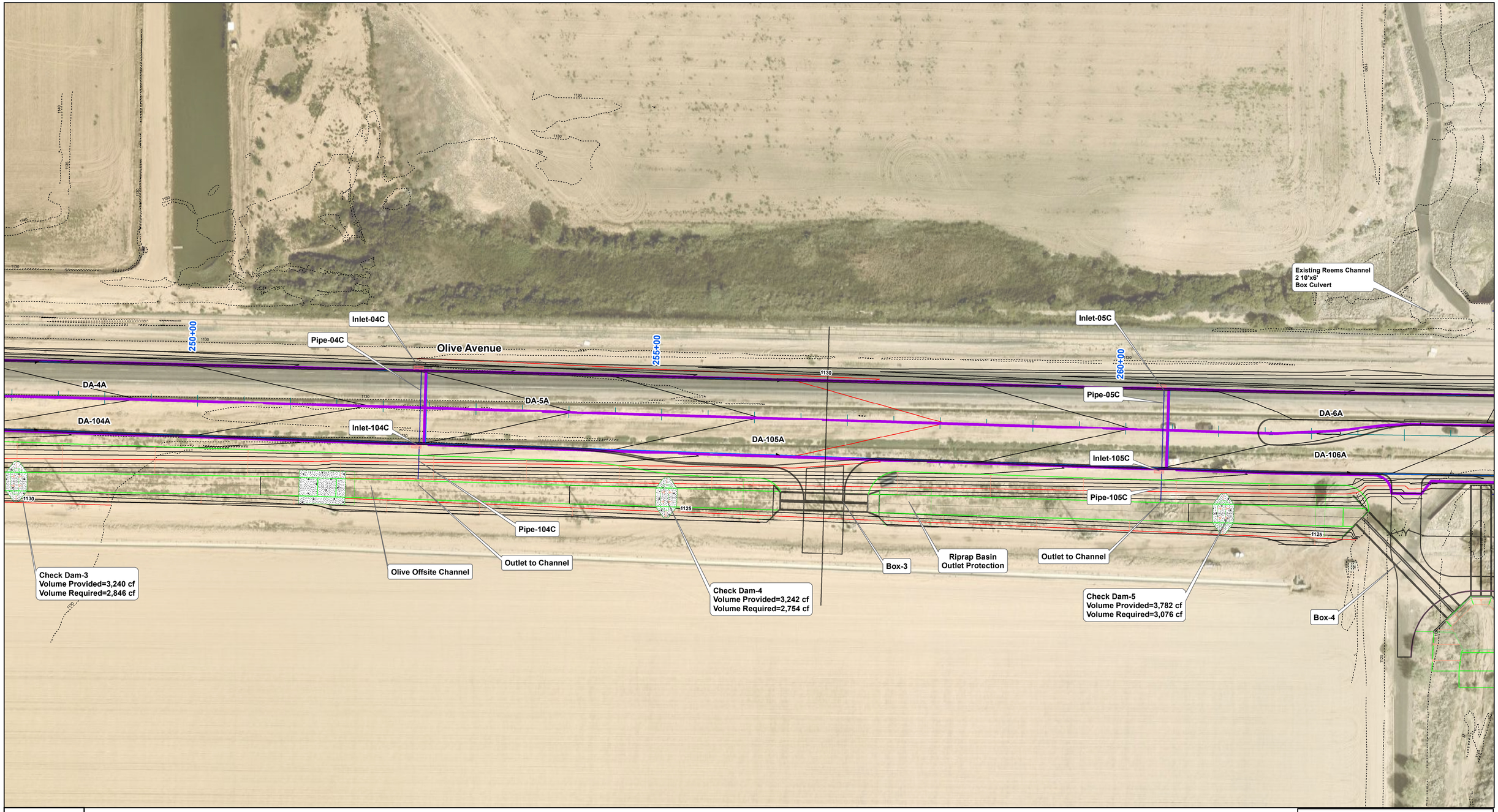
- Onsite Subbasins
- Onsite Flowpaths
- Proposed Major Contours
- Proposed Minor Contours
- Existing Contour

0 25 50 100 150 Feet

MARICOPA COUNTY ARIZONA

Exhibit 8
Drainage Improvement Map
Olive Ave Station 220+00 toStation 248+00
1 of 3

TY·LIN INTERNATIONAL



Legend

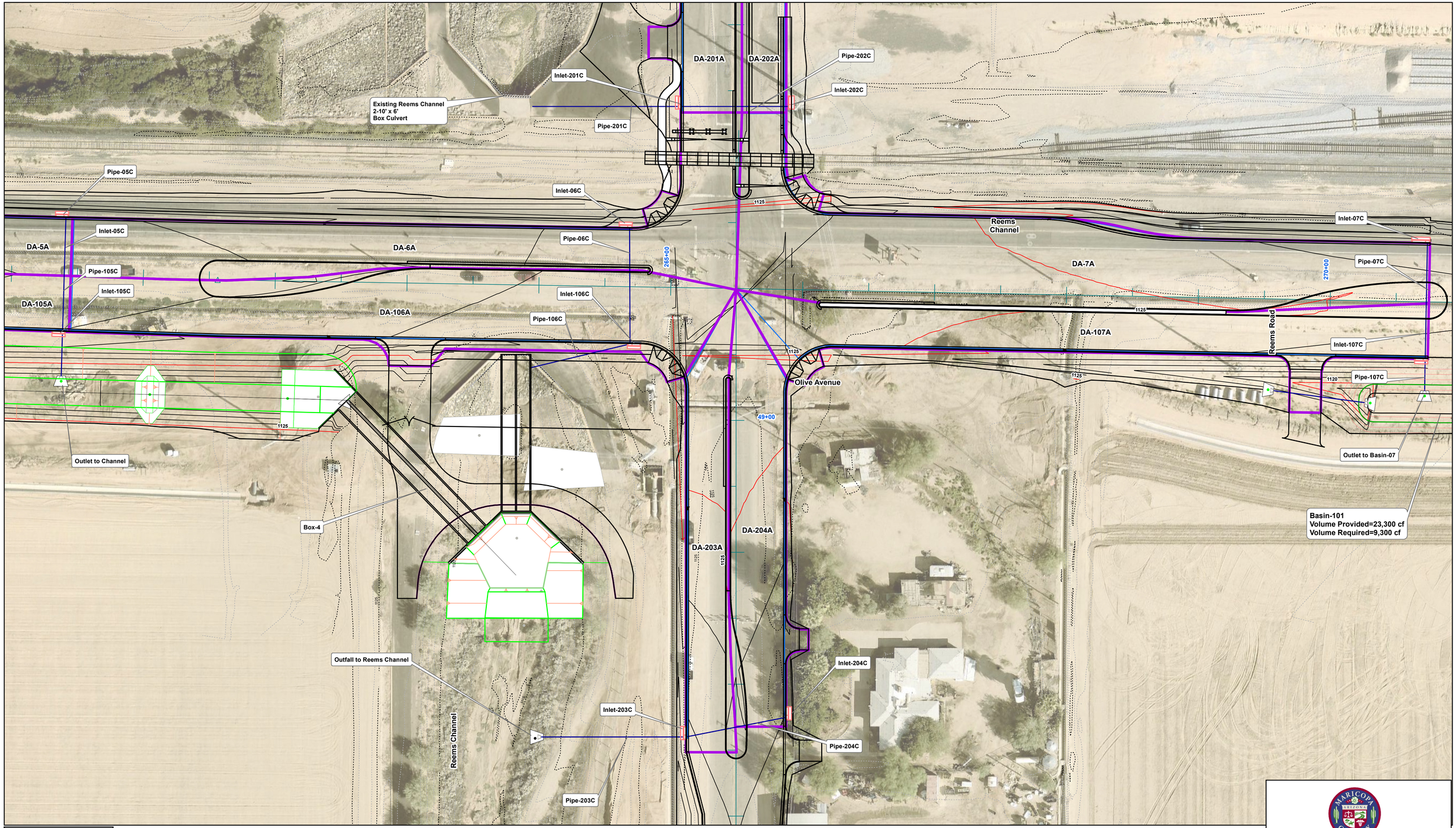
- Onsite Subbasins
- Onsite Flowpaths
- Proposed Major Contours
- Proposed Minor Contours
- Existing Contour

0 25 50 100 150 Feet

MARICOPA COUNTY ARIZONA

Exhibit 8
Drainage Improvement Map
Olive Ave Station 248+00 to Station 264+00
2 of 3

TY·LIN INTERNATIONAL



Legend

- Onsite Subbasins
- Onsite Flowpaths
- Proposed Major Contours
- Proposed Minor Contours
- Existing Contour

0 15 30 60 90 Feet

Exhibit 8
Drainage Improvement Map
Olive Ave Station 264+00 to Station 271+00
3 of 3

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