DS #: 4863

APN: 137-33-710-002

PROJECT: Summerlin Village 24 - Parcel COS-1 Wash

SUBMITTAL: 1st Submittal

SCANNED BY/DATE:

CHECKED BY/DATE:

CITY OF LAS VEGAS NEVADA

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM				DATE: February 16, 2017
TO: **Land Development Services** Department of Building & Safety				FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for: **Summerlin Village 24 – Parcel COS-1 Wash**			**COPIES TO:** GCW Engineers & Surveyors
Cross Streets:	Open Space between Parcel J and Parcel K			Howard Hughes Company, LLC
File Number:	F:\Depot\DSMemos\DS4863A.doc			Bart Anderson, P.E., DevCo
Parcel Number:	137-33-710-002			
Zoning Action:	FMP-62680			
FEMA Flood Zone	YES	NO	X	
Proposed Storm Drain	YES	NO	X	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1st Submittal	2/2/2017	2/16/2017	See Comments Below	$400.00	474382: $400
			TOTAL FEES (LDDRS):	**$400.00**	**----**

REMARKS:

The Drainage Study for the subject project has been reviewed and:

	is approved subject to conformance to all City standards and the following conditions:
X	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.
	is conditionally approved subject to Clark County Public Works Department concurrence.

1. The subject "COS-1" parcel is a common lot and public drainage easement to be privately maintained by the developer and future *Homeowners Association*. Label in the grading plans and to be recorded as such in the final map. If the drainage easement has been recorded, label the recorded document number or map number on the plans in the next submittal.

2. Provide a 12'-wide maintenance road throughout the whole Parcel COS-1 for maintenance crew of the developer and the future *Homeowners Association*.

NOTE: Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the *Nevada Division of Environmental Protection* a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site; for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until all stripped or disturbed surface areas have been covered by paving, building construction or planting. For more information, including forms and applications see http://ndep.nv.gov/bwpc/storm01.htm or call (775) 687-9429.

END OF REMARKS
ays

T/R/S: T20S/R59E/33
AREA K-33

****
*** FAX TX REPORT ***
****

TRANSMISSION OK

JOB NO.	3246
DESTINATION ADDRESS	7028042299
PSWD/SUBADDRESS	
DESTINATION ID	
ST. TIME	02/16 17:34
USAGE T	00'31
PGS.	1
RESULT	OK

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM				**DATE:** February 16, 2017
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NOTE: Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the *Nevada Division of Environmental Protection* a "Notice of Intent"

LETTER OF TRANSMITTAL

GCW ENGINEERS \ SURVEYORS

Project No.: 62024-226-2
Date: February 1, 2017

To: **City of Las Vegas**
333 N. Rancho Drive
Las Vegas, NV 89106

Attention: Flood Control - Albert Sung, PE

Subject: **Technical Drainage Study for Summerlin Village 24 Parcel COS-1 Wash**

Sent Via: Hand Delivery

Items being sent:

1 Copy of the TDS
1 Copy of Improvement Plans (rolled)
1 CD (bound)

These items are submitted:

- ☐ At your request
- ☒ For your approval
- ☐ For your review and comments
- ☒ For your action
- ☐ For your files
- ☐ For your information

Acknowledgment of receipt:

☒ **Required**

Received by: _____
Date: _____
Time: _____

Remarks:

Cordially,

GCW, INC.

Nelson Baggs
Engineering Intern

Copies to: Brian Schmidt, GCW
Rachael Dennis, GCW
Vicki Marjerrison, GCW
Josh Johnson, GCW
Jennifer Veras, GCW

1555 South Rainbow Boulevard
Las Vegas, Nevada 89146
O 702.804.2000
F 702.804.2299
info@gcwengineering.com
gcwengineering.com

TECHNICAL DRAINAGE STUDY
FOR
SUMMERLIN VILLAGE 24
PARCEL COS-1 WASH

62024-226-2

January 2017

GCW
ENGINEERS \ SURVEYORS

Prepared for:

The Howard Hughes Company, LLC
10801 W. Charleston Blvd., 3rd Floor
Las Vegas, Nevada 89135
Phone: (702) 791-4300
Fax: (702) 791-4450

62024.226.2

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Summerlin Village 24 Parcel COS-1 Wash Date: January 2017

Location of Development a) Descriptive (Cross Streets) North/South: Sky Vista Drive

East/West: Crossbridge Drive

b) Section: 33 Township: 20S Range: 59E

c) APN: 137-33-710-002

Name of Owner: The Howard Hughes Company, LLC.

Telephone No.: 791-4300 Fax No. 791-4450 E-Mail Address: Not available

Address: 10801 W. Charleston Blvd, 3rd Floor; Las Vegas, Nevada 89135

Contact Person-Name: Rachael R. Dennis, P.E. **Telephone No.:** (702) 804-2000

* **E-Mail Address:** Rdennis@gcwengineering.com **Fax No.:** (702) 804-2299

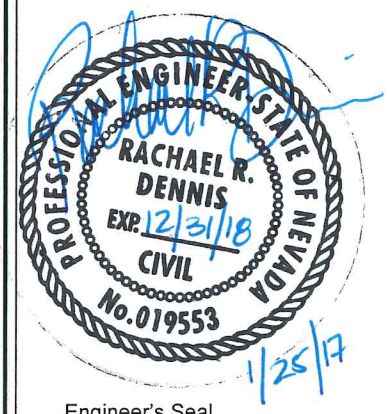
Firm: GCW, INC.

Address: 1555 S. Rainbow Blvd; Las Vegas, NV 89146

Type of Land Development/Land Disturbance

☐	Rezoning	☐	Subdivision Map	☐	Clearing and Grading Only
☐	Parcel Map	☐	Planned Unit Development	☒	Other (Please specify below)
☐	Large Parcel Map	☐	Building Permit	Storm Drain and Channel Improvements	

1. Total Owned Land Area: At Site: 396.57 ± acres Being Developed/Disturbed: 6.2 ± acres
2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? ☐ **Yes**** ☒ **No**
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? ☐ **Yes**** ☒ **No**
4. Proposed type of development (Residential, Commercial, Etc.): Storm Drain and Channel Improvements
5. Approximate upstream land area which drains to the subject site: 530.6 ± acres
6. Has the site drainage been evaluated in the past? ☒ **Yes** ☐ **No** If yes, please identify documentation: Update #2 to the Conceptual Drainage Study for Summerlin Village 24, GCW; Update to the Technical Drainage Study for Village 24 Parcel COS-2, GCW; Update #6 to the Technical Drainage Study for Summerlin Village 24 Unit 2 Improvements - Crossbridge Drive (Crossbridge Unit 1 to Suncreek Road), GCW; Update #4 to the Technical Drainage Study for Summerlin Village 24 Unit 2 Improvements – Sky Vista Improvements (Desert Moon Drive to Alta Drive Including Suncreek Road), GCW.
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: Existing Six-(6) 5'X5' RCBCs at Crossbridge Drive, existing 54-inch RCP in Crossbridge Drive, proposed 48-inch RCP in Crossbridge Drive.
8. Briefly describe your proposed schedule for the subject project: ASAP



Engineer's Seal

Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

*New Required Field

****Review and concurrence of the Clark County Regional Flood Control District is required.**

Local Entity File No.

Revision	Date

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name: Summerlin Village 24 Parcel COS-1 Wash	Map ID:
Firm Name: GCW, Inc	Engineer: Rachael R. Dennis
Address: 1555 S Rainbow Blvd	
City: Las Vegas	State: NV Zip: 89146
Phone Number: (702) 804-2000	Fax Number: (702) 804-2297
Property Owner: The Howard Hughes Company, LLC	
Address: 10801 W. Charleston Blvd, 3rd Floor	
City: Las Vegas	State: Nevada Zip: 89135

Reviewed By:	Date Received:	Date Accepted for Review:

The following checklist is intended as a guide for the engineer preparing a Technical Drainage Study to submit to the local entity and Clark County Regional Flood Control District (if necessary). The listed items are the minimum information required prior to the entity performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (MANUAL).

This document is intended as an aid in preparing Technical Drainage Studies. Each study submitted is reviewed for compliance with local and regional criteria. This form is not intended to be all inclusive and does not limit the extent of the information, calculations or exhibits which may be necessary to properly evaluate the intended land use.

If items are not applicable for the subject site, provide N/A.

I. GENERAL REQUIREMENT

Yes	No	
X		Design Manual **Standard Form 1** with the engineer's seal and signature.
X		Design Manual **Standard Form 4**.
X		2 copies of the 24" x 36" Drainage Plan.
	NA	A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge.

II. MAPS AND EXHIBITS

Yes	No	
X		A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.
X		A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.

REFERENCE:	**STANDARD FORM 2**

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS (Continued)

Yes	No	
X		Off-site drainage basin maps for existing, interim and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs.
X		On-site drainage basin maps for existing and proposed conditions showing the existing topography, basin boundaries, concentration points, and on-site and off-site flows in cfs.
X		Vicinity Map with local and major cross streets identified and a north arrow.

III. DRAINAGE PLAN

Yes	No	
X		Sheet size: 24" x 36" sealed by a registered engineer in the State of Nevada.
X		Minimum scale: 1" = 60'.
X		Project name.
X		Vicinity Map with local and major cross streets.
X		Revision box.
X		North arrow and bar scale.
X		Engineer's/consultant's address and phone number.
X		Elevation datum and benchmark.
X		Legend for symbols and abbreviations.
X		Cut/fill scarps, where applicable.
X		Street names, grades, widths.
X		Proposed future and existing spot grades for top of curbs and street crowns at lot lines, grade breaks, and along curb returns on both sides of the street.
X		Existing contours encompassing the site and 100 feet beyond with spot elevations for important locations, where appropriate.
	N/A	Minimum finish floor elevations with top-of-curb elevations at upstream end of lot.
	N/A	Proposed typical street sections.

REFERENCE:	STANDARD FORM 2

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
____	N/A	Streets with off-set crowns.
X	____	Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.
X	____	Property lines.
X	____	Right-of-way lines and widths, existing and proposed.
X	____	Existing improvements and their elevations.
X	____	Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points.
X	____	Concentration points and drainage flow direction with Q100 and V100 and D100 in streets.
X	____	Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
____	N/A	Location and cross-section of street capacity calculations.
X	____	Cross-sectional detail for channels, including cutoff wall locations.
X	____	Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk, ditches, swales, storm drain systems, unimproved and improved channels, and culverts, etc.) stating size, material, shape, and slope with plan and profile and HGL calculations.
X	____	Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
____	N/A	Location and detail of existing, proposed, and future block wall openings. Minimum size is 16" x 48". Wrought iron gate is required for flows > 10 cfs.
X	____	Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.
X	____	Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit.
____	NA	Building and/or lot numbers.
____	NA	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
X	____	Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.

REFERENCE:	**STANDARD FORM 2**

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
_____	NA	For areas in Zone A, AE, AH, and AO, base flood elevations (BFEs) must be shown for each lot; BFEs may be listed on each lot, or in a table. Finish floor elevations must be a minimum of 18 inches above BFE.
_____	NA	Appropriately elevated "humps" 6 inches above the 100 year water surface elevation at site accesses where the intent is to protect the site from the Q100 flows.
_____	NA	Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.
_____	NA	Location and detail of best management practice (BMP) for parking lots and low impact development (LID) (if required).

IV. HYDROLOGIC ANALYSIS

Yes	No	
X	_____	Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.
X	_____	Input and output information for existing conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.
X	_____	Input and output information for future conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.
X	_____	Use of correct precipitation values in and around the McCarran Airport rainfall area.
X	_____	A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations.
X	_____	A summary table of stormwater flows showing basin area, Q10 and Q100 for both individual basins and combined basin flows, where applicable.
X	_____	Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.
X	_____	On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law.
_____	NA	Calculation for impervious area for parking lots and LIDs (if required).

REFERENCE:	STANDARD FORM 2

DRAINAGE SUBMITTAL CHECKLIST

V. HYDRAULIC ANALYSIS

Yes	No	
X		Flow split calculations and supporting documentation or reference for the method of flow split calculations used.
	NA	Normal depth street flow calculations and cross section diagrams for all interior and perimeter streets. Provide "d x v" products for the Q100 and Q10 flows representing the worst case for interior and all perimeter streets. Q100 d x v < 8. Q10 d x v < 6 and 12 foot dry lane for rights-of-way > 80 feet. Calculations must be labeled by street name as indicated on the Grading Plan.
	NA	A summary table of interior and exterior street capacity calculations showing the street name, Q100 flow, slope, depth of flow, velocity and depth times velocity product and streets needing to meet 12 foot dry lane criteria.
	NA	Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.)
	NA	Appropriate hydraulic calculations at drainage easement entrance and discharge locations to set finish floor elevations. Hydraulic calculations must include submerged weir, superelevation and tee intersection losses, where appropriate.
	NA	Provide necessary freeboard requirements to set the finished floor elevations of all proposed buildings, 2 x depth of flow or depth of flow plus 18 inches of freeboard, whichever is less. The minimum requirement is 6 inches above adjacent upstream top of curb. Buildings adjacent to drainage easements must always be provided with 18 inches of freeboard above the Q100 weir height or flow depth, whichever is greater.
X		A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. • Field survey data. • Input and output information. • Plotted cross-sections based on survey with proper encroachments. • A map showing the location of the cross-sections. • Analysis of both sub and super-critical flow segments. • A summary table and a discussion of the results in the text of the report.
	NA	Provide a 50 percent clogging factor in the capacity calculation for drop inlets.
X		Hydraulic calculations for culverts and storm drains. D-Load calculations must be provided for storm drain pipes in public rights-of-way, including headwater pool inundation.
X		The mitigation of nuisance water, both during construction and in the fully developed condition, must be addressed.
	NA	Provide BMP type, size and supporting calculations for parking lots and LIDs (if required).

REFERENCE:	STANDARD FORM 2

CITY OF LAS VEGAS

MINIMUM DRAINAGE STUDY CRITERIA
STANDARD FORM 2 CHECKLIST SUPPLEMENT

(Revised 5/18/11)

The following checklist is intended as a supplemental guide for the engineer preparing a Technical Drainage Study submittal to the City of Las Vegas. This supplement focuses on requirements specific to the City of Las Vegas. The requirements presented are in addition to the Clark County Regional Flood Control District (CCRFCD) Manual Standard Form 2. The listed items are the minimum information required prior to the City performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the CCRFCD Hydrologic Criteria and Drainage Design Manual (Design Manual).

An appointment must be made to preview this checklist in conjunction with CCRFCD Standard Form 2 prior to the City accepting a new drainage study for review. The engineer must contact the Flood Control Section at (702) 229-6541 to schedule a submittal appointment.

If items are not applicable for the subject site, provide N/A.

I. GENERAL REQUIREMENT		
Yes	No	
	N/A	A notarized letter from the adjacent property owner(s) allowing off-site grading. (A copy of the letter must be received prior to final acceptance of the drainage study.)
X		Copies of all conditions of approval for development related to this property. (e.g. zoning, use permit, tentative map, etc.) Verify compliance with conditions.
X		An electronic copy of the complete submittal is required to be submitted with one original hard copy of the study. Electronic documents should be on a universal computer-readable digital output device replicating your submittal. An Indexed Portable Document Format (PDF) or Print Ready CAD file formats with a minimum of 300dpi are the desired formats. If figures are in color, they must be scanned in color and saved as a separate file. _____ by initial here, the engineer on record acknowledges that the electronic copy is an identical replicate of the original hard copy submitted to the City of Las Vegas.

II. GRADING PLAN INFORMATION		
Yes	No	
X		(1) 24" X 36" copy of the Grading Plan, (including all Detail Sheets) sealed by the engineer.
X		Proposed future and existing spot grades for top of curbs and street crowns at lot lines, grade breaks, and along curb returns on both sides of the street. Note: Proposed top of curb elevations must be provided for both sides of roadways even if only half street construction is required.
X		Label existing topography at a minimum 5 foot elevation interval including adjacent developments, finished floor elevations of existing buildings and top of existing curbs extending 100 feet* around the perimeter of the site. (*Measured from the centerline of the adjacent roadway.)

II. GRADING PLAN INFORMATION		
Yes	No	
X		Proposed on-site and off-site storm drains and other flood control facilities with plan and profile sheets for public storm drains showing the class of pipe, (Class III, IV, V, etc.), design hydraulic grade line, (HGL) and 100 year storm flow. A public drainage easement must be provided over on-site storm drains conveying off-site flows. An overflow path must be provided over all storm drains.
X		All existing and "to be constructed" walls with cross-sections showing wall type, (e.g. block wall, retaining wall, flood wall, etc.), with limits clearly defined, adjacent ground elevations. Wall heights must meet current ordinances and in no case exceed 14 feet above the adjacent property.
	N/A	Street slopes for both interior and perimeter streets. Note: The minimum slope for a roadway is 0.4 percent, a minimum 18-inch storm drain must be provided where minimum slopes cannot be met.
	N/A	Back of lot elevations and lot drainage pattern for all lots including common lots.
	N/A	Sites with a grade difference two feet above or below existing ground are required to have approval from City of Las Vegas Current Planning. Current Planning approval is required prior to final approval of the drainage study.
X		On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners. (The project must pass flows through the site every 600 feet where the project is blocking flow paths.)
	N/A	This project uses a solid grouted stem wall (or approved alternate) at the back of sidewalk to provide erosion protection for landscaped areas where the depth of flow in the roadway exceeds the back of walk elevation. A corresponding cross-section detail is included.
	N/A	Commercial and Common Lot Landscape areas are not allowed to drain over the sidewalk. The grading plans show flow lines with grades and sidewalk under drains for all landscape areas draining to the public ROW.

III. Local Entity Criteria - City of Las Vegas – Manual Section 1600		
Yes	No	
	N/A	Concrete valley gutters are required in parking lots with slopes less than 1 percent. Slopes through cul-de-sac must be at a 1 percent minimum where flow is drained through the cul-de-sac.
X		Ten-foot wide public drainage easements to be privately maintained are allowed for flow less than 20 cfs. The depth of flow entering the easement must be checked using the submerged weir calculation.
	N/A	The limits of the flood zones and the base flood elevations (BFE) must be shown on all grading plans for all developments within a Special Flood Hazard Zone A, AO, AE, etc.
	N/A	Minimum finish floor elevation is 6 inches above highest adjacent top of curb. Finish floor calculations must include allowances for super elevations on curves and velocity head for tee intersections.
	N/A	Finished floor elevations for buildings adjacent to public drainage easements must be a minimum of 18 inches above the Q100 weir of submerged weir elevation, whichever is greater.

III. Local Entity Criteria - City of Las Vegas – Manual Section 1600		
Yes	No	
	N/A	Lots with "B and C Type Drainage" that drain from one lot to another through a drainage easement shall be required to install an underground nuisance drainage system or a 2-foot valley gutter. 16" x 24" minimum block wall openings are required for both options.
	N/A	Bubblers are required across 80 foot and greater ROW streets. When flows exceed 10 cfs, bubblers larger than 18 inches will be required up to a maximum of 36". Inlets must be sized to match the pipe size provided.

- Contact the Flood Control Section regarding the drainage study review fee. These fees are payable at the time of submittal.
- The Drainage Study must be conditionally approved prior to submitting improvement plans to the Civil and Planning Development of the Department of Building and Safety for review.

This document is intended as an **aid** in preparing Technical Drainage Studies for the City of Las Vegas. Each study submitted is reviewed for compliance with local and regional criteria. This form is not intended to be all-inclusive and does not limit the extent of the information, calculations or exhibits which may be necessary to properly evaluate the intended land use.

TECHNICAL DRAINAGE STUDY
FOR
SUMMERLIN VILLAGE 24
PARCEL COS-1 WASH

62024-226-2

January 2017

Prepared for:

The Howard Hughes Company, LLC
10801 W. Charleston Blvd., 3rd Floor
Las Vegas, Nevada 89135
Phone: (702) 791-4300
Fax: (702) 791-4450

Prepared by:

GCW, INC.
1555 S. Rainbow Blvd.
Las Vegas, Nevada 89146
Phone: (702) 804-2000
Fax: (702) 804-2299

TABLE OF CONTENTS

	Description	Page
I.	INTRODUCTION	1
II.	LOCATION AND DESCRIPTION	3
III.	FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOOD HAZARD ANALYSIS	3
IV.	CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT (CCRFCD) FACILITIES	3
V.	HYDROLOGY	8
VI.	EXISTING / INTERIM CONDITIONS	9
VII.	ULTIMATE CONDITIONS	12
VIII.	RECOMMENDED FACILITY DESIGN	12
IX.	CONCLUSIONS AND RECOMMENDATIONS	19
X.	REFERENCES	21

LIST OF TABLES

No.	Description	Page
1	INTERIM CONDITIONS PRORATED FLOW SUMMARY	9
2	100-YEAR DITCH/BERM CHARACTERISTICS	11
3	HEC-RAS SUMMARY – MIXED FLOW (ULTIMATE CONDITIONS)	15
4	COS-1 SCOUR WALL CALCULATIONS (ULTIMATE CONDITIONS)	17

LIST OF FIGURES

No.	Description	Page
1	VICINITY MAP	4
2	LOCATION MAP	5
3	F.I.R.M.	6
4	CCRFCD FACILITIES	7
5	EXISTING/INTERIM CONDITIONS DRAINAGE MAP	10
6	HEC-RAS EXHIBIT	14

I. INTRODUCTION

The Howard Hughes Company, LLC, is proposing to construct channel improvements including slope stabilization measures within the Parcel COS-1 wash for approximately 2,075 linear feet. The channel improvements will extend southeast from the existing Unit 2 Western Washes to the existing Unit 2 six-(6) barrel 5-foot wide by 5-foot high RCBCs at Crossbridge Drive. Parcel COS-1 includes a designated Waters of the U.S. (WOTUS), the established adjacent development setback from the WOTUS, and proposed channel improvements. Since Parcel COS-1 contains a designated WOTUS, the existing channel bottom and flow line will remain in its natural condition with proposed channel stabilization measures along the north and south side of the channel including slope protection and cut-off walls. The proposed channel improvements provide adequate grading for the interim and ultimate development conditions adjacent to the WOTUS in Parcel COS-1.

A comprehensive conceptual drainage study for the Summerlin Village 24 development entitled: *Update #2 to the Conceptual Drainage Study for Summerlin Village 24* (Reference 1, hereinafter referred to as the CDS Study), was approved by City of Las Vegas (CLV) on October 9, 2014. The CDS Study presented ultimate conditions onsite drainage patterns and major storm drain facilities within the exterior and interior roadways required for Village 24 development. Pertinent referenced material from the CDS Study has been included in Appendix C. Note that the proposed improvements are consistent with the CDS Study.

Update to the Technical Drainage Study for Summerlin Village 24 Parcel COS-2 (Reference 2, hereinafter, referred to as the COS-2 Study) was approved by CLV on December 22, 2016. The COS-2 Study provided the design for the COS-2 channel improvements, located immediately downstream of the COS-1 channel. Pertinent referenced material from the COS-2 Study has been included in Appendix C.

Update #6 to the Technical Drainage Study for Summerlin Village Unit 2 Improvements – Crossbridge Drive (Crossbridge Unit 1 to Suncreek Road) (Reference 3, hereinafter, referred to as the Unit 2 Study) was approved by CLV on March 24, 2016. The Unit 2 Study included the existing conditions COS-1 wash analysis and the design for Crossbridge Drive and the culvert crossings with the USBR Type IV Stilling Basin at Crossbridge Drive which is currently under construction to be in place prior to

construction of the Parcel COS-1 channel improvements. The proposed COS-1 wash improvements will ultimately discharge flows into the existing downstream Unit 2 improvements. The referenced Unit 2 improvements direct offsite flows through the Crossbridge Drive culvert crossings and stilling basin and ultimately into the Parcel COS-2 improvements. Pertinent referenced material from the Unit 2 Study has been included in Appendix C.

Update #4 to the Technical Drainage Study for Summerlin Village 24 Unit 2 Improvements – Sky Vista Improvements (Desert Moon Drive to Alta Drive including Sunkcreek Road) (Reference 4, hereinafter, referred to as the Sky Vista Study) was approved by CLV on July 7, 2015. The Sky Vista Study constructed the existing 48-inch RCP stub in Crossbridge Drive just north of the intersection with Suncreek Road to collect flows from the future Parcel K. The proposed improvements will extend the existing 48-inch RCP. Pertinent referenced material from the Sky Vista Study has been included in Appendix C.

The purpose of this report is to accompany the improvement plans, to provide detailed hydrologic and hydraulic analyses for the site, and to determine adequate protection for the project from offsite and onsite flows. The following tasks were performed in the preparation of this report:

- Identify previous drainage studies for the project site and surrounding areas.
- Determine the FEMA floodplain designation for the project site.
- Identify existing and proposed regional drainage facilities adjacent to the site.
- Identify existing, proposed, and ultimate drainage areas and facilities that affect the site.
- Recommend channel stabilization measures along the north and south side of the wash.
- Estimate peak runoff impacting the proposed grading and storm drain during the 100-year return period storms for existing and proposed conditions.
- Prepare hydraulic analyses for storm drain and proposed channel improvements.

II. LOCATION AND DESCRIPTION

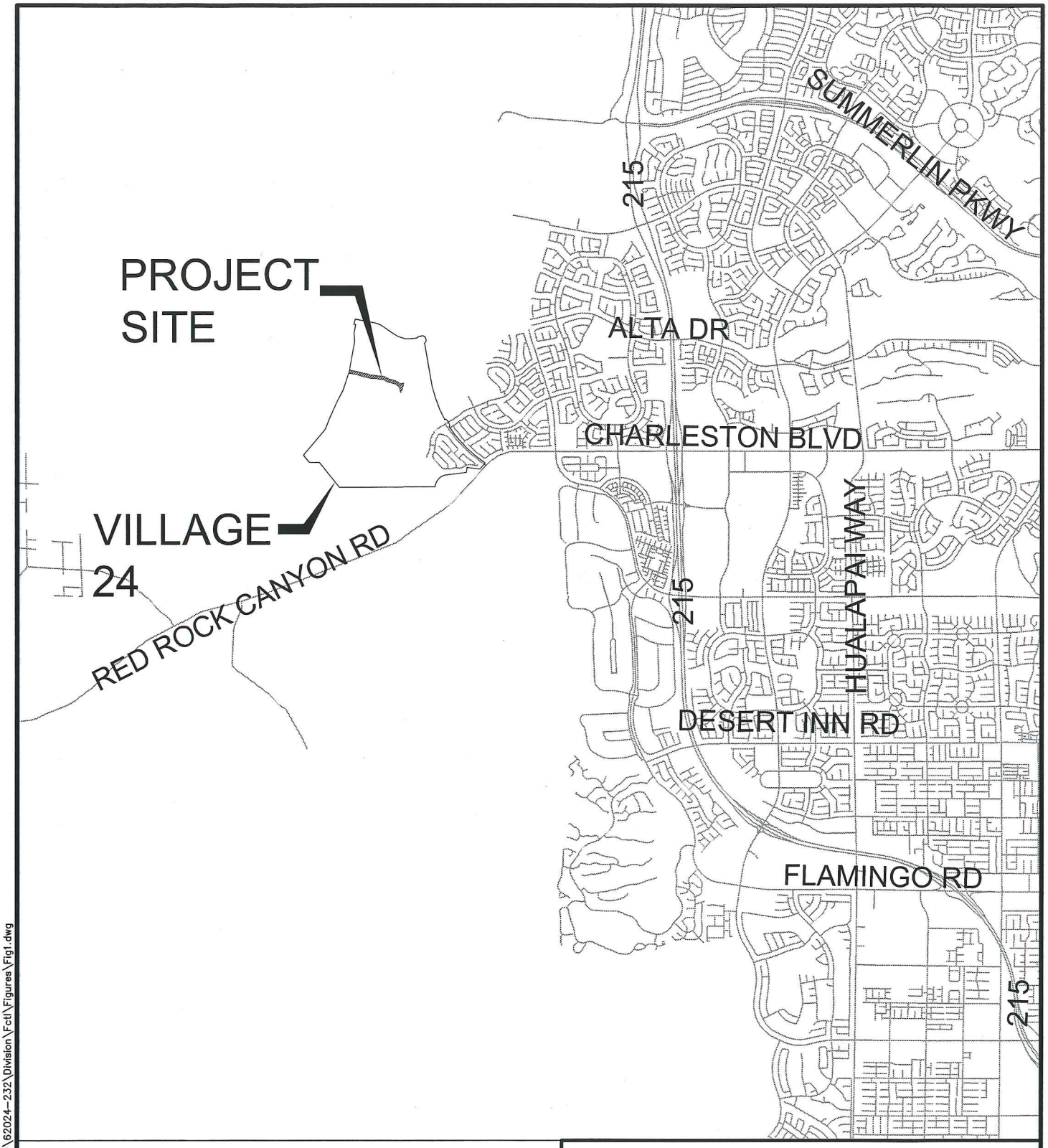
The project site is located within Summerlin Village 24 between the north Summerlin Village 24 boundary and Crossbridge Drive in Section 33, Township 20 South, Range 59 East M.D.M., in the City of Las Vegas, Nevada. The site is presently undeveloped with sparse vegetation and alluvial washes. The proposed improvements will provide protection for the existing WOTUS as well as active use trails. Please see Figure 1 and Figure 2 for the vicinity and location of the project site.

III. FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOOD HAZARD ANALYSIS

Based on the Flood Insurance Rate Map (FIRM) Community Panel 32003C 2150 E and Panel 32003C 2125E, dated September 27, 2002, the project site lies within a FEMA-designated Zone X. Areas designated as Zone X are described as being outside the 500-year floodplain and not located in a FEMA-designated Special Flood Hazard Area. Figure 3 shows the site denoted on a portion of the aforementioned FIRM.

IV. CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT (CCRFCD) FACILITIES

Figure 4 is reproduced from Figure F-29 of the 2013 Clark County Regional Flood Control District (CCRFCD) (Reference 5, hereinafter referred to as the 2013 MPU). This figure depicts the project site in relation to existing and proposed CCRFCD Facilities. As is shown on the figure, the proposed channel improvements are not adjacent to any CCRFCD Facilities. Flows from the proposed Parcel COS-1 Channel will ultimately discharge into the existing Red Rock Detention Basin (RRWA 0716) located south of Village 24. Note that the proposed improvements are consistent with the 2013 MPU and will not have an adverse impact on downstream facilities or properties.



GRAPHIC SCALE

5000 0 2500 5000

(IN FEET)

1 inch = 5000 ft.

NORTH

SUMMERLIN VILLAGE 24

PARCEL COS-1 WASH

FIGURE 1

VICINITY MAP

GCW ENGINEERS \ SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com

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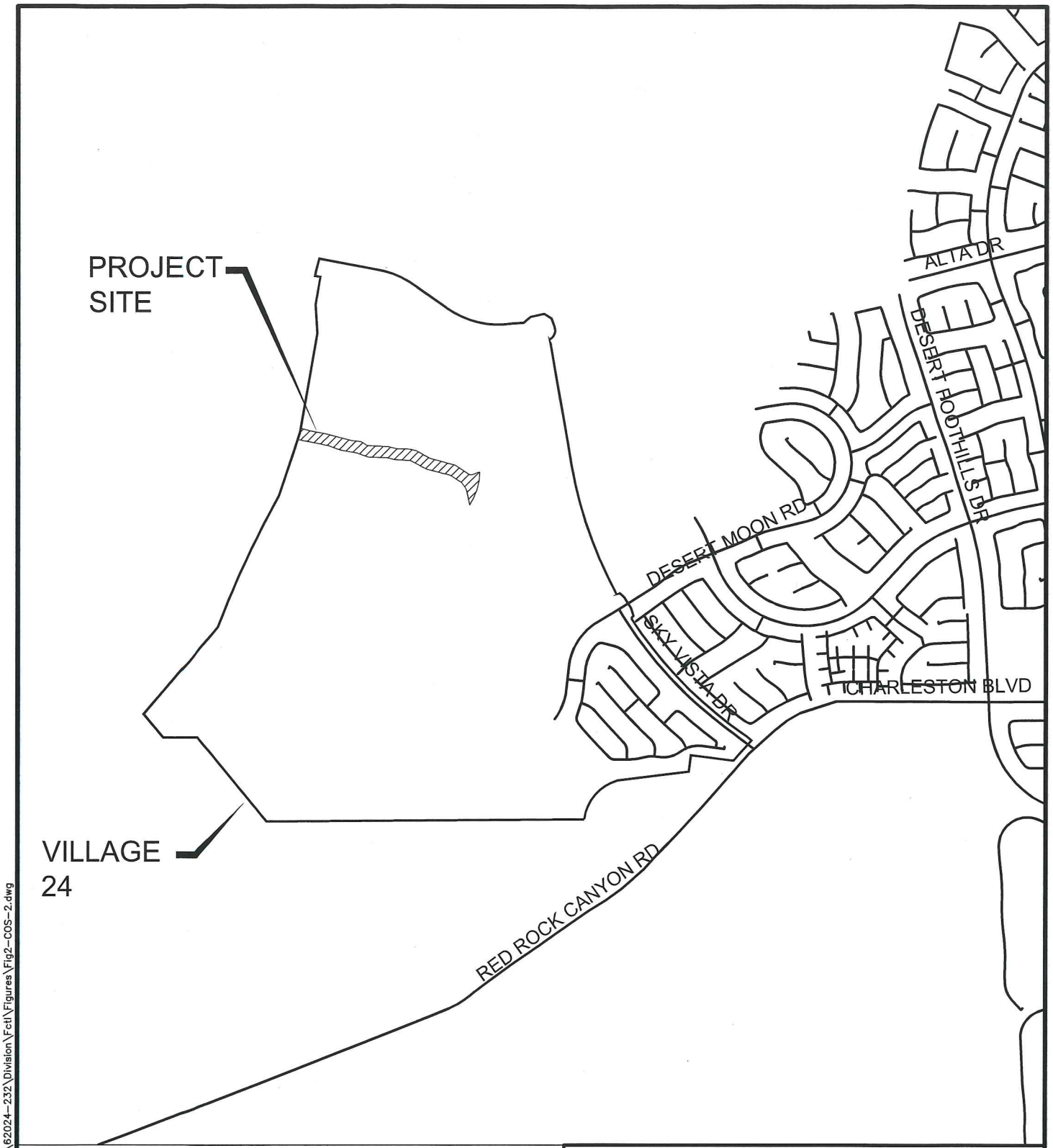

GRAPHIC SCALE

1500 0 750 1500

(IN FEET)

1 inch = 1500 ft.

NORTH

SUMMERLIN VILLAGE 24

PARCEL COS-1 WASH

FIGURE 2

LOCATION MAP

GCW ENGINEERS \ SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com

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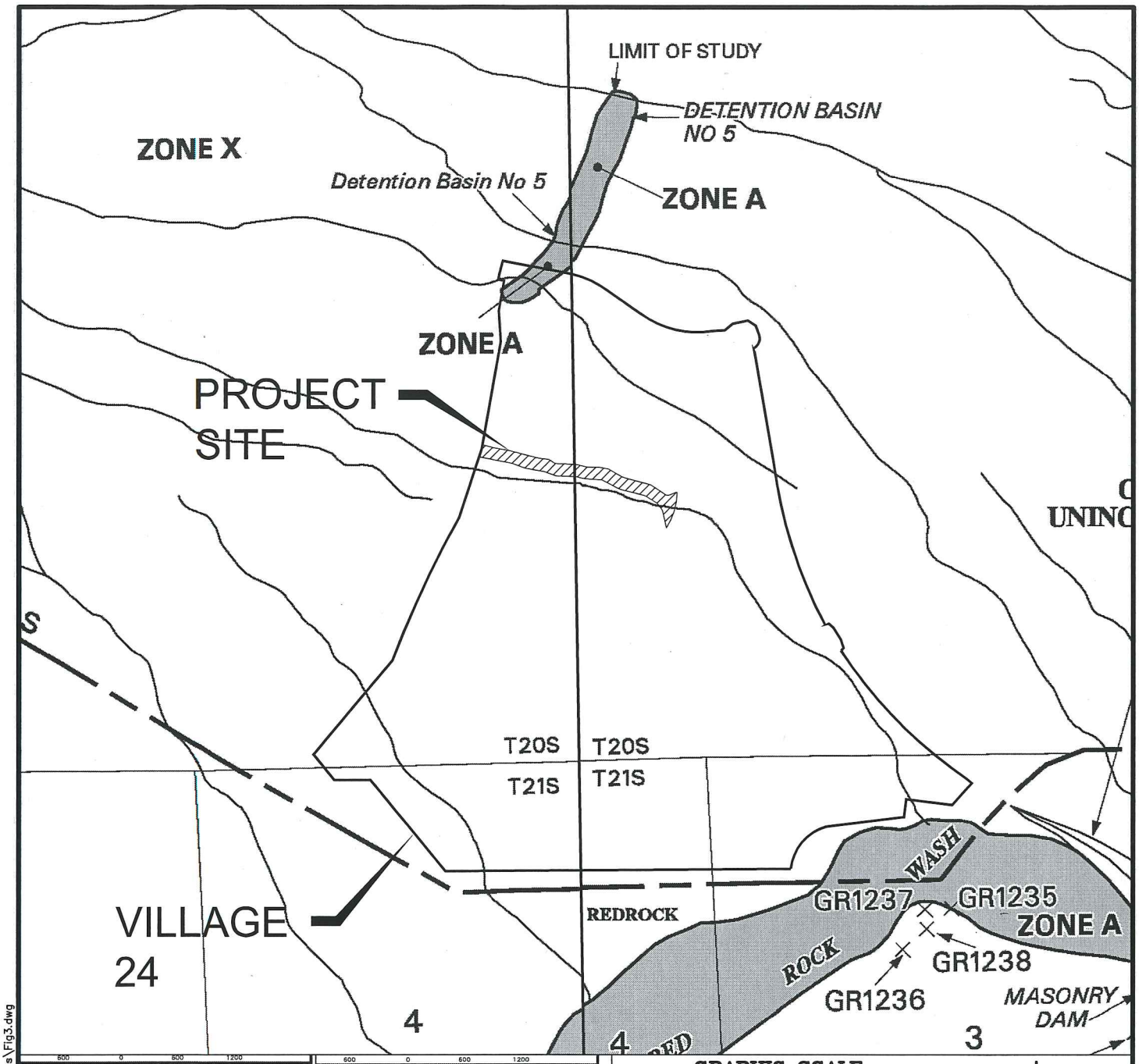

NFIP

PANEL 2125 E

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA AND INCORPORATED AREAS

PANEL 2125 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LAS VEGAS, CITY OF	325276	2125	E
CLARK COUNTY, UNINCORPORATED AREAS	320003	2125	E

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

MAP NUMBER 32003C2125 E

MAP REVISED: SEPTEMBER 27, 2002

Federal Emergency Management Agency

NFIP

PANEL 2150 E

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA AND INCORPORATED AREAS

PANEL 2150 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LAS VEGAS, CITY OF	325276	2150	E
CLARK COUNTY, UNINCORPORATED AREAS	320003	2150	E

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

MAP NUMBER 32003C2150 E

MAP REVISED: SEPTEMBER 27, 2002

Federal Emergency Management Agency

GRAPHIC SCALE

1500 0 750 1500

(IN FEET)

1 inch = 1500 ft.

NORTH

SUMMERLIN VILLAGE 24

PARCEL COS-1 WASH

FIGURE 3

F.I.R.M.

GCW ENGINEERS \ SURVEYORS
1555 S. RAINBOW BLVD.
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T: 702.804.2000
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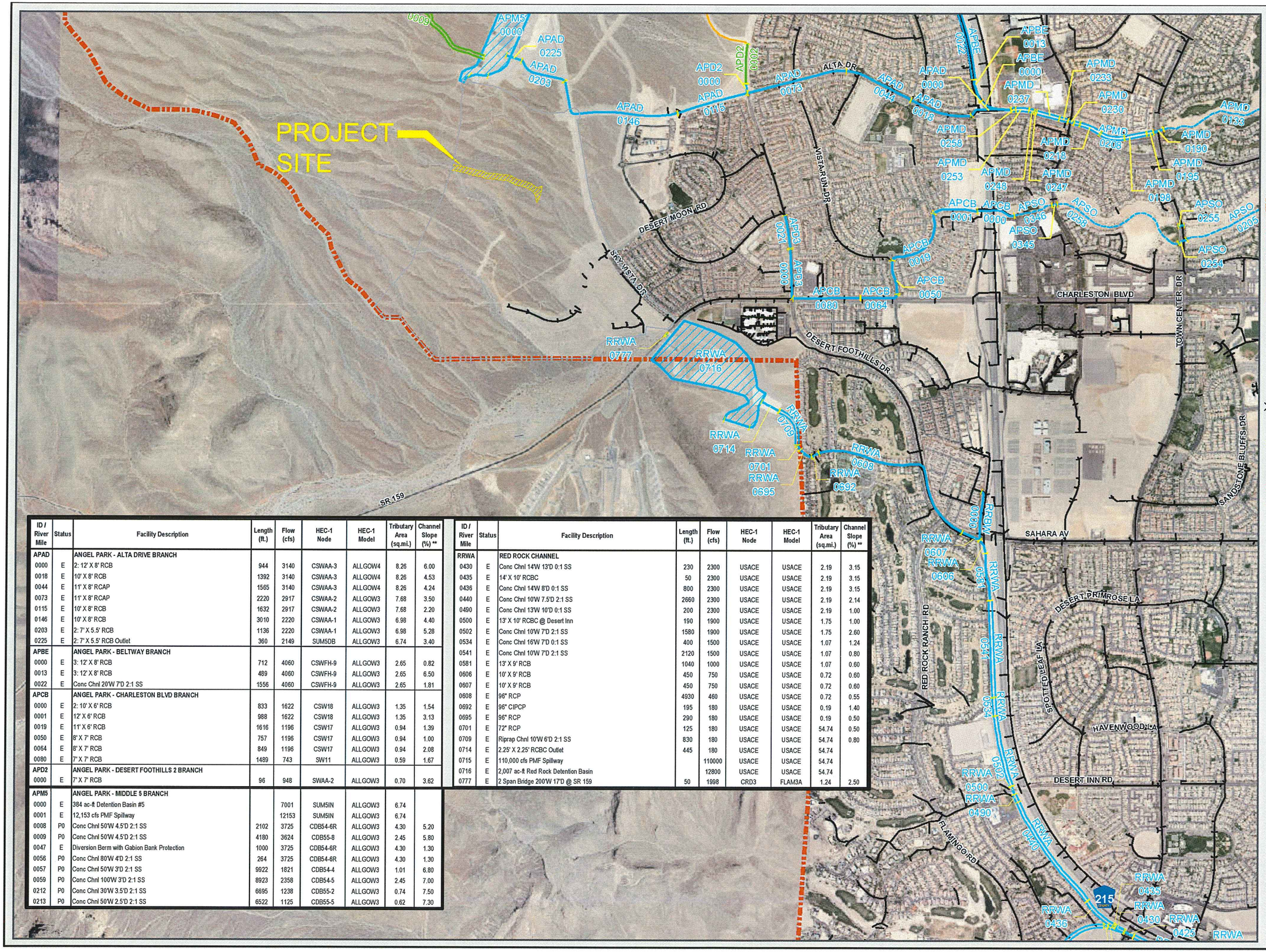
gcwengineering.com

nbaggs 01-24-17 18:18:25 F:\Projects\600\62024-232\Division\Fctl\Figures\Fig3.dwg



ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
APAD		ANGEL PARK - ALTA DRIVE BRANCH						
0000	E	2: 12' X 8' RCB	944	3140	CSWAA-3	ALLGOW4	8.26	6.00
0018	E	10' X 8' RCB	1392	3140	CSWAA-3	ALLGOW4	8.26	4.53
0044	E	11' X 8' RCAP	1565	3140	CSWAA-3	ALLGOW4	8.26	4.24
0073	E	11' X 8' RCAP	2220	2917	CSWAA-2	ALLGOW3	7.68	3.50
0115	E	10' X 8' RCB	1632	2917	CSWAA-2	ALLGOW3	7.68	2.20
0146	E	10' X 8' RCB	3010	2220	CSWAA-1	ALLGOW3	6.98	4.40
0203	E	2: 7' X 5.5' RCB	1136	2220	CSWAA-1	ALLGOW3	6.98	5.28
0225	E	2: 7' X 5.5' RCB Outlet	360	2149	SUM5DB	ALLGOW3	6.74	3.40
APBE		ANGEL PARK - BELTWAY BRANCH						
0000	E	3: 12' X 8' RCB	712	4060	CSWFH-9	ALLGOW3	2.65	0.82
0013	E	3: 12' X 8' RCB	489	4060	CSWFH-9	ALLGOW3	2.65	6.50
0022	E	Conc Chnl 20'W 7'D 2:1 SS	1556	4060	CSWFH-9	ALLGOW3	2.65	1.81
APCB		ANGEL PARK - CHARLESTON BLVD BRANCH						
0000	E	2: 10' X 6' RCB	833	1622	CSW18	ALLGOW3	1.35	1.54
0001	E	12' X 6' RCB	988	1622	CSW18	ALLGOW3	1.35	3.13
0019	E	11' X 6' RCB	1616	1196	CSW17	ALLGOW3	0.94	1.39
0050	E	8' X 7' RCB	757	1196	CSW17	ALLGOW3	0.94	1.00
0064	E	8' X 7' RCB	849	1196	CSW17	ALLGOW3	0.94	2.08
0080	E	7' X 7' RCB	1489	743	SW11	ALLGOW3	0.59	1.67
APD2		ANGEL PARK - DESERT FOOTHILLS 2 BRANCH						
0000	E	7' X 7' RCB	96	948	SWAA-2	ALLGOW3	0.70	3.62
APM5		ANGEL PARK - MIDDLE 5 BRANCH						
0000	E	384 ac-ft Detention Basin #5		7001	SUM5IN	ALLGOW3	6.74	
0001	E	12,153 cfs PMF Spillway		12153	SUM5IN	ALLGOW3	6.74	
0008	P0	Conc Chnl 50'W 4.5'D 2:1 SS	2102	3725	CDB54-6R	ALLGOW3	4.30	5.20
0009	P0	Conc Chnl 50'W 4.5'D 2:1 SS	4180	3624	CDB55-8	ALLGOW3	2.45	5.80
0047	E	Diversion Berm with Gabion Bank Protection	1000	3725	CDB54-6R	ALLGOW3	4.30	1.30
0056	P0	Conc Chnl 80'W 4'D 2:1 SS	264	3725	CDB54-6R	ALLGOW3	4.30	1.30
0057	P0	Conc Chnl 50'W 3'D 2:1 SS	9922	1821	CDB54-4	ALLGOW3	1.01	6.80
0059	P0	Conc Chnl 100'W 3'D 2:1 SS	8923	2358	CDB54-5	ALLGOW3	2.45	7.00
0212	P0	Conc Chnl 30'W 3.5'D 2:1 SS	6695	1238	CDB55-2	ALLGOW3	0.74	7.50
0213	P0	Conc Chnl 50'W 2.5'D 2:1 SS	6522	1125	CDB55-5	ALLGOW3	0.62	7.30

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
RRWA		RED ROCK CHANNEL						
0430	E	Conc Chnl 14'W 13'D 0:1 SS	230	2300	USACE	USACE	2.19	3.15
0435	E	14' X 10' RCBC	50	2300	USACE	USACE	2.19	3.15
0436	E	Conc Chnl 14'W 8'D 0:1 SS	800	2300	USACE	USACE	2.19	3.15
0440	E	Conc Chnl 10'W 7.5'D 2:1 SS	2660	2300	USACE	USACE	2.19	2.14
0490	E	Conc Chnl 13'W 10'D 0:1 SS	200	2300	USACE	USACE	2.19	1.00
0500	E	13' X 10' RCBC @ Desert Inn	190	1900	USACE	USACE	1.75	1.00
0502	E	Conc Chnl 10'W 7'D 2:1 SS	1580	1900	USACE	USACE	1.75	2.60
0534	E	Conc Chnl 16'W 7'D 0:1 SS	400	1500	USACE	USACE	1.07	1.24
0541	E	Conc Chnl 10'W 7'D 2:1 SS	2120	1500	USACE	USACE	1.07	0.80
0581	E	13' X 9' RCB	1040	1000	USACE	USACE	1.07	0.60
0606	E	10' X 9' RCB	450	750	USACE	USACE	0.72	0.60
0607	E	10' X 9' RCB	450	750	USACE	USACE	0.72	0.60
0608	E	96" RCP	4930	460	USACE	USACE	0.72	0.55
0692	E	96" CIPCP	195	180	USACE	USACE	0.19	1.40
0695	E	96" RCP	290	180	USACE	USACE	0.19	0.50
0701	E	72" RCP	125	180	USACE	USACE	54.74	0.50
0709	E	Riprap Chnl 10'W 6'D 2:1 SS	830	180	USACE	USACE	54.74	0.80
0714	E	2.25' X 2.25' RCBC Outlet	445	180	USACE	USACE	54.74	
0715	E	110,000 cfs PMF Spillway		110000	USACE	USACE	54.74	
0716	E	2,007 ac-ft Red Rock Detention Basin		12800	USACE	USACE	54.74	
0777	E	2 Span Bridge 200'W 17'D @ SR 159	50	1998	CRD3	FLAM3A	1.24	2.50

REGIONAL FLOOD CONTROL DISTRICT

2013
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FIGURE F- 29
FLOOD CONTROL FACILITIES

LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed Facilities
- Detention Basin
- Stormdrain
- Lined Channel
- Unlined Channel
- Levee/Dike
- Natural Wash/Floodway
- ID-Mile Separator

Remove & Replace/Parallel Facilities

Category A	Category B
Channel	Channel
Stormdrain	Stormdrain

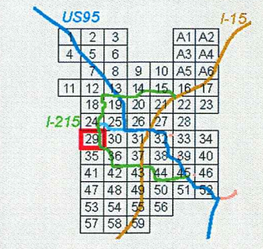
FIGURE 4

N

0 500 1,000 2,000 3,000
Feet

Scale: 1 inch = 2,000 feet

Refer to Figure G-2 for Aerial Source(s)



V. HYDROLOGY

The methodology presented in this study is in compliance with the *CCRFCD Hydrologic Criteria and Drainage Design Manual* (Reference 6, hereinafter referred to as the Manual).

Drainage Areas and Flow Patterns - The subbasins and flow patterns used to determine the existing/interim conditions flow rates impacting the proposed channel improvements were referenced from the Unit 2 Study and then prorated based on cfs per acre to determine the flows generated onsite. The onsite proposed conditions flow patterns match existing flow patterns. The project site lies within Subbasin RG6C shown on the referenced Unit 2 Study Figure 7U3R – Interim Conditions Drainage Map included in Appendix C. A unit flow rate (cfs/acre) for the subbasins were calculated by dividing the total flow rate of the subbasin by the overall subbasin area. The total flow rate generated by the areas shown on Figure 5 is approximated by multiplying the calculated unit flow rate (cfs/acre) by the delineated portion of tributary area (acres). Flows generated by the prorated subbasins will discharge to the south and ultimately into the existing Crossbridge Drive storm drain system. Prorate calculations for the Site have been included on Figure 5. Pertinent reference material has been included in Appendix C.

The subbasins and flow patterns used to determine the ultimate conditions onsite flow rates were referenced from the CDS Study. The project site lies within Subbasin COS-1 shown on the referenced CDS Study Figure 6U2 – Ultimate Conditions Drainage Basin Map included in Appendix C. Flows generated by the site will discharge to the south and ultimately into the existing Crossbridge Drive storm drain system. Pertinent reference material has been included in Appendix C.

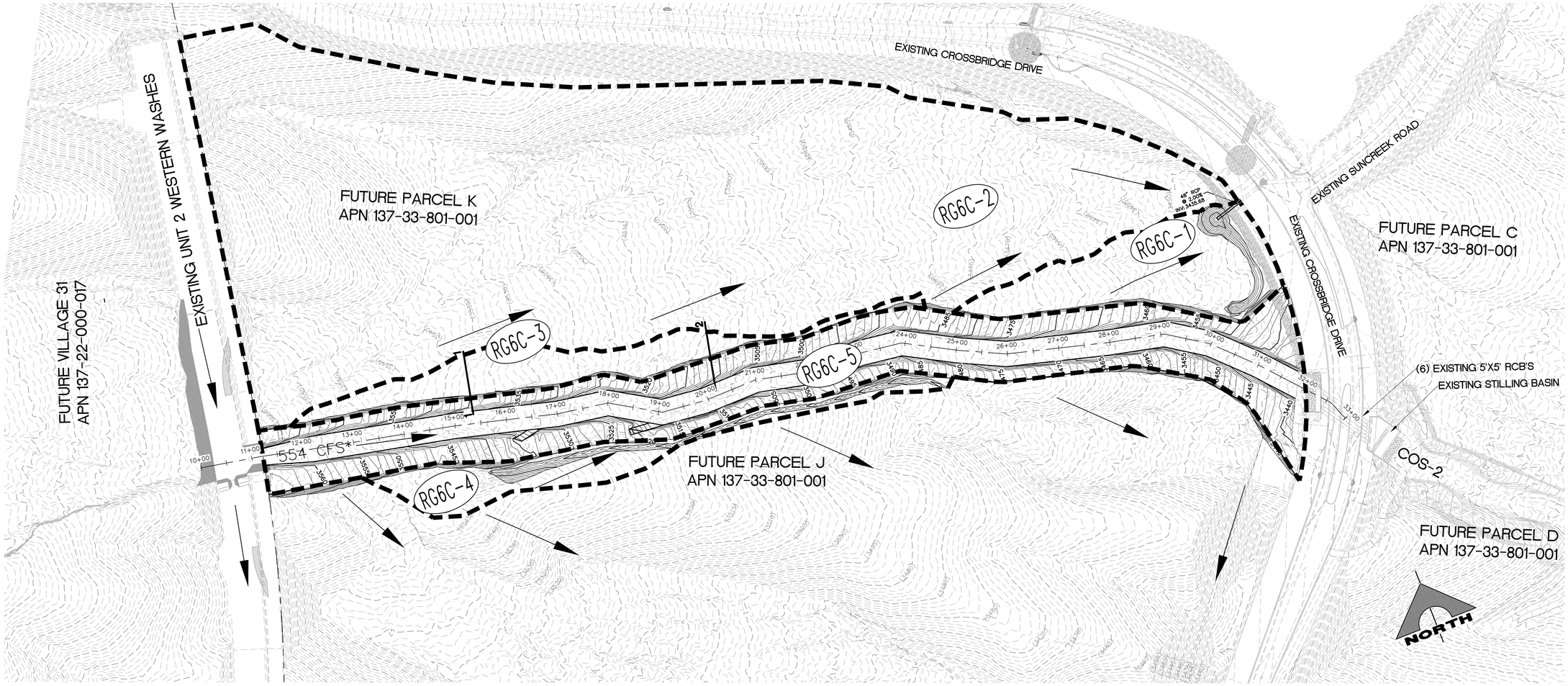
VI. EXISTING / INTERIM CONDITIONS

Existing conditions for the project were addressed in the Unit 2 Study. Pertinent reference materials have been included in Appendix C. Currently runoff west of the COS-1 channel improvements enters the existing Unit 2 Western Wash Channel where a portion of the flow (554 cfs) is diverted into natural washes through Parcel COS-1, and is directed via six-(6) barrel 5-foot wide by 5-foot high RCBCs at Crossbridge Drive into Parcel COS-2 and ultimately to existing drop structures and storm drain improvements within the Unit 1 Crossbridge Drive alignment. Offsite flows impacting the existing project site have been referenced and prorated from the Unit 2 Study. See referenced Figure 7U3R – Interim Conditions Drainage Map from the Unit 2 Study included in Appendix C. Interim conditions flows generated north and south of Parcel COS-1 will be conveyed parallel with the parcel and into the existing improvements from the Sky Vista and Unit 2 Studies at Crossbridge Drive. Figure 5 depicts the existing/interim drainage patterns used in the hydrologic analysis. Table 1 summarizes the prorated proposed conditions offsite flow rates and has been included on Figure 5.

TABLE 1
SUMMARY OF PRORATED STORM FLOWS
INTERIM CONDITION

Parent Basin	Area (ac)	Q_{100} (cfs)	Unit Flow (cfs/ac)
RG6C*	30.7	85	2.77
Prorated Subbasins			
Subbasin	Area (ac)	Unit Flow (cfs/ac)	Q_{100} (cfs)
RG6C-1	1.82	2.77	5
RG6C-2	20.62	2.77	57
RG6C-3	1.37	2.77	4
RG6C-4	1.28	2.77	4
RG6C-5	6.14	2.77	17

*Referenced from the Unit 2 Study
*See Figure 5



100-YEAR DITCH/BERM CHARACTERISTICS									
Ditch	Slope (%)	Q_{100} (cfs)	Depth of flow (ft)	Velocity (ft/s)	Bottom Width (ft)	Type	Side Slopes	Reqd d_{50} (in)	Tributary Subbasin
RG6C-1	0.50	5	0.85	2.3	0	V	3:1 / 3:1	N/A	RG6C-1
RG6C-4 MAX	10.20	4	0.53	4.73	0	V	3:1 / 3:1	12	RG6C-4
RG6C-4 MIN	5.00	4	0.61	3.62	0	V	3:1 / 3:1	12	RG6C-4
1-1	5.80	4	0.25	3.60	0	V	2:1 / NATURAL	N/A	RG6C-3
2-2	5.70	4	0.30	3.97	0	V	2:1 / NATURAL	N/A	RG6C-3

SUMMARY OF PRORATED STORM FLOWS INTERIM CONDITION			
100-Year Runoff			
Parent Basin	Area (ac)	Q_{100} (cfs)	Unit Flow (cfs/ac)
RG6C*	30.7	85	2.77
Prorated Subbasins			
SubBasin	Area (ac)	Unit Flow (cfs/ac)	Q_{100} (cfs)
RG6C-1	1.82	2.77	5
RG6C-2	20.62	2.77	57
RG6C-3	1.37	2.77	4
RG6C-4	1.28	2.77	4
RG6C-5	6.14	2.77	17

*Referenced from the Unit 2 Study

100 0 100 200
SCALE FEET

LEGEND

RG6C-1 PRORATE SUBBASIN

PRORATE SUBBASIN BOUNDARY

1 1 DITCH CROSS SECTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP	DATE:

PROJECT NO. 62024-226-2
DESIGN:
DRAWN:
CHECK:
PLOT DATE: 01-25-17
PLOT TIME: 13:15:32

GCW ENGINEERS \ SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com

F:\Projects\600\62024-226-2\Division\Fed\Figures\Fig_5U3R_INTERIM.dwg
Nelson Boggs

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 PARCEL COS-1 WASH

INTERIM CONDITIONS DRAINAGE MAP

DRAWING
FIG 5
1 OF 1 SHTS

LD#
HTE: 00-00000

In order to maintain drainage patterns approved in the CDS Study, ditches/berms have been provided along the northern and southern boundary of Parcel COS-1. Flows tributary to the proposed ditches/berms have been referenced and prorated from the Unit 2 Study Interim Drainage Conditions Figure 7U3R. Flows impacting the northern boundary of Parcel COS-1 will be directed to the proposed 48-inch RCP stub extending from Crossbridge Drive. Please note that the project proposes to extend the existing 48-inch RCP Sky Vista stub. The 48-inch RCP stub has been provided for interim and future development of Parcel K. The starting water surface elevation at the downstream end of the proposed 48-inch RCP model has been referenced from the Sky Vista Study at the existing 48-inch RCP stub in Crossbridge Drive. A copy of the hydraulic model and inlet control calculation has been included in Appendix B. Flows impacting the southern boundary of Parcel COS-1 will be directed east and south to existing channels west of Crossbridge Drive and ultimately into the Unit 2 54-inch RCP stub located in Crossbridge Drive located approximately 600 feet south of Parcel COS-1. The existing 54-inch RCP stub is for future development of Parcel J. Please not that these interim conditions flows are consistent with the Unit 2 Study. Copies of the hydraulic models have been included in Appendix B. Pertinent reference materials have been included in Appendix C. Information for the berms/ditches has been included on Figure 5. All offsite ditches/berms are summarized in Table 2. Normal depth calculations for the ditches have been included in Appendix B. Pertinent reference materials have been included in Appendix C.

TABLE 2
100-YEAR DITCH/BERM CHARACTERISTICS

Ditch*	Slope (%)	Q_{100} (cfs)	Depth of flow (ft)	Velocity (ft/s)	Bottom Width (ft)	Type	Side Slopes	Req'd d_{50} (in)	Tributary Subbasin
RG6C-1	0.50	5	0.85	2.3	0	V	3:1 / 3:1	N/A	RG6C-1
RG6C-4 MAX	10.20	4	0.53	4.73	0	V	3:1 / 3:1	12	RG6C-4
RG6C-4 MIN	5.00	4	0.61	3.62	0	V	3:1 / 3:1	12	RG6C-4
1-1	5.80	4	0.25	3.60	0	V	2:1 / NATURAL	N/A	RG6C-3
2-2	5.70	4	0.30	3.97	0	V	2:1 / NATURAL	N/A	RG6C-3

*See Figure 5

The proposed ditches will have a minimal freeboard above the calculated water surface elevation since the ditches serve to direct offsite flows for interim conditions only. Flows from the proposed ditches will be conveyed from northwest to southeast into the

existing Sky Vista and Unit 2 storm drain systems. The proposed discharge points are consistent with the previously approved referenced drainage studies.

VII. ULTIMATE CONDITIONS

Ultimate Conditions for the proposed Parcel COS-1 channel improvements have been referenced from the CDS Study. Ultimate conditions flows generated within Parcel COS-1 will discharge southeasterly into the existing Unit 2 six-(6) barrel 5-foot wide by 5-foot high RCBCs at Crossbridge Drive. Pertinent referenced materials from the CDS Study have been included in Appendix C.

The proposed 48-inch RCP has been provided for the future development of Parcel K and has been designed to convey the entire ultimate conditions flow rate of 80 cfs. The existing 54-inch RCP south of the project site is for the future development of Parcel J and has been designed to convey the entire ultimate conditions flow rate of 110 cfs. Copies of the hydraulic models have been included in Appendix B. Pertinent referenced materials from the CDS Study have been included in Appendix C.

Finished floor elevations for the future developments adjacent to parcel COS-1 wash will be set at 18-inches above the adjacent channel water surface elevation.

VIII. RECOMMENDED FACILITY DESIGN

Upstream of the existing Crossbrige Drive culverts, the referenced Unit 2 Study COS1 HEC-RAS Model runs from the western boundary channel and ends at the outlet of the proposed culvert upstream of the stilling basin. The referenced Unit 2 Study COS2 HEC-RAS Model begins at the downstream end of the stilling basin and ends at the existing downstream facilities located at the intersection of Sky Vista and Crossbridge Drive. Copies of the referenced models have been included Appendix C.

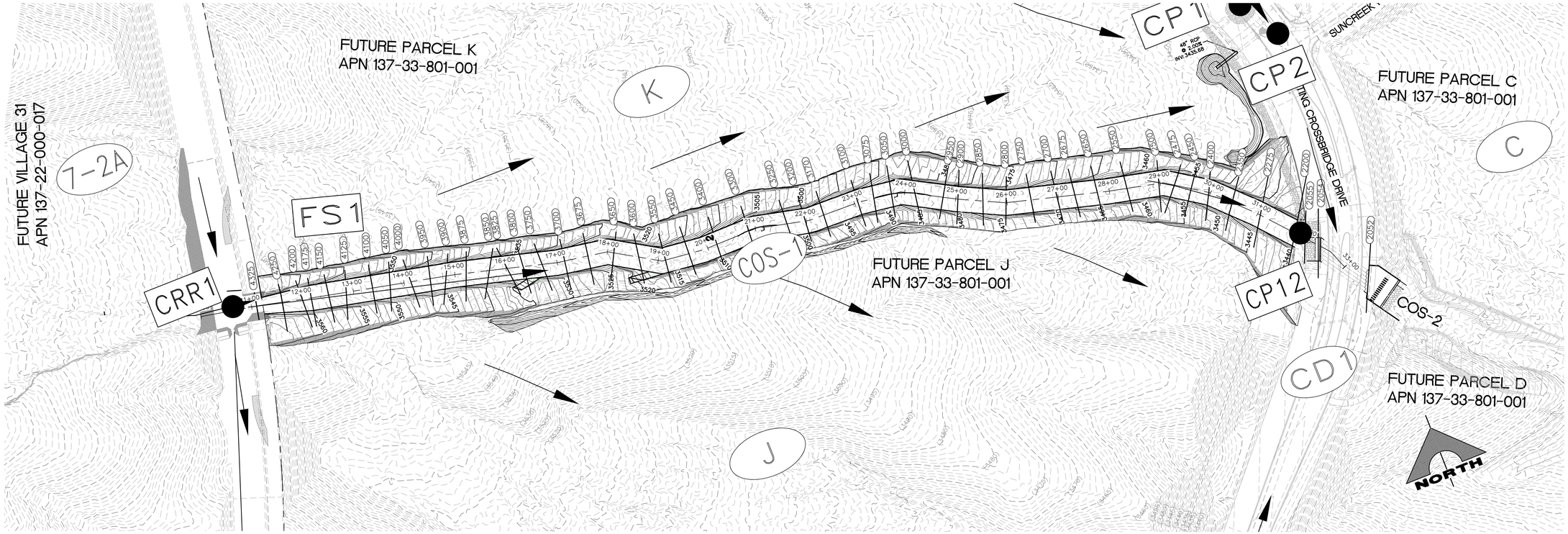
The proposed Parcel COS-1 channel improvements have been designed using the ultimate conditions flow rate of 554 cfs referenced from the CDS and the Unit 2 Study for the 100-year storm event since it represents the worst-case flow along Parcel COS-1. Hydraulic modeling for the proposed channel improvements were performed within the U.S. Army Corps of Engineers HEC-RAS River Analysis System computer program

version 4.1.0 (Reference 7). Corresponding stations correlating the hydraulic model stationing with the improvement plan centerline stationing have been included on Table 3 and on Figure 6. HEC-RAS output summary and station locations have been included on Figure 6. In general, HEC-RAS cross sections have been provided at 50 foot intervals to match the existing conditions Unit 2 HEC-RAS station locations. Additionally, HEC-RAS cross sections have been provided at and downstream of the proposed Crossbridge Drive Culverts, and at bend locations.

Mixed, subcritical, and supercritical flow regimes for the proposed COS-1 channel reach were modeled and reviewed. Results indicate that the mixed flow regime best represents the hydraulics of the Parcel COS-1 berm/channel improvements and governs the proposed design of the channel improvements. Table 3 summarizes the HEC-RAS results using the mixed flow regime with the calculated freeboard and super-elevation to evaluate the proposed channel wall heights necessary for the proposed channel. Where velocities are greater than 5 feet per second, rock-lining has been proposed with a 5-foot deep concrete cut-off wall to provide erosion protection along the proposed Parcel COS-1 berms.

Super-elevation heights along the proposed berms along the existing Parcel COS-1 were calculated using Equation 740 from the Manual. Freeboard for the proposed berms was calculated with Equation 748 from the Manual. Copies of the HEC-RAS models (including digital files) using a mixed flow regime for the ultimate conditions flow rates has been included in Appendix B. The following model has been included in Appendix B: COS1_ULT.

Expansion and contraction coefficients for the proposed channel cross sections and transitions have been utilized in the model according to the HEC-RAS River Analysis System Hydraulic Reference Manual (Reference 8, HEC-RAS Manual). In general, contraction and expansion coefficients at the cross sections assume values of 0.05 and 0.1, respectively, for gradual transitions under supercritical flow.



COS1 - HYDRAULIC MODELS RESULTS SUMMARY AND SUPER-ELEVATION CALCULATIONS (ULTIMATE CONDITIONS)														
Sta	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Freeboard	Superelevation	Total Depth	Berm Height
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)	(ft)
4325	11+10	554	3559.20	3561.44	2.24	8.23	39.42	0.97	0	1.6	0.0	3.8	4.0
4250	11+60	554	3558.00	3560.13	2.13	9.09	45.75	1.33	0	1.3	0.0	3.4	4.0
4200	11+99	554	3557.00	3558.30	1.30	10.17	53.39	1.73	0	1.3	0.0	2.6	3.5
4175	12+17	554	3556.00	3557.26	1.26	10.35	54.56	1.80	0	1.3	0.0	2.5	3.5
4150	12+51	554	3554.00	3555.19	1.19	10.46	55.17	1.84	0	1.3	0.0	2.5	3.5
4125	12+86	554	3552.00	3553.09	1.09	10.40	57.00	1.85	0	1.3	0.0	2.4	3.5
4100	13+38	554	3548.00	3549.97	1.97	10.13	48.44	1.68	0	1.3	0.0	3.3	3.5
4050	13+72	554	3546.00	3547.44	1.44	11.39	51.91	2.02	0	1.3	0.0	2.8	3.5
4000	14+13	554	3544.00	3545.21	1.21	10.67	49.34	1.78	0	1.3	0.0	2.5	3.5
3950	14+51	554	3542.00	3543.02	1.02	10.38	56.71	1.81	0	1.3	0.0	2.3	3.5
3900	14+83	554	3540.00	3541.28	1.28	10.12	51.59	1.69	0	1.3	0.0	2.6	3.5
3875	15+22	554	3537.00	3538.38	1.38	10.81	42.40	1.69	0	1.3	0.0	2.7	3.5
3850	15+67	554	3535.00	3536.22	1.22	10.23	52.80	1.74	0	1.3	0.0	2.5	3.5
3825	16+02	554	3533.00	3534.58	1.58	9.19	76.05	1.61	0	1.3	0.0	2.8	3.5
3800	16+33	554	3531.00	3532.33	1.33	10.15	64.66	1.95	0	1.3	0.0	2.6	3.5
3750	16+71	554	3529.00	3530.11	1.11	10.15	56.77	1.79	0	1.3	0.0	2.4	3.5
3700	17+15	554	3526.00	3527.00	1.00	10.77	54.75	1.90	0	1.3	0.0	2.3	3.5
3675	17+61	554	3523.00	3524.44	1.44	9.83	55.39	1.68	0	1.3	0.0	2.7	3.5
3650	18+13	554	3520.00	3521.23	1.23	10.56	53.77	1.86	160	1.3	0.6	3.1	3.5
3600	18+62	554	3517.00	3517.85	0.85	10.70	70.55	2.08	0	1.3	0.0	2.1	3.5
3550	19+14	554	3513.00	3514.80	1.80	10.15	52.14	1.68	200	1.3	0.4	3.5	3.5
3450	19+62	554	3510.00	3511.98	1.98	10.66	55.80	1.94	0	1.3	0.0	3.3	3.5
3400	20+19	554	3506.00	3508.22	2.22	9.97	52.97	1.69	0	1.3	0.0	3.5	3.5
3300	20+86	554	3502.00	3503.74	1.74	11.47	47.10	1.96	590	1.3	0.2	3.2	3.5
3250	21+62	554	3498.00	3499.10	1.10	10.46	54.89	1.85	0	1.3	0.0	2.4	3.5
3200	21+98	554	3496.00	3497.20	1.20	9.95	55.24	1.71	565	1.3	0.2	2.6	3.5
3170	22+36	554	3494.00	3495.03	1.03	10.18	56.11	1.77	0	1.3	0.0	2.3	3.5
3100	23+07	554	3489.00	3490.88	1.88	10.30	56.68	1.82	0	1.3	0.0	3.2	3.5
3075	23+39	554	3488.00	3488.99	0.99	10.22	59.08	1.81	0	1.3	0.0	2.2	3.5
3050	23+74	554	3485.00	3486.43	1.43	10.97	57.90	2.01	165	1.3	0.7	3.4	3.5
3000	24+20	554	3482.00	3482.96	0.96	11.04	56.57	2.03	165	1.3	0.6	2.9	3.5
2950	24+75	554	3479.00	3480.34	1.34	9.38	48.76	1.49	0	1.3	0.0	2.6	3.5
2900	25+04	554	3477.00	3478.26	1.26	10.39	51.33	1.79	0	1.3	0.0	2.5	3.5
2850	25+53	554	3474.00	3475.19	1.19	10.64	57.14	1.91	0	1.3	0.0	2.5	3.5
2800	25+98	554	3471.00	3472.41	1.41	10.19	54.67	1.76	850	1.3	0.1	2.8	3.5
2750	26+47	554	3469.00	3470.21	1.21	9.52	55.12	1.60	0	1.3	0.0	2.5	3.5
2700	26+98	554	3466.00	3467.21	1.21	10.28	54.13	1.80	0	1.3	0.0	2.5	3.5
2675	27+33	554	3464.00	3465.23	1.23	10.22	56.16	1.79	0	1.3	0.0	2.5	3.5
2650	27+76	554	3461.00	3462.67	1.67	10.35	55.97	1.81	0	1.3	0.0	3.0	3.5
2550	28+35	554	3458.00	3459.24	1.24	10.50	51.89	1.80	0	1.3	0.0	2.5	3.5
2500	28+97	554	3454.00	3455.15	1.15	10.95	52.07	1.92	440	1.3	0.2	2.7	3.5
2475	29+28	554	3452.00	3453.50	1.50	10.11	49.71	1.68	440	1.3	0.2	3.0	3.5
2450	29+62	554	3450.00	3451.80	1.80	10.25	49.00	1.68	440	1.3	0.2	3.3	3.5
2400	29+97	554	3448.00	3449.61	1.61	11.71	35.58	1.71	440	1.3	0.2	3.1	3.5
2350	30+46	554	3445.00	3446.14	1.14	12.17	54.85	2.34	440	1.3	0.3	2.7	3.5
2275	31+06	554	3441.00	3442.47	1.47	9.91	58.44	1.73	440	1.3	0.2	3.0	3.5
2200	31+82	554	3437.00	3438.21	1.21	10.08	56.94	1.78	0	1.3	0.0	2.5	3.5
2055	32+04	554	3434.00	3435.22	1.22	12.20	64.55	2.56	0	1.3	0.0	2.5	5.0
2054	32+33	554	3430.00	3434.34	4.34	1.89	69.54	0.16	0	1.0	0.0	5.3	12.0
2053	-	Culvert			-				-	-	-	-	-
2052	-	554	3425.00	3426.14	1.14	11.09	79.15	1.83	0	1.3	0.0	2.4	-

100 0 100 200
SCALE FEET

LEGEND

- COS-1 — DRAINAGE SUBBASIN
- CP1 — CONCENTRATION POINT
- SUBBASIN BOUNDARY
- 2052 — HEC-RAS CROSS SECTION

DATE:
GCW APP
DATE
AGEN APP
DATE
DESCRIPTION
REV DATE

PROJECT NO. 62024-226-2
DESIGN:
DRAWN:
CHECK:
PLOT DATE: 01-25-17
PLOT TIME: 13:18:00

GCW ENGINEERS \ SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com

F:\Projects\600\62024-226-2\Division\Fc1\Figures\Fig_9U3R.dwg
Nelson Boggs

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 PARCEL COS-1 WASH

HEC-RAS CROSS SECTION EXHIBIT (PARCEL COS-1)

DRAWING
FIG 6
1 OF 1 SHTS

LD#:

HTE: 00-00000

Please note that the starting water surface elevation at the downstream end of the COS1_ULT model is referenced from the Unit 2 Study at the existing Unit 2 six-(6) barrel 5-foot wide by 5-foot high RCBCs at Crossbridge Drive. The starting water surface elevation at the upstream end of the COS1_ULT model is referenced from the Unit 2 Study at the existing CRR1 Western Washes flow split structure. Pertinent reference materials have been included in Appendix C.

TABLE 3
HEC-RAS SUMMARY – MIXED FLOW (ULTIMATE CONDITIONS)

Sta*	Plan Sta	ULT Q (cfs)	FL Elev (ft)	WS Elev (ft)	Depth (ft)	Vel (ft/s)	Top Width (ft)	Froude #	Radius	Super -elev (ft)	Total Depth (ft)	Chnl Height (ft)
4325	11+10	554	3559.20	3561.44	2.24	8.23	39.42	0.97	0	0.0	3.8	4.0
4250	11+60	554	3558.00	3560.13	2.13	9.09	45.75	1.33	0	0.0	3.4	4.0
4200	11+99	554	3557.00	3558.30	1.30	10.17	53.39	1.73	0	0.0	2.6	3.5
4175	12+17	554	3556.00	3557.26	1.26	10.35	54.56	1.80	0	0.0	2.5	3.5
4150	12+51	554	3554.00	3555.19	1.19	10.46	55.17	1.84	0	0.0	2.5	3.5
4125	12+86	554	3552.00	3553.09	1.09	10.40	57.00	1.85	0	0.0	2.4	3.5
4100	13+38	554	3548.00	3549.97	1.97	10.13	48.44	1.68	0	0.0	3.3	3.5
4050	13+72	554	3546.00	3547.44	1.44	11.39	51.91	2.02	0	0.0	2.8	3.5
4000	14+13	554	3544.00	3545.21	1.21	10.67	49.34	1.78	0	0.0	2.5	3.5
3950	14+51	554	3542.00	3543.02	1.02	10.38	56.71	1.81	0	0.0	2.3	3.5
3900	14+83	554	3540.00	3541.28	1.28	10.12	51.59	1.69	0	0.0	2.6	3.5
3875	15+22	554	3537.00	3538.38	1.38	10.81	42.40	1.69	0	0.0	2.7	3.5
3850	15+67	554	3535.00	3536.22	1.22	10.23	52.80	1.74	0	0.0	2.5	3.5
3825	16+02	554	3533.00	3534.58	1.58	9.19	76.05	1.61	0	0.0	2.8	3.5
3800	16+33	554	3531.00	3532.33	1.33	10.15	64.66	1.95	0	0.0	2.6	3.5
3750	16+71	554	3529.00	3530.11	1.11	10.15	56.77	1.79	0	0.0	2.4	3.5
3700	17+15	554	3526.00	3527.00	1.00	10.77	54.75	1.90	0	0.0	2.3	3.5
3675	17+61	554	3523.00	3524.44	1.44	9.83	55.39	1.68	0	0.0	2.7	3.5
3650	18+13	554	3520.00	3521.23	1.23	10.56	53.77	1.86	160	0.6	3.1	3.5
3600	18+62	554	3517.00	3517.85	0.85	10.70	70.55	2.08	0	0.0	2.1	3.5
3550	19+14	554	3513.00	3514.80	1.80	10.15	52.14	1.68	200	0.4	3.5	3.5
3450	19+62	554	3510.00	3511.98	1.98	10.66	55.80	1.94	0	0.0	3.3	3.5
3400	20+19	554	3506.00	3508.22	2.22	9.97	52.97	1.69	0	0.0	3.5	3.5
3300	20+86	554	3502.00	3503.74	1.74	11.47	47.10	1.96	590	0.2	3.2	3.5

TABLE 3
HEC-RAS SUMMARY – MIXED FLOW (ULTIMATE CONDITIONS)

Sta*	Plan Sta	ULT Q (cfs)	FL Elev (ft)	WS Elev (ft)	Depth (ft)	Vel (ft/s)	Top Width (ft)	Froude #	Radius	Super -elev (ft)	Total Depth (ft)	Chnl Height (ft)
3250	21+62	554	3498.00	3499.10	1.10	10.46	54.89	1.85	0	0.0	2.4	3.5
3200	21+98	554	3496.00	3497.20	1.20	9.95	55.24	1.71	565	0.2	2.6	3.5
3170	22+36	554	3494.00	3495.03	1.03	10.18	56.11	1.77	0	0.0	2.3	3.5
3100	23+07	554	3489.00	3490.88	1.88	10.30	56.68	1.82	0	0.0	3.2	3.5
3075	23+39	554	3488.00	3488.99	0.99	10.22	59.08	1.81	0	0.0	2.2	3.5
3050	23+74	554	3485.00	3486.43	1.43	10.97	57.90	2.01	165	0.7	3.4	3.5
3000	24+20	554	3482.00	3482.96	0.96	11.04	56.57	2.03	165	0.6	2.9	3.5
2950	24+75	554	3479.00	3480.34	1.34	9.38	48.76	1.49	0	0.0	2.6	3.5
2900	25+04	554	3477.00	3478.26	1.26	10.39	51.33	1.79	0	0.0	2.5	3.5
2850	25+53	554	3474.00	3475.19	1.19	10.64	57.14	1.91	0	0.0	2.5	3.5
2800	25+98	554	3471.00	3472.41	1.41	10.19	54.67	1.76	850	0.1	2.8	3.5
2750	26+47	554	3469.00	3470.21	1.21	9.52	55.12	1.60	0	0.0	2.5	3.5
2700	26+98	554	3466.00	3467.21	1.21	10.28	54.13	1.80	0	0.0	2.5	3.5
2675	27+33	554	3464.00	3465.23	1.23	10.22	56.16	1.79	0	0.0	2.5	3.5
2650	27+76	554	3461.00	3462.67	1.67	10.35	55.97	1.81	0	0.0	3.0	3.5
2550	28+35	554	3458.00	3459.24	1.24	10.50	51.89	1.80	0	0.0	2.5	3.5
2500	28+97	554	3454.00	3455.15	1.15	10.95	52.07	1.92	440	0.2	2.7	3.5
2475	29+28	554	3452.00	3453.50	1.50	10.11	49.71	1.68	440	0.2	3.0	3.5
2450	29+62	554	3450.00	3451.80	1.80	10.25	49.00	1.68	440	0.2	3.3	3.5
2400	29+97	554	3448.00	3449.61	1.61	11.71	35.58	1.71	440	0.2	3.1	3.5
2350	30+46	554	3445.00	3446.14	1.14	12.17	54.85	2.34	440	0.3	2.7	3.5
2275	31+06	554	3441.00	3442.47	1.47	9.91	58.44	1.73	440	0.2	3.0	3.5
2200	31+82	554	3437.00	3438.21	1.21	10.08	56.94	1.78	0	0.0	2.5	3.5
2055	32+04	554	3434.00	3435.22	1.22	12.20	64.55	2.56	0	0.0	2.5	5.0
2054	32+33	554	3430.00	3434.34	4.34	1.89	69.54	0.16	0	0.0	5.3	12.0
2053	-	Culvert			-				-	-	-	-
2052	-	554	3425.00	3426.14	1.14	11.09	79.15	1.83	0	0.0	2.4	-

*See Figure 5.

Scour

Scour calculations were performed for velocities in the flow corridor exceeding 5 fps to determine erosion control measures to prevent undercutting of the proposed channel improvements. A 5-foot deep minimum vertical riprap cutoff wall is designed along the toe of the proposed channel improvements. Scour calculations are located in Appendix B. The results from the calculations are summarized in Table 4.

TABLE 4
COS-1 - SCOUR WALL CALCULATIONS (ULTIMATE CONDITIONS)

Sta*	Plan Sta	ULT Q (cfs)	FL Elevation (ft)	WS Elevation (ft)	Depth (ft)	Vel (ft/s)	Calculated Scour Depth (ft)	Provided Scour Protection (ft)
4325	11+10	554	3559.20	3561.44	2.24	8.23	1.51	5.00
4250	11+60	554	3558.00	3560.13	2.13	9.09		
4200	11+99	554	3557.00	3558.30	1.30	10.17	1.59	
4175	12+17	554	3556.00	3557.26	1.26	10.35		
4150	12+51	554	3554.00	3555.19	1.19	10.46		
4125	12+86	554	3552.00	3553.09	1.09	10.40		
4100	13+38	554	3548.00	3549.97	1.97	10.13		
4050	13+72	554	3546.00	3547.44	1.44	11.39		
4000	14+13	554	3544.00	3545.21	1.21	10.67	<1	
3950	14+51	554	3542.00	3543.02	1.02	10.38		
3900	14+83	554	3540.00	3541.28	1.28	10.12		
3875	15+22	554	3537.00	3538.38	1.38	10.81		
3850	15+67	554	3535.00	3536.22	1.22	10.23		
3825	16+02	554	3533.00	3534.58	1.58	9.19	1.87	
3800	16+33	554	3531.00	3532.33	1.33	10.15		
3750	16+71	554	3529.00	3530.11	1.11	10.15		
3700	17+15	554	3526.00	3527.00	1.00	10.77		
3675	17+61	554	3523.00	3524.44	1.44	9.83	3.04	
3650	18+13	554	3520.00	3521.23	1.23	10.56		
3600	18+62	554	3517.00	3517.85	0.85	10.70		
3550	19+14	554	3513.00	3514.80	1.80	10.15		
3450	19+62	554	3510.00	3511.98	1.98	10.66	1.82	
3400	20+19	554	3506.00	3508.22	2.22	9.97		
3300	20+86	554	3502.00	3503.74	1.74	11.47		
3250	21+62	554	3498.00	3499.10	1.10	10.46		
3200	21+98	554	3496.00	3497.20	1.20	9.95	<1	
3170	22+36	554	3494.00	3495.03	1.03	10.18		
3100	23+07	554	3489.00	3490.88	1.88	10.30		
3075	23+39	554	3488.00	3488.99	0.99	10.22		
3050	23+74	554	3485.00	3486.43	1.43	10.97		
3000	24+20	554	3482.00	3482.96	0.96	11.04		
2950	24+75	554	3479.00	3480.34	1.34	9.38		
2900	25+04	554	3477.00	3478.26	1.26	10.39		

TABLE 4
COS-1 - SCOUR WALL CALCULATIONS (ULTIMATE CONDITIONS)

Sta*	Plan Sta	ULT Q (cfs)	FL Elevation (ft)	WS Elevation (ft)	Depth (ft)	Vel (ft/s)	Calculated Scour Depth (ft)	Provided Scour Protection (ft)
2850	25+53	554	3474.00	3475.19	1.19	10.64		
2800	25+98	554	3471.00	3472.41	1.41	10.19		
2750	26+47	554	3469.00	3470.21	1.21	9.52	3.63	
2700	26+98	554	3466.00	3467.21	1.21	10.28		
2675	27+33	554	3464.00	3465.23	1.23	10.22		
2650	27+76	554	3461.00	3462.67	1.67	10.35		
2550	28+35	554	3458.00	3459.24	1.24	10.50		
2500	28+97	554	3454.00	3455.15	1.15	10.95		
2475	29+28	554	3452.00	3453.50	1.50	10.11	<1	
2450	29+62	554	3450.00	3451.80	1.80	10.25		
2400	29+97	554	3448.00	3449.61	1.61	11.71	1.27	
2350	30+46	554	3445.00	3446.14	1.14	12.17		
2275	31+06	554	3441.00	3442.47	1.47	9.91		
2200	31+82	554	3437.00	3438.21	1.21	10.08	<1	
2055	32+04	554	3434.00	3435.22	1.22	12.20		
2054	32+33	554	3430.00	3434.34	4.34	1.89		
2053	-	Culvert			-			
2052	-	554	3425.00	3426.14	1.14	11.09		

*See Figure 6

IX. CONCLUSIONS AND RECOMMENDATIONS

1. Methodology used in this report is in compliance with Clark County Regional Flood Control District (CCRFCD) criteria.

2. The proposed project lies within a Zone X. Therefore, the project is not currently located in a FEMA-designated Special Flood Hazard Area.

3. The site is not adjacent to any CCRFCD Facilities.

4. The portion of the site designated as a WOTUS will remain natural.

5. The recommended channel system proposes a natural bottom channel with concrete/rock-lined sides and a 5-foot cutoff wall along the northern and southern banks of the channel. Detailed hydraulic modeling of the proposed Parcel COS-1 channel improvements from the Unit 2 Western Washes to the Unit 2 Crossbridge Drive Culverts shows that the design flows will be contained within the channel and will not adversely impact the stilling basin and downstream COS-2 improvements. The design flows are based on the approved CDS Study ultimate conditions drainage patterns. The proposed channel and storm drain will convey the 100-year ultimate conditions flow with freeboard.

6. The proposed extension of the 48-inch RCP stub north of the COS1 Improvements will collect interim and ultimate flows generated north of the wash.

7. Proposed offsite ditches located on the north and south boundaries of Parcel COS-1 will convey offsite flows northeast and/ or southeast of and away from the project site to the proposed 48-inch and existing 54-inch storm drain stubs to be consistent with the ultimate Village 24 drainage patterns.

8. All finish floors adjacent to the Parcel COS-1 channel improvements will be designed as required by CLV Criteria.

9. The proposed drainage patterns in this report are generally consistent with those presented in the CDS, COS-2, Unit 2, and Sky Vista Studies.

10. The proposed improvements do not significantly alter existing peak flows or the character of flows downstream of the project.

11. Runoff generated from, or conveyed by, the project will not adversely impact any downstream properties and facilities.

X. REFERENCES

1. GCW, Inc., *Update #2 to the Conceptual Drainage Study for Summerlin Village 24*. September 2014.

2. GCW, Inc., *Update to the Technical Drainage Study for Summerlin Village 24 – Parcel COS-2. December 2016.*

3. GCW, Inc., *Update #6 to the Technical Drainage Study for Summerlin Village 24 Unit 2 Improvements – Crossbridge Drive (Crossbridge Unit 1 to Suncreek Road). March 2016.*

4. GCW, Inc., *Update #4 to the Technical Drainage Study for Summerlin Village 24 Unit 2 Improvements – Sky Vista Improvements (Desert Moon Drive to Alta Drive Including Suncreek Road). June 2015.*

5. *CCRFCD 2013 Las Vegas Valley Flood Control Master Plan Update*. 2013.

6. Clark County Regional Flood Control District (CCRFCD) *Hydrologic Criteria and Drainage Design Manual.* August 1999.

7. U.S. Army Corps of Engineers, *HEC-RAS River Analysis System*. January 2010. Version 4.1.0.

8. U.S. Army Corps of Engineers, *HEC-RAS River Analysis System Hydraulic Reference Manual*. January 2010. Version 4.1.

TECHNICAL DRAINAGE STUDY FOR SUMMERLIN V24 PARCEL COS-1 WASH APPENDIX LAYOUT

Appendix A. Hydrologic Calculations and Information

1. Interim Conditions Prorate Calculations

Appendix B. Hydraulic Calculations

1. Manning's "n" Calculation
2. Ditch Calculations
3. SF6 Model (48" RCP Ultimate)
4. Scour Wall Calculations
5. COS-1 HEC-RAS Model: COS1_ULT.prj
6. CD Containing HEC-RAS Model
7. D-Load Calculation

Appendix C. Referenced Materials

1. Limited Geotechnical Evaluation US Waters – Wash COS-1 and COS-2 Summerlin Village 24 Las Vegas, Nevada
   a) Figure 2A – Alignment Map Overview
   b) Figure 2D – Alignment Map
   c) Boring Logs for B-3 & B-4
   d) Summary of Test Results (D50)
   e) Photos of Test Locations

2. Update #2 to the Conceptual Drainage Study for Summerlin Village 24
   a) CLV Approval Letter
   b) Figure 6U – Ultimate Conditions Drainage Map
   c) Figure 8U2 – Proposed Facilities Drainage Map

3. Update to the Technical Drainage Study for Village 24 Parcel COS-2
   a) CLV Approval Letter
   b) COS-2: Ultimate Conditions HEC-RAS Model

4. Update #6 to the Technical Drainage Study for Summerlin Village 24 Unit 2 Improvements – Crossbridge Drive (Crossbridge Unit 1 to Suncreek Road)
   a) CLV Approval Letter
   b) Figure 7U3R – Interim Conditions Drainage Map
   c) Figure 8U3R - HEC-RAS Cross Section Exhibit
   d) Figure 9U3R – HEC-RAS Cross Section Exhibit (Parcels COS-1 and COS-2)
   e) Proposed/ Interim Conditions Standard Form 4
   f) Proposed/ Interim Conditions HEC-1 Model
   g) SF6 Model: Suncreek (Parcel K) 48-inch RCP Lateral
   h) COS-1: Existing Conditions HEC-RAS Model
   i) 5' X 5' Box Culvert Inlet Control Calculation
   j) Stilling Basin Calculation
   k) 5' X 5' Box Culvert Normal Depth Calculation
   l) Text Excerpt describing culverts at Crossbridge with stilling basin
   m) Western Boundary Ultimate Conditions HEC-RAS Model: CRR1_ULT.prj
   n) Flow Split Calculations (Weir)
   o) Improvement Plan Sheets: 1, 2, 6, 13-15, 20, 21, 24, 37, 40, 41, 48, 49, 51, 52

5. Update #4 to the Technical Drainage Study for Summerlin Village 24 Unit 2 Improvements – Sky Vista Improvements (Desert Moon Drive to Alta Drive Including Suncreek Road)
   a) CLV Approval Letter

b) SF6 Model: Mainline No. 2 (Sky Vista/ Crossbridge north to Sunkcreek west to Crossbridge and Parcel K)
c) SF6 Model: Suncreek (Parcel K) 48-inch RCP Lateral
d) Improvements Plans Sheets: 1, 6, 37

APPENDIX A

Hydrologic Calculations and Information

Mannings N Calculator Using Equation 732 in the HCDDM		
d_{50} (in)	d_{50} (ft)	n
12	1	0.040

SUMMARY OF PRORATED STORM FLOWS INTERIM CONDITION			
100-Year Runoff			
Parent Basin	Area (ac)	Q_{100} (cfs)	Unit Flow (cfs/ac)
RG6C*	30.7	85	2.77
Prorated Subbasins			
SubBasin	Area (ac)	Unit Flow (cfs/ac)	Q_{100} (cfs)
RG6C-1	1.82	2.77	5
RG6C-2	20.62	2.77	57
RG6C-3	1.37	2.77	4
RG6C-4	1.28	2.77	4
RG6C-5	6.14	2.77	17

*Referenced from the Unit 2 Study

APPENDIX B

Hydraulic Calculations

PIPE CULVERT

RG6C-1 48" RCP STUB

INPUT		
Pipe Diameter	48	in
Number of Pipes	1	
Length	50.0	ft
Slope	2.00	%
Manning's 'n'	0.013	
Flow "Q"	66	cfs
Entrance Coef.	0.35	
Tail Water	0	ft

INLET		
Thin Edge	4.03	ft
Sq. Edge	3.72	ft
Beveled	3.53	ft
Tapered	3.65	ft.

OUTLET		
Head Water	N/A	ft
Critical	2.45	ft
Velocity	5.25	ft/s

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ENGINEERS | PLANNERS | SURVEYORS

TRAPEZOIDAL CHANNEL

RG6C-1

Flow "Q"	5	cfs
Manning's "n"	0.025	
Slope (%)	0.50	
Bottom Width	0.0	ft
Side Slope (Lt)	3.0	H:1V
Side Slope (Rt)	3.0	H:1V
Radius	0.0	ft

OUTPUT:

Velocity	2.30	ft/sec
Depth	0.85	ft
Freeboard	0.58	ft
Total Depth	1.43	ft
Froude No.	0.62	ft
Superelevation	0.00	ft

Normal depth calculations using Manning's equation

Fb = 1+0.025Vd^(1/3) Supercritical; 0.5+V^2/2g Subcritical

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TRAPEZOIDAL CHANNEL

RG6C-4 MAX

Flow "Q"	4	cfs
Manning's "n"	0.040	
Slope (%)	10.20	
Bottom Width	0.0	ft
Side Slope (Lt)	3.0	H:1V
Side Slope (Rt)	3.0	H:1V
Radius	0.0	ft

OUTPUT:

Velocity	4.73	ft/sec
Depth	0.53	ft
Freeboard	1.10	ft
Total Depth	1.63	ft
Froude No.	1.62	ft
Superelevation	0.00	ft

Normal depth calculations using Manning's equation

Fb = 1+0.025Vd^(1/3) Supercritical; 0.5+V^2/2g Subcritical

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RIPRAP CHANNEL

RG6C-4 MAX

Flow "Q"	4	cfs
Manning's "n"	0.036	
Slope (%)	10.20	
Bottom Width	0.0	ft
Side Slope (Lt)	3.0	H:1V
Side Slope (Rt)	3.0	H:1V
Specific Gravity	2.50	

OUTPUT:

Velocity	5.12	ft/s
Depth	0.51	ft
Freeboard	1.10	ft
Total Depth	1.61	ft
Froude No.	1.79	
Riprap Size D50	7.1	in

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TRAPEZOIDAL CHANNEL

RG6C-4 MIN

Flow "Q"	4	cfs
Manning's "n"	0.040	
Slope (%)	5.00	
Bottom Width	0.0	ft
Side Slope (Lt)	3.0	H:1V
Side Slope (Rt)	3.0	H:1V
Radius	0.0	ft

OUTPUT:

Velocity	3.62	ft/sec
Depth	0.61	ft
Freeboard	1.08	ft
Total Depth	1.69	ft
Froude No.	1.16	ft
Superelevation	0.00	ft

Normal depth calculations using Manning's equation

Fb = 1+0.025Vd^(1/3) Supercritical; 0.5+V^2/2g Subcritical

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Worksheet for Ditch Cross Section 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05800	ft/ft
Discharge	4.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3.50
0+07	0.00
0+72	2.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3.50)	(0+72, 2.00)	0.025

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.25	ft
Elevation Range	0.00 to 3.50 ft	
Flow Area	1.11	ft²
Wetted Perimeter	8.81	ft
Hydraulic Radius	0.13	ft
Top Width	8.74	ft
Normal Depth	0.25	ft
Critical Depth	0.32	ft
Critical Slope	0.01694	ft/ft
Velocity	3.60	ft/s

Worksheet for Ditch Cross Section 1

Results

Velocity Head		0.20	ft
Specific Energy		0.46	ft
Froude Number		1.78	
Flow Type	Supercritical		

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	0.25	ft
Critical Depth	0.32	ft
Channel Slope	0.05800	ft/ft
Critical Slope	0.01694	ft/ft

Cross Section for Ditch Cross Section 1

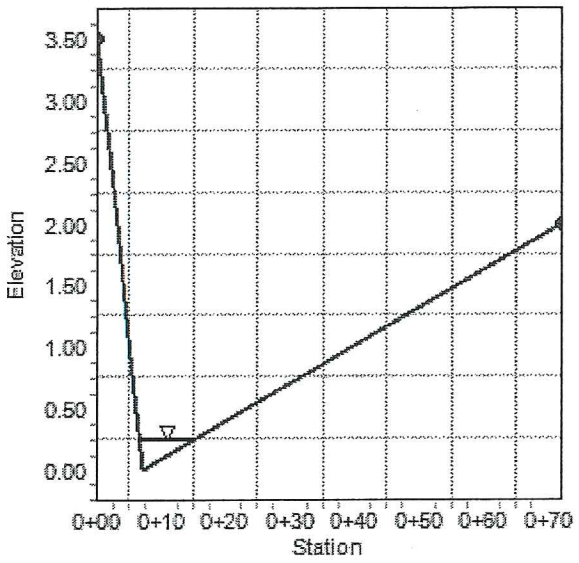
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05800	ft/ft
Normal Depth	0.25	ft
Discharge	4.00	ft³/s

Cross Section Image



Worksheet for Ditch Cross Section 2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05700	ft/ft
Discharge	4.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3.50
0+07	0.00
0+48	2.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3.50)	(0+48, 2.00)	0.025

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.30	ft
Elevation Range	0.00 to 3.50 ft	
Flow Area	1.01	ft²
Wetted Perimeter	6.80	ft
Hydraulic Radius	0.15	ft
Top Width	6.73	ft
Normal Depth	0.30	ft
Critical Depth	0.38	ft
Critical Slope	0.01609	ft/ft
Velocity	3.97	ft/s

Worksheet for Ditch Cross Section 2

Results

Velocity Head		0.24	ft
Specific Energy		0.54	ft
Froude Number		1.81	
Flow Type	Supercritical		

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	0.30	ft
Critical Depth	0.38	ft
Channel Slope	0.05700	ft/ft
Critical Slope	0.01609	ft/ft

Cross Section for Ditch Cross Section 2

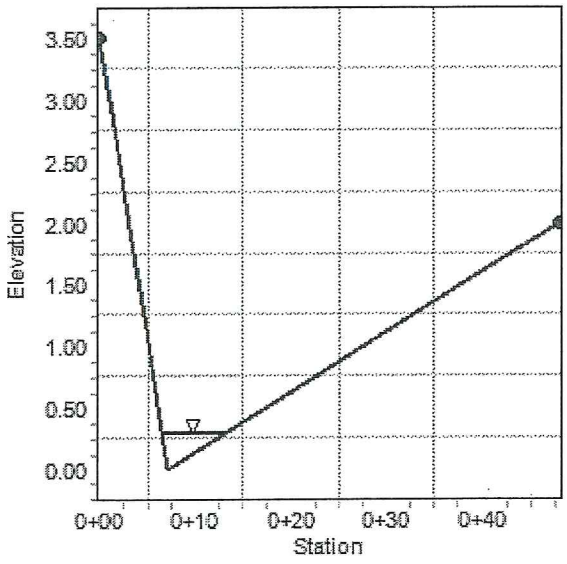
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05700	ft/ft
Normal Depth	0.30	ft
Discharge	4.00	ft³/s

Cross Section Image



Storm Drain Hydraulics Calculations

G.C. Wallace, Inc. | Suncreek (Parcel K) 48-inch RCP Lateral | DATE: 01/24/17 | FILE: SF6.xls

Storm Drain Manning's n (typ=0.013)= 0.013 | Inlet Structure Type or K_i= d | Headwall:Square Edge (cut concrete and CMP)

	CONDUIT DATA										FLOW DATA									ENERGY LOSS DATA																							EGL & HGL				COMMENTS	
																				PIPE	TRANSITION																											
	STATION			PIPE	BOX		IRREG		#	INVERT ELEV	L	S	A	Φ	Q	V	V2/2g	Sf	Ave.	Frict	Frict	Manhole			Junction			Contraction/ Inlet			Expansion/Outlet			Bend					Misc			CONDUIT		TRANSITION		FULL/	
	FROM	TO	T/R	D	SPAN	RISE	AREA	HYD RAD		D/S	U/S											Θ	K_{mh}	H_{mh}	Θ	K_j	H_j	Inlet/	K_i	H_c	Θ	K_o	H_o	R_{bend}	Θ	K_b	H_b	H_m	Total	U/S	U/S	U/S	U/S	PART	CRTL
	(ft)	(ft)		(in)	(ft)	(ft)	(ft^2)	(ft)		(ft)	(ft)	(ft)	(%)	(ft^2)		(cfs)	(ft/s)	(ft)	(ft/ft)	(S_f)	H_f (ft)	(ft)	(deg)		(ft)	(deg)		Cont		(ft)	(deg)		(ft)	(ft)	(deg)			(ft)	(ft)	(ft)	EGL	HGL	EGL	HGL	FLOW	
1		1000.00		48							3434.36																			Outlet K_o=		1.0												3442.79	3442.10		
2	1000.00	1013.00	R	48					1	3434.36	3434.62	13.0	2.00%	12.57	0.0049	84	6.64	0.69	0.0034	0.0034	0.04																				0.00	3442.83	3442.14			FULL	U/S
3	1013.00	1018.00	T	48					1	3434.62	3434.72	5.0	2.00%	12.57	0.0049	80	6.37	0.63	0.0031	0.0032		0.02	0	0.02	0.01	45	0.50	0.37												0.40			3443.23	3442.60	FULL	U/S
4	1018.00	1066.00	R	48					1	3434.72	3435.68	48.0	2.00%	12.57	0.0049	80	6.37	0.63	0.0031	0.0031	0.15																				0.00	3443.38	3442.75			FULL	U/S
5	1066.00	1116.00	R	48					1	3435.68	3436.68	50.0	2.00%	12.57	0.0049	80	6.37	0.63	0.0031	0.0031	0.15																				0.00	3443.53	3442.90			FULL	U/S
6	1116.00									3436.68																																			
7																																														

Summary of Results

	STATION	INVERT	SOFFIT	EGL	HGL	(Optional) GRADE	(Optional) LOCATION	(Optional) DESCRIPTION	HGL with respect to FG	Pressure Gasket Required?
1	1000.00	3434.36	3438.36	3442.79	3442.10	3444.50			OK	NO
2	1013.00	3434.62	3438.62	3442.83	3442.14	3444.77			OK	NO
3	1018.00	3434.72	3438.72	3443.23	3442.60	3444.77			OK	NO
4	1066.00	3435.68	3439.68	3443.38	3442.75	3445.36			OK	NO
5	1116.00	3436.68	3440.68	3443.53	3442.90	3450.13			OK	NO
6										
7										

Cross Section Location	Approach Flowrate CFS Q_1	Contracted Flowrate CFS Q_2	Approach Top Width Feet W_1	Contracted Top Width Feet W_2	Average Velocity FPS V_m	Maximum Depth Upstream of Bend Feet Y_{MAX}	Hydraulic Depth Upstream of Bend Feet Y_h	Approach Depth Feet Y_1	Average Depth In Main Channel Feet Y_o	Embankment Length Main Channel Feet L'	Average Depth After Contraction Scour Feet Y_2	Soil Particle Size Feet d_{50}	Critical Velocity FPS V_c	Energy Slope At Approach Section ft/ft Se_2	α Degrees	Froude Number Fr_1	Long-Term Bed Elevation Changes Feet Z_g	Anti-Dune Trough Feet Z_a	Anti-Dune Trough Feet Z_a	Bend Scour Feet Z_{bs}	Bend Scour Feet Z_{bs}	Contraction Scour Feet Z_{cs}	Contraction Scour Feet Z_{cs}	Local Scour Feet Z_s	Total Scour Feet Z_t	Proposed Minimum Depth of Footings Z_f	Factor of Safety
4325-4200	554	554	39.42	39.42	9.16	2.24	1.86	2.24	1.89	90.42	2.24	0.00984	2.68	0.0144	0.00	0.97	-0.2	1.15	0.95	-5.01	0.00	0.35	0.35	0.00	1.51	5.00	3.3
4200-4050	554	554	53.39	48.44	10.48	1.30	1.03	1.30	1.38	180.27	1.38	0.00984	2.45	0.0526	0.00	1.73	-0.9	1.51	0.69	-1.84	0.00	0.00	0.00	0.00	1.59	5.00	3.1
4050-3825	554	554	51.91	42.40	10.40	1.44	0.95	1.44	1.30	255.21	1.62	0.00984	2.49	0.0736	0.00	2.02	10.5	1.48	0.65	-2.62	0.00	0.32	0.32	0.00	-9.51	5.00	N/A
3825-3675	554	554	76.05	54.75	10.02	1.58	0.85	1.58	1.29	164.98	1.92	0.00984	2.53	0.0463	0.00	1.61	-0.6	1.37	0.65	-3.28	0.00	0.63	0.63	0.00	1.87	5.00	2.7
3675-3550	554	554	55.39	52.14	10.31	1.44	1.02	1.44	1.33	150.83	1.49	0.00984	2.49	0.0496	22.00	1.68	-2.0	1.46	0.67	0.21	0.21	0.16	0.16	0.00	3.04	5.00	1.6
3550-3250	554	554	52.14	47.10	10.54	1.80	1.06	1.80	1.77	258.30	1.91	0.00984	2.59	0.0495	0.00	1.68	-0.8	1.52	0.88	-3.67	0.00	0.14	0.14	0.00	1.82	5.00	2.7
3250-3000	554	554	54.89	54.89	10.45	1.10	0.97	1.10	1.23	261.30	1.10	0.00984	2.38	0.0611	0.00	1.85	1.0	1.49	0.61	-1.91	0.00	-0.13	0.00	0.00	-0.37	5.00	N/A
3000-2800	554	554	56.57	48.76	10.33	0.96	0.90	0.96	1.23	195.36	1.05	0.00984	2.33	0.0758	19.00	2.03	4.8	1.46	0.62	0.07	0.07	-0.18	0.00	0.00	-4.13	5.00	N/A
2800-2750	554	554	54.67	54.67	9.86	1.41	1.01	1.41	1.31	48.59	1.41	0.01640	2.95	0.0546	0.00	1.76	0.9	1.33	0.66	-2.84	0.00	0.10	0.10	0.00	-0.16	5.00	N/A
2750-2500	554	554	55.12	51.89	10.30	1.21	1.07	1.21	1.29	255.69	1.25	0.01640	2.87	0.0442	0.00	1.60	-3.0	1.45	0.64	-2.69	0.00	-0.03	0.00	0.00	3.63	5.00	1.4
2500-2400	554	554	52.07	35.58	10.76	1.15	0.98	1.15	1.52	103.59	1.44	0.01640	2.85	0.0661	18.00	1.92	0.4	1.58	0.76	0.02	0.02	-0.08	0.00	0.00	0.36	5.00	N/A
2400-2275	554	554	35.58	35.58	11.26	1.61	1.37	1.61	1.41	108.83	1.61	0.01640	3.01	0.0468	0.00	1.71	-0.4	1.74	0.70	-2.53	0.00	0.20	0.20	0.00	1.27	5.00	3.9
2275-2054	554	554	58.44	56.94	8.52	1.47	0.98	1.47	2.06	128.82	1.49	0.01640	2.97	0.0533	0.00	1.73	3.4	0.99	0.99	-2.12	0.00	-0.57	0.00	0.00	-2.43	5.00	N/A

(Equation 724) $Z_t = \{Z_{lt} + (1/2)Z_a + Z_{bs} + Z_{cs} + Z_s\}$

Where;

Z_t = The Total Scour Depth That Can Occur At A Structure.

Z_{lt} = The Long-Term Bed Elevation Changes Depth. (See attached worksheet.)

Z_a = The Anti-Dune Trough Depth

Z_{bs} = Bend-Scour Component of Total Scour Depth

Z_{cs} = Contraction-Scour Component of Total Scour Depth

Z_{cs} = Local Scour at Abutments Depth

Anti-Dune Trough Depth; Z_a

(Equation 708) $Z_a = (1/2)(0.14)(2\pi V^2/g) = 0.0137V^2$; Anti-Dune Trough Depth

Where;

V = Average Channel Velocity; fps

Bend-Scour Depth; Z_{bs}

(Equation 709) $Z_{bs} = (0.0685Y_{MAX}V^{0.8}/Y_h^{0.4}S_e^{0.5})[2.1[\text{Sin}^2(\alpha/2)/\text{Cos }\alpha]^{0.2} - 1]$

Where;

V = Average Channel Velocity; fps

Y_{MAX} = Maximum Depth of Flow Immediately Upstream of Bend; ft

Y_h = Hydraulic Depth of Flow Immediately Upstream of Bend; ft (Flow Area/ Flow Top Width)

S_{e1} = Energy Slope Immediately Upstream of Bend (or Bed Slope for Uniform Conditions), ft/ft

α = Angle Formed by the Projection of the Channel Centerline from the Point of Curvature to a Point Which Meets a Line Tangent to the Outer Bank of the Channel, degrees

Critical Velocity Above Which Material Will Be Transported; V_c

(Equation 712) $V_c = 10.95\ Y^{(1/6)}d_{50}^{(1/3)}$ Above Which Material Will Be Transported

Where;

Y = Average Depth of Flow in the Main Channel or Overbank at the Approach Section; ft

If $V_c < V$; use live bed contraction scour equations; if not assume clear-water contraction.

Live-Bed Contraction Scour; Z_{cs}

(Equation 713) $Y_2 = Y_1[Q_2/Q_1]^{(6/7)}[W_1/W_2]^{K1}$ Live-Bed Contraction Scour

(Equation 714) $Z_{cs} = Y_2 - Y_o$ Live-Bed Contraction Scour

Where;

Y_2 = Average Depth After Scour Contracted Section; ft

Y_1 = Average Depth in the Main Channel or Floodplain at the Approach Section; ft

Y_o = Average Depth in the Main Channel or Floodplain at the Contracted Section Before Scour; ft

Q_1 = Flow in the Main Channel or Floodplain at the Approach Section, Which is Transporting Sediment; cfs

Q_2 = Flow in the Main Channel or Floodplain at the Contracted Section, Which is Transporting Sediment; cfs

W_1 = Top Width of the Active Flow Area at the Approach Section; ft

W_2 = Top Width of the Active Flow Area at the Contracted Section; ft

K_1 = Exponent for Mode of Bed Material Transport

(1) $V_*/\omega < 0.5$, $K_1 = 0.59$: Mostly Contact Bed Material Discharge

(2) $V_*/\omega = 0.5$ to 2.0, $K_1 = 0.64$: Some Suspended Bed Material Discharge

(3) $V_*/\omega > 2.0$, $K_1 = 0.59$: Mostly Contact Bed Material Discharge

Where;

$V_* = (gY_1S_e)^{1/2}$, Shear Velocity in the Main Channel or Floodplain at the Approach Section, fps

ω = Fall Velocity of Bed material Based on d_{50}; fps

g = Acceleration of Gravity; fps

S_{e2} = Slope of the Energy Grade Line at the Approach Section; ft/ft

Clear-Water Contraction Scour; Z_{cs}

(Equation 715) $Y_2 = [Q_2^2/Cd_m^{(2/3)}W_2^2]^{(3/7)}$ Clear-Water Contraction Scour

(Equation 716) $Z_{cs} = Y_2 - Y_o$ Clear-Water Contraction Scour

Where;

d_m = Diameter of the Smallest Non-Transportable Particle in the Bed Material (1.25 d_{50}) in the Contracted Section; ft

d_{50} = Median Diameter of the Bed Material; ft

C = 120 for English Units (40 for Metric)

Local Scour At Abutments; Z_s

When the wetted embankment length, L', divided by the approach flow depth, Y_1, is greater than 25, use equation 717

When the wetted embankment length, L', divided by the approach flow depth, Y_1, is less than 25, use equation 718

(Equation 717) $Z_s = 4Y_1(K_1/0.55)K_2Fr_1^{0.33}$ Local Scour at Abutments (HIRE)

Where;

Y_1 = Depth of Flow at the Toe of the Abutment on the Overbank or in the Main Channel; ft

K_1 = Correction Factor for Abutment Shape

1.00, for Vertical-Wall Abutment

0.82, for Vertical-Wall Abutment with Wing Walls

0.55, for Spill-Through Abutment

Specify K_1 Value [1.00]

K_2 = Correction Factor for Angle of Attack(θ) of Flow With Abutment, θ = 90 degrees When Abutments are Perpendicular to the Flow, θ < 90 degrees if Embankment Points Downstream, and θ > 90 If Embankment Points Upstream $(\theta/90)^{0.4}$

Specify θ Value; degrees [0.00]

(Equation 718) $Z_s = 2.27K_1K_2(L')^{0.43}Y_a^{0.57}Fr^{0.61} + Y_a$ Local Scour at Abutments (FROELICH)

Where;

K_1 = Correction Factor for Abutment Shape

1.1, for Square Nose

1.0, for Round Nose, Circular Cylinder and Group of Cylinders

0.9, for Sharp Nose (Triangular)

Specify K_1 Value [1.1]

K_2 = Correction Factor for Angle of Attack(θ) of Flow With Abutment, θ = 90 degrees When Abutments are Perpendicular to the Flow, θ < 90 degrees if Embankment Points Downstream, and θ > 90 If Embankment Points Upstream $(\theta/90)^{0.4}$

Specify θ Value; degrees [0.00]

L' = Length of Abutment (Embankment) Projected Normal to Flow; ft

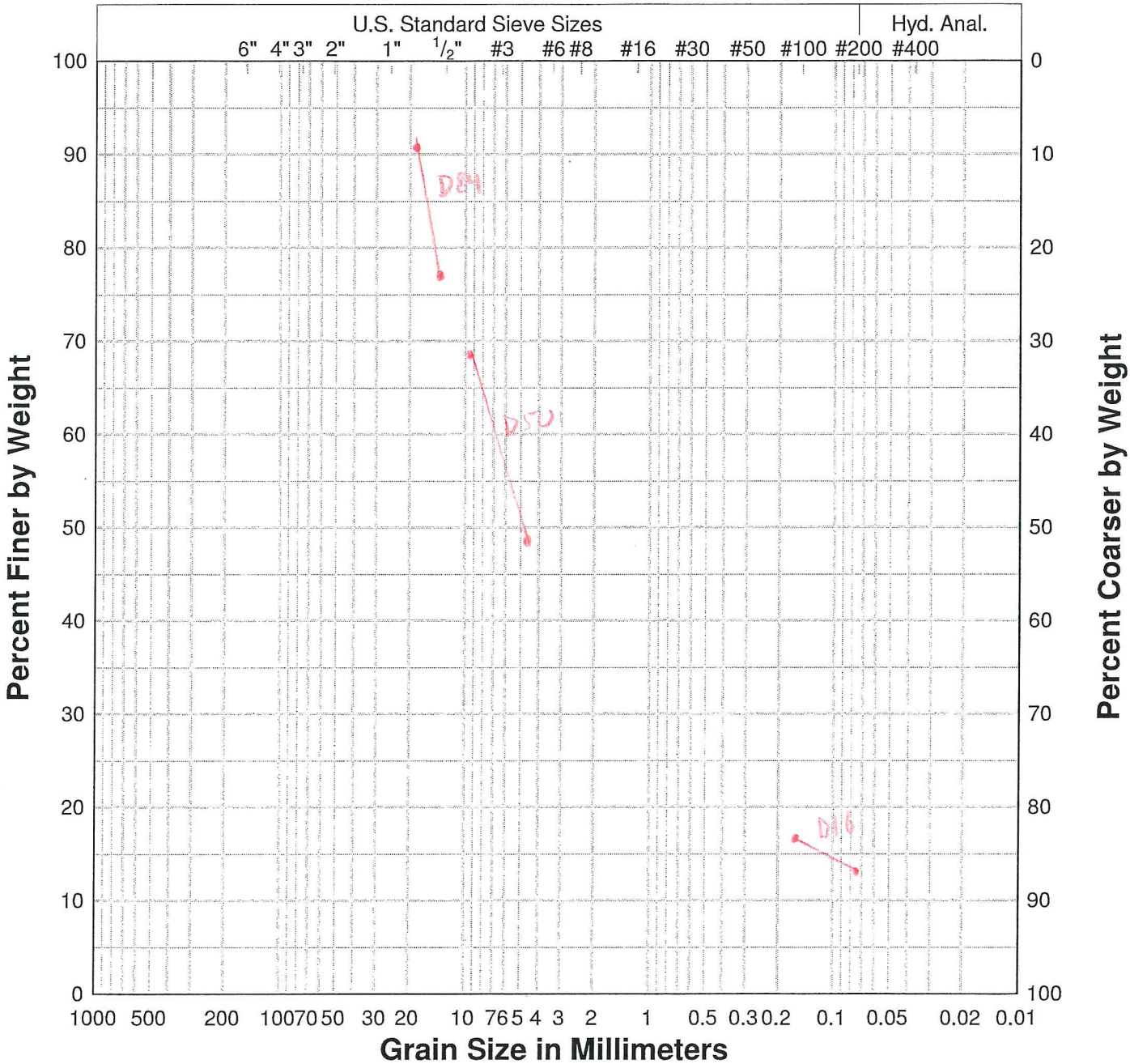
Ya = Average Depth of Flow on the Flow on the Floodplain at the Approach Section (Y_1); ft

Fr = Froude Number of the Floodplain at the Approach Section

Va = Average Velocity of the Approach Flow Va; fps

Aa = Flow Area of the Approach Section Obstructed by the Abutment and Embankment; ft

B-3



$$\frac{\left[\frac{D84}{D50}+\frac{D50}{D16}\right]}{2}=\frac{\frac{0.0525}{0.0164}+\frac{0.0164}{0.0004}}{2}=22.9$$

D84 = 16mm = 0.052493438
D50 = 5mm = 0.016404199
D16 = 0.13mm = 0.000426509

B-3

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

POWER EQUATIONS FOR TOTAL BED MATERIAL DISCHARGE IN SAND- AND FINE-GRAVEL-BED STREAMS

$$q_s = C_1 (Y)^{C_2} (V)^{C_3}$$

d_{50}								
(mm)	0.1	0.25	0.5	1.0	2.0	3.0	4.0	5.0
(inches)	0.00394	0.00984	0.0197	0.0394	0.0787	0.118	0.157	0.197
G_f=1.0								
C_1	3.30×10^{-5}	1.42×10^{-6}	7.6×10^{-6}	5.62×10^{-6}	5.64×10^{-6}	6.32×10^{-6}	7.10×10^{-6}	7.78×10^{-6}
C_2	0.715	0.495	0.28	0.06	-0.14	-0.24	-0.30	-0.34
C_3	3.30	3.61	3.82	3.93	3.95	3.92	3.89	3.87
G_f=2.0								
C_1		1.59×10^{-5}	9.8×10^{-6}	6.94×10^{-6}	6.32×10^{-6}	6.62×10^{-6}	6.94×10^{-6}	
C_2		0.51	0.33	0.12	-0.09	-0.196	-0.27	
C_3		3.55	3.73	3.86	3.91	3.91	3.90	
G_f=3.0								
C_1			1.21×10^{-5}	9.14×10^{-6}	7.44×10^{-6}			
C_2			0.36	0.18	-0.02			
C_3			3.66	3.76	3.86			
G_f=4.0								
C_1				1.0510^{-5}				
C_2				0.21				
C_3				3.71				

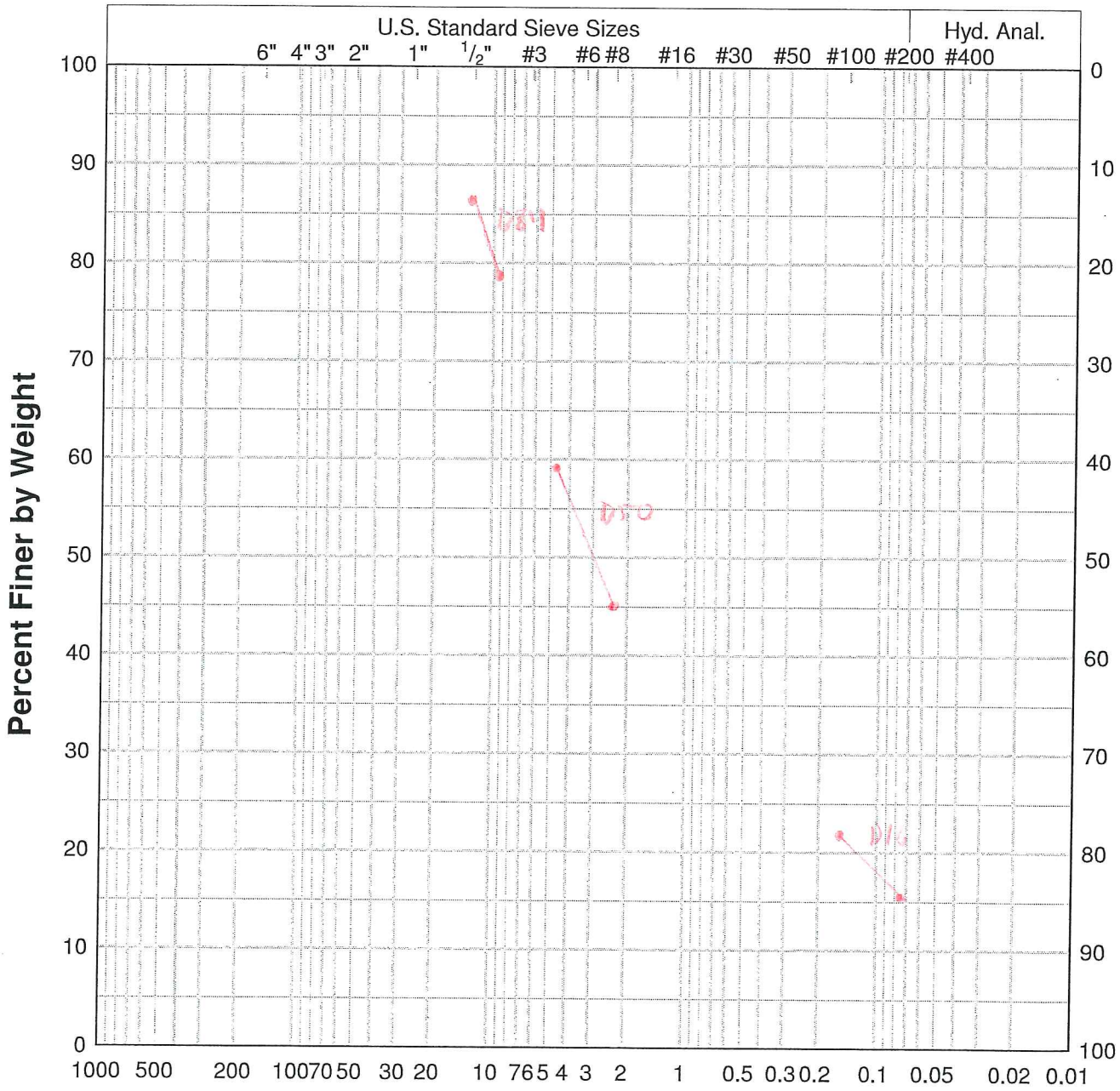
Definitions: q_s=Unit sediment transport rate in ft^2/s (unbulked); V=Velocity in ft/s; Y=Depth in ft; G_f=Gradation coefficient = $(d_{84}/d_{50} + d_{50}/d_{16})/2$.

Revision	Date

REFERENCE:

TABLE 703A

B-4



$$\frac{\left[\frac{D84}{D50} + \frac{D50}{D16}\right]}{2} = \frac{\frac{0.0394}{0.0098} + \frac{0.0098}{0.00026}}{2} = 20.66$$

D84 = 12mm = 0.039370079

D50 = 3mm = 0.009842519

D16 = 0.06mm = 0.000236407

B-4

POWER EQUATIONS FOR TOTAL BED MATERIAL DISCHARGE IN SAND- AND FINE-GRAVEL-BED STREAMS

$$q_s = C_1 (Y)^{C_2} (V)^{C_3}$$

d_{50}								
(mm)	0.1	0.25	0.5	1.0	2.0	3.0	4.0	5.0
(inches)	0.00394	0.00984	0.0197	0.0394	0.0787	0.118	0.157	0.197
G_f=1.0								
C_1	3.30×10^{-5}	1.42×10^{-6}	7.6×10^{-6}	5.62×10^{-6}	5.64×10^{-6}	6.32×10^{-6}	7.10×10^{-6}	7.78×10^{-6}
C_2	0.715	0.495	0.28	0.06	-0.14	-0.24	-0.30	-0.34
C_3	3.30	3.61	3.82	3.93	3.95	3.92	3.89	3.87
G_f=2.0								
C_1		1.59×10^{-5}	9.8×10^{-6}	6.94×10^{-6}	6.32×10^{-6}	6.62×10^{-6}	6.94×10^{-6}	
C_2		0.51	0.33	0.12	-0.09	-0.196	-0.27	
C_3		3.55	3.73	3.86	3.91	3.91	3.90	
G_f=3.0								
C_1			1.21×10^{-5}	9.14×10^{-6}	7.44×10^{-6}			
C_2			0.36	0.18	-0.02			
C_3			3.66	3.76	3.86			
G_f=4.0								
C_1				1.0510^{-5}				
C_2				0.21				
C_3				3.71				

Definitions: q_s=Unit sediment transport rate in ft^2/s (unbulked); V=Velocity in ft/s; Y=Depth in ft;
G_f=Gradation coefficient = $(d_{84}/d_{50} + d_{50}/d_{16})/2$.

Revision	Date

REFERENCE:

TABLE 703A

Determination of Long Term Bed Elevation Changes, Zlt: 4325-4200

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.86	ft
V = flow velocity in upstream channel, (in fps)	8.23	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	39.42	ft
So = upstream channel slope, (in ft/ft)	0.024	ft/ft
L = entire upstream channel length, (in ft)	90.42	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.0	cfs/ft
Qs = total sediment transport rate = qs*TW	0.9	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0220	73.8	7.5	54.9	1.64	1.34	0.9	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.0	cfs/ft
Qs = total sediment transport rate = qs*TW	0.9	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-0.2	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 4325-4200

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02200	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3560.00
0+08	3560.00
0+10	3559.00
0+12	3558.00
0+14	3557.00
0+25	3557.00
0+37	3557.00
0+41	3557.00
0+41	3557.00
0+64	3558.00
0+67	3559.00
0+69	3560.00
0+96	3560.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3560.00)	(0+14, 3557.00)	0.040
(0+14, 3557.00)	(0+64, 3558.00)	0.035
(0+64, 3558.00)	(0+96, 3560.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Worksheet for 4325-4200

Results

Normal Depth		1.64	ft
Elevation Range	3557.00 to 3560.00 ft		
Flow Area		73.79	ft²
Wetted Perimeter		55.45	ft
Hydraulic Radius		1.33	ft
Top Width		54.91	ft
Normal Depth		1.64	ft
Critical Depth		1.77	ft
Critical Slope		0.01644	ft/ft
Velocity		7.51	ft/s
Velocity Head		0.88	ft
Specific Energy		2.52	ft
Froude Number		1.14	
Flow Type	Supercritical		

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	1.64	ft
Critical Depth	1.77	ft
Channel Slope	0.02200	ft/ft
Critical Slope	0.01644	ft/ft

Cross Section for 4325-4200

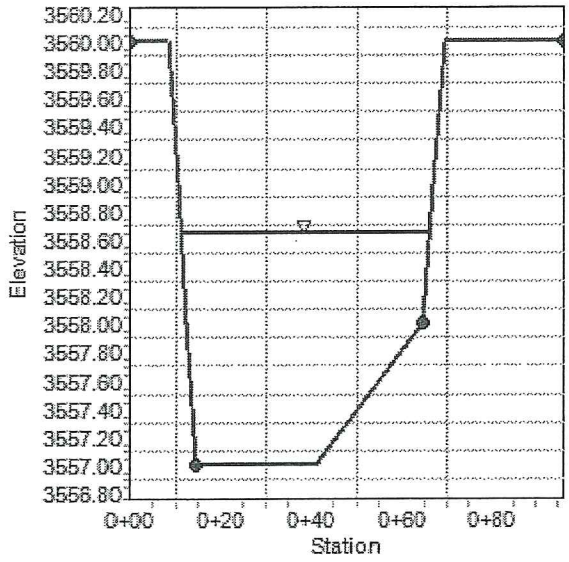
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02200	ft/ft
Normal Depth	1.64	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

4200-4050

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.03	ft
V = flow velocity in upstream channel, (in fps)	10.17	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	53.39	ft
So = upstream channel slope, (in ft/ft)	0.061	ft/ft
L = entire upstream channel length, (in ft)	180.27	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.0	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0560	54.5	10.2	52.5	1.55	1.04	3.0	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.0	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-0.9	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 4200-4050

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05600	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3550.00
0+13	3550.00
0+15	3549.00
0+17	3548.00
0+19	3547.00
0+39	3546.00
0+39	3546.00
0+43	3546.00
0+69	3547.00
0+73	3548.00
0+76	3549.00
0+79	3550.00
0+86	3551.00
0+96	3551.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3550.00)	(0+19, 3547.00)	0.040
(0+19, 3547.00)	(0+69, 3547.00)	0.035
(0+69, 3547.00)	(0+96, 3551.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method

Worksheet for 4200-4050

Options

Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.55	ft
Elevation Range	3546.00 to 3551.00 ft		
Flow Area		54.51	ft²
Wetted Perimeter		52.77	ft
Hydraulic Radius		1.03	ft
Top Width		52.53	ft
Normal Depth		1.55	ft
Critical Depth		2.04	ft
Critical Slope		0.01622	ft/ft
Velocity		10.16	ft/s
Velocity Head		1.61	ft
Specific Energy		3.15	ft
Froude Number		1.76	
Flow Type	Supercritical		

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	1.55	ft
Critical Depth	2.04	ft
Channel Slope	0.05600	ft/ft
Critical Slope	0.01622	ft/ft

Cross Section for 4200-4050

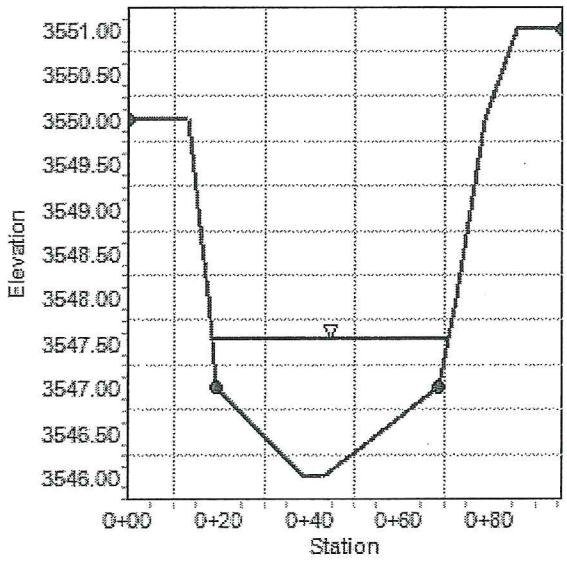
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05600	ft/ft
Normal Depth	1.55	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

4050-3825

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.95	ft
V = flow velocity in upstream channel, (in fps)	11.39	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	51.91	ft
So = upstream channel slope, (in ft/ft)	0.051	ft/ft
L = entire upstream channel length, (in ft)	255.21	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	4.7	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0920	53.1	10.4	70.4	1.43	0.75	4.7	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	4.7	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	10.5	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 4050-3825

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09200	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3538.00
0+08	3538.00
0+11	3537.00
0+13	3536.00
0+16	3535.00
0+27	3534.00
0+47	3533.52
0+70	3533.00
0+72	3533.00
0+76	3534.00
0+83	3534.00
0+84	3534.00
0+84	3534.00
0+89	3534.29
1+07	3535.00
1+09	3535.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3538.00)	(0+16, 3535.00)	0.040
(0+16, 3535.00)	(0+72, 3533.00)	0.035
(0+72, 3533.00)	(0+83, 3534.00)	0.040
(0+83, 3534.00)	(0+89, 3534.29)	0.030
(0+89, 3534.29)	(1+09, 3535.00)	0.040

Worksheet for 4050-3825

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.43	ft
Elevation Range	3533.00 to 3538.00 ft		
Flow Area		53.07	ft²
Wetted Perimeter		70.58	ft
Hydraulic Radius		0.75	ft
Top Width		70.41	ft
Normal Depth		1.43	ft
Critical Depth		1.95	ft
Critical Slope		0.01828	ft/ft
Velocity		10.44	ft/s
Velocity Head		1.69	ft
Specific Energy		3.12	ft
Froude Number		2.12	
Flow Type	Supercritical		

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	1.43	ft
Critical Depth	1.95	ft
Channel Slope	0.09200	ft/ft
Critical Slope	0.01828	ft/ft

Cross Section for 4050-3825

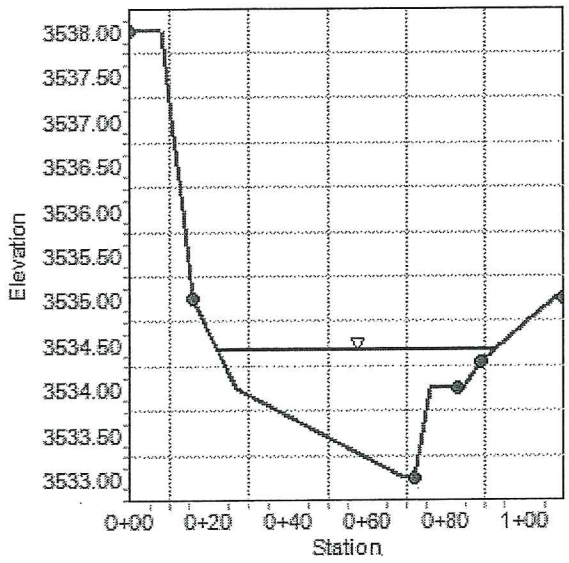
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09200	ft/ft
Normal Depth	1.43	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

3825-3675

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.85	ft
V = flow velocity in upstream channel, (in fps)	9.19	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	76.1	ft
So = upstream channel slope, (in ft/ft)	0.061	ft/ft
L = entire upstream channel length, (in ft)	164.98	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.0	cfs/ft
Qs = total sediment transport rate = qs*TW	3.0	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0570	55.2	10.0	55.2	1.41	1.00	3.0	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.0	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-0.6	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 3825-3675

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05700	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3527.00
0+08	3527.00
0+12	3526.00
0+15	3525.00
0+19	3524.00
0+27	3523.00
0+36	3523.00
0+52	3523.00
0+60	3524.00
0+62	3524.00
0+72	3524.00
0+74	3525.00
0+76	3526.00
0+83	3527.00
1+02	3527.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3527.00)	(0+19, 3524.00)	0.040
(0+19, 3524.00)	(0+72, 3524.00)	0.035
(0+72, 3524.00)	(1+02, 3527.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method

Worksheet for 3825-3675

Options

Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.41	ft
Elevation Range	3523.00 to 3527.00 ft		
Flow Area		55.22	ft²
Wetted Perimeter		55.51	ft
Hydraulic Radius		0.99	ft
Top Width		55.24	ft
Normal Depth		1.41	ft
Critical Depth		1.88	ft
Critical Slope		0.01628	ft/ft
Velocity		10.03	ft/s
Velocity Head		1.56	ft
Specific Energy		2.97	ft
Froude Number		1.77	
Flow Type	Supercritical		

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	1.88	ft
Channel Slope	0.05700	ft/ft
Critical Slope	0.01628	ft/ft

Cross Section for 3825-3675

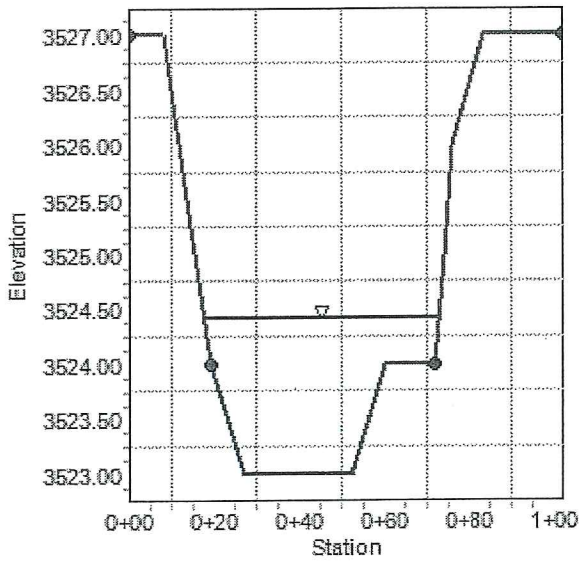
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05700	ft/ft
Normal Depth	1.41	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt: 3675-3550

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.02	ft
V = flow velocity in upstream channel, (in fps)	9.83	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	55.39	ft
So = upstream channel slope, (in ft/ft)	0.066	ft/ft
L = entire upstream channel length, (in ft)	150.83	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	2.8	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0530	55.5	10.0	52.2	1.80	1.06	2.8	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	2.8	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-2.0	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 3675-3550

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05300	ft/ft
Discharge	554.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3518.00
0+09	3518.00
0+18	3517.00
0+21	3516.00
0+24	3515.00
0+29	3514.17
0+30	3514.78
0+49	3514.00
0+53	3513.00
0+55	3513.00
0+67	3513.00
0+74	3513.00
0+76	3514.00
0+78	3515.00
0+80	3516.00
0+82	3517.00
0+84	3518.00
0+97	3518.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3518.00)	(0+29, 3514.17)	0.040
(0+29, 3514.17)	(0+78, 3515.00)	0.035
(0+78, 3515.00)	(0+97, 3518.00)	0.040

Worksheet for 3675-3550

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.80	ft
Elevation Range	3513.00 to 3518.00 ft		
Flow Area		55.46	ft²
Wetted Perimeter		52.95	ft
Hydraulic Radius		1.05	ft
Top Width		52.15	ft
Normal Depth		1.80	ft
Critical Depth		2.27	ft
Critical Slope		0.01638	ft/ft
Velocity		9.99	ft/s
Velocity Head		1.55	ft
Specific Energy		3.35	ft
Froude Number		1.71	
Flow Type	Supercritical		

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	1.80	ft
Critical Depth	2.27	ft
Channel Slope	0.05300	ft/ft
Critical Slope	0.01638	ft/ft

Cross Section for 3675-3550

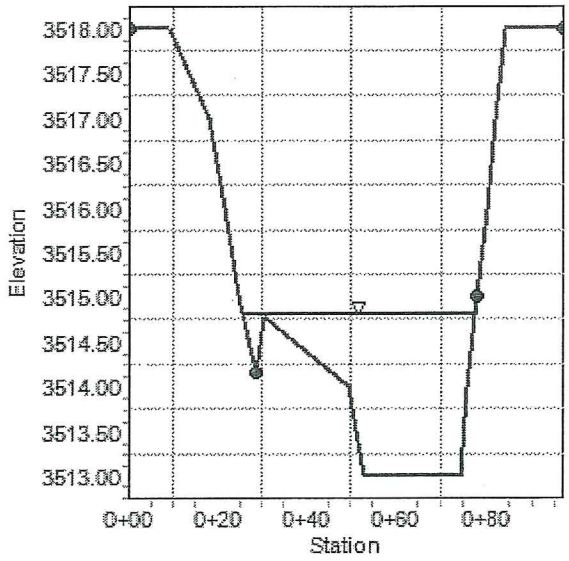
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05300	ft/ft
Normal Depth	1.80	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

3550-3250

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.06	ft
V = flow velocity in upstream channel, (in fps)	10.15	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	52.14	ft
So = upstream channel slope, (in ft/ft)	0.058	ft/ft
L = entire upstream channel length, (in ft)	258.30	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	2.9	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0550	55.9	9.9	55.1	1.14	1.01	2.9	«Compare to Qs Computed Above

8Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	2.9	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-0.8	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 3550-3250

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05500	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3502.00
0+03	3502.00
0+16	3501.00
0+18	3500.00
0+20	3499.00
0+22	3498.00
0+27	3498.00
0+43	3498.00
0+57	3498.00
0+64	3498.00
0+75	3499.00
0+78	3500.00
0+81	3501.00
0+84	3502.00
0+91	3502.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3502.00)	(0+22, 3498.00)	0.040
(0+22, 3498.00)	(0+75, 3499.00)	0.035
(0+75, 3499.00)	(0+91, 3502.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method

Worksheet for 3550-3250

Options

Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.14	ft
Elevation Range	3498.00 to 3502.00 ft		
Flow Area		55.85	ft²
Wetted Perimeter		55.45	ft
Hydraulic Radius		1.01	ft
Top Width		55.11	ft
Normal Depth		1.14	ft
Critical Depth		1.60	ft
Critical Slope		0.01632	ft/ft
Velocity		9.92	ft/s
Velocity Head		1.53	ft
Specific Energy		2.67	ft
Froude Number		1.74	
Flow Type	Supercritical		

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	1.14	ft
Critical Depth	1.60	ft
Channel Slope	0.05500	ft/ft
Critical Slope	0.01632	ft/ft

Cross Section for 3550-3250

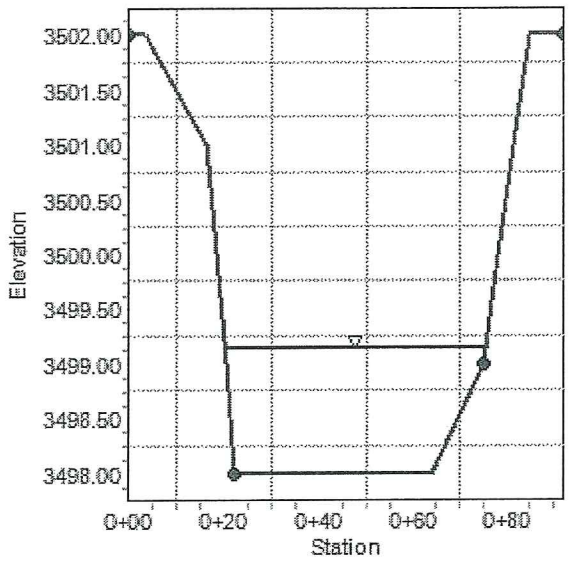
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05500	ft/ft
Normal Depth	1.14	ft
Discharge	554.00	ft^3/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

3250-3000

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.97	ft
V = flow velocity in upstream channel, (in fps)	10.46	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	54.89	ft
So = upstream channel slope, (in ft/ft)	0.061	ft/ft
L = entire upstream channel length, (in ft)	261.30	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3) 0.1 cfs/ft

Qs = total sediment transport rate = qs*TW 3.5 cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0650	53.8	10.3	56.9	1.01	0.94	3.5	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3) 0.1 cfs/ft

Qs = total sediment transport rate = qs*TW 3.5 cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L 1.0 ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 3250-3000

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06500	ft/ft
Discharge	554.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3488.00
0+05	3488.00
0+25	3487.00
0+33	3486.00
0+35	3485.00
0+37	3484.00
0+39	3483.00
0+43	3482.00
0+44	3482.00
0+57	3482.00
0+66	3482.00
0+70	3482.00
0+85	3482.00
0+93	3482.00
0+96	3483.00
0+99	3484.00
1+02	3485.00
1+15	3485.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3488.00)	(0+39, 3483.00)	0.040
(0+39, 3483.00)	(0+93, 3482.00)	0.035
(0+93, 3482.00)	(1+15, 3485.00)	0.040

Worksheet for 3250-3000

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.01	ft
Elevation Range	3482.00 to 3488.00 ft		
Flow Area		53.79	ft²
Wetted Perimeter		57.21	ft
Hydraulic Radius		0.94	ft
Top Width		56.93	ft
Normal Depth		1.01	ft
Critical Depth		1.51	ft
Critical Slope		0.01644	ft/ft
Velocity		10.30	ft/s
Velocity Head		1.65	ft
Specific Energy		2.66	ft
Froude Number		1.87	
Flow Type	Supercritical		

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	1.01	ft
Critical Depth	1.51	ft
Channel Slope	0.06500	ft/ft
Critical Slope	0.01644	ft/ft

Cross Section for 3250-3000

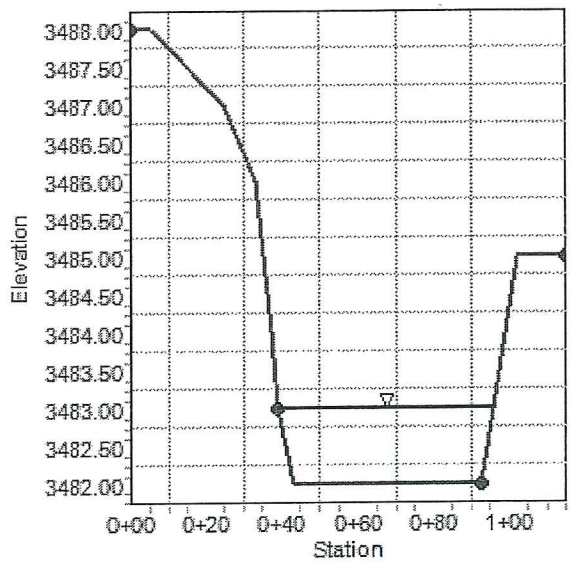
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06500	ft/ft
Normal Depth	1.01	ft
Discharge	554.00	ft^3/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

3000-2800

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.90	ft
V = flow velocity in upstream channel, (in fps)	11.04	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	56.57	ft
So = upstream channel slope, (in ft/ft)	0.056	ft/ft
L = entire upstream channel length, (in ft)	195.36	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	4.6	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0810	49.5	11.2	54.2	1.31	0.91	4.6	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	4.6	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	4.8	ft

if:
Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 3000-2800

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.08100	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3475.00
0+19	3475.00
0+21	3474.00
0+23	3473.00
0+25	3472.00
0+45	3471.47
0+63	3471.00
0+76	3471.00
0+78	3472.00
0+80	3473.00
0+82	3474.00
0+94	3474.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3475.00)	(0+25, 3472.00)	0.040
(0+25, 3472.00)	(0+76, 3471.00)	0.035
(0+76, 3471.00)	(0+94, 3474.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Worksheet for 3000-2800

Results

Normal Depth		1.31	ft
Elevation Range	3471.00 to 3475.00 ft		
Flow Area		49.48	ft²
Wetted Perimeter		54.63	ft
Hydraulic Radius		0.91	ft
Top Width		54.24	ft
Normal Depth		1.31	ft
Critical Depth		1.88	ft
Critical Slope		0.01639	ft/ft
Velocity		11.20	ft/s
Velocity Head		1.95	ft
Specific Energy		3.26	ft
Froude Number		2.07	
Flow Type	Supercritical		

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	1.31	ft
Critical Depth	1.88	ft
Channel Slope	0.08100	ft/ft
Critical Slope	0.01639	ft/ft

Cross Section for 3000-2800

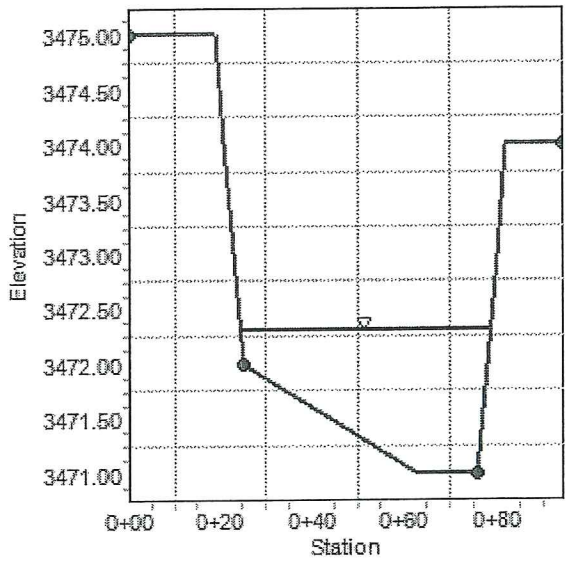
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.08100	ft/ft
Normal Depth	1.31	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2800-2750

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.01	ft
V = flow velocity in upstream channel, (in fps)	10.19	fps
C1 = sand material constant	0.00000778	
C2 = sand material constant	-0.34	
C3 = sand material constant	3.87	
TW = top width of upstream channel, (in ft)	54.67	ft
So = upstream channel slope, (in ft/ft)	0.041	ft/ft
L = entire upstream channel length, (in ft)	48.59	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.4	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0600	54.2	10.2	54.7	1.12	0.99	3.4	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.4	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	0.9	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 2800-2750

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06000	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3473.00
0+16	3473.00
0+19	3472.00
0+22	3471.00
0+25	3470.00
0+36	3469.00
0+49	3469.00
0+77	3469.00
0+79	3470.00
0+81	3471.00
0+86	3472.00
0+95	3472.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3473.00)	(0+25, 3470.00)	0.040
(0+25, 3470.00)	(0+77, 3469.00)	0.035
(0+77, 3469.00)	(0+95, 3472.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Worksheet for 2800-2750

Results

Normal Depth		1.12	ft
Elevation Range	3469.00 to 3473.00 ft		
Flow Area		54.23	ft²
Wetted Perimeter		55.02	ft
Hydraulic Radius		0.99	ft
Top Width		54.70	ft
Normal Depth		1.12	ft
Critical Depth		1.61	ft
Critical Slope		0.01630	ft/ft
Velocity		10.22	ft/s
Velocity Head		1.62	ft
Specific Energy		2.74	ft
Froude Number		1.81	
Flow Type	Supercritical		

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	1.12	ft
Critical Depth	1.61	ft
Channel Slope	0.06000	ft/ft
Critical Slope	0.01630	ft/ft

Cross Section for 2800-2750

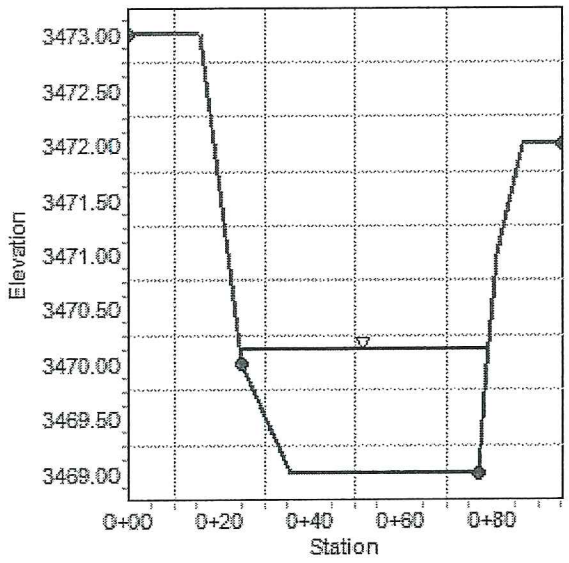
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06000	ft/ft
Normal Depth	1.12	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2750-2500

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.07	ft
V = flow velocity in upstream channel, (in fps)	9.52	fps
C1 = sand material constant	0.00000778	
C2 = sand material constant	-0.34	
C3 = sand material constant	3.87	
TW = top width of upstream channel, (in ft)	55.12	ft
So = upstream channel slope, (in ft/ft)	0.059	ft/ft
L = entire upstream channel length, (in ft)	255.69	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.0	cfs/ft
Qs = total sediment transport rate = qs*TW	2.6	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0470	56.1	9.6	52.8	1.27	1.06	2.6	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.0	cfs/ft
Qs = total sediment transport rate = qs*TW	2.6	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-3.0	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 2750-2500

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04700	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3458.00
0+13	3458.00
0+15	3457.00
0+17	3456.00
0+20	3455.12
0+25	3455.00
0+29	3454.00
0+37	3454.00
0+40	3454.00
0+50	3454.00
0+70	3454.00
0+72	3455.00
0+74	3456.00
0+76	3457.00
1+00	3457.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3458.00)	(0+20, 3455.12)	0.040
(0+20, 3455.12)	(0+70, 3454.00)	0.035
(0+70, 3454.00)	(1+00, 3457.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method

Worksheet for 2750-2500

Options

Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.27	ft
Elevation Range	3454.00 to 3458.00 ft		
Flow Area		57.64	ft²
Wetted Perimeter		53.17	ft
Hydraulic Radius		1.08	ft
Top Width		52.75	ft
Normal Depth		1.27	ft
Critical Depth		1.70	ft
Critical Slope		0.01627	ft/ft
Velocity		9.61	ft/s
Velocity Head		1.44	ft
Specific Energy		2.71	ft
Froude Number		1.62	
Flow Type	Supercritical		

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	1.27	ft
Critical Depth	1.70	ft
Channel Slope	0.04700	ft/ft
Critical Slope	0.01627	ft/ft

Cross Section for 2750-2500

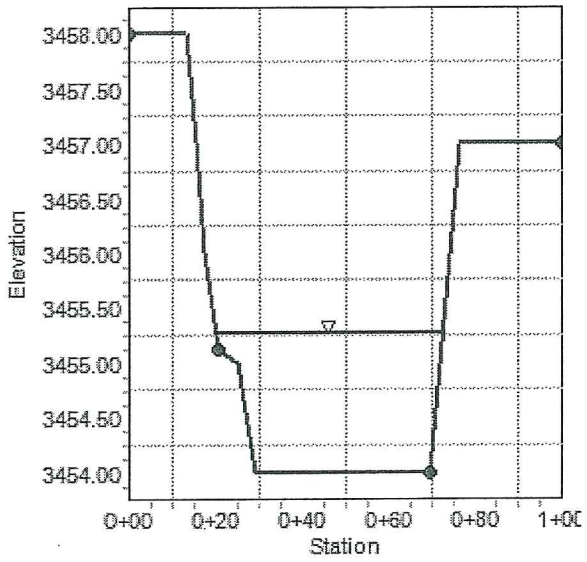
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04700	ft/ft
Normal Depth	1.27	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2500-2400

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.98	ft
V = flow velocity in upstream channel, (in fps)	10.76	fps
C1 = sand material constant	0.00000778	
C2 = sand material constant	-0.34	
C3 = sand material constant	3.87	
TW = top width of upstream channel, (in ft)	52.07	ft
So = upstream channel slope, (in ft/ft)	0.058	ft/ft
L = entire upstream channel length, (in ft)	103.59	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	4.0	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0620	45.3	12.2	35.0	1.51	1.29	4.0	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	4.0	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	0.4	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 2500-2400

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06200	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3453.00
0+02	3453.00
0+10	3452.00
0+12	3451.00
0+34	3450.00
0+37	3449.00
0+37	3449.00
0+42	3448.00
0+48	3448.00
0+67	3448.00
0+69	3449.00
0+72	3450.00
0+74	3451.00
0+95	3451.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3453.00)	(0+12, 3451.00)	0.040
(0+12, 3451.00)	(0+67, 3448.00)	0.035
(0+67, 3448.00)	(0+95, 3451.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method

Worksheet for 2500-2400

Options

Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.51	ft
Elevation Range	3448.00 to 3453.00 ft		
Flow Area		45.32	ft²
Wetted Perimeter		35.46	ft
Hydraulic Radius		1.28	ft
Top Width		35.00	ft
Normal Depth		1.51	ft
Critical Depth		2.29	ft
Critical Slope		0.01590	ft/ft
Velocity		12.22	ft/s
Velocity Head		2.32	ft
Specific Energy		3.83	ft
Froude Number		1.89	
Flow Type	Supercritical		

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	1.51	ft
Critical Depth	2.29	ft
Channel Slope	0.06200	ft/ft
Critical Slope	0.01590	ft/ft

Cross Section for 2500-2400

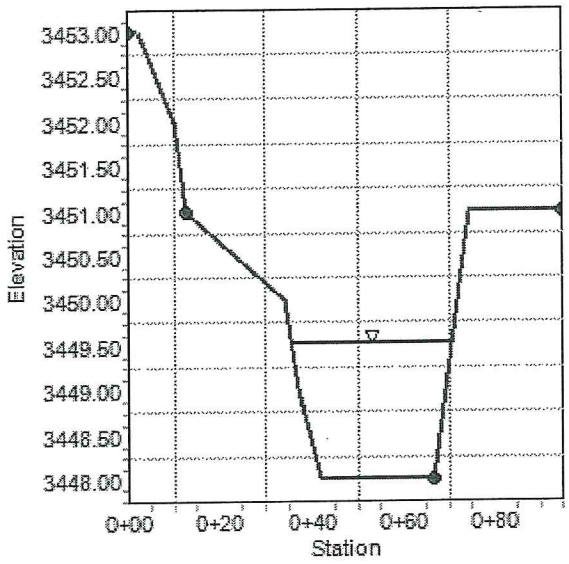
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06200	ft/ft
Normal Depth	1.51	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2400-2275

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.37	ft
V = flow velocity in upstream channel, (in fps)	11.72	fps
C1 = sand material constant	0.00000778	
C2 = sand material constant	-0.34	
C3 = sand material constant	3.87	
TW = top width of upstream channel, (in ft)	35.58	ft
So = upstream channel slope, (in ft/ft)	0.064	ft/ft
L = entire upstream channel length, (in ft)	108.83	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.4	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0610	55.6	10.0	58.3	1.44	0.95	3.4	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.4	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-0.4	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 2400-2275

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06100	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+01	3446.00
0+14	3446.00
0+28	3446.00
0+41	3445.00
0+44	3444.00
0+47	3443.00
0+51	3442.00
0+84	3441.31
0+98	3441.00
1+04	3441.00
1+06	3442.00
1+09	3443.00
1+11	3444.00
1+41	3444.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+01, 3446.00)	(0+51, 3442.00)	0.040
(0+51, 3442.00)	(1+04, 3441.00)	0.035
(1+04, 3441.00)	(1+41, 3444.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method

Worksheet for 2400-2275

Options

Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.44	ft
Elevation Range	3441.00 to 3446.00 ft		
Flow Area		55.56	ft²
Wetted Perimeter		58.63	ft
Hydraulic Radius		0.95	ft
Top Width		58.29	ft
Normal Depth		1.44	ft
Critical Depth		1.91	ft
Critical Slope		0.01673	ft/ft
Velocity		9.97	ft/s
Velocity Head		1.55	ft
Specific Energy		2.99	ft
Froude Number		1.80	
Flow Type	Supercritical		

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	1.44	ft
Critical Depth	1.91	ft
Channel Slope	0.06100	ft/ft
Critical Slope	0.01673	ft/ft

Cross Section for 2400-2275

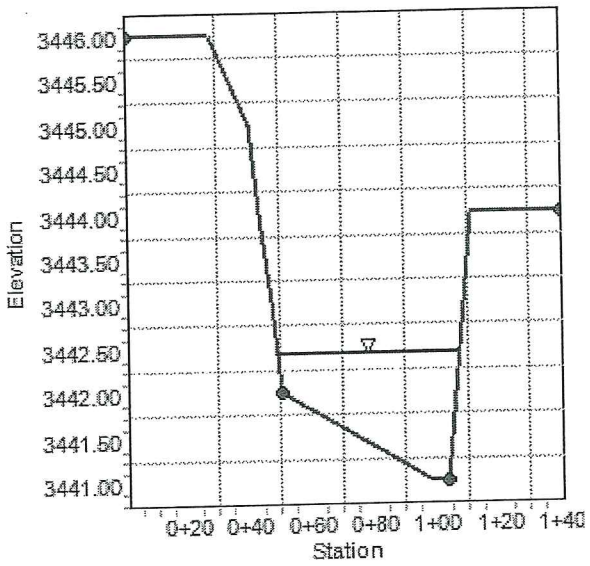
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06100	ft/ft
Normal Depth	1.44	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2275-2054

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.98	ft
V = flow velocity in upstream channel, (in fps)	9.91	fps
C1 = sand material constant	0.00000778	
C2 = sand material constant	-0.34	
C3 = sand material constant	3.87	
TW = top width of upstream channel, (in ft)	58.44	ft
So = upstream channel slope, (in ft/ft)	0.085	ft/ft
L = entire upstream channel length, (in ft)	128.82	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3) — 0.1 cfs/ft

Qs = total sediment transport rate = qs*TW — 3.3 cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.1120	58.6	9.5	68.0	0.86	0.86	3.3	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3) — 0.0 cfs/ft

Qs = total sediment transport rate = qs*TW — 3.3 cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L — 3.4 ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 2275-2054

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.11200	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3441.99
0+01	3441.98
0+01	3441.98
0+04	3441.95
0+06	3441.94
0+08	3441.92
0+08	3441.92
0+11	3441.90
0+11	3441.90
0+14	3441.88
0+15	3441.86
0+17	3441.85
0+18	3441.83
0+20	3441.82
0+22	3441.81
0+23	3441.80
0+25	3441.78
0+25	3441.78
0+31	3430.00
0+53	3430.00
0+57	3430.00
0+64	3430.00
0+72	3430.00
0+79	3430.00
0+87	3430.00
0+94	3430.00
0+98	3430.00

Worksheet for 2275-2054

Input Data

Station (ft)	Elevation (ft)
0+98	3440.73

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3441.99)	(0+98, 3430.00)	0.047
(0+98, 3430.00)	(0+98, 3440.73)	0.047

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.86	ft
Elevation Range	3430.00 to 3441.99 ft	
Flow Area	58.60	ft²
Wetted Perimeter	69.41	ft
Hydraulic Radius	0.84	ft
Top Width	67.99	ft
Normal Depth	0.86	ft
Critical Depth	1.28	ft
Critical Slope	0.03095	ft/ft
Velocity	9.45	ft/s
Velocity Head	1.39	ft
Specific Energy	2.25	ft
Froude Number	1.80	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

Worksheet for 2275-2054

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	0.86	ft
Critical Depth	1.28	ft
Channel Slope	0.11200	ft/ft
Critical Slope	0.03095	ft/ft

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

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Project in English units

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ScaleZ="1" /></SpatialReference>

PLAN DATA

Plan Title: COS1_ULT
Plan File : f:\Projects\600\62024-226-2\Division\Fctl\Calcs\HEC-RAS\GEO\COS1_ULT.p03

Geometry Title: COS1_ULT
Geometry File : f:\Projects\600\62024-226-2\Division\Fctl\Calcs\HEC-RAS\GEO\COS1_ULT.g03

Flow Title : COS1_ULT
Flow File : f:\Projects\600\62024-226-2\Division\Fctl\Calcs\HEC-RAS\GEO\COS1_ULT.f03

Plan Description:
Default Scenario

Plan Summary Information:

Number of:	Cross Sections	= 50	Multiple Openings	=	0
	Culverts	= 1	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	= 0.01
Critical depth calculation tolerance	= 0.01
Maximum number of iterations	= 20
Maximum difference tolerance	= 0.33
Flow tolerance factor	= 0.001

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

FLOW DATA

Flow Title: COS1_ULT
Flow File : f:\Projects\600\62024-226-2\Division\Fctl\Calcs\HEC-RAS\GEO\COS1_ULT.f03

Flow Data (cfs)

River	Reach	RS	PF 1
river	river	4325	554

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
river	river	PF 1	Known WS = 3562.2	Known WS = 3426.14

GEOMETRY DATA

Geometry Title: COS1_ULT
Geometry File : f:\Projects\600\62024-226-2\Division\Fctl\Calcs\HEC-RAS\GEO\COS1_ULT.g03

CROSS SECTION

RIVER: river
REACH: river RS: 4325

INPUT
Description:

Station Elevation Data	num=	4					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3563.7	13.5	3559.2	39.5	3559.2	53	3563.7

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.037	13.5	.037	39.5	.037

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
13.5	39.5	50.54	50.54	50.54	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4250

INPUT
Description:

Station Elevation Data	num=	16							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3562	10.77	3562	12.76	3561	14.75	3560	17.01	3559.7
20.07	3559.3	22.37	3559	38.09	3558	38.34	3558	39.12	3558
55.71	3559	59.74	3560	63.5	3561	67.26	3562	91.72	3563
92.74	3563								

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.04	14.75	.035	55.71	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
14.75	55.71	39.88	39.88	39.88	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4200

INPUT
Description:

Station Elevation Data	num=	13							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3560	8.43	3560	10.41	3559	12.4	3558	14.39	3557
24.61	3557	37.14	3557	40.51	3557	40.98	3557	64.45	3558
66.9	3559	69.35	3560	95.55	3560				

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.04	14.39	.035	64.45	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
14.39	64.45	17.86	17.86	17.86	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4175

INPUT
Description:

Station Elevation Data	num=	14							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3559	7.33	3559	9.35	3558	11.37	3557	13.39	3556
22.5	3556	32.44	3556	36.84	3556	40.72	3556	64.9	3557
66.91	3558	68.92	3559	70.93	3560	94.7	3560		

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.04	13.39	.035	64.9	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
13.39	64.9	34.43	34.43	34.43	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4150

INPUT
Description:

Station Elevation Data	num=	14							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	3557	7.35	3557	10.02	3556	12.69	3555	15.36	3554
21.57	3554	32.03	3554	40.37	3554	48.24	3554	66.98	3555
69.02	3556	71.06	3557	75.35	3558	94.61	3558		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	15.36	.035	66.98	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
15.36	66.98	34.58	34.58	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4125

INPUT
Description:
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3554	8.68	3554	12.01	3553	15.31	3552	45.08	3552
56.52	3552	68.52	3553	70.5	3554	72.48	3555	74.45	3556
95.55	3556								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	15.31	.035	68.52	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
15.31	68.52	58.09	58.09	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4100

INPUT
Description:
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1.73	3552	14.47	3552	14.49	3552	16.58	3551	18.63	3550
18.64	3550	20.09	3549.88	31.11	3549	31.13	3549	35.97	3548
35.98	3548	37.88	3548	37.9	3548	38.07	3548.01	61.86	3549
61.87	3549	67.58	3549.99	67.61	3550	70.86	3550.7	72.23	3551
74.53	3552	74.55	3552.01	76.83	3552.99	76.84	3553	94.76	3553

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1.73	.04	18.63	.035	72.23	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
18.63	72.23	35.31	35.31	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4050

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3550	13.28	3550	15.28	3549	17.31	3548	19.33	3547
38.76	3546	39.23	3546	42.79	3546	68.59	3547	72.55	3548
75.52	3549	78.51	3550	85.63	3551	95.63	3551		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	19.33	.035	68.59	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
19.33	68.59	39.1	39.1	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4000

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3549	13	3549	14.99	3548	16.98	3547	18.96	3546
18.97	3546	27.72	3545	32.26	3544	36.26	3544	50.77	3544
69.85	3544	71.44	3544	74.6	3545	77.77	3546	80.93	3547
97.79	3547								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	18.96	.035	71.44	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
18.96	71.44	40.37	40.37	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3950

INPUT
Description:
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1.04	3545	9.83	3545	12.92	3544	12.95	3543.99	15.99	3543
16.06	3542.98	18.97	3542	18.99	3542	32.17	3542	57.35	3542
67.38	3542	67.4	3542	69.54	3542	69.55	3542	72.56	3543
75.58	3544	78.59	3545	96.51	3545				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1.04	.04	18.97	.035	69.54	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
18.97	69.54	33.66	33.66	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3900

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3543	9.34	3543	11.82	3542	14.41	3541	17.13	3540
18.93	3540	24.46	3540	36.39	3540	50.93	3540	63.48	3541
69.82	3542	72.72	3543	75.66	3544	78.55	3545	97.81	3545

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	17.13	.035	69.82	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
17.13	69.82	55	55	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3875

INPUT
Description:
Station Elevation Data num= 24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-2.97	3540	6.8	3540	8.99	3539	11.16	3538	13.34	3537
13.57	3537	19.77	3537	19.8	3537	46.74	3537	46.77	3537
46.78	3537	46.92	3537	50.87	3538	55.81	3539	55.83	3539
64.14	3539.84	65.71	3540	66.85	3540.57	67.72	3541	69.8	3542
69.83	3542	77.39	3543	77.4	3543	93.18	3543		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-2.97	.04	13.34	.035	65.71	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
13.34	65.71	46.87	46.87	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3850

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3538	6.82	3538	10.03	3537	13.29	3536	16.58	3535
20.7	3535	40.16	3535	48.48	3535	54.14	3535	63.86	3536
71	3537	73.15	3538	75.58	3539	81.57	3540	98.81	3540

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	16.58	.035	71	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
16.58	71	40.21	40.21	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3825

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3538	7.8	3538	10.7	3537	13.42	3536	15.95	3535
26.78	3534	47.24	3533.52	69.52	3533	72.05	3533	75.99	3534
82.9	3534	84.15	3534	84.16	3534	88.96	3534.29	107.42	3535

```
  109.23    3535

Manning's n Values          num=        5
     Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   15.95    .035   72.05     .04    82.9     .03   88.96     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         15.95   72.05             30.81   30.81   30.81            .05      .1

CROSS SECTION


RIVER: river
REACH: river              RS: 3800

INPUT
Description:
Station Elevation Data    num=       12
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3535     5.34     3535     11.5     3534    13.49     3533    15.47     3532
   34.65  3531.63    66.68     3531    68.28     3531    78.66     3532    81.11     3533
   82.03     3534    96.02     3534

Manning's n Values          num=        4
     Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   15.47    .035   68.28     .03    78.66     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         15.47   68.28             36.29   36.29   36.29            .05      .1

CROSS SECTION


RIVER: river
REACH: river              RS: 3750

INPUT
Description:
Station Elevation Data    num=       16
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3533     6.77     3533    11.86     3532    13.87     3531    15.88     3530
   27.55     3529    31.83     3529    33.87     3529    39.76     3529     44.5     3529
   66.92     3529    69.38     3529    72.12     3530     74.9     3531    77.68     3532
   97.35     3532

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   15.88    .035   69.38     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         15.88   69.38             48.04   48.04   48.04            .05      .1

CROSS SECTION


RIVER: river
REACH: river              RS: 3700

INPUT
Description:
Station Elevation Data    num=       15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3529     11.4     3529    13.64     3528    15.89     3527    18.13     3526
   23.76     3526    27.07     3526    35.68     3526    48.95     3526    64.43     3526
   68.66     3526    70.65     3527    72.64     3528    74.61     3529    97.13     3529

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   18.13    .035   68.66     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         18.13   68.66             49.84   49.84   49.84            .05      .1

CROSS SECTION


RIVER: river
REACH: river              RS: 3675

INPUT
Description:
Station Elevation Data    num=       15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3527     8.02     3527    11.65     3526    15.29     3525    18.91     3524
   27.19     3523    36.13     3523    52.12     3523    60.18     3524    62.12     3524
   71.82     3524    73.89     3525    75.97     3526    83.18     3527   101.92     3527

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   18.91    .035   71.82     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         18.91   71.82             53.18   53.18   53.18            .05      .1

CROSS SECTION


RIVER: river
REACH: river              RS: 3650
```

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3523	9.74	3523	11.7	3522	13.64	3521	33.4	3520
41.2	3520	61.33	3520	66.19	3521	69.52	3522	72.9	3523
76.27	3524	93.94	3525	94.9	3525				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	13.64	.035	66.19	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
13.64	66.19	47.43	47.43	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3600

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3521	11.65	3521	13.72	3520	15.78	3519	17.84	3518
22.67	3517	28.03	3517	32.1	3517	36.28	3517	44.83	3517
46.61	3517	67.12	3517	69.87	3517	76.84	3517	91.26	3518
92.01	3519	97.81	3519						

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	17.84	.035	76.84	.03	91.26	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
17.84	76.84	50.22	50.22	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3550

INPUT
Description:
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3518	8.65	3518	17.79	3517	21.16	3516	24.46	3515
28.54	3514.17	29.93	3514.78	49.19	3514	52.91	3513	54.92	3513
67.3	3513	74.19	3513	75.83	3514	76.48	3514.29	8 78.01	3515
80.02	3516	82.02	3517	84.03	3518	96.97	3518		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	28.54	.035	76.48	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
28.54	76.48	46.03	46.03	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3450

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3515	19.75	3515	22.82	3514	25.86	3513	28.9	3512
34.01	3511.85	62.92	3511	71.14	3510	81.17	3510	83.21	3511
85.26	3512	87.93	3513	97.23	3513				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	28.9	.035	81.17	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
28.9	81.17	67.92	67.92	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3400

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3511	20.93	3511	24.06	3510	27.19	3509	31.14	3508.09
35.96	3508	42.52	3508	51.69	3508	59.41	3507	63.54	3506
67.06	3506	79.36	3506	81.16	3507	83.14	3508	85.11	3509
87.09	3510	96.9	3510						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	31.14	.035	79.36	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
31.14	79.36	67.51	67.51	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3300

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3507	8.54	3507	17.8	3506	20.83	3505	23.85	3504
45.96	3503	60.63	3502	65.72	3502	72.77	3502	74.99	3503
77.35	3504	79.6	3505	82.04	3506	86.26	3507	96.51	3507

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	23.85	.035	74.99	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
23.85	74.99	76.84	76.84	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3250

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3502	3.38	3502	16.43	3501	18.36	3500	20.28	3499
22.22	3498	26.68	3498	43.27	3498	56.99	3498	63.93	3498
74.66	3499	77.84	3500	81.04	3501	84.23	3502	91.49	3502

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	22.22	.035	74.66	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
22.22	74.66	36.75	36.75	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3200

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3500	14.04	3500	19.54	3499	21.52	3498	23.51	3497
38.81	3496	46.8	3496	65.1	3496	69.43	3496	75.65	3496
77.9	3497	80.24	3498	82.59	3499	91.08	3499		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	23.51	.035	75.65	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
23.51	75.65	39.53	39.53	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3170

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3497	14.82	3497	17.63	3496	20.3	3495	22.74	3494
31.81	3494	46.09	3494	55.85	3494	74.26	3494	76.26	3495
78.25	3496	80.25	3497	91.97	3497				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	22.74	.035	74.26	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
22.74	74.26	71.98	71.98	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3100

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3493	12.23	3493	14.83	3492	16.87	3491	18.89	3490

35.44	3490	42.12	3490	46.48	3490	54.12	3490	58.61	3490
69.93	3489	69.99	3489	70.91	3489.46	72	3490	74.04	3491
76.1	3492	93.14	3492						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	18.89	.035	69.93	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
18.89	69.93	32.02	32.02	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3075

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3491	10.51	3491	14.49	3490	18.46	3489	22.3	3488
42.29	3488	44.13	3488	49.66	3488	55.81	3488	63.2	3488
75.52	3488	77.6	3489	79.76	3490	84.67	3491	96.45	3491

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	22.3	.035	75.52	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
22.3	75.52	35.45	35.45	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3050

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3488	20.16	3488	23.77	3487	27.41	3486	31.07	3485
31.58	3485	31.62	3485	58.85	3485.54	82.5	3486	85.45	3487
88.45	3488	91.45	3489	101.25	3489				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	31.07	.035	82.5	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
31.07	82.5	45.57	45.57	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3000

INPUT
Description:
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3488	5.19	3488	24.53	3487	33.02	3486	35.05	3485
37.09	3484	39	3483	43	3482	44.3	3482	57.35	3482
65.54	3482	69.69	3482	84.54	3482	92.82	3482	95.89	3483
98.92	3484	101.95	3485	114.75	3485				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	39	.035	92.82	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
39	92.82	59.55	59.55	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2950

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3484	25.5	3484	27.51	3483	29.53	3482	31.54	3481
37.72	3480	39.56	3479	47.02	3479	79.65	3479	83.7	3480
85.69	3481	87.68	3482	99.28	3482				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	31.54	.035	83.7	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
31.54	83.7	38.42	38.42	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2900

INPUT
Description:
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
.42	3482	24.57	3482	26.57	3481	28.56	3480	28.58	3479.99
30.55	3479	30.58	3478.99	30.59	3478.99	34.03	3478	50.69	3477
50.7	3477	50.87	3477	75.59	3477	81.6	3477	83.86	3478
84.12	3478.11	86.26	3479	88.65	3480	96.77	3480		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
.42	.04	30.59	.035	84.12	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
30.59	84.12	49.06	49.06	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2850

INPUT
Description:
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
2.44	3478	22.32	3478	24.3	3477	26.29	3476	28.28	3475
38.32	3474.59	52.75	3474	63.44	3474	63.46	3474	66.1	3474
66.11	3474	80.99	3474	81	3474	84.38	3475	84.39	3475
87.76	3476	92.13	3477	97.41	3477				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
2.44	.04	28.28	.035	81	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
28.28	81	48.33	48.33	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2800

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3475	18.73	3475	20.78	3474	22.85	3473	24.92	3472
45.05	3471.47	62.84	3471	75.85	3471	77.9	3472	79.92	3473
81.94	3474	94.3	3474						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	24.92	.035	75.85	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
24.92	75.85	48.59	48.59	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2750

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3473	15.79	3473	18.81	3472	21.82	3471	24.75	3470
35.68	3469	49.2	3469	76.8	3469	78.84	3470	80.88	3471
86.36	3472	95.18	3472						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	24.75	.035	76.8	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
24.75	76.8	54.42	54.42	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2700

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3470	16.25	3470	19.26	3469	22.26	3468	25.27	3467
43.58	3466	62.11	3466	76.11	3466	78.34	3467	80.38	3468
82.42	3469	97.59	3469						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

```
      0     .04   25.27    .035   78.34     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        25.27   78.34             35.3    35.3    35.3           .05       .1

CROSS SECTION


RIVER: river
REACH: river              RS: 2675

INPUT
Description:
Station Elevation Data    num=      16
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3468    19.38     3468    21.51     3467    23.58     3466    25.64     3465
   47.62     3464    49.02     3464    52.44     3464    62.96     3464    67.72     3464
   74.58     3464    77.61     3464    80.64     3465    83.68     3466    86.82     3467
    95.4     3467

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   25.64    .035   77.61     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        25.64   77.61            43.49   43.49   43.49           .05       .1

CROSS SECTION


RIVER: river
REACH: river              RS: 2650

INPUT
Description:
Station Elevation Data    num=      15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3465     19.5     3465    22.08     3464    24.68     3463    27.31     3462
   42.15     3462    49.87     3462     54.5     3461     58.5     3461    61.41     3461
   79.53     3462    82.53     3463    85.64     3464    90.22     3465       96     3465

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   27.31    .035   79.53     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        27.31   79.53            58.43   58.43   58.43           .05       .1

CROSS SECTION


RIVER: river
REACH: river              RS: 2550

INPUT
Description:
Station Elevation Data    num=      17
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3463    13.93     3463    22.14     3462    24.29     3461    26.41     3460
   28.96  3459.18    34.73     3459     40.6     3458     49.7     3458    55.01     3458
   73.75     3458    77.81     3458    78.19     3458    80.18     3459    82.17     3460
   84.19     3461    99.32     3461

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   28.96    .035   78.19     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        28.96   78.19            64.05   64.05   64.05           .05       .1

CROSS SECTION


RIVER: river
REACH: river              RS: 2500

INPUT
Description:
Station Elevation Data    num=      15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3458    13.34     3458    15.36     3457    17.37     3456    20.31  3455.12
   25.22     3455    29.18     3454    37.22     3454    40.02     3454    50.07     3454
   69.71     3454    71.93     3455    74.16     3456    76.39     3457    99.77     3457

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   20.31    .035   69.71     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        20.31   69.71            33.42   33.42   33.42           .05       .1

CROSS SECTION


RIVER: river
REACH: river              RS: 2475

INPUT
Description:
```

Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1.12	3457	3.42	3457	8.94	3456	8.99	3455.98	12.14	3455
15.34	3454	15.36	3454	15.4	3453.99	18.21	3453.22	19.03	3453
19.07	3453	21.2	3453	23.43	3453	25.34	3453	32.25	3452
38.94	3452	43.21	3452	48.85	3452	55.4	3452	64.69	3453
69.16	3454	69.18	3454.01	71.39	3455	73.63	3456	78.77	3456.41
86.01	3457	99.37	3457						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1.12	.04	18.21	.035	69.18	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
18.21	69.18	34.13	34.13	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2450

INPUT
Description:
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1.03	3455	8.93	3455	10.96	3454	10.98	3453.99	13.02	3453
13.03	3453	15.17	3452	15.18	3452	33.25	3451.17	37.04	3451
40.08	3450	45.55	3450	57.79	3450	66.06	3451	66.07	3451
69.13	3452	72.19	3453	75.25	3454	95.82	3454		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1.03	.04	15.18	.035	66.07	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
15.18	66.07	36.04	36.04	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2400

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3453	2.29	3453	9.8	3452	12.46	3451	34.02	3450
37.25	3449	37.26	3449	41.96	3448	47.88	3448	66.55	3448
69.32	3449	71.88	3450	74.39	3451	94.71	3451		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	12.46	.035	66.55	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
12.46	66.55	48.05	48.05	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2350

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3449	19.46	3449	21.47	3448	23.48	3447	25.48	3446
52.12	3445	55.27	3445	74.02	3445	74.1	3445	79.6	3446
82.91	3447	86.23	3448	107.47	3448				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	25.48	.035	79.6	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
25.48	79.6	60.78	60.78	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2275

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
.95	3446	14.36	3446	27.5	3446	40.68	3445	44.02	3444
47.34	3443	50.63	3442	83.62	3441.31	98.46	3441	103.64	3441
106.35	3442	108.89	3443	111.43	3444	140.69	3444		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
.95	.04	50.63	.035	103.64	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.

50.63	103.64		76.35	76.35	76.35	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2200

INPUT
Description:

Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-86.59	3442	-31.85	3442	-8.24	3441	-8.23	3441	-5.28	3440
-5.26	3439.99	-3.25	3439	-1.21	3438	-1.2	3438	21.33	3437
31.87	3437	52.68	3437	52.69	3437	54.84	3438	57	3439
75.94	3439	105.75	3439	127.24	3440	149.06	3441	151.26	3441

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-86.59	.04	-1.21	.035	52.68	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-1.21	52.68	21.66 21.66	21.66	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2055

INPUT
Description:

Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3442.47	19.08	3442	21	3441	22.85	3440	24.75	3439
26.61	3438	28.56	3437	30.41	3436	32.32	3435	61.13	3434
95.25	3435	100.74	3436	100.74	3439				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.047	0	.047	100.74	.047

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	100.74	30.81 30.81	30.81	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2054

INPUT
Description:

Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3441.99	.71	3441.98	1.4	3441.98	4.42	3441.95	6.08	3441.94
7.77	3441.92	7.93	3441.92	10.74	3441.9	10.94	3441.9	13.66	3441.88
15.4	3441.86	17.18	3441.85	18.47	3441.83	20.06	3441.82	21.89	3441.81
22.88	3441.8	24.7	3441.78	25.23	3441.78	30.5	3430	52.6	3430
56.5	3430	64.1	3430	71.7	3430	79.3	3430	86.9	3430
94.4	3430	98.1	3430	98.1	3440.73				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.047	0	.047	98.1	.013

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	98.1	113.61 113.61	113.61	.05	.1

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	30.5	3441.7	F
113.8	98.1	3440.7	F

CULVERT

RIVER: river
REACH: river RS: 2053

INPUT
Description:
Distance from Upstream XS = .1
Deck/Roadway Width = 113.5
Weir Coefficient = 2.7
Upstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
24.7	3441.71		128.78	3440.7	

Upstream Bridge Cross Section Data
Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3441.99	.71	3441.98	1.4	3441.98	4.42	3441.95	6.08	3441.94
7.77	3441.92	7.93	3441.92	10.74	3441.9	10.94	3441.9	13.66	3441.88
15.4	3441.86	17.18	3441.85	18.47	3441.83	20.06	3441.82	21.89	3441.81
22.88	3441.8	24.7	3441.78	25.23	3441.78	30.5	3430	52.6	3430
56.5	3430	64.1	3430	71.7	3430	79.3	3430	86.9	3430
94.4	3430	98.1	3430	98.1	3440.73				

```
Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .047        0    .047     98.1    .013

Bank Sta: Left   Right    Coeff Contr.   Expan.
             0    98.1            .05       .1
Ineffective Flow     num=        2
   Sta L   Sta R    Elev  Permanent
       0    30.5  3441.7       F
   113.8    98.1  3440.7       F

Downstream  Deck/Roadway Coordinates
    num=        2
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
    5.54  3440.1           155.95 3441.27

Downstream Bridge Cross Section Data
Station Elevation Data     num=       12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    34.5  3440.5    34.5    3425    53.1    3425    56.6    3425    63.5    3425
    70.5    3425    77.6    3425    84.6    3425    91.6    3425      95    3425
  113.65    3425  113.65 3441.25

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
    34.5    .013    34.5    .013  113.65    .013

Bank Sta: Left   Right    Coeff Contr.   Expan.
          34.5  113.65            .05       .1
Ineffective Flow     num=        2
   Sta L   Sta R    Elev  Permanent
    34.5    52.1  3440.1       F
      96  113.65 3441.27       F

Upstream Embankment side slope                =       3 horiz. to 1.0 vertical
Downstream Embankment side slope              =       3 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =      .98
Elevation at which weir flow begins           =  3440.7
Energy head used in spillway design           =
Spillway height used in design                =
Weir crest shape                              = Broad Crested

Number of Culverts =  1

Culvert Name      Shape      Rise    Span
Crossbridge          Box        5       5
FHWA Chart # 59- Rectangular concrete
FHWA Scale # 1 - Slope tapered; Less favorable edges
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                 .1   113.5     .015     .015        0                    1                 1
Number of Barrels =  6
Upstream   Elevation =  3430
Centerline Stations
    Sta.    Sta.    Sta.    Sta.    Sta.    Sta.
    56.5    64.1    71.7    79.3    86.9    94.4
Downstream Elevation =  3425
Centerline Stations
    Sta.    Sta.    Sta.    Sta.    Sta.    Sta.
    56.6    63.5    70.5    77.6    84.6    91.6

CROSS SECTION


RIVER: river
REACH: river                RS: 2052

INPUT
Description:
Station Elevation Data     num=       12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    34.5  3440.5    34.5    3425    53.1    3425    56.6    3425    63.5    3425
    70.5    3425    77.6    3425    84.6    3425    91.6    3425      95    3425
  113.65    3425  113.65 3441.25

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
    34.5    .013    34.5    .013  113.65    .013

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          34.5  113.65                0       0       0             .05       .1
Ineffective Flow     num=        2
   Sta L   Sta R    Elev  Permanent
    34.5    52.1  3440.1       F
      96  113.65 3441.27       F


SUMMARY OF MANNING'S N VALUES

River:river

      Reach          River Sta.       n1        n2        n3        n4        n5

 river                4325              .037      .037      .037
 river                4250               .04      .035       .04
 river                4200               .04      .035       .04
 river                4175               .04      .035       .04
 river                4150               .04      .035       .04
```

river	4125	.04	.035	.04		
river	4100	.04	.035	.04		
river	4050	.04	.035	.04		
river	4000	.04	.035	.04		
river	3950	.04	.035	.04		
river	3900	.04	.035	.04		
river	3875	.04	.035	.04		
river	3850	.04	.035	.04		
river	3825	.04	.035	.04	.03	.04
river	3800	.04	.035	.03	.04	
river	3750	.04	.035	.04		
river	3700	.04	.035	.04		
river	3675	.04	.035	.04		
river	3650	.04	.035	.04		
river	3600	.04	.035	.03	.04	
river	3550	.04	.035	.04		
river	3450	.04	.035	.04		
river	3400	.04	.035	.04		
river	3300	.04	.035	.04		
river	3250	.04	.035	.04		
river	3200	.04	.035	.04		
river	3170	.04	.035	.04		
river	3100	.04	.035	.04		
river	3075	.04	.035	.04		
river	3050	.04	.035	.04		
river	3000	.04	.035	.04		
river	2950	.04	.035	.04		
river	2900	.04	.035	.04		
river	2850	.04	.035	.04		
river	2800	.04	.035	.04		
river	2750	.04	.035	.04		
river	2700	.04	.035	.04		
river	2675	.04	.035	.04		
river	2650	.04	.035	.04		
river	2550	.04	.035	.04		
river	2500	.04	.035	.04		
river	2475	.04	.035	.04		
river	2450	.04	.035	.04		
river	2400	.04	.035	.04		
river	2350	.04	.035	.04		
river	2275	.04	.035	.04		
river	2200	.04	.035	.04		
river	2055	.047	.047	.047		
river	2054	.047	.047	.013		
river	2053	Culvert				
river	2052	.013	.013	.013		

SUMMARY OF REACH LENGTHS

River: river

Reach	River Sta.	Left	Channel	Right
river	4325	50.54	50.54	50.54
river	4250	39.88	39.88	39.88
river	4200	17.86	17.86	17.86
river	4175	34.43	34.43	34.43
river	4150	34.58	34.58	34.58
river	4125	58.09	58.09	58.09
river	4100	35.31	35.31	35.31
river	4050	39.1	39.1	39.1
river	4000	40.37	40.37	40.37
river	3950	33.66	33.66	33.66
river	3900	55	55	55
river	3875	46.87	46.87	46.87
river	3850	40.21	40.21	40.21
river	3825	30.81	30.81	30.81
river	3800	36.29	36.29	36.29
river	3750	48.04	48.04	48.04
river	3700	49.84	49.84	49.84
river	3675	53.18	53.18	53.18
river	3650	47.43	47.43	47.43
river	3600	50.22	50.22	50.22
river	3550	46.03	46.03	46.03
river	3450	67.92	67.92	67.92
river	3400	67.51	67.51	67.51
river	3300	76.84	76.84	76.84
river	3250	36.75	36.75	36.75
river	3200	39.53	39.53	39.53
river	3170	71.98	71.98	71.98
river	3100	32.02	32.02	32.02
river	3075	35.45	35.45	35.45
river	3050	45.57	45.57	45.57
river	3000	59.55	59.55	59.55
river	2950	38.42	38.42	38.42
river	2900	49.06	49.06	49.06
river	2850	48.33	48.33	48.33
river	2800	48.59	48.59	48.59
river	2750	54.42	54.42	54.42
river	2700	35.3	35.3	35.3
river	2675	43.49	43.49	43.49
river	2650	58.43	58.43	58.43
river	2550	64.05	64.05	64.05
river	2500	33.42	33.42	33.42
river	2475	34.13	34.13	34.13
river	2450	36.04	36.04	36.04

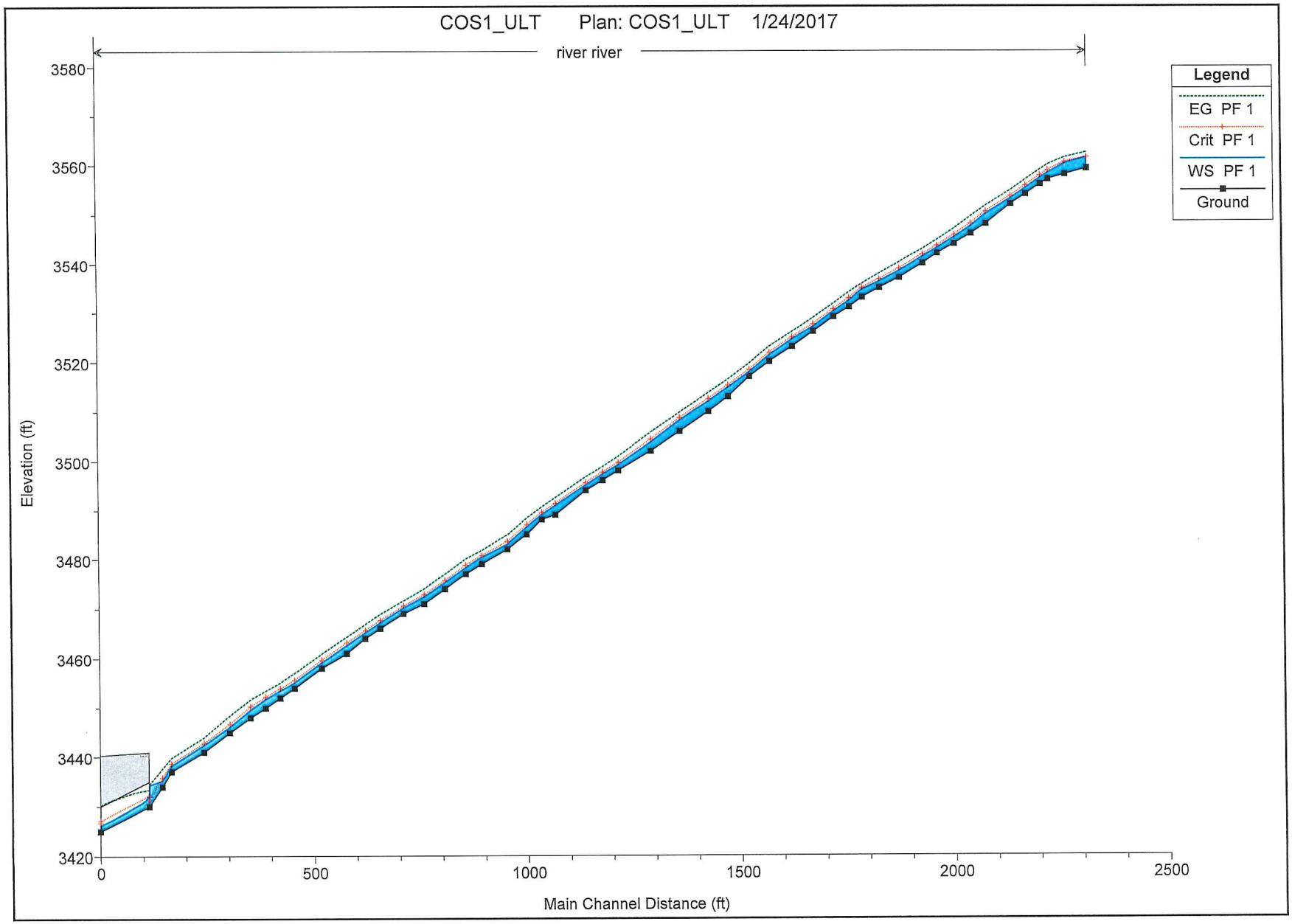
river	2400	48.05	48.05	48.05
river	2350	60.78	60.78	60.78
river	2275	76.35	76.35	76.35
river	2200	21.66	21.66	21.66
river	2055	30.81	30.81	30.81
river	2054	113.61	113.61	113.61
river	2053	Culvert		
river	2052	0	0	0

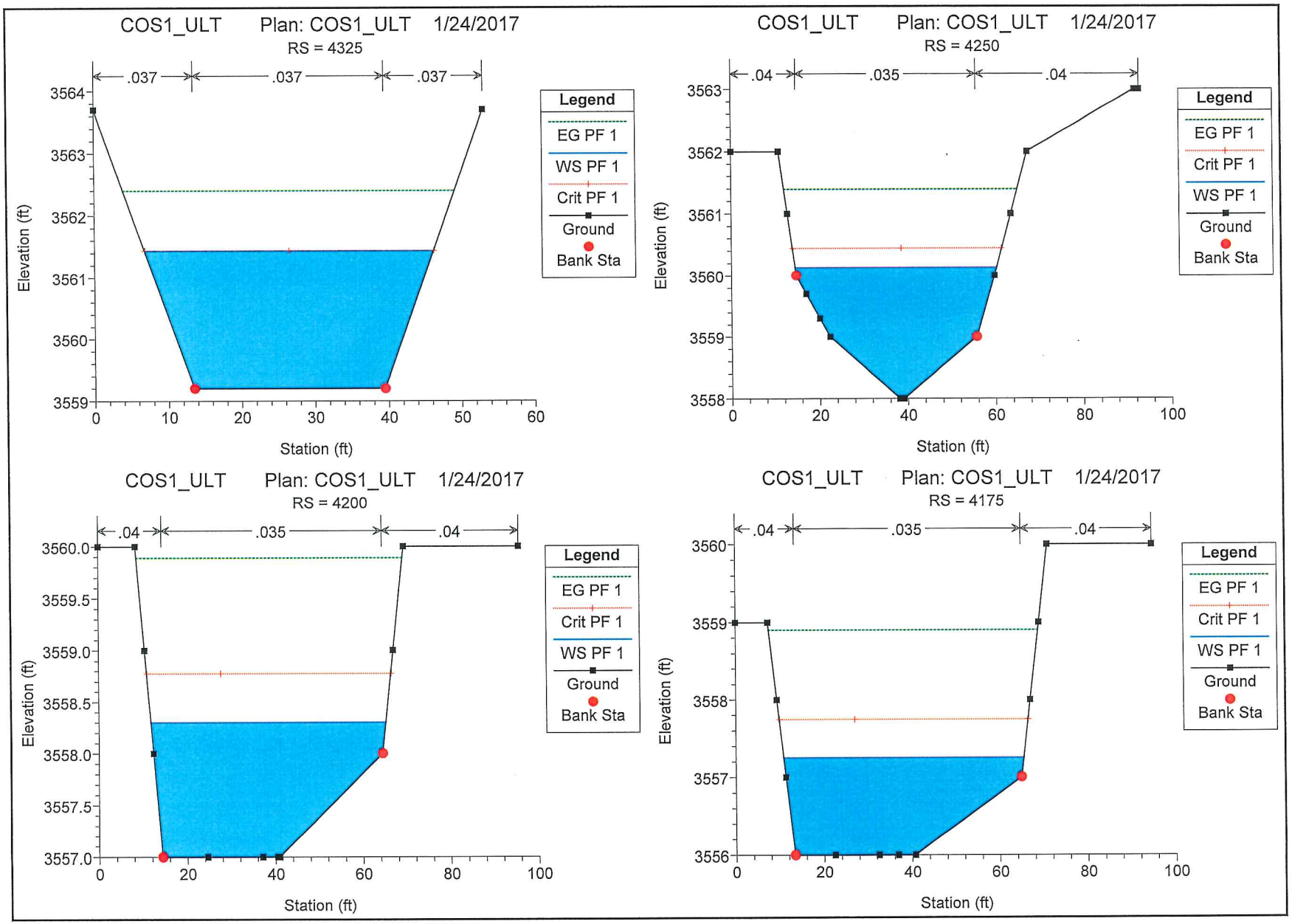
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: river

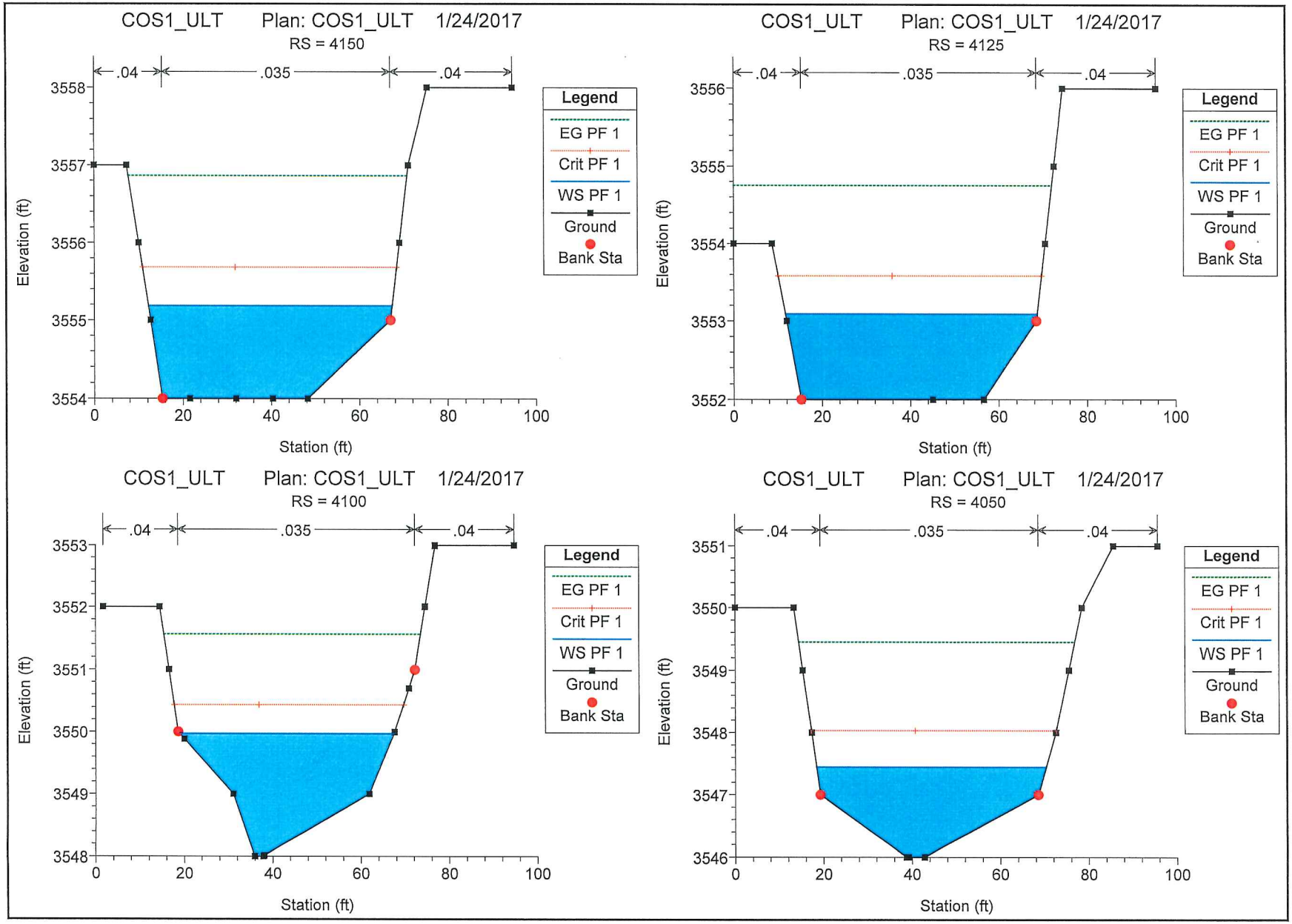
Reach	River Sta.	Contr.	Expan.
river	4325	.05	.1
river	4250	.05	.1
river	4200	.05	.1
river	4175	.05	.1
river	4150	.05	.1
river	4125	.05	.1
river	4100	.05	.1
river	4050	.05	.1
river	4000	.05	.1
river	3950	.05	.1
river	3900	.05	.1
river	3875	.05	.1
river	3850	.05	.1
river	3825	.05	.1
river	3800	.05	.1
river	3750	.05	.1
river	3700	.05	.1
river	3675	.05	.1
river	3650	.05	.1
river	3600	.05	.1
river	3550	.05	.1
river	3450	.05	.1
river	3400	.05	.1
river	3300	.05	.1
river	3250	.05	.1
river	3200	.05	.1
river	3170	.05	.1
river	3100	.05	.1
river	3075	.05	.1
river	3050	.05	.1
river	3000	.05	.1
river	2950	.05	.1
river	2900	.05	.1
river	2850	.05	.1
river	2800	.05	.1
river	2750	.05	.1
river	2700	.05	.1
river	2675	.05	.1
river	2650	.05	.1
river	2550	.05	.1
river	2500	.05	.1
river	2475	.05	.1
river	2450	.05	.1
river	2400	.05	.1
river	2350	.05	.1
river	2275	.05	.1
river	2200	.05	.1
river	2055	.05	.1
river	2054	.05	.1
river	2053	Culvert	
river	2052	.05	.1

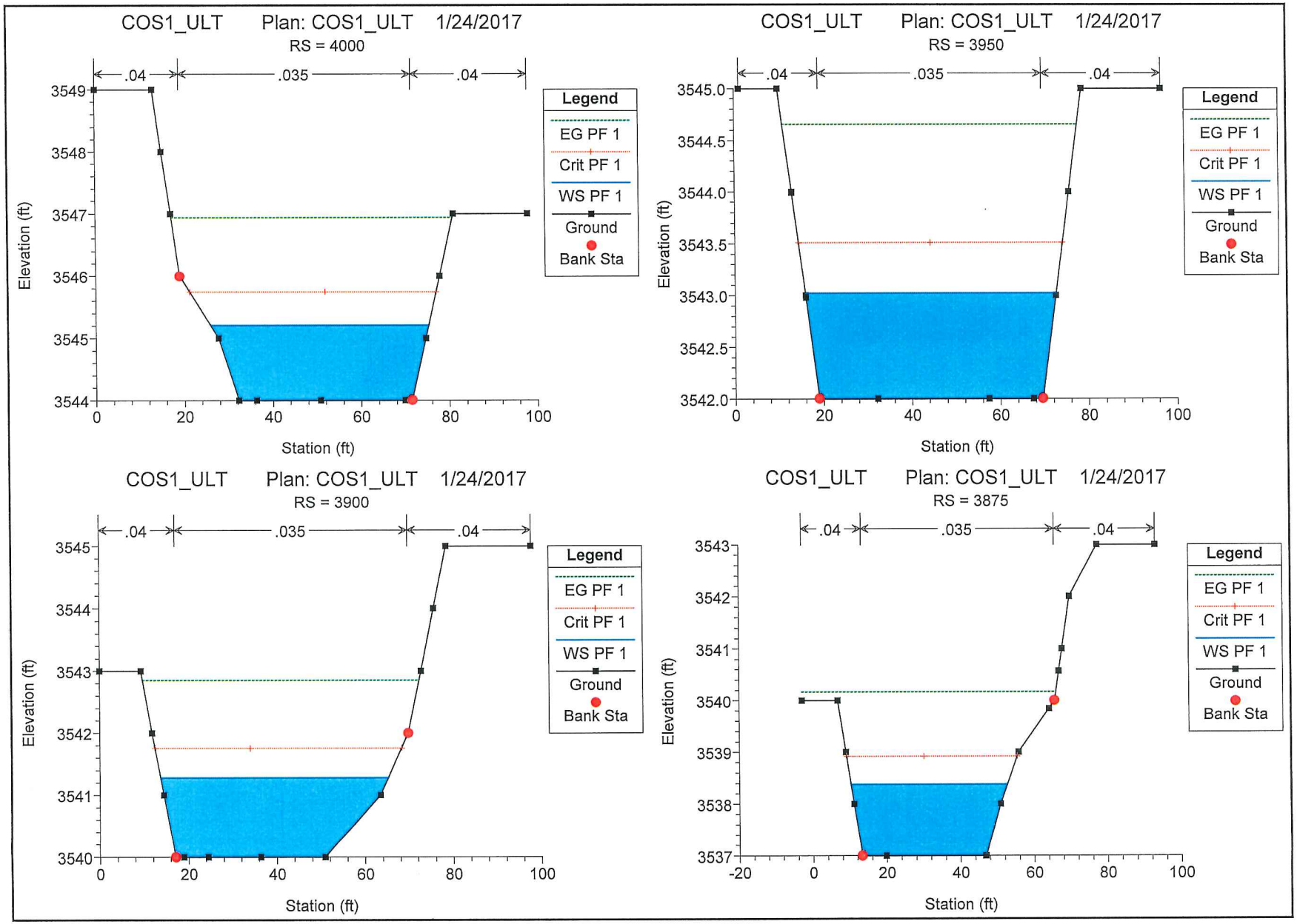
HEC-RAS Plan: COS1_ULT River: river Reach: river Profile: PF 1

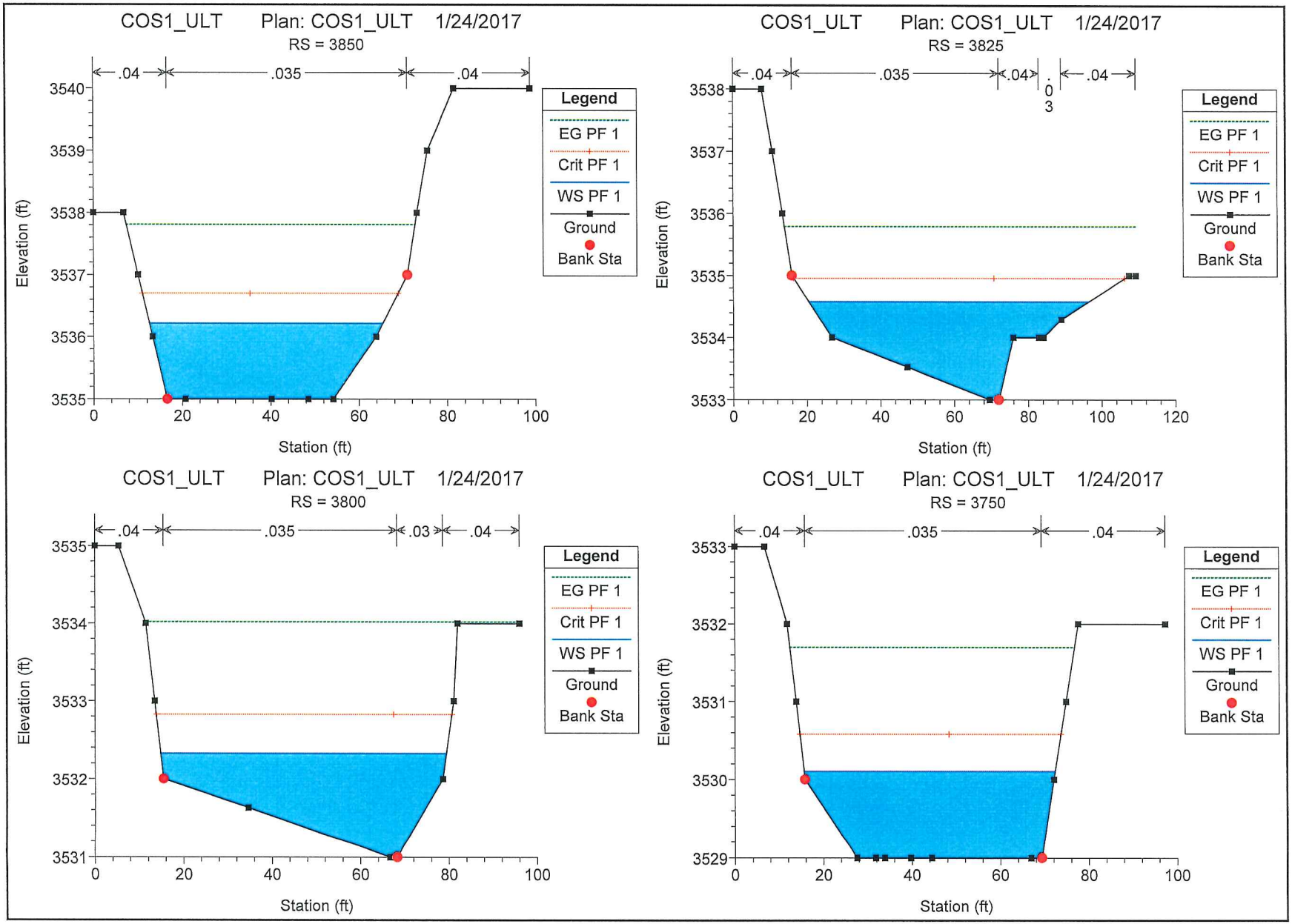
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
river	4325	PF 1	554.00	3559.20	3561.44	3561.44	3562.40	0.014363	8.23	73.18	39.42	0.97
river	4250	PF 1	554.00	3558.00	3560.13	3560.44	3561.40	0.027836	9.09	62.35	45.75	1.33
river	4200	PF 1	554.00	3557.00	3558.30	3558.77	3559.89	0.052621	10.17	55.25	53.39	1.73
river	4175	PF 1	554.00	3556.00	3557.26	3557.74	3558.90	0.057824	10.35	54.24	54.56	1.80
river	4150	PF 1	554.00	3554.00	3555.19	3555.68	3556.86	0.060424	10.46	53.75	55.17	1.84
river	4125	PF 1	554.00	3552.00	3553.09	3553.58	3554.75	0.061733	10.40	54.11	57.00	1.85
river	4100	PF 1	554.00	3548.00	3549.97	3550.44	3551.56	0.048826	10.13	54.66	48.44	1.68
river	4050	PF 1	554.00	3546.00	3547.44	3548.03	3549.45	0.073578	11.39	49.06	51.91	2.02
river	4000	PF 1	554.00	3544.00	3545.21	3545.74	3546.94	0.054946	10.67	52.94	49.34	1.78
river	3950	PF 1	554.00	3542.00	3543.02	3543.51	3544.66	0.058075	10.38	54.83	56.71	1.81
river	3900	PF 1	554.00	3540.00	3541.28	3541.76	3542.85	0.049575	10.12	55.65	51.59	1.69
river	3875	PF 1	554.00	3537.00	3538.38	3538.92	3540.17	0.047344	10.81	52.17	42.40	1.69
river	3850	PF 1	554.00	3535.00	3536.22	3536.70	3537.81	0.052511	10.23	55.16	52.80	1.74
river	3825	PF 1	554.00	3533.00	3534.58	3534.96	3535.80	0.046313	9.19	64.28	76.05	1.61
river	3800	PF 1	554.00	3531.00	3532.33	3532.83	3534.02	0.071624	10.15	53.46	64.66	1.95
river	3750	PF 1	554.00	3529.00	3530.11	3530.58	3531.69	0.057095	10.15	55.31	56.77	1.79
river	3700	PF 1	554.00	3526.00	3527.00	3527.52	3528.77	0.064594	10.77	52.47	54.75	1.90
river	3675	PF 1	554.00	3523.00	3524.44	3524.88	3525.93	0.049629	9.83	56.74	55.39	1.68
river	3650	PF 1	554.00	3520.00	3521.23	3521.75	3522.96	0.062326	10.56	52.56	53.77	1.86
river	3600	PF 1	554.00	3517.00	3517.85	3518.35	3519.57	0.082768	10.70	53.07	70.55	2.08
river	3550	PF 1	554.00	3513.00	3514.80	3515.27	3516.39	0.049503	10.15	55.37	52.14	1.68
river	3450	PF 1	554.00	3510.00	3511.98	3512.50	3513.72	0.068667	10.66	52.60	55.80	1.94
river	3400	PF 1	554.00	3506.00	3508.22	3508.65	3509.72	0.050281	9.97	56.46	52.97	1.69
river	3300	PF 1	554.00	3502.00	3503.74	3504.34	3505.77	0.068059	11.47	48.70	47.10	1.96
river	3250	PF 1	554.00	3498.00	3499.10	3499.60	3500.79	0.061051	10.46	53.49	54.89	1.85
river	3200	PF 1	554.00	3496.00	3497.20	3497.64	3498.72	0.051447	9.95	56.43	55.24	1.71
river	3170	PF 1	554.00	3494.00	3495.03	3495.50	3496.62	0.055147	10.18	55.55	56.11	1.77
river	3100	PF 1	554.00	3489.00	3490.88	3491.34	3492.48	0.059711	10.30	54.97	56.68	1.82
river	3075	PF 1	554.00	3488.00	3488.99	3489.46	3490.58	0.058740	10.22	55.57	59.08	1.81
river	3050	PF 1	554.00	3485.00	3486.43	3486.96	3488.24	0.073667	10.97	51.75	57.90	2.01
river	3000	PF 1	554.00	3482.00	3482.96	3483.51	3484.83	0.075770	11.04	50.79	56.57	2.03
river	2950	PF 1	554.00	3479.00	3480.34	3480.73	3481.71	0.037558	9.38	59.14	48.76	1.49
river	2900	PF 1	554.00	3477.00	3478.26	3478.76	3479.93	0.056929	10.39	53.32	51.33	1.79
river	2850	PF 1	554.00	3474.00	3475.19	3475.70	3476.92	0.066381	10.64	53.02	57.14	1.91
river	2800	PF 1	554.00	3471.00	3472.41	3472.89	3474.00	0.054601	10.19	55.25	54.67	1.76
river	2750	PF 1	554.00	3469.00	3470.21	3470.61	3471.60	0.044241	9.52	58.91	55.12	1.60
river	2700	PF 1	554.00	3466.00	3467.21	3467.69	3468.85	0.057750	10.28	54.00	54.13	1.80
river	2675	PF 1	554.00	3464.00	3465.23	3465.70	3466.82	0.056745	10.22	55.16	56.16	1.79
river	2650	PF 1	554.00	3461.00	3462.67	3463.16	3464.32	0.058340	10.35	54.30	55.97	1.81
river	2550	PF 1	554.00	3458.00	3459.24	3459.74	3460.93	0.057139	10.50	53.43	51.89	1.80
river	2500	PF 1	554.00	3454.00	3455.15	3455.70	3456.99	0.066127	10.95	51.23	52.07	1.92
river	2475	PF 1	554.00	3452.00	3453.50	3453.97	3455.08	0.048730	10.11	54.92	49.71	1.68
river	2450	PF 1	554.00	3450.00	3451.80	3452.28	3453.42	0.048531	10.25	54.64	49.00	1.68
river	2400	PF 1	554.00	3448.00	3449.61	3450.33	3451.67	0.046803	11.71	48.81	35.58	1.71
river	2350	PF 1	554.00	3445.00	3446.14	3446.78	3448.44	0.103885	12.17	45.55	54.85	2.34
river	2275	PF 1	554.00	3441.00	3442.47	3442.91	3443.96	0.053328	9.91	57.10	58.44	1.73
river	2200	PF 1	554.00	3437.00	3438.21	3438.67	3439.77	0.056303	10.08	55.63	56.94	1.78
river	2055	PF 1	554.00	3434.00	3435.22	3435.83	3437.53	0.238551	12.20	45.41	64.55	2.56
river	2054	PF 1	554.00	3430.00	3434.34	3431.28	3434.39	0.000549	1.89	293.13	69.54	0.16
river	2053		Culvert									
river	2052	PF 1	554.00	3425.00	3426.14	3426.71	3428.05	0.007912	11.09	49.98	79.15	1.83

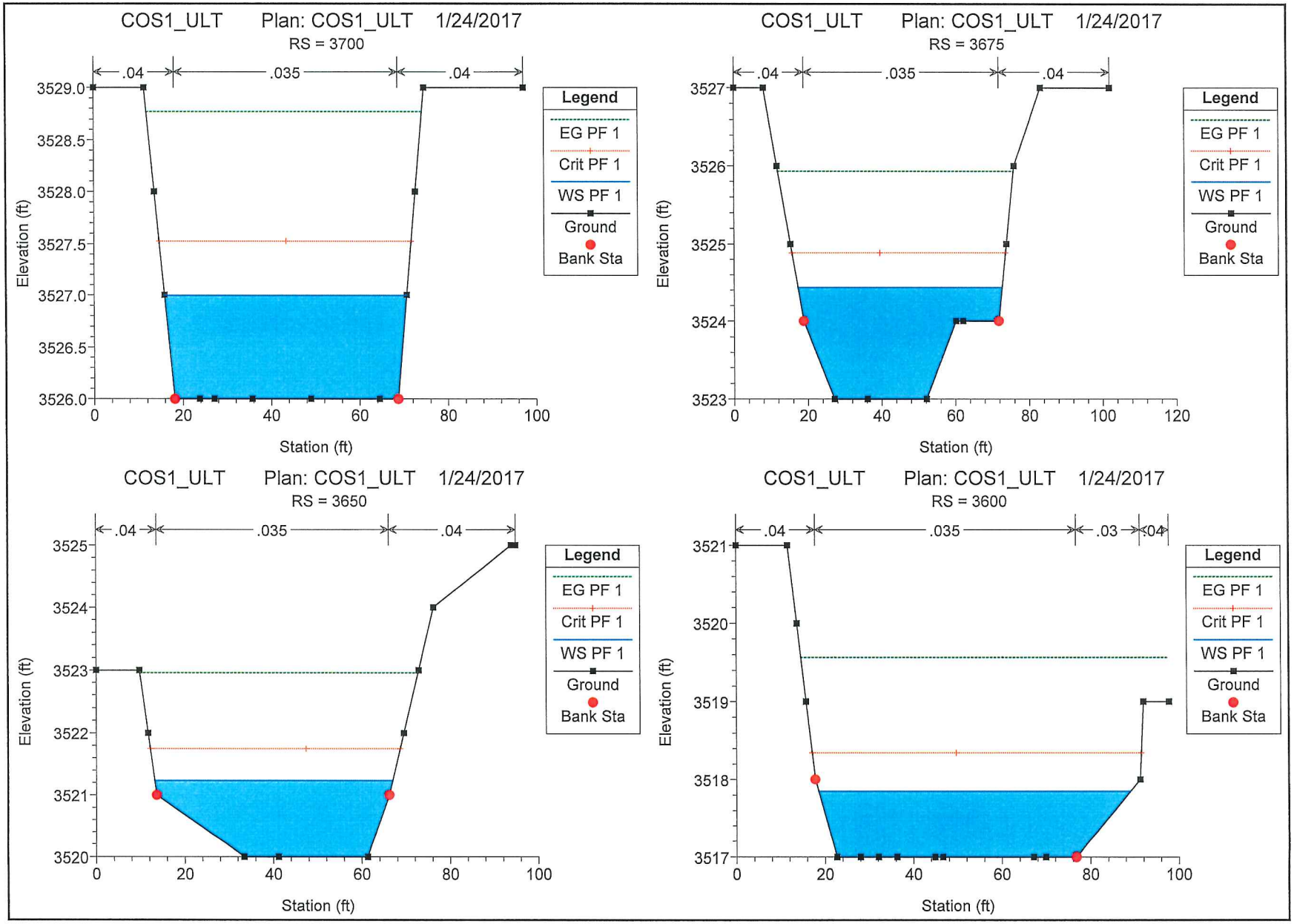

COS1_ULT Plan: COS1_ULT 1/24/2017
river river
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Elevation (ft)
3580
3560
3540
3520
3500
3480
3460
3440
3420
0
500
1000
1500
2000
2500
Main Channel Distance (ft)

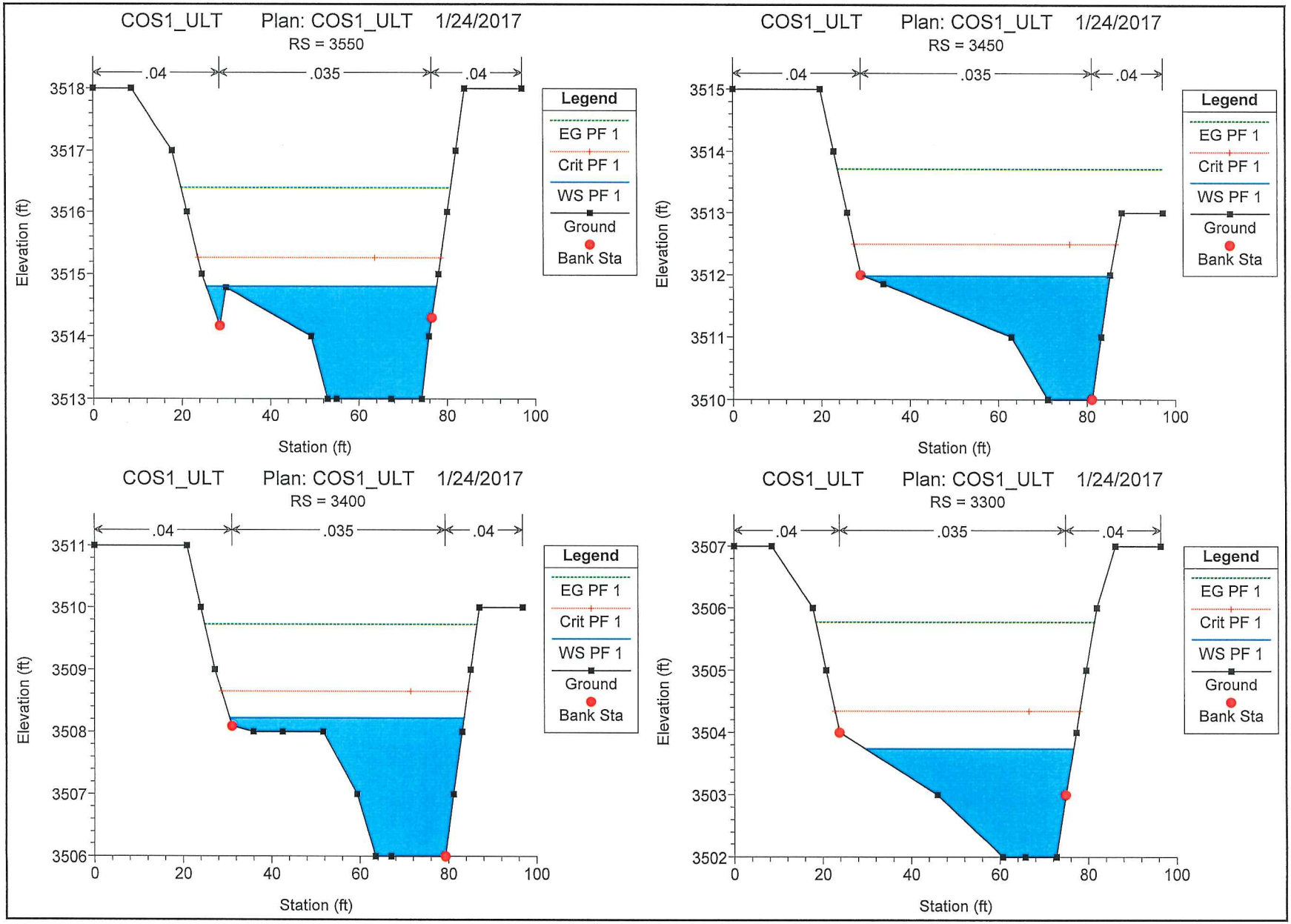

COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 4325
.037
.037
.037
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 4250
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 4200
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 4175
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta

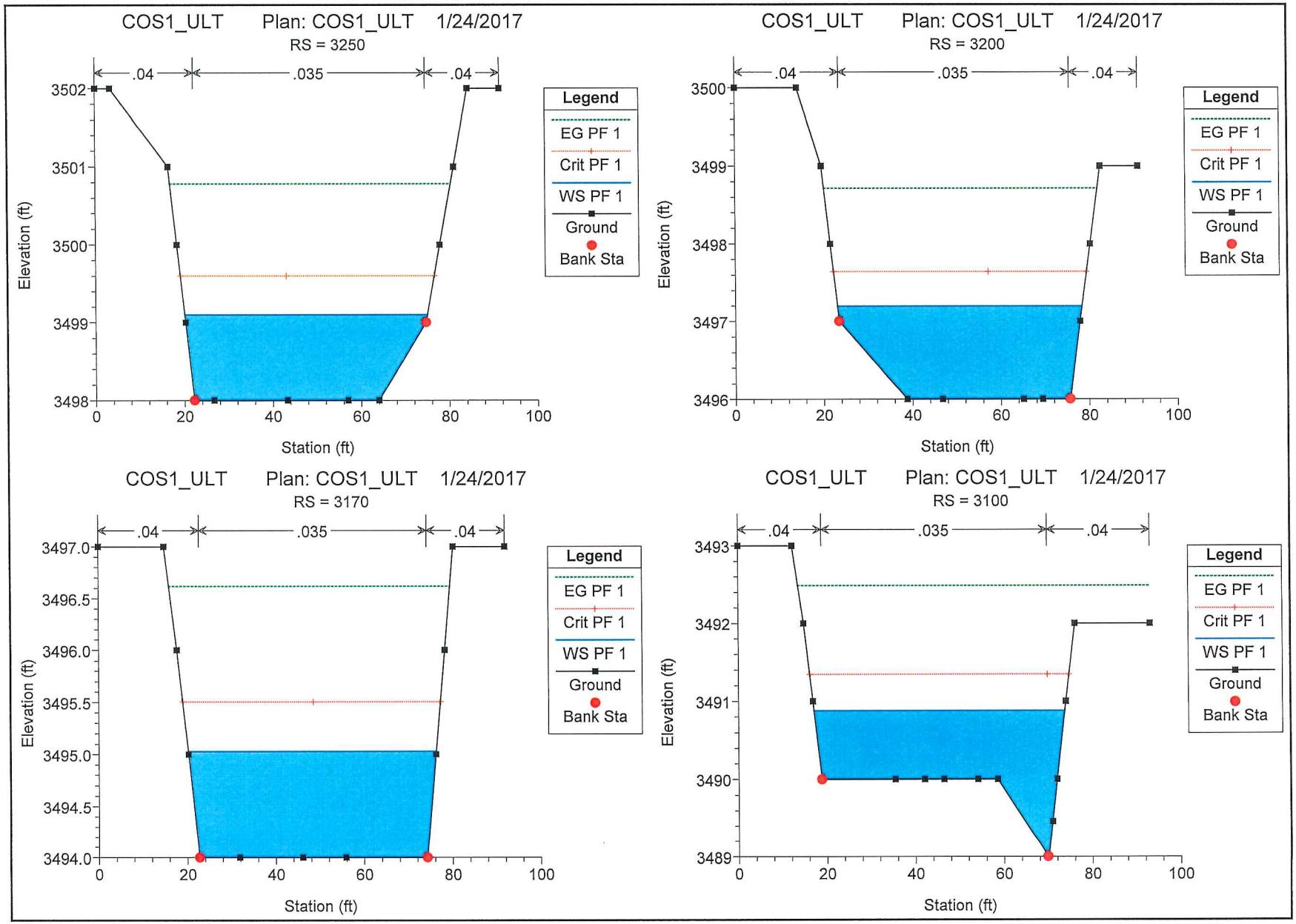

COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 4150
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 4125
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 4100
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 4050


COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 4000
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3950
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3900
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3875
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta


COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3850
.04
.035
.04
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3825
.04
.035
.04
.03
.04
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3800
.04
.035
.03
.04
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3750
.04
.035
.04
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3700
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3675
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3650
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3600
.04
.035
.03
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta


COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3550
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3450
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3400
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3300
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta


COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3250
.04
.035
.04
3502
3501
3500
3499
3498
Elevation (ft)
0
20
40
60
80
100
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3200
.04
.035
.04
3500
3499
3498
3497
3496
Elevation (ft)
0
20
40
60
80
100
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3170
.04
.035
.04
3497.0
3496.5
3496.0
3495.5
3495.0
3494.5
3494.0
Elevation (ft)
0
20
40
60
80
100
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
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RS = 3100
.04
.035
.04
3493
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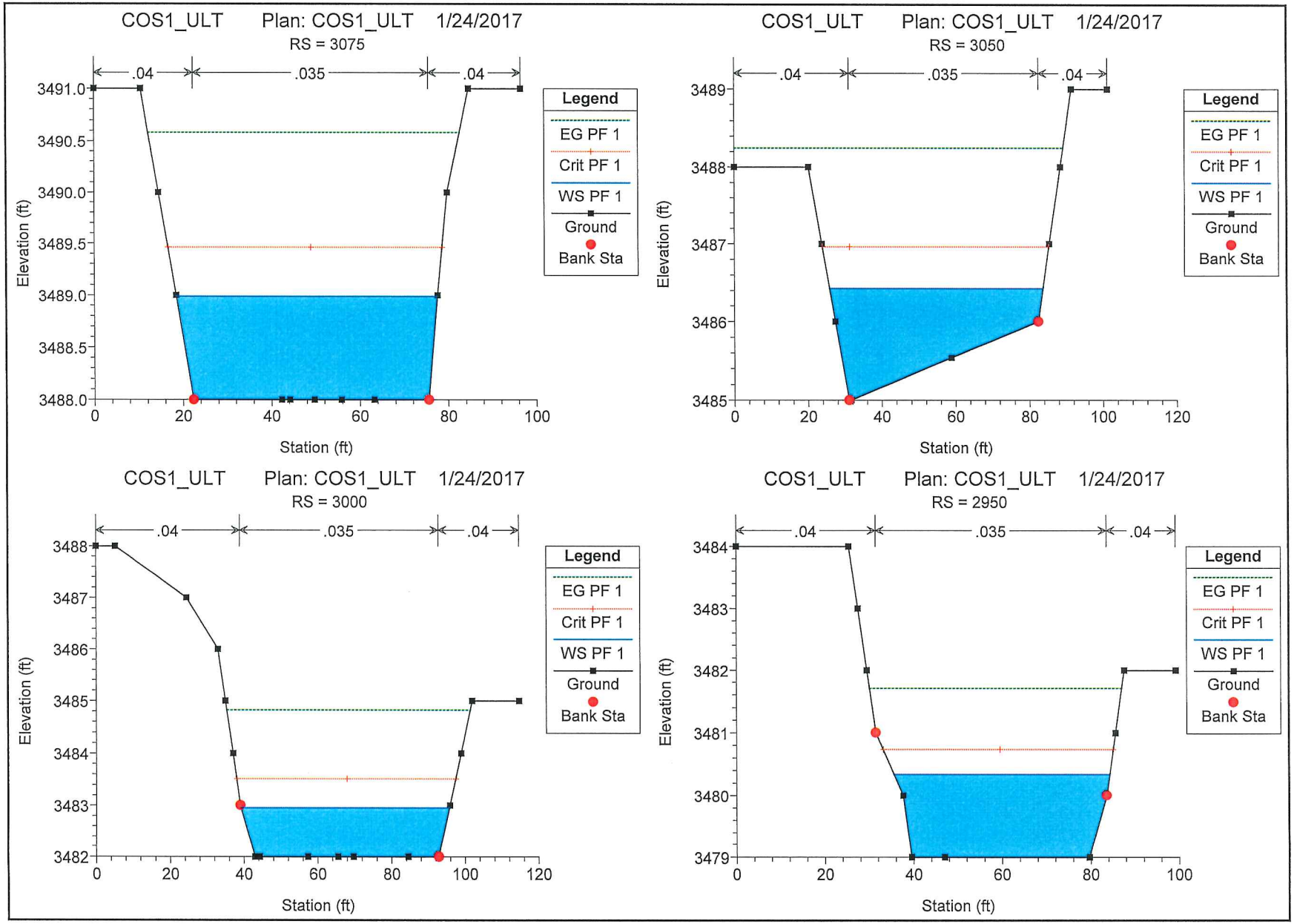
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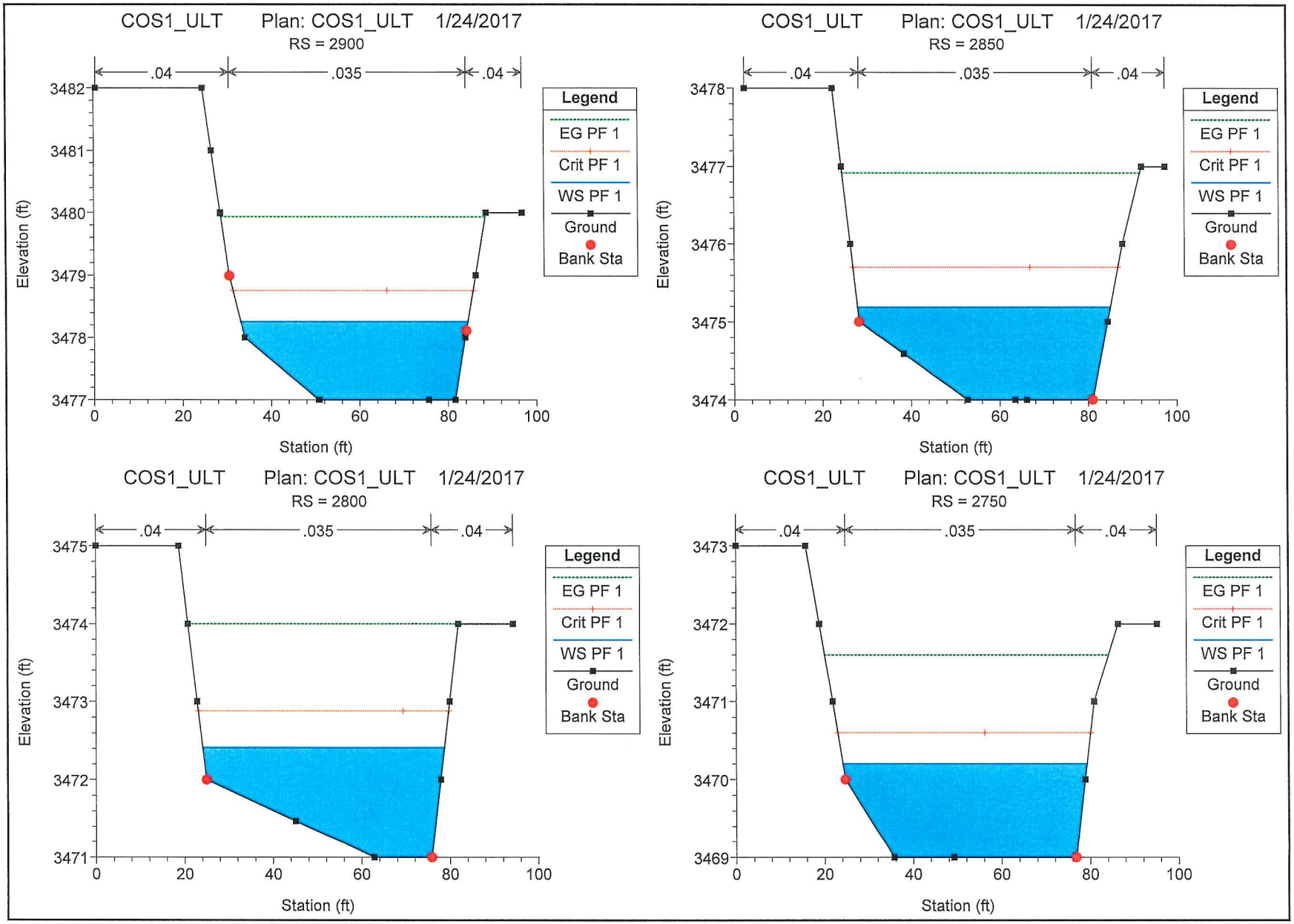
Bank Sta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100
Station (ft)
Legend
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Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
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.04
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3477
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Station (ft)
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WS PF 1
Ground
Bank Sta
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RS = 2800
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3474
3473
3472
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100
Station (ft)
Legend
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COS1_ULT Plan: COS1_ULT 1/24/2017
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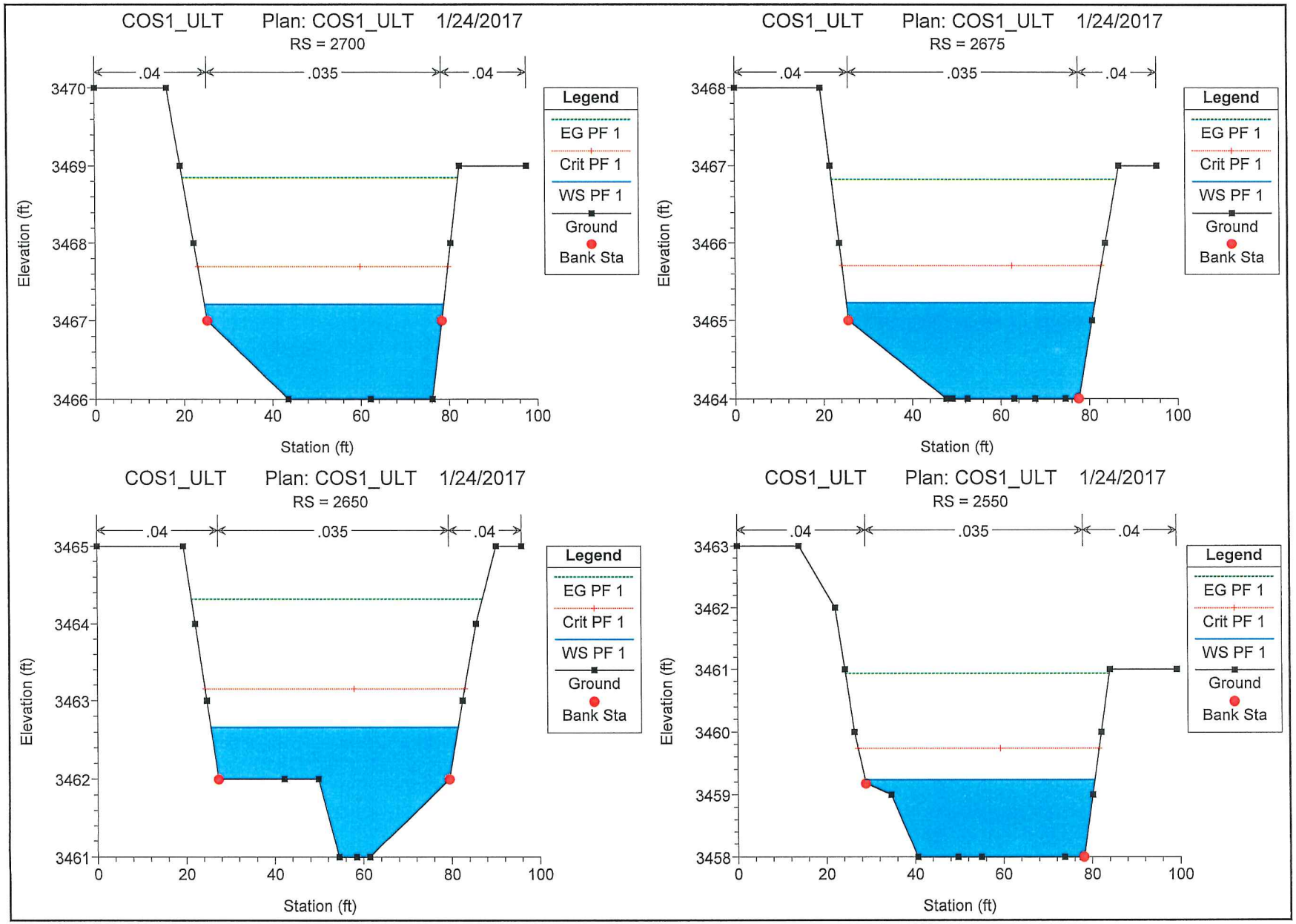
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Station (ft)
Legend
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Crit PF 1
WS PF 1
Ground
Bank Sta
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Station (ft)
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Crit PF 1
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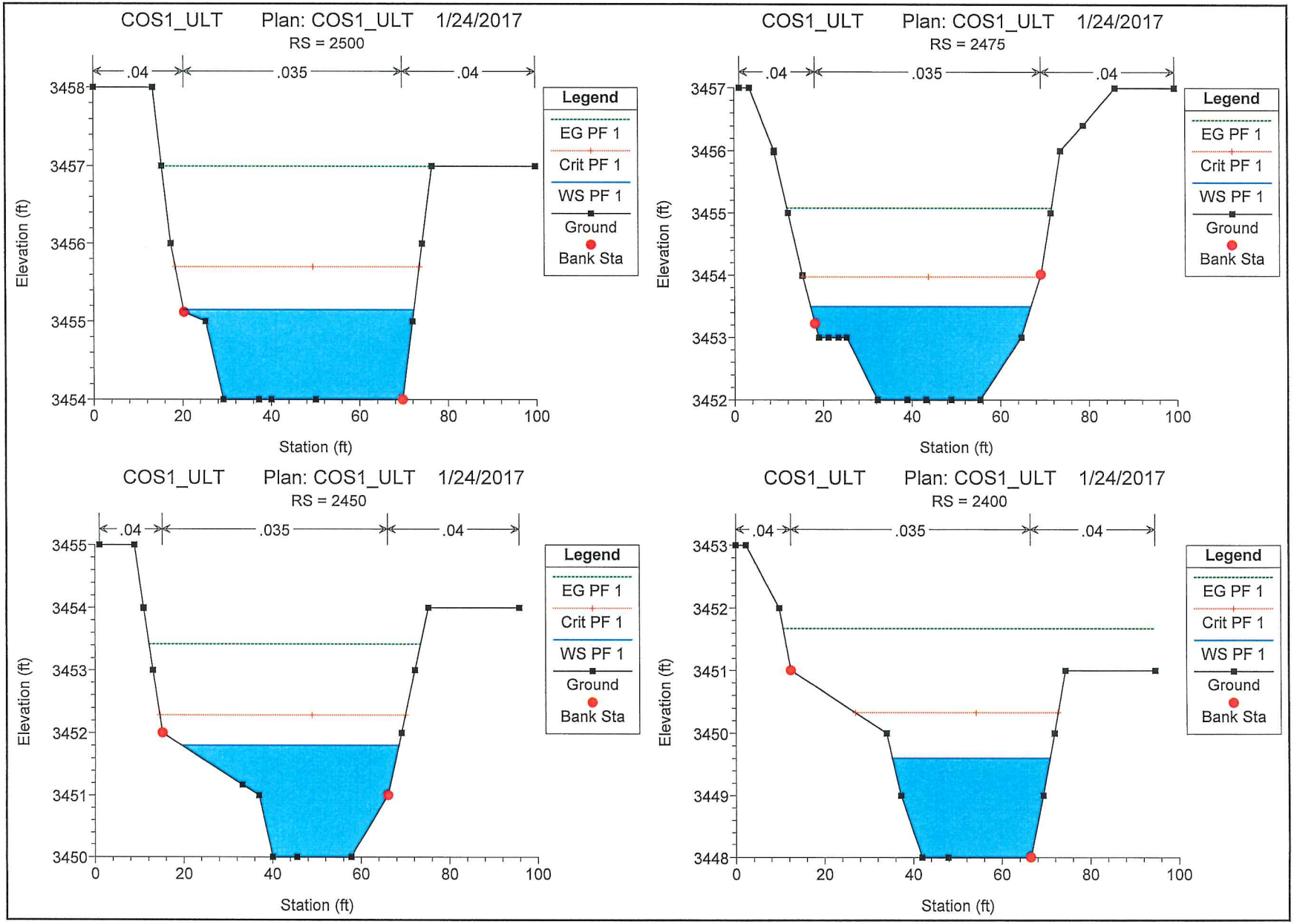
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.035
.04
Elevation (ft)
Station (ft)
Legend
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Crit PF 1
WS PF 1
Ground
Bank Sta
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.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
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.04
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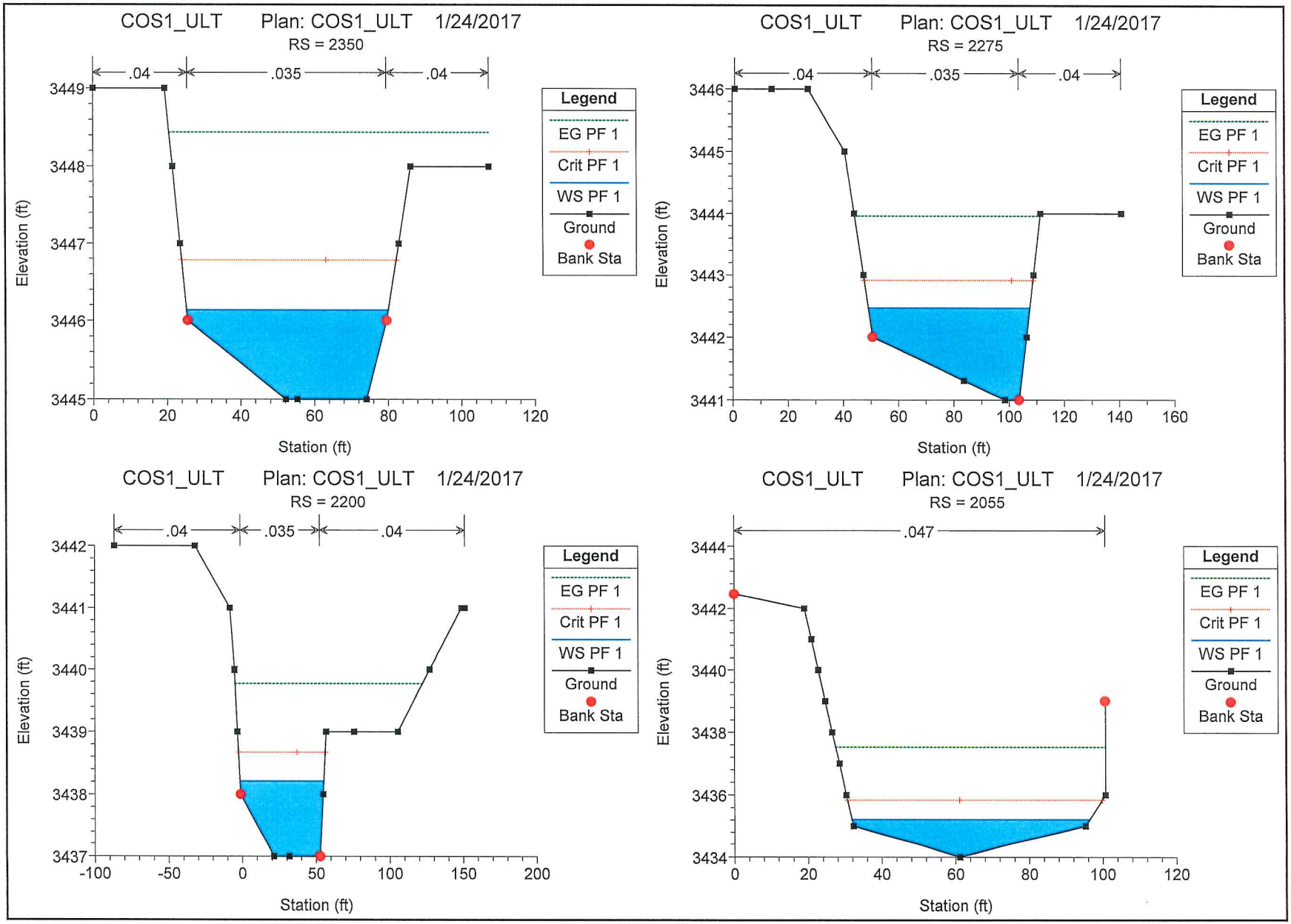
Bank Sta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Station (ft)
Legend
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Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 2275
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 2200
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
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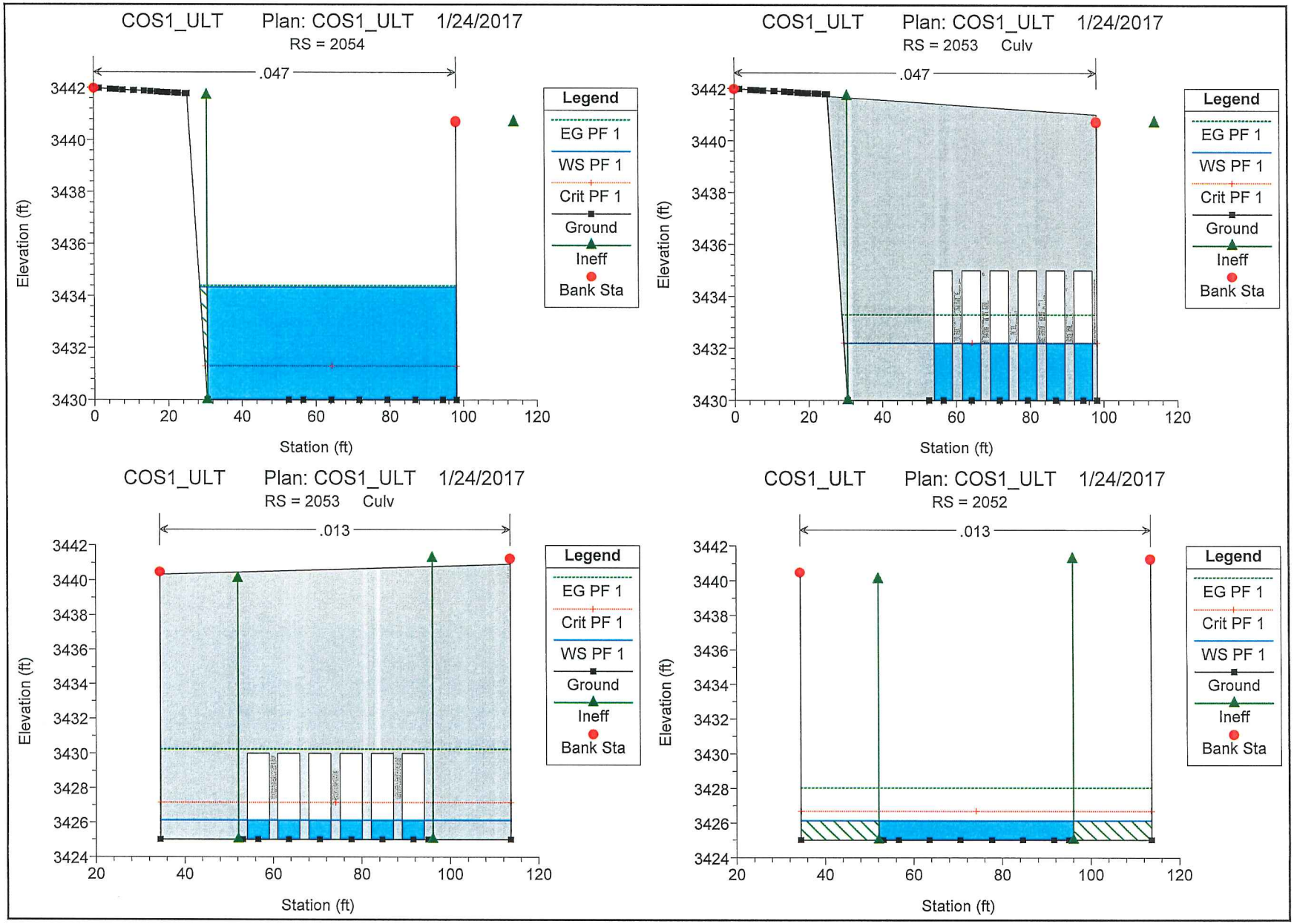
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta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Crit PF 1
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Ineff
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 2053 Culv
.047
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 2053 Culv
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Elevation (ft)
Station (ft)
Legend
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Crit PF 1
WS PF 1
Ground
Ineff
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 2052
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Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Ineff
Bank Sta

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design data 7

american concrete pipe association

CONCRETE PIPE SELECTION: Trench Installations

Trench conduits are usually installed in relatively narrow trenches excavated in undisturbed soil and backfilled to the original ground surface.

When a rigid conduit is installed in a narrow trench and backfilled, the backfill material will tend to settle. This downward movement generates frictional forces along the trench walls, which act upward to help support the weight of the backfill material. The magnitude of the frictional forces depends on the unit weight of the backfill material w, the value of Rankine's lateral pressure ratio K, and the coefficient of sliding friction μ' between the backfill material and the trench walls.

The backfill load on a conduit installed in a trench condition is equal to the weight of the mass of fill material within the trench less the summation of the frictional load transfers, and is expressed by the equation:

$$W_d = C_d \, w \, B_d^2$$

where

W_d=backfill load, pounds per linear foot
C_d=load coefficient for trench condition
w=unit weight of backfill material, pounds per cubic foot
B_d=width of trench at the top of the conduit, feet

Figures 2 through 5, based on the above equation, enable a direct determination of backfill load for a given trench width and depth of cover. As the trench width increases for a given depth of cover and pipe diameter, a point is reached at which an embankment condition develops. The curves showing pipe size indicate the limiting trench width for each pipe diameter beyond which greater trench widths will not affect the load. When this condition occurs, the load on the conduit remains constant. This load should be determined by the intersection of the vertical line representing the depth of cover and the dashed line representing the particular pipe diameter under consideration. For intermediate pipe sizes not shown in *Figures 2 through 5,* interpolation should be used.

The field supporting strength of a concrete pipe line is dependent on the inherent strength of the pipe, the type of foundation on which the pipe is installed and the compaction of the sidefill material adjacent to the pipe. A common method used to determine the inherent strength of a pipe is the three-edge bearing test, in which the pipe is subjected to concentrated loads at the crown and invert. The load that a pipe will support under this condition of loading is called the *three-edge bearing strength* and is expressed in pounds per linear foot.

ASTM Specification C14 covers three strength classes for non-reinforced concrete pipe — Class 1, 2 and 3. These three classes are specified to meet ultimate loads, expressed in terms of minimum strength in three-edge-bearing as listed in *Table I.*

TABLE I: Strength Requirements Non-reinforced Concrete Pipe ASTM C14

Pipe Diameter, Inches	Minimum Three-Edge Bearing Strengths, Pounds per Linear Foot		
	Class 1	Class 2	Class 3
4	1500	2000	2400
6	1500	2000	2400
8	1500	2000	2400
10	1600	2000	2400
12	1800	2250	2600
15	2000	2600	2900
18	2200	3000	3300
21	2400	3300	3850
24	2600	3600	4400
27	2800	3950	4600
30	3000	4300	4750
33	3150	4400	4875
36	3300	4500	5000

Another means of expressing pipe strength is in terms of D-load. The D-load of a pipe is the supporting strength of a pipe loaded under three-edge-bearing test conditions expressed in pounds per linear foot per foot of inside diameter. Thus the bearing strength may be converted to D-load by dividing by the inside diameter in feet.

ASTM Specification C76 specifies five strength classes reinforced concrete pipe. These strength classes are expressed in terms of D-load at 0.01-inch crack and for ultimate load. The D-load to produce the 0.01-inch crack $D_{0.01}$ is the maximum load applied to the concrete pipe before a crack occurs having a width of 0.01-inch measured at close intervals, throughout a length of at least 1-foot. The D-load to produce ultimate load D_u is the maximum three-edge-bearing test load carried by a pipe, expressed as D-load. *Table II* lists 0.01-inch crack and ultimate D-loads for the strength classes covered by ASTM Specification C76.

TABLE II: Strength Requirements Reinforced Concrete Pipe ASTM C76

Strength Class	Minimum D-Load in Three-Edge Bearing Pounds per Linear Foot per Foot of Internal Diameter	
	0.01 Inch Crack-$D_{0.01}$	Ultimate-D_u
I	800	1200
II	1000	1500
III	1350	2000
IV	2000	3000
V	3000	3750

PROGRAM SAMM
D-LOAD REQUIREMENTS FOR A 48 IN. DIAMETER CIRCULAR PIPE

****

P I P E D A T A

DIAMETER (in.)	48.00
WALL B, THICKNESS (in.)	5.000

I N S T A L L A T I O N C O N D I T I O N S

MINIMUM DEPTH OF FILL (ft.)	0.50
MAXIMUM DEPTH OF FILL (ft.)	20.00
SOIL DENSITY (lb/cu. ft.)	140.0
SPECIFIED BEDDING FACTOR	1.90
INSTALLATION TYPE	TRENCH
TRENCH WIDTH (ft.)	8.83
SOIL LATERAL PRESSURE/FRICTION TERM (KMU')	0.1650
PARAMETERS TO COMPUTE TRANSITION WIDTH	
POSITIVE PROJECTION RATIO	1.00
POSITIVE SETTLEMENT RATIO	0.50
SOIL LATERAL PRESSURE/FRICTION TERM (KMU)	0.1924
SOIL LATERAL PRESSURE COEFICIENT	0.33

A D D I T I O N A L L O A D S

LIVE LOAD	AASHTO HS-20
NO SURCHARGE LOAD	

F A C T O R S O F S A F E T Y

FACTOR OF SAFETY ON 0.01 INCH CRACK D-LOAD (EARTH,LIVE)	1.00; 1.00
FACTOR OF SAFETY ON ULTIMATE LOAD (EARTH,LIVE) IN ACCORDANCE WITH ASTM C 76	
DL.01 LESS THAN 2000 LBS/FT/FT	1.5
DL.01 GREATER THAN 3000 LBS/FT/FT	1.25
DL.01 BETWEEN 2000 AND 3000 LBS/FT/FT	INTERPOLATED

: E S U L T S O F A N A L Y S I S

```
SSSSSSSSS   AAAAAAAAA   MMM    MMM   MMM    MMM
SS          AA     AA   MM M M MM   MM M M MM
SSSSSSSSS   AAAAAAAAA   MM  M  MM   MM  M  MM
       SS   AA     AA   MM     MM   MM     MM
SSSSSSSSS   AA     AA   MM     MM   MM     MM
```

P R O G R A M S A M M

AMERICAN CONCRETE PIPE ASSOCIATION
VERSION 2.0 - 1 SEPTEMBER 1990

Program SAMM computes earth loads on concrete pipe in accordance with the methods presented in the Concrete Pipe Design Manual (March 1990) and the Concrete Pipe Handbook (January 1988), published by the American Concrete Pipe Association. The user must select input values suitable to his specific installation. The information presented in the computer output is for review, interpetation, application and approval by a qualified engineer who must assume full responsibility for verifying that said output is appropriate and correct. There are no express or implied warranties. The use of this product does not constitute endorsement by ACPA or any other agents.

PIPE DEPTH (ft.)	EARTH LOAD ARCHING FACTOR	>TRANS	EARTH LOAD (lb/ft)	LIVE LOAD (lb/ft)	SURCH LOAD (lb/ft)	TOTAL LOAD (lb/ft)	BED FACT	REQUIRED D-LOAD 0.01 in. (lb/ft/ft)	ULT. (lb/ft/ft)
0.5	1.02	Y	345.	2584.	0.	2929.	1.90	385.	578.
1.0	1.04	Y	704.	2331.	0.	3035.	1.90	399.	599.
1.5	1.06	Y	1078.	2623.	0.	3701.	1.90	487.	731.
2.0	1.08	Y	1467.	2475.	0.	3942.	1.90	519.	778.
2.5	1.11	Y	1872.	1994.	0.	3866.	1.90	509.	763.
3.0	1.13	Y	2293.	1474.	0.	3766.	1.90	496.	743.
3.5	1.15	Y	2731.	1226.	0.	3957.	1.90	521.	781.
4.0	1.18	Y	3187.	1039.	0.	4226.	1.90	556.	834.
4.5	1.20	Y	3662.	893.	0.	4555.	1.90	599.	899.
5.0	1.23	Y	4156.	778.	0.	4933.	1.90	649.	974.
5.5	1.25	Y	4670.	684.	0.	5353.	1.90	704.	1057.
6.0	1.28	Y	5204.	606.	0.	5811.	1.90	765.	1147.
6.5	1.31	Y	5761.	542.	0.	6303.	1.90	829.	1244.
7.0	1.34	Y	6340.	487.	0.	6827.	1.90	898.	1348.
7.5	1.37	Y	6943.	441.	0.	7384.	1.90	972.	1457.
8.0	1.40	Y	7570.	401.	0.	7971.	1.90	1049.	1573.
8.5	1.43	Y	8222.	366.	0.	8589.	1.90	1130.	1695.
9.0	1.46	Y	8884.	336.	0.	9220.	1.90	1213.	1820.
9.5	1.46	Y	9394.	309.	0.	9703.	1.90	1277.	1915.
10.0	1.47	Y	9917.	286.	0.	10203.	1.90	1343.	2014.
10.5	1.47	Y	10429.	265.	0.	10694.	1.90	1407.	2111.
11.0	1.47	Y	10940.	246.	0.	11187.	1.90	1472.	2208.
11.5	1.47	Y	11452.	230.	0.	11681.	1.90	1537.	2306.
12.0	1.47	N	11954.	215.	0.	12169.	1.90	1601.	2402.
12.5	1.46	N	12345.	201.	0.	12546.	1.90	1651.	2476.
13.0	1.45	N	12729.	189.	0.	12918.	1.90	1700.	2550.

13.5	1.43	N	13106.	177.	0.	13283.	1.90	1748.	2622.
14.0	1.42	N	13475.	167.	0.	13643.	1.90	1795.	2693.
14.5	1.41	N	13838.	158.	0.	13996.	1.90	1842.	2762.
15.0	1.40	N	14195.	149.	0.	14344.	1.90	1887.	2831.
15.5	1.39	N	14544.	141.	0.	14685.	1.90	1932.	2898.
16.0	1.38	N	14887.	134.	0.	15021.	1.90	1976.	2965.
16.5	1.36	N	15224.	127.	0.	15351.	1.90	2020.	3020.
17.0	1.35	N	15555.	121.	0.	15676.	1.90	2063.	3062.
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18.5	1.32	N	16510.	105.	0.	16615.	1.90	2186.	3177.
19.0	1.31	N	16817.	100.	0.	16917.	1.90	2226.	3213.
19.5	1.30	N	17118.	96.	0.	17213.	1.90	2265.	3247.
20.0	1.29	N	17413.	92.	0.	17505.	1.90	2303.	3280.

APPENDIX C

Reference Materials

LIMITED GEOTECHNICAL EVALUATION
US WATERS – WASH COS-1 AND COS-2
SUMMERLIN VILLAGE 24
LAS VEGAS, NEVADA

PROJECT NO.: E-15-086
MAY 21, 2015

Prepared for:

Howard Hughes®
THE HOWARD HUGHES CORPORATION

Prepared by:

NOVA GEOTECHNICAL
& inspection services

NOVA GEOTECHNICAL & INSPECTION SERVICES
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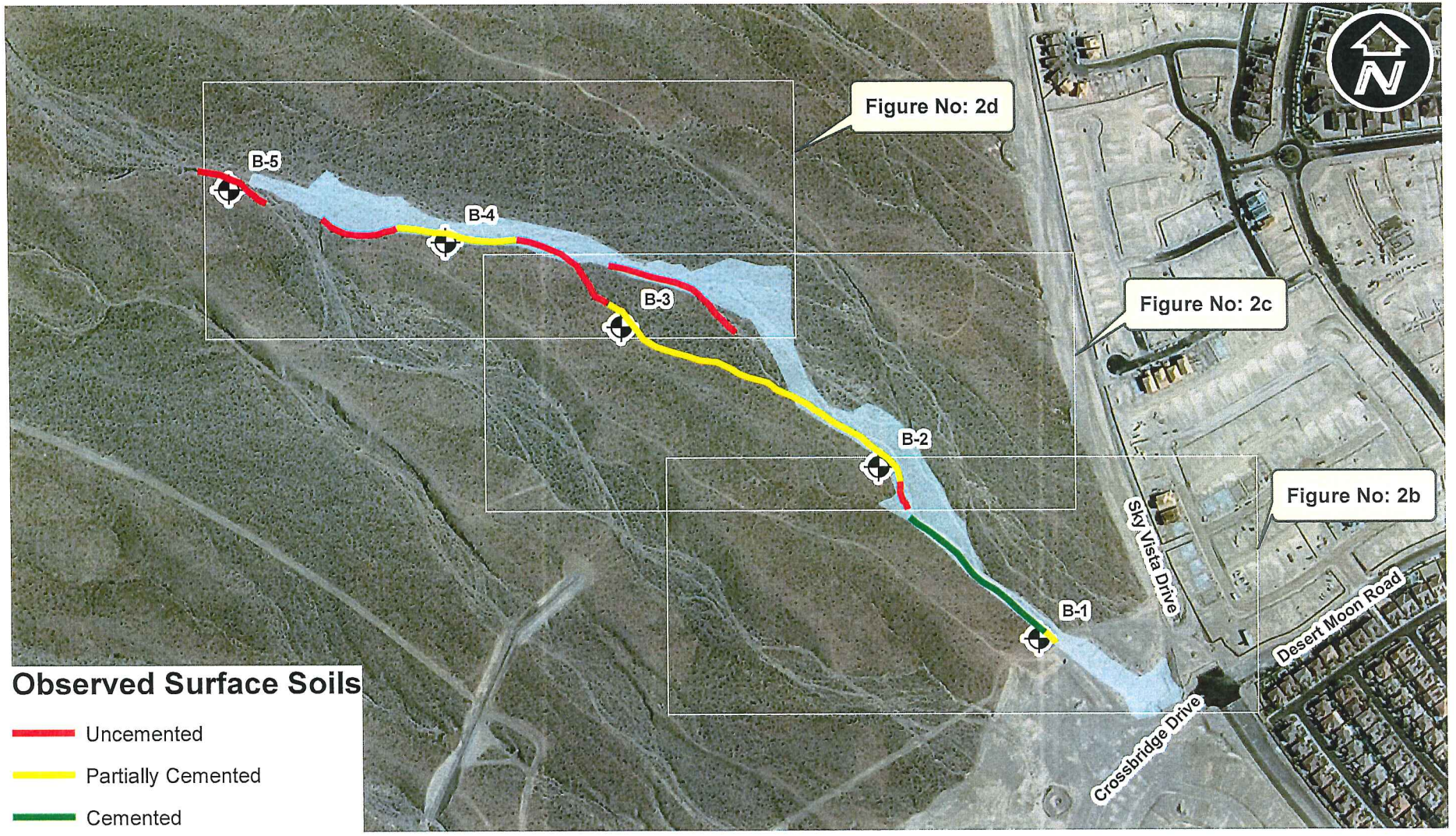


Legend

B-5 Approximate Boring Location

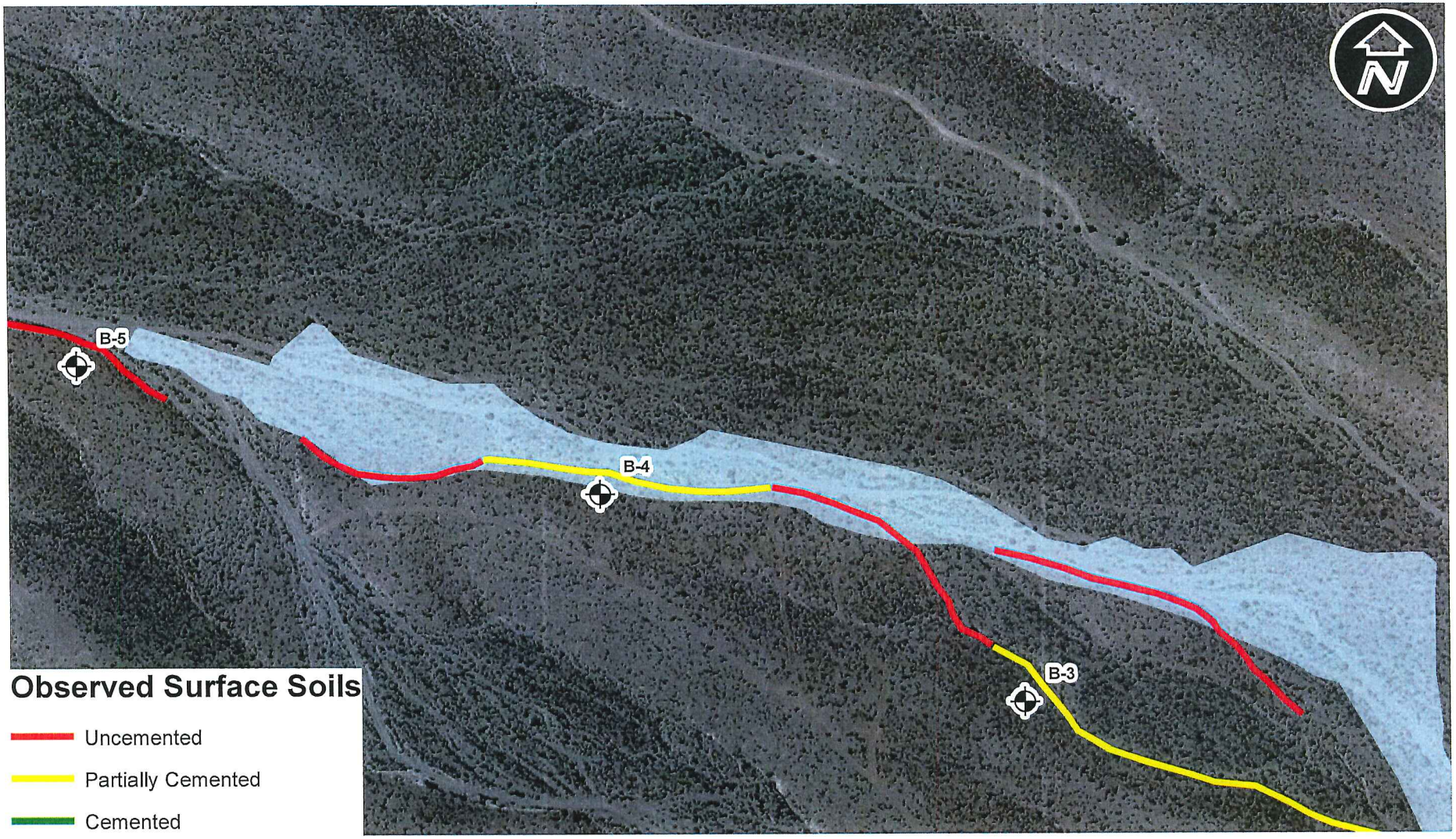
Approximate Area of Inundation (by others)

Feet

0 150 300 600 900 1,200

The presented layers were obtained from various sources including ESRI, USGS, USDA, CCBD GIZMO, CCFCD, GIS User Community among others. The GIS information is presented for reference only. No warranties, either expressed or implied, are intended or made. If you have any questions regarding this information, please contact NOVA.

NOVA Geotechnical & Inspection Services	PROJECT: Limited Geotechnical Evaluation Summerlin Village 24 US Waters - Wash COS-1 and COS-2 Las Vegas, Nevada	ALIGNMENT OVERVIEW MAP	
	CLIENT: The Howard Hughes Corporation	PROJECT NO: **E-15-086**	FIGURE NO: **2a**



Legend

B-5 Approximate Boring Location

Approximate Area of Inundation (by others)

Feet
0 62.5 125 250 375 500

The presented layers were obtained from various sources including ESRI, USGS, USDA, CCBD GIZMO, CCFCD, GIS User Community among others. The GIS information is presented for reference only. No warranties, either expressed or implied, are intended or made. If you have any questions regarding this information, please contact NOVA.

NOVA Geotechnical & Inspection Services	PROJECT:	Limited Geotechnical Evaluation Summerlin Village 24 US Waters - Wash COS-1 and COS-2 Las Vegas, Nevada	ALIGNMENT MAP
	CLIENT:	The Howard Hughes Corporation	PROJECT NO: **E-15-086** / FIGURE NO: **2d**

BORING LOG B-3

CLIENT:	PROJECT:
THE HOWARD HUGHES CORPORATION	V-24 US WATERS COS-1 AND COS-2 EVALUATION

BORING LOCATION:	ELEVATION (ft):	SITE:
SEE SITE MAP	NA	NWC CHARLESTON BLVD AND SKY VISTA DRIVE

MOISTURE CONTENT %	DRY DENSITY PCF	SAMPLE TYPE*	SAMPLE	BLOWS/FT	DEPTH, FT	USCS SYMBOL	GRAPHIC	SOIL DESCRIPTION	CONSISTENCY
					0	SM		Silty SAND with gravel, caliche debris, slightly moist	Loose
		SPT		50/1"	1			CALICHE (Cemented sand & gravel), light brown, dry	Hard
					2				
		B			3				M.Hard-Hard
					4				
		SPT		50/1"	5				
					6				
					7	GM		Silty GRAVEL with sand, cobbles, light brown, with thin cemented layers, slightly moist	V.Dense
					8				
					9				
					10				
		SPT		73/9"	11				
					12			CALICHE (Cemented sand & gravel), light brown, dry	M.Hard
		B			13	GM		Silty GRAVEL with sand, partially cemented, light brown, dry	V.Dense-M.Hard
					14				
		SPT		50/2"	15			CALICHE (Cemented sand & gravel), light brown, dry	M.Hard-

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

* SAMPLE TYPE: R = RING B = BAG SPT = STANDARD PENETRATION BN = BULL NOSE C = CORE

NOVA GEOTECHNICAL AND INSPECTION SERVICES

NOTES:
Groundwater not encountered within the depths drilled

DATE DRILLED:	PAGE NO:
5/7/15	1 of 2
PROJECT NO.:	PLATE NO.:
E-15-086	3

THIS SUMMARY APPLIES ONLY AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME AND AT OTHER LOCATIONS.

BORING LOG B-3

CLIENT:	PROJECT:
THE HOWARD HUGHES CORPORATION	V-24 US WATERS COS-1 AND COS-2 EVALUATION
BORING LOCATION: SEE SITE MAP	**ELEVATION (ft):** NA
SITE: NWC CHARLESTON BLVD AND SKY VISTA DRIVE	

MOISTURE CONTENT %	DRY DENSITY PCF	SAMPLE TYPE*	SAMPLE	BLOWS/FT	DEPTH, FT	USCS SYMBOL	GRAPHIC	SOIL DESCRIPTION	CONSISTENCY
					16			CALICHE (Cemented sand & gravel), lightbrown, dry	Hard
					17				
					18	GM		Silty Gravel with sand, cobbles, brown, slightly moist	Dense
					19				
					20			Bottom of Boring at 20 feet	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

* SAMPLE TYPE: R = RING B = BAG SPT = STANDARD PENETRATION BN = BULL NOSE C = CORE

NOVA GEOTECHNICAL AND INSPECTION SERVICES

NOTES:
Groundwater not encountered within the depths drilled

DATE DRILLED:	PAGE NO:
5/7/15	2 of 2
PROJECT NO.:	**PLATE NO.:**
E-15-086	3

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME AND AT OTHER LOCATIONS.

BORING LOG B-4

CLIENT:	PROJECT:
THE HOWARD HUGHES CORPORATION	V-24 US WATERS COS-1 AND COS-2 EVALUATION
BORING LOCATION: SEE SITE MAP	**ELEVATION (ft):** NA
	SITE: NWC CHARLESTON BLVD AND SKY VISTA DRIVE

MOISTURE CONTENT %	DRY DENSITY PCF	SAMPLE TYPE*	SAMPLE	BLOWS/FT	DEPTH, FT	USCS SYMBOL	GRAPHIC	SOIL DESCRIPTION	CONSISTENCY
					0	SM		Silty SAND with gravel, caliche debris, brown, slightly moist	Loose
					1			-increase in gravel fraction	V.Dense-M.Hard
					2				
					3	GM		Silty GRAVEL with sand, partially cemented, cobbles, light brown, dry	V.Dense-M.Hard
		SPT		90/10"	4				
					5			-very thin cemented layers	
		B			6				
					7				V.Dense
					8				
					9				
		SPT		82/12"	10				
					11			CALICHE (Cemented sand & gravel), light brown, dry	M.Hard
					12				
					13				M.Hard-Hard
		SPT		50/2"	14				
					15			Bottom of Boring at 15 feet	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

* SAMPLE TYPE: R = RING B = BAG SPT = STANDARD PENETRATION BN = BULL NOSE C = CORE

NOVA GEOTECHNICAL AND INSPECTION SERVICES

NOTES:
Groundwater not encountered within the depths drilled

DATE DRILLED:	PAGE NO:
5/7/15	1 of 1
PROJECT NO.:	**PLATE NO.:**
E-15-086	4

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME AND AT OTHER LOCATIONS.

SUMMARY OF TEST RESULTS

Boring & Depth	B-2 @ 3-8 ft.	B-3 @ 10-15 ft.	B-4 @ 4-9 ft.
Sieve	% PASSING		
1 1/2in.	100.0	100.0	100.0
1in.	100.0	95.1	97.9
3/4in.	98.2	90.3	94.0
1/2in.	89.4	77.3	86.6
3/8in.	80.5	68.6	79.0
#4	53.7	48.6	59.5
#8	37.7	33.7	45.0
#10	35.1	31.4	42.4
#16	29.8	26.3	36.6
#30	25.3	22.4	31.2
#40	23.8	21.1	29.3
#50	22.2	20.0	27.4
#100	17.8	17.1	22.2
#200	12.1	12.8	15.3
LL*	NV	NV	NV
PI**	NP	NP	NP
USCS	GM	GM	SM
OMC, %	8	6	6
MDD, pcf	146	134	145
ϕ, °	51	—	60
C, psf	1400	—	978
SO_4, %* **	0.00	0.00	0.00
Solubility,% * **	0.03	0.05	0.04

* NV = No Value (soil did not exhibit a liquid limit)

** NP = Non-Plastic

*** Performed by others



South containment: exposed cemented sand and gravel



South containment: approximately in the middle of wash alignment, facing south; pictures shows relatively shallow containment

NOVA Geotechnical & Inspection Services	PROJECT: **Limited Geotechnical Evaluation Summerlin Village 24 US Waters – Wash COS-1 and COS-2 Las Vegas, Nevada**	**PHOTOGRAPHS**	
	CLIENT: **The Howard Hughes Corporation**	PROJECT NO: **E-15-086**	PLATE NO: **B3**



South containment: close-up of the sand and gravel matrix cemented by calcium carbonate



South containment: close-up of exposed cemented and partially cemented materials exposed along the south containment

NOVA Geotechnical & Inspection Services	PROJECT: **Limited Geotechnical Evaluation Summerlin Village 24 US Waters – Wash COS-1 and COS-2 Las Vegas, Nevada**	**PHOTOGRAPHS**	
	CLIENT: **The Howard Hughes Corporation**	PROJECT NO: **E-15-086**	PLATE NO: **B4**

UPDATE #2 TO THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24

62024-320

September 2014

Prepared for:

The Howard Hughes Company, LLC
10801 W. Charleston Blvd., 3rd Floor
Las Vegas, Nevada 89135
Phone: (702) 791-4300
Fax: (702) 791-4450

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM				DATE: October 9, 2014
TO: Land Development Services Department of Public Works				FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for: Summerlin Village 24 – Conceptual – Update #2			COPIES TO: G.C. Wallace
Cross Streets:	NWC of Charleston Blvd. & Sky Vista Drive			Howard Hughes Corp.
File Number:	F:\Depot\DSMEMOS\DS3505F.doc			Bart Anderson, P.E., DevCo
Parcel Number:	137-22-000-010			CCRFCD
Zoning Action:				CCPW
FEMA Flood Zone	YES	NO X		
Proposed Storm Drain	YES X	NO		

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Trn. No.
1st Submittal	2/13/2004	2/27/2004	Not Approved	$400.00	119424: $400
2nd Submittal	3/19/2004	4/2/2004	Conditional Approval	$400.00	121560: $400
CCRFCD	5/18/2004	6/1/2004	Concurrence	N/C	N/C
CCPW	5/27/2004	6/10/2004	Concurrence	N/C	N/C
3rd Submittal	6/11/2014	6/24/2014	Approved	$100.00	359768: $100
4th Submittal	9/30/2014	10/9/2014	See Comments Below	$100.00	371844: $100
			TOTAL FEES (LDDRS):	**$1,000.00**	---

REMARKS:

4th Submittal: Update #2 for Minor Revision of site layout and storm drains facilities

3rd Submittal: Update to re-vitalize the conceptual drainage study for Summerlin Village 24

The Drainage Study for the subject project has been reviewed and:

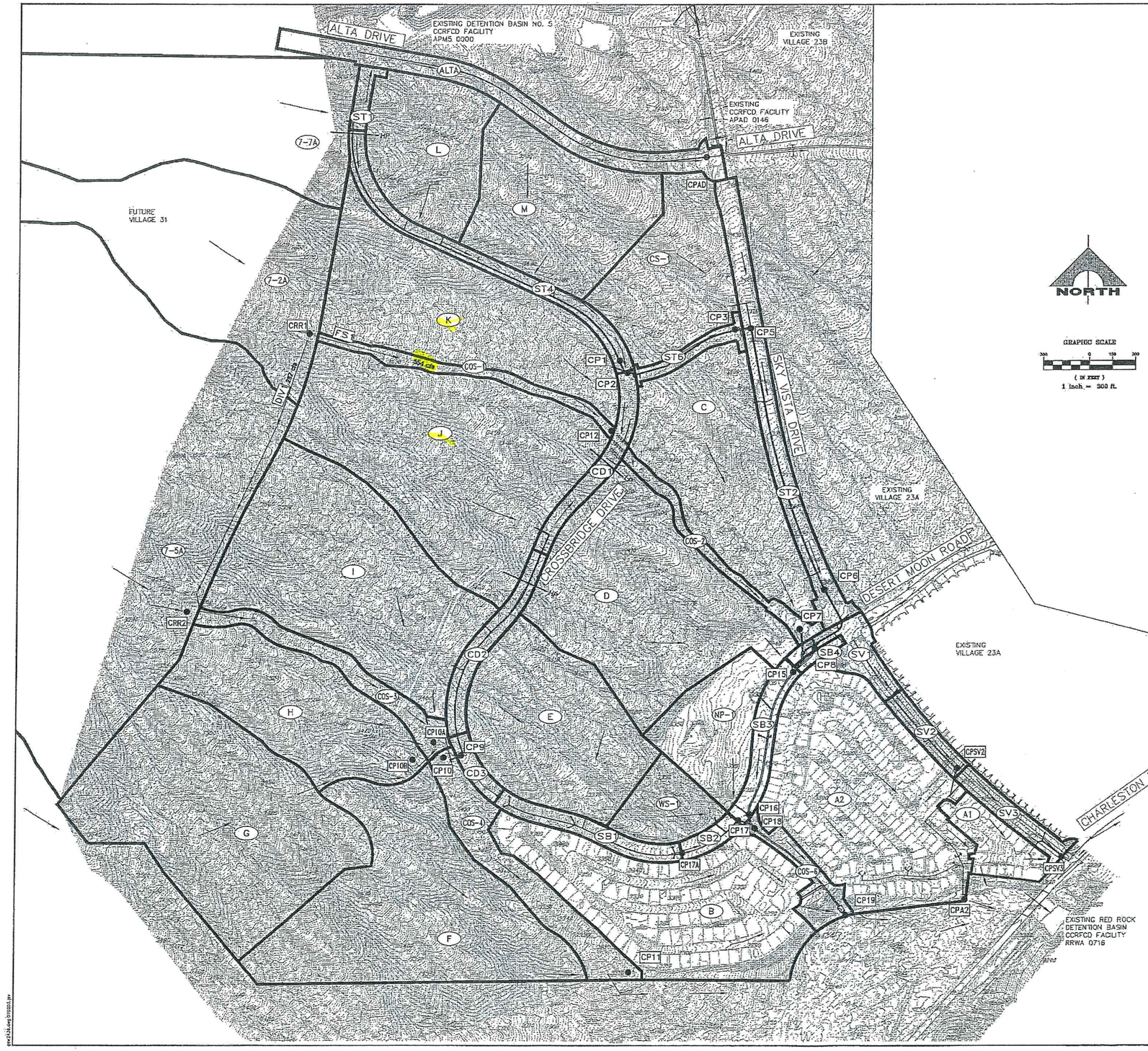
X	is approved subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.
	must have Clark County Department of Development Services concurrence

NOTE: Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the Nevada Division of Environmental Protection a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site; for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until all stripped or disturbed surface areas have been covered by paving, building construction or planting. For more information, including forms and applications see http://ndep.nv.gov/bwpc/storm01.htm or call (775) 687-9429.

NOTE: Any future changes to the proposed design (or design assumptions) as outlined in the approved drainage study and attached preliminary grading plan which affect drainage must be addressed in a Drainage Study Amendment and accepted by the City of Las Vegas Flood Control Section. Additionally, conditional acceptance of a drainage study is valid for a period of one (1) year. If the proposed construction has not been completed in that time period, the City of Las Vegas reserves the right to require additional conditions and/or submission and acceptance of a complete drainage study update prior to further construction of a project.

END OF REMARKS
B&H/ays

T/R/S: T20S/R59E/22
AREA K-22



SUMMARY OF ULTIMATE CONDITIONS
HEC-1 MODEL

SC OR CP	AREA (sq.mi.)	Q100 (cfs)	Q10 (cfs)
ALTA	0.5	35	16
-	-	-	-
7-2A	288.8	687	315
7-2B	69.4	182	82
7-5A	130.0	309	225
7-7A	51.8	153	70
A1	4.8	14	6
A2	33.9	100	47
B	30.1	90	43
C	24.9	61	26
CD1	3.7	15	6
CD2	3.8	13	7
CD3	1.4	6	3
COS-1	3.2	8	3
COS-2	3.1	7	3
COS-3	6.5	14	6
COS-4	9.4	22	8
COS-5	3.3	8	3
CP1	-	262	125
CP10	-	1031	452
CP10A	-	769	350
CP10B	-	155	63
CP11	-	1120	490
CP12	-	543	251
CP15	-	1024	479
CP16	-	1020	480
CP17	-	102	46
CP17A	-	76	34
CP18	-	1102	526
CP19	-	1172	558
CP2	-	354	164
CP3	-	358	165
CP5	-	403	192
CP6	-	435	204
CP7	-	595	274
CP8	-	949	449
CP9	-	123	52
CPA2	-	114	54
CPAD	-	40	21
CPSV2	-	23	12
CPSV3	-	25	12
CRR1	-	841	388
CRR2	-	730	313
CS-1	16.8	55	27
D	34.8	88	37
DIV1	-	287	132
E	24.1	64	27
F	97.8	92	36
FS1	-	554	255
G	42.8	100	39
H	22.1	58	24
I	38.6	102	45
J	43.6	110	46
K	29.8	80	34
L	15.5	53	26
M	22.0	73	36
NP-1	10.5	22	8
RETD1	-	287	132
SB1	3.5	14	7
SB2	1.2	5	3
SB3	3.9	13	7
SB4	0.5	2	1
ST1	1.1	5	2
ST2	3.3	33	17
ST4	6.0	22	12
ST5	1.3	8	4
SV1	3.2	14	8
SV2	2.1	9	4
SV3	2.7	11	6
WS-1	8.0	19	9

LEGEND

- SUBBASIN BOUNDARY
- (ST1) SUBBASIN DESIGNATION
- (CP1) COMBINATION POINT
- FLOW DIRECTION/DIVERSION

% COMPLETE

REV	DATE	DESCRIPTION	DATE	AGENT APP	DATE	GCW APP	DATE

PROJECT NO.
62024-320

DESIGN: _____ BRD, DRG: _____
DRAWN: _____
CHECKED: _____
PLOT DATE: 09-25-14
PLOT TIME: 14:46:16

G.C. WALLACE COMPANIES
ENGINEERS · PLANNERS · SURVEYORS
5371 RIETH AVENUE · LAS VEGAS, NEVADA 89139
T: (702) 896-2000 · F: (702) 896-2299 · GCWALLACE.COM

LAS VEGAS

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Suzanne Trebis

THE HOWARD HUGHES COMPANY, LLC

SUMMERLIN VILLAGE 24

FIGURE 6U2
ULTIMATE CONDITIONS DRAINAGE MAP

DRAWING
FIG 6U2
OF XX SHTS

HTE: 00-00000

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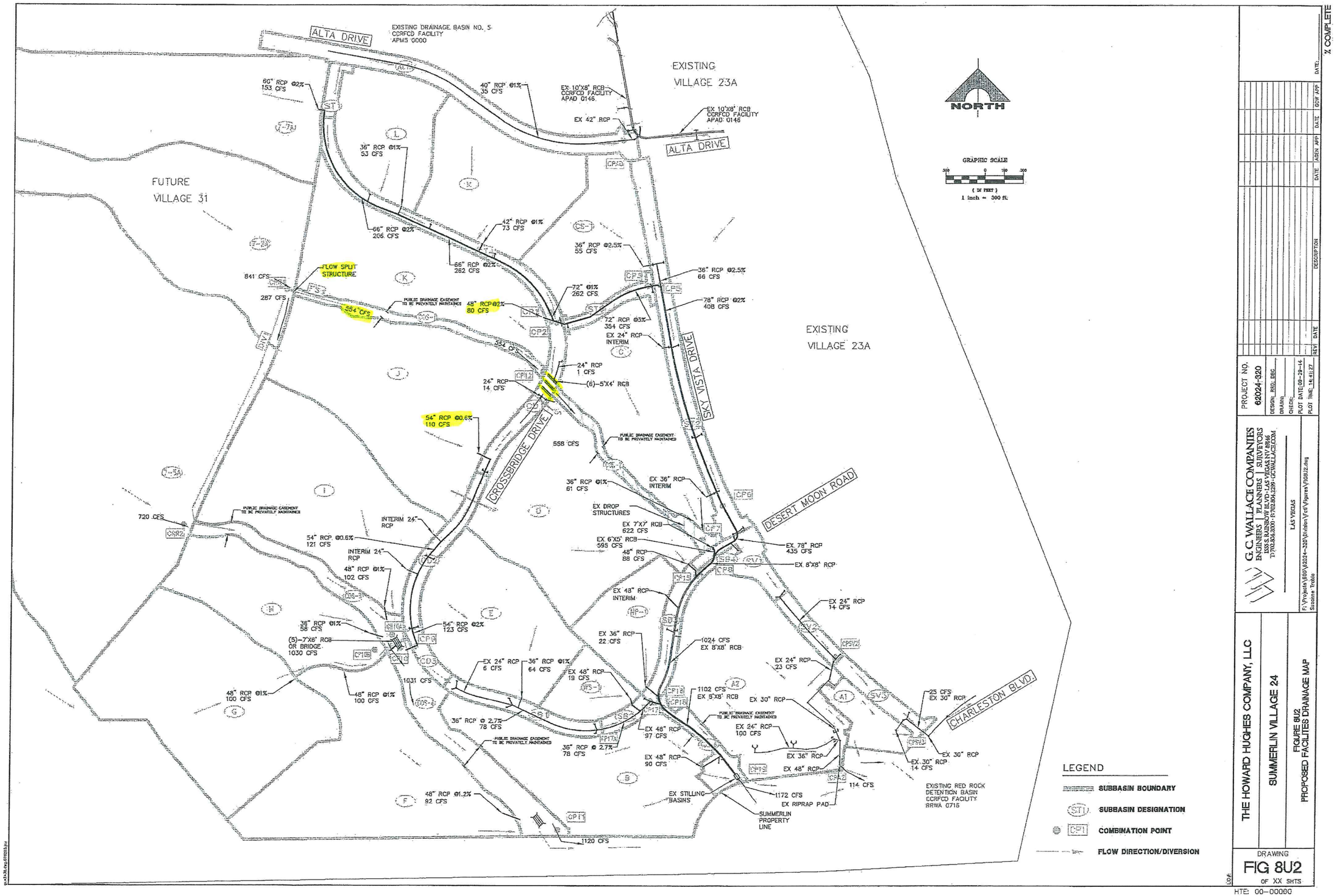

% COMPLETE

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	DGW APP	DATE

PROJECT NO.
62024-320
DESIGN_RSD_RBC
DRAWN_
CHECK_
PLOT DATE:09-29-16
PLOT TIME:_14:41:27

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD. LAS VEGAS, NV 89146
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LAS VEGAS
F:\Projects\6000\62024-320\Exhibits\Fy\Figures\Fig8U2.dwg
Sisatsina • Trobio

THE HOWARD HUGHES COMPANY, LLC

SUMMERLIN VILLAGE 24

FIGURE 8U2
PROPOSED FACILITIES DRAINAGE MAP

DRAWING
FIG 8U2
OF XX SHTS

HTE: 00-00000

UPDATE TO THE TECHNICAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24 PARCEL COS-2

62024-232

December 2016

GCW
ENGINEERS \ SURVEYORS

Prepared for:

The Howard Hughes Company, LLC
10801 W. Charleston Blvd., 3rd Floor
Las Vegas, Nevada 89135
Phone: (702) 791-4300
Fax: (702) 791-4450

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM				DATE: December 22, 2016
TO: **Land Development Services** Department of Building & Safety				FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for: **Summerlin Village 24 – Parcel COS-2 Wash - Update**			**COPIES TO:** GCW Engineers & Surveyors
Cross Streets:	Open Space between Parcel C and Parcel D			Howard Hughes Company, LLC
File Number:	F:\Depot\DSMemos\DS4774C.doc			Bart Anderson, P.E., DevCo
Parcel Number:	137-33-801-002			
Zoning Action:	FMP-62680			
FEMA Flood Zone	YES	NO	X	
Proposed Storm Drain	YES	NO	X	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1st Submittal	12/30/2015	1/21/2016	Not Approved	$400.00	427966: $400
2nd Submittal	3/10/2016	4/6/2016	Approved	$400.00	436538: $400
3rd Submittal	12/5/2016	12/22/2016	See Comments Below	$100.00	467659: $100
			TOTAL FEES (LDDRS):	**$900.00**	----

REMARKS:

3rd Submittal: Update to revise the side slope of channel at various locations from 2:1 to 3:1, 4:1 or 5:1

The Drainage Study for the subject project has been reviewed and:

X	is approved subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.
	is conditionally approved subject to Clark County Public Works Department concurrence.

1. The subject "COS-2" parcel is a common lot and public drainage easement to be privately maintained by the developer and future *Homeowners Association*. Record as such in the final map.

NOTE: Any future changes to the proposed design (or design assumptions) as outlined in the approved drainage study and attached preliminary grading plan which affect drainage must be addressed in a Drainage Study Update and accepted by the *City of Las Vegas Flood Control Section*. Additionally, conditional acceptance of a drainage study is valid for a period of one (1) year. If the proposed construction has not been completed in that time period, the *City of Las Vegas* reserves the right to require additional conditions and/or submission and acceptance of a complete drainage study update prior to further construction of a project.

NOTE: Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the *Nevada Division of Environmental Protection* a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site; for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until all stripped or disturbed surface areas have been covered by paving, building construction or planting. For more information, including forms and applications see http://ndep.nv.gov/bwpc/storm01.htm or call (775) 687-9429.

END OF REMARKS

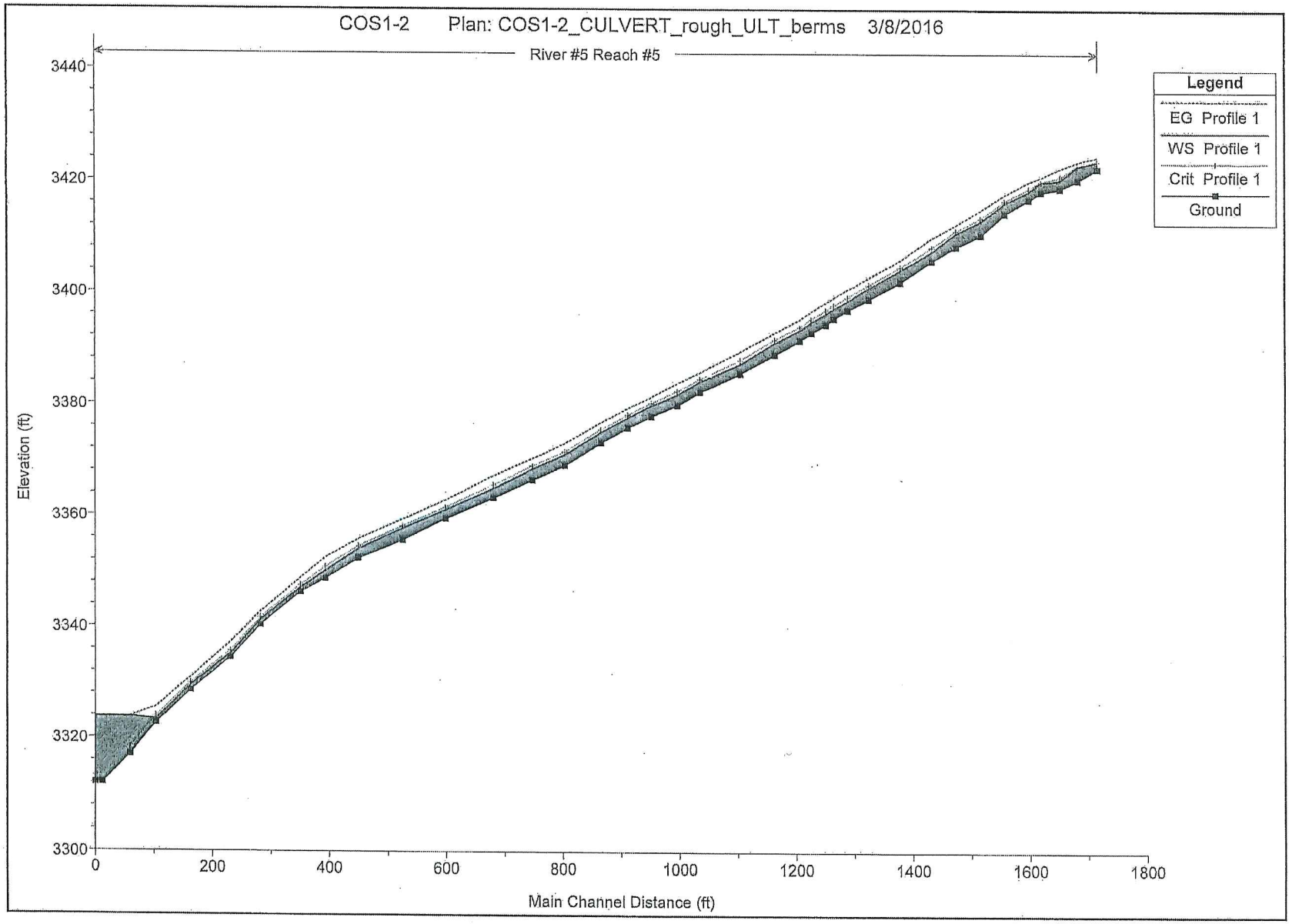
ays

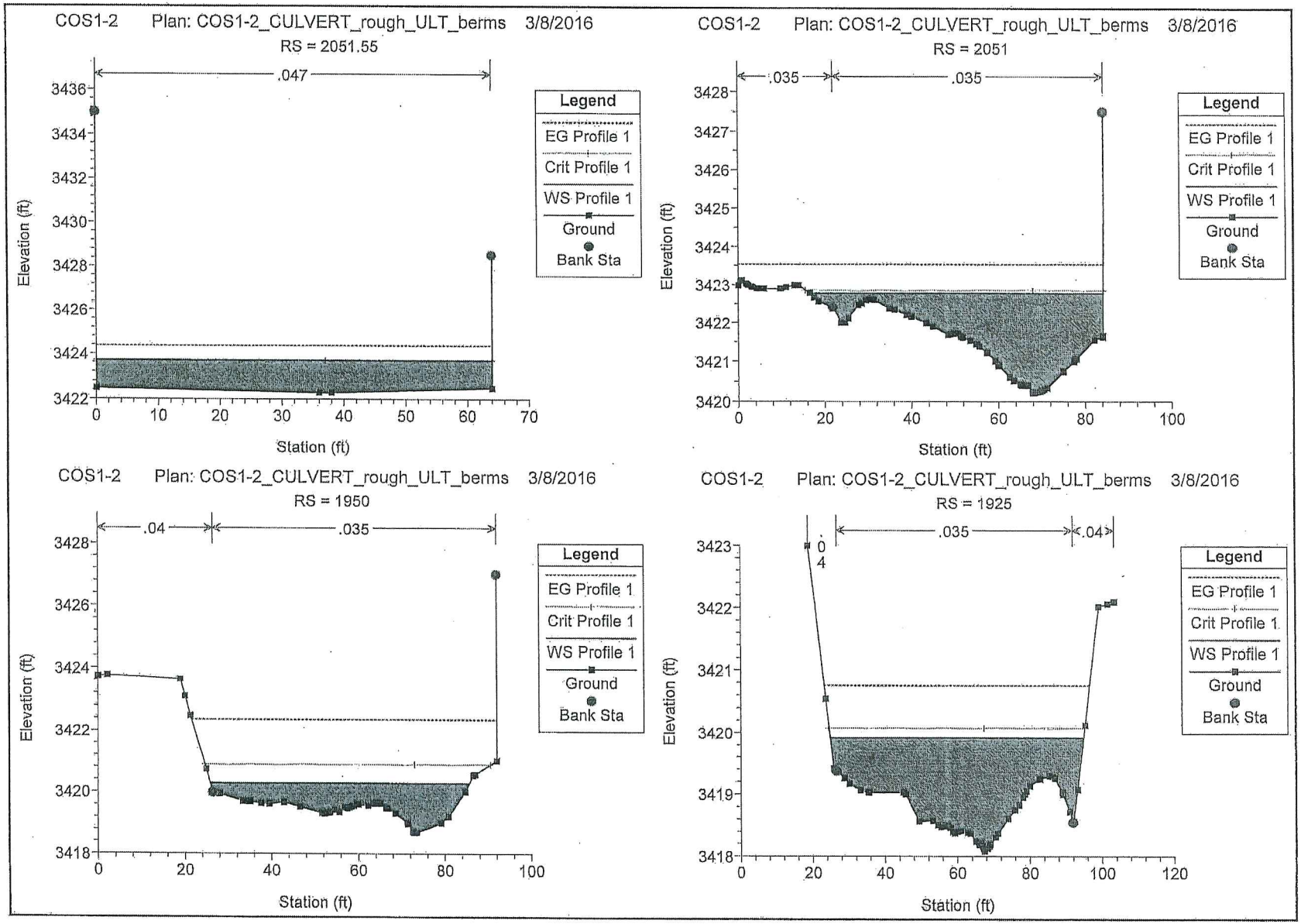
T/R/S: T20S/R59E/33

AREA K-33

HEC-RAS Plan: ult_berms River: River #5 Reach: Reach #5 Profile: Profile 1

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 #5	2051.55	Profile 1	554.00	3422.27	3423.69	3423.69	3424.36	0.031257	6.56	84.46	64.00	1.01
Reach #5	2051	Profile 1	554.00	3420.21	3422.79	3422.86	3423.53	0.019780	6.93	80.82	67.70	1.08
Reach #5	1950	Profile 1	554.00	3418.67	3420.27	3420.87	3422.34	0.097895	11.53	48.13	59.82	2.25
Reach #5	1925	Profile 1	554.00	3418.08	3419.92	3420.07	3420.75	0.025997	7.39	76.24	70.16	1.23
Reach #5	1900	Profile 1	554.00	3415.68	3418.22	3418.72	3419.90	0.062665	10.48	53.60	55.35	1.86
Reach #5	1875	Profile 1	554.00	3414.26	3416.10	3416.53	3417.58	0.049814	9.86	57.09	54.20	1.68
Reach #5	1825	Profile 1	554.00	3410.33	3412.90	3413.45	3414.86	0.092282	10.78	49.86	60.91	2.17
Reach #5	1800	Profile 1	554.00	3408.24	3410.73	3411.20	3412.24	0.042653	10.01	56.39	45.44	1.59
Reach #5	1750	Profile 1	554.00	3405.74	3407.40	3408.13	3409.80	0.083607	12.45	44.52	43.38	2.16
Reach #5	1675	Profile 1	554.00	3401.92	3404.10	3404.62	3405.89	0.061565	10.76	51.80	50.68	1.85
Reach #5	1600	Profile 1	554.00	3398.81	3400.93	3401.46	3402.72	0.056376	10.74	51.56	45.94	1.79
Reach #5	1510	Profile 1	554.00	3396.83	3398.51	3399.19	3400.62	0.057416	11.66	47.74	39.18	1.85
Reach #5	1500	Profile 1	554.00	3395.29	3397.14	3397.76	3399.15	0.065485	11.39	48.70	45.10	1.93
Reach #5	1485	Profile 1	554.00	3394.22	3396.18	3396.81	3398.25	0.068210	11.59	48.23	45.53	1.97
Reach #5	1475	Profile 1	554.00	3392.76	3394.67	3395.23	3396.57	0.067785	11.09	49.97	49.19	1.94
Reach #5	1460	Profile 1	554.00	3391.37	3393.24	3393.81	3395.18	0.069941	11.19	49.56	49.71	1.97
Reach #5	1450	Profile 1	554.00	3388.84	3390.92	3391.52	3392.72	0.046907	10.79	51.88	41.33	1.67
Reach #5	1350	Profile 1	554.00	3385.52	3387.17	3387.84	3389.36	0.069006	11.94	47.13	43.99	1.99
Reach #5	1300	Profile 1	554.00	3382.23	3384.14	3384.60	3385.73	0.040317	10.18	55.52	45.46	1.57
Reach #5	1275	Profile 1	554.00	3379.81	3381.75	3382.37	3383.79	0.061358	11.46	48.35	42.14	1.89
Reach #5	1225	Profile 1	554.00	3377.86	3379.79	3380.24	3381.33	0.047723	9.99	56.11	51.67	1.66
Reach #5	1200	Profile 1	554.00	3375.82	3377.63	3378.12	3379.30	0.053293	10.49	54.18	50.69	1.75
Reach #5	1150	Profile 1	554.00	3373.09	3375.02	3375.53	3376.74	0.057791	10.59	53.29	52.31	1.81
Reach #5	1125	Profile 1	554.00	3368.96	3370.95	3371.53	3372.93	0.064341	11.36	49.60	47.68	1.91
Reach #5	1000	Profile 1	554.00	3366.41	3368.39	3368.91	3370.21	0.038243	11.04	52.30	36.95	1.57
Reach #5	900	Profile 1	554.00	3363.16	3364.88	3365.57	3367.16	0.054476	12.19	46.75	37.74	1.83
Reach #5	850	Profile 1	554.00	3359.34	3360.99	3361.51	3362.76	0.051663	10.74	52.57	46.91	1.74
Reach #5	775	Profile 1	554.00	3355.47	3357.61	3358.07	3359.17	0.045632	10.17	55.82	47.91	1.64
Reach #5	700	Profile 1	554.00	3352.26	3353.97	3354.46	3355.64	0.047428	10.37	53.49	45.09	1.67
Reach #5	660	Profile 1	554.00	3348.65	3350.02	3350.70	3352.35	0.071655	12.25	45.24	40.09	2.03
Reach #5	620	Profile 1	554.00	3346.20	3346.95	3347.44	3348.63	0.105609	10.48	53.46	82.46	2.27
Reach #5	550	Profile 1	554.00	3340.30	3341.13	3341.54	3342.51	0.075867	9.41	58.87	81.47	1.95
Reach #5	475	Profile 1	554.00	3334.40	3335.05	3335.57	3337.02	0.155469	11.26	49.13	88.83	2.67
Reach #5	400	Profile 1	595.00	3328.50	3329.38	3329.76	3330.68	0.062744	9.16	64.97	81.16	1.80
Reach #5	350	Profile 1	595.00	3322.60	3323.31	3323.89	3325.43	0.130321	11.68	50.93	76.41	2.52
Reach #5	300	Profile 1	595.00	3317.00	3323.75	3318.17	3323.75	0.000020	0.55	1083.47	216.83	0.04
Reach #5	260	Profile 1	595.00	3312.00	3323.75		3323.75	0.000004	0.35	1699.45	186.00	0.02
Reach #5	250	Profile 1	595.00	3312.00	3323.75	3313.30	3323.75	0.000004	0.35	1676.89	197.16	0.02


COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
River #5 Reach #5
Legend
EG Profile 1
WS Profile 1
Crit Profile 1
Ground
Elevation (ft)
3440
3420
3400
3380
3360
3340
3320
3300
0
200
400
600
800
1000
1200
1400
1600
1800
Main Channel Distance (ft)


COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 2051.55
.047
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 2051
.035
.035
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1950
.04
.035
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
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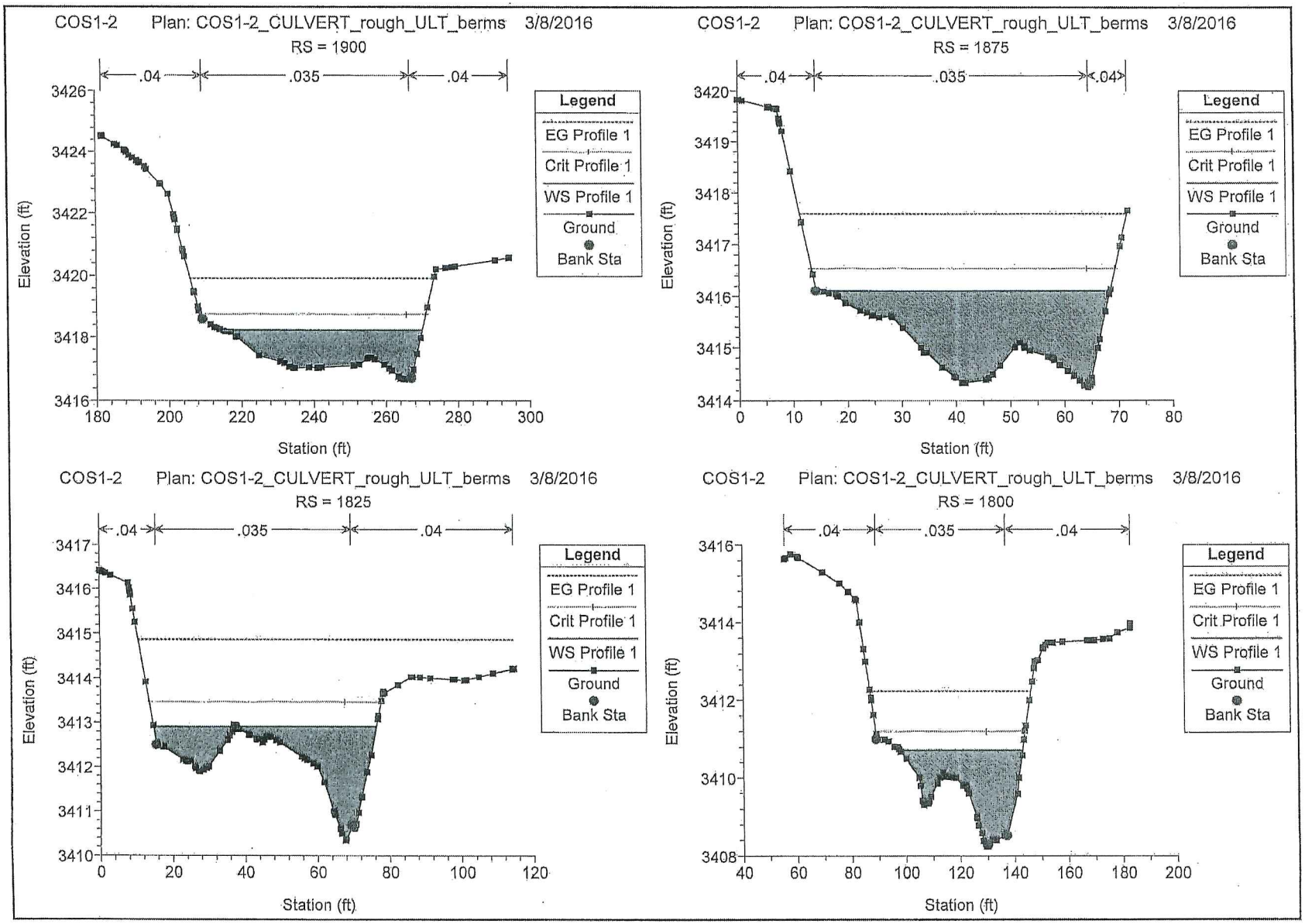
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta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WS Profile 1
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Bank Sta
Elevation (ft)
Station (ft)
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Station (ft)
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Station (ft)
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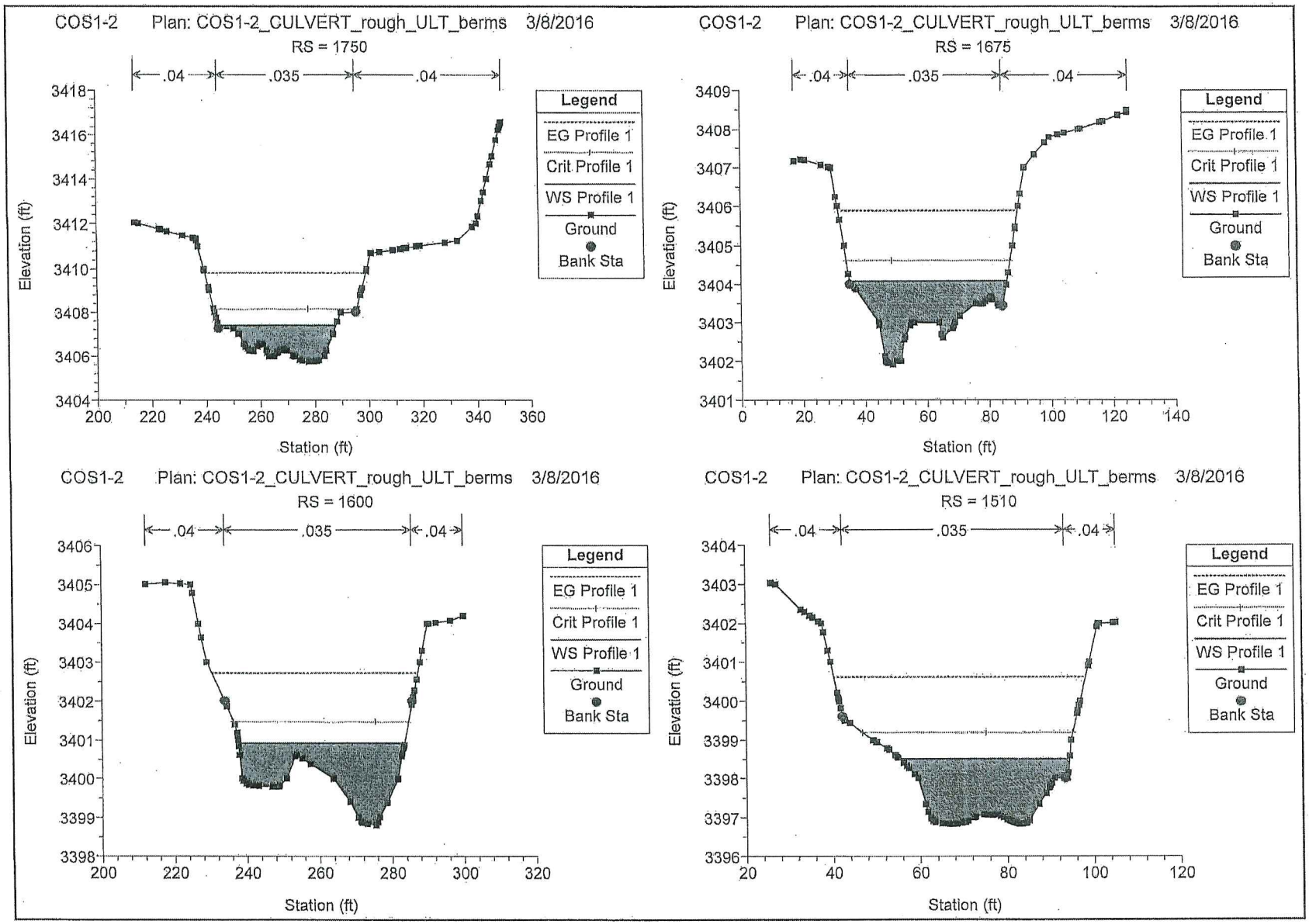
Station (ft)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Elevation (ft)
Station (ft)
Legend
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Crit Profile 1
WS Profile 1
Ground
Bank Sta
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Elevation (ft)
Station (ft)
Legend
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WS Profile 1
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Station (ft)
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Bank Sta
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Station (ft)
Legend
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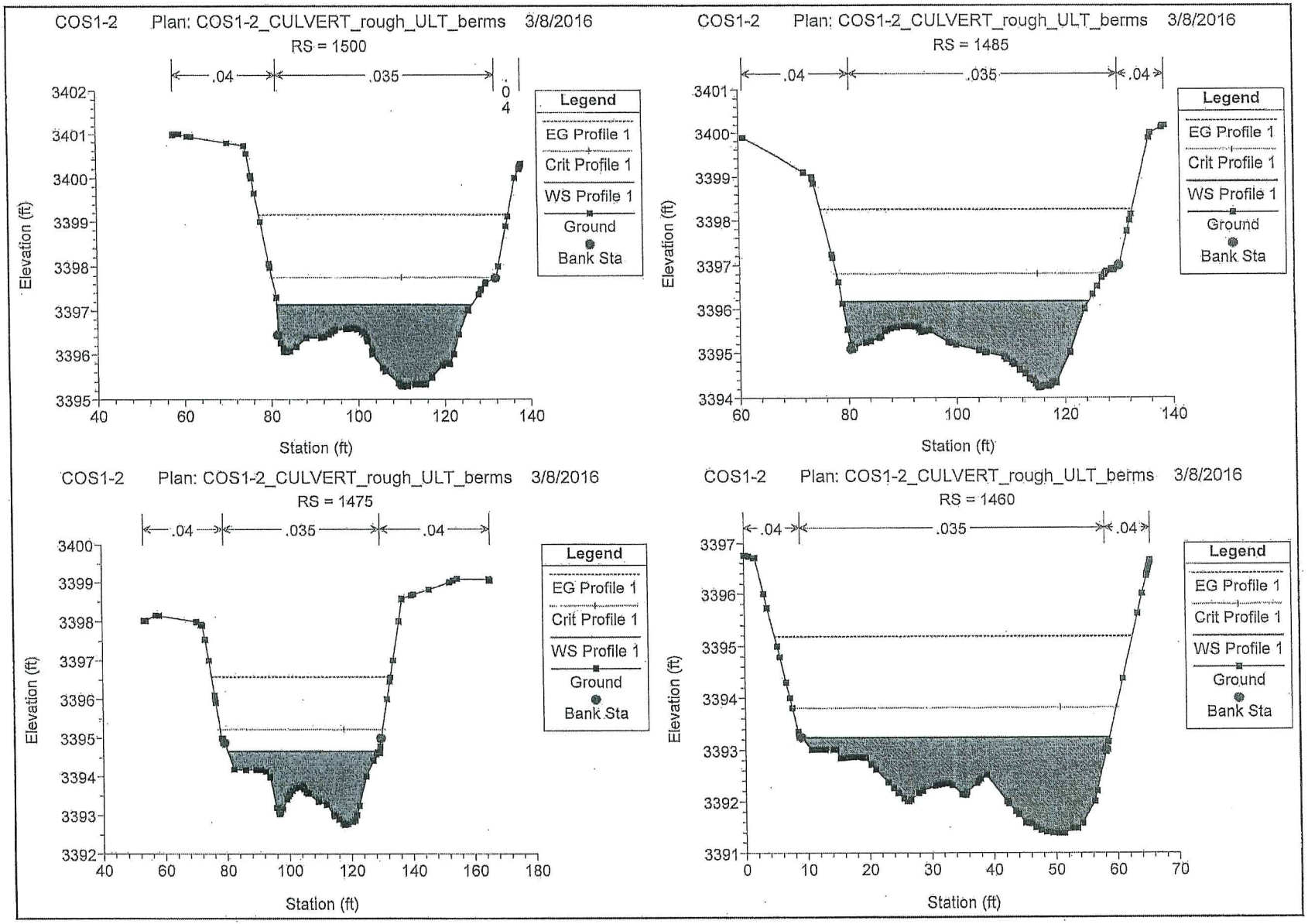
Ground
Bank Sta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Legend
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Bank Sta
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Station (ft)
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Bank Sta
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Station (ft)
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Legend
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Station (ft)
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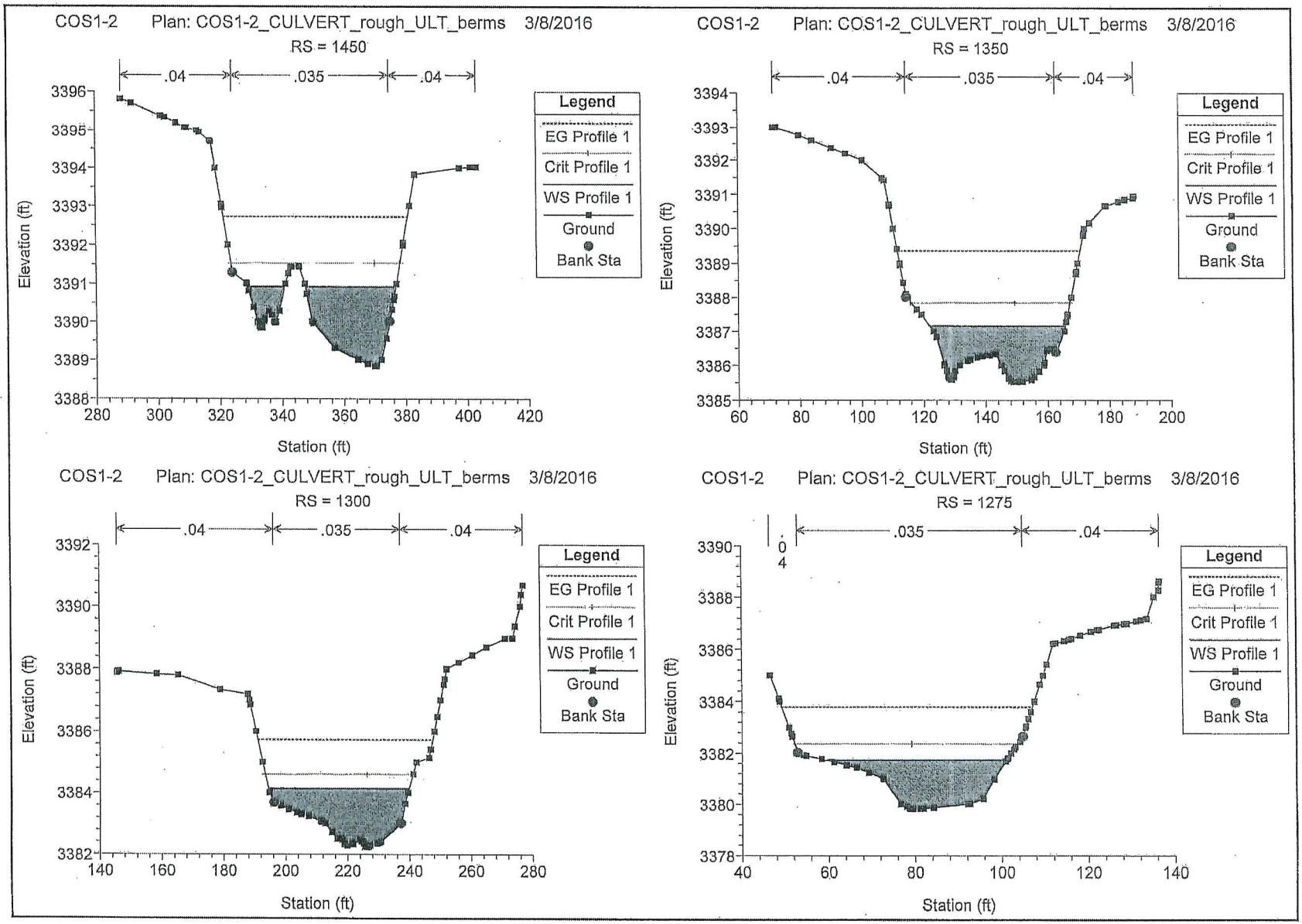
Station (ft)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Elevation (ft)
Station (ft)
Legend
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WS Profile 1
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Bank Sta
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.04
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Station (ft)
Legend
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WS Profile 1
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Bank Sta
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.035
.04
Elevation (ft)
Station (ft)
Legend
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Crit Profile 1
WS Profile 1
Ground
Bank Sta
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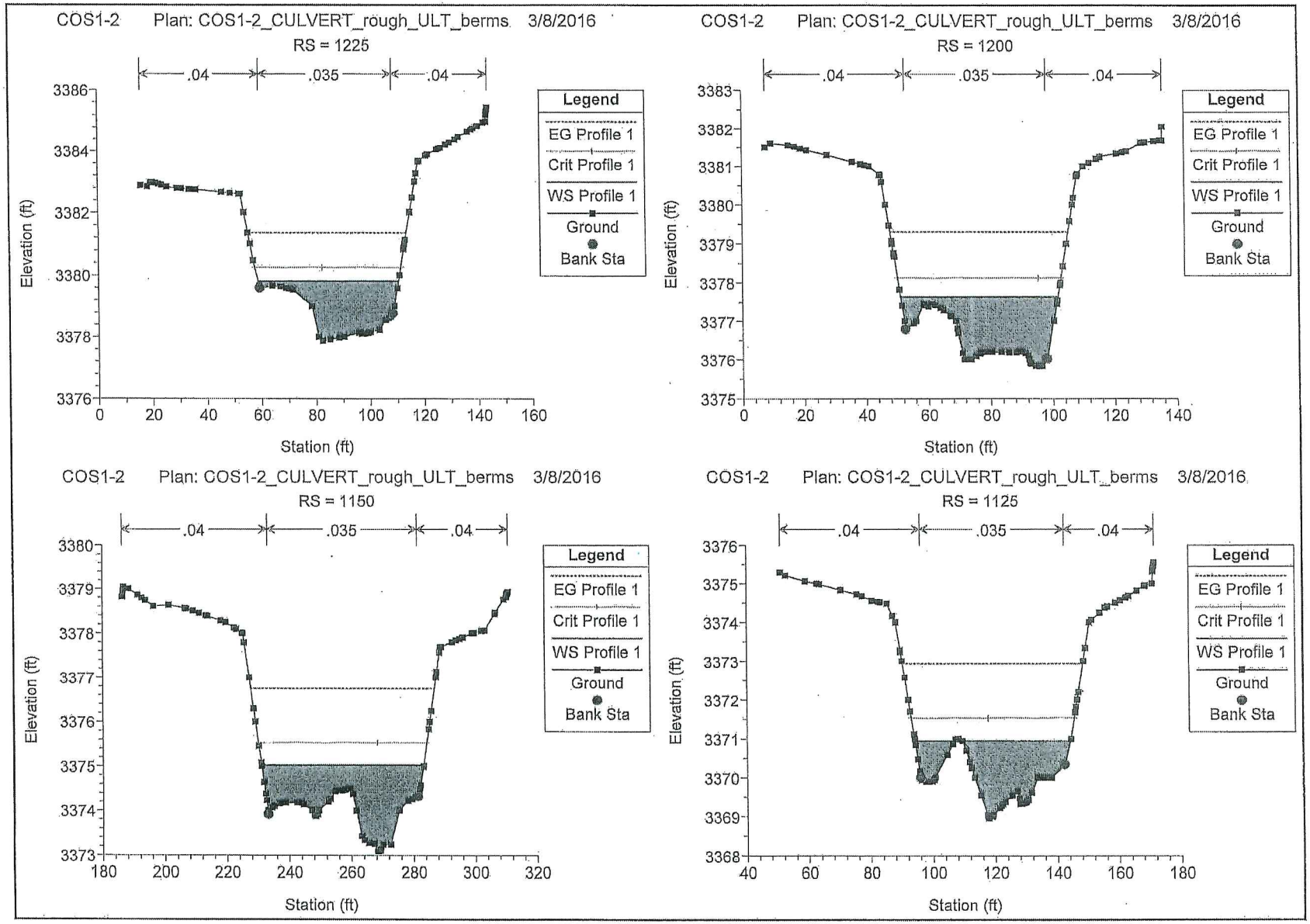
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta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.035
.04
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Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1200
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.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1150
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
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.035
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Station (ft)
Legend
EG Profile 1
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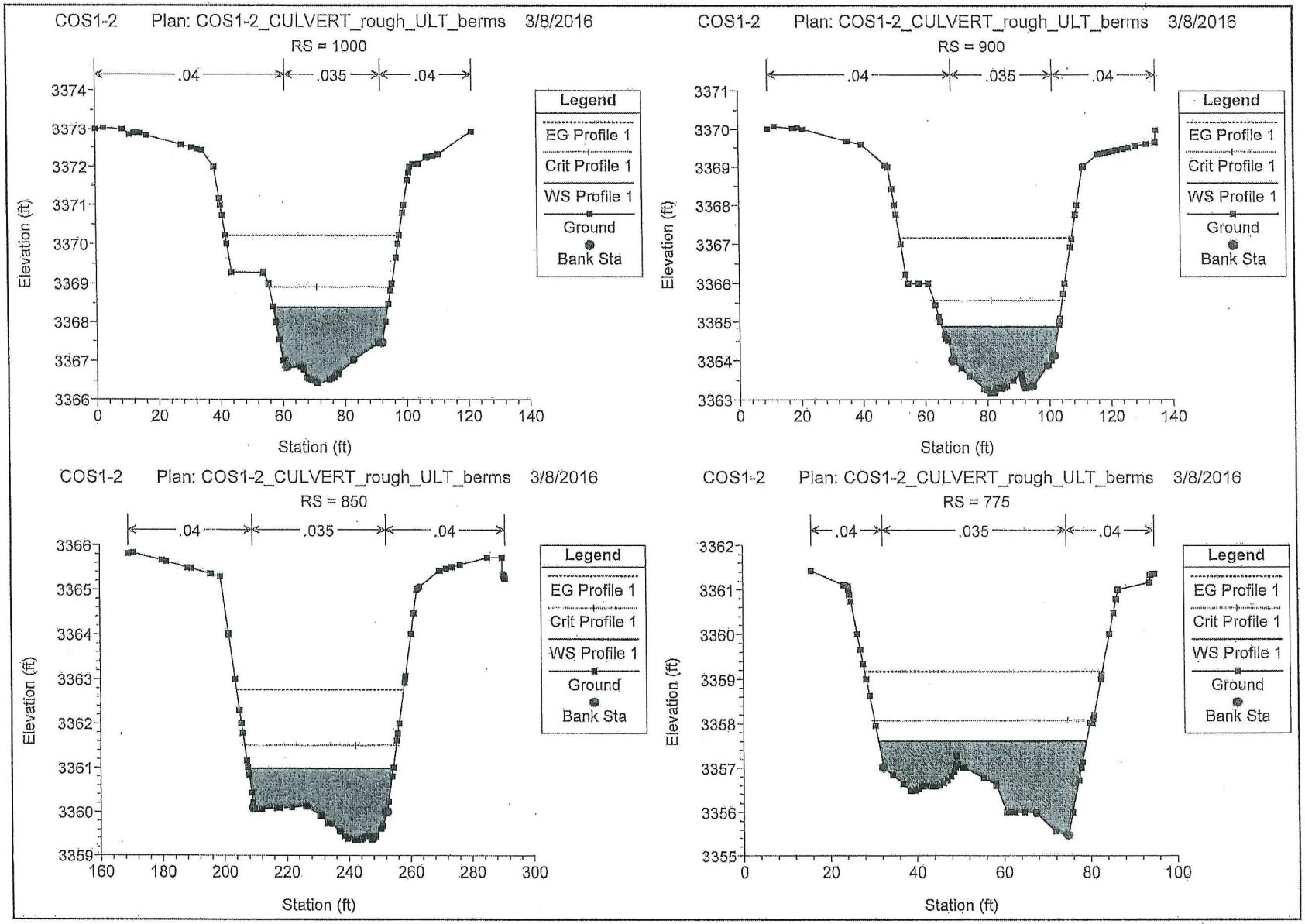
WS Profile 1
Ground
Bank Sta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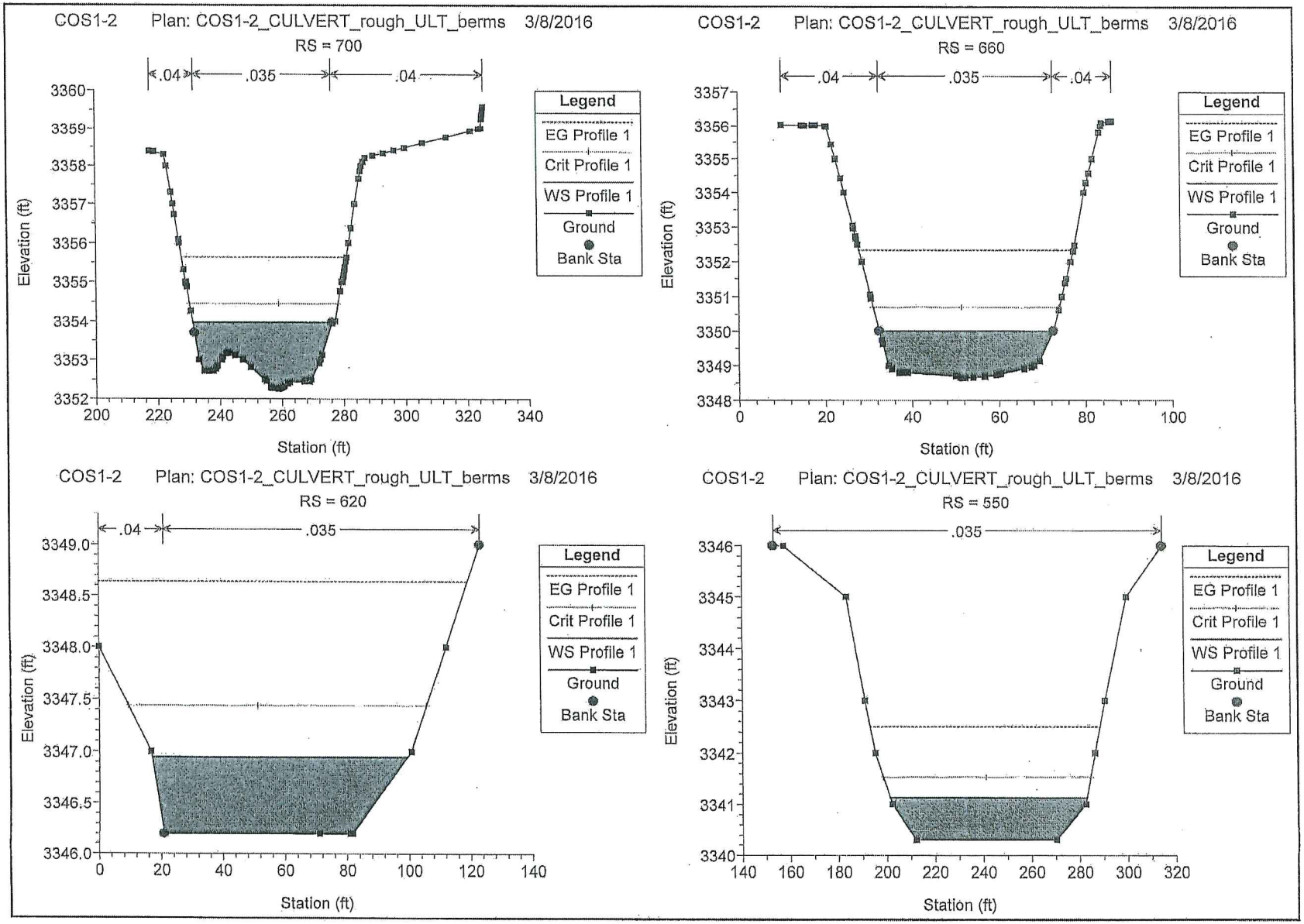
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 900
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 850
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 775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Station (ft)
Legend
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Crit Profile 1
WS Profile 1
Ground
Bank Sta
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.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 620
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.035
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
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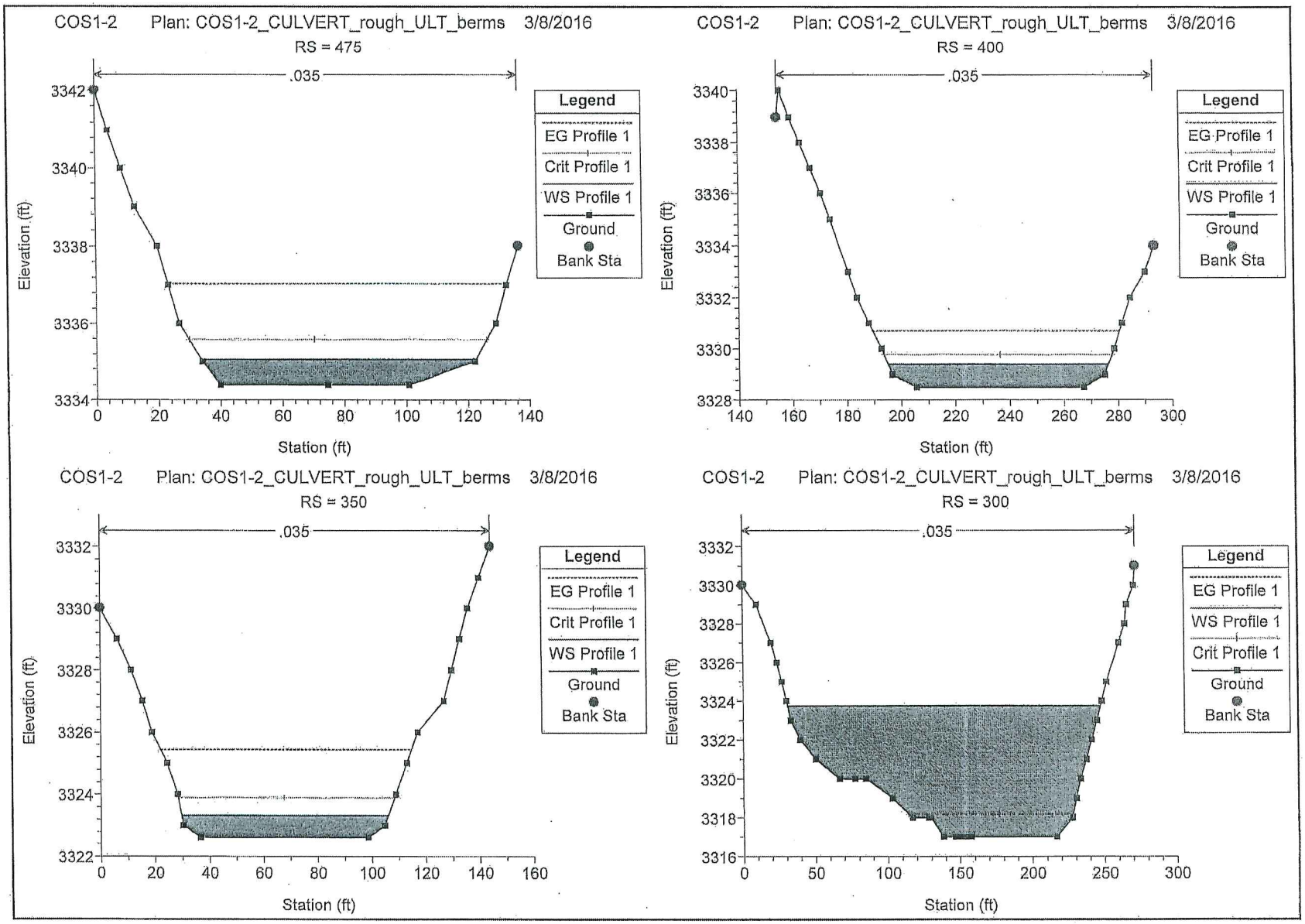
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta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Legend
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Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 400
.035
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 350
.035
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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Legend
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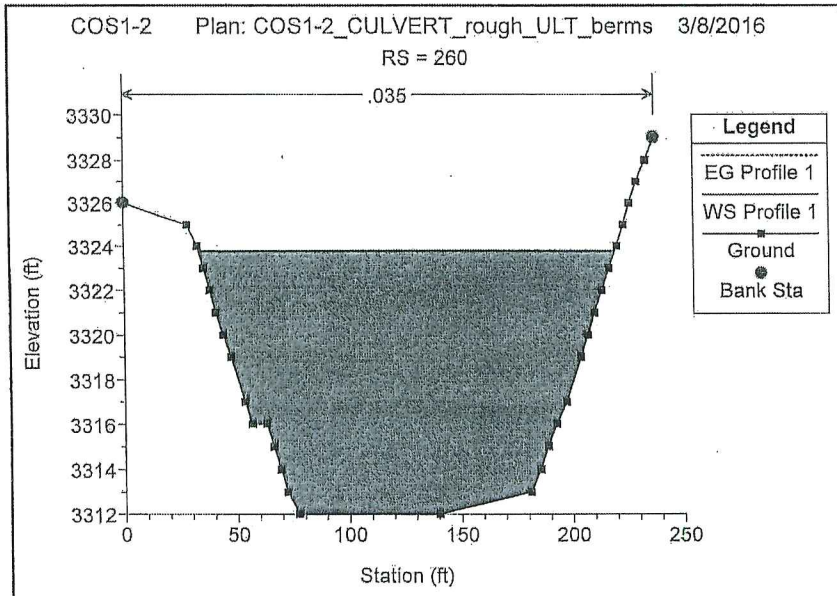
Crit Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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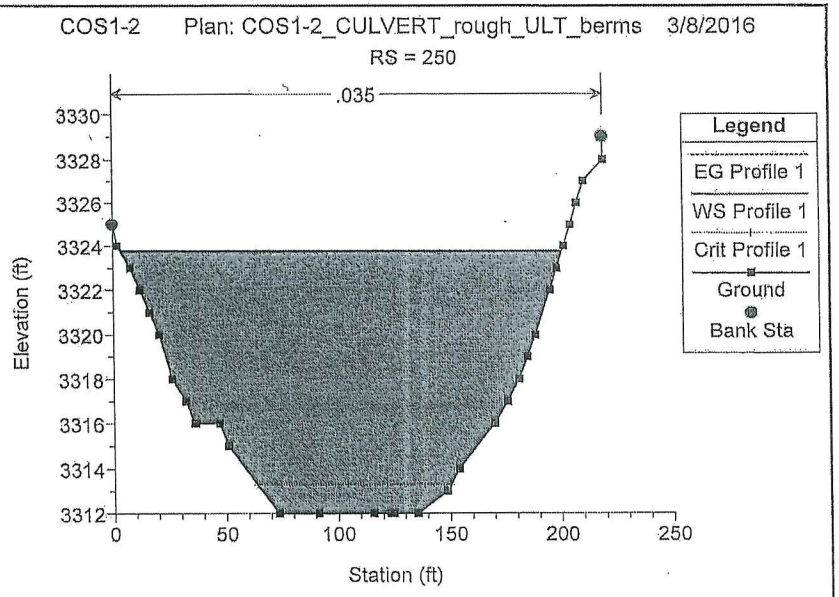
Elevation (ft)
3330
3328
3326
3324
3322
3320
3318
3316
3314
3312
0
50
100
150
200
250
Station (ft)
Legend
EG Profile 1
WS Profile 1
Ground
Bank Sta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.035
Elevation (ft)
3330
3328
3326
3324
3322
3320
3318
3316
3314
3312
0
50
100
150
200
250
Station (ft)
Legend
EG Profile 1
WS Profile 1
Crit Profile 1
Ground
Bank Sta

UPDATE #6 TO THE TECHNICAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24 UNIT 2 IMPROVEMENTS - CROSSBRIDGE DRIVE (CROSSBRIDGE UNIT 1 TO SUNCREEK ROAD)

62024-222

March 2016

GCW
ENGINEERS \ SURVEYORS

Prepared by:

GCW, Inc.
1555 S. Rainbow Blvd.
Las Vegas, Nevada 89146
Phone: (702) 804-2000
Fax: (702) 804-2299

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM			DATE: March 24, 2016
TO: **Land Development Services** Department of Public Works			FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:		**COPIES TO:**
Summerlin Village 24 Unit 2 Improvements – Update #6 **Crossbridge Drive Improvements** **(from Crossbridge Unit 1 to Sun Creek Road)**			GCW Engineers/Surveyors
Cross Streets:	SWC of Sky Vista Drive & Alta Drive		Howard Hughes Corp.
File Number:	F:\Depot\DSMemos\DS4136L.doc		Bart Anderson, P.E., DevCo
Parcel Number:	137-22-000-015		
Zoning Action:	N/A		
FEMA Flood Zone	YES	NO X	
Proposed Storm Drain	YES X	NO	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Transaction #
1st Submittal	2/21/2007	3/29/2007	Not Approved	$400.00	63487: $400
2nd Submittal	5/4/2007	5/29/2007	Not Approved	$400.00	68552: $400
3rd Submittal	5/15/2014 & 6/5/2014	6/9/2014	Conditional Approval	$400.00	357117: $400
4th Submittal	9/22/2014	10/7/2014	Approved	$100.00	371022: $100
5th Submittal	11/6/2014	11/26/2014	Approved	$100.00	376121: $100
6th Submittal	2/10/2015	2/24/2015	Not Approved	$100.00	385212: $100
7th Submittal	5/14/2015	6/15/2015	Not Approved	$400.00	397629: $400
8th Submittal	6/22/2015	7/7/2015	Approved	$100.00	402841: $100
9th Submittal	10/6/2015	10/22/2015	Not Approved	$400.00	417806: $400
10th Submittal	11/4/2015	11/18/2015	Approved	$400.00	421434: $400
11th Submittal	3/7/2016	3/24/2016	See Comments Below	$100.00	435704: $100
			TOTAL FEES (LDDRS):	$2,900.00	----

REMARKS:

11th Submittal: Update #6 to remove two previously proposed 24"-stub

10th Submittal: Addendum #3 to Update #3

9th Submittal: Addendum #2 to Update #3

8th Submittal: Update #4 for Sky Vista Drive Improvements – Revise the connection angle of a 48"-Stub to Future Parcel K at the intersection of Crossbridge Drive and Suncreek Road

6th & 7th Submittals: Update #3 and Addendum to construct a channel along the west boundary of *Village 24* and Extend *Crossbridge Drive* beyond *Suncreek Road*

The Drainage Study for the subject project has been reviewed and:

X	is approved subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.



LEGEND

- SUBBASIN BOUNDARY
- PRORATED SUBBASIN BOUNDARY
- ON8R — DRAINAGE SUBBASIN
- ON8R-1 — PRORATED DRAINAGE SUBBASIN
- CRR1 — CONCENTRATION POINT
- FLOW DIRECTION

SUMMARY OF HEC-1 MODEL INTERIM CONDITION

Basin	Remarks	Area (ac)	Q_{100} (cfs)	Q_{10} (cfs)
ADS	Roads circled Alta and offsite to north	40.2	122	56
F2B	Offsite area west of Summerlin tributary	92.4	152	52
F2A*	Offsite area west of Village 24 drains south within western boundary channel	280.5	635	287
CRR1*	Combine flows at Village 24 boundary at northerly existing wash, F2B+F2A	—	768	331
DVS*	Flow diverts to the south	—	239	113
DCRR1	Remaining flow that continues to culverts at Crossridge	—	701	218
RG6C	Offsite area draining to multiple culverts under Crossridge	30.7	85	38
CP12A*	Combine flows at upstream side of culverts under Crossridge	—	547	224
CD1*	Portion of Crossbridge Drive draining to culverts under Crossridge	3.7	13	7
CP12B*	Combine flows at downstream side of culverts, CD1+CP12A	—	563	227
F*	Future parcel CS-1	24.9	51	20
OFF7S	Offsite area southwest of multiple culverts at Crossbridge	85.4	56	26
CPRCB*	Combine flows at existing 7' x 3' open inlet in Unit 1	—	633	269
CBRC	Roughly paved Crossbridge Drive	12.0	24	17
SR6	Suncreek Road	1.6	7	4
SR6D	Area southwest of Alta and Sky Vista	4.8	14	6
RG6A	Area west of Crossridge, crosses Crossridge at sag section	16.2	75	13
RG6B	Area west of Crossridge, crosses Crossridge at sag section	44.3	116	31
RG6E	Area bounded by Alta, Crossridge, Suncreek, Sky Vista	44.8	123	54
CP8	Combine flows in Sky Vista storm drain at intersection with Suncreek	—	269	125
SR5	Sky Vista between Alta and Crossridge	10.0	33	11
RG6F	Area south of Suncreek and west of Sky Vista; drains to open inlet in Sky Vista storm drain	17.2	48	21
CP10	Combine flows in Sky Vista storm drain CP8+ST2+RG6F	—	364	160
CP1B	Combine flows at existing 7' x 3' open inlet in Unit 1 and flows in Sky Vista storm drain	—	961	432
CBRC	Offsite area west of Village 24 and drains south within western boundary channel	3.5	13	6
CBRC*	Offsite area west of Village 24 drains south within western boundary channel	76.1	263	61
CBRC	Offsite area west of Village 24 drains south within western boundary channel	13.8	40	18
CBRC	Offsite area west of Village 24 drains south within western boundary channel	4.4	15	7
CBRC	Offsite area west of Village 24 drains south within western boundary channel	7.4	24	11
CBRC	Offsite area west of Village 24, drains south within western boundary channel	91.6	262	113
CBRC	Offsite area west of Village 24, drains south within western boundary channel	—	723	325
CRR2	ON5+CBRC+OFF11A	34.5	97	44
ON11	Onsite area west of existing berm	7.3	21	9
ON7R	Onsite area draining south to RG6 stub	27.2	77	34
ON8R*	Onsite area west of Crossridge	—	97	44
CP1	Combine portions of onsite area west of Crossridge; ON7R + ON8R	—	97	44
CD2*	Portion of Crossbridge Drive	3.8	13	7
ON10R	Onsite area between existing berm and Crossridge	5.1	16	7
CP2	Combine flows in Crossridge storm drain CP1 + ON10R + CD2	—	126	57
OFF11B*	Offsite area south of Crossridge	95.8	1530	648
CP11	Combine offsite area west of Village 24+CRR2+ON11+OFF11B	—	1655	692
RG7*	Portion of Unit 2 Crossridge improvements that drains to existing Unit 1 improvements	1.4	6	3

* Revised with Update #3.
** Referenced from the Update #2 Conceptual Study.

SUMMARY OF PRORATED STORM FLOWS INTERIM CONDITION
100-Year and 10-Year Runoff

Parent Basin	Area (ac)	Q_{100} (cfs)	Unit Flow (cfs/ac)	Q_{10} (cfs)	Unit Flow (cfs/ac)
RG6	40.16	122	3.04	56	1.39
RG5D	4.79	14	2.92	6	1.25
RG6E	44.8	123	2.75	54	1.21
RG6F	17.2	48	2.79	21	1.22
ON8R*	24.9	76	3.05	34	1.37
Prorated Subbasins					
SubBasin	Area (ac)	Unit Flow (cfs/ac)	Q_{100} (cfs)	Unit Flow (cfs/ac)	Q_{10} (cfs)
RG6-1	24.42	3.04	74	1.39	34
D1A	1.62	2.92	5	1.25	2
D1B	2.42	2.92	7	1.25	3
D2	0.75	2.92	2	1.25	1
E1	2.34	2.75	7	1.21	4
E2A	8.53	2.75	23	1.21	10
E2B	7.06	2.75	19	1.21	9
E3A	23.03	2.75	63	1.21	28
E3B	3.84	2.75	11	1.21	5
F1	1.55	2.79	4	1.22	2
F2	3.87	2.79	11	1.22	5
F3	11.79	2.79	33	1.22	14
ON8R-1	3.77	3.05	12	1.37	5

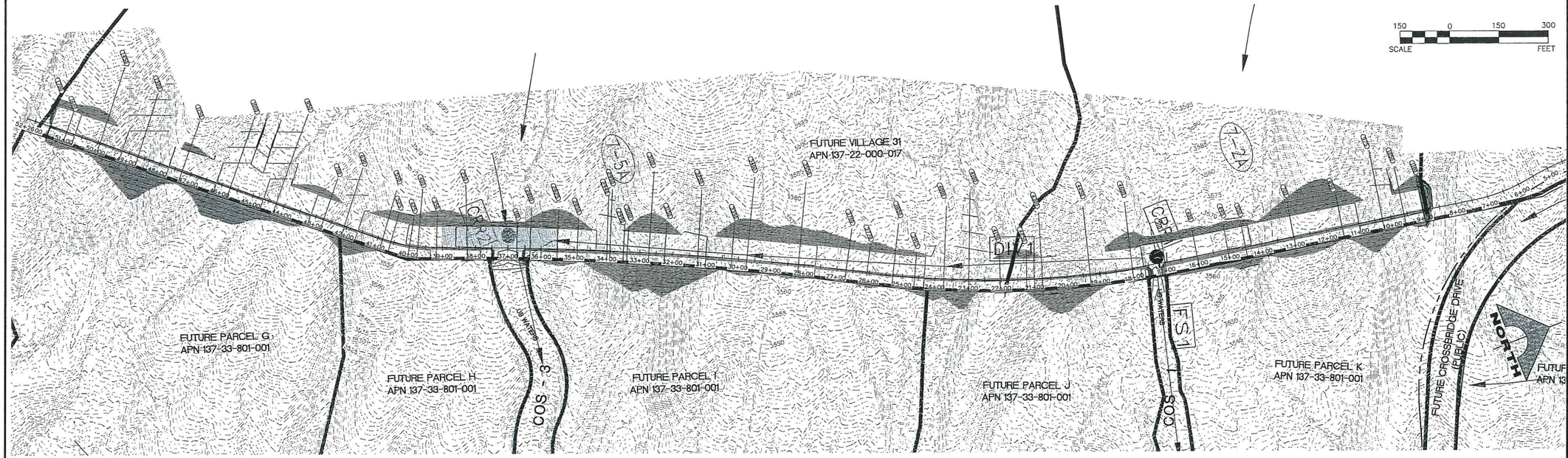
CROSS SECTION	DISCHARGE (cfs)	ACTUAL DEPTH (ft)	VELOCITY (ft/s)	SCOUR PROTECTION REQUIRED
CH1	1900	0.9	9.2	Gabions/6-foot cutoff wall
CH2	1900	1.2	11.2	Gabions/6-foot cutoff wall
CH3	1900	0.8	8.9	Gabions/6-foot cutoff wall

Note: Table is referenced from the Unit 1 improvements

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
T: 702.814.2000 FX: 702.243.2299 GCWALLACE.COM

SUMMERLIN VILLAGE 24
UNIT 2 IMPROVEMENTS
FIGURE 7U3R
INTERIM CONDITION DRAINAGE MAP

DRAWING
FIG7U3R
QF SHT5



CRR2B - HYDRAULIC MODELS RESULTS SUMMARY AND SUPER-ELEVATION CALCULATIONS

Sta	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Freeboard	Superelevation	Total Depth	Actual Depth	Riprap
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)	(ft)	(D50- inches)
1700	51+50.00	253	3562.50	3563.42	0.92	4.39	65.52	0.83	0	1.0	0.0	1.9	3.0	-
1600	51+00.00	253	3562.19	3563.18	0.99	4.04	66.08	0.73	0	1.0	0.0	2.0	3.0	-
1450	49+90.40	253	3561.52	3562.33	0.81	5.03	64.83	1.01	0	1.1	0.0	1.9	3.0	-
1320	48+67.16	253	3560.69	3561.61	0.92	3.25	109.26	0.68	0	1.0	0.0	1.9	3.0	-
1150	47+25.00	253	3559.76	3560.68	0.92	4.40	65.51	0.83	0	1.0	0.0	1.9	3.0	-
1000	45+70.96	253	3558.75	3559.51	0.76	4.13	100.83	0.93	0	1.0	0.0	1.8	3.0	-
850	44+22.48	253	3557.76	3558.73	0.97	3.03	111.63	0.62	0	1.0	0.0	2.0	3.0	-
700	42+71.49	253	3556.76	3557.57	0.81	5.02	64.97	1.01	0	1.1	0.0	1.9	3.0	-
630	42+04.74	253	3556.24	3557.25	1.01	3.01	109.36	0.60	0	1.0	0.0	2.0	3.0	-
550	40+83.66	253	3555.49	3557.15	1.66	2.03	81.48	0.29	500	1.0	0.0	2.7	3.0	-
525	40+56.00	253	3555.31	3557.08	1.77	2.19	70.63	0.30	500	1.0	0.0	2.8	3.5	-
425	40+00.00	253	3554.93	3557.07	2.14	1.78	72.92	0.22	500	1.0	0.0	3.1	3.5	-
400	39+72.21	253	3554.77	3557.07	2.30	1.63	75.14	0.20	500	1.0	0.0	3.3	3.5	-
350	39+14.98	720	3554.38	3556.62	2.24	4.83	73.39	0.60	11926	1.0	0.0	3.2	3.5	12
250	38+23.68	720	3553.79	3556.00	2.21	4.86	73.34	0.61	11926	1.0	0.0	3.2	3.5	12
100	36+32.08	720	3553.33	3555.35	2.02	5.42	71.31	0.70	11926	1.0	0.0	3.0	3.5	12, 24 (LOB)

CRR2A - HYDRAULIC MODELS RESULTS SUMMARY AND SUPER-ELEVATION CALCULATIONS

Sta	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Freeboard	Superelevation	Total Depth	Actual Depth	Riprap
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)	(ft)	(D50- inches)
4600	18+00.00	287	3558.90	3560.60	1.70	2.60	70.22	0.37	11926	1.0	0.0	2.7	3.0	-
4450	19+28.47	540	3558.51	3560.27	1.76	3.73	93.60	0.51	11926	1.0	0.0	2.8	3.0	-
4300	20+74.12	540	3558.07	3559.91	1.84	4.20	88.08	0.56	11926	1.0	0.0	2.8	3.0	-
4250	21+22.19	540	3557.93	3559.67	1.74	4.76	70.46	0.66	11926	1.0	0.0	2.7	3.0	-
4150	22+02.06	540	3557.69	3559.24	1.55	5.33	69.92	0.78	11926	1.0	0.0	2.6	3.0	-
4100	22+97.42	540	3557.40	3559.22	1.82	2.73	156.71	0.43	11926	1.0	0.0	2.8	3.0	-
4000	23+72.68	540	3557.17	3559.07	1.90	3.18	107.98	0.42	11926	1.0	0.0	2.9	3.0	-
3915	24+60.08	540	3556.91	3558.70	1.79	4.81	70.76	0.63	11926	1.0	0.0	2.8	3.0	-
3850	25+27.17	540	3556.71	3558.54	1.83	4.39	75.10	0.56	11926	1.0	0.0	2.8	3.0	-
3770	26+07.18	540	3556.47	3558.28	1.81	4.59	70.17	0.62	2964	1.0	0.0	2.8	3.0	-
3700	26+68.77	540	3556.28	3558.09	1.81	4.56	70.82	0.62	2964	1.0	0.0	2.8	3.0	-
3550	28+15.85	540	3555.83	3557.63	1.80	4.57	70.86	0.62	2964	1.0	0.0	2.8	3.0	-
3400	29+72.06	540	3555.38	3557.15	1.77	4.69	70.60	0.65	2964	1.0	0.0	2.8	3.0	-
3350	30+18.41	540	3555.23	3556.96	1.73	4.80	70.35	0.67	2964	1.0	0.0	2.7	3.0	-
3250	31+22.61	540	3554.92	3556.87	1.95	3.32	94.64	0.43	2964	1.0	0.0	3.0	3.0	-
3150	32+23.12	540	3554.62	3556.58	1.96	4.18	71.76	0.55	2964	1.0	0.0	3.0	3.0	-
3100	32+71.05	540	3554.48	3556.49	2.01	4.07	72.06	0.53	2964	1.0	0.0	3.0	3.0	-
3000	33+36.60	540	3554.40	3556.44	2.04	4.00	72.27	0.52	2964	1.0	0.0	3.0	3.5	-
2990	33+50.00	540	3554.25	3556.36	2.11	3.86	73.81	0.49	2964	1.0	0.0	3.1	3.5	-
2950	33+88.92	540	3554.13	3556.44	2.31	1.92	181.38	0.27	2964	1.0	0.0	3.3	3.5	-
2850	34+88.28	540	3553.83	3556.23	2.40	3.36	73.46	0.40	2964	1.0	0.0	3.4	3.5	-
2825	35+50.00	540	3553.65	3556.15	2.50	3.20	75.00	0.38	2964	1.0	0.0	3.5	3.5	12
2800	36+32.16	720	3553.39	3555.35	1.96	5.58	71.72	0.73	2964	1.0	0.0	3.0	3.5	12

CRR1 - HYDRAULIC MODELS RESULTS SUMMARY AND SUPER-ELEVATION CALCULATIONS

Sta	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Freeboard	Superelevation	Total Depth	Actual Depth	Riprap
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)	(ft)	(D50- inches)
1100	9+00.00	344	3561.59	3563.50	1.91	2.74	71.45	0.36	0	1.0	0.0	2.9	4.0	-
1050	9+59.36	344	3561.41	3563.46	2.05	2.55	72.28	0.33	0	1.0	0.0	3.1	4.0	-
975	10+26.73	344	3561.21	3563.48	2.27	1.30	155.50	0.17	0	1.0	0.0	3.3	4.0	-
850	11+49.84	344	3560.84	3563.41	2.57	1.98	75.41	0.23	0	1.0	0.0	3.6	4.0	-
700	12+99.60	841	3560.39	3562.87	2.48	5.02	74.89	0.59	0	1.0	0.0	3.5	4.0	-
550	14+50.00	841	3559.94	3562.55	2.61	4.94	75.65	0.56	0	1.0	0.0	3.6	4.0	24 (ROB)
455	15+00.00	841	3559.78	3562.45	2.67	4.81	75.89	0.53	0	1.0	0.0	3.7	4.5	24 (ROB)
400	15+99.60	841	3559.50	3562.32	2.82	4.54	76.92	0.49	0	1.0	0.0	3.8	4.5	24 (ROB)
310	17+00.00	841	3559.20	3562.20	3.00	4.24	78.00	0.45	2964	1.0	0.0	4.0	4.5	24 (ROB)

DATE:
GCW APP
DATE
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DATE
DESCRIPTION
REV DATE

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DESIGN: GCW
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Michelle Castell

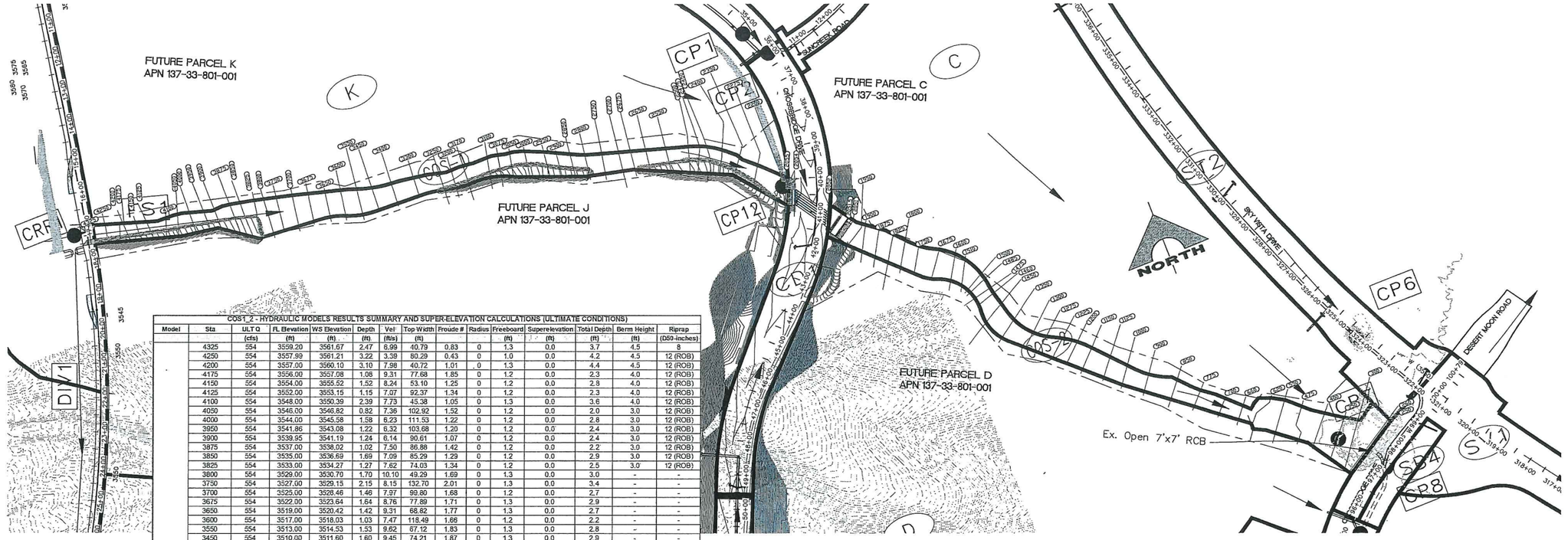
THE HOWARD HUGHES COMPANY, LLC

SUMMERLIN VILLAGE 24

FIGURE 8U3R
HEC-RAS CROSS SECTION EXHIBIT

DRAWING
FIG 8U3R
1 OF 8 SHTS

cm24.16.dwg 07/2023 jm



COST_2 - HYDRAULIC MODELS RESULTS SUMMARY AND SUPER-ELEVATION CALCULATIONS (ULTIMATE CONDITIONS)

Model	Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Freeboard	Superelevation	Total Depth	Berm Height	Riprap
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)	(ft)	(D50-inches)
	4325	554	3559.20	3561.67	2.47	6.99	40.79	0.83	0	1.3	0.0	3.7	4.5	8
	4250	554	3557.99	3561.21	3.22	3.39	80.29	0.43	0	1.0	0.0	4.2	4.5	12 (ROB)
	4200	554	3557.00	3560.10	3.10	7.98	40.72	1.01	0	1.3	0.0	4.4	4.5	12 (ROB)
	4175	554	3556.00	3557.08	1.08	9.31	77.68	1.85	0	1.2	0.0	2.3	4.0	12 (ROB)
	4150	554	3554.00	3555.52	1.52	8.24	53.10	1.25	0	1.2	0.0	2.8	4.0	12 (ROB)
	4125	554	3552.00	3553.15	1.15	7.07	92.37	1.34	0	1.2	0.0	2.3	4.0	12 (ROB)
	4100	554	3548.00	3550.39	2.39	7.73	45.38	1.05	0	1.3	0.0	3.6	4.0	12 (ROB)
	4050	554	3546.00	3546.82	0.82	7.36	102.92	1.52	0	1.2	0.0	2.0	3.0	12 (ROB)
	4000	554	3544.00	3545.58	1.58	6.23	111.53	1.22	0	1.2	0.0	2.8	3.0	12 (ROB)
	3950	554	3541.86	3543.08	1.22	6.32	103.68	1.20	0	1.2	0.0	2.4	3.0	12 (ROB)
	3900	554	3539.95	3541.19	1.24	6.14	90.61	1.07	0	1.2	0.0	2.4	3.0	12 (ROB)
	3875	554	3537.00	3538.02	1.02	7.50	86.88	1.42	0	1.2	0.0	2.2	3.0	12 (ROB)
	3850	554	3535.00	3536.69	1.69	7.09	85.29	1.29	0	1.2	0.0	2.9	3.0	12 (ROB)
	3825	554	3533.00	3534.27	1.27	7.62	74.03	1.34	0	1.2	0.0	2.5	3.0	12 (ROB)
	3800	554	3529.00	3530.70	1.70	10.10	49.29	1.69	0	1.3	0.0	3.0	-	-
	3750	554	3527.00	3529.15	2.15	8.15	132.70	2.01	0	1.3	0.0	3.4	-	-
	3700	554	3525.00	3528.46	1.46	7.97	99.80	1.68	0	1.2	0.0	2.7	-	-
	3675	554	3522.00	3523.64	1.64	8.76	77.89	1.71	0	1.3	0.0	2.9	-	-
	3650	554	3519.00	3520.42	1.42	9.31	68.82	1.77	0	1.3	0.0	2.7	-	-
	3600	554	3517.00	3518.03	1.03	7.47	118.49	1.66	0	1.2	0.0	2.2	-	-
	3550	554	3513.00	3514.53	1.53	9.62	67.12	1.83	0	1.3	0.0	2.8	-	-
	3450	554	3510.00	3511.60	1.60	9.45	74.21	1.87	0	1.3	0.0	2.9	-	-
	3400	554	3506.00	3508.11	2.11	8.04	107.10	1.76	0	1.3	0.0	3.4	-	-
	3300	554	3502.00	3503.79	1.79	9.29	66.13	1.72	0	1.3	0.0	3.1	-	-
COS-1	3250	554	3499.00	3500.32	1.32	6.74	84.31	1.18	0	1.2	0.0	2.5	3.5	12 (ROB)
	3200	554	3496.00	3497.56	1.56	7.41	73.19	1.27	0	1.2	0.0	2.8	3.5	12 (ROB)
	3170	554	3493.00	3494.61	1.61	8.62	66.99	1.54	0	1.3	0.0	2.9	3.5	12 (ROB)
	3100	554	3489.00	3490.85	1.85	7.43	74.13	1.26	0	1.2	0.0	3.1	3.5	12 (ROB)
	3075	554	3487.00	3488.89	1.89	8.27	59.05	1.34	0	1.3	0.0	3.1	3.5	12 (ROB)
	3050	554	3485.00	3486.52	1.52	9.09	49.25	1.40	0	1.3	0.0	2.8	3.5	12 (ROB)
	3000	554	3482.00	3483.80	1.80	9.73	37.78	1.32	0	1.3	0.0	3.1	3.5	12 (ROB)
	2950	554	3479.00	3481.41	2.41	9.09	40.26	1.22	0	1.3	0.0	3.7	4.0	12 (ROB)
	2900	554	3477.00	3478.83	1.83	10.51	37.90	1.49	0	1.3	0.0	3.2	4.0	12 (ROB)
	2850	554	3474.00	3475.97	1.97	10.31	43.87	1.58	0	1.3	0.0	3.3	4.0	12 (ROB)
	2800	554	3471.00	3473.13	2.13	9.70	48.72	1.52	0	1.3	0.0	3.4	4.0	12 (ROB)
	2750	554	3469.00	3470.18	1.18	7.23	83.72	1.33	0	1.2	0.0	2.4	-	-
	2700	554	3466.00	3467.14	1.14	8.74	77.76	1.71	0	1.2	0.0	2.4	-	-
	2675	554	3463.85	3465.00	1.15	8.77	86.39	1.78	0	1.2	0.0	2.4	-	-
	2650	554	3461.00	3462.85	1.85	6.97	86.19	1.26	0	1.2	0.0	3.1	3.5	12 (ROB)
	2550	554	3457.75	3459.41	1.66	6.78	100.47	1.32	0	1.2	0.0	2.9	3.5	12 (ROB)
	2500	554	3454.00	3455.22	1.22	5.65	168.34	1.30	0	1.2	0.0	2.4	3.5	12 (ROB)
	2475	554	3452.00	3453.85	1.85	5.83	108.17	1.09	0	1.2	0.0	3.0	3.5	12 (ROB)
	2450	554	3450.00	3452.80	2.80	5.13	143.91	1.04	0	1.2	0.0	4.0	4.0	12 (ROB)
	2400	554	3448.00	3449.22	1.22	6.53	127.86	1.41	0	1.2	0.0	2.4	4.0	12 (ROB)
	2350	554	3445.00	3446.90	1.90	4.77	146.82	0.94	0	1.0	0.0	2.9	4.0	12 (ROB)
	2275	554	3442.00	3443.32	1.32	5.34	142.72	1.10	0	1.1	0.0	2.5	4.0	12 (ROB)
	2200	554	3437.00	3438.45	1.45	4.65	115.47	0.68	0	1.0	0.0	2.4	4.0	12 (ROB)
	2055	554	3434.00	3435.83	1.83	6.42	69.07	1.01	0	1.2	0.0	3.0	4.0	36
	2054	554	3430.00	3433.67	3.67	3.32	56.50	0.31	0	1.0	0.0	4.7	5.0	Concrete
	2053	Culvert				16.26			-	-	-	-	-	-
	2052	554	3425.00	3426.14	1.14	11.09	79.15	1.83	0	1.3	0.0	2.4	-	Stilling Basin
	2051.55	554	3422.27	3426.77	4.50	4.73	64.00	0.62	0	1.0	0.0	5.5	-	36
	2051	554	3420.30	3422.66	2.36	7.40	72.69	1.29	0	1.2	0.0	3.6	-	-
	1950	554	3419.00	3420.95	1.95	3.26	184.32	0.60	0	1.0	0.0	2.9	-	-
	1900	554	3417.34	3419.60	2.26	6.32	71.56	1.01	0	1.2	0.0	3.5	-	-
	1875	554	3414.43	3416.61	2.18	8.56	55.31	1.40	0	1.3	0.0	3.5	-	-
	1825	554	3411.57	3413.17	1.60	8.93	60.17	1.55	0	1.3	0.0	2.9	-	-
	1800	554	3409.75	3410.74	0.99	6.15	125.83	1.28	0	1.2	0.0	2.1	-	-
	1750	554	3406.00	3408.23	2.23	7.53	58.19	1.18	200	1.2	0.3	3.7	-	-
	1675	554	3403.00	3404.57	1.57	8.28	64.96	1.44	200	1.2	0.3	3.2	-	-
	1600	554	3399.00	3401.23	2.23	8.73	51.66	1.39	200	1.3	0.3	3.8	-	-
	1510	554	3398.00	3399.35	1.35	9.37	50.97	1.56	200	1.3	0.4	3.0	-	-
	1500	554	3394.00	3394.99	0.99	14.17	44.43	2.86	200	1.4	0.7	3.0	-	-
	1485	554	3393.00	3394.06	1.06	12.53	48.73	2.32	200	1.3	0.6	3.0	-	-
	1475	554	3390.00	3391.90	1.90	11.85	51.85	2.20	200	1.4	0.6	3.8	-	-
	1460	554	3389.00	3391.09	2.09	10.07	54.28	1.76	146	1.3	0.6	4.0	-	-
	1450	554	3388.00	3389.53	1.53	5.12	144.29	1.04	146	1.1	0.4	3.1	-	-
	1350	554	3385.00	3386.67	1.67	7.27	98.87	1.46	146	1.2	0.6	3.4	-	-
	1300	554	3382.00	3383.50	1.50	6.73	113.73	1.39	146	1.2	0.5	3.2	-	-
COS-2	1275	554	3380.00	3381.82	1.82	7.43	88.10	1.42	0	1.2	0.0	3.0	-	-
	1225	554	3378.00	3379.13	1.13	7.29	122.38	1.63	0	1.2	0.0	2.3	-	-
	1200	554	3376.00	3377.03	1.03	7.78	93.74	1.57	0	1.2	0.0	2.2	-	-
	1150	554	3373.00	3374.90	1.90	7.94	74.24	1.44	0	1.2	0.0	3.1	-	-
	1125	554	3369.00	3371.12	2.12	9.77	56.50	1.72	0	1.3	0.0	3.4	-	-
	1000	554	3367.00	3368.49	1.49	10.50	43.31	1.68	0	1.3	0.0	2.8	-	-
	900	554	3364.00	3365.41	1.41	10.84	40.96	1.71	0	1.3	0.0	2.7	-	-
	850	554	3360.00	3361.31	1.31	10.02	55.66	1.77	0	1.3	0.0	2.6	-	-
	775	554	3356.00	3357.57	1.57	9.72	56.29	1.70	0	1.3	0.0	2.9	-	-
	700	554	3353.00	3354.22	1.22	9.74	50.79	1.62	0	1.3	0.0	2.5	-	-
	660	554	3349.00	3350.10	1.10	10.60	60.28	2.01	0	1.3	0.0	2.4	-	-
	620	554	3346.20	3347.00	0.80	9.28	88.71	2.00	0	1.2	0.0	2.0	-	-
	550	554	3340.30	3341.10	0.80	9.83	81.13	2.08	0	1.2	0.0	2.0	-	-
	475	554	3334.40	3335.09	0.69	10.55	89.37	2.42	0	1.2	0.0	1.9	-	-
	400	595	3328.50	3329.33	0.83	9.72	80.82	1.97	0	1.2	0.0	2.1	-	-
	350	595	3322.60	3323.37	0.77	10.70	76.77	2.22	0	1.2	0.0	2.0	-	-
	300	595	3317.00	3323.75	6.75	0.55	216.83	0.04	0	1.0	0.0	7.8	-	-
	260	595	3312.00	3323.75	11.75	0.35	185.00	0.02	0	1.0	0.0	12.8	-	-
	250	595	3312.00	3323.75	11.75	0.35	197.16	0.02	0	1.0	0.0	12.8	-	-

150 0 150 300
SCALE FEET

LEGEND

- COS-1 — DRAINAGE SUBBASIN
- CP1 — CONCENTRATION POINT
- SUBBASIN BOUNDARY
- 850 — HEC-RAS CROSS SECTION

DATE: | DESCRIPTION | DATE | AGEN APP | DATE | GCW APP | REV | DATE

PROJECT NO. 62024-221
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David Clark

THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24
HEC-RAS CROSS SECTION EXHIBIT (PARCELS COS-1 + COS-2)

DRAWING
FIG 9U3R
2 OF 8 SHTS

gce2430.dwg 07/02/03 jw

HYDROLOGIC CRITERIA AND DESIGN MANUAL

TIME OF CONCENTRATION

G. C. WALLACE, INC.
Engineers/Planners/Surveyors

SUMMERLIN VILLAGE 24
UNIT 2 IMPROVEMENTS
PROPOSED/INTERIM CONDITIONS

Project No: 62024-221
Date: 23-Feb-15
Calculated by: JYA/MMC

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc CHECK URBANIZED BASINS		Tc	Tlag	REMARKS
DESIG: (1)	DEV./EX. (D or E)	CN (16)	K (2)	AREA Ac (3)	AREA Sq Mi (4)	INITIAL LENGTH Feet (5)	SLOPE % (6)	Ti Min (7)	TRAVEL LENGTH Feet (8)	SLOPE % (9a)	V1 VELOCITY fps (9b)	V2 VELOCITY fps (10)	Tt Min (11)	TOTAL LENGTH Feet (12)	Tc = (L/180)+10 Min (13)	Min (14)	Tlag = 0.6Tc/60 Hours (15)	Rainfall (In)
Precipitaion values for basins are referenced from the *Conceptual Drainage Study*. OFF11A includes the areas for OFF12 through OFF17; OFF11B includes a portion of the area for ON12.																		3.43
OFF11A	E	88	0.7716	91.8	0.14306	500	8.0	6.9	3975	7.3	2.0	7.8	5.4	4475	N/A	16.0	0.160	3.34
OFF11B	E	88	0.7716	56.8	0.08867	500	7.2	6.8	3410	6.1	3.7	7.8	5.9	3910	N/A	16.8	0.168	
Parameters are referenced from the *SWPA Update* and the *Conceptual Drainage Study*. For the proposed/interim conditions, the subbasin is assumed undeveloped; therefore the CN used is for subbasin OFF5 from the *Conceptual Drainage Study*; precipitation value is from subbasin 7-2A from the *SWPA Update*. The area and lag time have been revised for the present study.																		3.50
7-2A*	E	88	0.7716	283.5	0.44300	500	9.0	6.4	9490	7.2	4.0	7.8	24.2	9990	N/A	27.5	0.275	
Crossbridge Drive and onsite areas draining towards Crossbridge Drive; precipitation value for all basins and CN for Crossbridge Drive are taken from the *Conceptual Drainage Study Update #2*.																		3.34
ON7R*	E	88	0.7716	7.3	0.01145	500	7.2	6.8	1165	5.2	3.4	6.7	4.7	1665	N/A	16.0	0.110	3.34
ON8R*	E	88	0.7716	27.2	0.04245	500	7.0	6.9	1430	6.1	3.5	7.15	4.4	1930	N/A	16.0	0.116	3.34
ON10R	E	88	0.7716	5.4	0.00845	65	10.8	2.2	190	7.4	4.0	8.0	0.3	255	N/A	2.9	0.100	3.34
CD1	D	94	0.8508	3.7	0.00578	25	2.0	1.8	870	0.6	1.0	2.4	0.778	895	15.0	9.7	0.097	3.38
CD2	D	94	0.8508	3.8	0.00594	25	2.0	1.8	1100	0.6	1.0	2.4	0.9	1125	16.3	11.3	0.113	3.37
CD3	D	94	0.8508	1.4	0.00219	35	2.0	2.1	490	6.3	5.1	7.71	1.16	525	12.9	9.7	0.050	3.36
Offsite area draining towards existing Unit 1 Improvements; precipitation value and CN are taken from the *Conceptual Drainage Study*																		3.34
ON7R2	E	88	0.7716	20.4	0.03191	500	9.4	6.9	1260	6.4	3.6	7.5	4.9	1760	N/A	10.2	0.102	
Rough-graded Cossbridge Drive and Alta Drive with offsite (RG6); precipitation for RG6 is a portion of basin RG6 in the *Village 23A Rough Grade Study*																		3.29
RG6	E	90.2	0.8006	40.2	0.06275	500	6.6	6.6	1230	5.2	3.4	6.7	3.6	1730	N/A	10.7	0.107	3.34
CBRG	E	94	0.8508	12.2	0.01909	45	2.0	2.4	2090	0.5	1.0	2.0	2.1	2135	N/A	23.5	0.235	
These subbasins are subdivided from Basin RG6 which is from the *Village 23A Rough Grade Study*; areas and lag times are revised; precipitation and CN are from the *Village 23A Rough Grade Study*																		3.29
RG6A	E	88	0.7716	10.2	0.01597	500	7.0	6.9	1925	7.6	4.0	8.0	5.0	2425	N/A	15.8	0.158	3.29
RG6B	E	88	0.7716	44.3	0.06920	500	6.4	7.1	3735	6.8	3.9	7.8	9.2	4235	N/A	15.3	0.153	3.29
RG6C*	E	88	0.7716	30.7	0.04793	240	8.0	4.8	2450	5.3	3.4	6.8	7.8	3690	N/A	11.6	0.116	3.29
RG6D	E	88	0.7716	4.8	0.00749	500	7.4	6.8	425	6.6	3.8	7.5	1.8	925	N/A	9.6	0.100	3.29
RG6E	E	88	0.7716	44.8	0.07000	500	9.2	6.3	2450	5.0	Sta	8.5	7.4	2950	N/A	13.6	0.136	3.29
RG6F	E	88	0.7716	17.2	0.02689	500	5.8	7.4	1205	5.4	3.4	6.8	2.9	1705	N/A	11.6	0.116	

Tc = Ti + Tt Tlag = 0.6 Tc

$Ti = 1.8\ (1.1 - K)\ L^{1/2} / S^{1/3}$

K = 0.0132 (CN) - 0.39

For the travel time (Tt) calculations,
V1 applies to the first 500 feet of travel distance;
V2 applies to the remaining travel distance.

Existing: $V1 = 14.8*(S/100)^{1/2}$ $V2 = 29.4*(S/100)^{1/2}$

Developed: $V1 = 20.2*(S/100)^{1/2}$ $V2 = 30.6*(S/100)^{1/2}$

REFERENCE:

STANDARD FORM 4

*Revised as part of *Update #3 to the Unit 2 Study due to added offsite channel and flow split weirs*.

File: SF4-V24-Int.xls Printed: 5/11/2015 7:29 PM

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1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*          VERSION 4.1                  *
*                                       *
*  RUN DATE   17MAR15  TIME  15:28:15   *
*                                       *
*****************************************
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*            (916) 756-1104             *
*                                       *
*****************************************
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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
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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

HEC-1 INPUT

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

              *DIAGRAM
              ID  ************************************************************
              ID  * ..................................................... : *
              ID  * :                SUMMERLIN VILLAGE 24                 : *
              ID  * :                  UNIT 2 IMPROVEMENTS                : *
              ID  * :              PROPOSED/INTERIM CONDITIONS            : *
              ID  * :         PROPOSED FLOW SPLIT AT VILLAGE 24 BOUNDARY  : *
              ID  * :.....................................................: *
              ID  * :  RETURN PERIOD_ _ _ _100/10-YEAR                    : *
              ID  * :  DISTRIBUTUION_ _ _ _6-HOUR SDN3                    : *
              ID  * :  PROJECT NO_ _ _ _ _ 62024-221                      : *
              ID  * :  FILENAME_ _ _ _ _ _ INT-V24-PRSPLIT.H1             : *
              ID  * :  DATE_ _ _ _ _ _ _ 3/04/15                         : *
              ID  * :.....................................................: *
              ID
              ID
              ID          DEPTH AREA REDUCTION FACTOR
              ID    DARFS RERERENCED FROM THE CONCEPTUAL DRAINAGE STUDY
              ID        SQ MILES              DARF
              ID          0-.1                1.0
              ID          .1-.3               .988
              ID          .3-.5               .980
              ID          .5-.7               .976
              ID          .7-.9               .972
              ID          .9-2.0              .950
              ID         10-YEAR              .575
              ID
              ID
              IT     5       0       0     300
              IO     5
              IN     5       0       0
              JR   PREC      1    .988    .980    .976    .972    .950    .575
              *

              KK   RG6*
              KM   SUBBASIN RG6*
              KM   A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
              KM   AREA AND CURVE NUMBER REVISED TO INCLUDE UNIT 2 IMPROVEMENTS
              KM   INCLUDES ROUGH-GRADED ALTA AND SKY VISTA DRIVES AND OFFSITE AREA TO THE NORT
              BA  .06275
              PB   3.29
              PC   .000   .020   .057   .070   .087   .108   .124   .130   .130   .130
              PC   .130   .130   .130   .133   .140   .142   .148   .158   .172   .181
              PC   .190   .197   .199   .200   .201   .204   .214   .229   .241   .249
              PC   .251   .256   .270   .278   .281   .283   .295   .322   .352   .409
              PC   .499   .590   .710   .744   .781   .812   .819   .835   .851   .856
              PC   .860   .868   .876   .888   .910   .926   .937   .950   .970   .976
              PC   .982   .985   .987   .989   .990   .993   .993   .994   .995   .998
              PC   .998   .999  1.00
              LS     0   90.2
              UD   .107
              *
              * END RUNOFF TO ALTA DRIVE
              *
              * BEGIN RUNOFF TO MULTIPLE CULVERTS AT CROSSBRIDGE DRIVE
              *
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HEC-1 INPUT

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

  48          KK   7-2B
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49          KM   SUBBASIN 7-2B
            *  REFERENCED FROM THE 2006 SUMMERLIN WEST PLANNING AREA FLOOD CONTROL MASTER PL
50          BA  0.0944
51          PB    3.58
52          LS       0       88
53          UD   0.149
            *

54          KK   7-2Br
55          KM   ROUTE 7-2Br TO CP12
56          RD    9490    .072    .025            TRAP       0       50
            *

57          KK   7-2A*
58          KM   SUBBASIN 7-2A* (SUBBASIN OFF5 IN THE CONCEPTUAL DRAINAGE STUDY)
            *  REFERENCED FROM THE 2006 SUMMERLIN WEST PLANNING AREA FLOOD CONTROL MASTER PL
            *  FOR INTERIM CONDTION, THIS BASIN ASSUMED UNDEVELOPED
            *  AREA AND LAG TIME HAVE BEEN REVISED FOR INTERIM, UNDEVLOPED CONDITIONS
59          BA  .44300
60          PB    3.50
61          LS       0       88
62          UD   0.275
            *

63          KK    CRR1
64          KM   CONCENTRATION POINT CRR1
65          KM   COMBINE 7-2B AND 7-2A* NEAR VILLAGE 24 BOUNDARY
66          HC       2
            *

67          KK   DCRR1
68          KM   DIVERT FLOW FROM EXISTING WASH AT VILLAGE 24 BOUNDARY
69          KM   DIVERTED FLOW (DIVS) TURNS SOUTH
70          DT    DIVS
71          DI       0      760
72          DQ       0      259
            *

73          KK    RG6C
74          KM   SUBBASIN RG6C
75          KM    A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
76          BA  .04793
77          PB    3.29
78          LS       0       88
79          UD   0.118
            *

80          KK   CP12A
81          KM   CONCENTRATION POINT CP12 (AT UPSTREAM SIDE OF BRIDGE)
82          KM   COMBINE CRR1 AND RG6C AT CULVERTS CROSSING CROSSBRIDGE DRIVE
83          HC       2
            *
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                                    HEC-1 INPUT

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

84          KK     CD1
85          KM   SUBBASIN CD1
86          KM   PORTION OF CROSSBRIDGE DRIVE
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY UPDATE #2
87          BA  .00578
88          PB    3.38
89          LS       0       94
90          UD   0.097
            *

91          KK   CP12B
92          KM   CONCENTRATION POINT CP12 (AT DOWNSTREAM SIDE OF BRIDGE)
93          KM   COMBINE CP12A AND CD1
94          HC       2
            *
            * END RUNOFF TO CULVERTS AT CROSSBRIDGE DRIVE
            * BEGIN RUNOFF TO EXISTING 7' BY 7' RCB - PART OF UNIT 1 IMPROVEMENTS
            *

95          KK       C
96          KM   SUBBASIN PARCEL C
97          KM   DEVELOPED SUBBASIN ADDED TO THIS FILE TO FIND WORST-CASE FLOW AT
98          KM   EXISTING 7' BY 7' RCB - PARCEL C IS NOT PROPOSED FOR DEVELOPMENT AT THIS TIME
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY UPDATE #2
99          BA  .03888
100         PB    3.37
101         LS       0       85.7
102         UD   0.165
            *

103         KK   ON7R2
104         KM   SUBBASIN ON7R2
105         BA  .03191
106         PB    3.34
107         LS       0       88
108         UD   0.102
            *

109         KK   CPRCB
110         KM   CONCENTRATION POINT CPRCB AT EXISTING RCB AT CROSSBRIDGE
111         KM   COMBINE CP12B, FUTURE PARCEL C AND ON7R2
112         HC       3
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                *
                * BEGIN RUNOFF TO PROPOSED STORM DRAIN STARTING IN CROSSBRIDGE DRIVE, EXTENDING
                * EAST IN SUNCREEK AND SOUTH IN SKY VISTA AND
                * CONNECTING TO EXISTING STORM DRAIN IN SKY VISTA
                *

113             KK    CBRG
114             KM   SUBBASIN CBRG
115             KM    A PORTION OF ROUGH GRADED CROSSBRIDGE DRIVE
116             BA  .01909
117             PB    3.34
118             LS       0       94
                                                                                                PAGE  4
                                          HEC-1 INPUT
1
LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

119             UD   0.235
                *

120             KK    ST6*
121             KM   SUBBASIN ST6
122             KM   SUNCREEK ROAD
                *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
                *  AREA SLIGHTLY REVISED
123             BA  .00284
124             PB    3.34
125             LS       0       94
126             UD   0.075
                *

127             KK     CP5
128             KM   CONCENTRATION POINT CP5
129             KM   COMBINE ST6 AND CBRG IN STORM DRAIN AT INTERSECTION OF
130             KM   SUNCREEK ROAD AND SKY VISTA DRIVE
131             HC       2
                *
                * BEGIN RUNOFF TO PROPOSED STORM DRAIN IN SKY VISTA
                *

132             KK    RG6D
133             KM   SUBBASIN RG6D
134             KM    A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
135             BA  .00748
136             PB    3.29
137             LS       0       88
138             UD   0.100
                *

139             KK    RG6A
140             KM   SUBBASIN RG6A
141             KM    A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
142             BA  .01597
143             PB    3.29
144             LS       0       88
145             UD   0.119
                *

146             KK   RG6Ar
147             KM   ROUTE RG6A TO CP6
148             RD    2880    .056    .025            TRAP       0       50
                *

149             KK    RG6B
150             KM   SUBBASIN RG6B
151             KM    A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
152             BA  .06920
153             PB    3.29
154             LS       0       88
155             UD   0.163
                *
                                                                                                PAGE  5
                                          HEC-1 INPUT
1
LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

156             KK   RG6Br
157             KM   ROUTE RG6B TO CP6
158             RD    2740    .055    .025            TRAP       0       50
                *

159             KK    RG6E
160             KM   SUBBASIN RG6E
161             KM    A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
162             BA  .07000
163             PB    3.29
164             LS       0       88
165             UD   0.138
                *

166             KK     CP6
167             KM   CONCENTRATION POINT CP6
168             KM   COMBINE RG6A, RG6B AND RG6E AT STUB TO SKY VISTA STORM DRAIN
169             HC       3
                *

170             KK     CP7
171             KM   CONCENTRATION POINT CP7
172             KM   COMBINE RG6D AND CP6 IN STORM DRAIN UPSTREAM OF INTERSECTION OF
173             KM   SUNCREEK ROAD AND SKY VISTA DRIVE
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174         HC       2
            *

175         KK     CP8
176         KM    CONCENTRATION POINT CP8
177         KM    COMBINE CP5 AND CP7 IN STORM DRAIN AT INTERSECTION OF
178         KM    SUNCREEK ROAD AND SKY VISTA DRIVE
179         HC       2
            *

180         KK     ST2
181         KM    SUBBASIN ST2
182         KM    SKY VISTA DRIVE FROM ALTA DRIVE TO CROSSBRIDGE DRIVE
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
183         BA   .01563
184         PB    3.34
185         LS       0       94
186         UD    0.140
            *

187         KK     RG6F
188         KM    SUBBASIN RG6F
189         KM    A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
190         KM    DRAINS TO TEMPORARY STUB TO THE SKY VISTA STORM DRAIN
191         BA   .02689
192         PB    3.29
193         LS       0       88
194         UD    0.115
            *
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1                                    HEC-1 INPUT

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

195         KK     CP9
196         KM    CONCENTRATION POINT CP9
197         KM    COMBINE CP8, RG6F AND ST2 IN SKY VISTA STORM DRAIN
198         HC       3
            *

199         KK     CP9B
200         KM    COMBINE CPRCB AND CP9 IN UNIT 1 CROSSBRIDGE DRIVE STORM DRAIN
201         HC       2
            *
            * BEGIN OFFSITE WESTERN BOUNDARY AND ONSITE RUNOFF TO EXISTING WASH SOUTH OF UNI
            *

202         KK    RETDS
203         KM    RETRIEVE DIVERTED FLOW
204         DR     DIVS
            *

205         KK     OFF6
206         KM    SUBBASIN OFF6
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
207         BA   .00550
208         PB    3.43
209         LS       0       88
210         UD    0.050
            *

211         KK     OFF7
212         KM    OFFSITE SUBBASIN OFF7
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
213         BA   .11888
214         PB    3.43
215         LS       0       88
216         UD    0.174
            *

217         KK     OFF8
218         KM    OFFSITE SUBBASIN OFF8
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
219         BA   .02153
220         PB    3.43
221         LS       0       88
222         UD    0.113
            *

223         KK     OFF9
224         KM    OFFSITE SUBBASIN OFF9
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
225         BA   .00694
226         PB    3.43
227         LS       0       88
228         UD    0.077
            *
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1                                    HEC-1 INPUT

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

229         KK    OFF10
230         KM    OFFSITE SUBBASIN OFF10
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
231         BA   .01161
232         PB    3.43
233         LS       0       88
234         UD    0.088
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                *
235             KK  COFF10
236             KM   DUMMY
237             KM   COMBINE DIVS, OFF6, OFF7, OFF8, OFF9 AND OFF10
238             HC       6
                *
239             KK  OFF11A
240             KM   SUBBASIN OFF11A
                *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
                *  CONSISTS OF THE AREA FOR SUBBASINS OFF12 THROUGH OFF17
241             BA  .14308
242             PB    3.43
243             LS       0       88
244             UD   0.160
                *
245             KK    CRR2
246             KM   CONCENTRATION POINT CRR2
247             KM   COMBINE COFF10 AND OFF11-A
248             HC       2
                *
249             KK    ON11
250             KM   ONSITE SUBBASIN ON11
                *  REFERENCED FROM THE TECHNICAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24 UNIT 1
                *  IMPROVEMENTS INCLUDING PARCELS "A" AND "B" MASS GRADING
251             BA  .05391
252             PB    3.34
253             LS       0       88
254             UD   0.115
                *
255             KK    ON7R
256             KM   SUBBASIN ON7R
257             BA  .01145
258             PB    3.34
259             LS       0       88
260             UD   0.110
                *
                                    HEC-1 INPUT                                                    PAGE  8
1
LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

261             KK    ON8R
262             KM   SUBBASIN ON8R
263             BA  .04245
264             PB    3.34
265             LS       0       88
266             UD   0.113
                *
267             KK    CP1
268             KM   CONCENTRATION POINT CP1
269             KM   COMBINE ON7R AND ON8R AT STORM DRAIN STUB
270             HC       2
                *
271             KK     CD2
272             KM   SUBBASIN CD2
273             KM   PORTION OF CROSSBRIDGE DRIVE
                *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY UPDATE #2
274             BA  .00594
275             PB    3.37
276             LS       0       94
277             UD   0.113
                *
278             KK   ON10R
279             KM   SUBBASIN ON10R
280             KM   AREA BETWEEN EXISTING BERM AND CROSSBRIDGE DRIVE
281             BA  .00845
282             PB    3.34
283             LS       0       88
284             UD   0.100
                *
285             KK    CP2
286             KM   CONCENTRATION POINT CP2
287             KM   COMBINE CP1, CD2 AND ON10R IN STORM DRAIN IN CROSSBRIDGE
288             HC       3
                *
289             KK    CP2r
290             KM   ROUTE CP2 TO CP11
291             RD    1885    .056    .025            TRAP       0       50
                *
292             KK  OFF11B
293             KM   SUBBASIN OFF11B
294             BA  .08867
295             PB    3.34
296             LS       0       88
297             UD   0.158
                *
                                    HEC-1 INPUT                                                    PAGE  9
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LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

298           KK    CP11
299           KM   CONCENTRATION POINT CP11
300           KM   COMBINE CRR2, ON11, CP2 AND OFF11B
301           HC       4
              *
              * END RUNOFF TO EXISTING WASH SOUTH OF UNIT 2 IMPROVEMENTS
              *
              * BEGIN RUNOFF TO UNIT 1 IMPROVEMENTS
              *
302           KK     CD3
303           KM   SUBBASIN CD3
304           KM   PORTION OF CROSSBRIDGE DRIVE
              *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY UPDATE #2
305           BA  .00219
306           PB    3.36
307           LS       0       94
308           UD   0.050
              *
              *
              * END FILE
              *
309           ZZ
```
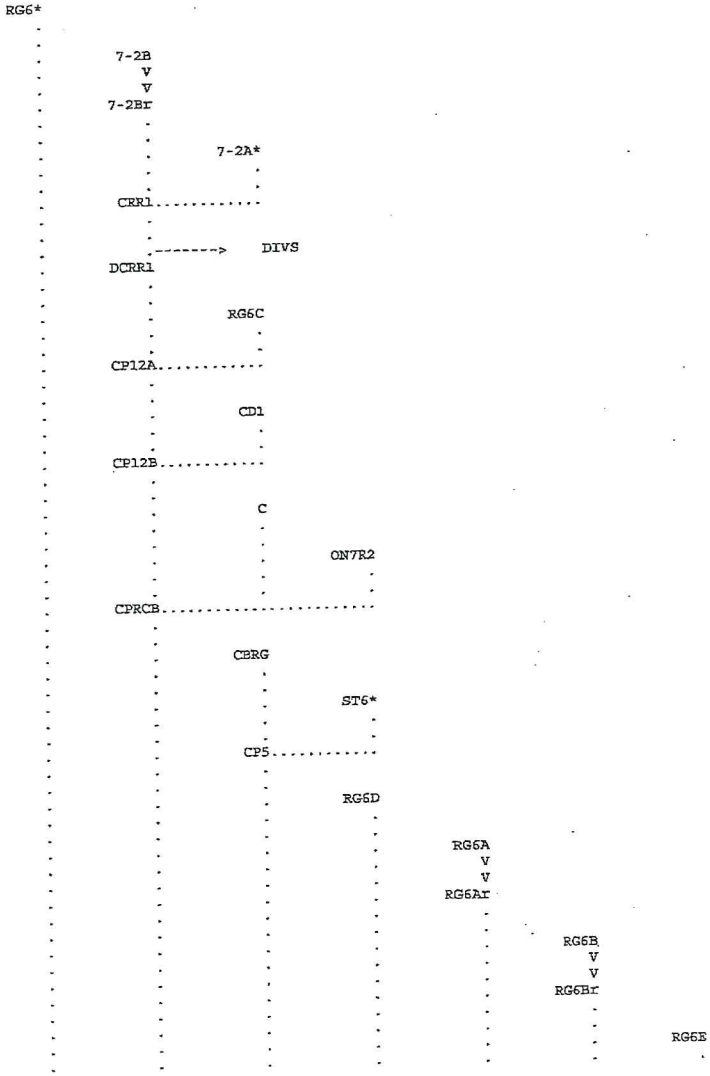
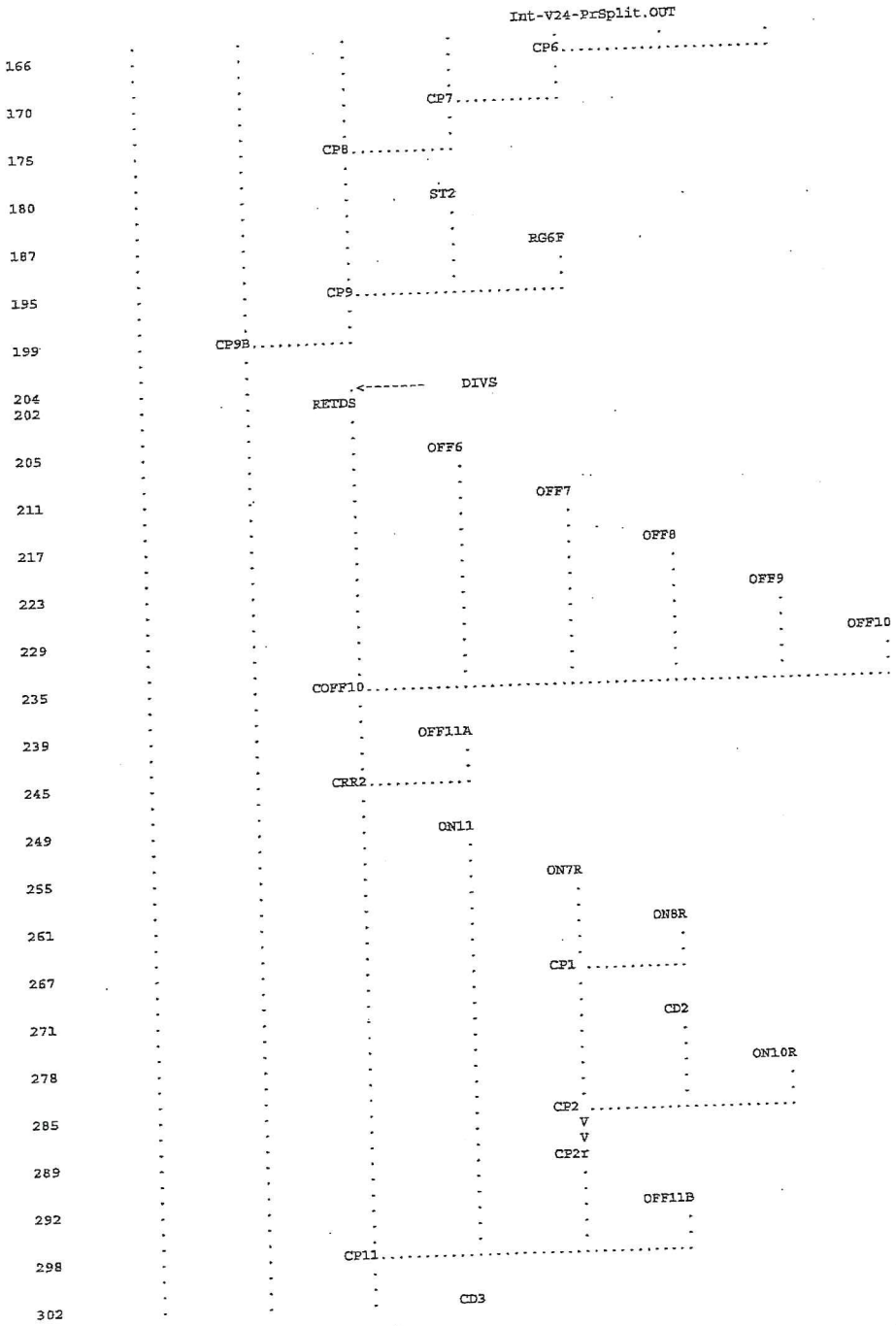

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING
(.) CONNECTOR
(---->) DIVERSION OR PUMP FLOW
(<----) RETURN OF DIVERTED OR PUMPED FLOW





(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   17MAR15  TIME  15:28:15   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*            (916) 756-1104             *
*                                       *
*****************************************
```

SUMMERLIN VILLAGE 24
UNIT 2 IMPROVEMENTS
PROPOSED/INTERIM CONDITIONS
PROPOSED FLOW SPLIT AT VILLAGE 24 BOUNDARY

RETURN PERIOD	100/10-YEAR
DISTRIBUTUION	6-HOUR SDN3
PROJECT NO	62024-221
FILENAME	INT-V24-PRSPLIT.H1
DATE	3/04/15

DEPTH AREA REDUCTION FACTOR
DARFS RERERENCED FROM THE CONCEPTUAL DRAINAGE STUDY

SQ MILES	DARF
0-.1	1.0
.1-.3	.988
.3-.5	.980
.5-.7	.976
.7-.9	.972
.9-2.0	.950
10-YEAR	.575

28 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	1	0	STARTING DATE
ITTIME		0000	STARTING TIME
NQ		300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	2	0	ENDING DATE
NDTIME		0055	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 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

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1.00 .99 .98 .98 .97 .95 .57

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION						
OPERATION	STATION	AREA	PLAN		RATIO 1 1.00	RATIO 2 .99	RATIO 3 .98	RATIO 4 .98	RATIO 5 .97	RATIO 6 .95	RATIO 7 .57
HYDROGRAPH AT +	RG6*	.06	1	FLOW	122.	120.	118.	118.	117.	114.	56.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT +	7-2B	.09	1	FLOW	182.	179.	177.	176.	175.	170.	82.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO +	7-2Br	.09	1	FLOW	174.	172.	170.	169.	168.	163.	82.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT +	7-2A*	.44	1	FLOW	653.	643.	636.	632.	629.	609.	287.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT +	CRR1	.54	1	FLOW	786.	773.	764.	760.	756.	732.	331.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.83
DIVERSION TO +	DIVS	.54	1	FLOW	268.	264.	261.	259.	258.	249.	113.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT +	DCRR1	.54	1	FLOW	518.	510.	504.	501.	498.	482.	218.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT +	RG6C	.05	1	FLOW	85.	84.	83.	82.	82.	79.	38.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58

2 COMBINED AT	CP12A	.59	1	FLOW	566.	556.	550.	547.	544.	527.	234.
+				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT	CD1	.01	1	FLOW	13.	13.	13.	13.	13.	13.	7.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT	CP12B	.59	1	FLOW	572.	562.	556.	553.	550.	532.	237.
+				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	C	.04	1	FLOW	61.	60.	59.	59.	58.	56.	25.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	ON7R2	.03	1	FLOW	60.	59.	58.	58.	58.	56.	26.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	CPRCB	.66	1	FLOW	656.	644.	637.	633.	629.	609.	269.
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.75
HYDROGRAPH AT	CBRG	.02	1	FLOW	34.	33.	33.	33.	33.	32.	17.
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT	ST6*	.00	1	FLOW	7.	7.	7.	7.	7.	7.	4.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT	CP5	.02	1	FLOW	38.	37.	37.	37.	36.	35.	19.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	RG6D	.01	1	FLOW	14.	14.	13.	13.	13.	13.	6.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	RG6A	.02	1	FLOW	28.	28.	28.	27.	27.	26.	13.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO	RG6Ar	.02	1	FLOW	27.	27.	26.	26.	26.	25.	12.
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.75
HYDROGRAPH AT	RG6B	.07	1	FLOW	116.	114.	113.	113.	112.	108.	51.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO	RG6Br	.07	1	FLOW	111.	109.	108.	108.	107.	104.	48.
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.75
HYDROGRAPH AT	RG6E	.07	1	FLOW	123.	121.	119.	119.	118.	114.	54.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT	CP6	.16	1	FLOW	239.	235.	232.	230.	229.	222.	102.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.67	3.67
2 COMBINED AT	CP7	.16	1	FLOW	252.	247.	245.	243.	242.	234.	106.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.67
2 COMBINED AT	CP8	.18	1	FLOW	289.	284.	281.	280.	278.	269.	125.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT	ST2	.02	1	FLOW	33.	32.	32.	32.	32.	31.	17.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	RG6F	.03	1	FLOW	48.	47.	46.	46.	46.	44.	21.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT	CP9	.23	1	FLOW	370.	364.	360.	358.	356.	344.	160.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	CP9B	.89	1	FLOW	1000.	983.	973.	967.	961.	931.	422.
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT	RETDS	.00	1	FLOW	268.	264.	261.	259.	258.	249.	113.
+				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT	OFF6	.01	1	FLOW	13.	13.	13.	13.	13.	12.	6.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	OFF7	.12	1	FLOW	206.	203.	201.	199.	198.	192.	91.
+											

				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	OFF8	.02	1	FLOW	40.	40.	39.	39.	39.	38.	18.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	OFF9	.01	1	FLOW	15.	15.	14.	14.	14.	14.	7.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	OFF10	.01	1	FLOW	24.	23.	23.	23.	23.	22.	11.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
6 COMBINED AT	COFF10	.16	1	FLOW	498.	489.	484.	481.	478.	463.	212.
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.58
HYDROGRAPH AT	OFF11A	.14	1	FLOW	256.	252.	249.	248.	246.	239.	113.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	CRR2	.31	1	FLOW	749.	736.	728.	724.	720.	697.	325.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	ON11	.05	1	FLOW	97.	96.	95.	94.	94.	91.	44.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	ON7R	.01	1	FLOW	21.	20.	20.	20.	20.	19.	9.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.58
HYDROGRAPH AT	ON8R	.04	1	FLOW	77.	75.	75.	74.	74.	72.	34.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	CP1	.05	1	FLOW	97.	96.	95.	94.	94.	91.	44.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	CD2	.01	1	FLOW	13.	13.	13.	12.	12.	12.	7.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	ON10R	.01	1	FLOW	16.	16.	16.	15.	15.	15.	7.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	CP2	.07	1	FLOW	126.	124.	122.	122.	121.	117.	57.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.58
ROUTED TO	CP2r	.07	1	FLOW	123.	121.	120.	119.	118.	114.	57.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT	OFF11B	.09	1	FLOW	153.	151.	149.	149.	148.	143.	68.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
4 COMBINED AT	CP11	.52	1	FLOW	1123.	1104.	1092.	1086.	1080.	1045.	492.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	CD3	.00	1	FLOW	6.	6.	6.	6.	6.	6.	3.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50

1 SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO=	.00								
7-2Br MANE	4.00	174.34	232.00	2.35	5.00	174.33	230.00	2.35	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1178E+02 EXCESS= .0000E+00 OUTFLOW= .1181E+02 BASIN STORAGE= .4691E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO=	.00							
7-2Br MANE	4.00	171.85	232.00	2.31	5.00	171.52	230.00	2.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1158E+02 EXCESS= .0000E+00 OUTFLOW= .1161E+02 BASIN STORAGE= .4663E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO=	.00							
7-2Br MANE	4.00	170.18	232.00	2.28	5.00	169.65	230.00	2.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1145E+02 EXCESS= .0000E+00 OUTFLOW= .1148E+02 BASIN STORAGE= .4643E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00
7-2Br MANE 4.00 169.35 232.00 2.27 5.00 168.71 230.00 2.27

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1139E+02 EXCESS= .0000E+00 OUTFLOW= .1141E+02 BASIN STORAGE= .4634E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00
7-2Br MANE 4.00 168.52 232.00 2.25 5.00 167.77 230.00 2.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1132E+02 EXCESS= .0000E+00 OUTFLOW= .1135E+02 BASIN STORAGE= .4624E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00
7-2Br MANE 4.00 163.92 232.00 2.18 5.00 162.58 230.00 2.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1096E+02 EXCESS= .0000E+00 OUTFLOW= .1099E+02 BASIN STORAGE= .4519E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00
7-2Br MANE 5.00 81.92 235.00 1.02 5.00 81.92 235.00 1.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5098E+01 EXCESS= .0000E+00 OUTFLOW= .5120E+01 BASIN STORAGE= .3825E-02 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.25 27.73 221.00 2.08 5.00 27.10 220.00 2.08

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1766E+01 EXCESS= .0000E+00 OUTFLOW= .1768E+01 BASIN STORAGE= .1546E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.25 27.28 221.00 2.04 5.00 26.65 220.00 2.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1736E+01 EXCESS= .0000E+00 OUTFLOW= .1738E+01 BASIN STORAGE= .1534E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.50 26.88 220.50 2.02 5.00 26.47 220.00 2.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1718E+01 EXCESS= .0000E+00 OUTFLOW= .1720E+01 BASIN STORAGE= .1509E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.50 26.73 220.50 2.01 5.00 26.32 220.00 2.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1708E+01 EXCESS= .0000E+00 OUTFLOW= .1710E+01 BASIN STORAGE= .1505E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.50 26.58 220.50 2.00 5.00 26.17 220.00 2.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1697E+01 EXCESS= .0000E+00 OUTFLOW= .1700E+01 BASIN STORAGE= .1501E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.25 25.85 221.00 1.93 5.00 25.22 220.00 1.93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1641E+01 EXCESS= .0000E+00 OUTFLOW= .1643E+01 BASIN STORAGE= .1497E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.25 12.14 225.25 .88 5.00 12.12 225.00 .88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7467E+00 EXCESS= .0000E+00 OUTFLOW= .7478E+00 BASIN STORAGE= .1509E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.50 112.81 220.50 2.08 5.00 111.33 220.00 2.08

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7667E+01 EXCESS= .0000E+00 OUTFLOW= .7672E+01 BASIN STORAGE= .1184E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.50 110.95 220.50 2.04 5.00 109.48 220.00 2.05

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7536E+01 EXCESS= .0000E+00 OUTFLOW= .7541E+01 BASIN STORAGE= .1174E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.50 109.72 220.50 2.02 5.00 108.25 220.00 2.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7448E+01 EXCESS= .0000E+00 OUTFLOW= .7453E+01 BASIN STORAGE= .1167E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.50 109.10 220.50 2.01 5.00 107.63 220.00 2.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7405E+01 EXCESS= .0000E+00 OUTFLOW= .7410E+01 BASIN STORAGE= .1164E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.50 108.48 220.50 2.00 5.00 107.01 220.00 2.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7361E+01 EXCESS= .0000E+00 OUTFLOW= .7366E+01 BASIN STORAGE= .1160E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.50 105.07 220.50 1.93 5.00 103.62 220.00 1.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7121E+01 EXCESS= .0000E+00 OUTFLOW= .7126E+01 BASIN STORAGE= .1142E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.75 49.71 223.25 .88 5.00 47.83 225.00 .88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3241E+01 EXCESS= .0000E+00 OUTFLOW= .3244E+01 BASIN STORAGE= .1381E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 4.00 125.91 216.00 2.17 5.00 122.95 215.00 2.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7905E+01 EXCESS= .0000E+00 OUTFLOW= .7910E+01 BASIN STORAGE= .8482E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 4.00 123.91 216.00 2.14 5.00 120.97 215.00 2.14

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7772E+01 EXCESS= .0000E+00 OUTFLOW= .7777E+01 BASIN STORAGE= .8409E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 4.00 122.58 216.00 2.11 5.00 119.65 215.00 2.11

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7683E+01 EXCESS= .0000E+00 OUTFLOW= .7688E+01 BASIN STORAGE= .8359E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 4.00 121.92 216.00 2.10 5.00 118.99 215.00 2.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7639E+01 EXCESS= .0000E+00 OUTFLOW= .7644E+01 BASIN STORAGE= .8335E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 4.00 121.25 216.00 2.09 5.00 118.33 215.00 2.09

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7595E+01 EXCESS= .0000E+00 OUTFLOW= .7600E+01 BASIN STORAGE= .8310E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 4.25 117.43 216.75 2.02 5.00 113.57 215.00 2.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7352E+01 EXCESS= .0000E+00 OUTFLOW= .7356E+01 BASIN STORAGE= .9335E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 5.00 57.17 220.00 .94 5.00 57.17 220.00 .94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3422E+01 EXCESS= .0000E+00 OUTFLOW= .3425E+01 BASIN STORAGE= .1241E-02 PERCENT ERROR= -.1

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

Storm Drain Hydraulics Calculations

G.C. Wallace, Inc. | Suncreek (Parcel K) 48-inch RCP Lateral | DATE 02/09/15 | FILE: SF6.xls

Storm Drain Manning's n (typ=0.013)= 0.013 | Inlet Structure Type or K_i= 0 | Headwall:Square Edge (cut concrete and CMP)

	CONDUIT DATA									FLOW DATA								ENERGY LOSS DATA																			EGL & HGL				COMMENTS	
																		PIPE	TRANSITION																						
	STATION			PIPE	BOX		IRREG		INVERT ELEV	L	S	A	Φ	Q	V	V2/2g	Sf	Ave.	Fric	Fric	Manhole			Junction			Contraction/ Inlet			Expansion/Outlet			Bend				Misc		CONDUIT		TRANSITION		FULL/	
	FROM (ft)	TO (ft)	T/R	D (in)	SPAN (ft)	RISE (ft)	AREA (ft^2)	HYD RAD (ft)	#	D/S (ft)	U/S (ft)	(ft)		(ft^2)		(cfs)	(ft/s)	(ft)	(S_f)	(S_f)	H_f (ft)	H_f (ft)	Θ (deg)	K_{mh}	H_{mh} (ft)	Θ (deg)	K_j	H_j (ft)	Inlet/ Cont	K_j	H_c (ft)	Θ (deg)	K_e	H_o (ft)	R_{bend} (ft)	Θ (deg)	K_b	H_b (ft)	H_m (ft)	Total (ft)	U/S EGL	U/S HGL	U/S EGL	U/S HGL	PART FLOW	CRTL
1		1000.00		48							3434.36																			Outlet K_o=	1.0												
2	1000.00	1016.50	R	48					1	3434.36	3434.69	16.5	2.00%	12.57	0.0049	84	6.64	0.69	0.0034	0.0034	0.06																	0.00	3442.57	3441.89			FULL	U/S
3	1016.50	1021.50	T	48					1	3434.69	3434.79	5.0	2.00%	12.57	0.0049	80	6.37	0.63	0.0031	0.0032		0.02	0	0.02	0.01	45	0.50	0.37											0.40			3442.97	3442.34	FULL	U/S
4	1021.50	1081.00	R	48					1	3434.79	3435.98	59.5	2.00%	12.57	0.0049	80	6.37	0.63	0.0031	0.0031	0.18																	0.00	3443.16	3442.53			FULL	U/S
5	1081.00									3435.98																																	

Summary of Results

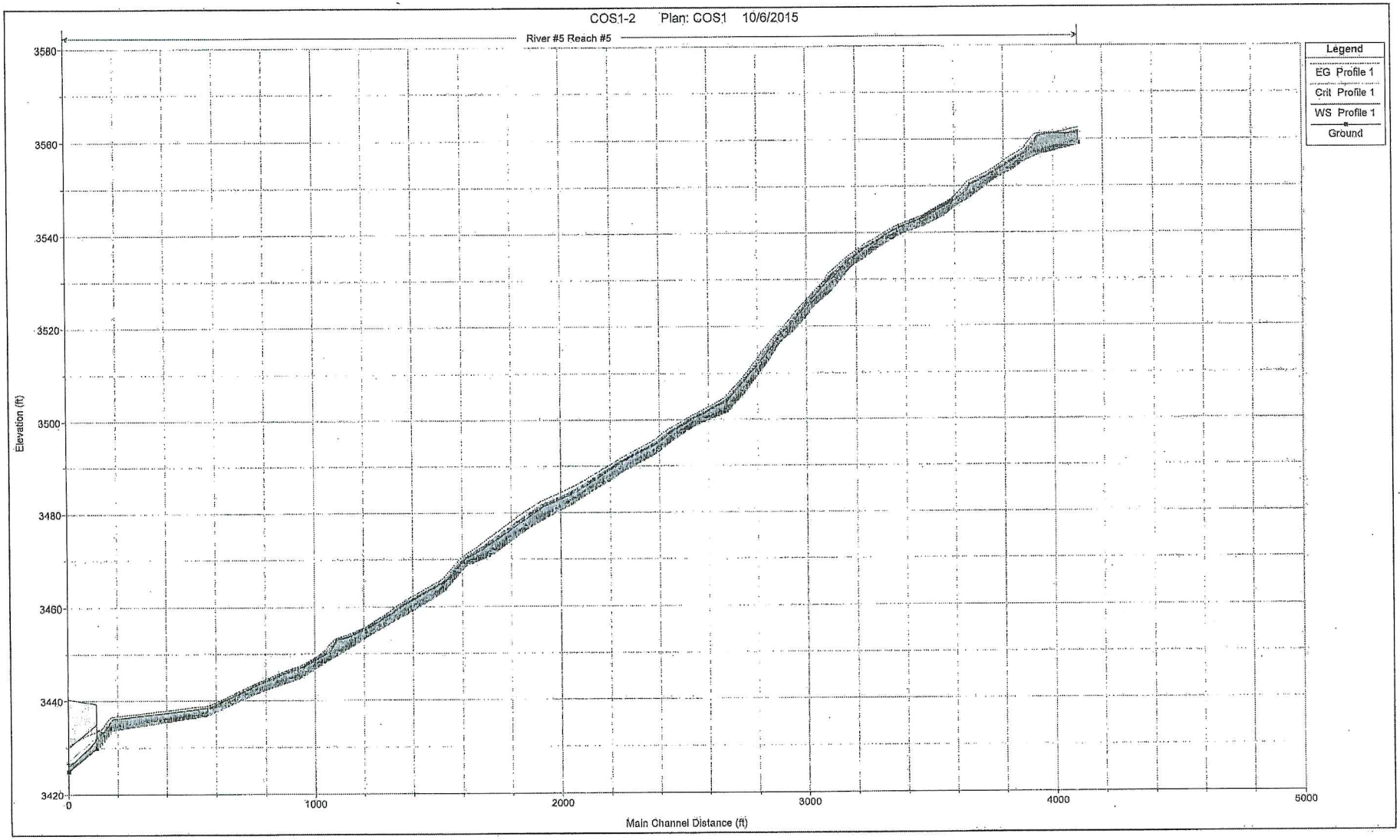
	STATION	INVERT	SOFFIT	EGL	HGL	(Optional) GRADE	(Optional) LOCATION	(Optional) DESCRIPTION	HGL with respect to FG	Pressure Gasket Required?
1	1000.00	3434.36	3438.36	3442.52	3441.83	3444.50			OK	NO
2	1016.50	3434.69	3438.69	3442.57	3441.89	3444.86			OK	NO
3	1021.50	3434.79	3438.79	3442.97	3442.34	3444.86			OK	NO
4	1081.00	3435.98	3439.98	3443.16	3442.53	3445.36			OK	NO

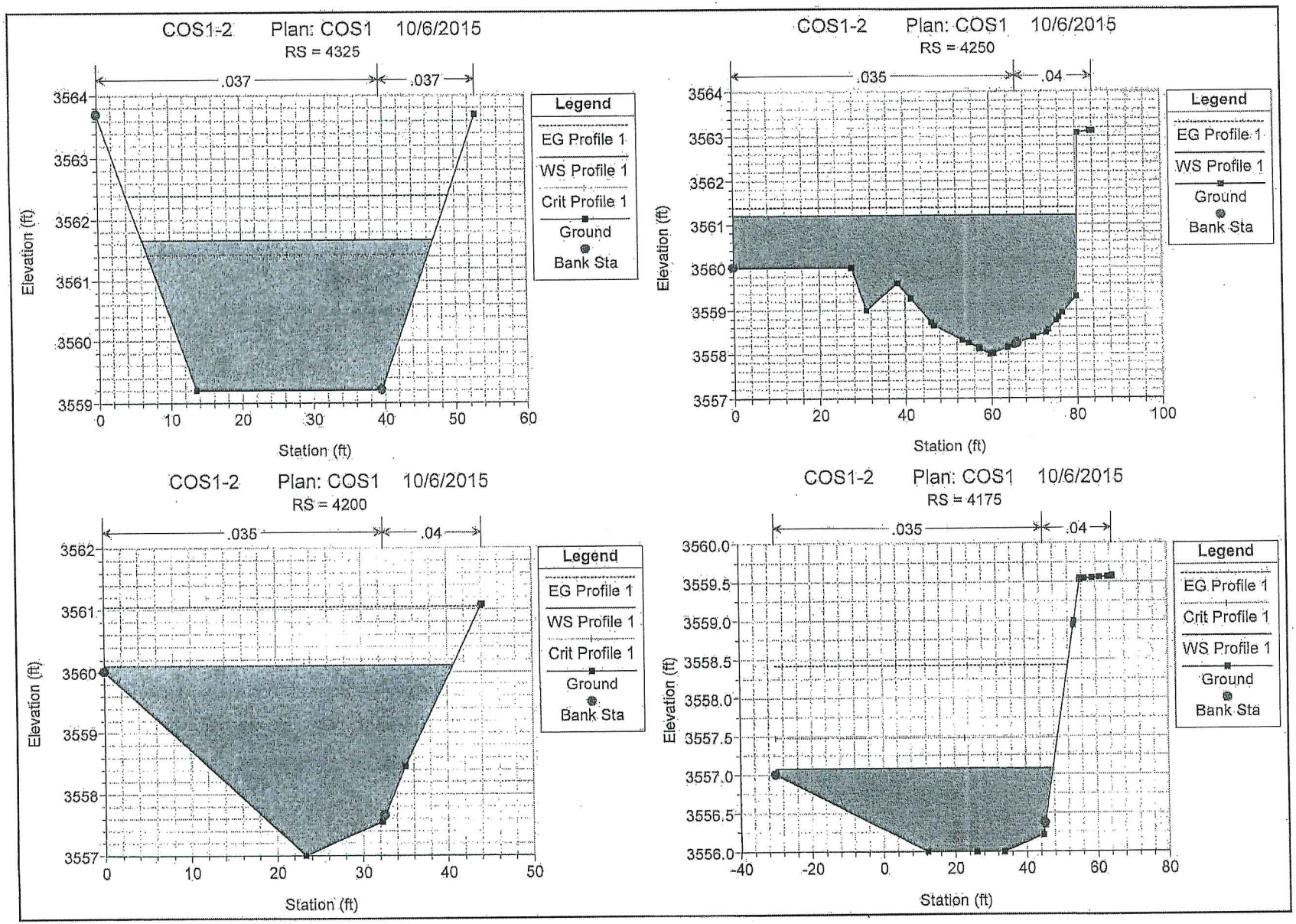
HEC-RAS Plan: COS1 River: River #5 Reach: Reach #5 Profile: Profile 1

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 #5	4325	Profile 1	554.00	3559.20	3561.67	3561.41	3562.39	0.010803	6.99	82.34	40.79	0.83
Reach #5	4250	Profile 1	554.00	3557.99	3561.21		3561.39	0.002730	3.39	163.69	80.29	0.43
Reach #5	4200	Profile 1	554.00	3557.00	3560.10	3560.10	3561.04	0.014727	7.98	73.12	40.72	1.01
Reach #5	4175	Profile 1	554.00	3556.00	3557.08	3557.48	3558.42	0.066507	9.31	59.93	77.68	1.85
Reach #5	4150	Profile 1	554.00	3554.00	3555.52	3555.74	3556.56	0.025882	8.24	68.41	53.10	1.25
Reach #5	4125	Profile 1	554.00	3552.00	3553.15	3553.33	3553.92	0.033486	7.07	79.11	92.37	1.34
Reach #5	4100	Profile 1	554.00	3548.00	3550.39	3550.46	3551.31	0.017363	7.73	72.70	45.38	1.05
Reach #5	4050	Profile 1	554.00	3546.00	3546.62	3547.06	3547.66	0.045670	7.36	75.26	102.92	1.52
Reach #5	4000	Profile 1	554.00	3544.00	3545.58	3545.70	3546.18	0.028578	6.23	89.58	111.53	1.22
Reach #5	3950	Profile 1	554.00	3541.86	3543.08	3543.19	3543.69	0.026954	6.32	88.48	103.68	1.20
Reach #5	3900	Profile 1	554.00	3539.95	3541.19	3541.24	3541.77	0.020546	6.14	90.59	90.61	1.07
Reach #5	3875	Profile 1	554.00	3537.00	3538.02	3538.27	3538.89	0.037485	7.50	74.55	86.88	1.42
Reach #5	3850	Profile 1	554.00	3535.00	3536.69	3536.85	3537.45	0.030546	7.09	79.10	85.29	1.29
Reach #5	3825	Profile 1	554.00	3533.00	3534.27	3534.48	3535.17	0.032313	7.62	73.07	74.03	1.34
Reach #5	3800	Profile 1	554.00	3529.00	3530.70	3531.31	3532.28	0.049439	10.10	54.88	49.29	1.69
Reach #5	3750	Profile 1	554.00	3527.00	3529.15	3529.45	3530.18	0.090505	8.15	67.95	132.70	2.01
Reach #5	3700	Profile 1	554.00	3525.00	3526.46	3526.75	3527.45	0.057452	7.97	69.48	99.80	1.58
Reach #5	3675	Profile 1	554.00	3522.00	3523.64	3524.02	3524.84	0.056616	8.76	63.24	77.89	1.71
Reach #5	3650	Profile 1	554.00	3519.00	3520.42	3520.83	3521.77	0.058551	9.31	59.49	68.82	1.77
Reach #5	3600	Profile 1	554.00	3517.00	3518.03	3518.28	3518.89	0.057851	7.47	74.21	118.49	1.66
Reach #5	3550	Profile 1	554.00	3513.00	3514.53	3515.14	3515.97	0.063701	9.62	57.57	67.12	1.83
Reach #5	3450	Profile 1	554.00	3510.00	3511.60	3512.13	3512.99	0.068511	9.46	58.60	74.21	1.87
Reach #5	3400	Profile 1	554.00	3506.00	3508.11	3506.40	3509.11	0.065090	8.04	68.95	107.10	1.76
Reach #5	3300	Profile 1	554.00	3502.00	3503.79	3504.25	3505.13	0.055613	9.29	59.63	66.13	1.72
Reach #5	3250	Profile 1	554.00	3499.00	3500.32	3500.44	3501.01	0.025105	6.74	83.44	84.31	1.18
Reach #5	3200	Profile 1	554.00	3496.00	3497.56	3497.75	3498.40	0.028328	7.41	75.91	73.19	1.27
Reach #5	3170	Profile 1	554.00	3493.00	3494.61	3494.94	3495.76	0.042775	8.62	64.45	66.99	1.54
Reach #5	3100	Profile 1	554.00	3489.00	3490.85	3491.04	3491.70	0.029294	7.43	75.55	74.13	1.28
Reach #5	3075	Profile 1	554.00	3487.00	3488.89	3489.16	3489.95	0.030824	8.27	67.51	59.05	1.34
Reach #5	3050	Profile 1	554.00	3485.00	3486.52	3486.86	3487.79	0.032474	9.09	61.87	49.25	1.40
Reach #5	3000	Profile 1	554.00	3482.00	3483.80	3484.19	3485.22	0.026575	9.73	59.23	37.78	1.32
Reach #5	2950	Profile 1	554.00	3479.00	3481.41	3481.72	3482.62	0.022922	9.09	64.04	40.26	1.22
Reach #5	2900	Profile 1	554.00	3477.00	3478.83	3479.33	3480.50	0.034673	10.51	54.43	37.90	1.49
Reach #5	2850	Profile 1	554.00	3474.00	3475.97	3476.46	3477.58	0.040710	10.31	55.12	43.87	1.58
Reach #5	2800	Profile 1	554.00	3471.00	3473.13	3473.56	3474.56	0.038158	9.70	58.64	48.72	1.52
Reach #5	2750	Profile 1	554.00	3469.00	3470.18	3470.38	3471.00	0.032806	7.23	76.58	83.72	1.33
Reach #5	2700	Profile 1	554.00	3466.00	3467.14	3467.51	3468.32	0.055858	8.74	63.38	77.76	1.71
Reach #5	2675	Profile 1	554.00	3463.85	3465.00	3465.37	3466.17	0.061808	8.77	64.07	86.39	1.78
Reach #5	2650	Profile 1	554.00	3461.00	3462.85	3463.00	3463.59	0.029079	6.97	80.44	86.19	1.26
Reach #5	2550	Profile 1	554.00	3457.75	3459.41	3459.56	3460.11	0.033238	6.78	82.38	100.47	1.32
Reach #5	2500	Profile 1	554.00	3454.00	3455.22	3455.33	3455.71	0.036236	5.65	98.15	158.34	1.30
Reach #5	2475	Profile 1	554.00	3452.00	3453.85	3453.90	3454.38	0.022384	5.83	95.02	108.17	1.09
Reach #5	2450	Profile 1	554.00	3450.00	3452.80	3452.80	3453.21	0.021164	5.13	108.50	143.91	1.04
Reach #5	2400	Profile 1	554.00	3448.00	3449.22	3449.40	3449.88	0.041141	6.53	84.80	127.86	1.41
Reach #5	2350	Profile 1	554.00	3445.00	3446.90	3446.86	3447.25	0.017090	4.77	116.39	146.82	0.94
Reach #5	2275	Profile 1	554.00	3442.00	3443.32	3443.35	3443.76	0.023792	5.34	104.28	142.72	1.10
Reach #5	2200	Profile 1	554.00	3437.00	3438.45		3438.75	0.003746	4.65	137.28	115.47	0.68
Reach #5	2055	Profile 1	554.00	3434.00	3435.83	3435.83	3436.47	0.030900	6.42	86.23	69.07	1.01
Reach #5	2054	Profile 1	554.00	3430.00	3433.67	3431.67	3433.84	0.000165	3.32	166.85	56.50	0.31
Reach #5	2053		Culvert									
Reach #5	2052	Profile 1	554.00	3425.00	3426.14	3426.71	3428.05	0.007912	11.09	49.98	79.15	1.83

Plan: COS1 River #5 Reach #5 RS: 2053 Culv Group: Crossbridge Profile: Profile 1

Q Culv Group (cfs)	554.00	Culv Full Len (ft)	
# Barrels	6	Culv Vel US (ft/s)	8.41
Q Barrel (cfs)	92.33	Culv Vel DS (ft/s)	16.26
E.G. US. (ft)	3433.84	Culv Inv El Up (ft)	3430.00
W.S. US. (ft)	3433.67	Culv Inv El Dn (ft)	3425.00
E.G. DS (ft)	3427.56	Culv Frctn Ls (ft)	3.05
W.S. DS (ft)	3426.71	Culv Exit Loss (ft)	2.69
Delta EG (ft)	6.29	Culv Entr Loss (ft)	0.55
Delta WS (ft)	6.95	Q Weir (cfs)	
E.G. IC (ft)	3433.49	Weir Sta Lft (ft)	
E.G. OC (ft)	3433.84	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	3432.20	Weir Max Depth (ft)	
Culv WS Outlet (ft)	3426.14	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	1.08	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.20	Min El Weir Flow (ft)	3441.01


COS1-2 Plan: COS1 10/6/2015
River #5 Reach #5
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Elevation (ft)
3580
3560
3540
3520
3500
3480
3460
3440
3420
0
1000
2000
3000
4000
5000
Main Channel Distance (ft)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RS = 4325
.037
.037
Legend
EG Profile 1
WS Profile 1
Crit Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 4250
.035
.04
Legend
EG Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 4200
.035
.04
Legend
EG Profile 1
WS Profile 1
Crit Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 4175
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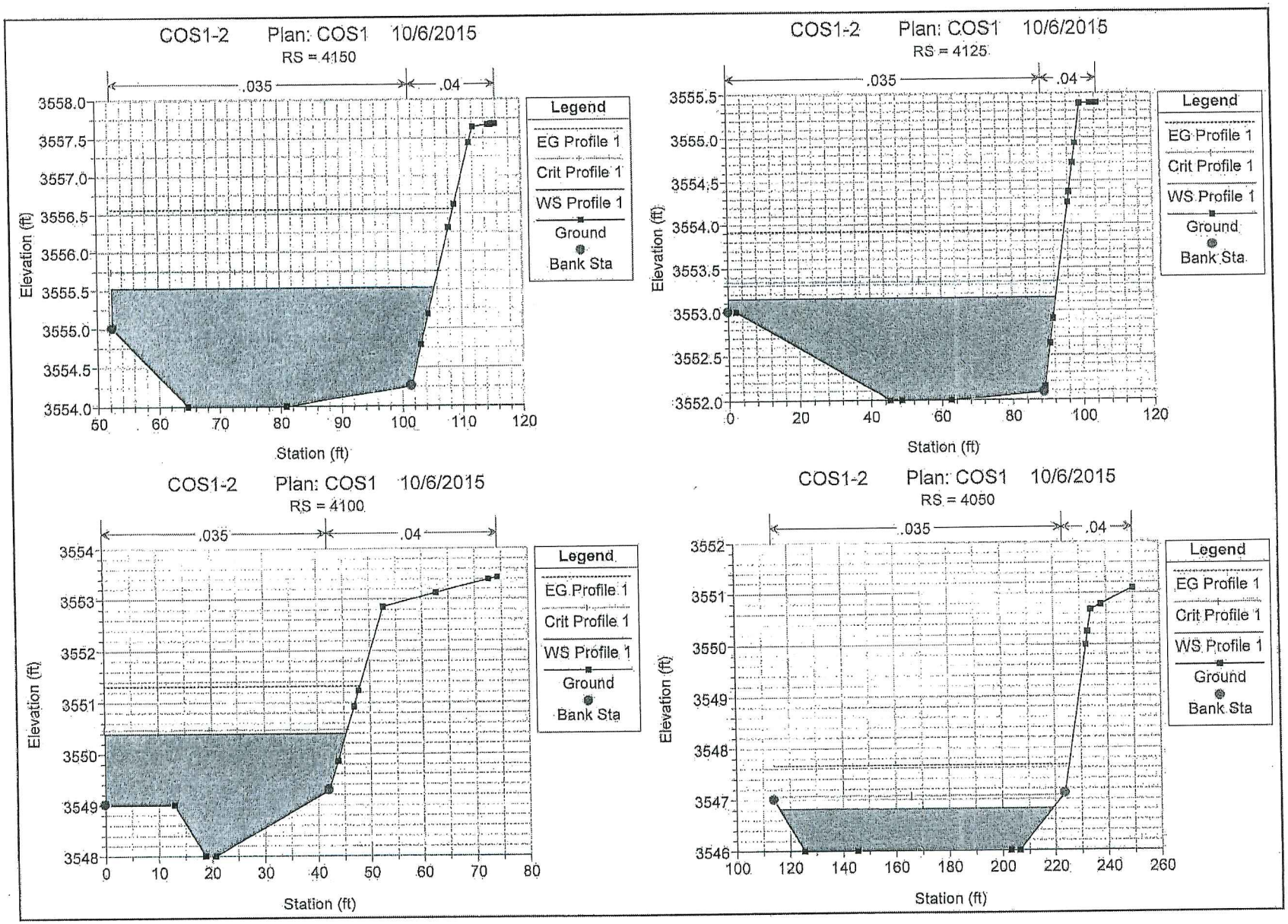
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 4125
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 4100
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 4050
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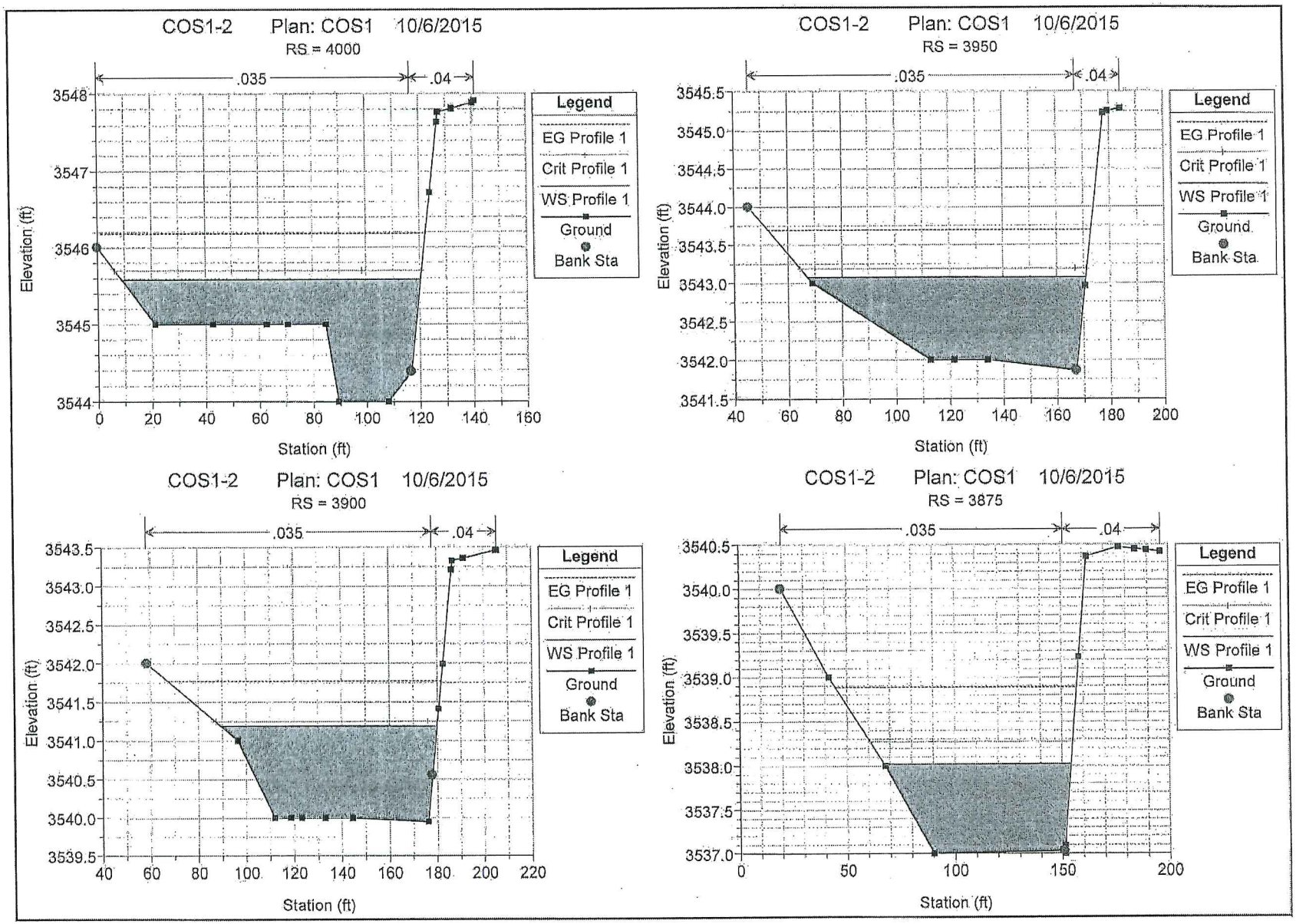
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta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.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 3950
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 3900
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
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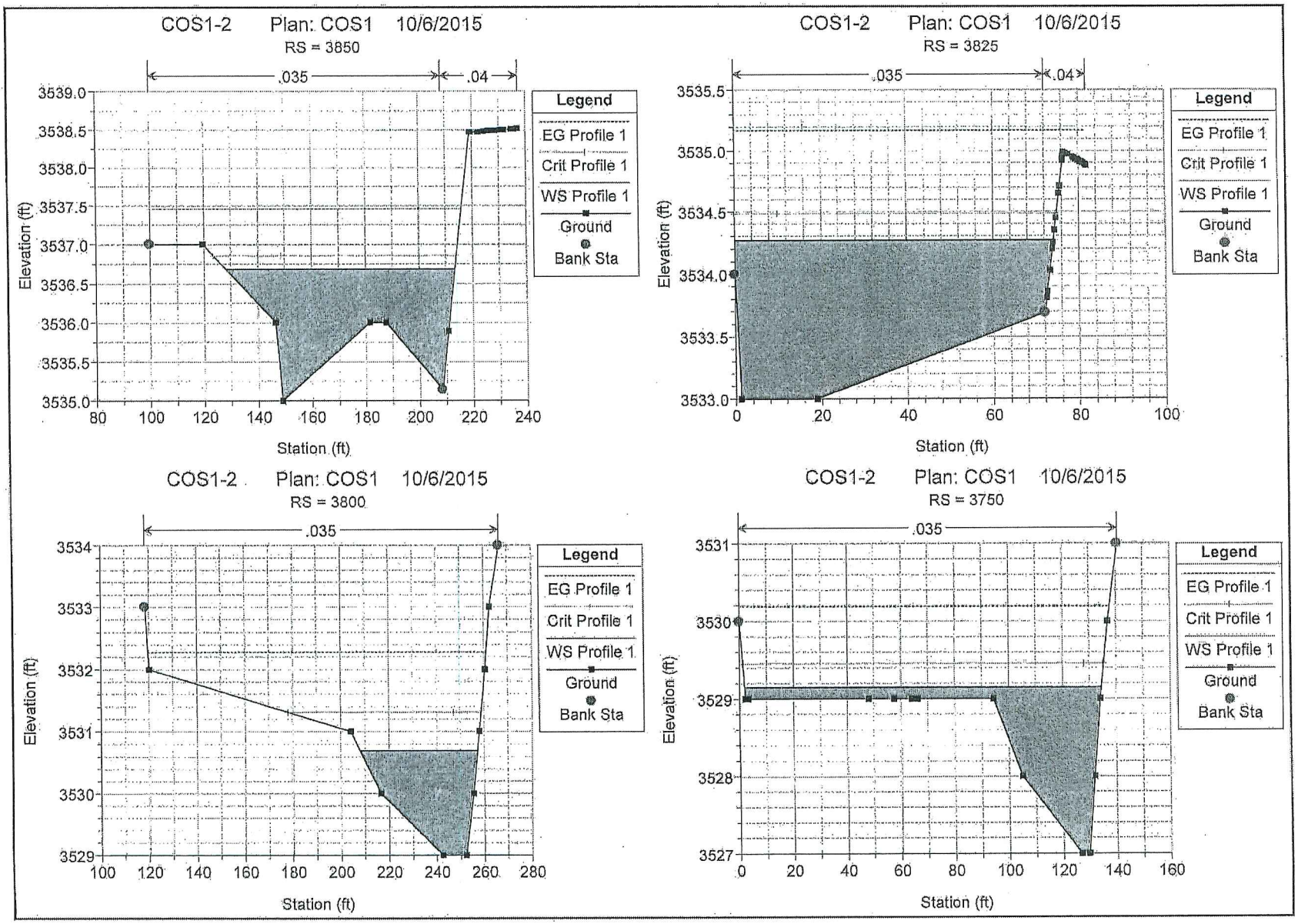
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta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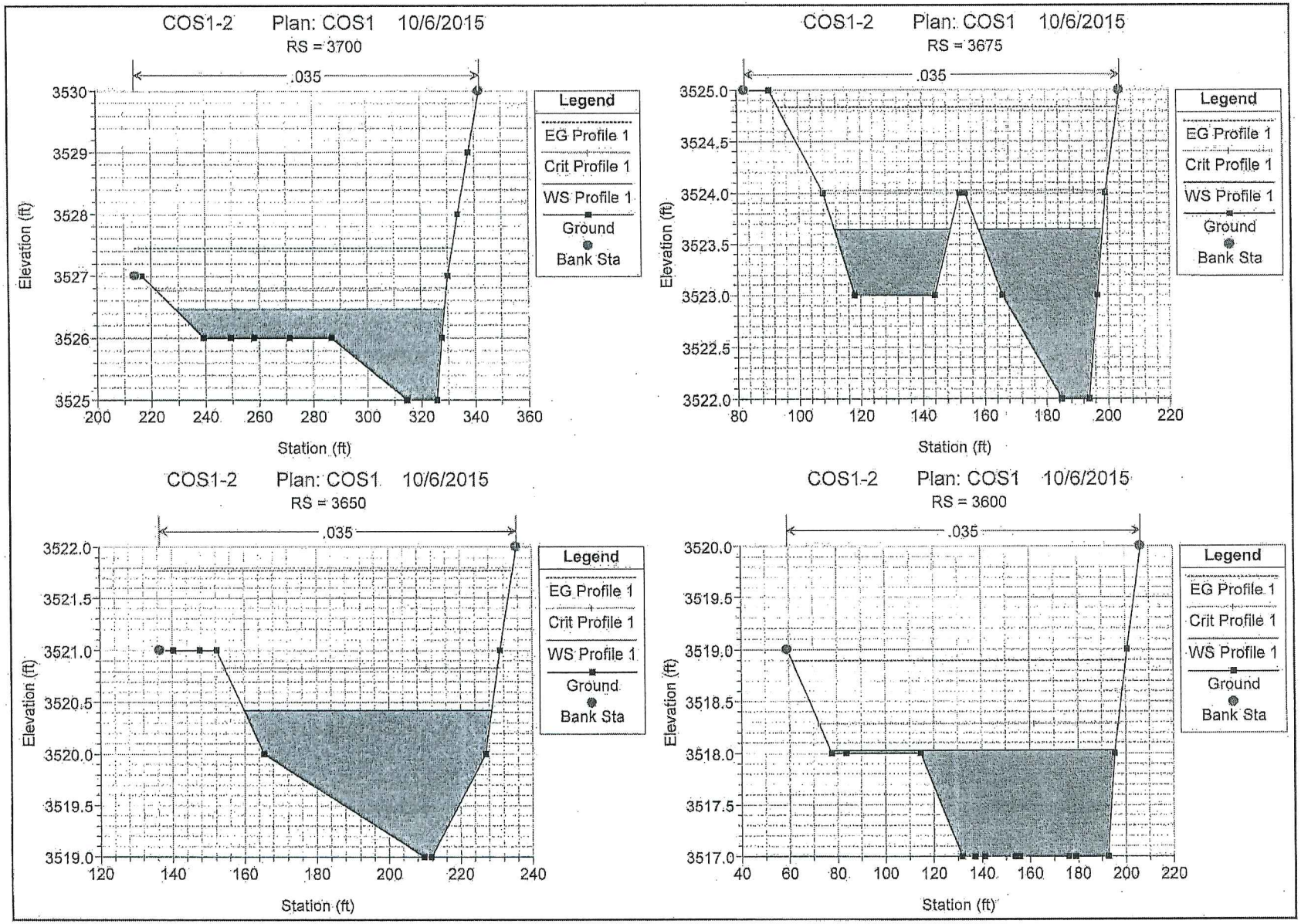
RS = 3850
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 3825
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 3800
.035
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 3750
.035
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta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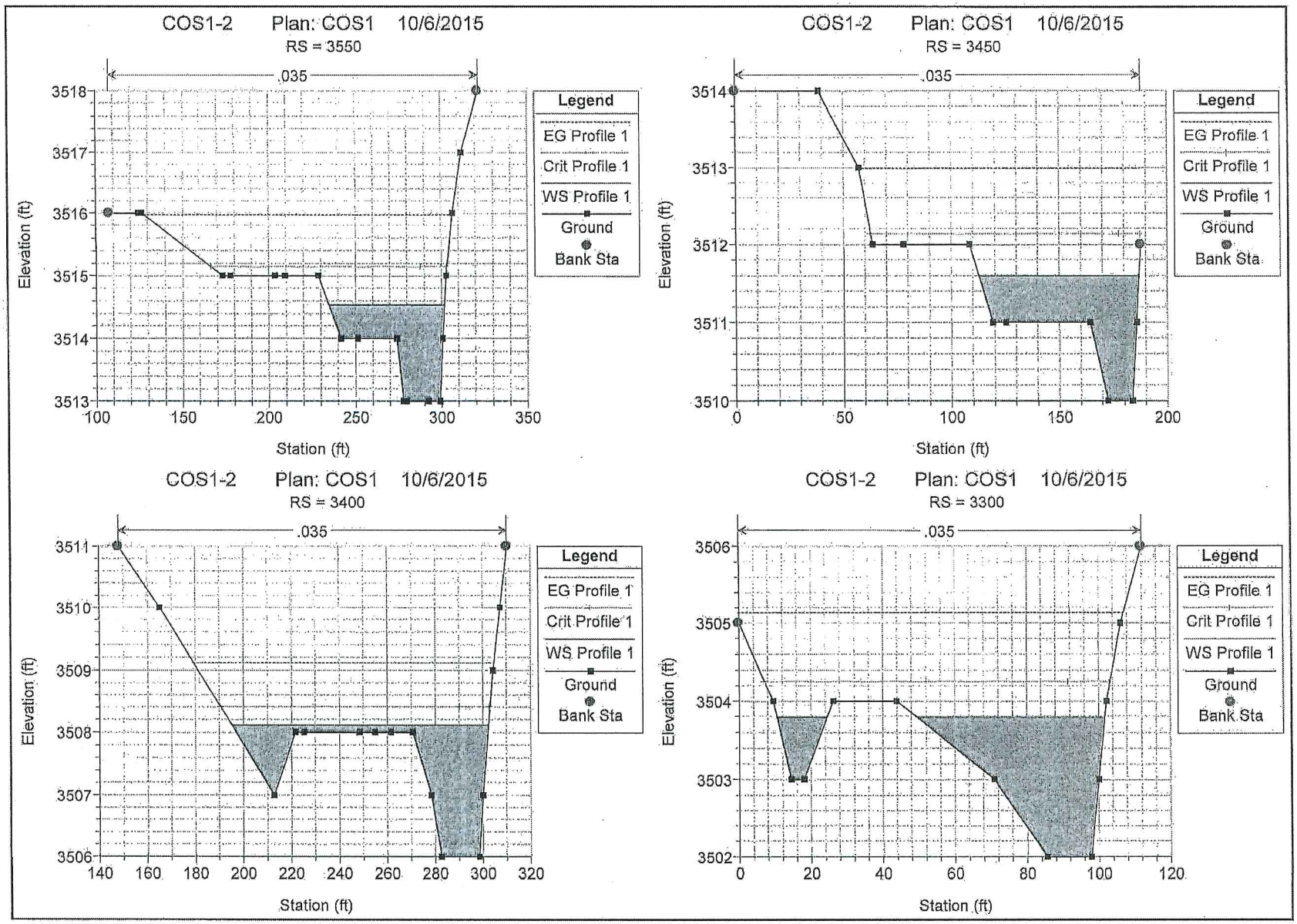
RS = 3700
.035
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 3675
.035
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 3650
.035
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 3600
.035
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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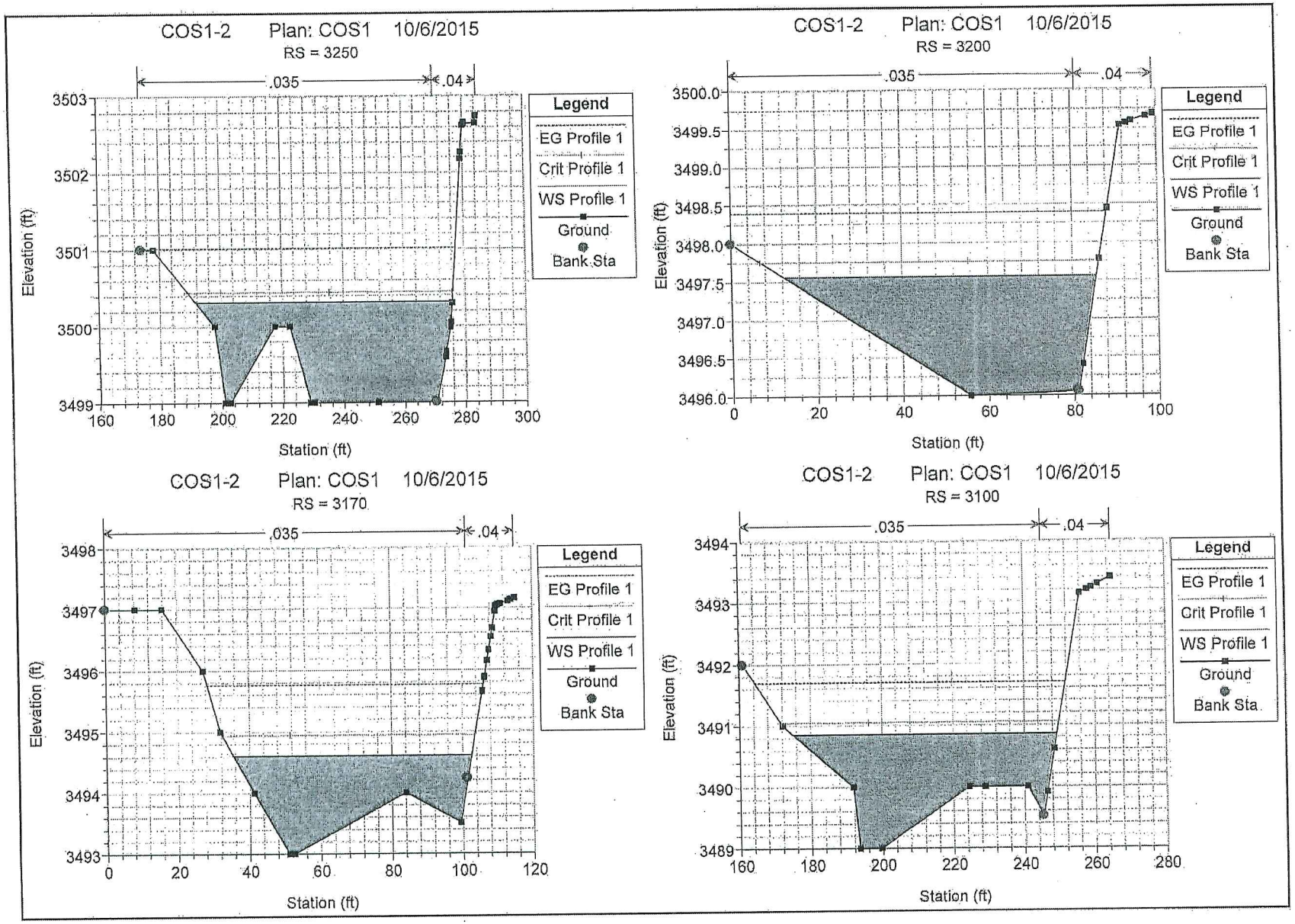
RS = 3550
.035
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 3450
.035
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 3400
.035
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 3300
.035
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta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RS = 3250
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 3200
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 3170
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 3100
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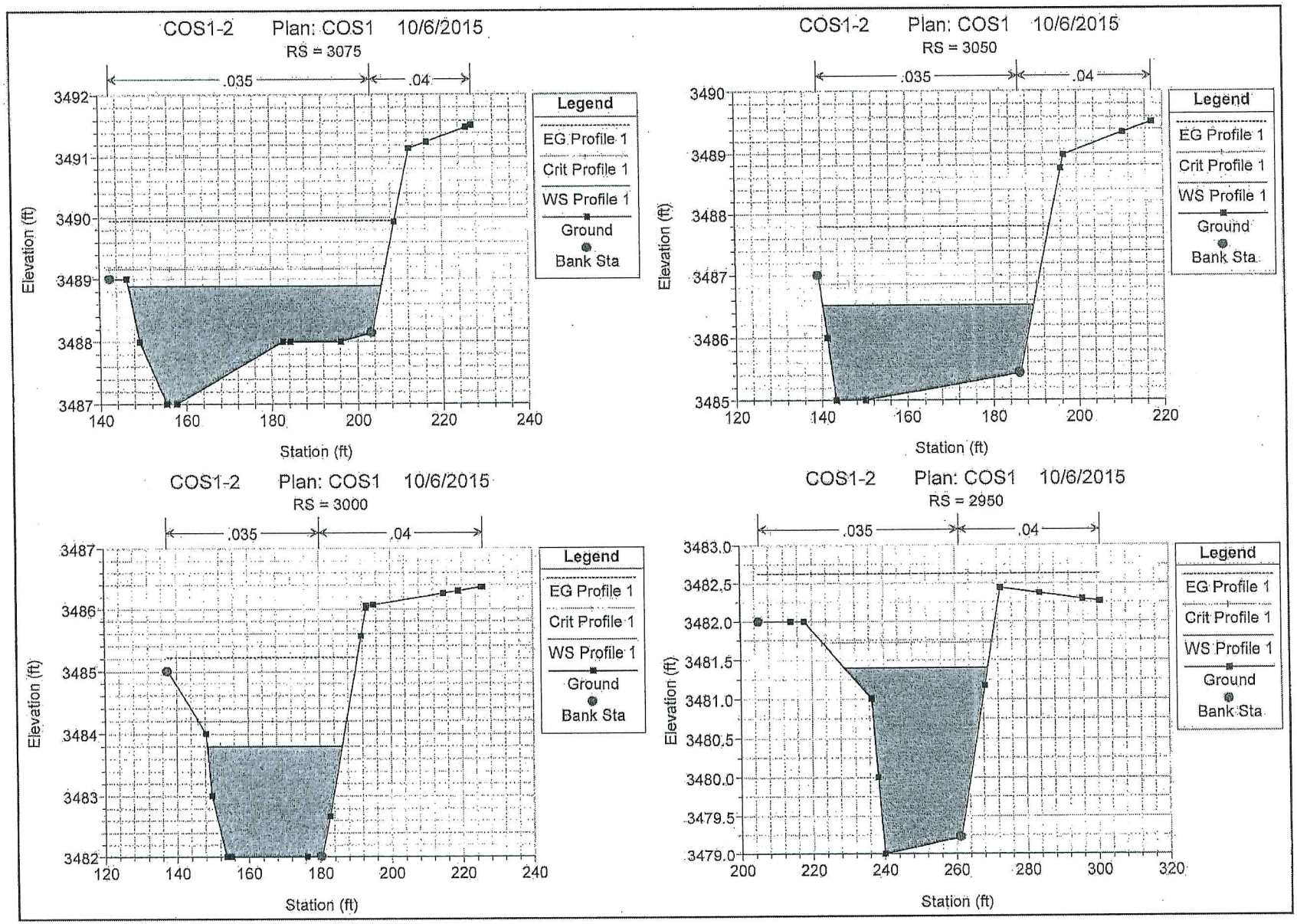
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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RS = 3075
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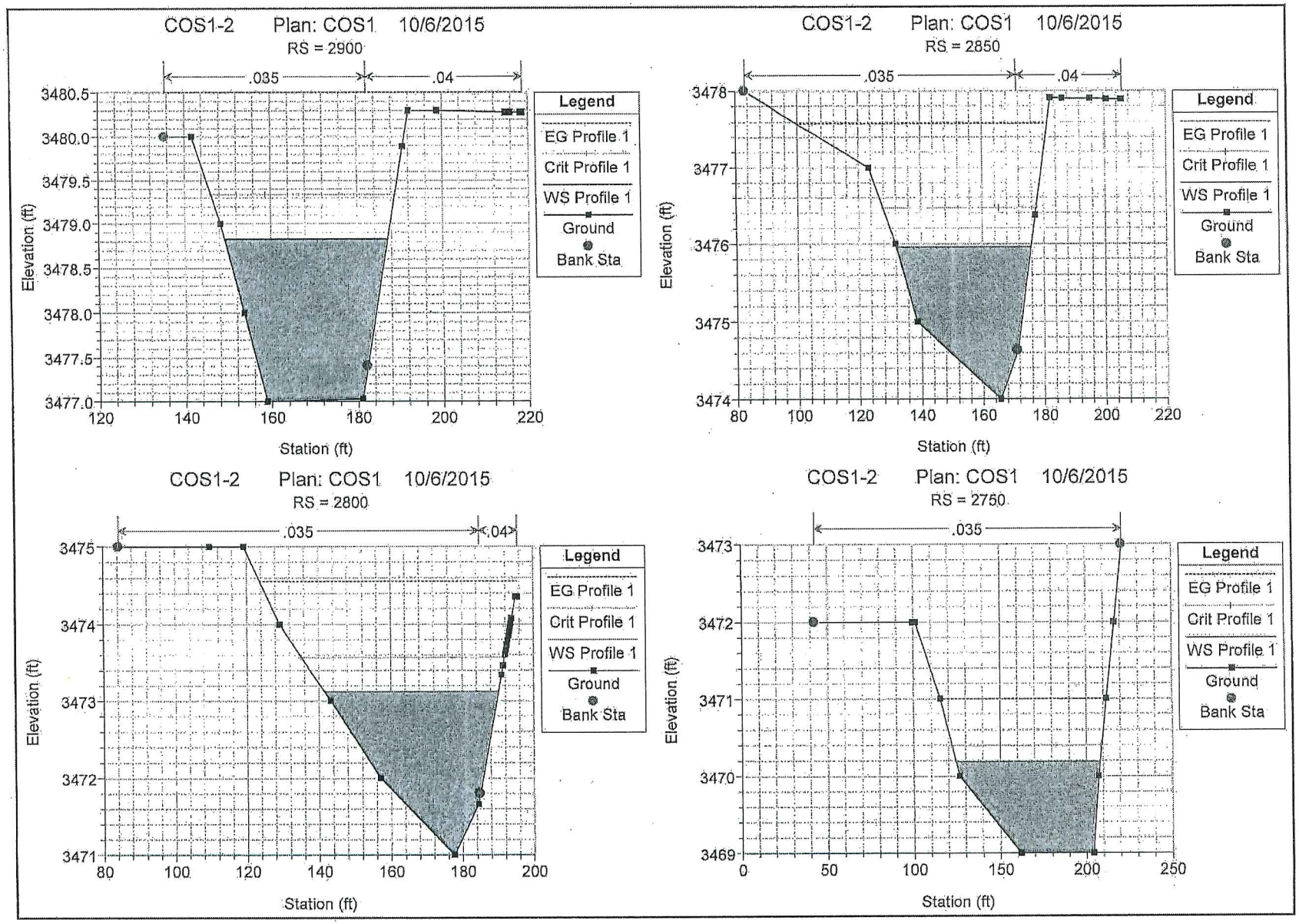
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 3050
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 3000
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 2950
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


COS1-2 Plan: COS1 10/6/2015
RS = 2900
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 2850
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Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 2800
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Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 2750
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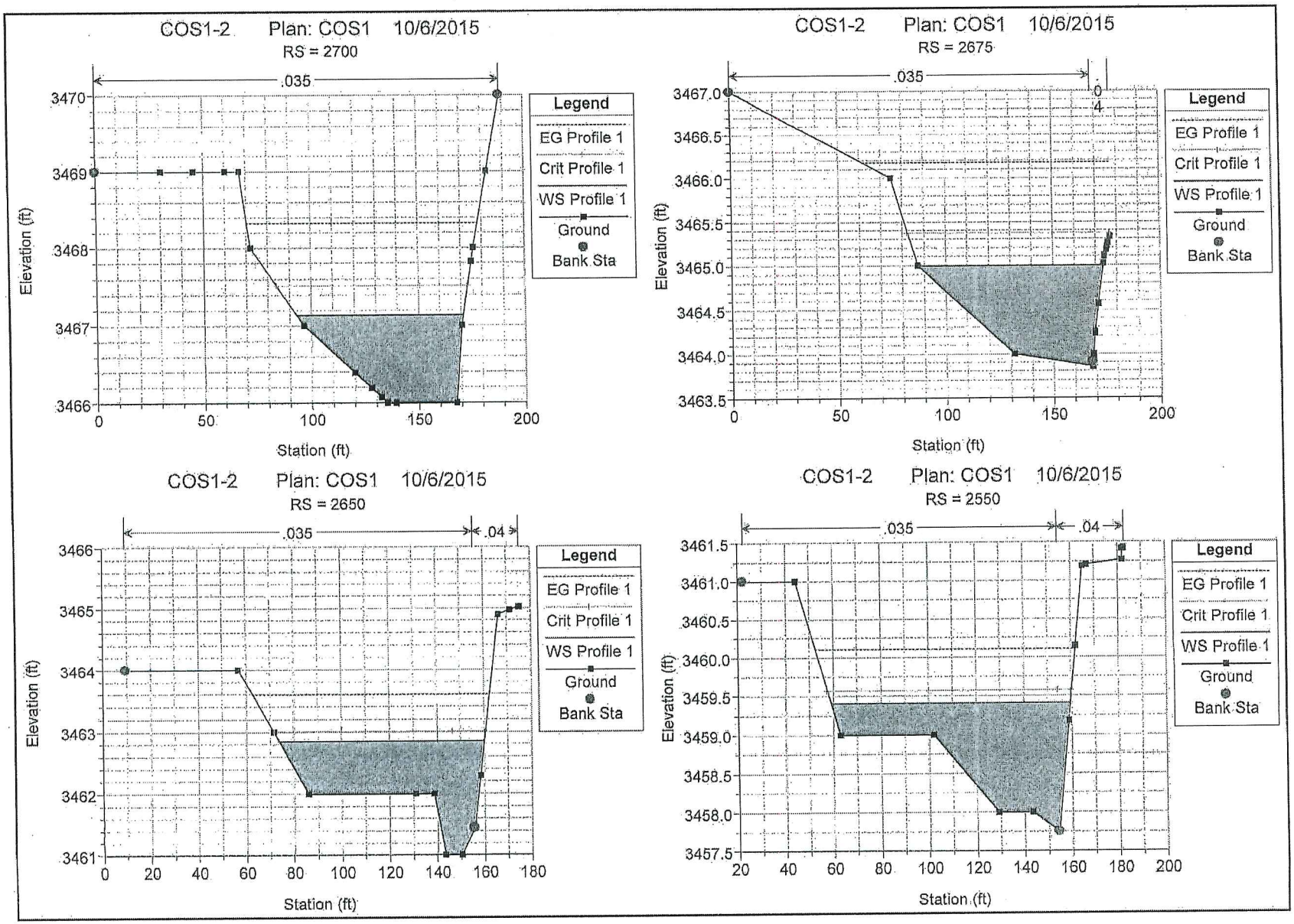
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta


COS1-2 Plan: COS1 10/6/2015
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Legend
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Crit Profile 1
WS Profile 1
Ground
Bank Sta
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Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 2675
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.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 2650
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
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EG Profile 1
Crit Profile 1
WS Profile 1
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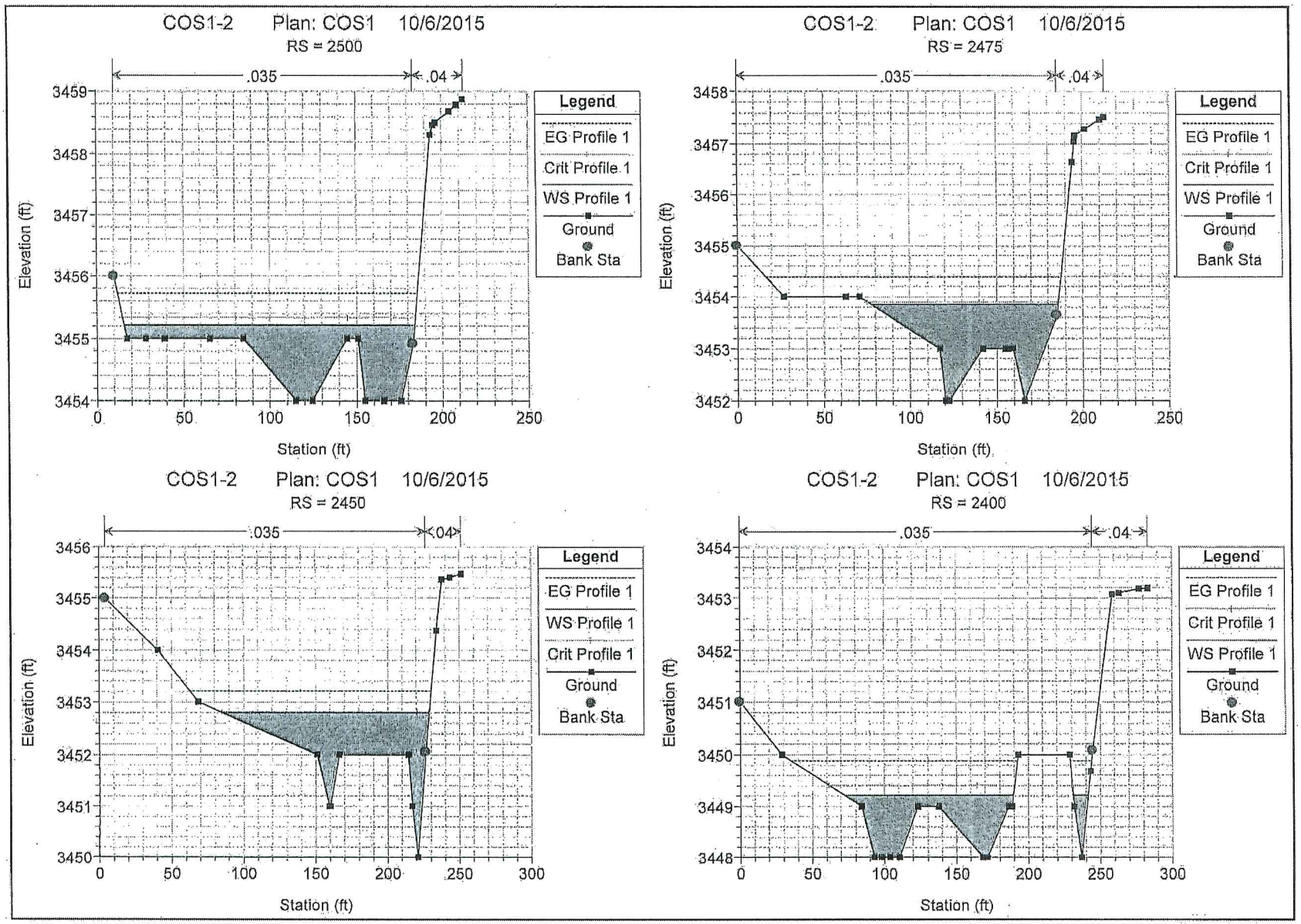
Bank Sta
Elevation (ft)
Station (ft)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Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 2475
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.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 2450
.035
.04
Legend
EG Profile 1
WS Profile 1
Crit Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
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.035
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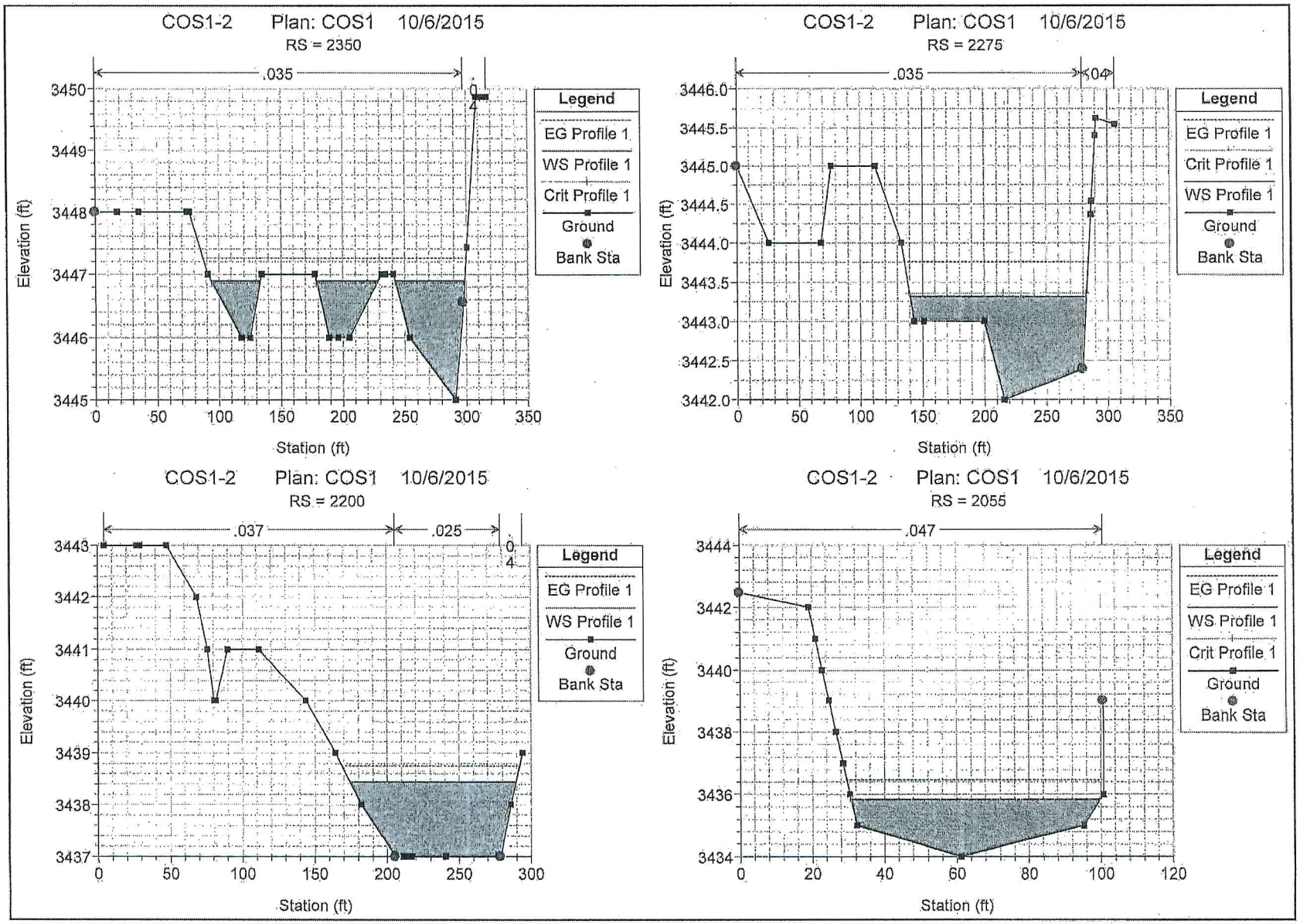
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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WS Profile 1
Crit Profile 1
Ground
Bank Sta
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Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 2275
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.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 2200
.037
.025
Legend
EG Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
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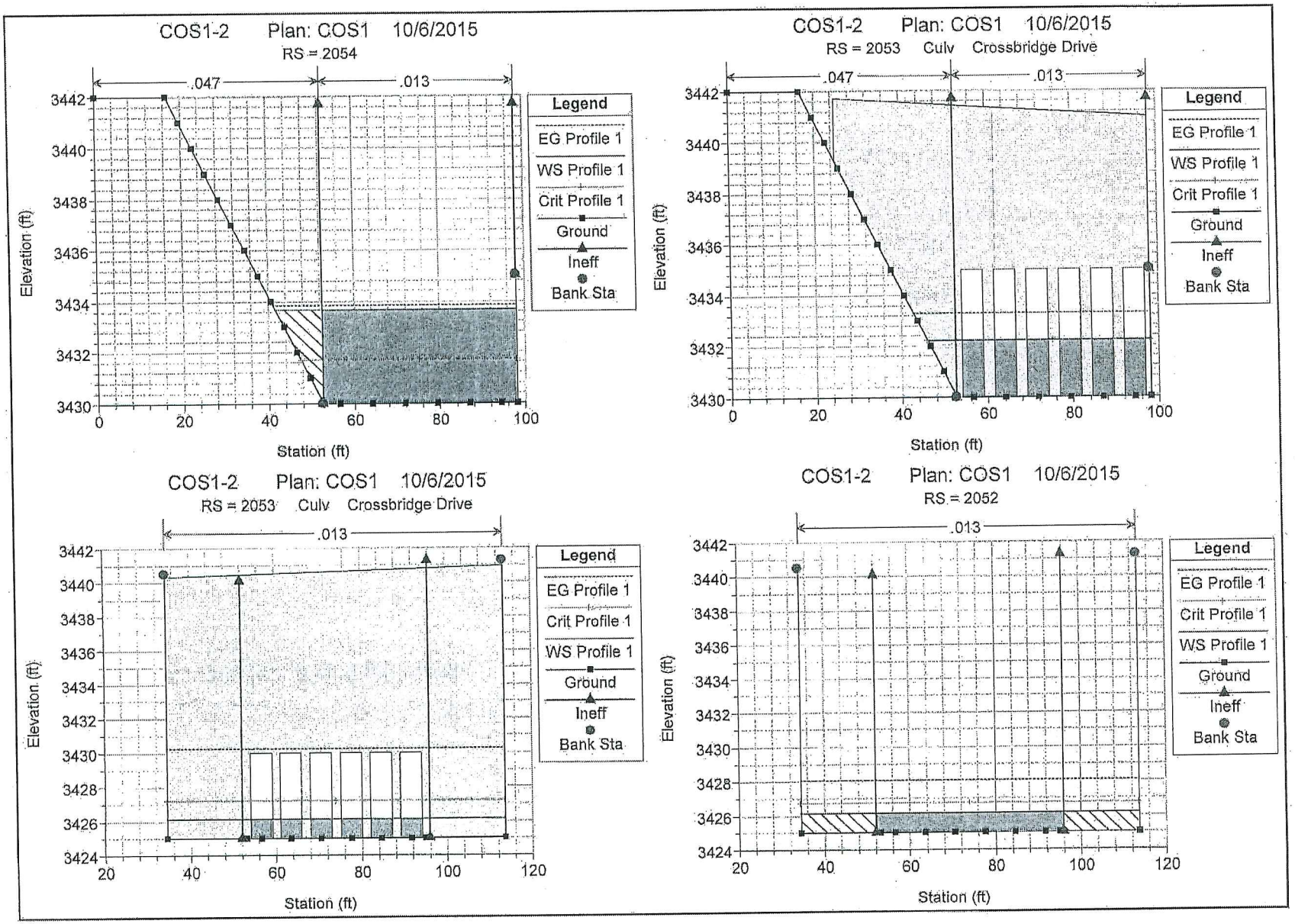
Legend
EG Profile 1
WS Profile 1
Crit Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


COS1-2 Plan: COS1 10/6/2015
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.013
Legend
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WS Profile 1
Crit Profile 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 2053 Culv Crossbridge Drive
.047
.013
Legend
EG Profile 1
WS Profile 1
Crit Profile 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 2053 Culv Crossbridge Drive
.013
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 2052
.013
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

BOX CULVERT

Crossbridge Drive Sta 41+00 (Inlet)

INPUT

Width of Box	5.00	ft
Height of Box	5.00	ft
Number of Barrels	6	
Length	100.00	ft
Slope	4.36	%
Manning's 'n'	0.015	
Flow "Q"	554	cfs
Entrance Coef.	0.35	
Tail Water	0	ft

INLET

45d WWall	3.40	ft
Sq. Edge	3.63	ft
Beveled	3.46	ft
Tapered	3.32	ft

OUTLET

Head Water	N/A	ft
Critical	5.00	ft
Velocity	3.69	ft/s

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS

Channel Protection Sizing Using Equation 718

Known:

d50=	Riprap size (in)	36
Sg=	Specific Gravity of Rock (typ=2.5)	2.5
s=	Longitudinal Channel Slope (ft/ft)	0.040

$$Vel=3*(d_{50}^{0.5})*(Sg-1)/(S^{0.17})$$

Solve For:

Max Allowable Velocity= 13.47 fps

USBR TYPE IV STILLING BASIN

Flow Characteristics				Chute Blocks			Sill	Basin			Total	
US Depth (d_1,ft)	US Froude # (F_1,ft)	DS Depth[1] (d_2,ft)	T.W.[2] (ft)	Height (ft)	Width (ft)	Spacing (ft)	Height (ft)	L_j/d_2[3] (ft/ft)	Length (ft)	Width (ft)	Cells (#)	Width (ft)
1.1	2.9	3.9	4.3	2.2	1.1	2.7	1.4	5.2	20	9	6	54

[1] From equation $d_2/d_1=0.5*((1+8F^2)^{0.5}-1)$

[2] Tailwater Depth, from equation $T.W./d_2=1.1$

[3] Basin length to downstream depth ratio, from Figure 9-39

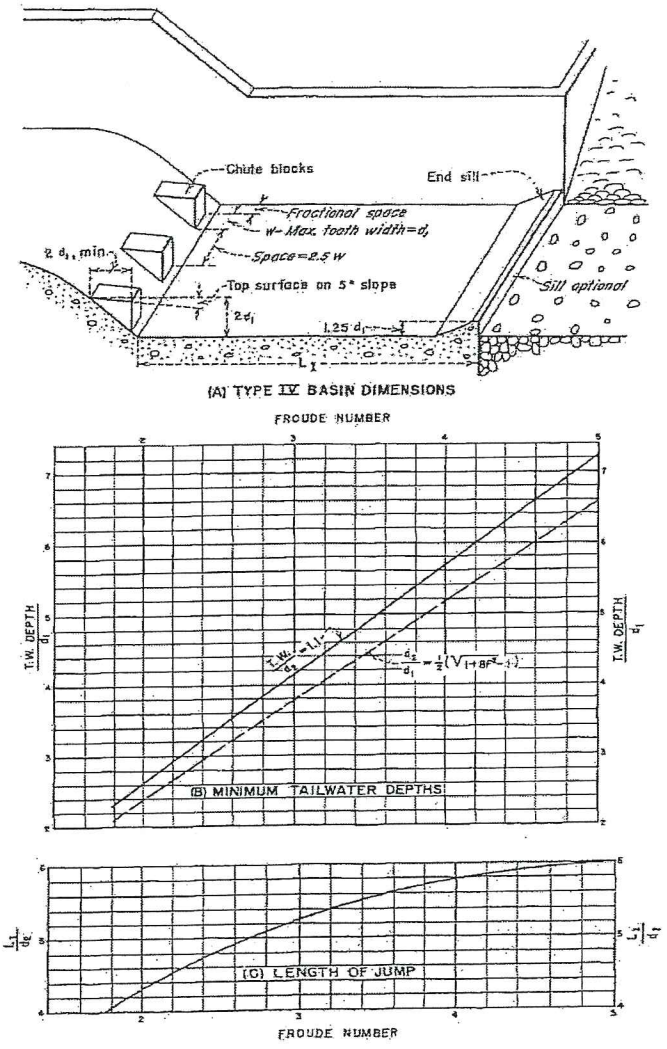


Figure 9-39.—Stilling basin characteristics for Froude numbers between 2.5 and 4.5. 288-D-2425.

Design information taken from Design of Small Dams by the US Bureau of Reclamation, pg. 390.

Worksheet for (6) - 5x5 Crossbridge Drive Sta 41+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.015	
Channel Slope	4.36000	%
Height	5.00	ft
Bottom Width	5.00	ft
Discharge	93.00	ft^3/s

Results

Normal Depth	1.08	ft
Flow Area	5.42	ft^2
Wetted Perimeter	7.17	ft
Hydraulic Radius	0.76	ft
Top Width	5.00	ft
Critical Depth	2.21	ft
Percent Full	21.7	%
Critical Slope	0.00585	ft/ft
Velocity	17.16	ft/s
Velocity Head	4.58	ft
Specific Energy	5.66	ft
Froude Number	2.91	
Discharge Full	600.06	ft^3/s
Slope Full	1.81511	ft/ft
Flow Type	Supercritical	

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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	21.67	%
Downstream Velocity	Infinity	ft/s

Worksheet for (6) - 5x5 Crossbridge Drive Sta 41+00

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.08	ft
Critical Depth	2.21	ft
Channel Slope	4.36000	%
Critical Slope	0.00585	ft/ft

Cross Section for (6) - 5x5 Crossbridge Drive Sta 41+00

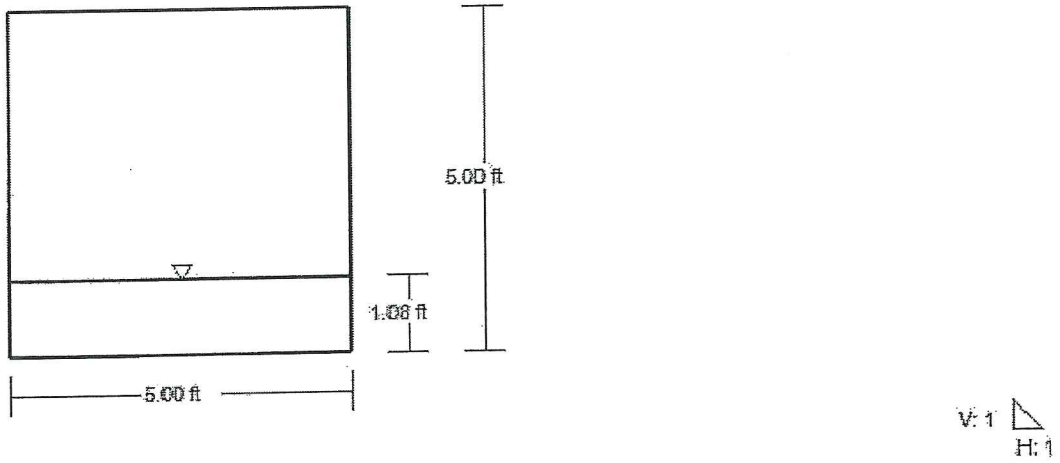
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.015	
Channel Slope	4.36000	%
Normal Depth	1.08	ft
Height	5.00	ft
Bottom Width	5.00	ft
Discharge	93.00	ft³/s

Cross Section Image



provide sufficient maintenance access to the culvert cells. A concrete pad has been provided in lieu of riprap at the upstream and downstream end of the cells to provide a buffer to turn. Additionally, the access ramp on the west side of Crossbridge Drive has been shifted to avoid the drop inlet at approximate Station 42+00.

Comment: "3. **Sheet 40:**

"The proposed 12"-high tumbling blocks within the 6# 5'x4' RCBs appear to pose difficulty for maintenance crew when they need repair in the future. This may merit taller and wider boxes. Also, the 30"-d_{50} riprap at the downstream ends of the culverts appear not drivable for the maintenance vehicles. These concerns must be discussed and resolved with the *City Street & Sanitation Department* prior to the final approval of the drainage study."

Response: Based on discussions with CLV Flood and Streets and Sanitation Department, it was determined that a stilling basin for energy dissipation should be located at the downstream end of the culverts outside of the RCBs for ease of maintenance. Additionally, the culverts have been revised to six (6) - 5-foot wide by 5- foot high RCBs to address maintenance access concerns. In order to provide the additional 1-foot of height, the profile of the RCBs was revised. Revised hydraulic calculations have been included in Appendix B. Section 1002.3 of the Manual specifies that an energy dissipater be provided for outlet velocities greater than 15 fps. Based on a maximum discharge of 93 cfs (554 cfs / 6 RCB cells = 93 cfs / RCB cell) from one 5-foot wide by 5-foot high RCB cell at the outlet, the exit velocity is approximately 17.2 fps under a supercritical flow regime. Therefore, a USBR Type IV Stilling Basin has been provided at the culvert crossing outlet for energy dissipation. Calculations used to determine the dimensions for the USBR Type IV Stilling Basin have been included in Appendix B. The dimensions have been labeled on the improvement plans. Structural calculations for the stilling basin will be submitted hereafter. We request that the structural calculations for the USBR Type IV Stilling Basin be a condition of approval. Copies of the normal depth calculations have been included in Appendix B.

Culverts @ Crossbridge w/Stilling Basin

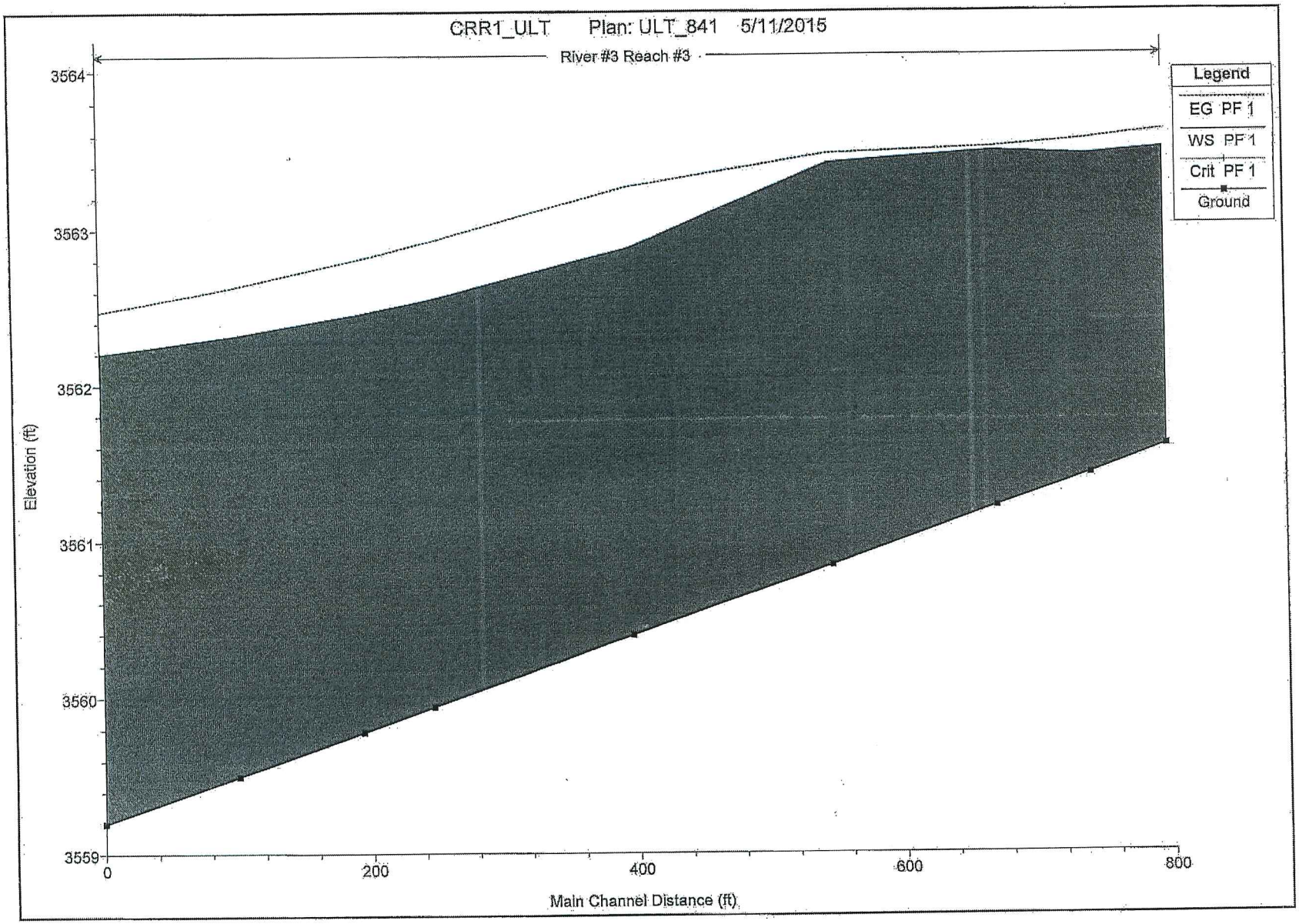
Due to the revised culvert crossing and stilling basin, the hydraulic models and calculations have been updated to account for the revised culvert slopes. The hydraulic model for COS-1 and COS-2 was previously submitted as one model and has been re-analyzed as two separate models (COS1 and COS2) with this report. The COS1 HEC-RAS Model runs from the western boundary channel and ends at the outlet of the proposed culvert upstream of the stilling basin. The COS2 HEC-RAS Model begins at the downstream end of the stilling basin and ends at the existing downstream facilities located at the intersection of Sky Vista and Crossbridge Drive. Copies of the revised models have been included Appendix B. Digital copies of the models and reports have been included on CD in Appendix B.

A 9-foot wide concrete pad has been provided at the upstream and downstream ends of the culvert to provide drivable access from the access ramps to the culverts. The width and location of the drivable access ramps and concrete pads have been coordinated with the CLV Streets and Sanitation department.

HEC-RAS Plan: ULT_841 River: River #3 Reach: Reach #3 Profile: PF 1

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 #3	1100	PF 1	344.00	3561.59	3563.50		3563.62	0.001015	2.74	125.50	71.45	0.36
Reach #3	1050	PF 1	344.00	3561.41	3563.46		3563.56	0.000808	2.55	135.06	72.28	0.33
Reach #3	975	PF 1	344.00	3561.21	3563.48		3563.51	0.000228	1.30	265.76	155.50	0.17
Reach #3	850	PF 1	344.00	3560.84	3563.41		3563.47	0.000368	1.98	174.08	75.41	0.23
Reach #3	700	PF 1	841.00	3560.39	3562.87		3563.27	0.002472	5.02	167.55	74.89	0.59
Reach #3	550	PF 1	841.00	3559.94	3562.55		3562.92	0.002099	4.94	176.88	75.65	0.56
Reach #3	495	PF 1	841.00	3559.78	3562.45		3562.81	0.001930	4.81	181.59	75.89	0.53
Reach #3	400	PF 1	841.00	3559.50	3562.32		3562.63	0.001613	4.54	192.77	76.92	0.49
Reach #3	310	PF 1	841.00	3559.20	3562.20	3560.98	3562.47	0.001298	4.24	207.02	78.00	0.45

Referenced Starting WSE


CRR1_ULT Plan: ULT_841 5/11/2015
River #3 Reach #3
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
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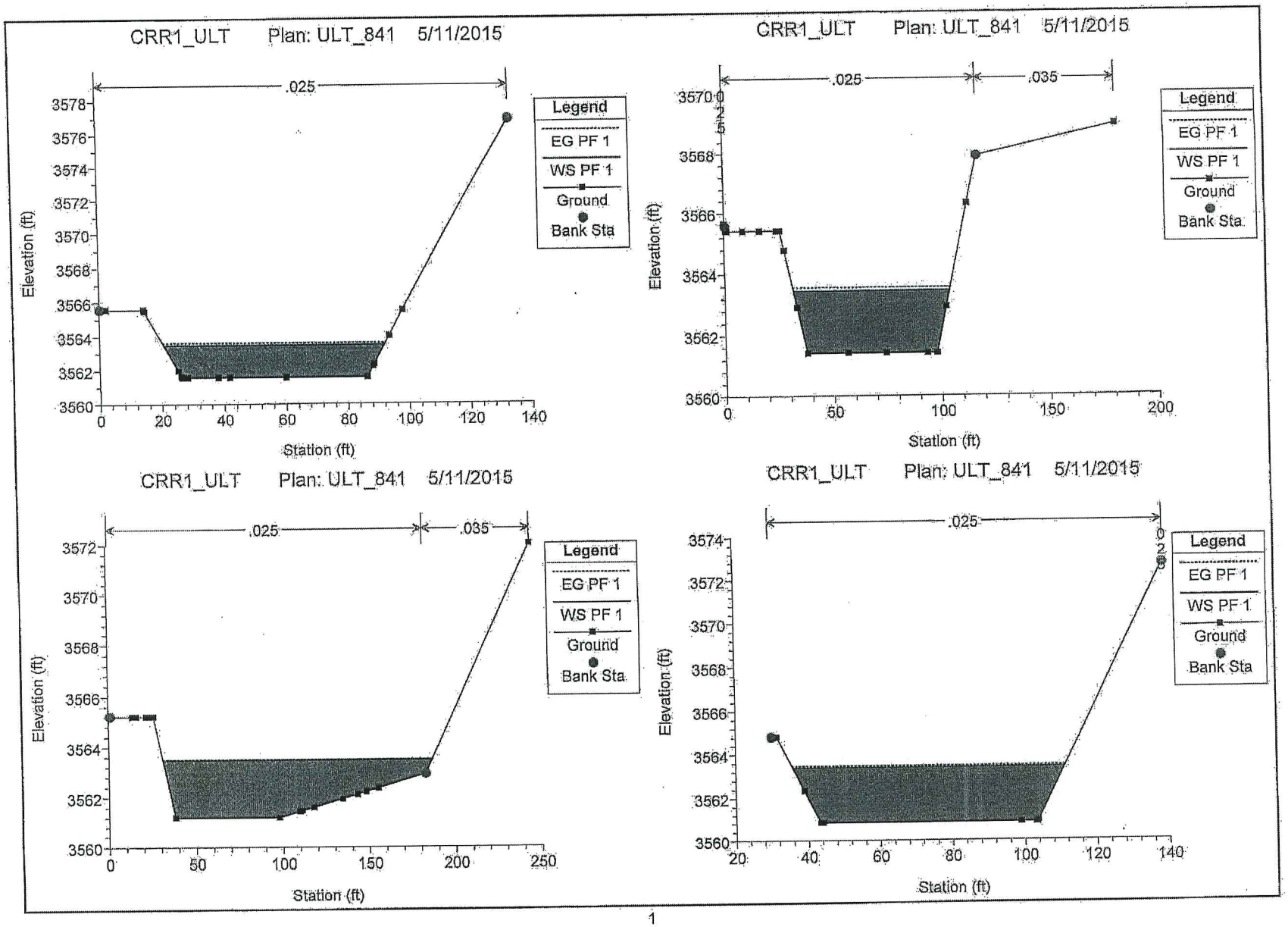
3564
3563
3562
3561
3560
3559
0
200
400
600
800
Main Channel Distance (ft)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Legend
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WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
CRR1_ULT Plan: ULT_841 5/11/2015
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
CRR1_ULT Plan: ULT_841 5/11/2015
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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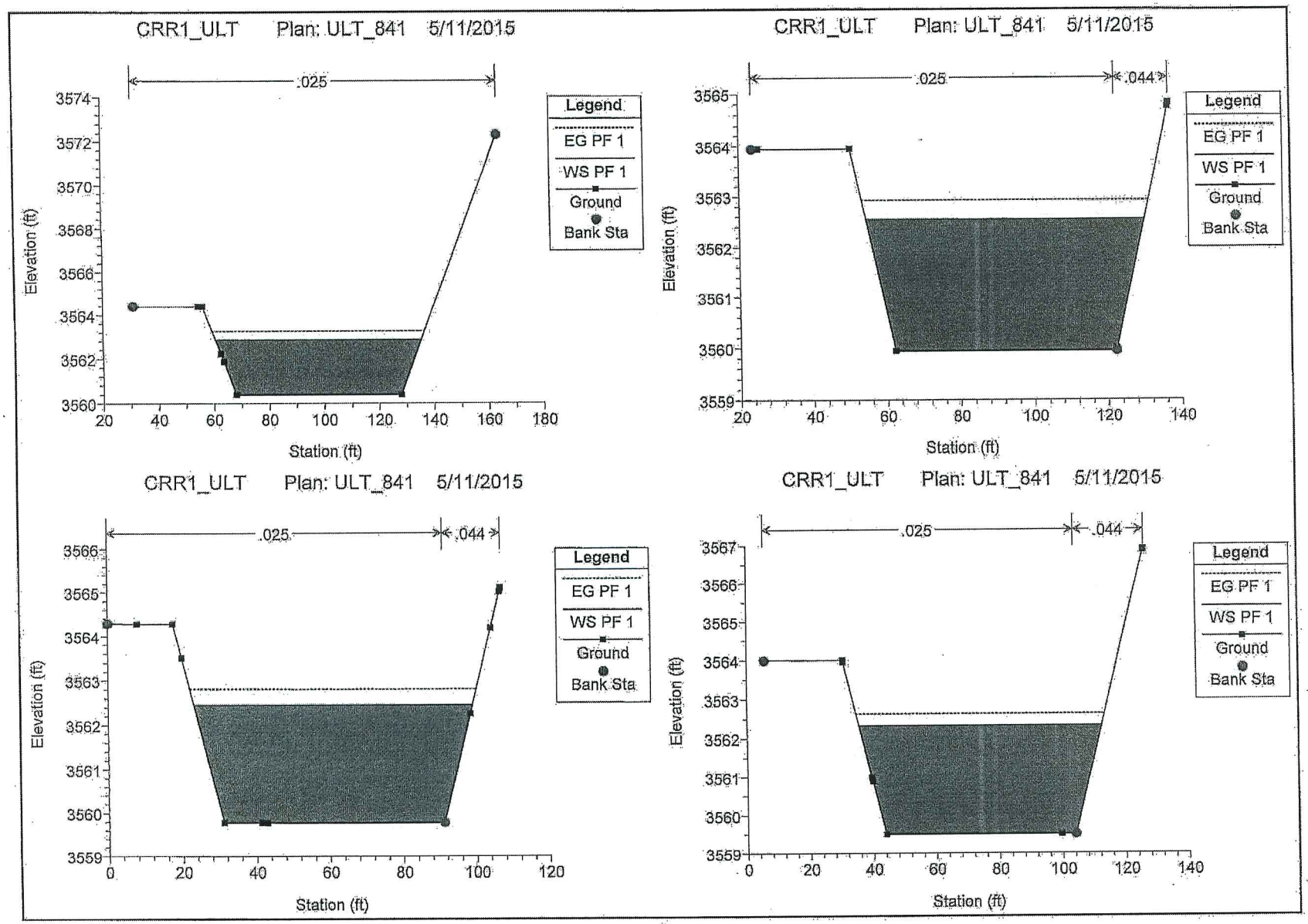
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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WS PF 1
Ground
Bank Sta
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Station (ft)
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3572
3570
3568
3566
3564
3562
3560
20 40 60 80 100 120 140 160 180
CRR1_ULT Plan: ULT_841 5/11/2015
.025
.044
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
3565
3564
3563
3562
3561
3560
3559
20 40 60 80 100 120 140
CRR1_ULT Plan: ULT_841 5/11/2015
.025
.044
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
3566
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3564
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3562
3561
3560
3559
0 20 40 60 80 100 120
CRR1_ULT Plan: ULT_841 5/11/2015
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.044
Legend
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WS PF 1
Ground
Bank Sta
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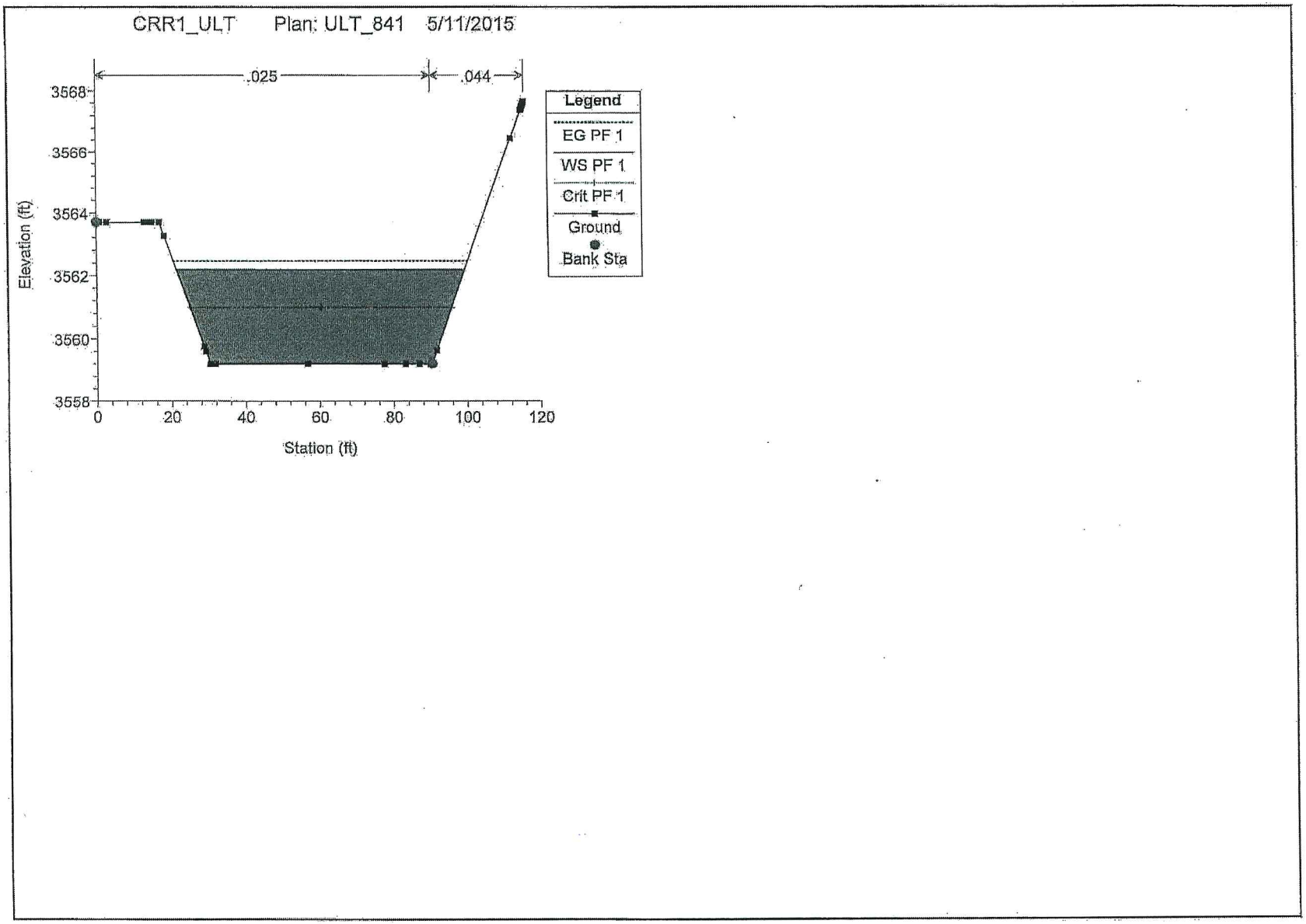
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.044
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3566
3564
3562
3560
3558
Elevation (ft)
0
20
40
60
80
100
120
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

Worksheet for Rectangular Weir - 26 COS-1

Project Description

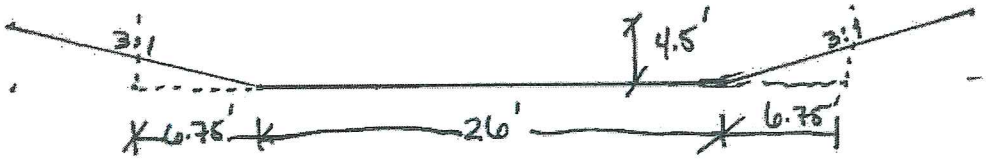
Solve For	Headwater Elevation

Input Data

Discharge		554.00	ft³/s
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Weir Coefficient		2.70	US
Crest Length		39.50	ft
Number Of Contractions	0		

Results

Headwater Elevation	3.00	ft
Headwater Height Above Crest	3.00	ft
Tailwater Height Above Crest	0.00	ft
Flow Area	118.48	ft²
Velocity	4.68	ft/s
Wetted Perimeter	45.50	ft
Top Width	39.50	ft



Cross Section for Rectangular Weir - 26 COS-1

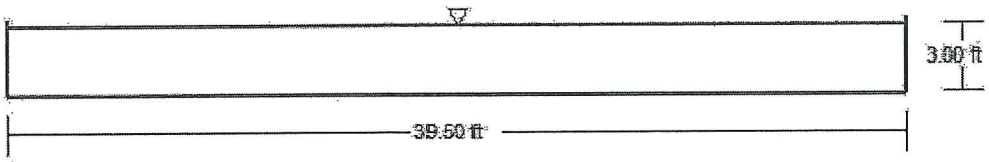
Project Description

Solve For	Headwater Elevation

Input Data

Discharge		554.00	ft³/s
Headwater Elevation		3.00	ft
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Weir Coefficient		2.70	US
Crest Length		39.50	ft
Number Of Contractions	0		

Cross Section Image



V: 1
H: 1

Worksheet for Rectangular Weir - 7 DIV1

Project Description

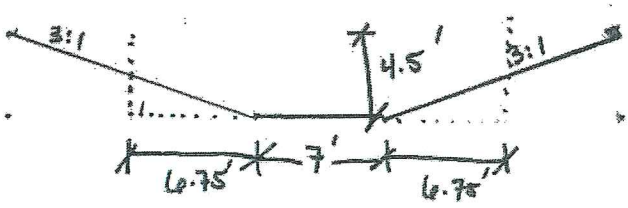
Solve For	Crest Length

Input Data

Discharge	287.00	ft³/s
Headwater Elevation	3.00	ft
Crest Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Weir Coefficient	2.70	US
Number Of Contractions	0	

Results

Crest Length	20.46	ft
Headwater Height Above Crest	3.00	ft
Tailwater Height Above Crest	0.00	ft
Flow Area	61.37	ft²
Velocity	4.68	ft/s
Wetted Perimeter	26.46	ft
Top Width	20.46	ft



Cross Section for Rectangular Weir - 7 DIV1

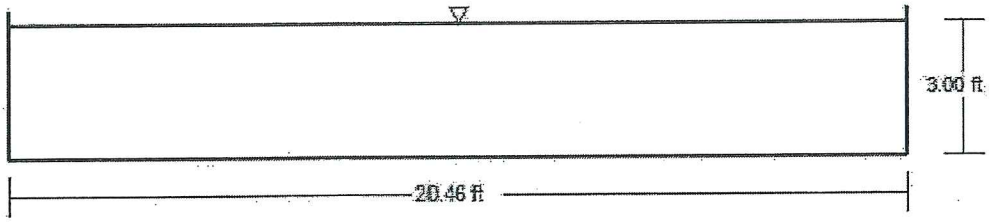
Project Description

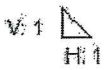
Solve For	Crest Length

Input Data

Discharge		287.00	ft³/s
Headwater Elevation		3.00	ft
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Weir Coefficient		2.70	US
Crest Length		20.46	ft
Number Of Contractions	0		

Cross Section Image





SUMMERLIN

SM

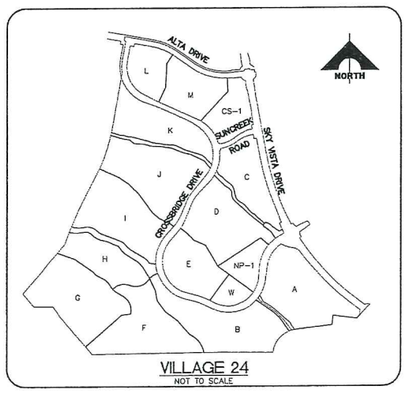
VILLAGE 24
CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

FROM CROSSBRIDGE UNIT 1 TO SUNCREEK ROAD

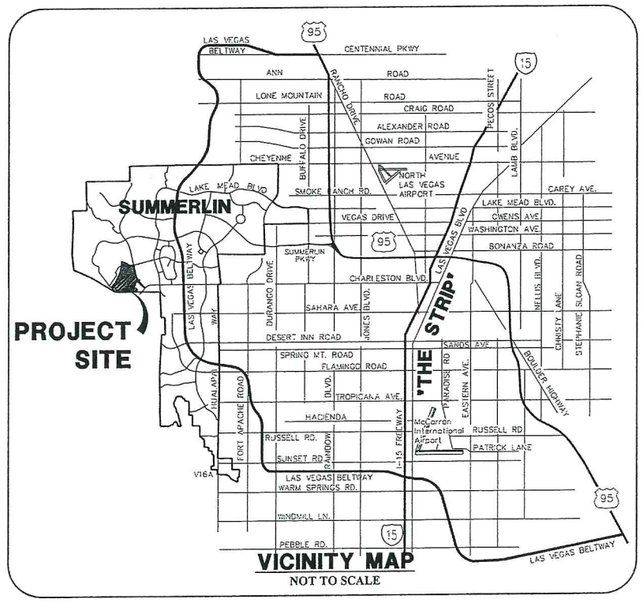
SID # 812 PROJECT 2

2014

A.P.N. 137-33-801-001



VILLAGE 24
NOT TO SCALE



VICINITY MAP
NOT TO SCALE

SHEET INDEX	
SHT #	DESCRIPTION
1	COVER SHEET
2	PROJECT DATA SHEET
3	NOTE SHEET
4	HORIZONTAL CONTROL PLAN
5	WATER MASTER PLAN
6	STORM DRAIN MASTER PLAN
7	SEWER MASTER PLAN
8	ROADWAY PLAN AND PROFILE 1
9	ROADWAY PLAN AND PROFILE 2
10	ROADWAY PLAN AND PROFILE 3
11	ROADWAY PLAN AND PROFILE 4
12	ROADWAY PLAN AND PROFILE 5
13	ROADWAY PLAN AND PROFILE 6
14	ROADWAY PLAN AND PROFILE 7
15	ROADWAY PLAN AND PROFILE 8
16	UTILITY PLAN AND PROFILE 1
17	UTILITY PLAN AND PROFILE 2
18	UTILITY PLAN AND PROFILE 3
19	UTILITY PLAN AND PROFILE 4
20	UTILITY PLAN AND PROFILE 5
21	UTILITY PLAN AND PROFILE 6
22	UTILITY PLAN AND PROFILE 7
23	UTILITY PLAN AND PROFILE 8
24	GRADING AT DRAINAGE CORRIDOR CROSSING
25	WESTERN BORDER CHANNEL 1
26	WESTERN BORDER CHANNEL 2
27	WESTERN BORDER CHANNEL 3
28	CROSSBRIDGE DRIVE ROUGH GRADE 1
29	CROSSBRIDGE DRIVE ROUGH GRADE 2
30	CROSSBRIDGE DRIVE ROUGH GRADE 3
31	COS-1 BERM GRADING
32	ADDITONAL LIMITS OF GRADING
33	TYPICAL SECTIONS
34	UTILITY DETAILS 1
35	UTILITY DETAILS 2
36	CONSTRUCTION DETAILS
37	LATERAL DETAILS 1
38	LATERAL DETAILS 2
39	LATERAL DETAILS 3
40	DRAINAGE CORRIDOR CROSSING DETAILS 1
41	DRAINAGE CORRIDOR CROSSING DETAILS 2
N.I.C.	~~42~~ ~~STRIPING AND SIGNAGE PLAN 1~~
N.I.C.	~~43~~ ~~STRIPING AND SIGNAGE PLAN 2~~
N.I.C.	~~44~~ ~~STREETLIGHT AND ELECTRICAL NOTES~~
N.I.C.	~~45~~ ~~MASTER CONDUIT AND ELECTRICAL PLAN 1~~
N.I.C.	~~46~~ ~~MASTER CONDUIT AND ELECTRICAL PLAN 2~~
47	TYPICAL STRUCTURAL DETAILS AND NOTES
48	DRAINAGE CORRIDOR STRUCTURAL DETAILS 1
49	DRAINAGE CORRIDOR STRUCTURAL DETAILS 2
50	DRAINAGE CORRIDOR STRUCTURAL DETAILS 3
51	DRAINAGE CORRIDOR STRUCTURAL DETAILS 4
52	OUTLET STRUCTURE PLAN AND DETAILS
N.I.C.	~~53~~ ~~FLOW CONTROL VALVE DETAILS~~

DRAINAGE CERTIFICATION

I CERTIFY THAT THE GRADING PLANS ARE IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

JOSHUA L. JOHNSON P.E. 15789 DATE

ALLEN PAVELKA: PE, PE# 9029 DATE
CITY ENGINEER
CITY OF LAS VEGAS, NEVADA

APPROVAL OF THESE PLANS IS LIMITED TO THOSE IMPROVEMENTS CONSTRUCTED IN THE DEDICATED RIGHTS-OF-WAY AND/OR DEDICATED EASEMENTS. THIS APPROVAL DOES NOT AUTHORIZE THE CONSTRUCTION OF ANY IMPROVEMENTS THAT DEVIATE FROM ADOPTED STANDARDS AND/OR SPECIFICATIONS, EXCEPT THOSE SPECIFICALLY LISTED UNDER "DEVIATIONS FROM STANDARDS". THE ENGINEER SHALL RESOLVE ANY DEVIATION OTHER THAN THOSE LISTED IN "DEVIATIONS FROM STANDARDS" IN FAVOR OF THE UNIFORM STANDARD DRAWINGS AND SPECIFICATIONS CLARK COUNTY AREA NEVADA.

CLV PLANNING DEPARTMENT

THIS PLAN MEETS THE APPLICABLE STANDARDS OF THE CITY OF LAS VEGAS PLANNING DEPARTMENT

CHRIS KNIGHT, DIRECTOR BUILDING AND SAFETY DATE

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123547 DATE:
DRAWINGS: 1-3, 5-7, 16-23, 35, 37-41 & 52

THE HOWARD HUGHES COMPANY, LLC

KEVIN ORROCK DATE
VICE PRESIDENT

PLAN APPROVAL

NOTE: THIS PROJECT PLAN APPROVAL CONTINGENT ON

LVVWD #123259 VILLAGE 23A/24 SKY VISTA IMPROVEMENT PLANS

UTILITY/AGENCY APPROVALS

COX COMMUNICATIONS LAS VEGAS, INC. DATE

CENTRAL TELEPHONE CO., DBA CENTURYLINK DATE

THE AFFIXED CENTURYLINK APPROVAL DOES NOT ASSUME OR GUARANTEE LIABILITY FOR KNOWN OR UNKNOWN CONFLICTS WITH EXISTING OR PROPOSED IMPROVEMENTS. RESOLUTION OF ANY CONFLICT WILL BE ACCOMPLISHED PURSUANT TO LOCAL ORDINANCES, NEVADA REVISED STATUTES AND/OR PUBLIC UTILITY COMMISSION RULES AND REGULATIONS.

NV ENERGY DATE

NEVADA POWER COMPANY ACKNOWLEDGES THAT WE HAVE RECEIVED YOUR PLANS AND WILL PROVIDE SERVICE TO ALL ELECTRICAL NEEDS ASSOCIATED WITH THIS PROJECT. NEVADA POWER COMPANY RESERVES THE RIGHT TO ADDRESS ANY EXISTING OR FUTURE CONFLICTS ONCE THE FINAL DESIGN IS COMPLETED. THE NEW SERVICE AND THE RESOLUTION OF ANY CONFLICTS WILL BE ACCOMPLISHED PURSUANT TO THE NEVADA PUBLIC UTILITY COMMISSION'S RULES AND REGULATIONS.

NV ENERGY - TRANSMISSION ENGINEERING DATE

SOUTHWEST GAS CORP. DATE

OWNER/DEVELOPER

THE HOWARD HUGHES COMPANY, LLC
10801 W. CHARLESTON BLVD., 3RD FLOOR
LAS VEGAS, NEVADA 89146
OFFICE PHONE NO. (702) 791-4300

ENGINEER

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD · LAS VEGAS, NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM

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Avoid cutting underground utility lines. It's easy.
Call 811
1-800-227-2600
OR
CLARK COUNTY TRAFFIC OPERATIONS
1-702-455-6000

CALL BEFORE YOU DIG OVERHEAD
AVOID HITTING OVERHEAD POWER LINES. IT'S EASY!

FAST
Call before you UnderGround
1-702-432-5300
FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

DATE: 10/01/2015
TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	CCW APP

PROJECT NO. 62024-222
DESIGN: CCW
DRAWN: CCW
CHECK: JJJ
PLOT DATE: 10-01-15
PLOT TIME: 13:18:04

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LAS VEGAS
F:\Projects\600\62024-222\GWC\Production\24CB2sc01_CV.dwg
Paul Brennord

THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS
COVER SHEET

DRAWING 1
1 OF 53 SHTS

SID NO. 812 PROJECT 2

sv24-2sc.dwg 070203.lsv

LEGEND

- PROPOSED UTILITIES
- EXISTING UTILITIES
- FUTURE UTILITIES
- SECTION LINE
- EASEMENT LINE
- RIGHT-OF-WAY LINE
- PROPERTY LINE
- CENTERLINE
- 100 YR HYDRAULIC GRADE LINE (ULT)
- 100 YR HYDRAULIC GRADE LINE (INT)
- PROPOSED UTILITY (BY OTHERS)
- PROPOSED SEWER LINE W/MH
- FUTURE SEWER LINE W/MH
- EXISTING SEWER LINE W/MH
- EXISTING WATER LINE & GATE VALVE
- PROPOSED WATER LINE & GATE VALVE
- FUTURE WATER LINE & GATE VALVE
- 2" G — EXISTING GAS LINE
- 2-6" E — EXISTING UNDERGROUND ELECTRICAL
- CATV — EXISTING CABLE TV
- TEL — EXISTING TELEPHONE
- OHP — EXISTING OVERHEAD AND POWER POLES
- PROPOSED STORM DRAIN W/MH
- EXISTING STORM DRAIN W/MH
- FUTURE STORM DRAIN W/MH
- EXISTING SIDEWALK AND RAMP
- CONSTRUCT CURB DEPRESSION FOR FUTURE HANDICAP RAMP
- VIEW FENCE
- NEW ABANDONED PIPE
- EXISTING ABANDONMENT
- SAWCUT
- STEEL CASING
- APPROXIMATE PAVEMENT RESTORATION
- TO BE ABANDONED PROFILE HATCH
- WATER STUB WITH BLOW-OFF
- FUTURE WATER STUB WITH BLOW-OFF
- SEWER STUB WITH CAP
- FUTURE SEWER STUB WITH CAP
- EDGE OF PAVEMENT
- OUTSIDE EDGE
- C — C — CUT LIMIT LINE
- F — F — FILL LIMIT LINE

- 1 / CD1 — DRAWING NUMBER FOR DETAIL W/ REF. TO THE SHEET WHERE IT IS SHOWN
- XX / YYY — STANDARD DRAWING NUMBER / GOVERNING AGENCY
- BENCHMARK
- POTHOLE LOCATION
- EXISTING NVR RS-100
- EXISTING DROP INLET
- PROPOSED DROP INLET
- FUTURE DROP INLET
- EXISTING GATE VALVE
- PROPOSED GATE VALVE
- FUTURE GATE VALVE
- EXISTING WATER METER
- PROPOSED WATER METER
- EXISTING TRAFFIC SIGNAL PULL BOX
- PROPOSED SIGNAL PULLBOX
- EXISTING TELEPHONE MANHOLE
- EXISTING POWER POLE
- EXISTING ELEC MARKER
- EXISTING TRAFFIC SIGNAL
- PROPOSED TRAFFIC SIGNAL
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT
- FUTURE FIRE HYDRANT
- EXISTING UTILITY BOX
- EXISTING METER BOX
- 3005 — PROPOSED CONTOUR
- (3005) — EXISTING CONTOUR
- 60.50 TC — SPOT ELEVATION
- (50.50) TC — EXISTING SPOT ELEVATION
- (50.50) TC — FUTURE SPOT ELEVATION
- EXISTING CLARK COUNTY STREET LIGHT (STLT)
- 1.00% — ROAD SLOPE
- EXISTING SUMMERLIN STREET LIGHT (STLT)
- PROPOSED SUMMERLIN STREET LIGHT (STLT)
- TOP SLOPE / TOE SLOPE — 3:1 SLOPE UNLESS OTHERWISE NOTED ON PLAN

ABBREVIATIONS

A	AIR	FH	FIRE HYDRANT	RCB	REINFORCED CONCRETE BOX
AC	ASPHALT CONCRETE, ACRE	FL	FLOW LINE	RCP	REINFORCED CONCRETE PIPE
ACP	ASBESTOS CEMENT PIPE	FO	FIBER OPTIC	RD	ROAD
ADD'L	ADDITIONAL	FRP	FIBERGLASS REINFORCED PLASTIC	RDWY	ROADWAY
AP	ANGLE POINT	FS	FINISH SURFACE	REC	RECTANGULAR
APN	ASSESSOR'S PARCEL NUMBER	FT	FOOT/FEET	REF	REFERENCE
APPROX	APPROXIMATELY	FTG	FOOTING	REINF	REINFORCED
AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS	FUT	FUTURE	REQD	REQUIRED
		G	GAS	RIM	TOP OF RIM ELEVATION
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS	GA	GAGE, GUY ANCHOR	RND	ROUND
		GB	GRADE BREAK	ROW,R/W	RIGHT OF WAY
AVE	AVENUE	GND	GROUND	RP	RADIUS POINT
AVAR	AIR VALVE, AIR RELEASE ASSEMBLY	GRD	GRADE, GROUND	RPM	RAISED PAVEMENT MARKERS
AWWA	AMERICAN WATER WORKS ASSOCIATION	H, HGT	HEIGHT	RSGV	RESILIENT SEAT GATE VALVE
		HDWL	HEADWALL	S	SOUTH
BC	BACK OF CURB	HGL	HYDRAULIC GRADE LINE	SCH	SCHEDULE
BCR	BEGIN CURB RETURN	HORIZ	HORIZONTAL	SD	STORM DRAIN
BLM	BUREAU OF LAND MANAGEMENT	HP	HIGH POINT, HIGH PRESSURE	SDMH	STORM DRAIN MANHOLE
BLVD	BOULEVARD	HPS	HIGH PRESSURE SODIUM	SECT	SECTION
BM	BENCHMARK	IBC	INTERNATIONAL BUILDING CODE	SF	SQUARE FOOT/FEET
BO	BLOW-OFF	INV	INVERT	SHLDR	SHOULDER
BVCE	BEGIN VERTICAL CURVE ELEVATION	INT	INTERIM	SHT	SHEET
BVCS	BEGIN VERTICAL CURVE STATION	JT	JOINT	SIS	SUMMERLIN IMPROVEMENT STANDARDS
BW	BACK OF SIDEWALK	L	LENGTH		
C, ℄	CENTERLINE	L, LT	LEFT	SL	STREET LIGHT
C&G	CURB AND GUTTER	LF	LINEAR FEET	SP	SERVICE POINT
CATV	UNDERGROUND CABLE TV	LIP	LIP OF GUTTER	SQ	SQUARE
CCBM	CLARK COUNTY BENCH MARK	LN	LANE	SR	SEWER RECLAIM MAIN
CCPW	CLARK COUNTY PUBLIC WORKS	LP	LIGHT POLE	SS	SANITARY SEWER
CCTV	CLOSED-CIRCUIT TELEVISION	LSCP	LANDSCAPE	SSMH	SANITARY SEWER MANHOLE
CCWRD	CLARK COUNTY WATER RECLAMATION DISTRICT	LVVWD	LAS VEGAS VALLEY WATER DISTRICT	STA	STATION
		MAX	MAXIMUM	ST	STREET
CFS	CUBIC FEET PER SECOND	MH	MANHOLE	STD	STANDARD
CIP	CAPITAL IMPROVEMENTS PROJECT, CORRUGATED IRON PIPE	MIN	MINIMUM	STL	STEEL
		MLCP	MORTAR LINED AND COATED PIPE	STRUCT	STRUCTURE
	CAST IN PLACE	MP	MESA PARK	SVZ	SIGHT VISIBILITY ZONE
CIPM	CAST-IN-PLACE MANHOLE	MOD	MODIFY/MODIFIED	SW	SIDEWALK
CIPP	CAST-IN-PLACE PIPE	MON	MONUMENT	SWG	SOUTHWEST GAS
CIR	CIRCLE	MPH	MILES PER HOUR	T	TELEPHONE OR TOP
CLR	CLEAR OR CLEARANCE	N	NORTH	TAN	TANGENT
CLSM	CONTROLLED LOW STRENGTH MATERIAL	NDOT	NEVADA DEPARTMENT OF TRANSPORTATION	TB	TOP OF BERM
				TC	TOP OF CURB
CLV	CITY OF LAS VEGAS	NO	NUMBER	TCE	TEMPORARY CONSTRUCTION ESMT
CMP	CORRUGATED METAL PIPE	NOSHA	STATE OF NEVADA OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION	TEL,TELE	TELEPHONE
CMU	CONCRETE MASONRY UNIT			TEMP	TEMPORARY
CNLV	CITY OF NORTH LAS VEGAS	NVE	NEVADA ENERGY	TF	TOP OF FOOTING
CO	CLEANOUT	NTS	NOT TO SCALE	TG	TOP OF GRATE
CONC	CONCRETE	OB	OVERBUILD	TMH	TOP OF MANHOLE
COND	CONDUIT	OC	ON CENTER	TOP	TOP OF PIPE
CONST	CONSTRUCT OR CONSTRUCTION	OHC	OVERHEAD COX COMMUNICATION	TP	TELEPHONE POLE
COORD	COORDINATE	OHP	OVERHEAD POWER LINE	TRANS	TRANSITION
COR	CORNER	P	POWER LINE	TRW	TOP OF RETAINING WALL
CPEP	CORRUGATED POLYETHELYNE PIPE	PB	PULL BOX	TS	TRAFFIC SIGNAL
CT	COURT	PBS	PLANTMIX BITUMINOUS SURFACE	TW	TOP OF WALL
CY	CUBIC YARD(S)	PC	POINT OF CURVE, PRESSURE CLASS	TYP,(TYP)	TYPICAL
Δ	DELTA	PCC	POINT OF COMPOUND CURVE	UDACS	UNIFORM DESIGN AND CONSTRUCTION STANDARDS FOR WATER DISTRIBUTION SYSTEMS (LATEST EDITION)
DBL	DOUBLE	PE	PROJECT ENGINEER OR POLYETHYLENE		
DCSWCS	DESIGN AND CONSTRUCTION STANDARDS FOR WASTEWATER COLLECTION SYSTEM (LATEST EDITION)	PED	PEDESTRIAN	UG	UNDERGROUND
		PGL	PROFILE GRADE LINE	ULT	ULTIMATE
		PH	POTHOLE	USD	UNIFORM DESIGN AND CONSTRUCTION STANDARDS
DEFL	DEFLECTION	PI	POINT OF INTERSECTION	USDCCA	UNIFORM STD. DRAWINGS FOR PUBLIC WORKS' CONSTRUCTION OFF-SITE IMPROVEMENTS CLARK COUNTY AREA, NEVADA (LATEST EDITION)
DG	DESIGN GRADE	PIV	POST INDICATOR VALVE		
DIA, ⌀	DIAMETER	R	PROPERTY LINE		
DIP	DUCTILE IRON PIPE	PLCP	POLYURETHANE LINED AND COATED STEEL PIPE		
DIST	DISTANCE	PMF	PAVEMENT MARKING FILM	UT	UNDERGROUND TELEPHONE
DR	DRIVE	POB	POINT OF BEGINNING	VAR	VARIABLE/VARIES
DS	DOWNSPOUT	POC	POINT ON CURVE	VC	VERTICAL CURVE
DTL	DETAIL	P.O.C.	POINT OF CONNECTION	VCP	VITRIFIED CLAY PIPE
DW	DRIVEWAY	POT	POINT ON TANGENT	VERT	VERTICAL
DWG	DRAWING	PP	POWER POLE	VG	VALLEY GUTTER
E	EAST	PROP	PROPOSED	VOL	VOLUME
ECR	END CURB RETURN	PRC	POINT OF REVERSE CURVE	W	WATER, WEST
ELE,ELEC	ELECTRICAL	PRVC	POINT OF REVERSE VERTICAL CURVE	W/	WITH
ELEV	ELEVATION			WS	WATER SUPPLY
EP, EOP	EDGE OF PAVEMENT	PSI	POUNDS PER SQUARE INCH	WT	WEIGHT
ESMT	EASEMENT	PT	POINT OF TANGENCY	WTR	WATER
EVC	END VERTICAL CURVE	PVC	POLYVINYL CHLORIDE	XING	CROSSING
EXIST,EX	EXISTING	PVI	POINT OF VERTICAL INTERSECTION	YD	YARD, YARD DRAIN
EXP	EXPANSION JOINT	PVMT	PAVEMENT	Z	PRESSURE ZONE
FC	FACE OF CURB	PZ	PRESSURE ZONE		
FF, FFE	FINISH FLOOR ELEVATION	R, RAD	RADIAL, RADIUS		
FG	FINISH GRADE	R, RT	RIGHT		

IMPROVEMENT NOTES:

1. INSTALL "A" TYPE ISLAND CURB PER USD DWG NO. 219
2. INSTALL "L" TYPE CURB & GUTTER PER USD DWG NO. 216
3. INSTALL A.C. PAVEMENT PER TYPICAL STREET SECTION DETAILS
4. INSTALL HANDICAP RAMP CURB DEPRESSION (BY OTHERS)
5. VERIFY LOCATION AND ELEVATION OF EXISTING IMPROVEMENT. IF DISCREPANCY EXISTS, NOTIFY ENGINEER PRIOR TO CONSTRUCTION
6. SAWCUT AND REPLACE EXISTING A.C. PAVEMENT
7. INSTALL CONCRETE ENCASEMENT
8. EXISTING RIPRAP TO BE REMOVED AND STOCKPILED
9. INSTALL "L" TYPE ISLAND CURB PER USD DWG NO. 219
10. RELOCATE WATER APPURTENANCES (VALVES TO REMAIN ACCESSIBLE AT ALL TIMES)

WATER CONSTRUCTION NOTES:

1. INSTALL FIRE HYDRANT & ASSEMBLY PER UDACS PLT. NO. 39 & 40
2. INSTALL TEE/CROSS PER UDACS PLT. NO. 31 (*)
3. INSTALL BEND PER UDACS PLT. NO. 31. (SEE PLAN FOR ∠) (*)
4. INSTALL GATE VALVE PER UDACS PLT. NO. 30 AND 39 (*)
5. INSTALL REDUCER PER UDACS PLT. NO. 30 (*)
6. INSTALL CAP W/ 2" BLOW-OFF ASSY PER UDACS PLT. NO. 36 (*)
7. 1" MAX. DEFLECTION (PVC), 2.5° MAX. DEFLECTION (DIP)
8. INSTALL STEEL CASING PER UDACS PLT. 22 & 23
9. INSTALL VERT. 45° BEND PER UDACS PLT. NO. 31 (*)
10. REMOVE CAP & BLOWOFF PER UDACS PLT. NO. 36 AND CONNECT TO EXISTING WATER LINE
11. INSTALL 6" MANUAL BLOW OFF ASSY PER UDACS PLT. NO. 37
12. INSTALL 4" COMBINATION AIR VALVE PER UDACS PLT. NO. 38
13. INSTALL 1 1/2" TYPE K COPPER W/SERVICE SADDLE, 1 1/2" METER & 1 1/2 RPPA PER UDACS PLATE NO. 4 & 8.

* SEE PLANS AND WAKE NOTE OF ATTACHED PIPE SIZE FOR TEE, BEND, GATE VALVE, REDUCER AND CAP SIZES

SEWER CONSTRUCTION NOTES:

1. INSTALL 48" SEWER MANHOLE
2. INSTALL 60" SEWER MANHOLE
3. INSTALL TEMPORARY PLUG AND CAP SEWER STUB
4. REMOVE EXISTING PLUG AND CONNECT TO EXISTING SEWER LINE
5. INSTALL CORROSION PROTECTION PER DCSWCS 3.16.8B AND 4.9.9

STORM DRAIN CONSTRUCTION NOTES:

1. INSTALL TYPE "CM2" DROP INLET PER USD DWG. NO. 412.1 AND 421
2. INSTALL TYPE I 60" MANHOLE PER USD DWG. NO. 403
3. INSTALL TYPE III MANHOLE PER USD DWG. NO. 406
4. INSTALL TYPE II-SD MANHOLE PER USD DWG. NO. 405.2
5. INSTALL WATER TIGHT ELASTOMERIC JOINTS PER UDACS 2.22.02
6. INSTALL TEMPORARY PLUG AND CAP STORM DRAIN LINE
7. CULVERT HEADWALL (SEE DETAIL XX ON SHEET X)
8. REMOVE EXISTING PLUG AND CONNECT TO EXISTING STORM DRAIN LINE

** CONTRACTOR TO VERIFY SIZE, INVERT, AND LOCATION OF EXISTING STORM DRAIN LINE

IRRIGATION CONSTRUCTION NOTES:

1. BANK "A": 1-6" & 2-4" SCH 40 PVC PER DETAIL 1 ON SHEET 29
2. BANK "B" : 2-4" SCHD. 40 PVC PER DETAIL 2 ON SHEET 29

DEVIATIONS FROM STANDARDS

1. ADD RAISED MEDIAN TO NEIGHBORHOOD COLLECTOR LEVEL 2 (PER S.I.S. DWG NO S-6) TO ENHANCE MARKETING AND SALES ENTRIES INTO VILLAGE 24. RIGHT-OF-WAY (BC-BC) EXPANDS TO 67.34 FEET TO 84.00 FEET (AS MEDIAN ISLAND VARIES), IN LIEU OF 54.00 FEET. TRAVEL LANES REMAIN UNCHANGED.
2. REDUCE LANDSCAPE MEDIAN ISLAND IN FUTURE "GATED" PARCEL ENTRIES (PER S.I.S. DWG NO S-12A) FROM 15.00 FEET TO 13.34 FEET, IN EXCHANGE FOR WIDER COMMON AREAS WHICH ARE PROPOSED 20 FEET WIDE IN LIEU OF 15 FEET. THIS ADDITIONAL AREA WILL BE UTILIZED FOR GRADING AND SLOPE ADJUSTMENTS. CORRESPONDINGLY, THE RIGHT-OF-WAY IS REDUCED FROM 84.00 FEET TO 61.34 FEET. TRAVEL LANES REMAIN UNCHANGED.
3. STREET LIGHTS, AT ALL FUTURE PARCEL ENTRIES, WILL BE SET AT 10 FEET OUTSIDE OF BCR AND 2.5 FEET OF BC (IN LIEU OF LOCATIONS SET PER S.I.S. E-16 FOR MEANDERING SIDEWALK). THIS WILL ALLOW ADJUSTMENTS TO PARCEL ENTRIES WITHOUT AFFECTING STREET LIGHT LOCATIONS.

NOTES TO CONTRACTOR:

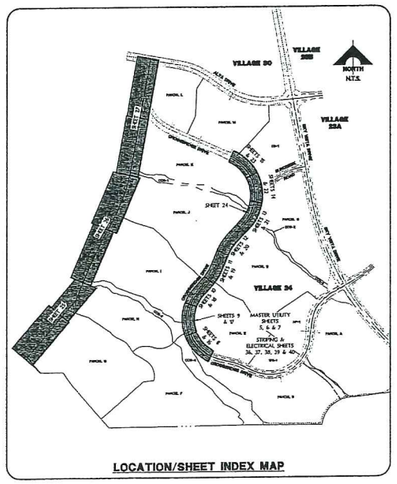
1. ALL EXISTING UTILITY CROSSINGS MUST BE VERIFIED PRIOR TO CONSTRUCTION OF ANY MAIN LINES OR LATERALS THAT MAY BE ADVERSELY AFFECTED. ANY DISCREPANCIES IN LOCATION AND/OR ELEVATION MUST BE PROVIDED TO THE ENGINEER FOR ACCEPTANCE PRIOR TO CONSTRUCTION.
2. ALL COMMON LOTS AS SHOWN HEREIN TO BE PRIVATELY MAINTAINED BY THE SUMMERLIN H.O.A. A FUTURE MEANDERING SIDEWALK WILL BE INSTALLED BY SUMMERLIN AS REQUIRED TO SERVICE THE DEVELOPMENT OF EACH PARCEL.
3. ALL WATER LINE GATE VALVES, SERVICE GATE VALVES, AND FIRE HYDRANT GATE VALVES ARE TO BE CONSTRUCTED UNDER A.C. PAVEMENT. IT IS THE CONTRACTORS RESPONSIBILITY TO VERIFY THAT ALL WATER VALVE CANS DO NOT CREATE CONFLICTS WITH THE PROPOSED CURB LINE PRIOR TO PLACEMENT OF CONCRETE. ALL WATER FACILITIES SHOWN IN THESE DRAWINGS HAVE BEEN "SCALED-UP" FOR CLARITY ONLY.

SUMMERLIN STREET CLASSIFICATION

CROSSBRIDGE DRIVE: NEIGHBORHOOD COLLECTOR LEVEL 1 AND LEVEL 2 WITH SHARED BIKE LANES

STREET QUANTITIES (PUBLIC)

STREETS	
3" A.C. PAVEMENT	22,131 S.Y.
4" TYPE II AGGREGATE	2,871 C.Y.
8" TYPE "A" ISLAND CURB	3,883 L.F.
6" TYPE "L" CURB & GUTTER	7,466 L.F.
EXCAVATION	10,990 C.Y.
EMBANKMENT	133,591 C.Y.
ADJUST EXISTING FACILITIES TO GRADE	0 EA.
STREET LIGHTS	
SINGLE ARM ST. LT.	14 EA.
DOUBLE ARM ST. LT.	11 EA.
CONDUIT	5,108 L.F.
IRRIGATION	
IRRIGATION SLEEVES – BANK "A"	271 L.F.
IRRIGATION SLEEVES – BANK "B"	138 L.F.



LOCATION/SHEET INDEX MAP

FAST — Call before you Underground 1-702-432-5300 FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

Call before you Dig — Avoid cutting underground utility lines. It's easy. Call 811 or 1-800-227-2600 OR CLARK COUNTY TRAFFIC OPERATIONS 1-702-455-6000

AVOID HITTING OVERHEAD POWER LINES IT'S EASY — CALL BEFORE YOU DIG OVERHEAD — 1-702-227-2929

NOTE

THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS

BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER

PROJECT NO. 123547 DATE:

ENGINEER - STATE OF NEVADA — JOSHUA M. HUGHES — No. 15788 — PROFESSIONAL ENGINEER — DATE: 10/09/2015

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

PROJECT NO. 62024-222

DESIGN: GCW
DRAWN: GCW
CHECK: JMJ
PLOT DATE: 10-05-15
PLOT TIME: 11:25:24

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD. LAS VEGAS, NEVADA 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-222\DWG\production\24x36x02_P0.dwg
Michael Fong

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2 IMPROVEMENT PLANS

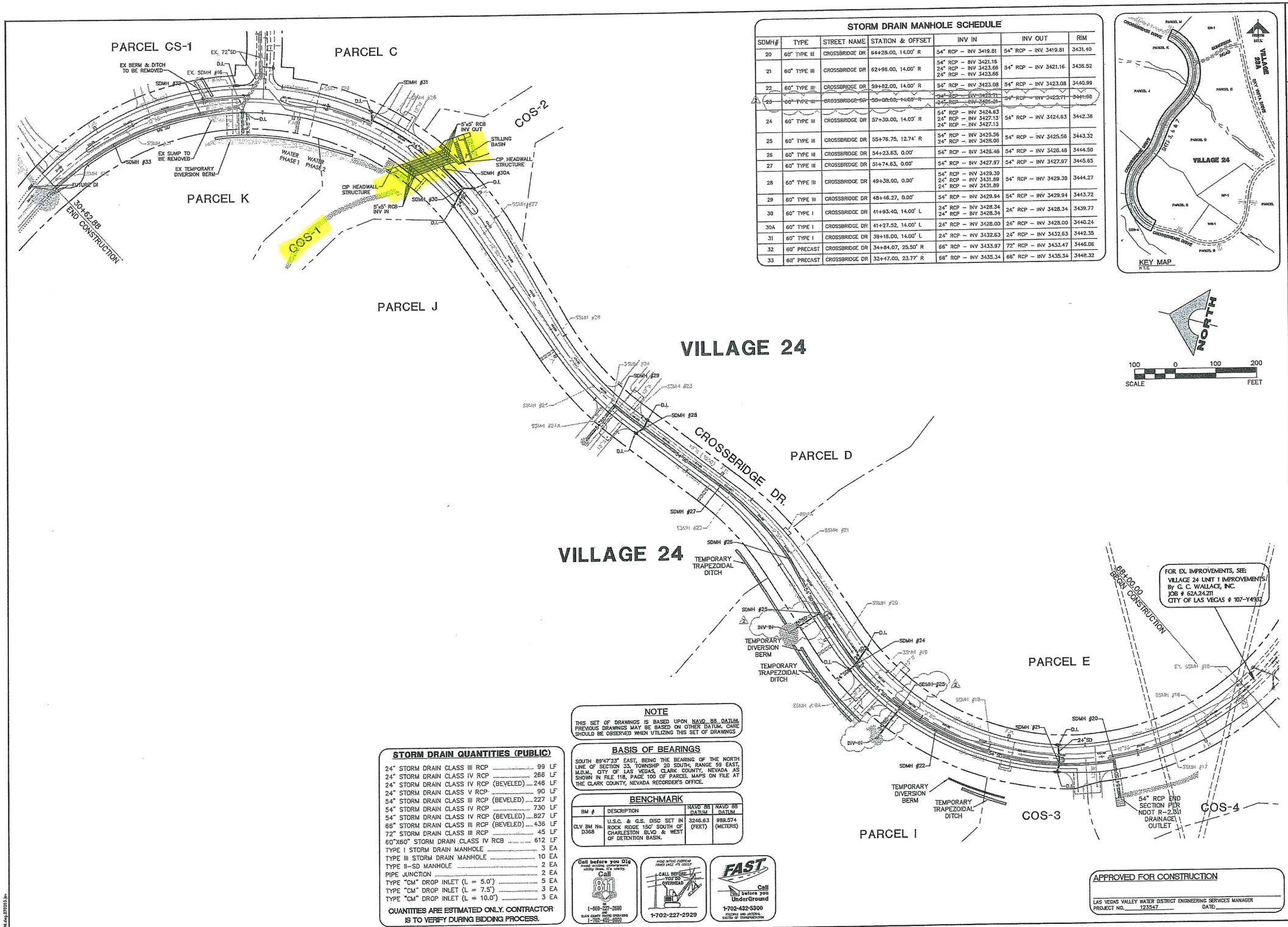
PROJECT DATA SHEET

DRAWING 2

2 OF 53 SHTS

SID NO. 812 PROJECT 2

sm24.36.dwg 070103.pr



STORM DRAIN MANHOLE SCHEDULE

SDMH#	TYPE	STREET NAME	STATION & OFFSET	INV IN	INV OUT	RIM
20	60" TYPE III	CROSSBRIDGE DR	64+28.00, 14.00' R	54" RCP – INV 3419.81	54" RCP – INV 3419.81	3431.40
21	60" TYPE III	CROSSBRIDGE DR	62+96.00, 14.00' R	54" RCP – INV 3421.16 24" RCP – INV 3423.66 24" RCP – INV 3423.66	54" RCP – INV 3421.16	3436.52
22	60" TYPE III	CROSSBRIDGE DR	59+82.00, 14.00' R	54" RCP – INV 3423.08	54" RCP – INV 3423.08	3440.99
23	60" TYPE III	CROSSBRIDGE DR	58+08.00, 14.00' R	54" RCP – INV 3423.71 24" RCP – INV 3426.21	54" RCP – INV 3423.71	3441.98
24	60" TYPE III	CROSSBRIDGE DR	57+30.00, 14.00' R	54" RCP – INV 3424.63 24" RCP – INV 3427.13 24" RCP – INV 3427.13	54" RCP – INV 3424.63	3442.38
25	60" TYPE III	CROSSBRIDGE DR	55+76.75, 12.74' R	54" RCP – INV 3425.56 24" RCP – INV 3428.06	54" RCP – INV 3425.56	3443.32
26	60" TYPE III	CROSSBRIDGE DR	54+23.63, 0.00'	54" RCP – INV 3426.48	54" RCP – INV 3426.48	3444.50
27	60" TYPE III	CROSSBRIDGE DR	51+74.63, 0.00'	54" RCP – INV 3427.97	54" RCP – INV 3427.97	3445.65
28	60" TYPE III	CROSSBRIDGE DR	49+38.00, 0.00'	54" RCP – INV 3429.39 24" RCP – INV 3431.89 24" RCP – INV 3431.89	54" RCP – INV 3429.39	3444.27
29	60" TYPE III	CROSSBRIDGE DR	48+46.27, 0.00'	54" RCP – INV 3429.94	54" RCP – INV 3429.94	3443.72
30	60" TYPE I	CROSSBRIDGE DR	41+93.40, 14.00' L	24" RCP – INV 3428.34 24" RCP – INV 3428.34	24" RCP – INV 3428.34	3439.77
30A	60" TYPE I	CROSSBRIDGE DR	41+27.52, 14.00' L	24" RCP – INV 3428.00	24" RCP – INV 3428.00	3440.24
31	60" TYPE I	CROSSBRIDGE DR	39+16.00, 14.00' L	24" RCP – INV 3432.63	24" RCP – INV 3432.63	3442.35
32	60" PRECAST	CROSSBRIDGE DR	34+84.07, 25.50' R	66" RCP – INV 3433.97	72" RCP – INV 3433.47	3446.06
33	60" PRECAST	CROSSBRIDGE DR	32+47.00, 23.77' R	66" RCP – INV 3435.34	66" RCP – INV 3435.34	3448.32

STORM DRAIN QUANTITIES (PUBLIC)

24" STORM DRAIN CLASS III RCP	99 LF
24" STORM DRAIN CLASS IV RCP	266 LF
24" STORM DRAIN CLASS IV RCP (BEVELED)	246 LF
24" STORM DRAIN CLASS V RCP	90 LF
54" STORM DRAIN CLASS III RCP (BEVELED)	227 LF
54" STORM DRAIN CLASS IV RCP	730 LF
54" STORM DRAIN CLASS IV RCP (BEVELED)	827 LF
66" STORM DRAIN CLASS III RCP (BEVELED)	436 LF
72" STORM DRAIN CLASS III RCP	45 LF
60"X60" STORM DRAIN CLASS IV RCB	612 LF
TYPE I STORM DRAIN MANHOLE	3 EA
TYPE III STORM DRAIN MANHOLE	10 EA
TYPE II–SD MANHOLE	2 EA
PIPE JUNCTION	2 EA
TYPE "CM" DROP INLET (L = 5.0')	5 EA
TYPE "CM" DROP INLET (L = 7.5')	3 EA
TYPE "CM" DROP INLET (L = 10.0')	3 EA

QUANTITIES ARE ESTIMATED ONLY. CONTRACTOR IS TO VERIFY DURING BIDDING PROCESS.

NOTE

THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS

BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

Call before you Dig — Avoid cutting underground utility lines. It's costly. Call 811 or 1-800-227-2600 or CLARK COUNTY TRAFFIC OPERATIONS 1-702-455-6000

AVOID INITIAL OVERHEAD POWER LINES. IT'S COSTLY. CALL BEFORE YOU DIG OVERHEAD 1-702-227-2929

FAST — Call before you UnderGround 1-702-432-5300 CITIZENS AND INDUSTRIAL SECURITY OF TRANSPORTATION

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123547 DATE:

ENGINEER – STATE OF NEVADA – JOSHUA L. JOHNSON – No. 19764 – CIVIL – PROFESSIONAL ENGINEER – DATE: 03/10/2016

NO.	DATE	DESCRIPTION	DRAWN	APPD
2	10/16/15	SHEETED TO STUDY 18 PARCELS, MADE INTO PHASES		
1	8/24/15	SPOT CORRECTION OF SOME MINOR ITEMS		

PROJECT NO. 62024-222
DESIGN: GDW
DRAWN: GDW
CHECK: JLJ
PLOT DATE: 03-10-16
PLOT TIME: 10:01:16

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
3333 S. RAINBOW BLVD · LAS VEGAS, NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM
LAS VEGAS

F:\Projects\600\62024-222\DWG\Production\24CB2plotSh_sht2.dwg
Lupe Garcia

THE HOWARD HUGHES COMPANY, LLC

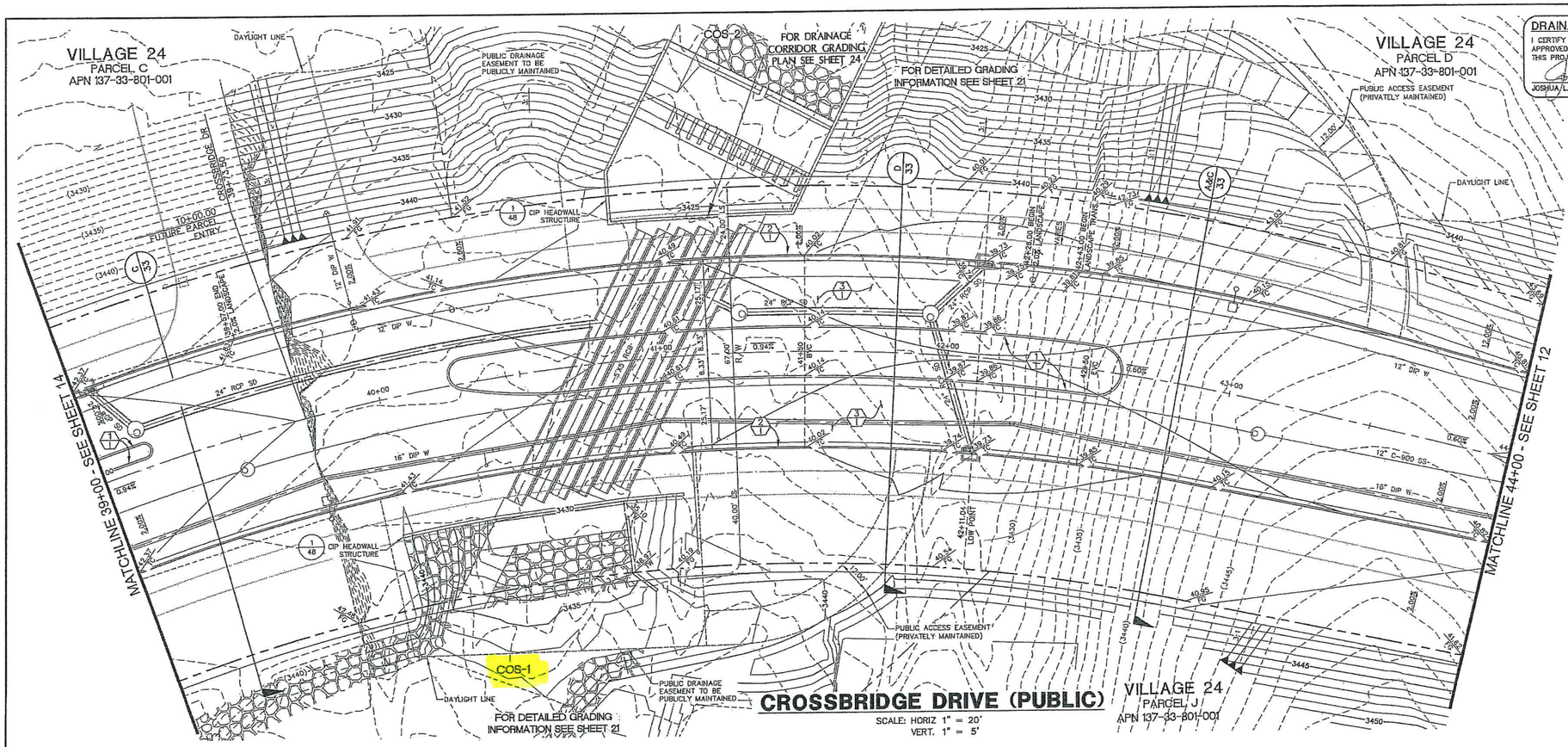
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2 IMPROVEMENT PLANS

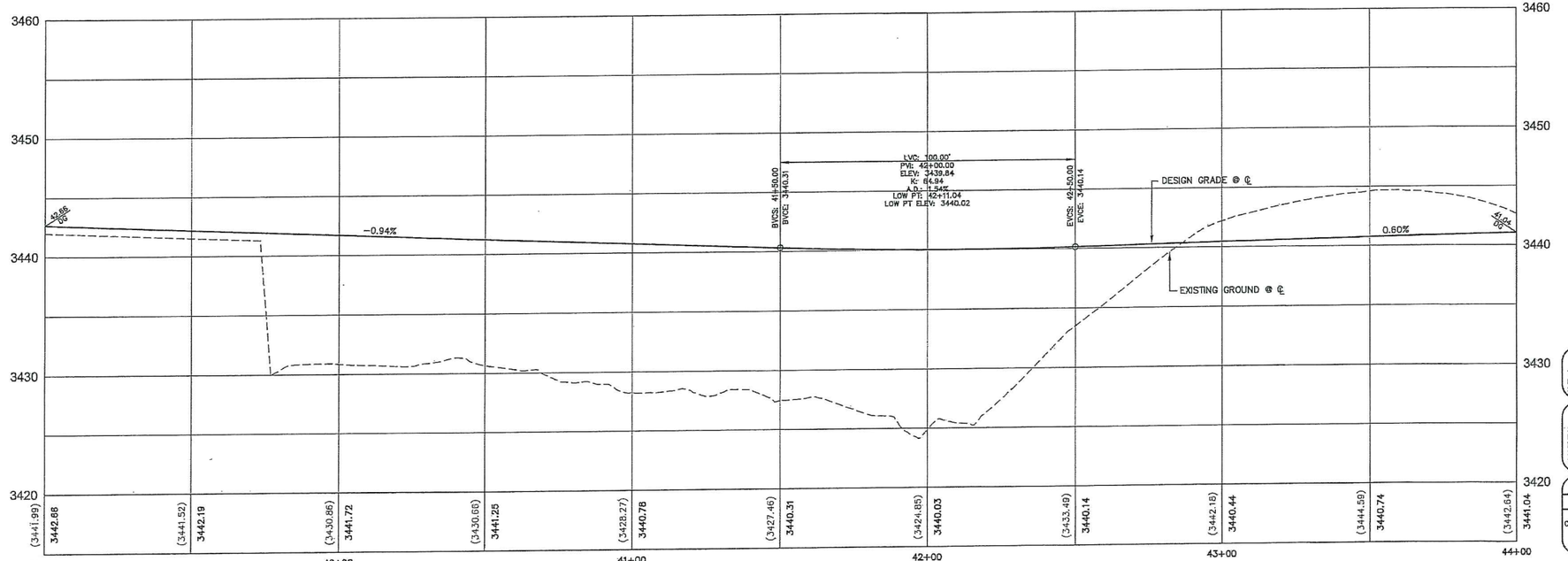
MASTER UTILITY PLAN – STORM DRAIN

DRAWING 6
6 OF 53 SHTS

SID NO. 812 PROJECT 9A, 9B AND 10A

dwg 24.36.dwg 070203.lay





DRAINAGE CERTIFICATION

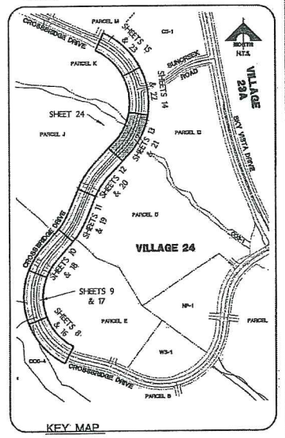
I CERTIFY THAT THE GRADING PLANS ARE IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

JOSHUA L. JOHNSON P.E. 15789 — DATE 10/28/15

NORTH

SCALE 20 0 20 40 FEET

KEY MAP



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BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 119, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM (FEET)	NAVD 88 DATUM (METERS)
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3248.83	989.574

FAST — Call before you UnderGround 1-702-432-5300 FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

Call before you Dig — Call 811 or 1-800-227-2600 or CLARK COUNTY TRAFFIC ENGINEERING 1-702-455-6000

CALL BEFORE YOU DIG POWER LINES ARE NOT BURIED — CALL BEFORE YOU DIG OVERHEAD 1-702-227-2929

ENGINEER - STATE OF NEVADA — JOSHUA L. JOHNSON — No. 15789 — EXPIRES 12-31-16 — DATE: 10/29/2015

REV	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP
	TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION				

PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JWJ
PLOT DATE: 10-28-15
PLOT TIME: 11:09:23

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD - LAS VEGAS, NV 89146
P: 702.804.2000 - F: 702.804.2299 - GCWALLACE.COM
LAS VEGAS

F:\Projects\000\62024-222\DWG\Production\24CB2st3_PP6.dwg
Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

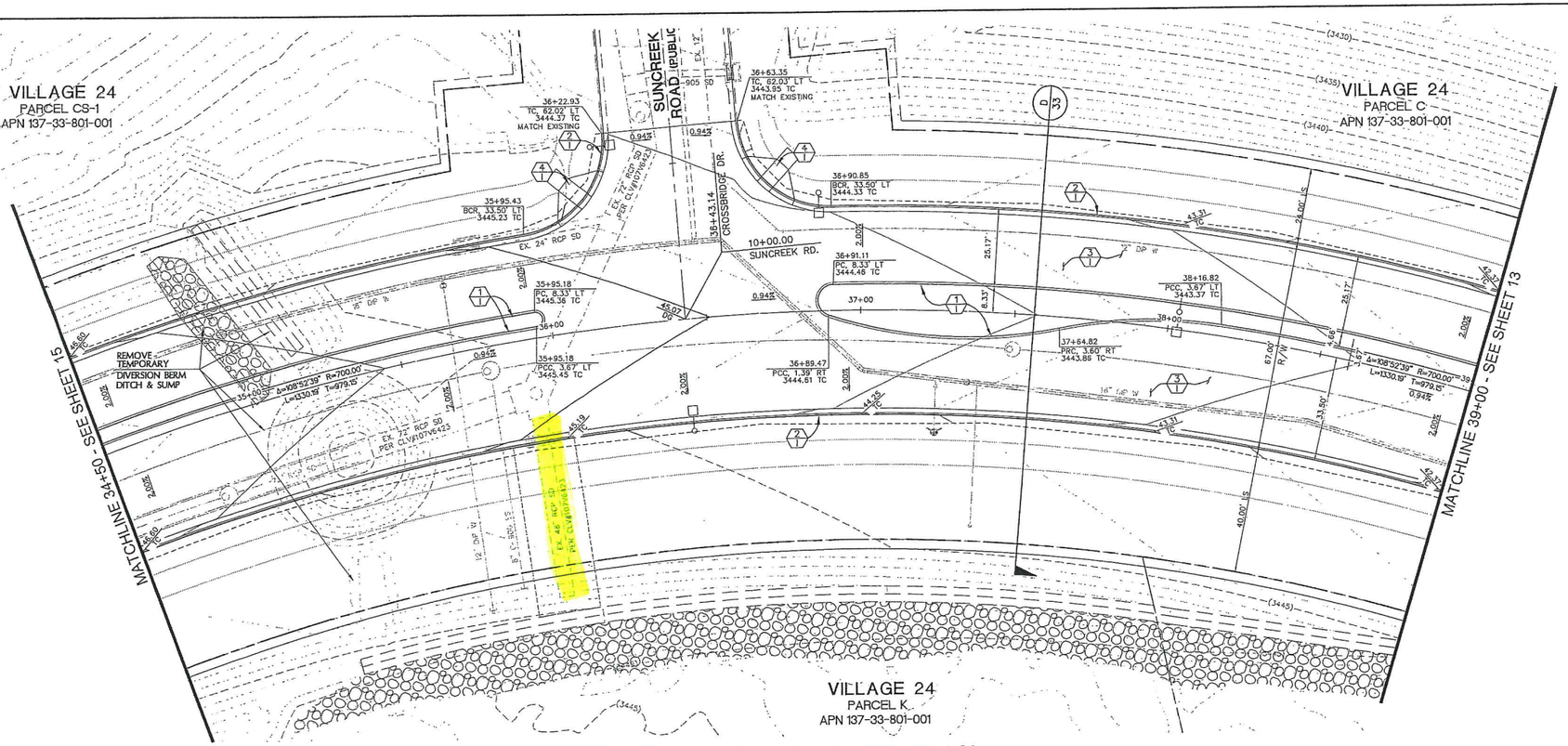
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

CROSSBRIDGE DRIVE
ROADWAY PLAN AND PROFILE 6

DRAWING 13
13 OF 53 SHTS

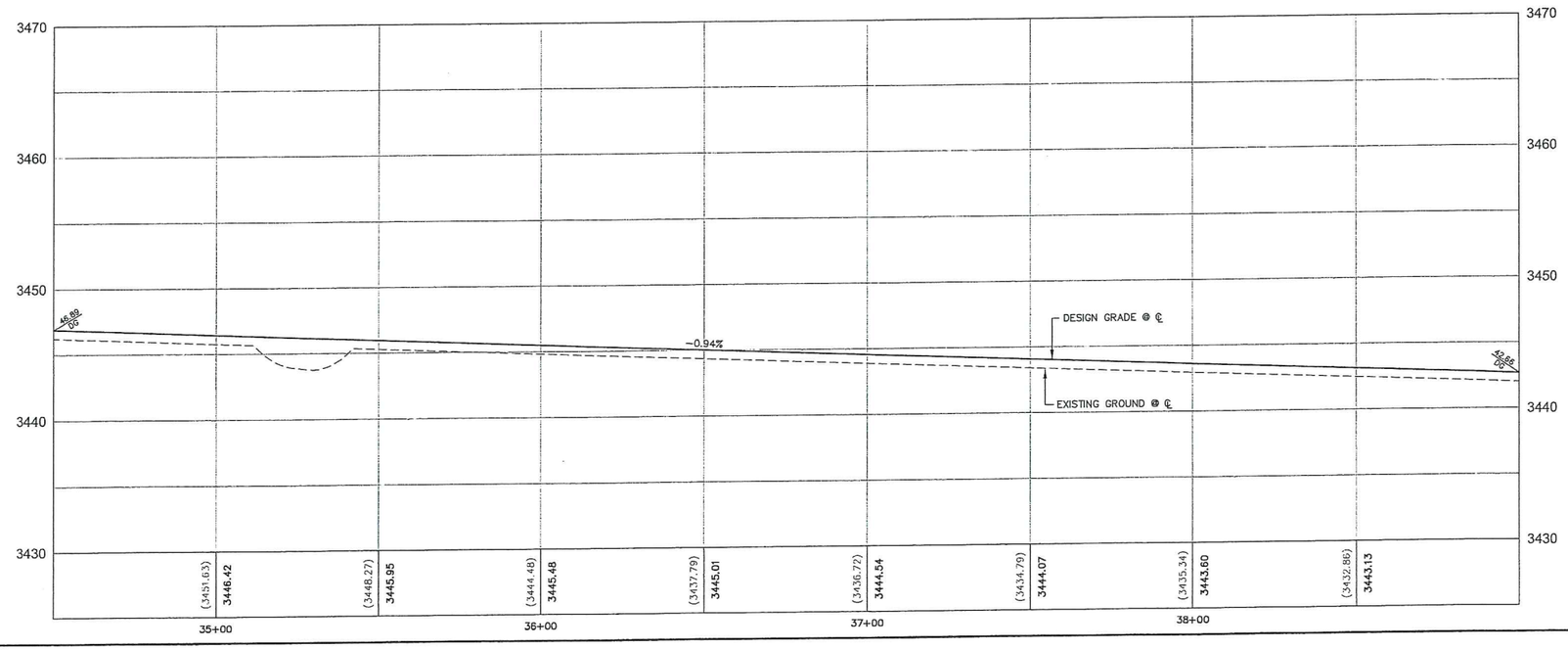
SID NO. 812 PROJECT 2

dgn:24ST4.dwg 07/2013.dgn



CROSSBRIDGE DRIVE (PUBLIC)

SCALE: HORIZ 1" = 20'
VERT. 1" = 5'



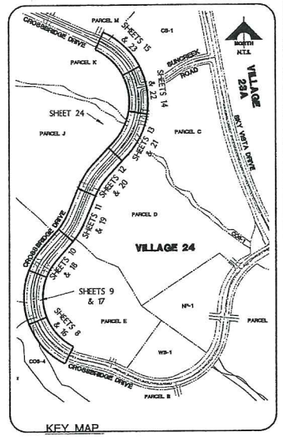
DRAINAGE CERTIFICATION

I CERTIFY THAT THE GRADING PLANS ARE IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

JOSHUA L. JOHNSON P.E. 15789 DATE

NORTH

SCALE: 20 0 20 40 FEET



KEY MAP

NOTE

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BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

FAST Call before you UnderGround 1-702-432-5300 FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

Call before you Dig Avoid cutting or damaging utility lines underground. Call 811 or 1-800-227-2600 CLARK COUNTY WATER OPERATIONS 1-702-455-6000

AVOID POWER OVERHEAD POWER LINES, IT'S CRAZY! CALL BEFORE YOU DO OVERHEAD 1-702-227-2929

ENGINEER, STATE OF NEVADA, JOSHUA L. JOHNSON, No. 15789, PROFESSIONAL

DATE: 10/01/2015

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 10-01-15
PLOT TIME: 11:19:30

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD - LAS VEGAS, NV 89146
T: 702.804.2000 F: 702.804.2229 - GCWALLACE.COM
LAS VEGAS

F:\Projects\60\62024-222\DWG\Production\24CB2d14_PP7.dwg
Paul Brainerd

THE HOWARD HUGHES COMPANY, LLC

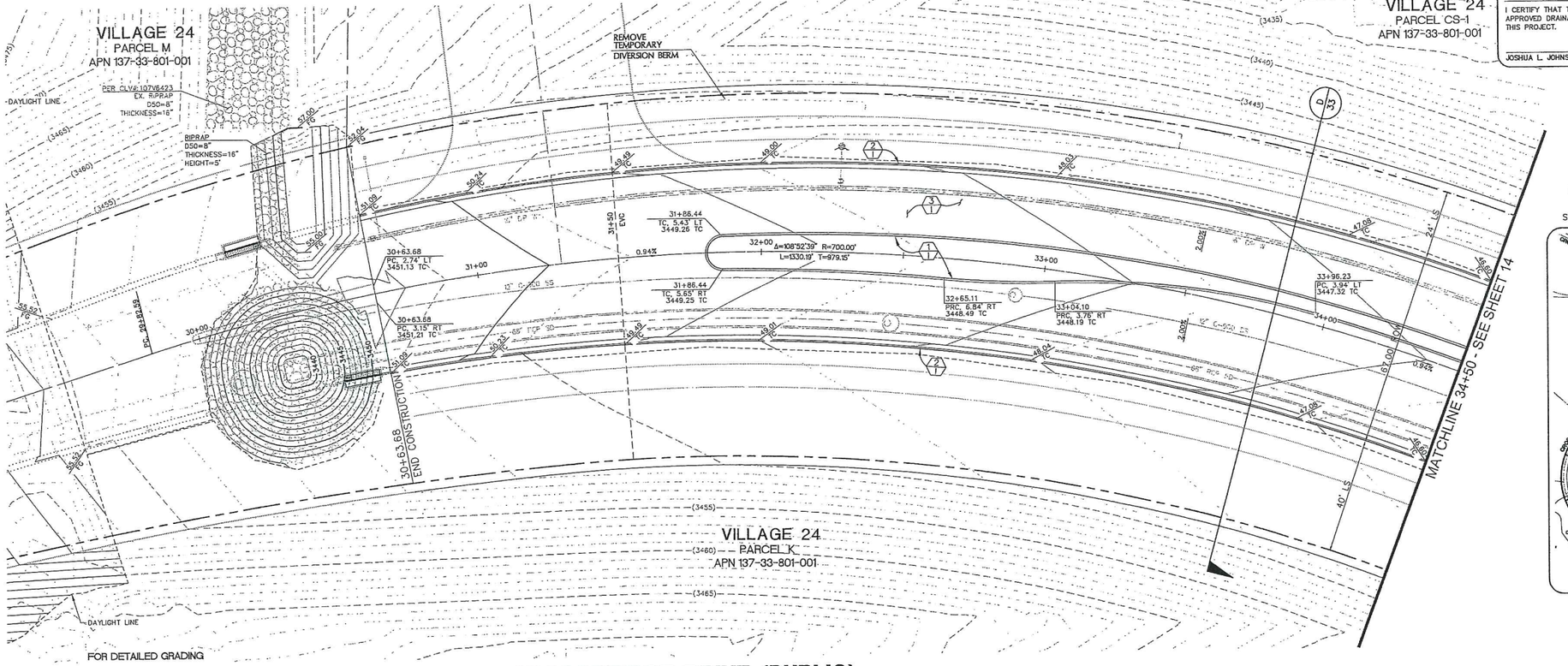
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

CROSSBRIDGE DRIVE
ROADWAY PLAN AND PROFILE 7

DRAWING 14
14 OF 53 SHTS

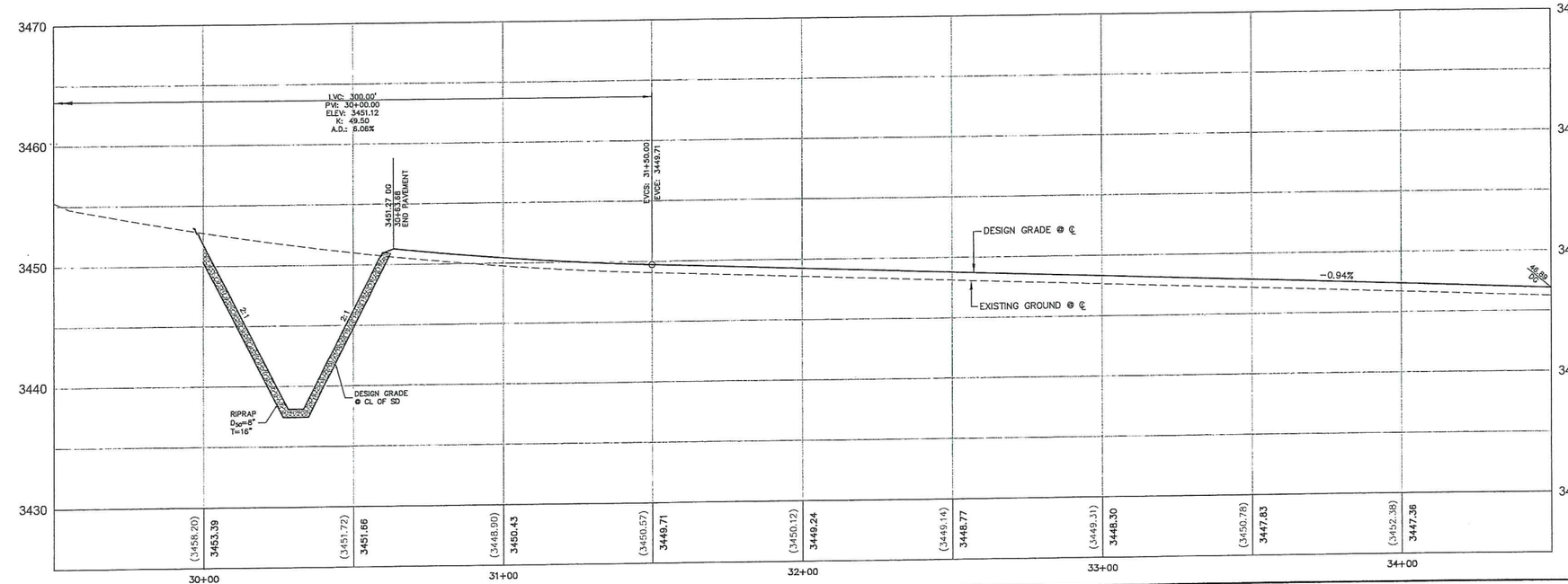
SID NO. 812 PROJECT 2

gw24136.dwg 070203.sv



CROSSBRIDGE DRIVE (PUBLIC)

SCALE: HORIZ 1" = 20'
VERT. 1" = 5'



DRAINAGE CERTIFICATION

I CERTIFY THAT THE GRADING PLANS ARE IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

JOSHUA L. JOHNSON P.E. 15789 DATE

FAST Call before you UnderGround 1-702-432-5300 (DEDAY AND ARTERIAL SYSTEM OF TRANSPORTATION)

Call before you Dig Avoid cutting underground utility lines, it's costly. Call 811 1-800-227-2600 OR CLARK COUNTY WASTEWATER OPERATIONS 1-702-455-6000

AVOID POTENTIAL ELECTROCUTION POWER LINES, IT'S COSTLY. CALL BEFORE YOU DIG OVERHEAD 1-702-227-2929

NOTE

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BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

ENGINEER – STATE OF NEVADA – JOSHUA L. JOHNSON – No. 15789 – PROFESSIONAL ENGINEER – DATE: 10/01/2015

REV	DATE	DESCRIPTION	DATE	HGSN APP	DATE	GCW APP

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 10-01-15
PLOT TIME: 11:21:58

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD · LAS VEGAS, NV 89146
T: 702.804.2000 · F: 702.804.2399 · GCWALLACE.COM
LAS VEGAS
F:\Projects\G00\62024-222\DWG\Production\24CB2st15_PP8.dwg
Paul Brennord

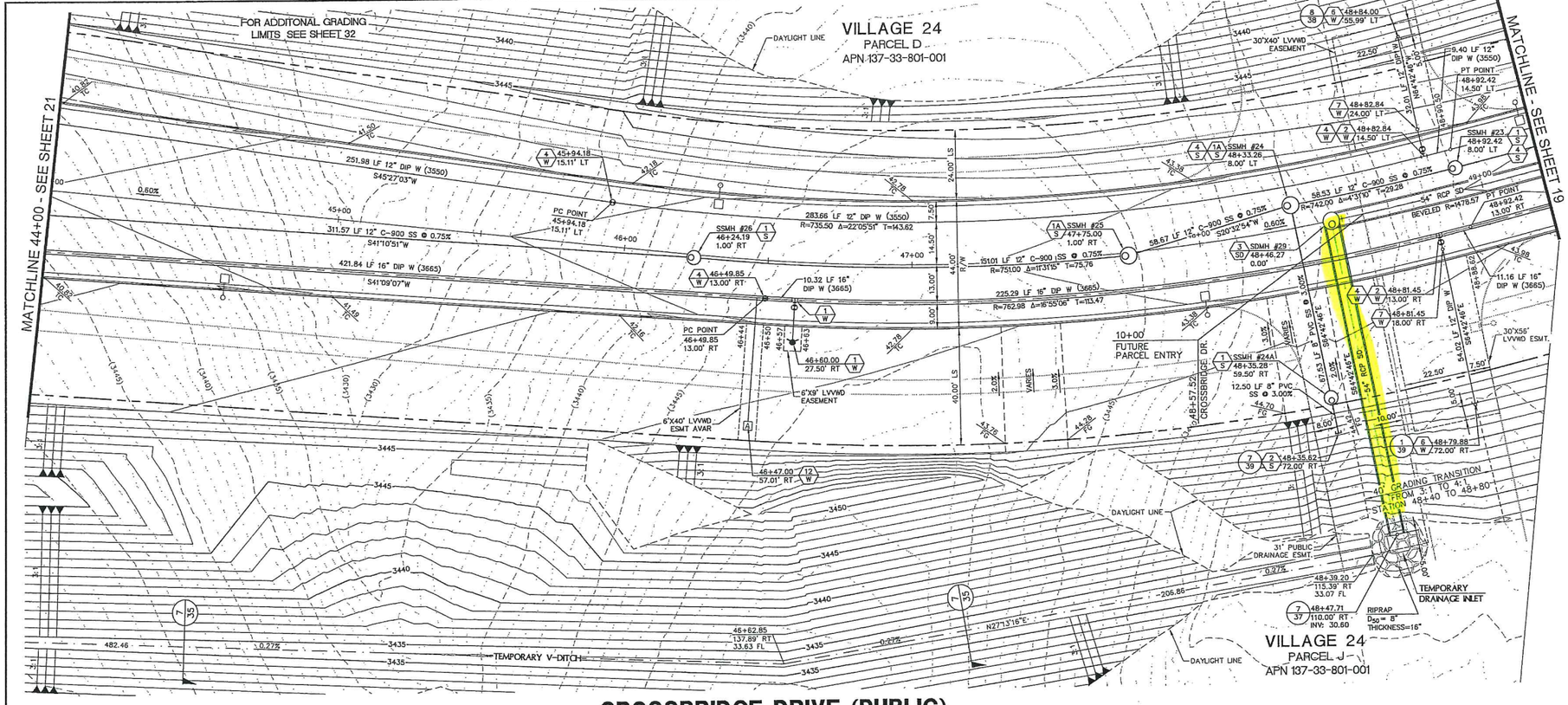
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 – CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

CROSSBRIDGE DRIVE
ROADWAY PLAN AND PROFILE 8

DRAWING 15
15 OF 53 SHTS

SID NO. 812 PROJECT 2


FOR ADDITONAL GRADING LIMITS SEE SHEET 32
MATCHLINE 44+00 - SEE SHEET 21
MATCHLINE - SEE SHEET 19
VILLAGE 24
PARCEL D
APN:137-33-801-001
VILLAGE 24
PARCEL J
APN 137-33-801-001
DAYLIGHT LINE
TEMPORARY V-DITCH
CROSSBRIDGE DR.
10+00 FUTURE PARCEL ENTRY
6'X40' LVVWD ESMT AVAR
6'X9' LVVWD EASEMENT
30'X40' LVVWD EASEMENT
30'X55' LVVWD ESMT.
31' PUBLIC DRAINAGE ESMT.
TEMPORARY DRAINAGE INLET
RIPRAP D50= 8" THICKNESS=16"
45+94.18 15.11' LT
PC POINT 45+94.18 15.11' LT
251.98 LF 12" DIP W (3550) S45°27'03"W
311.57 LF 12" C-900 SS @ 0.75% S41°10'51"W
421.84 LF 16" DIP W (3665) S41°09'07"W
283.66 LF 12" DIP W (3550) R=735.50 Δ=22°05'51" T=143.62
SSMH #26 46+24.19 1.00' RT
46+49.85 13.00' RT
PC POINT 46+49.85 13.00' RT
10.32 LF 16" DIP W (3665)
46+50.00 27.50' RT
46+47.00 57.01' RT
225.29 LF 16" DIP W (3665) R=762.98 Δ=16°55'06" T=113.47
151.01 LF 12" C-900 SS @ 0.75% R=751.00 Δ=11°31'15" T=75.76
SSMH #25 47+75.00 1.00' RT
58.67 LF 12" C-900 SS @ 0.75% R=742.00 Δ=4°31'40" T=29.28 S20°12'54"W
SSMH #24 48+33.26 8.00' LT
SDMH #29 48+46.27 0.00'
48+57.52 CROSSBRIDGE DR.
12.50 LF 8" PVC SS @ 3.00%
47.63 LF 8" PVC SS @ 3.00% S64°42'46"E
54" RCP SD @ 0.60% S64°42'46"E
48+84.00 55.99' LT
9.40 LF 12" DIP W (3550)
PT POINT 48+92.42 14.50' LT
48+82.84 24.00' LT
48+82.84 14.50' LT
SSMH #23 48+92.42 8.00' LT
54" RCP SD @ 0.75% S64°42'46"E
54" RCP SD BEVELED R=1478.57 PT POINT 48+92.42 13.00' RT
11.16 LF 16" DIP W (3665)
48+81.45 13.00' RT
48+81.45 18.00' RT
48+79.88 72.00' RT
48+35.62 72.00' RT
48+39.20 115.39' RT 33.07 FL
48+47.71 110.00' RT INV: 30.60
46+62.85 137.89' RT 33.63 FL
482.46
206.85
N27°13'16"E
0.60%
0.27%
0.75%
3.00%
2.00%
4.50%
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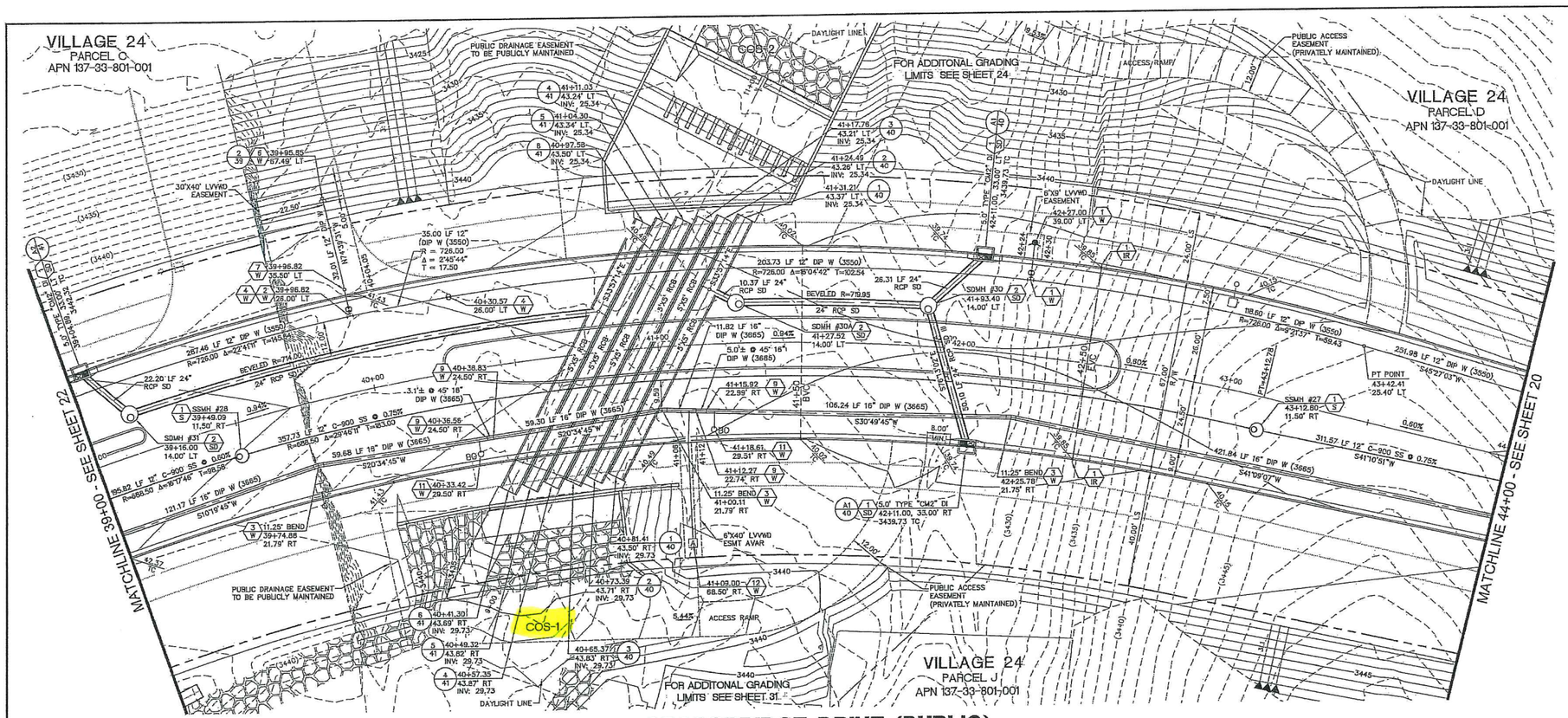

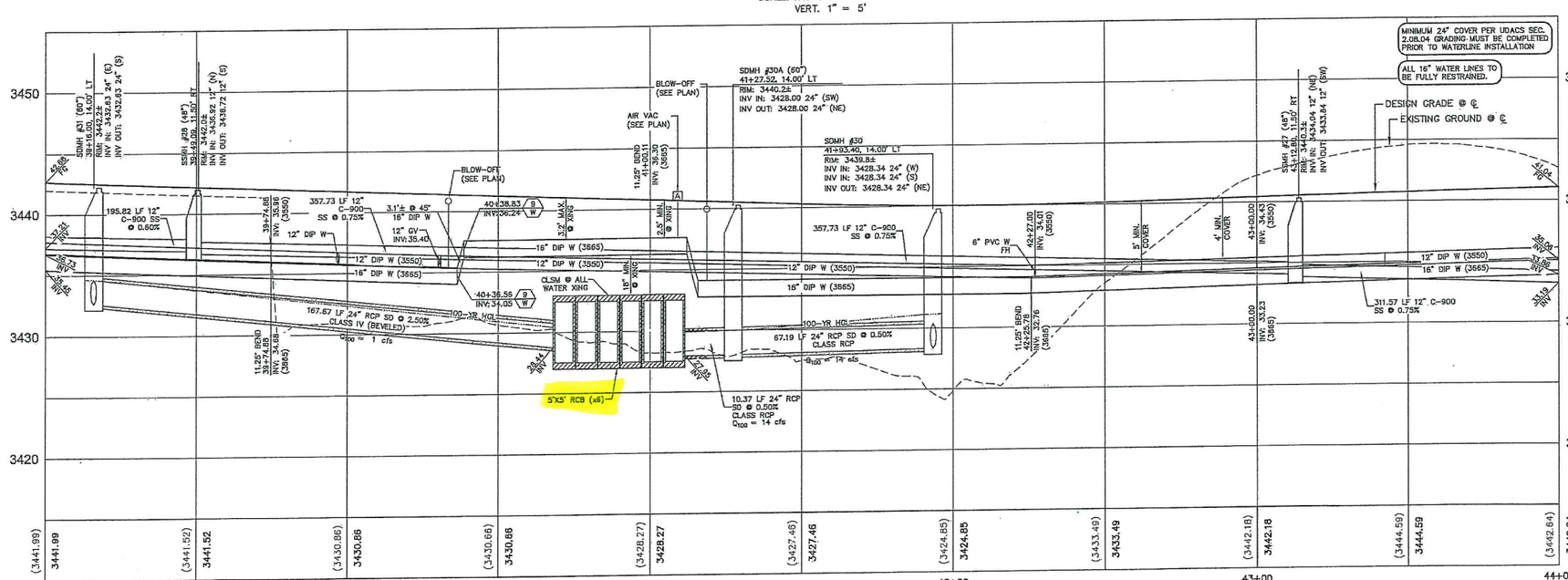

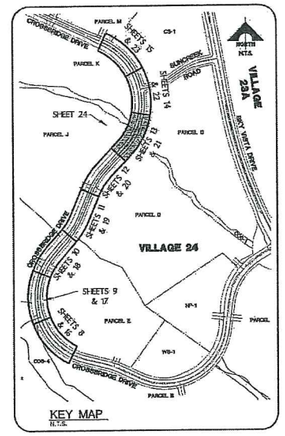

SCALE: 20 0 20 40 FEET

FAST Call before you UnderGround 1-702-432-5300

Call before you Dig Call 811 or 1-800-227-2600 or CLARK COUNTY TRAFFIC OPERATIONS 1-702-455-6000

AVOID OVERHEAD POWER LINES, IT'S EASY. CALL BEFORE YOU DIG (OVERHEAD) 1-702-227-2929

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BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D358	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123547 DATE:

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	CCW APP
1	11/11/11					

PROJECT NO. 62024-222
DESIGN: CCW
DRAWN: CCW
CHECK: JLJ
PLOT DATE: 10-28-15
PLOT TIME: 11:11:11

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
3553 S. RAINBOW BLVD · LAS VEGAS, NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-222\DWG\Production\24CB2x21_U16.dwg
Matthew Burge

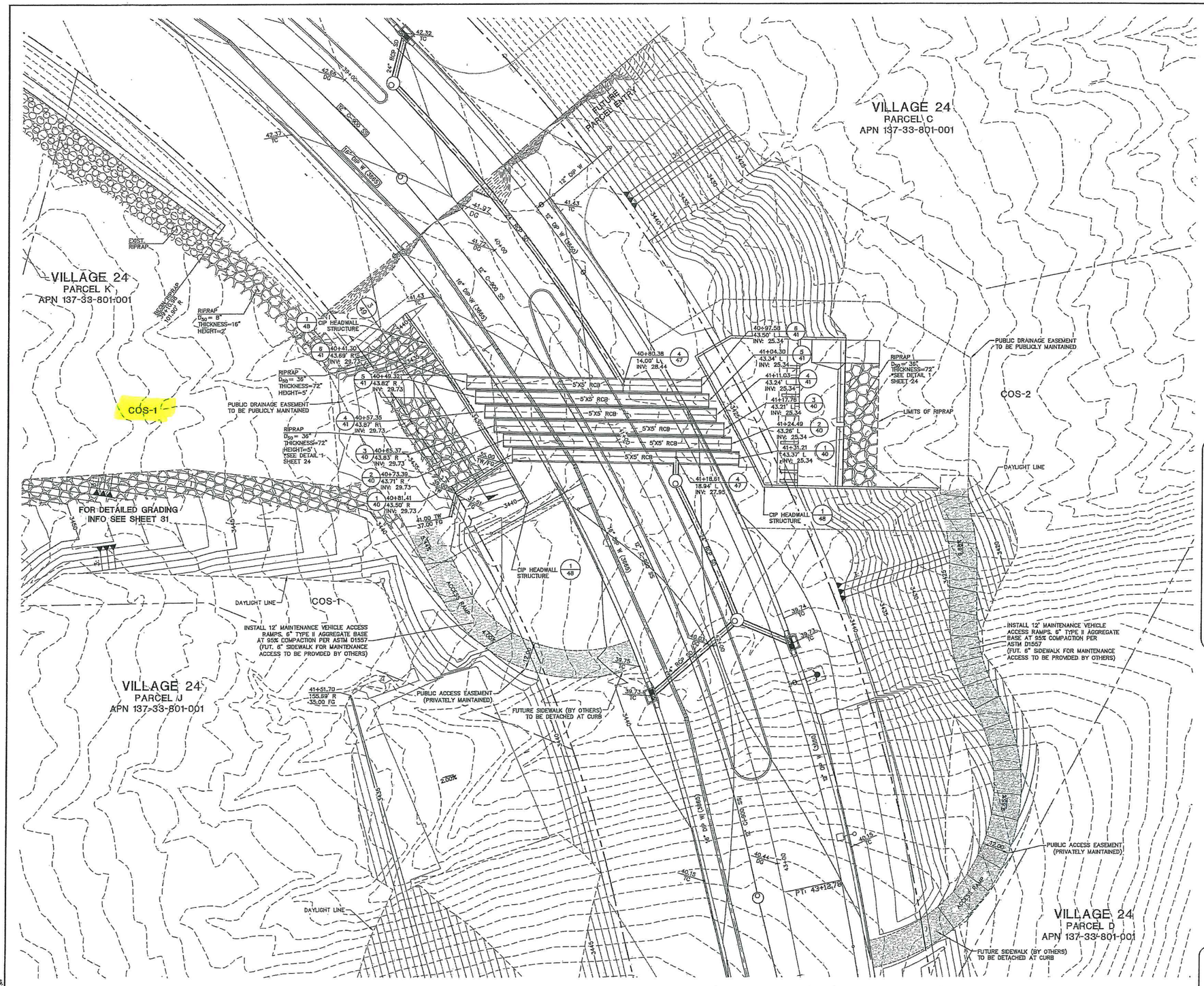
THE HOWARD HUGHES COMPANY, LLC

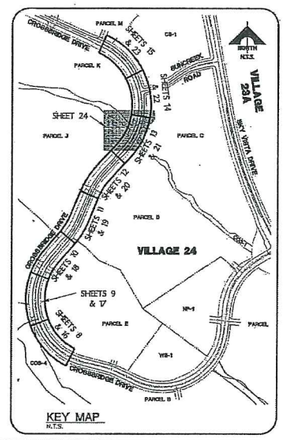
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

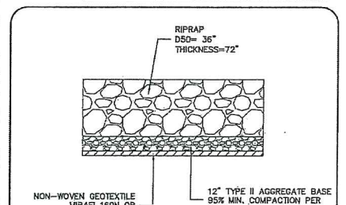
CROSSBRIDGE DRIVE
UTILITY PLAN AND PROFILE 6

DRAWING 21
21 OF 53 SHTS

SID NO. 812 PROJECT 2







RIPRAP DETAIL — 1 / NTS

NOTE

THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS

BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D358	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

Call before you Dig — Avoid cutting underground utility lines. It's costly. Call 811 or 1-800-227-2600 AND CLARK COUNTY TRAFFIC OPERATIONS 1-702-455-6000

CALL BEFORE YOU DIG OVERHEAD — AVOID UTILITY OVERHEAD POWER LINES IT'S COSTLY — 1-702-227-2929

FAST — Call before you UnderGround — 1-702-432-5300 — CLEETUS AND ASSOCIATED SYSTEM OF TRANSPORTATION

CROSSBRIDGE DRIVE (PUBLIC) - DRAINAGE CORRIDOR CROSSING

SCALE: HORIZ. 1" = 20'

ENGINEER - STATE OF NEVADA — JOSHUA M. JOHNSON — No. 15181 — PROFESSIONAL — 10/28/2015

DATE: 10/28/2015

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-222

DESIGN: GCW
DRAWN: GCW
CHECK: JMJ
PLOT DATE: 10-28-15
PLOT TIME: 11:14:20

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
3555 S. RAINBOW BLVD - LAS VEGAS NV 89146
P: 702.804.2000 - F: 702.804.2299 - GCWALLACE.COM

LAS VEGAS

F:\Projects\600\62024-222\DWG\Production\24CB2x24_G01.dwg
Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

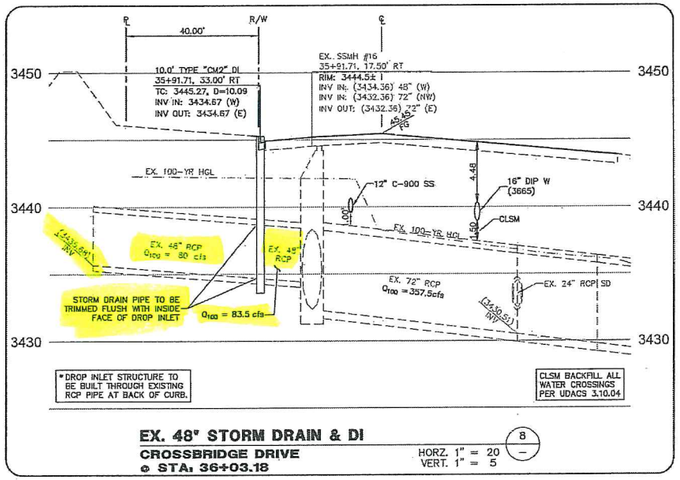
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2 IMPROVEMENT PLANS

CROSSBRIDGE DRIVE
GRADING AT DRAINAGE CORRIDOR CROSSING

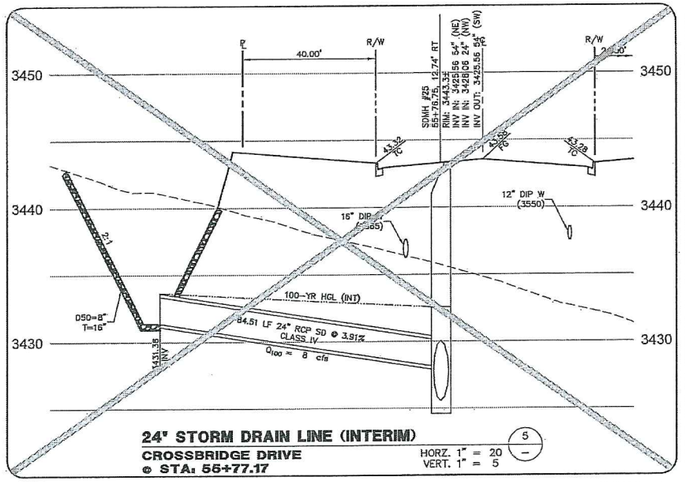
SID NO. 812 PROJECT 2

DRAWING 24
24 OF 53 SHTS

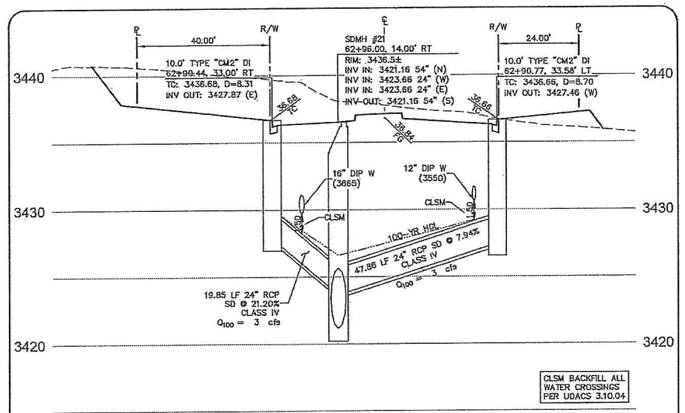
cw24x36.dwg,10/28/15,jw



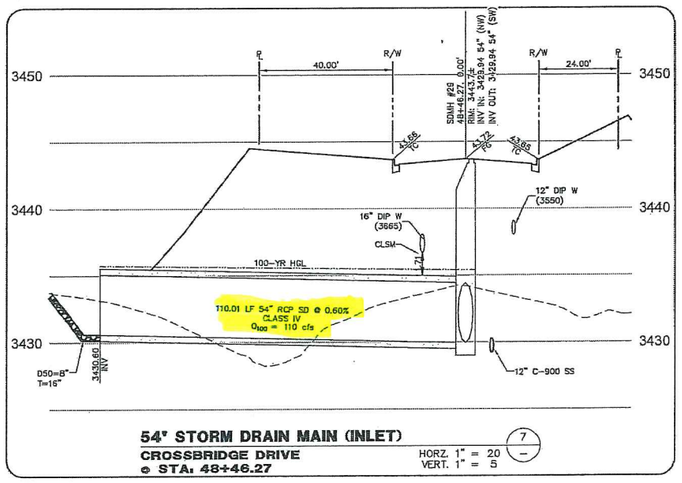
EX. 48" STORM DRAIN & DI
CROSSBRIDGE DRIVE
@ STA: 36+03.18
HORZ. 1" = 20
VERT. 1" = 5
8



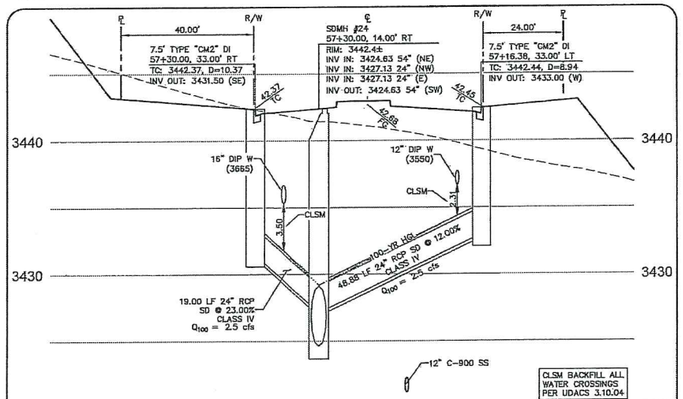
24" STORM DRAIN LINE (INTERIM)
CROSSBRIDGE DRIVE
@ STA: 56+77.17
HORZ. 1" = 20
VERT. 1" = 5
5



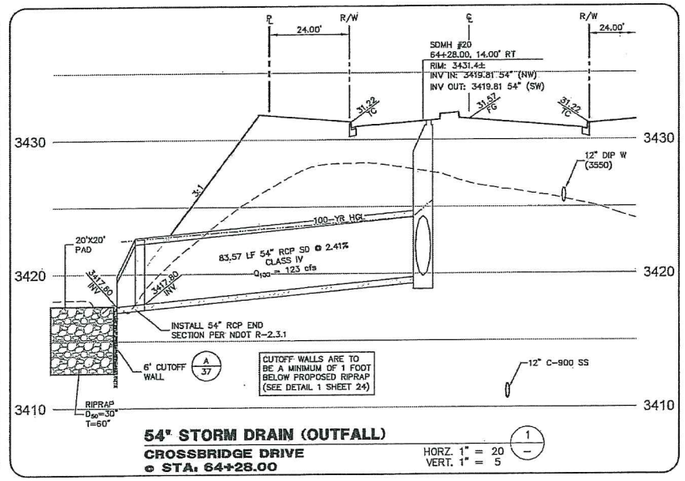
24" STORM DRAIN & DI
CROSSBRIDGE DRIVE
@ STA: 62+94.54
HORZ. 1" = 20
VERT. 1" = 5
2



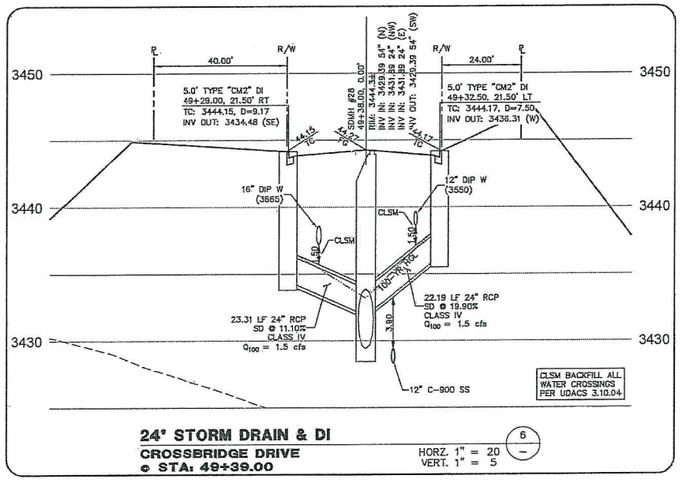
54" STORM DRAIN MAIN (INLET)
CROSSBRIDGE DRIVE
@ STA: 48+46.27
HORZ. 1" = 20
VERT. 1" = 5
7



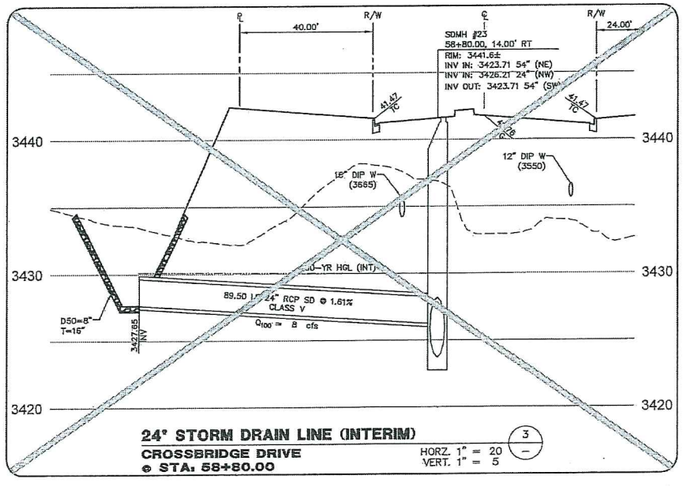
24" STORM DRAIN & DI
CROSSBRIDGE DRIVE
@ STA: 57+26.15
HORZ. 1" = 20
VERT. 1" = 5
4



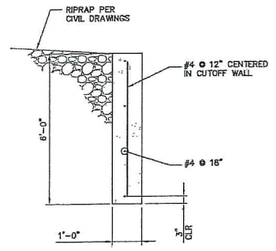
54" STORM DRAIN (OUTFALL)
CROSSBRIDGE DRIVE
@ STA: 64+28.00
HORZ. 1" = 20
VERT. 1" = 5
1



24" STORM DRAIN & DI
CROSSBRIDGE DRIVE
@ STA: 49+39.00
HORZ. 1" = 20
VERT. 1" = 5
6



24" STORM DRAIN LINE (INTERIM)
CROSSBRIDGE DRIVE
@ STA: 58+80.00
HORZ. 1" = 20
VERT. 1" = 5
3



SINGLE CUTOFFWALL DETAIL
NTS
A

DROP INLET NOTE

WHERE 10 FEET PARALLEL SEPARATION IS NOT PRACTICABLE:

CAST-IN-PLACE MONOLITHIC POUR WITH WATERSTOP BETWEEN SLAB AND WALLS, BASE, WALLS AND TOP TO BE CONSTRUCTED WITH WATERSTOPS, CENTER BULB, OR FLAT STRIP (VINYLEX, GREENSTREAK PLASTIC PRODUCTS OR APPROVED EQUAL).

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123547 DATE:

STATE OF NEVADA — PROFESSIONAL ENGINEER — JOHNSON — DATE: 03/07/2016

NO.	DATE	DESCRIPTION	DATE	AGEN. APP	DATE	CGW APP
1	05/2016	ADDED SIGNAGE & REVISED STUBS W/ PARCEL				

PROJECT NO. 62024-222
DESIGN: CGW
DRAWN: CGW
CHECK: JJJ
PLOT DATE: 03-07-16
PLOT TIME: 12:34:46

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
5555 S. RANDOM BLVD. LAS VEGAS, NV 89166
T: (702) 804-8000 F: (702) 804-8299 GCWALLACE.COM
LAS VEGAS

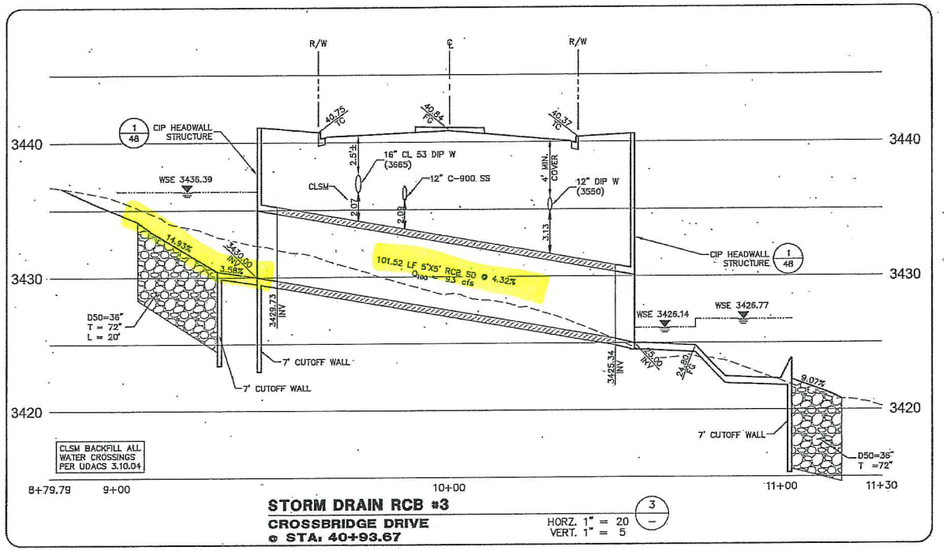
F:\Projects\6000\62024-222\GWC\Production\X45826J7_LAT1.dwg
Luis Criollo

THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS
LATERAL DETAILS 1

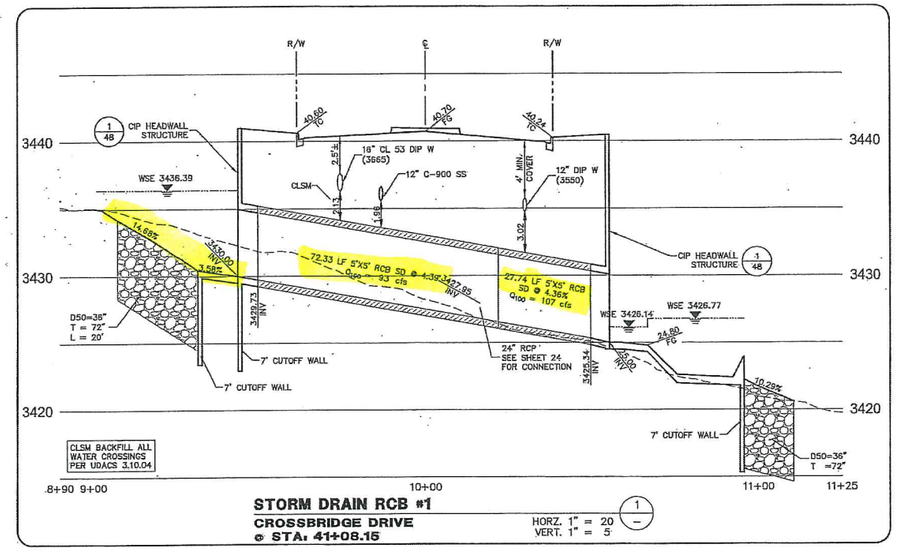
DRAWING 37
37 OF 53 SHTS

SID NO. 812 PROJECT 9A, 9B AND 10A

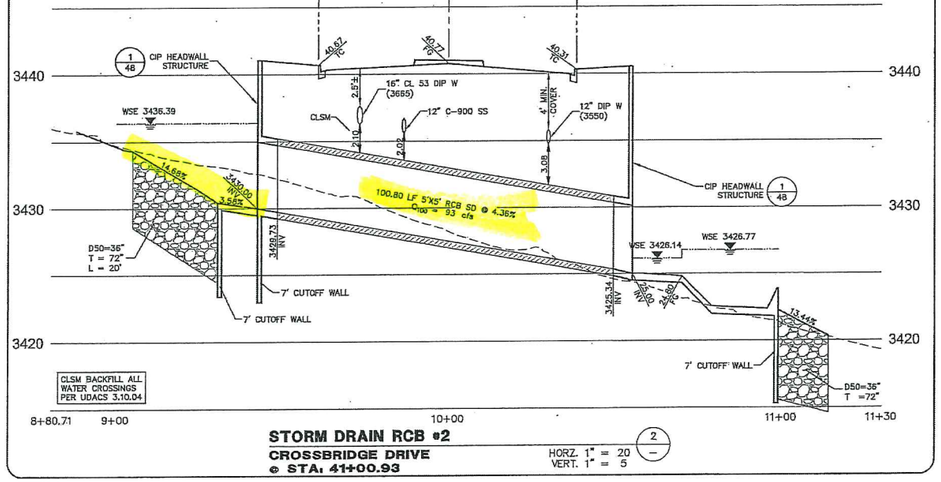
gwx4326.dwg,070203.jw



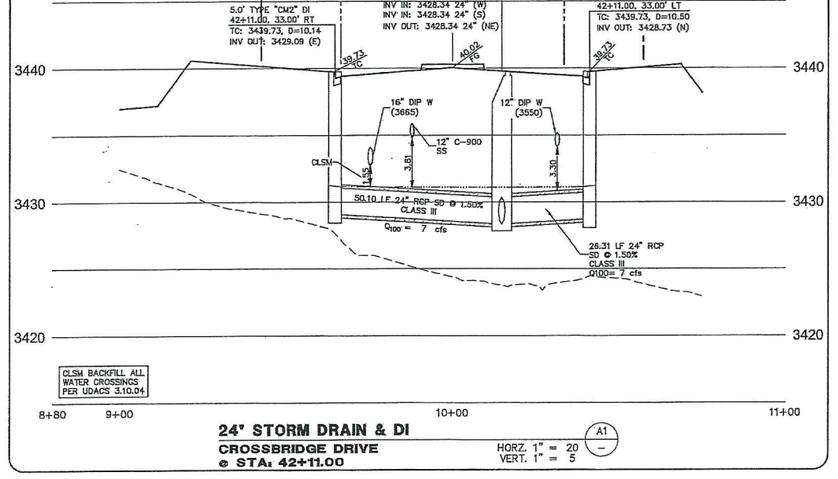
STORM DRAIN RCB #3
CROSSBRIDGE DRIVE
@ STA: 40+93.67
HORZ. 1" = 20
VERT. 1" = 5
3 / —



STORM DRAIN RCB #1
CROSSBRIDGE DRIVE
@ STA: 41+08.15
HORZ. 1" = 20
VERT. 1" = 5
1 / —



STORM DRAIN RCB #2
CROSSBRIDGE DRIVE
@ STA: 41+00.93
HORZ. 1" = 20
VERT. 1" = 5
2 / —



24' STORM DRAIN & DI
CROSSBRIDGE DRIVE
@ STA: 42+11.00
HORZ. 1" = 20
VERT. 1" = 5
A1 / —

DROP INLET NOTE

WHERE 10 FEET PARALLEL SEPARATION IS NOT PRACTICABLE:

CAST-IN-PLACE MONOLITHIC POUR WITH WATERSTOP BETWEEN SLAB AND WALLS. BASE, WALLS AND TOP TO BE CONSTRUCTED WITH WATERSTOPS, CENTER BULB, OR FLAT STRIP (VINYLEX, GREENSTREAK PLASTIC PRODUCTS OR APPROVED EQUAL).

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123547 DATE:

ENGINEER
JOSHUA L. JOHNSON
No. 19787
PROFESSIONAL
STATE OF NEVADA
DATE: 10/28/2015

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 10-29-15
PLOT TIME: 11:16:13

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 SOUTH RAINBOW BLVD. | LAS VEGAS, NEVADA 89146
T: 702.804.2000 • F: 702.804.2299 • GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-222\DWG\Production\24CB2+40_LAY1.dwg
Matthew Burga

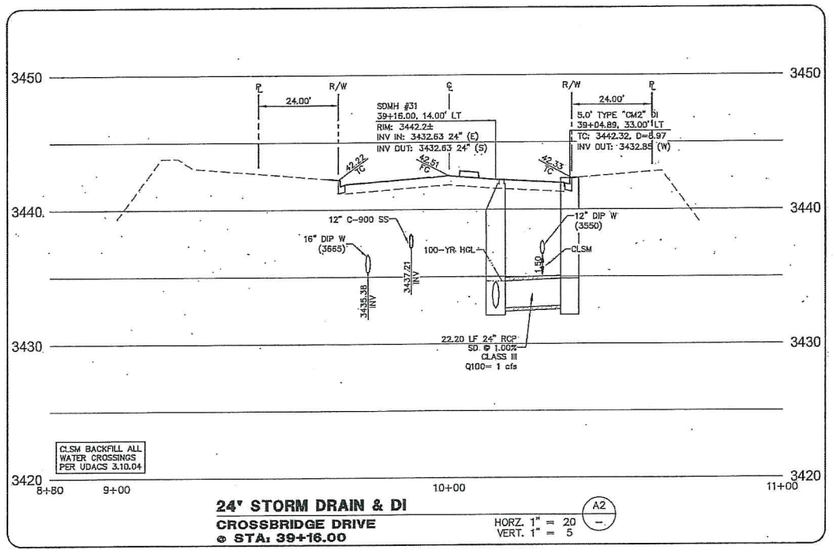
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

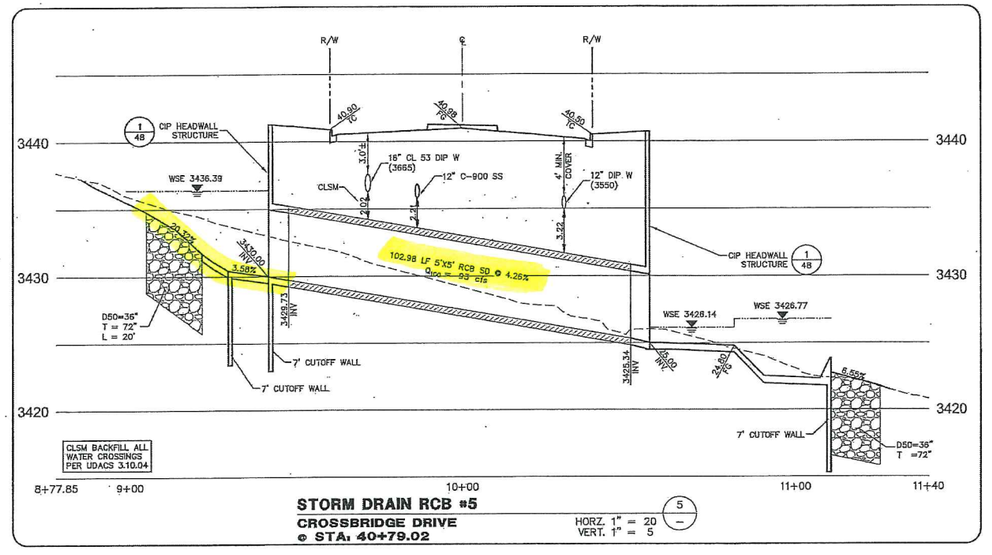
OFFSITE GRADING AND CROSSBRIDGE DRIVE
DRAINAGE CORRIDOR CROSSING DETAILS 1

DRAWING
40
40 OF 53 SHTS

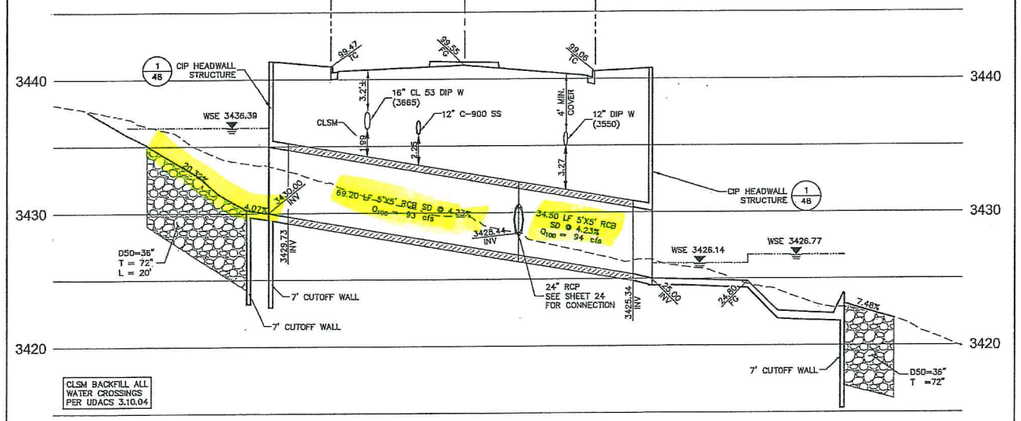
SID NO. 812 PROJECT 2



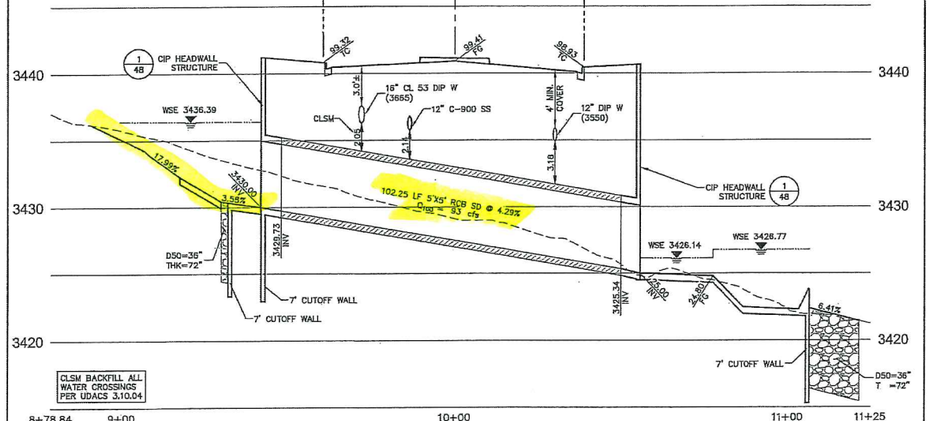
24" STORM DRAIN & DI
CROSSBRIDGE DRIVE
@ STA: 39+16.00
HORZ. 1" = 20
VERT. 1" = 5
A2 / –



STORM DRAIN RCB #5
CROSSBRIDGE DRIVE
@ STA: 40+79.02
HORZ. 1" = 20
VERT. 1" = 5
5 / –



STROM DRAIN RCB #6
CROSSBRIDGE DRIVE
@ STA: 40+71.62
HORZ. 1" = 20
VERT. 1" = 5
6 / –



STORM DRAIN RCB #4
CROSSBRIDGE DRIVE
@ STA: 40+86.37
HORZ. 1" = 20
VERT. 1" = 5
4 / –

DROP INLET NOTE

WHERE 10 FEET PARALLEL SEPARATION IS NOT PRACTICABLE:

CAST-IN-PLACE MONOLITHIC POUR WITH WATERSTOP BETWEEN SLAB AND WALLS. BASE, WALLS AND TOP TO BE CONSTRUCTED WITH WATERSTOPS, CENTER BULB, OR FLAT STRIP (VINYLEX, GREENSTREAK PLASTIC PRODUCTS OR APPROVED EQUAL).

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123647 DATE:

STATE OF NEVADA — JAMES M. HANSON — No. 9879 — PROFESSIONAL ENGINEER
DATE: 10/29/2015

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JMJ
PLOT DATE: 10-28-15
PLOT TIME: 11:17:08

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD - LAS VEGAS, NV 89146
T: 702.804.2000 - F: 702.804.2299 - GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-222\DWG\Production\24C02241_LA75.dwg
Matthew Burge

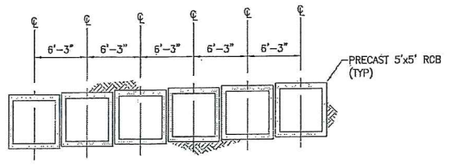
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

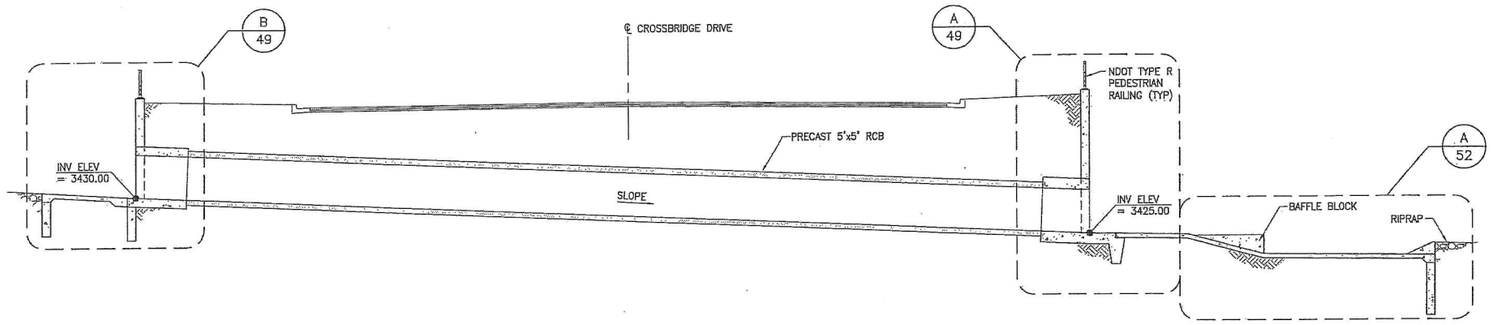
OFFSITE GRADING AND CROSSBRIDGE DRIVE
DRAINAGE CORRIDOR CROSSING DETAILS 2

DRAWING
41
41 OF 53 SHTS

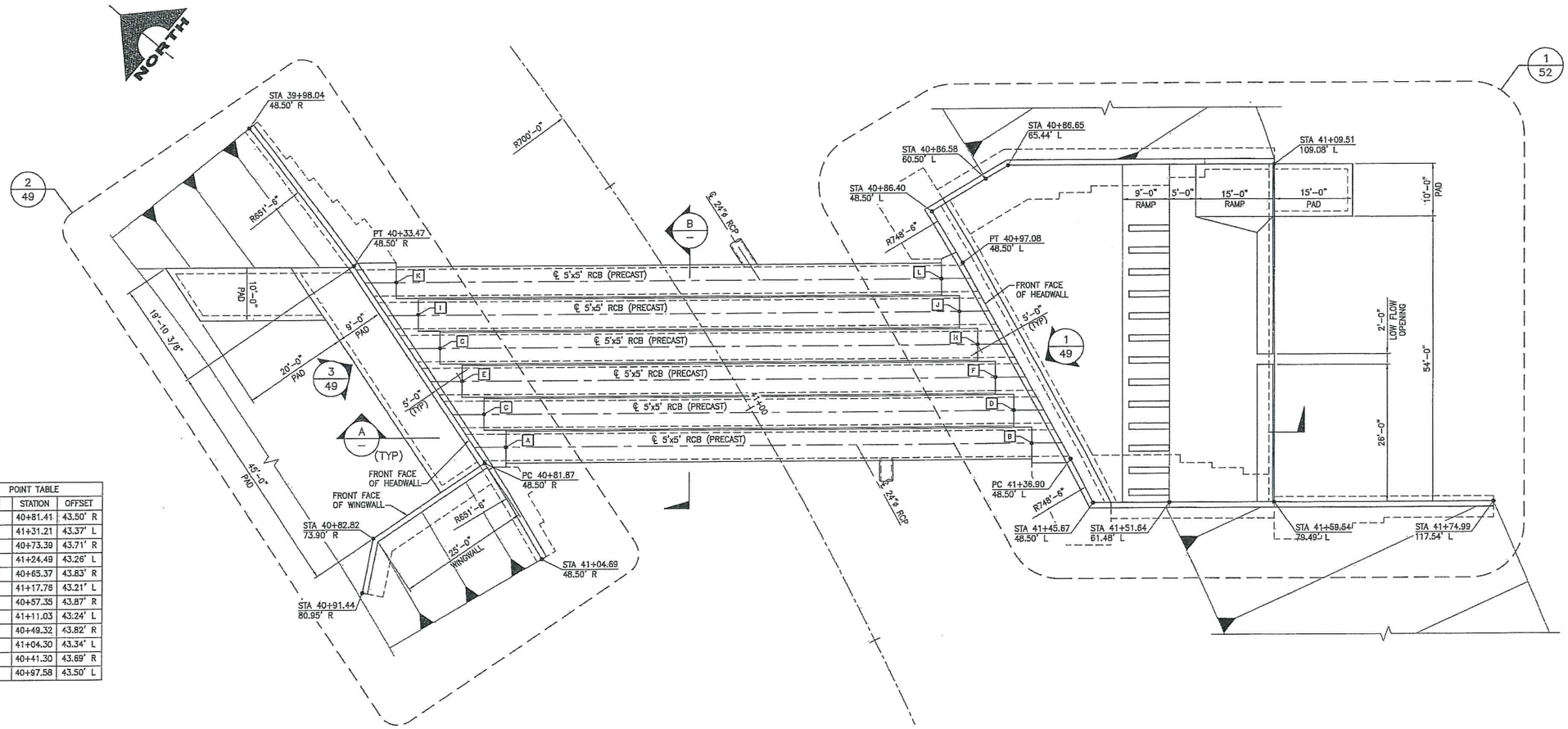
SID NO. 812 PROJECT 2



B TYP SECTION AT PRECAST (6)-5'x5' RCB
SCALE: 1/8" = 1'-0"



A PROFILE
SCALE: 1/8" = 1'-0"



POINT TABLE		
POINT	STATION	OFFSET
A	40+81.41	43.50' R
B	41+31.21	43.37' L
C	40+73.39	43.71' R
D	41+24.49	43.26' L
E	40+65.37	43.83' R
F	41+17.76	43.21' L
G	40+57.35	43.87' R
H	41+11.03	43.24' L
I	40+49.32	43.82' R
J	41+04.30	43.34' L
K	40+41.30	43.69' R
L	40+97.58	43.50' L

1 PLAN - DRAINAGE CORRIDOR CROSSING
SCALE: 3/32" = 1'-0"

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

DATE: 10/28/2015

REV	DATE	DESCRIPTION	DATE	AGEN. APP	DATE	GCW APP

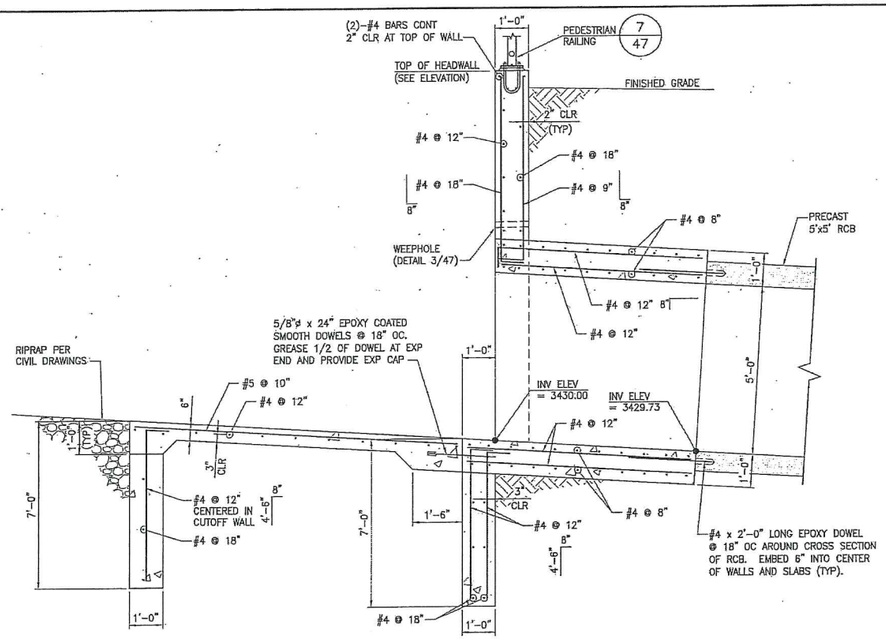
PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 10-28-15
PLOT TIME: 11:17:23

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD · LAS VEGAS, NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-222\DWG\Production\24CB2c48_SC2.dwg
Matthew Burge

THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS
DRAINAGE CORRIDOR STRUCTURAL DETAILS 1

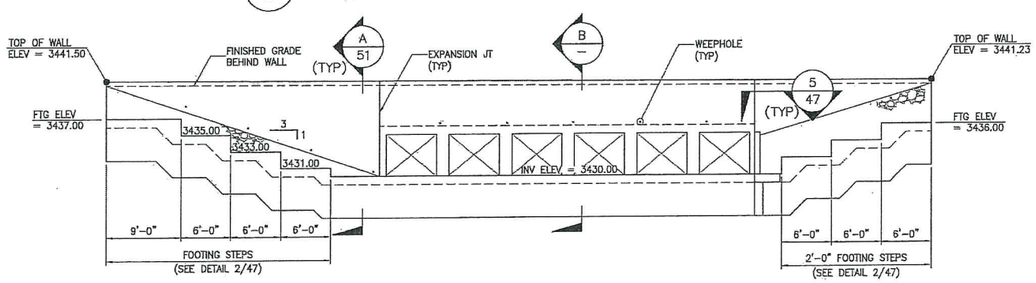
DRAWING
48
48 OF 53 SHTS

SID NO. 812 PROJECT 2



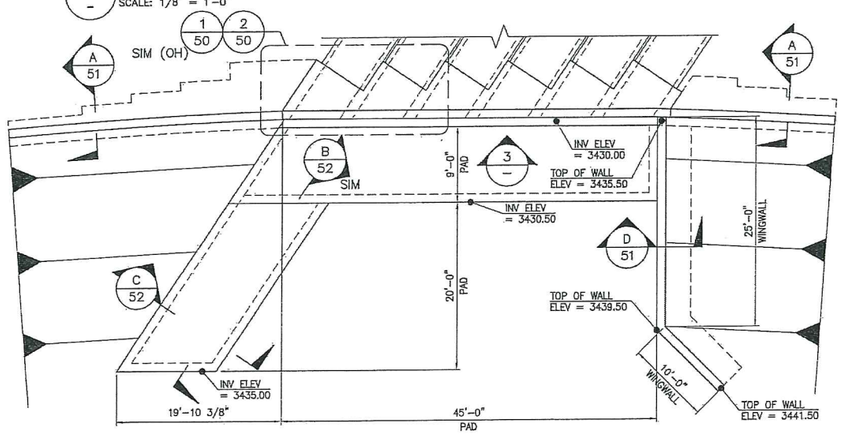
B UPSTREAM HEADWALL SECTION

SCALE: 1/2" = 1'-0"



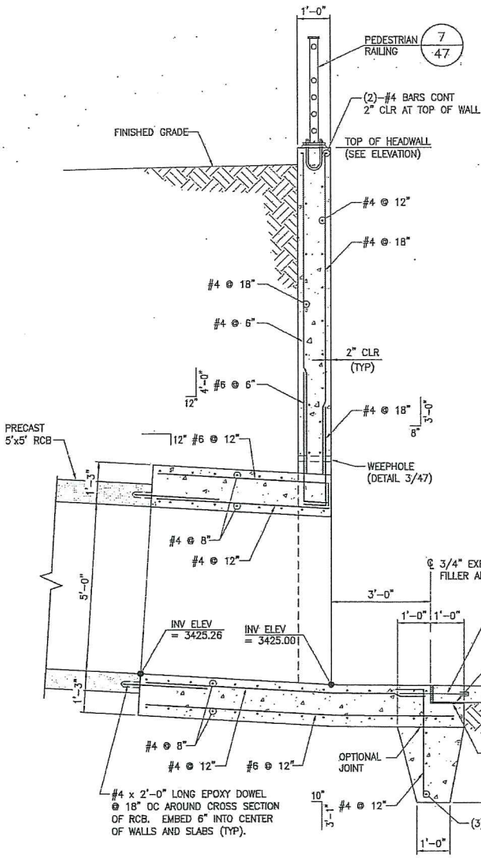
3 UPSTREAM HEADWALL ELEVATION

SCALE: 1/8" = 1'-0"



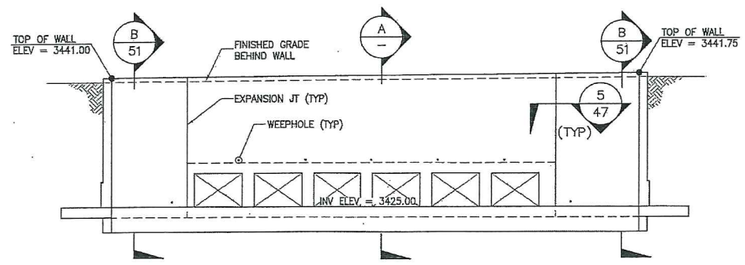
2 UPSTREAM HEADWALL ENLARGED PLAN

SCALE: 1/8" = 1'-0"



A DOWNSTREAM HEADWALL SECTION

SCALE: 1/2" = 1'-0"



1 DOWNSTREAM HEADWALL ELEVATION

SCALE: 1/8" = 1'-0"

STATE OF NEVADA
ENGINEER
ERIC G. GILES
No. 14010
PROFESSIONAL
DATE: 10/28/2015

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 10-28-15
PLOT TIME: 11:44:59

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 SAN MIGUEL, LAS VEGAS, NEVADA 89102
T: 702.384.2000 · F: 702.384.2259 · GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-222\Civil\Production\24282s49_SC3.dwg
Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

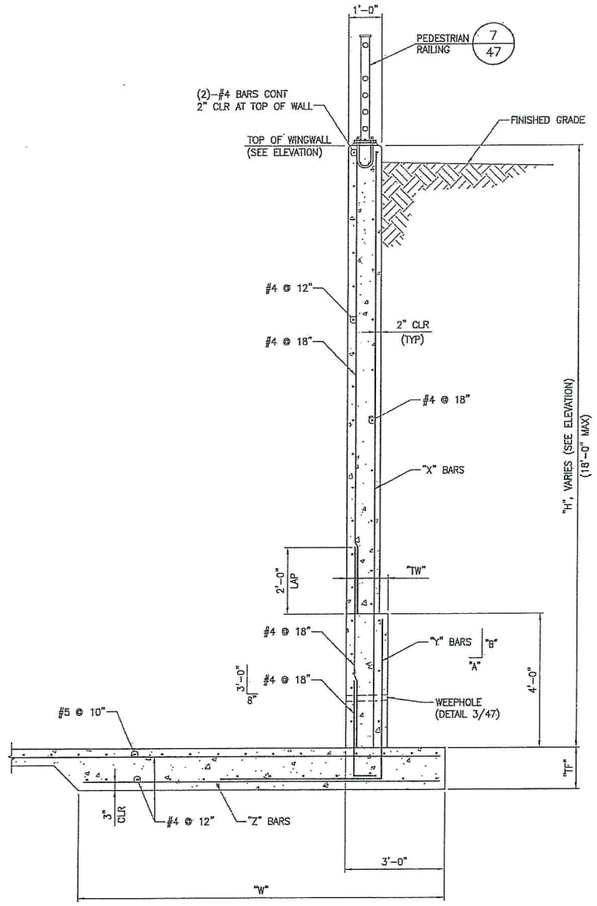
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2 IMPROVEMENT PLANS

DRAINAGE CORRIDOR STRUCTURAL DETAILS 2

DRAWING 49
49 OF 53 SHTS

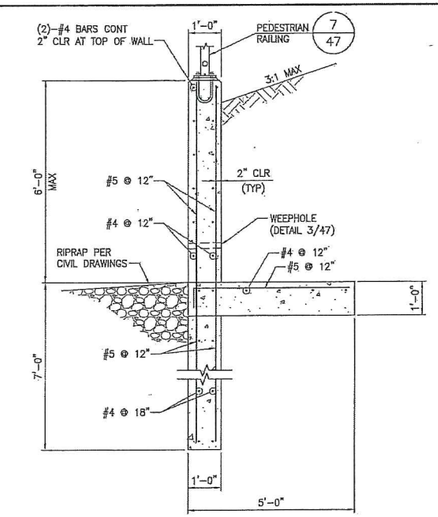
SID NO. 812 PROJECT 2

S:\Projects\600\62024-222\Civil\Production\24282s49_SC3.dwg 10/28/2015 3:44:

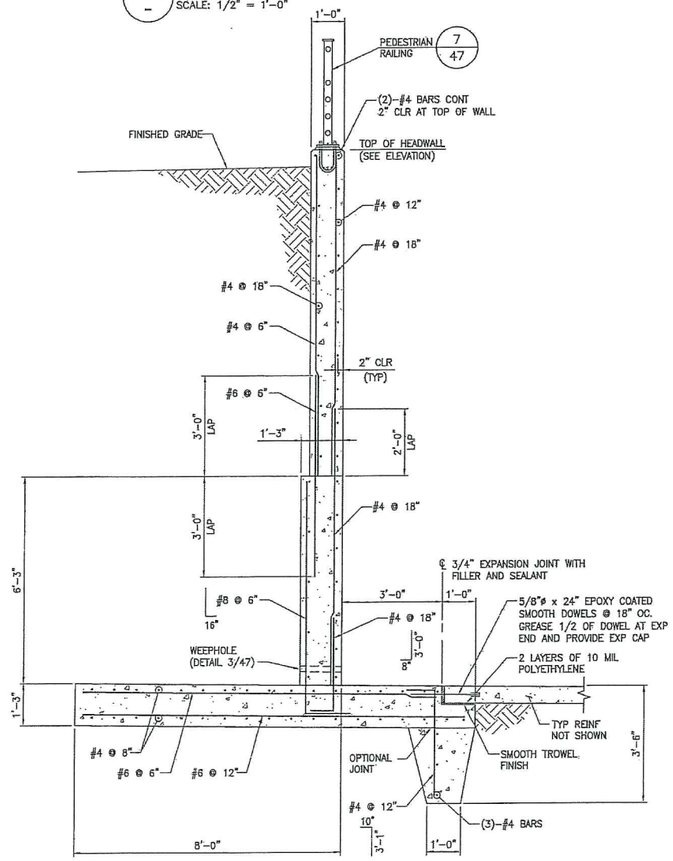


DIMENSIONS				"X"	"Y"	"Z"	"A"	"B"
H	W	TW	TF	BARS	BARS	BARS		
≤ 6'-0"	4'-0"	1'-0"	1'-0"	#4 @ 9"	#4 @ 9"	#4 @ 9"	8"	2'-9"
≤ 8'-0"	5'-6"	1'-0"	1'-0"	#4 @ 9"	#5 @ 9"	#4 @ 9"	10"	3'-3"
≤ 10'-0"	7'-0"	1'-0"	1'-0"	#4 @ 6"	#5 @ 6"	#4 @ 6"	10"	3'-3"
≤ 12'-0"	8'-3"	1'-0"	1'-0"	#4 @ 6"	#6 @ 6"	#5 @ 6"	12"	3'-9"
≤ 14'-0"	9'-6"	1'-3"	1'-3"	#5 @ 6"	#7 @ 6"	#5 @ 6"	4'-10"	4'-10"
≤ 16'-0"	10'-6"	1'-3"	1'-3"	#5 @ 6"	#8 @ 6"	#6 @ 6"	4'-10"	4'-10"
≤ 18'-0"	12'-0"	1'-3"	1'-3"	#7 @ 6"	#9 @ 6"	#7 @ 6"	4'-10"	4'-10"

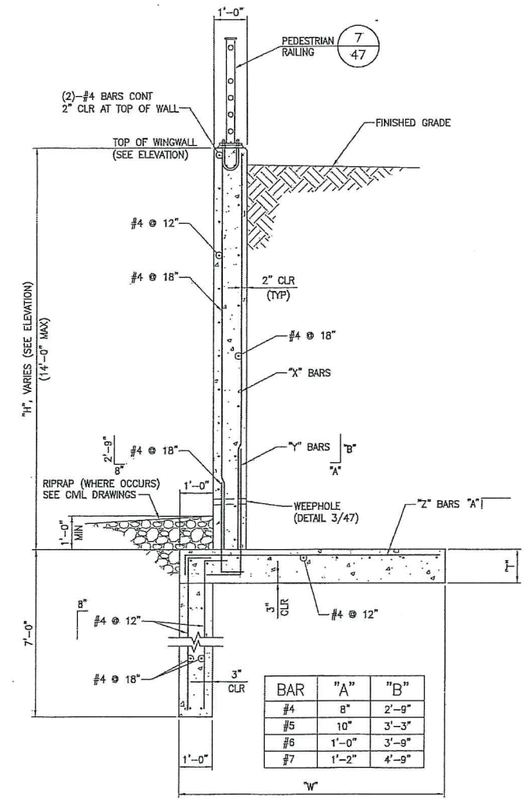
C TYPICAL OUTLET WALL SECTION
SCALE: 1/2" = 1'-0"



D TYPICAL WINGWALL SECTION
SCALE: 1/2" = 1'-0"



B WALL SECTION AT OUTLET
SCALE: 1/2" = 1'-0"



BAR	"A"	"B"
#4	8"	2'-9"
#5	10"	3'-3"
#6	1'-0"	3'-9"
#7	1'-2"	4'-9"

WINGWALL SCHEDULE ("H" ≤ 14'-0")					
DIMENSIONS			"X"*	"Y"	"Z"
H	W	T	BARS	BARS	BARS
≤ 4'-0"	3'-0"	1'-0"	#4 @ 12"	#4 @ 12"	#4 @ 12"
≤ 6'-0"	4'-0"	1'-0"	#4 @ 9"	#4 @ 9"	#4 @ 9"
≤ 8'-0"	5'-0"	1'-0"	#4 @ 9"	#5 @ 9"	#4 @ 9"
≤ 10'-0"	6'-0"	1'-0"	#4 @ 6"	#5 @ 6"	#4 @ 6"
≤ 12'-0"	8'-0"	1'-0"	#4 @ 6"	#6 @ 6"	#5 @ 6"
≤ 14'-0"	9'-6"	1'-3"	#5 @ 6"	#7 @ 6"	#7 @ 6"

*"X" BARS MAY BE ELIMINATED BY EXTENDING THE "Y" BARS TO THE TOP OF THE RETAINING WALL.

A TYPICAL WINGWALL SECTION
SCALE: 1/2" = 1'-0"

STATE OF NEVADA
ERIC G. GILES
No. 13600
STRUCTURAL
ENGINEER
DATE: 10/28/2015

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-222

DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 10-28-15
PLOT TIME: 11:45:19

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD - LAS VEGAS, NV 89146
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LAS VEGAS
F:\Projects\600\62024-222\DWG\Production\24x36x51_Sc5.dwg
Matthew Burge

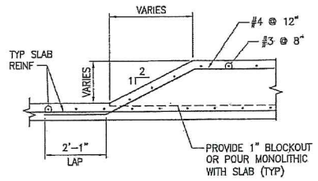
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

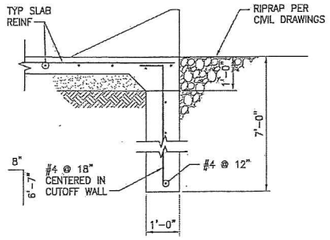
DRAINAGE CORRIDOR STRUCTURAL DETAILS 4

DRAWING 51
51 OF 53 SHTS

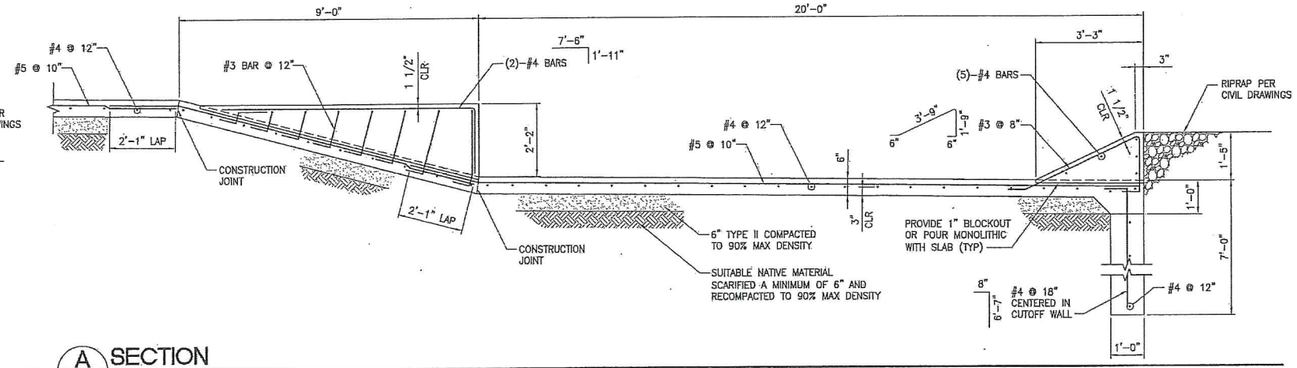
SID NO. 812 PROJECT 2



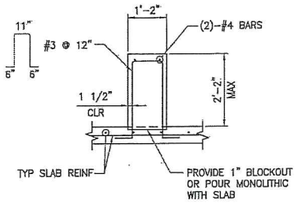
F SECTION
SCALE: 1/2" = 1'-0"



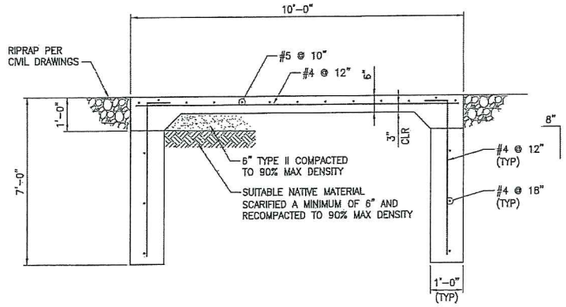
E SECTION
SCALE: 1/2" = 1'-0"



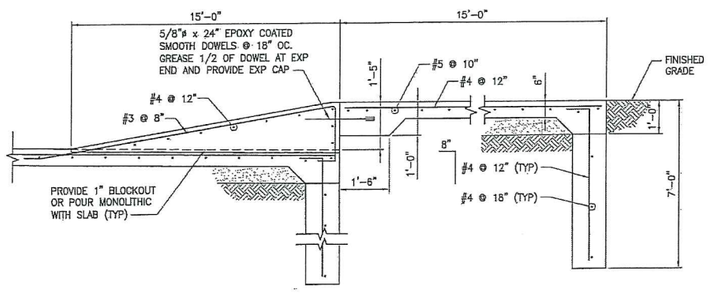
A SECTION
SCALE: 1/2" = 1'-0"



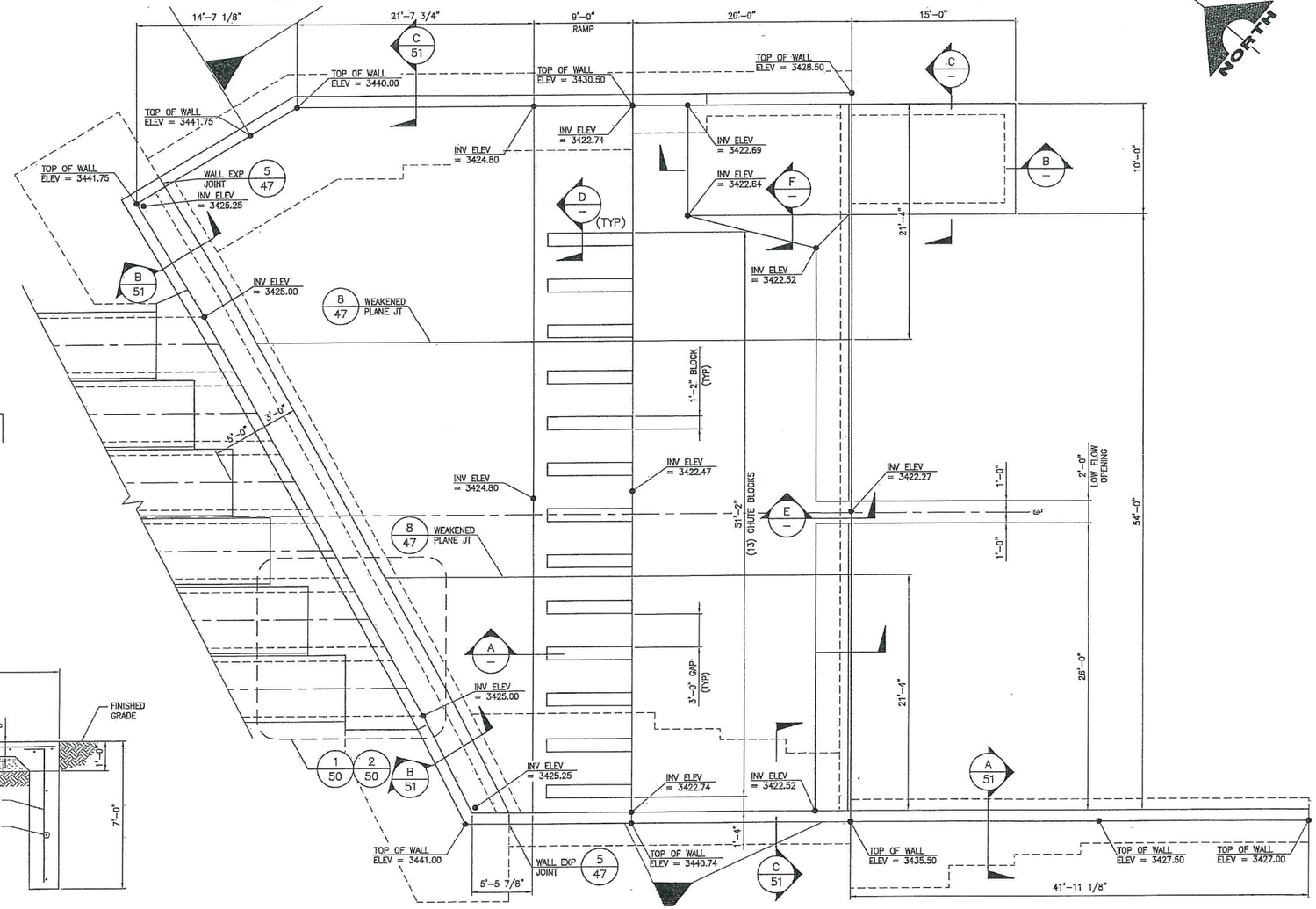
D SECTION
SCALE: 1/2" = 1'-0"



C SECTION
SCALE: 1/2" = 1'-0"



B SECTION
SCALE: 1/2" = 1'-0"



1 ENLARGED PLAN - DRAINAGE CORRIDOR CROSSING OUTLET STRUCTURE
SCALE: 3/16" = 1'-0"

NORTH

STATE OF NEVADA — ERIC G. GILES — No. 14370 — PROFESSIONAL ENGINEER — CIVIL, STRUCTURAL — DATE: 10/28/2015

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

PROJECT NO. 62024-222

DESIGN: GCW
DRAWN: GCW
CHECK: JJJ
PLOT DATE: 10-28-15
PLOT TIME: 11:17:37

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
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LAS VEGAS

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Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2 IMPROVEMENT PLANS

OUTLET STRUCTURE PLAN AND DETAILS

DRAWING 52
52 OF 53 SHTS

SID NO. 812 PROJECT 2

pw24x36.dwg 07/2015.tbl

UPDATE #4 TO THE TECHNICAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24 UNIT 2 IMPROVEMENTS- SKY VISTA IMPROVEMENTS (DESERT MOON DRIVE TO ALTA DRIVE INCLUDING SUNCREEK ROAD)

62024-221

June 2015

Prepared for:

The Howard Hughes Company, LLC
10801 W. Charleston Blvd., 3rd Floor
Las Vegas, Nevada 89135
Phone: (702) 791-4300
Fax: (702) 791-4450

Prepared by:

G. C. Wallace Companies
1555 S. Rainbow Blvd.
Las Vegas, Nevada 89146
Phone: (702) 804-2000
Fax: (702) 804-2299

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM				DATE: July 7, 2015
TO: **Land Development Services** Department of Public Works				FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:			**COPIES TO:**
Summerlin Village 24 Unit 2 Improvements – Update #4 Sky Vista Drive Improvements (Desert Moon Drive to Alta Drive including Sun Creek Road)				G.C. Wallace, Inc.
Cross Streets:	Sky Vista & Alta Drive			Howard Hughes Corp.
File Number:	F:\Depot\DSMemos\DS4136H.doc			Bart Anderson, P.E., DevCo
Parcel Number:	137-22-000-015			
Zoning Action:				
FEMA Flood Zone	YES	NO X		
Proposed Storm Drain	YES X	NO		

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Transaction #
1st Submittal	2/21/2007	3/29/2007	Not Approved	$400.00	63487: $400
2nd Submittal	5/4/2007	5/29/2007	Not Approved	$400.00	68552: $400
3rd Submittal	5/15/2014 & 6/5/2014	6/9/2014	Conditional Approval	$400.00	357117: $400
4th Submittal	9/22/2014	10/7/2014	Approved	$100.00	371022: $100
5th Submittal	11/6/2014	11/26/2014	Approved	$100.00	376121: $100
6th Submittal	2/10/2015	2/24/2015	Not Approved	$100.00	385212: $100
7th Submittal	5/14/2015	6/15/2015	Not Approved	$400.00	397629: $400
8th Submittal	6/22/2015	7/7/2015	See Comments Below	$100.00	402841: $100
			TOTAL FEES (LDDRS):	$2,000.00	----

REMARKS:

8th Submittal: Update #4 for Sky Vista Drive Improvements – Revise the connection angle of a 48"-Stub to Future Parcel K at the Intersection of Crossbridge Drive and Suncreek Road

6th & 7th Submittals: Updaet #3 and Addendum for Crossbridge Drive Improvements

5th Submittal: Update #2 for Sky Vista Drive Improvements

The Drainage Study for the subject project has been reviewed and:

X	is approved subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.
	is conditionally approved subject to Clark County Public Works Department concurrence.

1. Please note that any future technical drainage study submittals that differ from the Master Drainage Study (ie. Changes in pods, infrastructure, flows etc.) will require an update to the Master Drainage Study and this update must be approved by the *City of Las Vegas Flood Control Section* prior to final approval of technical drainage study.

2. Structural plans for the storm drain improvements must be submitted for review. Provide a soils report, structural calculations and specifications, two wet stamped structural sets, and a grading plan to the *Building Department* for processing. The engineer must provide a copy of *Building Department* approval of the structures to *Flood Control* prior to final acceptance of the improvement plans.

3. The project proposes to build temporary drainage facilities. Prior to final plan approval the developer must complete a maintenance and liability agreement for the interim drainage improvements and post a minimum maintenance bond of $25,000 or 25-percent of the construction cost for the improvements, whichever is greater. The engineer must submit an estimate of the quantities for constructing the facility and an 8.5-inch by 11-inch exhibit that adequately shows the location and limits of the drainage facility to *Flood Control* for approval. Once the drainage study is conditionally approved, the engineer should contact the City's Land Development Section (229-6371) to begin the agreement process.

4. Please obtain necessary 404 permits from Army Corps of Engineers and provide a copy of the permit to Flood Control prior to issuance of the grading permit. The contact information for Army Corps of Engineers is listed below:

   Steven W. Roberts
   Chief, Regulatory Field Office
   US Army Corps of Engineers
   321 North Mall Drive
   Suite L-101
   St. George, UT 84790

   (435) 986-3979 (Office)
   (435) 986-3981 (FAX)
   steven.w.roberts@usace.army.mil

NOTE: Any future changes to the proposed design (or design assumptions) as outlined in the approved drainage study and attached preliminary grading plan which affect drainage must be addressed in a Drainage Study Update and accepted by the *City of Las Vegas Flood Control Section*. Additionally, conditional acceptance of a drainage study is valid for a period of one (1) year. If the proposed construction has not been completed in that time period, the *City of Las Vegas* reserves the right to require additional conditions and/or submission and acceptance of a complete drainage study update prior to further construction of a project.

NOTE: Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the Nevada Division of Environmental Protection a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site; for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until all stripped or disturbed surface areas have been covered by paving, building construction or planting. For more information, including forms and applications see http://ndep.nv.gov/bwpc/storm01.htm or call (775) 687-9429.

END OF REMARKS
Osk/ays

T/R/S: T20S/R59E/33 and 34
AREA K-22

Storm Drain Hydraulics Calculations

G.C. Wallace, Inc. | Hydraulic Calculations for Main Line No. 2: From existing SD at Sky Vista/Crossbridge north to Suncreek west to Crossbridge and Parcel K (Ultimate) | DATE 06/09/15 | FILE: SF6.xls

Storm Drain Manning's n (typ=0.013)= 0.013 | Inlet Structure Type or K_i= A | Headwall; Grooved Edge

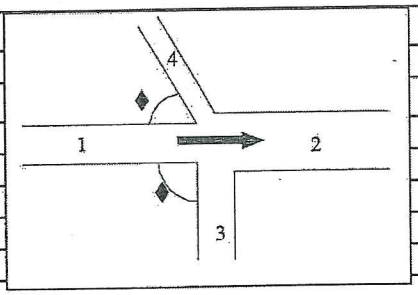
CONDUIT DATA										FLOW DATA									ENERGY LOSS DATA																	EGL & HGL				COMMENTS	
																			PIPE	TRANSITION																				
STATION			PIPE	BOX		IRREG		#	INVERT ELEV	L	S	A	Φ	Q	V	V2/2g	Sf	Ave.	Frict	Frict	Manhole			Junction			Contraction/ Inlet			Expansion/Outlet			Bend				Misc		CONDUIT		TRANSITION		FULL/	
FROM (ft)	TO (ft)	T/R	D (in)	SPAN (ft)	RISE (ft)	AREA (ft^2)	HYD RAD (ft)		D/S (ft)	U/S (ft)	(ft)	(%)	(ft^2)		(cfs)	(ft/s)	(ft)	(S_f) (ft/ft)	H_f (ft)	H_f (ft)	Θ (deg)	K_{mh}	H_{mh} (ft)	Θ (deg)	K_j	H_j (ft)	Inlet/ Cont	K_i	H_e (ft)	Θ (deg)	K_e	H_e (ft)	R_{bend} (ft)	Θ (deg)	K_b	H_b (ft)	H_m (ft)	Total (ft)	U/S EGL	U/S HGL	U/S EGL	U/S HGL	PART FLOW	CRTL
	0.00		78							19.61																													28.97	26.11		
																																									Outlet K_o=	1.0						
0.00	37.74	R	78					1	19.61	20.67	37.7	2.80%	33.18	0.0049	450	13.56	2.86	0.0074	0.0074	0.28																	0.00	30.02	27.17			FULL	D/S
37.74	49.67	R	78					1	20.67	20.91	11.9	2.05%	33.18	0.0049	450	13.56	2.86	0.0074	0.0074	0.09																	0.00	30.27	27.41			FULL	D/S
49.67	135.46	R	78					1	20.91	22.63	85.8	2.00%	33.18	0.0049	450	13.56	2.86	0.0074	0.0074	0.63															6007	1	0.03	0.08	0.08	31.99	29.13	31.99	29.13	FULL	D/S
135.46	138.46	R	78					1	22.63	22.69	3.0	2.00%	33.18	0.0049	447	13.47	2.82	0.0073	0.0073	0.02															6007	1	0.03	0.07	0.07	32.01	29.19	32.08	29.26	FULL	U/S
138.46	170.01	R	78					1	22.69	23.33	31.6	2.03%	33.18	0.0049	447	13.47	2.82	0.0073	0.0073	0.23															6007	1	0.02	0.05	0.05	32.65	29.83	32.65	29.83	FULL	D/S
170.01	175.01	R	78					1	23.33	23.51	5.0	3.60%	33.18	0.0049	447	13.47	2.82	0.0073	0.0073	0.04																	0.00	32.83	30.01			FULL	D/S
175.01	569.94	R	78					1	23.51	45.02	394.9	5.45%	33.18	0.0049	447	13.47	2.82	0.0073	0.0073	2.87															6007	4	0.05	0.14	0.14	54.34	51.52	54.34	51.52	PART	D/S
569.94	574.94	R	78					1	45.02	45.21	5.0	3.74%	33.18	0.0049	447	13.47	2.82	0.0073	0.0073	0.04																	0.00	54.52	51.71			FULL	D/S
574.94	583.13	R	78					1	45.21	45.60	8.2	4.80%	33.18	0.0049	447	13.47	2.82	0.0073	0.0073	0.06																	0.00	54.92	52.10			FULL	D/S
583.13	585.13	R	78					1	45.60	45.70	2.0	4.80%	33.18	0.0049	440	13.26	2.73	0.0070	0.0072		0.01																0.01			54.93	52.20	FULL	U/S
585.13	586.13	R	78					1	45.70	45.74	1.0	4.80%	33.18	0.0049	440	13.26	2.73	0.0070	0.0070	0.01																	0.00	54.97	52.24			FULL	D/S
586.13	953.86	R	78					1	45.74	63.41	367.7	4.80%	33.18	0.0049	440	13.26	2.73	0.0070	0.0070	2.59															4436	5	0.06	0.16	0.16	72.64	69.91	72.64	69.91	PART	D/S
953.86	958.86	R	78					1	63.41	63.56	5.0	3.08%	33.18	0.0049	440	13.26	2.73	0.0070	0.0070	0.04																	0.00	72.79	70.06			FULL	D/S
958.86	1289.51	R	78					1	63.56	73.75	330.7	3.08%	33.18	0.0049	440	13.26	2.73	0.0070	0.0070	2.33															4436	4	0.05	0.14	0.14	82.98	80.25	82.98	80.25	PART	D/S
1289.51	1299.57	R	78					1	73.75	74.01	10.1	2.60%	33.18	0.0049	440	13.26	2.73	0.0070	0.0070	0.07																	0.00	83.24	80.51			FULL	D/S
1299.57	1301.57	R	78					1	74.01	74.06	2.0	2.60%	33.18	0.0049	419	12.63	2.48	0.0064	0.0067	0.01																	0.37	0.37	83.26	80.78	83.63	81.15	FULL	U/S
1301.57	1302.57	R	78					1	74.06	74.09	1.0	2.60%	33.18	0.0049	419	12.63	2.48	0.0064	0.0064	0.01																	0.00	83.63	81.16			FULL	U/S
1302.57	1537.01	R	78					1	74.09	80.17	234.4	2.60%	33.18	0.0049	419	12.63	2.48	0.0064	0.0064	1.50																	0.00	89.15	86.67			PART	D/S
1537.01	1542.01	R	78					1	80.17	80.40	5.0	4.52%	33.18	0.0049	419	12.63	2.48	0.0064	0.0064	0.03																	0.00	89.38	86.90			FULL	D/S
1542.01	1769.51	R	78					1	80.40	90.42	227.5	4.40%	33.18	0.0049	419	12.63	2.48	0.0064	0.0064	1.45																	0.00	99.40	96.92			PART	D/S
1769.51	1780.51	R	72					1	90.42	90.90	11.0	4.40%	28.27	0.0049	356	12.59	2.46	0.0071	0.0067		0.07	45	0.46	1.14	0												1.21			100.61	98.15	FULL	U/S
1780.51	1806.50	R	72					1	90.90	91.43	26.0	2.00%	28.27	0.0049	356	12.59	2.46	0.0071	0.0071		0.18														3	45	0.35	0.86	1.05			101.65	99.19	FULL	U/S
1806.50	1831.80	R	72					1	91.43	91.93	25.3	2.00%	28.27	0.0049	356	12.59	2.46	0.0071	0.0071	0.18																	0.00	101.83	99.37			FULL	U/S
1831.80	1836.80	R	72					1	91.93	92.03	5.0	2.00%	28.27	0.0049	356	12.59	2.46	0.0071	0.0071	0.04																	0.00	101.87	99.41			FULL	U/S
1836.80	1845.30	R	72					1	92.03	92.20	8.5	2.00%	28.27	0.0049	356	12.59	2.46	0.0071	0.0071	0.06																	0.00	101.93	99.47			FULL	U/S
1845.30	1847.30	R	72					1	92.20	92.24	2.0	2.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.01																	0.00	101.94	99.51			FULL	U/S
1847.30	1902.97	R	72					1	92.24	93.36	55.7	2.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.39																	0.00	102.33	99.90			FULL	U/S
1902.97	1907.97	R	72					1	93.36	93.50	5.0	2.90%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070		0.03																	0.03			102.37	99.93	FULL	U/S
1907.97	2185.32	R	72					1	93.50	109.86	277.4	5.90%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	1.94															654	24	0.13	0.31	0.31	118.29	115.86	118.29	115.86	PART	D/S
2185.32	2190.32	R	72					1	109.86	110.16	5.0	5.90%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070		0.03																	0.03			118.59	116.16	FULL	D/S
2190.32	2290.06	R	72					1	110.16	116.04	99.7	5.90%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.70																	0.00	124.48	122.04			PART	D/S
2290.06	2295.06	R	72					1	116.04	116.31	5.0	5.44%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070		0.03																	0.03			124.75	122.31	FULL	D/S
2295.06	2505.32	R	72					1	116.31	126.81	210.3	4.99%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	1.47															654	19	0.11	0.28	0.28	135.24	132.81	135.24	132.81	PART	D/S
2505.32	2510.32	R	72					1	126.81	127.01	5.0	4.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070		0.03																	0.03			135.44	133.01	FULL	D/S
2510.32	2579.20	R	72					1	127.01	129.07	68.9	3.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.48																	0.00	137.50	135.07			PART	D/S
2579.20	2591.20	R	72					1	129.07	129.43	12.0	3.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.08																	0.00	137.86	135.43			FULL	D/S
2591.20	2603.20	R	72					1	129.43	129.79	12.0	3.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070		0.08	34	0.22	0.54														0.62			138.48	136.05	FULL	U/S
2603.20	2626.20	R	72					1	129.79	130.48	23.0	3.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.16																	0.00	138.91	136.48			FULL	D/S
2626.20	2628.20	R	72					1	130.48	130.54	2.0	3.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.01																	0.00	138.97	136.54			FULL	D/S
2628.20	2686.43	R	72					1	130.54	132.29	58.2	3.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.41																	0.00	140.72	138.29			PART	D/S
2686.43	2691.43	T	72					1	132.29	132.39	5.0	2.03%	28.27	0.0049	262	9.27	1.33	0.0038	0.0054		0.03	48	0.46	1.12	33	0.65	1.57										2.71			143.43	142.10	FULL	U/S
2691.43	2749.15	R	72					1	132.39	133.00	57.7	1.06%	28.27	0.0049	262	9.27	1.33	0.0038	0.0038	0.22																	0.00	143.65	142.32			FULL	U/S
2749.15									133.00																																	

Starting WSE

Junction Head Loss Calculation

SV Sta 336+94

Known	
Diameter of Pipe 1 (in)	78.0
Diameter of Pipe 2 (in)	78.0
Diameter of Pipe 3 (in)	24.0
Diameter of Pipe 4 (in)*	
Flow in Pipe 1 (cfs)	426
Flow in Pipe 2 (cfs)	441
Flow in Pipe 3 (cfs)	15
Flow in Pipe 4 (cfs)*	
Angle of Pipe 3	90
Angle of Pipe 4*	



*Optional

Headloss is applied at Entrance to Junction

Insert Loss in Misc. Loss Column and leave Junction Loss Column Blank

Solve For	
Area of Pipe 1 (ft^2)	33.18
Area of Pipe 2 (ft^2)	33.18
Area of Pipe 3 (ft^2)	3.14
Area of Pipe 4 (ft^2)	
Head Loss at Junction (ft)	**0.37**

Equation Used:

Incorporates Pressure plus Momentum Laws

$$Hj=((Q_2^2/A_{2*g}-Q_1^2/A_{1*g}-Q_3^2*\cos(Ang3)/A_{3*g}-Q_4^2*\cos(Ang4)/A_{4*g})*2/(A_1+A_2)-D_1+D_2)$$

Summary of Results: Main Line 2 - From existing SD at Sky Vista/Crossbridge north to Suncreek west to Crossbridge and Parcel K (Ultimate)											
						(Optional)				HGL with respect	Pressure Gasket
STATION	INVERT	SOFFIT	EGL	HGL	GRADE	LOCATION	DESCRIPTION	FREEBOARD	COVER	to FG	Required?
0.00	19.61	26.11	28.97	26.11	29.90	SV Sta 324+00	Connect to existing SD	3.79	3.79	OK	NO
37.74	20.67	27.17	30.02	27.17	31.30	SV Sta 324+37.53	PC and vertical angle point	4.14	4.14	OK	NO
49.67	20.91	27.41	30.27	27.41	31.80	SV Sta 324+49.46	MH#17	4.39	4.39	OK	NO
135.46	22.63	29.13	31.99	29.13	35.60	SV Sta 325+36.45	24" lateral to DI	6.47	6.47	OK	NO
138.46	22.69	29.19	32.08	29.26	35.60			6.34	6.41	OK	NO
170.01	23.33	29.83	32.65	29.83	37.50	SV Sta 325+72	MH#18 and vertical angle pt	7.67	7.67	OK	NO
175.01	23.51	30.01	32.83	30.01	37.50			7.49	7.49	OK	NO
569.94	45.02	51.52	54.34	51.52	58.30	SV Sta 329+70.31	MH#19 and PCC and vertical angle point	6.78	6.78	OK	NO
574.94	45.21	51.71	54.52	51.71	58.30			6.59	6.59	OK	NO
583.13	45.60	52.10	54.92	52.10	58.90	SV Sta 329+82	24" lateral to DIs	6.80	6.80	OK	NO
585.13	45.70	52.20	54.93	52.20	58.90			6.70	6.70	OK	NO
586.13	45.74	52.24	54.97	52.24	58.90	SV Sta 329+83	Reach	6.66	6.66	OK	NO
953.86	63.41	69.91	72.64	69.91	76.70	SV Sta 333+50	MH#20	6.79	6.79	OK	NO
958.86	63.56	70.06	72.79	70.06	76.70			6.64	6.64	OK	NO
1289.51	73.75	80.25	82.98	80.25	86.90	SV Sta 336+81.94	MH#21 and PT and vertical angle point	6.65	6.65	OK	NO
1299.57	74.01	80.51	83.24	80.51	87.20	SV Sta 336+94	24" lateral to DIs	6.69	6.69	OK	NO
1301.57	74.06	80.56	83.63	81.15	87.20			6.05	6.64	OK	NO
1302.57	74.09	80.59	83.63	81.16	87.20	SV Sta 337+94	Reach	6.04	6.61	OK	NO
1537.01	80.17	86.67	89.15	86.67	94.60	SV Sta 339+32	MH#22	7.93	7.93	OK	NO
1542.01	80.40	86.90	89.38	86.90	94.60			7.70	7.70	OK	NO
1769.51	90.42	96.92	99.40	96.92	104.60	SV Sta 341+65 SR 18+70.83	MH#7	7.68	7.68	OK	NO
1780.51	90.90	96.90	100.61	98.15	104.60			6.45	7.70	OK	NO
1806.50	91.43	97.43	101.65	99.19	104.20	SR Sta 18+46.80	Horizontal Angle Pt	5.01	6.78	OK	NO
1831.80	91.93	97.93	101.83	99.37	105.50	SR 18+19	MH#11	6.13	7.57	OK	NO
1836.80	92.03	98.03	101.87	99.41	105.50			6.09	7.47	OK	NO
1845.30	92.20	98.20	101.93	99.47	105.70	SR 18+07	24" laterals to DIs	6.23	7.50	OK	NO
1847.30	92.24	98.24	101.94	99.51	105.70			6.19	7.46	OK	NO
1902.97	93.36	99.36	102.33	99.90	106.90	SR Sta 17+50.33	MH#12 and PT and vertical angle point	7.00	7.55	OK	NO
1907.97	93.50	99.50	102.37	99.93	106.90			6.97	7.40	OK	NO
2185.32	109.86	115.86	118.29	115.86	123.10	SR Sta 14+78.33	MH#13 and PC	7.24	7.24	OK	NO
2190.32	110.16	116.16	118.59	116.16	123.10			6.94	6.94	OK	NO
2290.06	116.04	122.04	124.48	122.04	131.00	SR Sta 13+71.59	MH#14	8.96	8.96	OK	NO
2295.06	116.31	122.31	124.75	122.31	131.00			8.69	8.69	OK	NO
2505.32	126.81	132.81	135.24	132.81	141.10	SR 11+51.61	MH#14A	8.29	8.29	OK	NO
2510.32	127.01	133.01	135.44	133.01	141.10			8.09	8.10	OK	NO
2579.20	129.07	135.07	137.50	135.07	143.70	SR 10+67.47	MH#15	8.63	8.63	OK	NO
2591.20	129.43	135.43	137.86	135.43	143.70			8.27	8.27	OK	NO
2603.20	129.79	135.79	138.48	136.05	144.00	SR Sta 10+55.51	Horizontal Angle Pt	7.95	8.21	OK	NO
2626.20	130.48	136.48	138.91	136.48	144.80	SR 10+34.56	24" lateral to DI	8.32	8.32	OK	NO
2628.20	130.54	136.54	138.97	136.54	144.80			8.26	8.26	OK	NO
2686.43	132.29	138.29	140.72	138.29	144.50	SR Sta 9+80.66 CD 35+91.71	MH#16	6.21	6.21	OK	NO
2691.43	132.39	138.39	143.43	142.10	144.50			2.40	6.11	OK	NO

Storm Drain Hydraulics Calculations

G.C. Wallace, Inc. | Suncreek (Parcel K) 48-inch RCP Lateral | DATE 06/09/15 | FILE: SF6.xls

Storm Drain Manning's n (typ=0.013)= 0.013 | Inlet Structure Type or K_i= d | Headwall:Square Edge (cut concrete and CMP)

	CONDUIT DATA										FLOW DATA									ENERGY LOSS DATA																				EGL & HGL				COMMENTS	
																				PIPE	TRANSITION																									
	STATION			PIPE	BOX		IRREG		#	INVERT ELEV	L	S	A	Φ	Q	V	V2/2g	Sf	Ave.	Frict	Frict	Manhole			Junction			Contraction/ Inlet			Expansion/Outlet			Bend			Misc			CONDUIT		TRANSITION		FULL/	
	FROM (ft)	TO (ft)	T/R	D (in)	SPAN (ft)	RISE (ft)	AREA (ft^2)	HYD RAD (ft)		D/S (ft)	U/S (ft)	(ft)	(%)	(ft^2)		(cfs)	(ft/s)	(ft)	(ft^2/ft)	(ft^3/ft)	H_f (ft)	H_f (ft)	Θ (deg)	K_{mh}	H_{mh} (ft)	Θ (deg)	K_j	H_j (ft)	Inlet/ Cont	K_i	H_c (ft)	Θ (deg)	K_o	H_e (ft)	R_{bend} (ft)	Θ (deg)	K_b	H_b (ft)	H_m (ft)	Total (ft)	U/S EGL	U/S HGL	U/S EGL	U/S HGL	PART FLOW	CRTL
1		1000.00		48						3434.36																				Outlet K_o=	1.0													
2	1000.00	1066.00	R	48					1	3434.36	3435.68	66.0	2.00%	12.57	0.0049	60	6.37	0.63	0.0031	0.0031	0.20																			0.00	3442.93	3442.30			FULL	U/S
3	1066.00								1	3435.68																																		
4																																												

SUMMERLIN

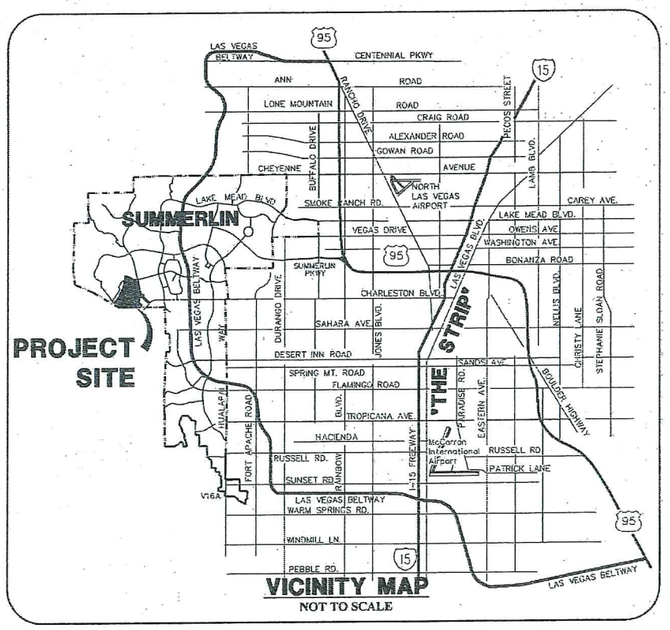
SM

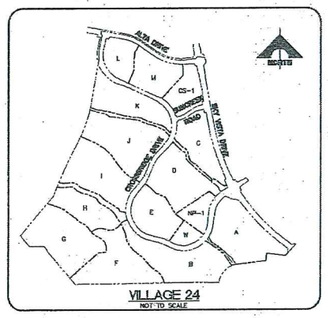
VILLAGE 23A/24
SKY VISTA IMPROVEMENT PLANS

FROM DESERT MOON DRIVE TO ALTA DRIVE
INCLUDING SUNCREEK ROAD

SID #812 PROJECTS 5 & 12, 2 & 13
#809 PROJECT 13 & #810 PROJECT 8

A.P.N. 137-33-801-001
2015





OWNER/DEVELOPER

THE HOWARD HUGHES COMPANY, LLC
10801 W. CHARLESTON BLVD., 3RD FLOOR
LAS VEGAS, NEVADA 89146
OFFICE PHONE NO. (702) 791-4300

ENGINEER

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD · LAS VEGAS, NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM

Call before you Dig
Avoid existing underground utility lines. It's costly.
Call 811 or 1-800-227-2500 or CLARK COUNTY WATER AUTHORITIES 1-702-455-6000

ABOVE VEGAS ADVANCED POWER LINES. IT'S COSTLY.
CALL BEFORE YOU DIG YOU'RE OVERHEAD
1-702-227-2929

FAST
Call before you UnderGround
1-702-432-5300
FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

SHEET INDEX

SHT. #	DESCRIPTION
1	COVER SHEET
2	LEGEND AND ABBREVIATIONS
3	GENERAL NOTES
4	HORIZONTAL CONTROL
5	MASTER UTILITY PLAN – WATER
6	MASTER UTILITY PLAN – STORM DRAIN
7	MASTER UTILITY PLAN – SEWER
8	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 1
9	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 2
10	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 3
11	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 4
12	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 5
13	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 6
14	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 7
15	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 8
16	ALTA DRIVE – ROADWAY PLAN AND PROFILE 9
17	SUNCREEK ROAD – ROADWAY PLAN AND PROFILE 10
18	SUNCREEK ROAD – ROADWAY PLAN AND PROFILE 11
19	CONSTRUCTION DETAILS
20	SKY VISTA DRIVE – ROUGH GRADING PLAN 1
21	ALTA DRIVE – ROUGH GRADING PLAN 2
22	ALTA DRIVE – ROUGH GRADING PLAN 3
23	ALTA DRIVE – ROUGH GRADING PLAN 4
24	CROSSBRIDGE DRIVE – ROUGH GRADING PLAN 5
25	CS-1 BOUNDARY – ROUGH GRADING PLAN 6
26	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 1
27	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 2
28	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 3
29	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 4
30	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 5
31	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 6
32	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 7
33	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 8
34	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 9
35	ALTA DRIVE – ROADWAY PLAN AND PROFILE 10
36	SUNCREEK ROAD – UTILITY PLAN AND PROFILE 11
37	SUNCREEK ROAD – UTILITY PLAN AND PROFILE 12
38	LATERAL PROFILES 1
39	LATERAL PROFILES 2
40	LATERAL PROFILES 3
41	ROADWAY SECTIONS
42	UTILITY DETAILS 1
43	UTILITY DETAILS 2
44	GRADING DETAILS
45	SKY VISTA DRIVE – STRIPING AND SIGNAGE PLAN 1
46	SKY VISTA DRIVE – STRIPING AND SIGNAGE PLAN 2
47	SUNCREEK ROAD – STRIPING AND SIGNAGE PLAN 3
48	STREET LIGHT NOTES AND DETAILS
49	STREET LIGHT, MASTER CONDUIT AND ELECTRICAL PLAN 1
50	STREET LIGHT, MASTER CONDUIT AND ELECTRICAL PLAN 2
51	STREET LIGHT, MASTER CONDUIT AND ELECTRICAL PLAN 3
52	STRUCTURAL DETAILS 1
53	STRUCTURAL DETAILS 2
54	STRUCTURAL DETAILS 3

DRAINAGE CERTIFICATION

I CERTIFY THAT THE GRADING PLANS ARE IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

JOSHUA L. JOHNSON P.E. 15789 DATE

ALLEN PAVELKA: PE # 9029 DATE
CITY ENGINEER
CITY OF LAS VEGAS, NEVADA

APPROVAL OF THESE PLANS IS LIMITED TO THOSE IMPROVEMENTS CONSTRUCTED IN THE DEDICATED RIGHTS-OF-WAY AND/OR DEDICATED EASEMENTS. THIS APPROVAL DOES NOT AUTHORIZE THE CONSTRUCTION OF ANY IMPROVEMENTS THAT DEVIATE FROM ADOPTED STANDARDS AND/OR SPECIFICATIONS, EXCEPT THOSE SPECIFICALLY LISTED UNDER "DEVIATIONS FROM STANDARDS". THE ENGINEER SHALL RESOLVE ANY DEVIATION OTHER THAN THOSE LISTED IN "DEVIATIONS FROM STANDARDS" IN FAVOR OF THE UNIFORM STANDARD DRAWINGS AND SPECIFICATIONS CLARK COUNTY AREA NEVADA.

CLV PLANNING DEPARTMENT

THIS PLAN MEETS THE APPLICABLE STANDARDS OF THE CITY OF LAS VEGAS PLANNING DEPARTMENT

CHRIS KNIGHT, DIRECTOR BUILDING AND SAFETY DATE

APPROVED FOR CONSTRUCTION 1ST APPD. 03/24/15

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. #123259 DATE:
DRAWINGS: 1–3, 5–18, 20–40, & 43

THE HOWARD HUGHES COMPANY, LLC

KEVIN ORROCK DATE
VICE PRESIDENT

APPROVED FOR CONSTRUCTION

CITY OF LAS VEGAS FIRE DEPARTMENT DATE

UTILITY/AGENCY APPROVALS

COX COMMUNICATIONS LAS VEGAS, INC. DATE

CENTRAL TELEPHONE CO., DBA CENTURYLINK DATE

THE AFFIXED CENTURYLINK APPROVAL DOES NOT ASSUME OR GUARANTEE LIABILITY FOR KNOWN OR UNKNOWN CONFLICTS WITH EXISTING OR PROPOSED IMPROVEMENTS. RESOLUTION OF ANY CONFUCT WILL BE ACCOMPLISHED PURSUANT TO LOCAL ORDINANCES, NEVADA REVISED STATUTES AND/OR PUBLIC UTILITY COMMISSION RULES AND REGULATIONS.

NV ENERGY DATE

NEVADA POWER COMPANY ACKNOWLEDGES THAT WE HAVE RECEIVED YOUR PLANS AND WILL PROVIDE SERVICE TO ALL ELECTRICAL NEEDS ASSOCIATED WITH THIS PROJECT. NEVADA POWER COMPANY RESERVES THE RIGHT TO ADDRESS ANY EXISTING OR FUTURE CONFLICTS ONCE THE FINAL DESIGN IS COMPLETED. THE NEW SERVICE AND THE RESOLUTION OF ANY CONFLICTS WILL BE ACCOMPLISHED PURSUANT TO THE NEVADA PUBLIC UTILITY COMMISSION'S RULES AND REGULATIONS.

NV ENERGY – TRANSMISSION ENGINEERING DATE

SOUTHWEST GAS CORP. DATE

PROFESSIONAL ENGINEER STATE OF NEVADA — No. 15789 — JOSHUA L. JOHNSON — DATE: 6/18/15

ISSUE FOR BID - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP
1	5/29/15	REVISED SHEETS: 4-7, 19-20, 24-43, 51, 53				

PROJECT NO. 62024-221
DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 06-19-15
PLOT TIME: 14:35:37

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD · LAS VEGAS NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM
LAS VEGAS
F:\Projects\600\V2024-221\DWG\Production\V24-221_01-CV.dwg
Paul Brenner

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 23A/24 - SKY VISTA IMPROVEMENT PLANS
DESERT MOON DR TO ALTA DR INCLUDING SUNCREEK RD

COVER SHEET

DRAWING 1
1 OF 54 SHTS

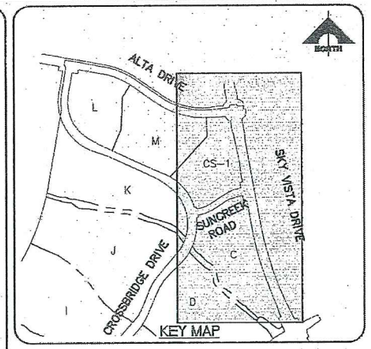
SID NO. 812 PROJECT 5 AND 12
SID NO. 809 PROJECT 13 AND 810 PROJECT 8

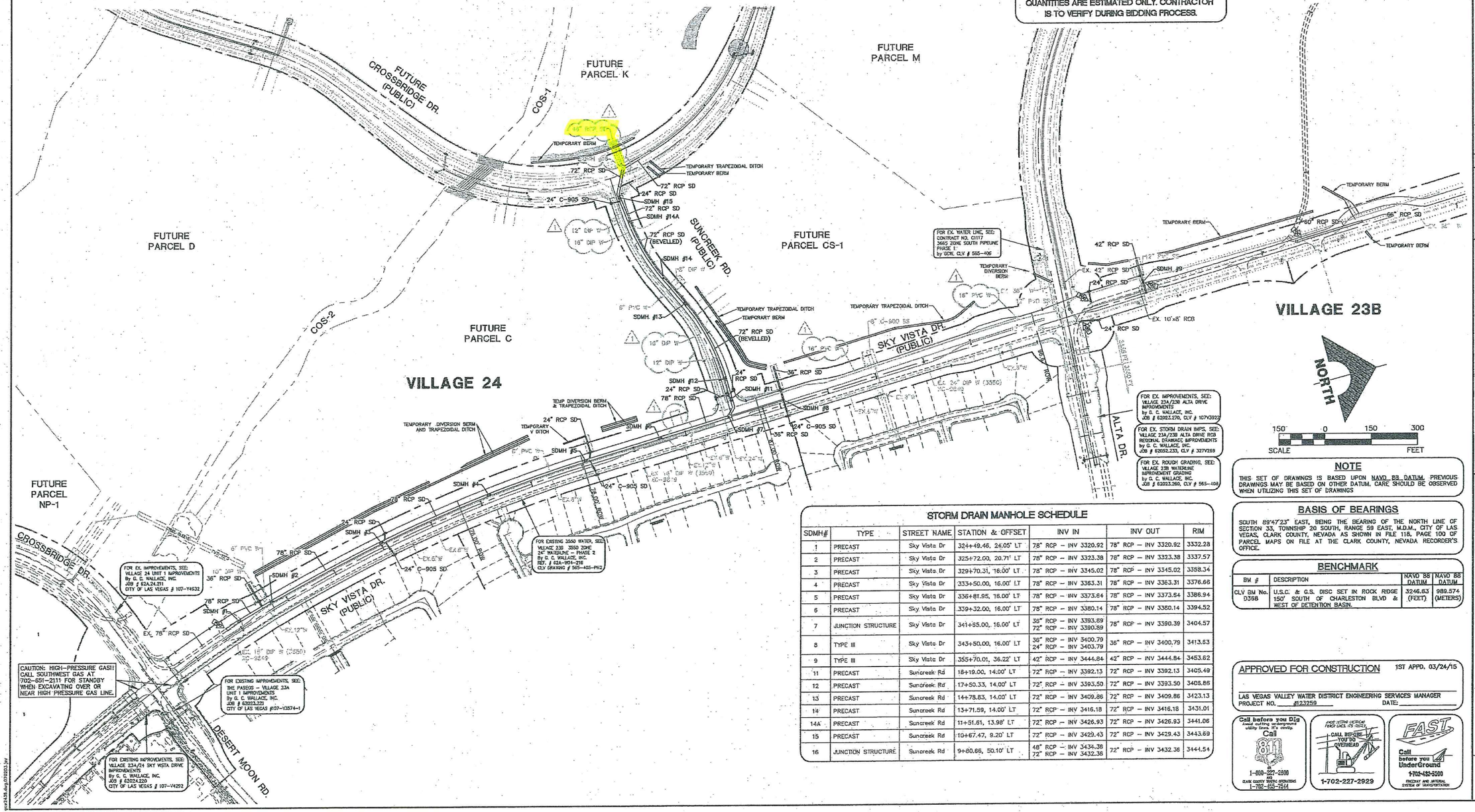
cswf439.dwg 070203.jhr

STORM DRAIN QUANTITIES (PUBLIC)

24" STORM DRAIN CLASS III RCP	393 LF
24" STORM DRAIN C-905	100 LF
36" STORM DRAIN CLASS III RCP	383 LF
42" STORM DRAIN CLASS III RCP	73 LF
48" STORM DRAIN CLASS III RCP	66 LF
60" STORM DRAIN CLASS III RCP	196 LF
66" STORM DRAIN CLASS III RCP	4 LF
72" STORM DRAIN CLASS III RCP	479 LF
72" STORM DRAIN CLASS III RCP (BEVELED)	493 LF
78" STORM DRAIN CLASS III RCP	656 LF
78" STORM DRAIN CLASS III RCP (BEVELED)	1,114 LF
JUNCTION STRUCTURE	2 EA
TYPE III STORM DRAIN MANHOLE	2 EA
48" PRECAST MANHOLE TEE W/ RISER	10 EA
60" PRECAST MANHOLE TEE W/ RISER	2 EA
PRECAST ELBOW	3 EA
PIPE JUNCTION	6 EA
TYPE "CM" DROP INLET (L = 5.0')	4 EA
TYPE "CM" DROP INLET (L = 10.0')	7 EA
TYPE "CM" DROP INLET (L = 12.5')	4 EA
TYPE "CM" DROP INLET (L = 15.0')	1 EA
CONCRETE COLLAR	5 EA
TEMPORARY PLUG	2 EA

QUANTITIES ARE ESTIMATED ONLY. CONTRACTOR IS TO VERIFY DURING BIDDING PROCESS.





STORM DRAIN MANHOLE SCHEDULE

SDMH#	TYPE	STREET NAME	STATION & OFFSET	INV IN	INV OUT	RIM
1	PRECAST	Sky Vista Dr	324+49.46, 24.05' LT	78" RCP – INV 3320.92	78" RCP – INV 3320.92	3332.28
2	PRECAST	Sky Vista Dr	325+72.60, 20.71' LT	78" RCP – INV 3323.38	78" RCP – INV 3323.38	3337.57
3	PRECAST	Sky Vista Dr	329+70.31, 16.00' LT	78" RCP – INV 3345.02	78" RCP – INV 3345.02	3358.34
4	PRECAST	Sky Vista Dr	333+50.00, 16.00' LT	78" RCP – INV 3363.31	78" RCP – INV 3363.31	3376.66
5	PRECAST	Sky Vista Dr	336+81.95, 16.00' LT	78" RCP – INV 3373.64	78" RCP – INV 3373.64	3386.94
6	PRECAST	Sky Vista Dr	339+32.00, 16.00' LT	78" RCP – INV 3380.14	78" RCP – INV 3380.14	3394.52
7	JUNCTION STRUCTURE	Sky Vista Dr	341+85.00, 16.00' LT	36" RCP – INV 3393.89 72" RCP – INV 3390.89	78" RCP – INV 3390.39	3404.57
8	TYPE III	Sky Vista Dr	343+50.00, 16.00' LT	36" RCP – INV 3400.79 24" RCP – INV 3403.79	36" RCP – INV 3400.79	3413.53
9	TYPE III	Sky Vista Dr	355+70.01, 36.22' LT	42" RCP – INV 3444.84	42" RCP – INV 3444.84	3453.62
11	PRECAST	Suncreek Rd	18+19.00, 14.00' LT	72" RCP – INV 3392.13	72" RCP – INV 3392.13	3405.49
12	PRECAST	Suncreek Rd	17+50.33, 14.00' LT	72" RCP – INV 3393.50	72" RCP – INV 3393.50	3408.86
13	PRECAST	Suncreek Rd	14+78.83, 14.00' LT	72" RCP – INV 3409.86	72" RCP – INV 3409.86	3423.13
14	PRECAST	Suncreek Rd	13+71.59, 14.00' LT	72" RCP – INV 3416.18	72" RCP – INV 3416.18	3431.01
14A	PRECAST	Suncreek Rd	11+51.61, 13.98' LT	72" RCP – INV 3426.93	72" RCP – INV 3426.93	3441.06
15	PRECAST	Suncreek Rd	10+67.47, 9.20' LT	72" RCP – INV 3429.43	72" RCP – INV 3429.43	3443.69
16	JUNCTION STRUCTURE	Suncreek Rd	9+80.66, 50.10' LT	48" RCP – INV 3434.36 72" RCP – INV 3432.36	72" RCP – INV 3432.36	3444.54

NOTE

THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS

BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 85 DATUM	NAVD 88 DATUM
CLV BM No. D35B	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.83 (FEET)	989.574 (METERS)

APPROVED FOR CONSTRUCTION — 1ST APPD. 03/24/15

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. #123259 DATE:

Call before you Dig — Two working days before you dig, avoid hitting underground utility lines. It's costly. Call 811 or 1-800-227-2600 or Clark County Water Reclamation 1-702-455-7564

Caution: Keep Visible Power Lines, It's Safe! — Call Before You Dig Overhead — 1-702-227-2929

FAST — Call before you UnderGround 1-702-452-5000 Freeway and Arterial System of Transportation

ISSUE FOR BID - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN. APP	DATE	CCW APP
1	6/16/15	REVISED 48" & 24" WATERLINE LOCATION PER AS-BUILTS				

ENGINEER - STATE OF NEVADA — JOSHUA L. JOHNSON — No. 15681 — PROFESSIONAL ENGINEER — DATE: 6/16/2015

PROJECT NO. 62024-221
DESIGN: GCW
DRAWN: GCW
CHECK: AJJ
PLOT DATE: 06-18-15
PLOT TIME: 15:30:54

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
6330 S. RAINBOW BLVD. LAS VEGAS, NEVADA 89118
T: 702.896.2000 F: 702.896.2299 GCWALLACE.COM
LAS VEGAS

F:\Projects\600\62024-221\DWG Production\V24-221_06-MU2.dwg
Paul Brennard

THE HOWARD HUGHES COMPANY, LLC

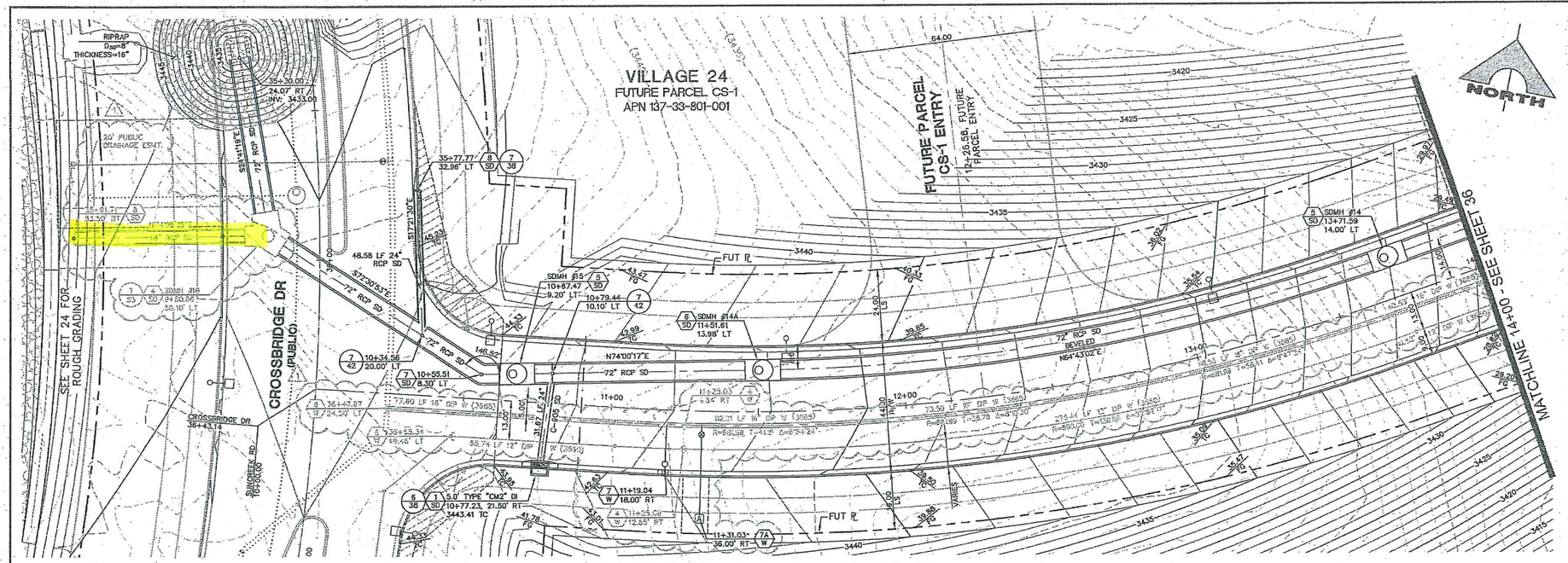
VILLAGE 23A/24 - SKY VISTA IMPROVEMENT PLANS
DESERT MOON DR TO ALTA DR INCLUDING SUNCREEK RD

STORM DRAIN MASTER PLAN

DRAWING 6
6 OF 54 SHTS

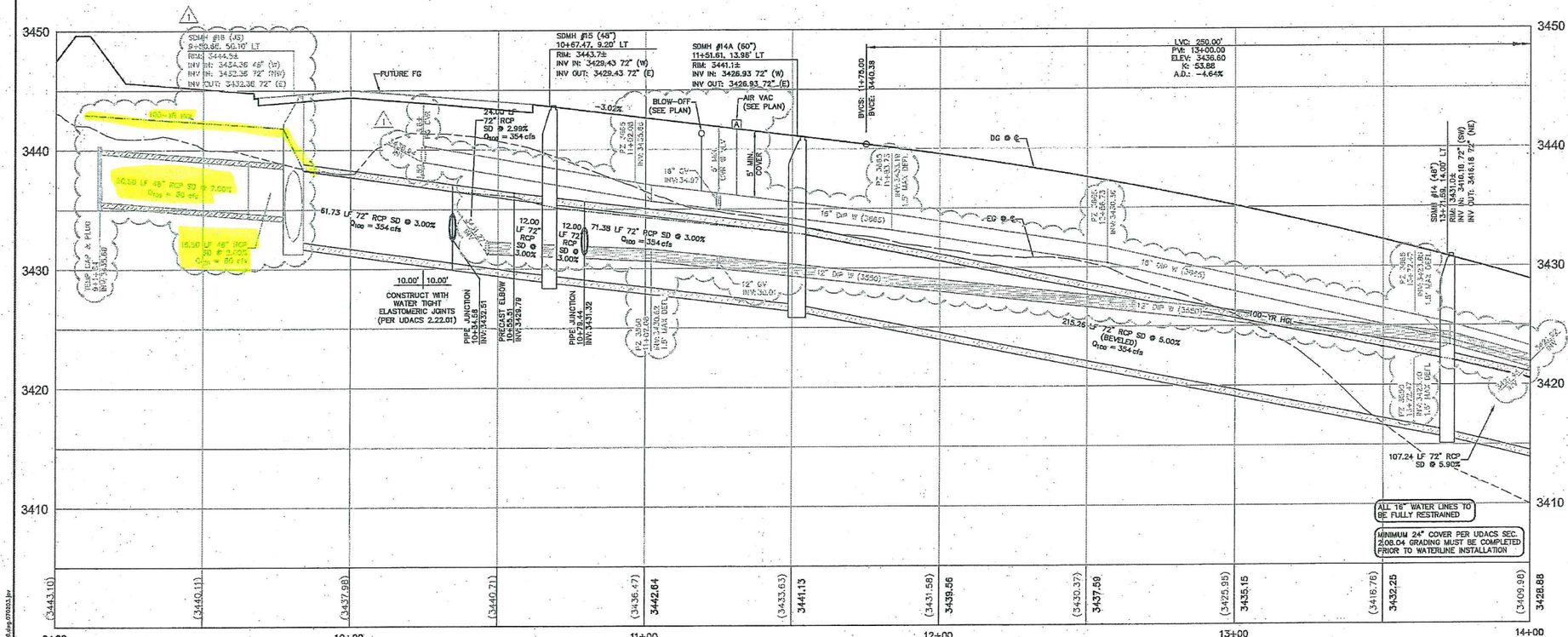
SID NO. 812 PROJECT 5 AND 12
SID NO. 809 PROJECT 13 AND 810 PROJECT 8

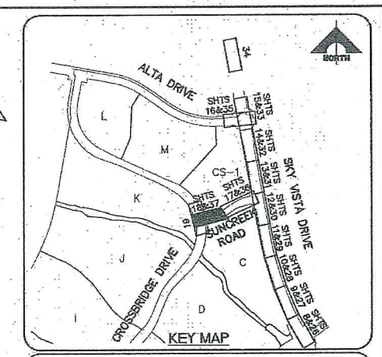
vp24.55.dwg 07/02/15 sw



SUNCREEK ROAD (PUBLIC)

HORIZ SCALE: 1" = 20'
VERT SCALE: 1" = 5'





IMPROVEMENT NOTES:

1. PROTECT IN PLACE AND ADJUST TO GRADE AS REQUIRED
2. RELOCATE WATER APPURTENANCES (VALVES TO REMAIN ACCESSIBLE AT ALL TIMES)

WATER CONSTRUCTION NOTES:

1W. INSTALL FIRE HYDRANT PER UDACS PLT. NO. 39 & 40
1AW. INSTALL FIRE HYDRANT ASSEMBLY PER UDACS PLT. NO. 39 & 40
2W. INSTALL TEE/CROSS PER UDACS PLT. NO. 31
3W. INSTALL BEND PER UDACS PLT. NO. 31. (SEE PLAN FOR ∠)
4W. INSTALL GATE VALVE PER UDACS PLT. NO. 30 AND 39
5W. INSTALL REDUCER PER UDACS PLT. NO. 30
6W. INSTALL CAP W/ 2" BLOW-OFF ASSEMBLY PER UDACS PLT. NO. 36
7W. INSTALL 6" MANUAL BLOW OFF ASSY PER UDACS PLT. NO. 37
7AW. INSTALL 4" COMBINATION AIR VALVE PER UDACS PLT. NO. 38
8W. INSTALL STEEL CASING PER UDACS PLATE 22 & 23
9W. INSTALL VERT. 45° BEND PER UDACS PLT. NO. 31
10W. REMOVE CAP & BLOWOFF PER UDACS PLT. NO. 36 AND CONNECT TO EXISTING WATER LINE

SEWER CONSTRUCTION NOTES:

1S. INSTALL 48" SEWER MANHOLE
1AS. INSTALL 60" SEWER MANHOLE
2S. INSTALL TEMPORARY PLUG AND CAP SEWER STUB
3S. INSTALL ELASTOMERIC JOINT SEALANT AT ALL MANHOLE JOINTS
4S. REMOVE EXISTING PLUG AND CONNECT TO EXISTING SEWER LINE

STORM DRAIN CONSTRUCTION NOTES:

5SD. INSTALL TYPE "CM2" DROP INLET PER USD DWG. NO. 412.1 AND 421
6SD. NOT USED
7SD. INSTALL TYPE III MANHOLE PER USD DWG. NO. 406
8SD. INSTALL JUNCTION STRUCTURE
9SD. INSTALL PRECAST MANHOLE TEE W/ 48" DIA. RISER
10SD. INSTALL PRECAST MANHOLE TEE W/ 60" DIA. RISER
11SD. INSTALL PRECAST ELBOW (SEE PLAN FOR ∠)
12SD. INSTALL TEMPORARY PLUG AND CAP STORM DRAIN LINE
13SD. INSTALL CONCRETE COLLAR PER DETAIL 5 ON SHEET 42
14SD. REMOVE EXISTING PLUG AND CONNECT TO EXISTING STORM DRAIN LINE

IRRIGATION CONSTRUCTION NOTES:

1IR. BANK "A": 1-6" & 2-4" SCH 40 PVC PER DETAIL 1 ON SHEET 42
2IR. BANK "B" : 2-4" SCHD. 40 PVC PER DETAIL 2 ON SHEET 42

* CONTRACTOR TO VERIFY SIZE AND LOCATION OF EXISTING UTILITIES PRIOR TO CONSTRUCTION

SCALE 40 0 40 80 FEET

NOTE

THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS

BASIS OF BEARINGS

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BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. 0368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

APPROVED FOR CONSTRUCTION

CITY OF LAS VEGAS FIRE DEPARTMENT DATE

APPROVED FOR CONSTRUCTION

1ST APPD. 03/24/15

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. #123259 DATE:

Call before you Dig — Avoid cutting underground utility lines. It's costly. Call 811 or 1-800-227-2600 (CLARK COUNTY RIGHTS-OF-WAYS) 1-702-455-6000

CALL BEFORE YOU DIG — AVOID HITTING OVERHEAD POWER LINES. IT'S COSTLY. 1-702-227-2929

FAST — Call before you UnderGround 1-702-432-6300 FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

LDF:

HTE: 00-00000

ENGINEER - STATE OF NEVADA — CHRISTOPHER G. WALLACE — No. 15788 — PROFESSIONAL ENGINEER

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	CCW APP	DATE
2	6/18/2015	ADDED 24" SANITARY SEWER & MANHOLE, REVISED STORM DRAIN					
1	4/24/2015	REVISED STORM DRAIN					

ISSUE FOR BID - NOT FOR CONSTRUCTION

PROJECT NO. 62024-221

DESIGN: CCW
DRAWN: CCW
CHECK: AJJ
PLOT DATE: 06-18-15
PLOT TIME: 15:36:02

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD · LAS VEGAS NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-221\DWG\Production\v24-221_37-U112.dwg
Paul Bremard

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 23A/24 - SKY VISTA IMPROVEMENT PLANS
DESERT MOON DR TO ALTA DR INCLUDING SUNCREEK RD

SUNCREEK ROAD
UTILITY PLAN AND PROFILE 12

DRAWING 37
37 OF 54 SHTS

SID NO. 812 PROJECT 5 AND 12
SID NO. 809 PROJECT 18 AND 810 PROJECT 8

TECHNICAL DRAINAGE STUDY FOR SUMMERLIN V24 PARCEL COS-1 WASH APPENDIX LAYOUT

Appendix A. Hydrologic Calculations and Information

1. Interim Conditions Prorate Calculations

Appendix B. Hydraulic Calculations

1. Manning's "n" Calculation
2. Ditch Calculations
3. SF6 Model (48" RCP Ultimate)
4. Scour Wall Calculations
5. COS-1 HEC-RAS Model: COS1_ULT.prj
6. CD Containing HEC-RAS Model
7. D-Load Calculation

Appendix C. Referenced Materials

1. Limited Geotechnical Evaluation US Waters – Wash COS-1 and COS-2 Summerlin Village 24 Las Vegas, Nevada
   a) Figure 2A – Alignment Map Overview
   b) Figure 2D – Alignment Map
   c) Boring Logs for B-3 & B-4
   d) Summary of Test Results (D50)
   e) Photos of Test Locations

2. Update #2 to the Conceptual Drainage Study for Summerlin Village 24
   a) CLV Approval Letter
   b) Figure 6U – Ultimate Conditions Drainage Map
   c) Figure 8U2 – Proposed Facilities Drainage Map

3. Update to the Technical Drainage Study for Village 24 Parcel COS-2
   a) CLV Approval Letter
   b) COS-2: Ultimate Conditions HEC-RAS Model

4. Update #6 to the Technical Drainage Study for Summerlin Village 24 Unit 2 Improvements – Crossbridge Drive (Crossbridge Unit 1 to Suncreek Road)
   a) CLV Approval Letter
   b) Figure 7U3R – Interim Conditions Drainage Map
   c) Figure 8U3R - HEC-RAS Cross Section Exhibit
   d) Figure 9U3R – HEC-RAS Cross Section Exhibit (Parcels COS-1 and COS-2)
   e) Proposed/ Interim Conditions Standard Form 4
   f) Proposed/ Interim Conditions HEC-1 Model
   g) SF6 Model: Suncreek (Parcel K) 48-inch RCP Lateral
   h) COS-1: Existing Conditions HEC-RAS Model
   i) 5' X 5' Box Culvert Inlet Control Calculation
   j) Stilling Basin Calculation
   k) 5' X 5' Box Culvert Normal Depth Calculation
   l) Text Excerpt describing culverts at Crossbridge with stilling basin
   m) Western Boundary Ultimate Conditions HEC-RAS Model: CRR1_ULT.prj
   n) Flow Split Calculations (Weir)
   o) Improvement Plan Sheets: 1, 2, 6, 13-15, 20, 21, 24, 37, 40, 41, 48, 49, 51, 52

5. Update #4 to the Technical Drainage Study for Summerlin Village 24 Unit 2 Improvements – Sky Vista Improvements (Desert Moon Drive to Alta Drive Including Suncreek Road)
   a) CLV Approval Letter

b) SF6 Model: Mainline No. 2 (Sky Vista/ Crossbridge north to Sunkcreek west to Crossbridge and Parcel K)
c) SF6 Model: Suncreek (Parcel K) 48-inch RCP Lateral
d) Improvements Plans Sheets: 1, 6, 37

APPENDIX A

Hydrologic Calculations and Information

Mannings N Calculator Using Equation 732 in the HCDDM		
d_{50} (in)	d_{50} (ft)	n
12	1	0.040

SUMMARY OF PRORATED STORM FLOWS INTERIM CONDITION			
100-Year Runoff			
Parent Basin	Area (ac)	Q_{100} (cfs)	Unit Flow (cfs/ac)
RG6C*	30.7	85	2.77
Prorated Subbasins			
SubBasin	Area (ac)	Unit Flow (cfs/ac)	Q_{100} (cfs)
RG6C-1	1.82	2.77	5
RG6C-2	20.62	2.77	57
RG6C-3	1.37	2.77	4
RG6C-4	1.28	2.77	4
RG6C-5	6.14	2.77	17

*Referenced from the Unit 2 Study

APPENDIX B

Hydraulic Calculations

PIPE CULVERT

RG6C-1 48" RCP STUB

INPUT		
Pipe Diameter	48	in
Number of Pipes	1	
Length	50.0	ft
Slope	2.00	%
Manning's 'n'	0.013	
Flow "Q"	66	cfs
Entrance Coef.	0.35	
Tail Water	0	ft

INLET		
Thin Edge	4.03	ft
Sq. Edge	3.72	ft
Beveled	3.53	ft
Tapered	3.65	ft.

OUTLET		
Head Water	N/A	ft
Critical	2.45	ft
Velocity	5.25	ft/s

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TRAPEZOIDAL CHANNEL

RG6C-1

Flow "Q"	5	cfs
Manning's "n"	0.025	
Slope (%)	0.50	
Bottom Width	0.0	ft
Side Slope (Lt)	3.0	H:1V
Side Slope (Rt)	3.0	H:1V
Radius	0.0	ft

OUTPUT:

Velocity	2.30	ft/sec
Depth	0.85	ft
Freeboard	0.58	ft
Total Depth	1.43	ft
Froude No.	0.62	ft
Superelevation	0.00	ft

Normal depth calculations using Manning's equation

Fb = 1+0.025Vd^(1/3) Supercritical; 0.5+V^2/2g Subcritical

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TRAPEZOIDAL CHANNEL

RG6C-4 MAX

Flow "Q"	4	cfs
Manning's "n"	0.040	
Slope (%)	10.20	
Bottom Width	0.0	ft
Side Slope (Lt)	3.0	H:1V
Side Slope (Rt)	3.0	H:1V
Radius	0.0	ft

OUTPUT:

Velocity	4.73	ft/sec
Depth	0.53	ft
Freeboard	1.10	ft
Total Depth	1.63	ft
Froude No.	1.62	ft
Superelevation	0.00	ft

Normal depth calculations using Manning's equation

Fb = 1+0.025Vd^(1/3) Supercritical; 0.5+V^2/2g Subcritical

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RIPRAP CHANNEL

RG6C-4 MAX

Flow "Q"	4	cfs
Manning's "n"	0.036	
Slope (%)	10.20	
Bottom Width	0.0	ft
Side Slope (Lt)	3.0	H:1V
Side Slope (Rt)	3.0	H:1V
Specific Gravity	2.50	

OUTPUT:

Velocity	5.12	ft/s
Depth	0.51	ft
Freeboard	1.10	ft
Total Depth	1.61	ft
Froude No.	1.79	
Riprap Size D50	7.1	in

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS

TRAPEZOIDAL CHANNEL

RG6C-4 MIN

Flow "Q"	4	cfs
Manning's "n"	0.040	
Slope (%)	5.00	
Bottom Width	0.0	ft
Side Slope (Lt)	3.0	H:1V
Side Slope (Rt)	3.0	H:1V
Radius	0.0	ft

OUTPUT:

Velocity	3.62	ft/sec
Depth	0.61	ft
Freeboard	1.08	ft
Total Depth	1.69	ft
Froude No.	1.16	ft
Superelevation	0.00	ft

Normal depth calculations using Manning's equation

Fb = 1+0.025Vd^(1/3) Supercritical; 0.5+V^2/2g Subcritical

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS

Worksheet for Ditch Cross Section 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05800	ft/ft
Discharge	4.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3.50
0+07	0.00
0+72	2.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3.50)	(0+72, 2.00)	0.025

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.25	ft
Elevation Range	0.00 to 3.50 ft	
Flow Area	1.11	ft²
Wetted Perimeter	8.81	ft
Hydraulic Radius	0.13	ft
Top Width	8.74	ft
Normal Depth	0.25	ft
Critical Depth	0.32	ft
Critical Slope	0.01694	ft/ft
Velocity	3.60	ft/s

Worksheet for Ditch Cross Section 1

Results

Velocity Head		0.20	ft
Specific Energy		0.46	ft
Froude Number		1.78	
Flow Type	Supercritical		

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	0.25	ft
Critical Depth	0.32	ft
Channel Slope	0.05800	ft/ft
Critical Slope	0.01694	ft/ft

Cross Section for Ditch Cross Section 1

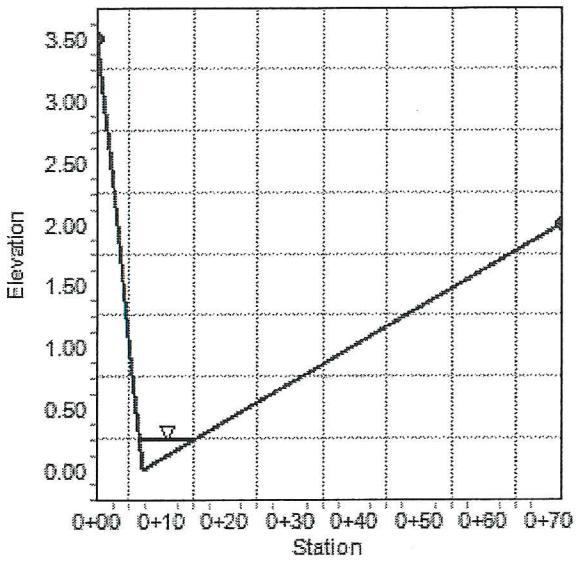
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05800	ft/ft
Normal Depth	0.25	ft
Discharge	4.00	ft³/s

Cross Section Image



Worksheet for Ditch Cross Section 2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05700	ft/ft
Discharge	4.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3.50
0+07	0.00
0+48	2.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3.50)	(0+48, 2.00)	0.025

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.30	ft
Elevation Range	0.00 to 3.50 ft	
Flow Area	1.01	ft²
Wetted Perimeter	6.80	ft
Hydraulic Radius	0.15	ft
Top Width	6.73	ft
Normal Depth	0.30	ft
Critical Depth	0.38	ft
Critical Slope	0.01609	ft/ft
Velocity	3.97	ft/s

Worksheet for Ditch Cross Section 2

Results

Velocity Head		0.24	ft
Specific Energy		0.54	ft
Froude Number		1.81	
Flow Type	Supercritical		

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	0.30	ft
Critical Depth	0.38	ft
Channel Slope	0.05700	ft/ft
Critical Slope	0.01609	ft/ft

Cross Section for Ditch Cross Section 2

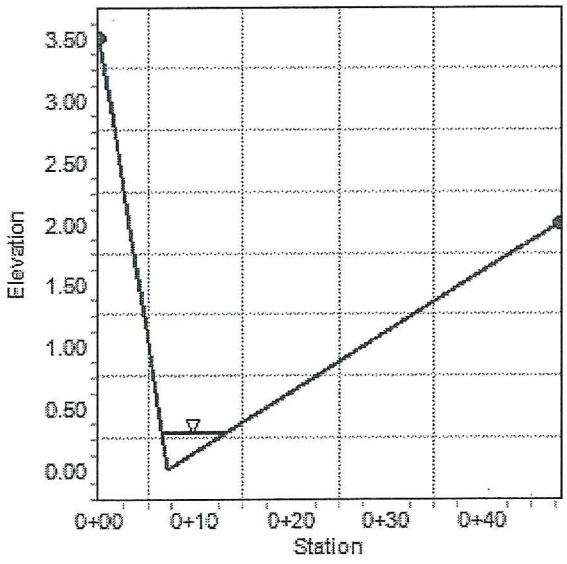
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05700	ft/ft
Normal Depth	0.30	ft
Discharge	4.00	ft³/s

Cross Section Image



Storm Drain Hydraulics Calculations

G.C. Wallace, Inc. | Suncreek (Parcel K) 48-inch RCP Lateral | DATE: 01/24/17 | FILE: SF6.xls

Storm Drain Manning's n (typ=0.013)= 0.013 | Inlet Structure Type or K_i= d | Headwall:Square Edge (cut concrete and CMP)

	CONDUIT DATA										FLOW DATA									ENERGY LOSS DATA																							EGL & HGL				COMMENTS	
																				PIPE	TRANSITION																											
	STATION			PIPE	BOX		IRREG		#	INVERT ELEV	L	S	A	Φ	Q	V	V2/2g	Sf	Ave.	Frict	Frict	Manhole			Junction			Contraction/ Inlet			Expansion/Outlet			Bend					Misc			CONDUIT		TRANSITION		FULL/	
	FROM	TO	T/R	D	SPAN	RISE	AREA	HYD RAD		D/S	U/S											Θ	K_{mh}	H_{mh}	Θ	K_j	H_j	Inlet/	K_i	H_c	Θ	K_o	H_o	R_{bend}	Θ	K_b	H_b	H_m	Total	U/S	U/S	U/S	U/S	PART	CRTL
	(ft)	(ft)		(in)	(ft)	(ft)	(ft^2)	(ft)		(ft)	(ft)	(ft)	(%)	(ft^2)		(cfs)	(ft/s)	(ft)	(ft/ft)	(S_f)	H_f (ft)	(ft)	(deg)		(ft)	(deg)		Cont		(ft)	(deg)		(ft)	(ft)	(deg)			(ft)	(ft)	(ft)	EGL	HGL	EGL	HGL	FLOW	
1		1000.00		48							3434.36																			Outlet K_o=		1.0												3442.79	3442.10		
2	1000.00	1013.00	R	48					1	3434.36	3434.62	13.0	2.00%	12.57	0.0049	84	6.64	0.69	0.0034	0.0034	0.04																				0.00	3442.83	3442.14			FULL	U/S
3	1013.00	1018.00	T	48					1	3434.62	3434.72	5.0	2.00%	12.57	0.0049	80	6.37	0.63	0.0031	0.0032		0.02	0	0.02	0.01	45	0.50	0.37												0.40			3443.23	3442.60	FULL	U/S
4	1018.00	1066.00	R	48					1	3434.72	3435.68	48.0	2.00%	12.57	0.0049	80	6.37	0.63	0.0031	0.0031	0.15																				0.00	3443.38	3442.75			FULL	U/S
5	1066.00	1116.00	R	48					1	3435.68	3436.68	50.0	2.00%	12.57	0.0049	80	6.37	0.63	0.0031	0.0031	0.15																				0.00	3443.53	3442.90			FULL	U/S
6	1116.00									3436.68																																			
7																																														

Summary of Results

	STATION	INVERT	SOFFIT	EGL	HGL	(Optional) GRADE	(Optional) LOCATION	(Optional) DESCRIPTION	HGL with respect to FG	Pressure Gasket Required?
1	1000.00	3434.36	3438.36	3442.79	3442.10	3444.50			OK	NO
2	1013.00	3434.62	3438.62	3442.83	3442.14	3444.77			OK	NO
3	1018.00	3434.72	3438.72	3443.23	3442.60	3444.77			OK	NO
4	1066.00	3435.68	3439.68	3443.38	3442.75	3445.36			OK	NO
5	1116.00	3436.68	3440.68	3443.53	3442.90	3450.13			OK	NO
6										
7										

Cross Section Location	Approach Flowrate CFS Q_1	Contracted Flowrate CFS Q_2	Approach Top Width Feet W_1	Contracted Top Width Feet W_2	Average Velocity FPS V_m	Maximum Depth Upstream of Bend Feet Y_{MAX}	Hydraulic Depth Upstream of Bend Feet Y_h	Approach Depth Feet Y_1	Average Depth In Main Channel Feet Y_o	Embankment Length Main Channel Feet L'	Average Depth After Contraction Scour Feet Y_2	Soil Particle Size Feet d_{50}	Critical Velocity FPS V_c	Energy Slope At Approach Section ft/ft Se_2	α Degrees	Froude Number Fr_1	Long-Term Bed Elevation Changes Feet Z_g	Anti-Dune Trough Feet Z_a	Anti-Dune Trough Feet Z_a	Bend Scour Feet Z_{bs}	Bend Scour Feet Z_{bs}	Contraction Scour Feet Z_{cs}	Contraction Scour Feet Z_{cs}	Local Scour Feet Z_s	Total Scour Feet Z_t	Proposed Minimum Depth of Footings Z_f	Factor of Safety
4325-4200	554	554	39.42	39.42	9.16	2.24	1.86	2.24	1.89	90.42	2.24	0.00984	2.68	0.0144	0.00	0.97	-0.2	1.15	0.95	-5.01	0.00	0.35	0.35	0.00	1.51	5.00	3.3
4200-4050	554	554	53.39	48.44	10.48	1.30	1.03	1.30	1.38	180.27	1.38	0.00984	2.45	0.0526	0.00	1.73	-0.9	1.51	0.69	-1.84	0.00	0.00	0.00	0.00	1.59	5.00	3.1
4050-3825	554	554	51.91	42.40	10.40	1.44	0.95	1.44	1.30	255.21	1.62	0.00984	2.49	0.0736	0.00	2.02	10.5	1.48	0.65	-2.62	0.00	0.32	0.32	0.00	-9.51	5.00	N/A
3825-3675	554	554	76.05	54.75	10.02	1.58	0.85	1.58	1.29	164.98	1.92	0.00984	2.53	0.0463	0.00	1.61	-0.6	1.37	0.65	-3.28	0.00	0.63	0.63	0.00	1.87	5.00	2.7
3675-3550	554	554	55.39	52.14	10.31	1.44	1.02	1.44	1.33	150.83	1.49	0.00984	2.49	0.0496	22.00	1.68	-2.0	1.46	0.67	0.21	0.21	0.16	0.16	0.00	3.04	5.00	1.6
3550-3250	554	554	52.14	47.10	10.54	1.80	1.06	1.80	1.77	258.30	1.91	0.00984	2.59	0.0495	0.00	1.68	-0.8	1.52	0.88	-3.67	0.00	0.14	0.14	0.00	1.82	5.00	2.7
3250-3000	554	554	54.89	54.89	10.45	1.10	0.97	1.10	1.23	261.30	1.10	0.00984	2.38	0.0611	0.00	1.85	1.0	1.49	0.61	-1.91	0.00	-0.13	0.00	0.00	-0.37	5.00	N/A
3000-2800	554	554	56.57	48.76	10.33	0.96	0.90	0.96	1.23	195.36	1.05	0.00984	2.33	0.0758	19.00	2.03	4.8	1.46	0.62	0.07	0.07	-0.18	0.00	0.00	-4.13	5.00	N/A
2800-2750	554	554	54.67	54.67	9.86	1.41	1.01	1.41	1.31	48.59	1.41	0.01640	2.95	0.0546	0.00	1.76	0.9	1.33	0.66	-2.84	0.00	0.10	0.10	0.00	-0.16	5.00	N/A
2750-2500	554	554	55.12	51.89	10.30	1.21	1.07	1.21	1.29	255.69	1.25	0.01640	2.87	0.0442	0.00	1.60	-3.0	1.45	0.64	-2.69	0.00	-0.03	0.00	0.00	3.63	5.00	1.4
2500-2400	554	554	52.07	35.58	10.76	1.15	0.98	1.15	1.52	103.59	1.44	0.01640	2.85	0.0661	18.00	1.92	0.4	1.58	0.76	0.02	0.02	-0.08	0.00	0.00	0.36	5.00	N/A
2400-2275	554	554	35.58	35.58	11.26	1.61	1.37	1.61	1.41	108.83	1.61	0.01640	3.01	0.0468	0.00	1.71	-0.4	1.74	0.70	-2.53	0.00	0.20	0.20	0.00	1.27	5.00	3.9
2275-2054	554	554	58.44	56.94	8.52	1.47	0.98	1.47	2.06	128.82	1.49	0.01640	2.97	0.0533	0.00	1.73	3.4	0.99	0.99	-2.12	0.00	-0.57	0.00	0.00	-2.43	5.00	N/A

(Equation 724) $Z_t = \{Z_{lt} + (1/2)Z_a + Z_{bs} + Z_{cs} + Z_s\}$

Where;

Z_t = The Total Scour Depth That Can Occur At A Structure.

Z_{lt} = The Long-Term Bed Elevation Changes Depth. (See attached worksheet.)

Z_a = The Anti-Dune Trough Depth

Z_{bs} = Bend-Scour Component of Total Scour Depth

Z_{cs} = Contraction-Scour Component of Total Scour Depth

Z_{cs} = Local Scour at Abutments Depth

Anti-Dune Trough Depth; Z_a

(Equation 708) $Z_a = (1/2)(0.14)(2\pi V^2/g) = 0.0137V^2$; Anti-Dune Trough Depth

Where;

V = Average Channel Velocity; fps

Bend-Scour Depth; Z_{bs}

(Equation 709) $Z_{bs} = (0.0685Y_{MAX}V^{0.8}/Y_h^{0.4}S_e^{0.5})[2.1[\text{Sin}^2(\alpha/2)/\text{Cos }\alpha]^{0.2} - 1]$

Where;

V = Average Channel Velocity; fps

Y_{MAX} = Maximum Depth of Flow Immediately Upstream of Bend; ft

Y_h = Hydraulic Depth of Flow Immediately Upstream of Bend; ft (Flow Area/ Flow Top Width)

S_{e1} = Energy Slope Immediately Upstream of Bend (or Bed Slope for Uniform Conditions), ft/ft

α = Angle Formed by the Projection of the Channel Centerline from the Point of Curvature to a Point Which Meets a Line Tangent to the Outer Bank of the Channel, degrees

Critical Velocity Above Which Material Will Be Transported; V_c

(Equation 712) $V_c = 10.95\ Y^{(1/6)}d_{50}^{(1/3)}$ Above Which Material Will Be Transported

Where;

Y = Average Depth of Flow in the Main Channel or Overbank at the Approach Section; ft

If $V_c < V$; use live bed contraction scour equations; if not assume clear-water contraction.

Live-Bed Contraction Scour; Z_{cs}

(Equation 713) $Y_2 = Y_1[Q_2/Q_1]^{(6/7)}[W_1/W_2]^{K1}$ Live-Bed Contraction Scour

(Equation 714) $Z_{cs} = Y_2 - Y_o$ Live-Bed Contraction Scour

Where;

Y_2 = Average Depth After Scour Contracted Section; ft

Y_1 = Average Depth in the Main Channel or Floodplain at the Approach Section; ft

Y_o = Average Depth in the Main Channel or Floodplain at the Contracted Section Before Scour; ft

Q_1 = Flow in the Main Channel or Floodplain at the Approach Section, Which is Transporting Sediment; cfs

Q_2 = Flow in the Main Channel or Floodplain at the Contracted Section, Which is Transporting Sediment; cfs

W_1 = Top Width of the Active Flow Area at the Approach Section; ft

W_2 = Top Width of the Active Flow Area at the Contracted Section; ft

K_1 = Exponent for Mode of Bed Material Transport

(1) $V_*/\omega < 0.5$, $K_1 = 0.59$: Mostly Contact Bed Material Discharge

(2) $V_*/\omega = 0.5$ to 2.0, $K_1 = 0.64$: Some Suspended Bed Material Discharge

(3) $V_*/\omega > 2.0$, $K_1 = 0.59$: Mostly Contact Bed Material Discharge

Where;

$V_* = (gY_1S_e)^{1/2}$, Shear Velocity in the Main Channel or Floodplain at the Approach Section, fps

ω = Fall Velocity of Bed material Based on d_{50}; fps

g = Acceleration of Gravity; fps

S_{e2} = Slope of the Energy Grade Line at the Approach Section; ft/ft

Clear-Water Contraction Scour; Z_{cs}

(Equation 715) $Y_2 = [Q_2^2/Cd_m^{(2/3)}W_2^2]^{(3/7)}$ Clear-Water Contraction Scour

(Equation 716) $Z_{cs} = Y_2 - Y_o$ Clear-Water Contraction Scour

Where;

d_m = Diameter of the Smallest Non-Transportable Particle in the Bed Material (1.25 d_{50}) in the Contracted Section; ft

d_{50} = Median Diameter of the Bed Material; ft

C = 120 for English Units (40 for Metric)

Local Scour At Abutments; Z_s

When the wetted embankment length, L', divided by the approach flow depth, Y_1, is greater than 25, use equation 717

When the wetted embankment length, L', divided by the approach flow depth, Y_1, is less than 25, use equation 718

(Equation 717) $Z_s = 4Y_1(K_1/0.55)K_2Fr_1^{0.33}$ Local Scour at Abutments (HIRE)

Where;

Y_1 = Depth of Flow at the Toe of the Abutment on the Overbank or in the Main Channel; ft

K_1 = Correction Factor for Abutment Shape

1.00, for Vertical-Wall Abutment

0.82, for Vertical-Wall Abutment with Wing Walls

0.55, for Spill-Through Abutment

Specify K_1 Value [1.00]

K_2 = Correction Factor for Angle of Attack(θ) of Flow With Abutment, θ = 90 degrees When Abutments are Perpendicular to the Flow, θ < 90 degrees if Embankment Points Downstream, and θ > 90 If Embankment Points Upstream $(\theta/90)^{0.4}$

Specify θ Value; degrees [0.00]

(Equation 718) $Z_s = 2.27K_1K_2(L')^{0.43}Y_a^{0.57}Fr^{0.61} + Y_a$ Local Scour at Abutments (FROELICH)

Where;

K_1 = Correction Factor for Abutment Shape

1.1, for Square Nose

1.0, for Round Nose, Circular Cylinder and Group of Cylinders

0.9, for Sharp Nose (Triangular)

Specify K_1 Value [1.1]

K_2 = Correction Factor for Angle of Attack(θ) of Flow With Abutment, θ = 90 degrees When Abutments are Perpendicular to the Flow, θ < 90 degrees if Embankment Points Downstream, and θ > 90 If Embankment Points Upstream $(\theta/90)^{0.4}$

Specify θ Value; degrees [0.00]

L' = Length of Abutment (Embankment) Projected Normal to Flow; ft

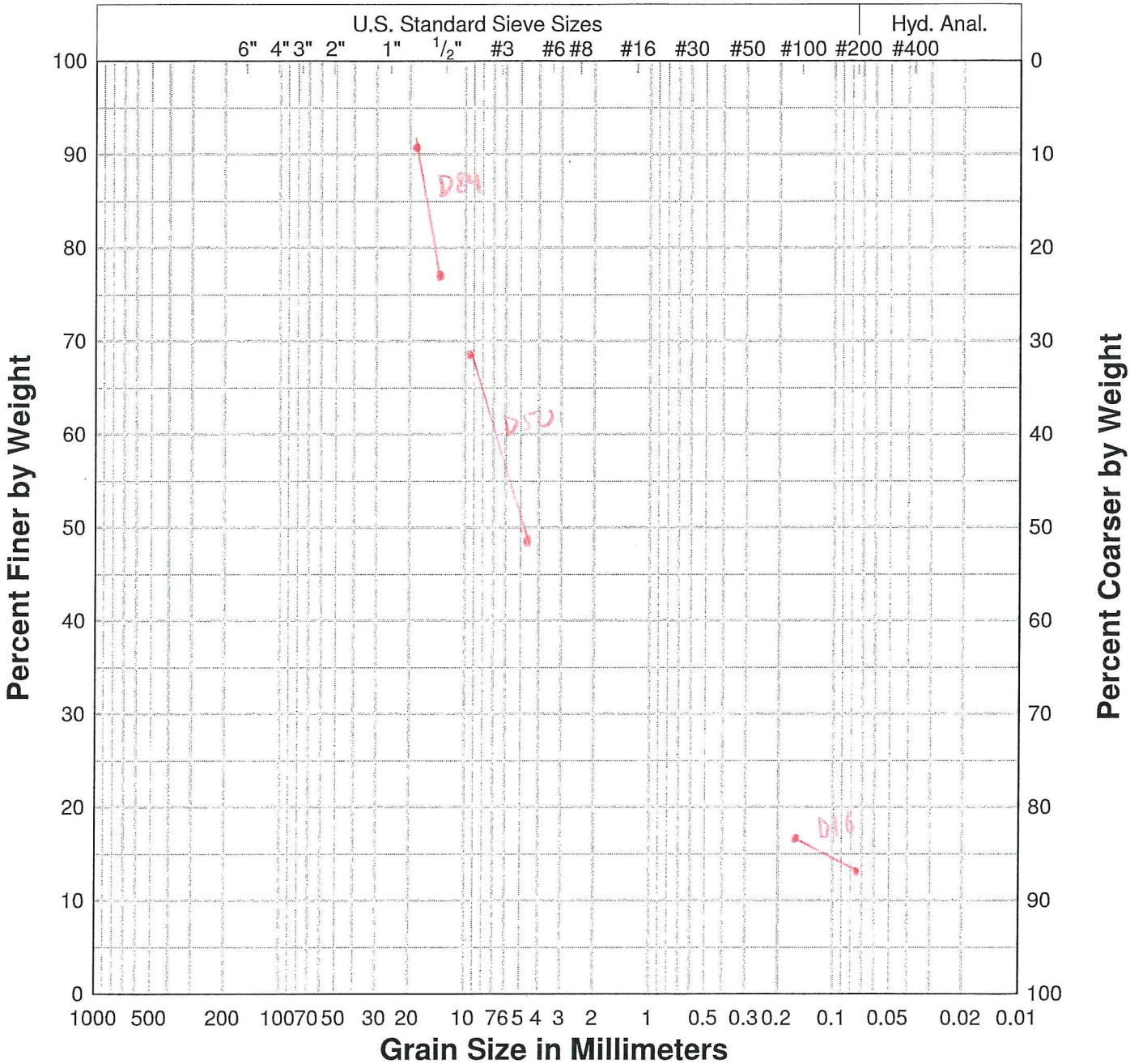
Ya = Average Depth of Flow on the Flow on the Floodplain at the Approach Section (Y_1); ft

Fr = Froude Number of the Floodplain at the Approach Section

Va = Average Velocity of the Approach Flow Va; fps

Aa = Flow Area of the Approach Section Obstructed by the Abutment and Embankment; ft

B-3



$$\frac{\left[\frac{D84}{D50}+\frac{D50}{D16}\right]}{2}=\frac{\frac{0.0525}{0.0164}+\frac{0.0164}{0.0004}}{2}=22.9$$

D84 = 16mm = 0.052493438
D50 = 5mm = 0.016404199
D16 = 0.13mm = 0.000426509

B-3

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

POWER EQUATIONS FOR TOTAL BED MATERIAL DISCHARGE IN SAND- AND FINE-GRAVEL-BED STREAMS

$$q_s = C_1 (Y)^{C_2} (V)^{C_3}$$

d_{50}								
(mm)	0.1	0.25	0.5	1.0	2.0	3.0	4.0	5.0
(inches)	0.00394	0.00984	0.0197	0.0394	0.0787	0.118	0.157	0.197
G_f=1.0								
C_1	3.30×10^{-5}	1.42×10^{-6}	7.6×10^{-6}	5.62×10^{-6}	5.64×10^{-6}	6.32×10^{-6}	7.10×10^{-6}	7.78×10^{-6}
C_2	0.715	0.495	0.28	0.06	-0.14	-0.24	-0.30	-0.34
C_3	3.30	3.61	3.82	3.93	3.95	3.92	3.89	3.87
G_f=2.0								
C_1		1.59×10^{-5}	9.8×10^{-6}	6.94×10^{-6}	6.32×10^{-6}	6.62×10^{-6}	6.94×10^{-6}	
C_2		0.51	0.33	0.12	-0.09	-0.196	-0.27	
C_3		3.55	3.73	3.86	3.91	3.91	3.90	
G_f=3.0								
C_1			1.21×10^{-5}	9.14×10^{-6}	7.44×10^{-6}			
C_2			0.36	0.18	-0.02			
C_3			3.66	3.76	3.86			
G_f=4.0								
C_1				1.0510^{-5}				
C_2				0.21				
C_3				3.71				

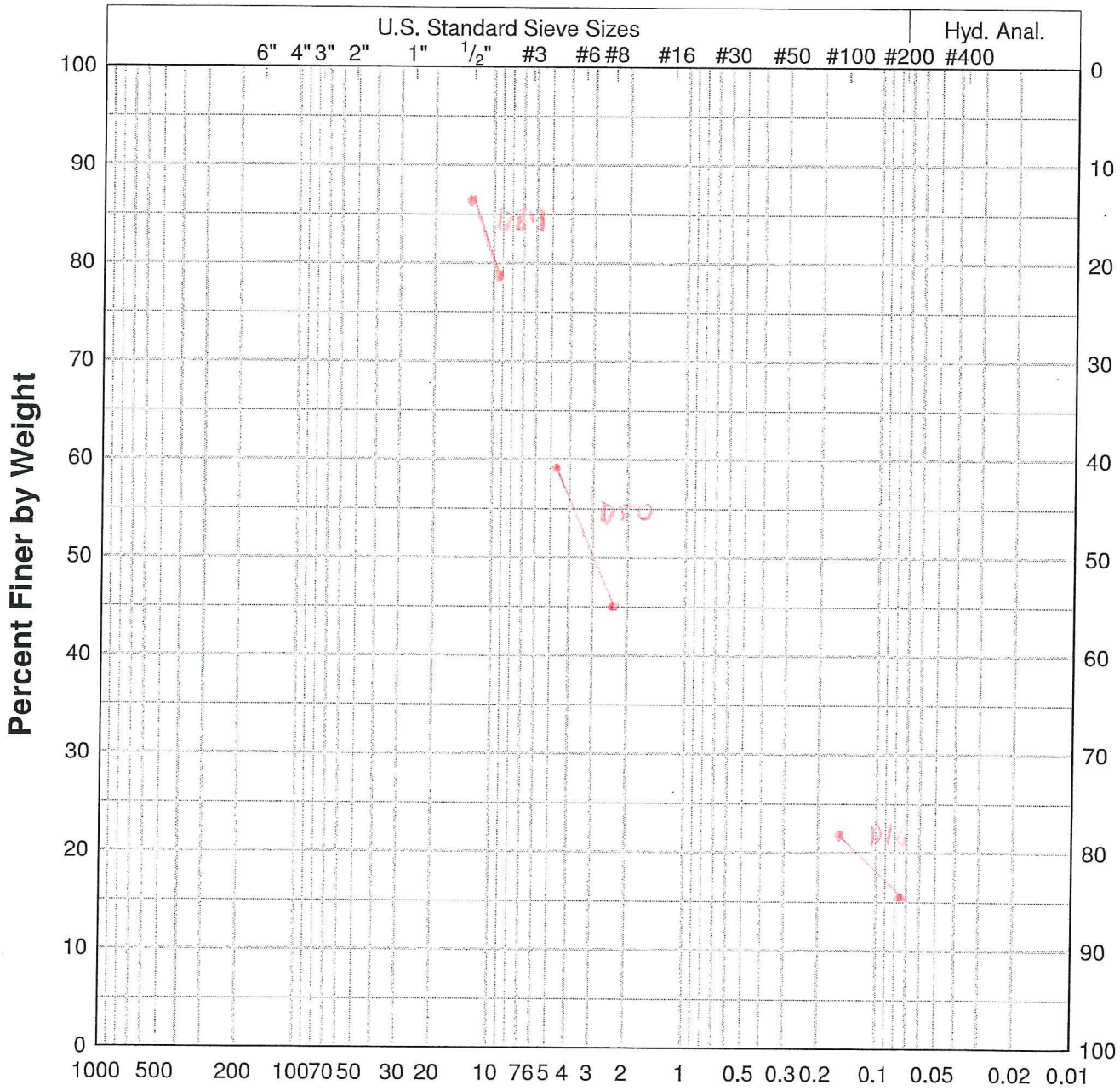
Definitions: q_s=Unit sediment transport rate in ft^2/s (unbulked); V=Velocity in ft/s; Y=Depth in ft; G_f=Gradation coefficient = $(d_{84}/d_{50} + d_{50}/d_{16})/2$.

Revision	Date

REFERENCE:

TABLE 703A

B-4



$$\frac{\left[\frac{D84}{D50} + \frac{D50}{D16}\right]}{2} = \frac{\frac{0.0394}{0.0098} + \frac{0.0098}{0.00026}}{2} = 20.66$$

D84 = 12mm = 0.039370079

D50 = 3mm = 0.009842519

D16 = 0.06mm = 0.000236407

B-4

POWER EQUATIONS FOR TOTAL BED MATERIAL DISCHARGE IN SAND- AND FINE-GRAVEL-BED STREAMS

$$q_s = C_1 (Y)^{C_2} (V)^{C_3}$$

d_{50}								
(mm)	0.1	0.25	0.5	1.0	2.0	3.0	4.0	5.0
(inches)	0.00394	0.00984	0.0197	0.0394	0.0787	0.118	0.157	0.197
G_f=1.0								
C_1	3.30×10^{-5}	1.42×10^{-6}	7.6×10^{-6}	5.62×10^{-6}	5.64×10^{-6}	6.32×10^{-6}	7.10×10^{-6}	7.78×10^{-6}
C_2	0.715	0.495	0.28	0.06	-0.14	-0.24	-0.30	-0.34
C_3	3.30	3.61	3.82	3.93	3.95	3.92	3.89	3.87
G_f=2.0								
C_1		1.59×10^{-5}	9.8×10^{-6}	6.94×10^{-6}	6.32×10^{-6}	6.62×10^{-6}	6.94×10^{-6}	
C_2		0.51	0.33	0.12	-0.09	-0.196	-0.27	
C_3		3.55	3.73	3.86	3.91	3.91	3.90	
G_f=3.0								
C_1			1.21×10^{-5}	9.14×10^{-6}	7.44×10^{-6}			
C_2			0.36	0.18	-0.02			
C_3			3.66	3.76	3.86			
G_f=4.0								
C_1				1.0510^{-5}				
C_2				0.21				
C_3				3.71				

Definitions: q_s=Unit sediment transport rate in ft^2/s (unbulked); V=Velocity in ft/s; Y=Depth in ft;
G_f=Gradation coefficient = $(d_{84}/d_{50} + d_{50}/d_{16})/2$.

Revision	Date

REFERENCE:

TABLE 703A

Determination of Long Term Bed Elevation Changes, Zlt: 4325-4200

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.86	ft
V = flow velocity in upstream channel, (in fps)	8.23	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	39.42	ft
So = upstream channel slope, (in ft/ft)	0.024	ft/ft
L = entire upstream channel length, (in ft)	90.42	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.0	cfs/ft
Qs = total sediment transport rate = qs*TW	0.9	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0220	73.8	7.5	54.9	1.64	1.34	0.9	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.0	cfs/ft
Qs = total sediment transport rate = qs*TW	0.9	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-0.2	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 4325-4200

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02200	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3560.00
0+08	3560.00
0+10	3559.00
0+12	3558.00
0+14	3557.00
0+25	3557.00
0+37	3557.00
0+41	3557.00
0+41	3557.00
0+64	3558.00
0+67	3559.00
0+69	3560.00
0+96	3560.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3560.00)	(0+14, 3557.00)	0.040
(0+14, 3557.00)	(0+64, 3558.00)	0.035
(0+64, 3558.00)	(0+96, 3560.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Worksheet for 4325-4200

Results

Normal Depth		1.64	ft
Elevation Range	3557.00 to 3560.00 ft		
Flow Area		73.79	ft²
Wetted Perimeter		55.45	ft
Hydraulic Radius		1.33	ft
Top Width		54.91	ft
Normal Depth		1.64	ft
Critical Depth		1.77	ft
Critical Slope		0.01644	ft/ft
Velocity		7.51	ft/s
Velocity Head		0.88	ft
Specific Energy		2.52	ft
Froude Number		1.14	
Flow Type	Supercritical		

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	1.64	ft
Critical Depth	1.77	ft
Channel Slope	0.02200	ft/ft
Critical Slope	0.01644	ft/ft

Cross Section for 4325-4200

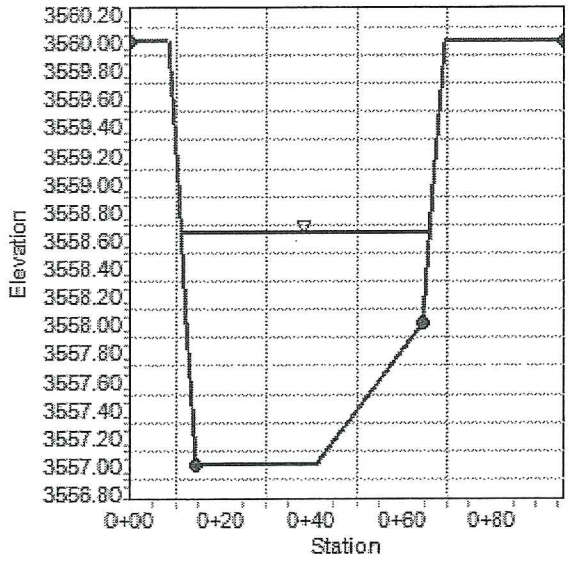
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02200	ft/ft
Normal Depth	1.64	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

4200-4050

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.03	ft
V = flow velocity in upstream channel, (in fps)	10.17	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	53.39	ft
So = upstream channel slope, (in ft/ft)	0.061	ft/ft
L = entire upstream channel length, (in ft)	180.27	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.0	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0560	54.5	10.2	52.5	1.55	1.04	3.0	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.0	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-0.9	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 4200-4050

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05600	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3550.00
0+13	3550.00
0+15	3549.00
0+17	3548.00
0+19	3547.00
0+39	3546.00
0+39	3546.00
0+43	3546.00
0+69	3547.00
0+73	3548.00
0+76	3549.00
0+79	3550.00
0+86	3551.00
0+96	3551.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3550.00)	(0+19, 3547.00)	0.040
(0+19, 3547.00)	(0+69, 3547.00)	0.035
(0+69, 3547.00)	(0+96, 3551.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method

Worksheet for 4200-4050

Options

Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.55	ft
Elevation Range	3546.00 to 3551.00 ft		
Flow Area		54.51	ft²
Wetted Perimeter		52.77	ft
Hydraulic Radius		1.03	ft
Top Width		52.53	ft
Normal Depth		1.55	ft
Critical Depth		2.04	ft
Critical Slope		0.01622	ft/ft
Velocity		10.16	ft/s
Velocity Head		1.61	ft
Specific Energy		3.15	ft
Froude Number		1.76	
Flow Type	Supercritical		

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	1.55	ft
Critical Depth	2.04	ft
Channel Slope	0.05600	ft/ft
Critical Slope	0.01622	ft/ft

Cross Section for 4200-4050

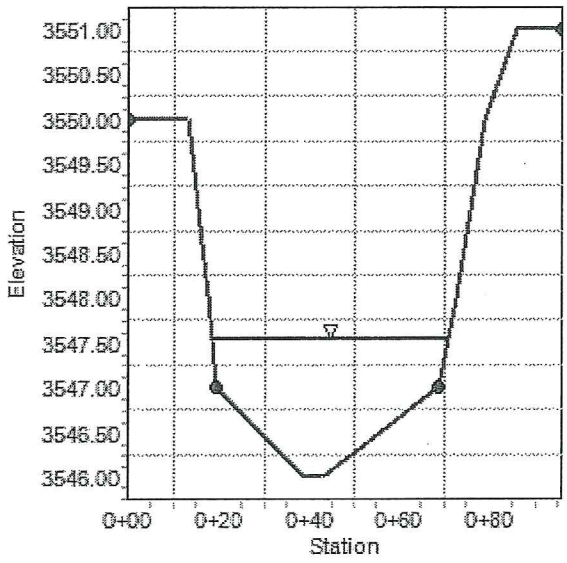
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05600	ft/ft
Normal Depth	1.55	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

4050-3825

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.95	ft
V = flow velocity in upstream channel, (in fps)	11.39	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	51.91	ft
So = upstream channel slope, (in ft/ft)	0.051	ft/ft
L = entire upstream channel length, (in ft)	255.21	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	4.7	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0920	53.1	10.4	70.4	1.43	0.75	4.7	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	4.7	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	10.5	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 4050-3825

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09200	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3538.00
0+08	3538.00
0+11	3537.00
0+13	3536.00
0+16	3535.00
0+27	3534.00
0+47	3533.52
0+70	3533.00
0+72	3533.00
0+76	3534.00
0+83	3534.00
0+84	3534.00
0+84	3534.00
0+89	3534.29
1+07	3535.00
1+09	3535.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3538.00)	(0+16, 3535.00)	0.040
(0+16, 3535.00)	(0+72, 3533.00)	0.035
(0+72, 3533.00)	(0+83, 3534.00)	0.040
(0+83, 3534.00)	(0+89, 3534.29)	0.030
(0+89, 3534.29)	(1+09, 3535.00)	0.040

Worksheet for 4050-3825

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.43	ft
Elevation Range	3533.00 to 3538.00 ft		
Flow Area		53.07	ft²
Wetted Perimeter		70.58	ft
Hydraulic Radius		0.75	ft
Top Width		70.41	ft
Normal Depth		1.43	ft
Critical Depth		1.95	ft
Critical Slope		0.01828	ft/ft
Velocity		10.44	ft/s
Velocity Head		1.69	ft
Specific Energy		3.12	ft
Froude Number		2.12	
Flow Type	Supercritical		

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	1.43	ft
Critical Depth	1.95	ft
Channel Slope	0.09200	ft/ft
Critical Slope	0.01828	ft/ft

Cross Section for 4050-3825

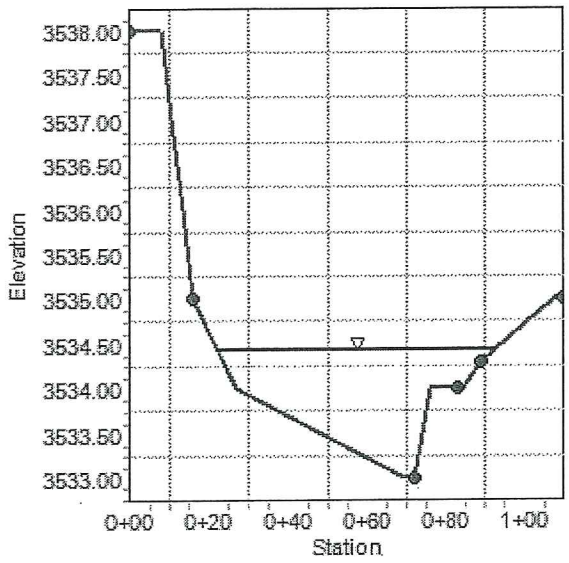
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09200	ft/ft
Normal Depth	1.43	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

3825-3675

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.85	ft
V = flow velocity in upstream channel, (in fps)	9.19	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	76.1	ft
So = upstream channel slope, (in ft/ft)	0.061	ft/ft
L = entire upstream channel length, (in ft)	164.98	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.0	cfs/ft
Qs = total sediment transport rate = qs*TW	3.0	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0570	55.2	10.0	55.2	1.41	1.00	3.0	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.0	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-0.6	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 3825-3675

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05700	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3527.00
0+08	3527.00
0+12	3526.00
0+15	3525.00
0+19	3524.00
0+27	3523.00
0+36	3523.00
0+52	3523.00
0+60	3524.00
0+62	3524.00
0+72	3524.00
0+74	3525.00
0+76	3526.00
0+83	3527.00
1+02	3527.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3527.00)	(0+19, 3524.00)	0.040
(0+19, 3524.00)	(0+72, 3524.00)	0.035
(0+72, 3524.00)	(1+02, 3527.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method

Worksheet for 3825-3675

Options

Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.41	ft
Elevation Range	3523.00 to 3527.00 ft		
Flow Area		55.22	ft²
Wetted Perimeter		55.51	ft
Hydraulic Radius		0.99	ft
Top Width		55.24	ft
Normal Depth		1.41	ft
Critical Depth		1.88	ft
Critical Slope		0.01628	ft/ft
Velocity		10.03	ft/s
Velocity Head		1.56	ft
Specific Energy		2.97	ft
Froude Number		1.77	
Flow Type	Supercritical		

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	1.88	ft
Channel Slope	0.05700	ft/ft
Critical Slope	0.01628	ft/ft

Cross Section for 3825-3675

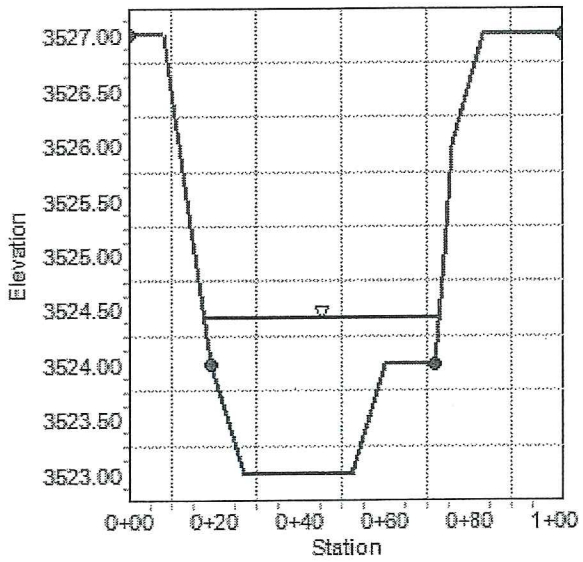
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05700	ft/ft
Normal Depth	1.41	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt: 3675-3550

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.02	ft
V = flow velocity in upstream channel, (in fps)	9.83	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	55.39	ft
So = upstream channel slope, (in ft/ft)	0.066	ft/ft
L = entire upstream channel length, (in ft)	150.83	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	2.8	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0530	55.5	10.0	52.2	1.80	1.06	2.8	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	2.8	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-2.0	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 3675-3550

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05300	ft/ft
Discharge	554.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3518.00
0+09	3518.00
0+18	3517.00
0+21	3516.00
0+24	3515.00
0+29	3514.17
0+30	3514.78
0+49	3514.00
0+53	3513.00
0+55	3513.00
0+67	3513.00
0+74	3513.00
0+76	3514.00
0+78	3515.00
0+80	3516.00
0+82	3517.00
0+84	3518.00
0+97	3518.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3518.00)	(0+29, 3514.17)	0.040
(0+29, 3514.17)	(0+78, 3515.00)	0.035
(0+78, 3515.00)	(0+97, 3518.00)	0.040

Worksheet for 3675-3550

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.80	ft
Elevation Range	3513.00 to 3518.00 ft		
Flow Area		55.46	ft²
Wetted Perimeter		52.95	ft
Hydraulic Radius		1.05	ft
Top Width		52.15	ft
Normal Depth		1.80	ft
Critical Depth		2.27	ft
Critical Slope		0.01638	ft/ft
Velocity		9.99	ft/s
Velocity Head		1.55	ft
Specific Energy		3.35	ft
Froude Number		1.71	
Flow Type	Supercritical		

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	1.80	ft
Critical Depth	2.27	ft
Channel Slope	0.05300	ft/ft
Critical Slope	0.01638	ft/ft

Cross Section for 3675-3550

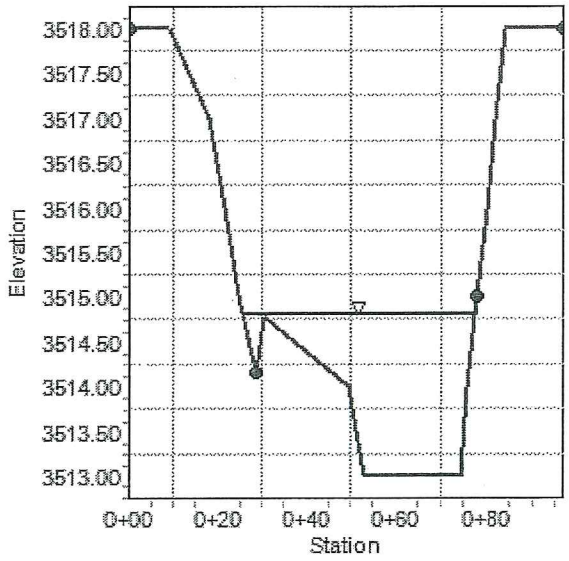
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05300	ft/ft
Normal Depth	1.80	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

3550-3250

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.06	ft
V = flow velocity in upstream channel, (in fps)	10.15	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	52.14	ft
So = upstream channel slope, (in ft/ft)	0.058	ft/ft
L = entire upstream channel length, (in ft)	258.30	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	2.9	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0550	55.9	9.9	55.1	1.14	1.01	2.9	«Compare to Qs Computed Above

8Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	2.9	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-0.8	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 3550-3250

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05500	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3502.00
0+03	3502.00
0+16	3501.00
0+18	3500.00
0+20	3499.00
0+22	3498.00
0+27	3498.00
0+43	3498.00
0+57	3498.00
0+64	3498.00
0+75	3499.00
0+78	3500.00
0+81	3501.00
0+84	3502.00
0+91	3502.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3502.00)	(0+22, 3498.00)	0.040
(0+22, 3498.00)	(0+75, 3499.00)	0.035
(0+75, 3499.00)	(0+91, 3502.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method

Worksheet for 3550-3250

Options

Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.14	ft
Elevation Range	3498.00 to 3502.00 ft		
Flow Area		55.85	ft²
Wetted Perimeter		55.45	ft
Hydraulic Radius		1.01	ft
Top Width		55.11	ft
Normal Depth		1.14	ft
Critical Depth		1.60	ft
Critical Slope		0.01632	ft/ft
Velocity		9.92	ft/s
Velocity Head		1.53	ft
Specific Energy		2.67	ft
Froude Number		1.74	
Flow Type	Supercritical		

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	1.14	ft
Critical Depth	1.60	ft
Channel Slope	0.05500	ft/ft
Critical Slope	0.01632	ft/ft

Cross Section for 3550-3250

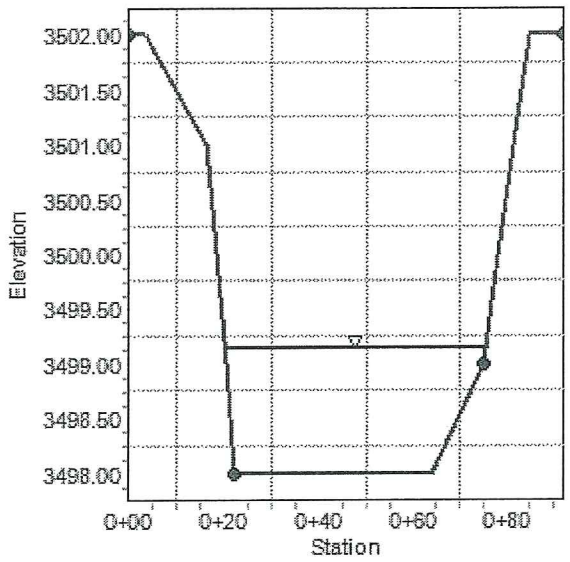
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05500	ft/ft
Normal Depth	1.14	ft
Discharge	554.00	ft^3/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

3250-3000

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.97	ft
V = flow velocity in upstream channel, (in fps)	10.46	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	54.89	ft
So = upstream channel slope, (in ft/ft)	0.061	ft/ft
L = entire upstream channel length, (in ft)	261.30	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3) 0.1 cfs/ft

Qs = total sediment transport rate = qs*TW 3.5 cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0650	53.8	10.3	56.9	1.01	0.94	3.5	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3) 0.1 cfs/ft

Qs = total sediment transport rate = qs*TW 3.5 cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L 1.0 ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 3250-3000

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06500	ft/ft
Discharge	554.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3488.00
0+05	3488.00
0+25	3487.00
0+33	3486.00
0+35	3485.00
0+37	3484.00
0+39	3483.00
0+43	3482.00
0+44	3482.00
0+57	3482.00
0+66	3482.00
0+70	3482.00
0+85	3482.00
0+93	3482.00
0+96	3483.00
0+99	3484.00
1+02	3485.00
1+15	3485.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3488.00)	(0+39, 3483.00)	0.040
(0+39, 3483.00)	(0+93, 3482.00)	0.035
(0+93, 3482.00)	(1+15, 3485.00)	0.040

Worksheet for 3250-3000

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.01	ft
Elevation Range	3482.00 to 3488.00 ft		
Flow Area		53.79	ft²
Wetted Perimeter		57.21	ft
Hydraulic Radius		0.94	ft
Top Width		56.93	ft
Normal Depth		1.01	ft
Critical Depth		1.51	ft
Critical Slope		0.01644	ft/ft
Velocity		10.30	ft/s
Velocity Head		1.65	ft
Specific Energy		2.66	ft
Froude Number		1.87	
Flow Type	Supercritical		

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	1.01	ft
Critical Depth	1.51	ft
Channel Slope	0.06500	ft/ft
Critical Slope	0.01644	ft/ft

Cross Section for 3250-3000

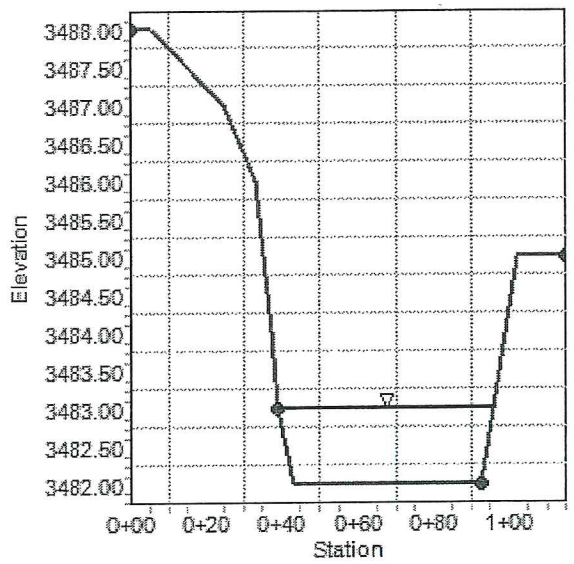
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06500	ft/ft
Normal Depth	1.01	ft
Discharge	554.00	ft^3/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

3000-2800

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.90	ft
V = flow velocity in upstream channel, (in fps)	11.04	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	56.57	ft
So = upstream channel slope, (in ft/ft)	0.056	ft/ft
L = entire upstream channel length, (in ft)	195.36	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	4.6	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0810	49.5	11.2	54.2	1.31	0.91	4.6	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	4.6	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	4.8	ft

if:
Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 3000-2800

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.08100	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3475.00
0+19	3475.00
0+21	3474.00
0+23	3473.00
0+25	3472.00
0+45	3471.47
0+63	3471.00
0+76	3471.00
0+78	3472.00
0+80	3473.00
0+82	3474.00
0+94	3474.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3475.00)	(0+25, 3472.00)	0.040
(0+25, 3472.00)	(0+76, 3471.00)	0.035
(0+76, 3471.00)	(0+94, 3474.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Worksheet for 3000-2800

Results

Normal Depth		1.31	ft
Elevation Range	3471.00 to 3475.00 ft		
Flow Area		49.48	ft²
Wetted Perimeter		54.63	ft
Hydraulic Radius		0.91	ft
Top Width		54.24	ft
Normal Depth		1.31	ft
Critical Depth		1.88	ft
Critical Slope		0.01639	ft/ft
Velocity		11.20	ft/s
Velocity Head		1.95	ft
Specific Energy		3.26	ft
Froude Number		2.07	
Flow Type	Supercritical		

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	1.31	ft
Critical Depth	1.88	ft
Channel Slope	0.08100	ft/ft
Critical Slope	0.01639	ft/ft

Cross Section for 3000-2800

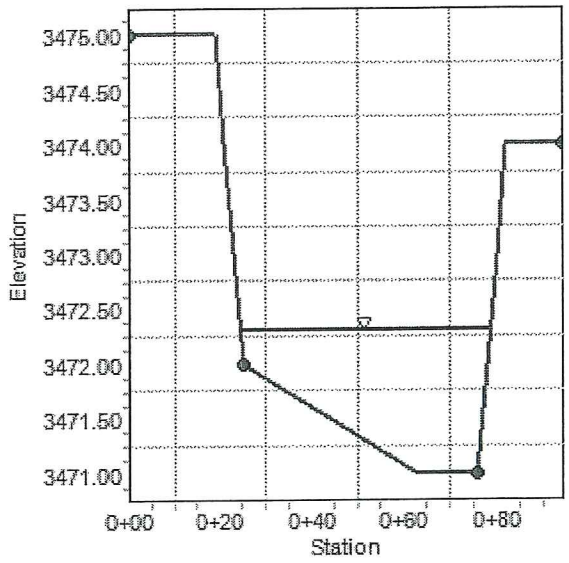
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.08100	ft/ft
Normal Depth	1.31	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2800-2750

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.01	ft
V = flow velocity in upstream channel, (in fps)	10.19	fps
C1 = sand material constant	0.00000778	
C2 = sand material constant	-0.34	
C3 = sand material constant	3.87	
TW = top width of upstream channel, (in ft)	54.67	ft
So = upstream channel slope, (in ft/ft)	0.041	ft/ft
L = entire upstream channel length, (in ft)	48.59	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.4	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0600	54.2	10.2	54.7	1.12	0.99	3.4	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.4	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	0.9	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 2800-2750

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06000	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3473.00
0+16	3473.00
0+19	3472.00
0+22	3471.00
0+25	3470.00
0+36	3469.00
0+49	3469.00
0+77	3469.00
0+79	3470.00
0+81	3471.00
0+86	3472.00
0+95	3472.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3473.00)	(0+25, 3470.00)	0.040
(0+25, 3470.00)	(0+77, 3469.00)	0.035
(0+77, 3469.00)	(0+95, 3472.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Worksheet for 2800-2750

Results

Normal Depth		1.12	ft
Elevation Range	3469.00 to 3473.00 ft		
Flow Area		54.23	ft²
Wetted Perimeter		55.02	ft
Hydraulic Radius		0.99	ft
Top Width		54.70	ft
Normal Depth		1.12	ft
Critical Depth		1.61	ft
Critical Slope		0.01630	ft/ft
Velocity		10.22	ft/s
Velocity Head		1.62	ft
Specific Energy		2.74	ft
Froude Number		1.81	
Flow Type	Supercritical		

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	1.12	ft
Critical Depth	1.61	ft
Channel Slope	0.06000	ft/ft
Critical Slope	0.01630	ft/ft

Cross Section for 2800-2750

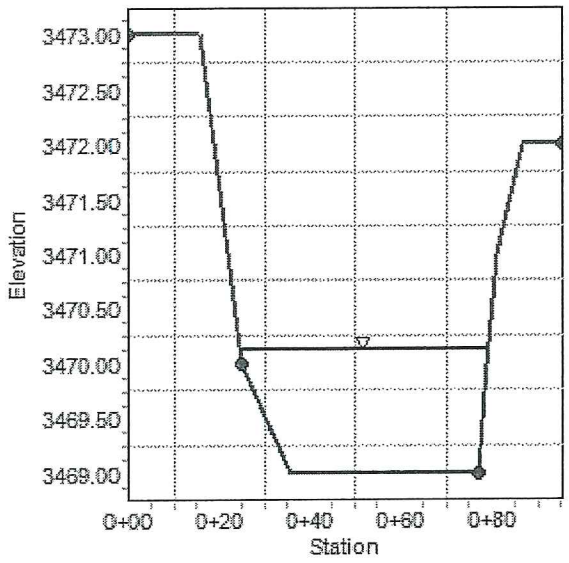
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06000	ft/ft
Normal Depth	1.12	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2750-2500

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.07	ft
V = flow velocity in upstream channel, (in fps)	9.52	fps
C1 = sand material constant	0.00000778	
C2 = sand material constant	-0.34	
C3 = sand material constant	3.87	
TW = top width of upstream channel, (in ft)	55.12	ft
So = upstream channel slope, (in ft/ft)	0.059	ft/ft
L = entire upstream channel length, (in ft)	255.69	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.0	cfs/ft
Qs = total sediment transport rate = qs*TW	2.6	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0470	56.1	9.6	52.8	1.27	1.06	2.6	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.0	cfs/ft
Qs = total sediment transport rate = qs*TW	2.6	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-3.0	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 2750-2500

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04700	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3458.00
0+13	3458.00
0+15	3457.00
0+17	3456.00
0+20	3455.12
0+25	3455.00
0+29	3454.00
0+37	3454.00
0+40	3454.00
0+50	3454.00
0+70	3454.00
0+72	3455.00
0+74	3456.00
0+76	3457.00
1+00	3457.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3458.00)	(0+20, 3455.12)	0.040
(0+20, 3455.12)	(0+70, 3454.00)	0.035
(0+70, 3454.00)	(1+00, 3457.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method

Worksheet for 2750-2500

Options

Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.27	ft
Elevation Range	3454.00 to 3458.00 ft		
Flow Area		57.64	ft²
Wetted Perimeter		53.17	ft
Hydraulic Radius		1.08	ft
Top Width		52.75	ft
Normal Depth		1.27	ft
Critical Depth		1.70	ft
Critical Slope		0.01627	ft/ft
Velocity		9.61	ft/s
Velocity Head		1.44	ft
Specific Energy		2.71	ft
Froude Number		1.62	
Flow Type	Supercritical		

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	1.27	ft
Critical Depth	1.70	ft
Channel Slope	0.04700	ft/ft
Critical Slope	0.01627	ft/ft

Cross Section for 2750-2500

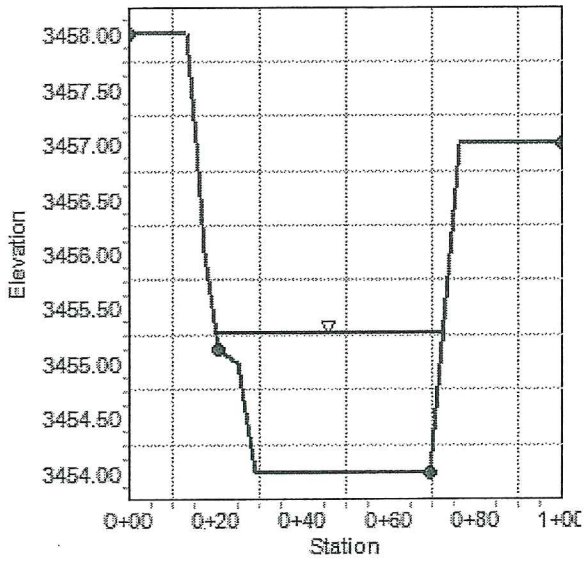
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04700	ft/ft
Normal Depth	1.27	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2500-2400

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.98	ft
V = flow velocity in upstream channel, (in fps)	10.76	fps
C1 = sand material constant	0.00000778	
C2 = sand material constant	-0.34	
C3 = sand material constant	3.87	
TW = top width of upstream channel, (in ft)	52.07	ft
So = upstream channel slope, (in ft/ft)	0.058	ft/ft
L = entire upstream channel length, (in ft)	103.59	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	4.0	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0620	45.3	12.2	35.0	1.51	1.29	4.0	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	4.0	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	0.4	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 2500-2400

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06200	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3453.00
0+02	3453.00
0+10	3452.00
0+12	3451.00
0+34	3450.00
0+37	3449.00
0+37	3449.00
0+42	3448.00
0+48	3448.00
0+67	3448.00
0+69	3449.00
0+72	3450.00
0+74	3451.00
0+95	3451.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3453.00)	(0+12, 3451.00)	0.040
(0+12, 3451.00)	(0+67, 3448.00)	0.035
(0+67, 3448.00)	(0+95, 3451.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method

Worksheet for 2500-2400

Options

Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.51	ft
Elevation Range	3448.00 to 3453.00 ft		
Flow Area		45.32	ft²
Wetted Perimeter		35.46	ft
Hydraulic Radius		1.28	ft
Top Width		35.00	ft
Normal Depth		1.51	ft
Critical Depth		2.29	ft
Critical Slope		0.01590	ft/ft
Velocity		12.22	ft/s
Velocity Head		2.32	ft
Specific Energy		3.83	ft
Froude Number		1.89	
Flow Type	Supercritical		

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	1.51	ft
Critical Depth	2.29	ft
Channel Slope	0.06200	ft/ft
Critical Slope	0.01590	ft/ft

Cross Section for 2500-2400

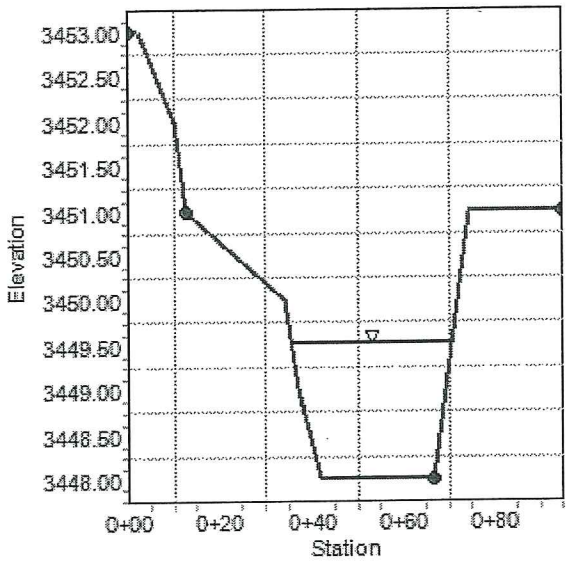
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06200	ft/ft
Normal Depth	1.51	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2400-2275

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.37	ft
V = flow velocity in upstream channel, (in fps)	11.72	fps
C1 = sand material constant	0.00000778	
C2 = sand material constant	-0.34	
C3 = sand material constant	3.87	
TW = top width of upstream channel, (in ft)	35.58	ft
So = upstream channel slope, (in ft/ft)	0.064	ft/ft
L = entire upstream channel length, (in ft)	108.83	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.4	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0610	55.6	10.0	58.3	1.44	0.95	3.4	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3)	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	3.4	cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L	-0.4	ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 2400-2275

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06100	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+01	3446.00
0+14	3446.00
0+28	3446.00
0+41	3445.00
0+44	3444.00
0+47	3443.00
0+51	3442.00
0+84	3441.31
0+98	3441.00
1+04	3441.00
1+06	3442.00
1+09	3443.00
1+11	3444.00
1+41	3444.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+01, 3446.00)	(0+51, 3442.00)	0.040
(0+51, 3442.00)	(1+04, 3441.00)	0.035
(1+04, 3441.00)	(1+41, 3444.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method

Worksheet for 2400-2275

Options

Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.44	ft
Elevation Range	3441.00 to 3446.00 ft		
Flow Area		55.56	ft²
Wetted Perimeter		58.63	ft
Hydraulic Radius		0.95	ft
Top Width		58.29	ft
Normal Depth		1.44	ft
Critical Depth		1.91	ft
Critical Slope		0.01673	ft/ft
Velocity		9.97	ft/s
Velocity Head		1.55	ft
Specific Energy		2.99	ft
Froude Number		1.80	
Flow Type	Supercritical		

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	1.44	ft
Critical Depth	1.91	ft
Channel Slope	0.06100	ft/ft
Critical Slope	0.01673	ft/ft

Cross Section for 2400-2275

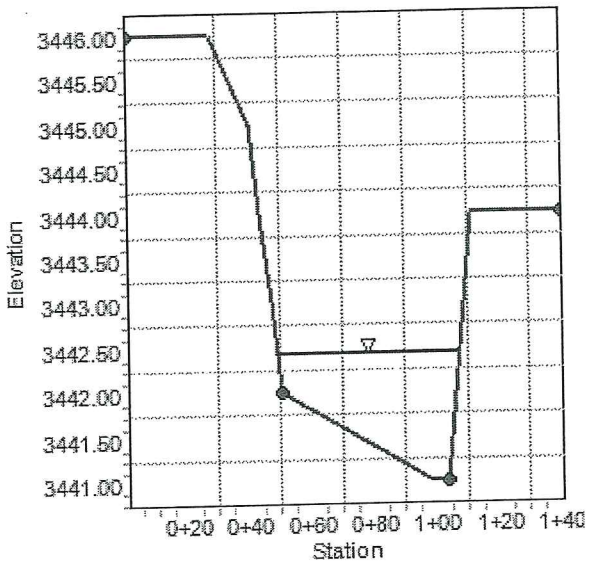
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06100	ft/ft
Normal Depth	1.44	ft
Discharge	554.00	ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2275-2054

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.98	ft
V = flow velocity in upstream channel, (in fps)	9.91	fps
C1 = sand material constant	0.00000778	
C2 = sand material constant	-0.34	
C3 = sand material constant	3.87	
TW = top width of upstream channel, (in ft)	58.44	ft
So = upstream channel slope, (in ft/ft)	0.085	ft/ft
L = entire upstream channel length, (in ft)	128.82	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3) — 0.1 cfs/ft

Qs = total sediment transport rate = qs*TW — 3.3 cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.1120	58.6	9.5	68.0	0.86	0.86	3.3	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = C1*(Yh^C2)*(V^C3) — 0.0 cfs/ft

Qs = total sediment transport rate = qs*TW — 3.3 cfs

Zlt Calculation:

Zlt = long term bed elevation changes = (Se - So)*L — 3.4 ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 2275-2054

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.11200	ft/ft
Discharge	554.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3441.99
0+01	3441.98
0+01	3441.98
0+04	3441.95
0+06	3441.94
0+08	3441.92
0+08	3441.92
0+11	3441.90
0+11	3441.90
0+14	3441.88
0+15	3441.86
0+17	3441.85
0+18	3441.83
0+20	3441.82
0+22	3441.81
0+23	3441.80
0+25	3441.78
0+25	3441.78
0+31	3430.00
0+53	3430.00
0+57	3430.00
0+64	3430.00
0+72	3430.00
0+79	3430.00
0+87	3430.00
0+94	3430.00
0+98	3430.00

Worksheet for 2275-2054

Input Data

Station (ft)	Elevation (ft)
0+98	3440.73

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3441.99)	(0+98, 3430.00)	0.047
(0+98, 3430.00)	(0+98, 3440.73)	0.047

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.86	ft
Elevation Range	3430.00 to 3441.99 ft	
Flow Area	58.60	ft²
Wetted Perimeter	69.41	ft
Hydraulic Radius	0.84	ft
Top Width	67.99	ft
Normal Depth	0.86	ft
Critical Depth	1.28	ft
Critical Slope	0.03095	ft/ft
Velocity	9.45	ft/s
Velocity Head	1.39	ft
Specific Energy	2.25	ft
Froude Number	1.80	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

Worksheet for 2275-2054

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	0.86	ft
Critical Depth	1.28	ft
Channel Slope	0.11200	ft/ft
Critical Slope	0.03095	ft/ft

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X     X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X      X    X        X
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PROJECT DATA
Project Title: COS1_ULT
Project File : COS1_ULT.prj
Run Date and Time: 1/24/2017 7:51:33 PM

Project in English units

Project Description:
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PLAN DATA

Plan Title: COS1_ULT
Plan File : f:\Projects\600\62024-226-2\Division\Fctl\Calcs\HEC-RAS\GEO\COS1_ULT.p03

Geometry Title: COS1_ULT
Geometry File : f:\Projects\600\62024-226-2\Division\Fctl\Calcs\HEC-RAS\GEO\COS1_ULT.g03

Flow Title : COS1_ULT
Flow File : f:\Projects\600\62024-226-2\Division\Fctl\Calcs\HEC-RAS\GEO\COS1_ULT.f03

Plan Description:
Default Scenario

Plan Summary Information:

Number of:	Cross Sections	= 50	Multiple Openings	=	0
	Culverts	= 1	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	= 0.01
Critical depth calculation tolerance	= 0.01
Maximum number of iterations	= 20
Maximum difference tolerance	= 0.33
Flow tolerance factor	= 0.001

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

FLOW DATA

Flow Title: COS1_ULT
Flow File : f:\Projects\600\62024-226-2\Division\Fctl\Calcs\HEC-RAS\GEO\COS1_ULT.f03

Flow Data (cfs)

River	Reach	RS	PF 1
river	river	4325	554

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
river	river	PF 1	Known WS = 3562.2	Known WS = 3426.14

GEOMETRY DATA

Geometry Title: COS1_ULT
Geometry File : f:\Projects\600\62024-226-2\Division\Fctl\Calcs\HEC-RAS\GEO\COS1_ULT.g03

CROSS SECTION

RIVER: river
REACH: river RS: 4325

INPUT
Description:

Station Elevation Data	num=	4					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3563.7	13.5	3559.2	39.5	3559.2	53	3563.7

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.037	13.5	.037	39.5	.037

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
13.5	39.5	50.54	50.54	50.54	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4250

INPUT
Description:

Station Elevation Data	num=	16							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3562	10.77	3562	12.76	3561	14.75	3560	17.01	3559.7
20.07	3559.3	22.37	3559	38.09	3558	38.34	3558	39.12	3558
55.71	3559	59.74	3560	63.5	3561	67.26	3562	91.72	3563
92.74	3563								

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.04	14.75	.035	55.71	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
14.75	55.71	39.88	39.88	39.88	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4200

INPUT
Description:

Station Elevation Data	num=	13							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3560	8.43	3560	10.41	3559	12.4	3558	14.39	3557
24.61	3557	37.14	3557	40.51	3557	40.98	3557	64.45	3558
66.9	3559	69.35	3560	95.55	3560				

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.04	14.39	.035	64.45	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
14.39	64.45	17.86	17.86	17.86	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4175

INPUT
Description:

Station Elevation Data	num=	14							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3559	7.33	3559	9.35	3558	11.37	3557	13.39	3556
22.5	3556	32.44	3556	36.84	3556	40.72	3556	64.9	3557
66.91	3558	68.92	3559	70.93	3560	94.7	3560		

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.04	13.39	.035	64.9	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
13.39	64.9	34.43	34.43	34.43	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4150

INPUT
Description:

Station Elevation Data	num=	14							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	3557	7.35	3557	10.02	3556	12.69	3555	15.36	3554
21.57	3554	32.03	3554	40.37	3554	48.24	3554	66.98	3555
69.02	3556	71.06	3557	75.35	3558	94.61	3558		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	15.36	.035	66.98	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
15.36	66.98	34.58	34.58	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4125

INPUT
Description:
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3554	8.68	3554	12.01	3553	15.31	3552	45.08	3552
56.52	3552	68.52	3553	70.5	3554	72.48	3555	74.45	3556
95.55	3556								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	15.31	.035	68.52	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
15.31	68.52	58.09	58.09	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4100

INPUT
Description:
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1.73	3552	14.47	3552	14.49	3552	16.58	3551	18.63	3550
18.64	3550	20.09	3549.88	31.11	3549	31.13	3549	35.97	3548
35.98	3548	37.88	3548	37.9	3548	38.07	3548.01	61.86	3549
61.87	3549	67.58	3549.99	67.61	3550	70.86	3550.7	72.23	3551
74.53	3552	74.55	3552.01	76.83	3552.99	76.84	3553	94.76	3553

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1.73	.04	18.63	.035	72.23	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
18.63	72.23	35.31	35.31	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4050

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3550	13.28	3550	15.28	3549	17.31	3548	19.33	3547
38.76	3546	39.23	3546	42.79	3546	68.59	3547	72.55	3548
75.52	3549	78.51	3550	85.63	3551	95.63	3551		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	19.33	.035	68.59	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
19.33	68.59	39.1	39.1	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 4000

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3549	13	3549	14.99	3548	16.98	3547	18.96	3546
18.97	3546	27.72	3545	32.26	3544	36.26	3544	50.77	3544
69.85	3544	71.44	3544	74.6	3545	77.77	3546	80.93	3547
97.79	3547								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	18.96	.035	71.44	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
18.96	71.44	40.37	40.37	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3950

INPUT
Description:
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1.04	3545	9.83	3545	12.92	3544	12.95	3543.99	15.99	3543
16.06	3542.98	18.97	3542	18.99	3542	32.17	3542	57.35	3542
67.38	3542	67.4	3542	69.54	3542	69.55	3542	72.56	3543
75.58	3544	78.59	3545	96.51	3545				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1.04	.04	18.97	.035	69.54	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
18.97	69.54	33.66	33.66	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3900

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3543	9.34	3543	11.82	3542	14.41	3541	17.13	3540
18.93	3540	24.46	3540	36.39	3540	50.93	3540	63.48	3541
69.82	3542	72.72	3543	75.66	3544	78.55	3545	97.81	3545

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	17.13	.035	69.82	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
17.13	69.82	55	55	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3875

INPUT
Description:
Station Elevation Data num= 24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-2.97	3540	6.8	3540	8.99	3539	11.16	3538	13.34	3537
13.57	3537	19.77	3537	19.8	3537	46.74	3537	46.77	3537
46.78	3537	46.92	3537	50.87	3538	55.81	3539	55.83	3539
64.14	3539.84	65.71	3540	66.85	3540.57	67.72	3541	69.8	3542
69.83	3542	77.39	3543	77.4	3543	93.18	3543		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-2.97	.04	13.34	.035	65.71	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
13.34	65.71	46.87	46.87	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3850

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3538	6.82	3538	10.03	3537	13.29	3536	16.58	3535
20.7	3535	40.16	3535	48.48	3535	54.14	3535	63.86	3536
71	3537	73.15	3538	75.58	3539	81.57	3540	98.81	3540

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	16.58	.035	71	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
16.58	71	40.21	40.21	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3825

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3538	7.8	3538	10.7	3537	13.42	3536	15.95	3535
26.78	3534	47.24	3533.52	69.52	3533	72.05	3533	75.99	3534
82.9	3534	84.15	3534	84.16	3534	88.96	3534.29	107.42	3535

```
  109.23    3535

Manning's n Values          num=        5
     Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   15.95    .035   72.05     .04    82.9     .03   88.96     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         15.95   72.05             30.81   30.81   30.81            .05      .1

CROSS SECTION


RIVER: river
REACH: river              RS: 3800

INPUT
Description:
Station Elevation Data    num=       12
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3535     5.34     3535     11.5     3534    13.49     3533    15.47     3532
   34.65  3531.63    66.68     3531    68.28     3531    78.66     3532    81.11     3533
   82.03     3534    96.02     3534

Manning's n Values          num=        4
     Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   15.47    .035   68.28     .03    78.66     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         15.47   68.28             36.29   36.29   36.29            .05      .1

CROSS SECTION


RIVER: river
REACH: river              RS: 3750

INPUT
Description:
Station Elevation Data    num=       16
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3533     6.77     3533    11.86     3532    13.87     3531    15.88     3530
   27.55     3529    31.83     3529    33.87     3529    39.76     3529     44.5     3529
   66.92     3529    69.38     3529    72.12     3530     74.9     3531    77.68     3532
   97.35     3532

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   15.88    .035   69.38     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         15.88   69.38             48.04   48.04   48.04            .05      .1

CROSS SECTION


RIVER: river
REACH: river              RS: 3700

INPUT
Description:
Station Elevation Data    num=       15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3529     11.4     3529    13.64     3528    15.89     3527    18.13     3526
   23.76     3526    27.07     3526    35.68     3526    48.95     3526    64.43     3526
   68.66     3526    70.65     3527    72.64     3528    74.61     3529    97.13     3529

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   18.13    .035   68.66     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         18.13   68.66             49.84   49.84   49.84            .05      .1

CROSS SECTION


RIVER: river
REACH: river              RS: 3675

INPUT
Description:
Station Elevation Data    num=       15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3527     8.02     3527    11.65     3526    15.29     3525    18.91     3524
   27.19     3523    36.13     3523    52.12     3523    60.18     3524    62.12     3524
   71.82     3524    73.89     3525    75.97     3526    83.18     3527   101.92     3527

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   18.91    .035   71.82     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         18.91   71.82             53.18   53.18   53.18            .05      .1

CROSS SECTION


RIVER: river
REACH: river              RS: 3650
```

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3523	9.74	3523	11.7	3522	13.64	3521	33.4	3520
41.2	3520	61.33	3520	66.19	3521	69.52	3522	72.9	3523
76.27	3524	93.94	3525	94.9	3525				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	13.64	.035	66.19	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
13.64	66.19	47.43	47.43	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3600

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3521	11.65	3521	13.72	3520	15.78	3519	17.84	3518
22.67	3517	28.03	3517	32.1	3517	36.28	3517	44.83	3517
46.61	3517	67.12	3517	69.87	3517	76.84	3517	91.26	3518
92.01	3519	97.81	3519						

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	17.84	.035	76.84	.03	91.26	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
17.84	76.84	50.22	50.22	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3550

INPUT
Description:
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3518	8.65	3518	17.79	3517	21.16	3516	24.46	3515
28.54	3514.17	29.93	3514.78	49.19	3514	52.91	3513	54.92	3513
67.3	3513	74.19	3513	75.83	3514	76.48	3514.29	8 78.01	3515
80.02	3516	82.02	3517	84.03	3518	96.97	3518		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	28.54	.035	76.48	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
28.54	76.48	46.03	46.03	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3450

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3515	19.75	3515	22.82	3514	25.86	3513	28.9	3512
34.01	3511.85	62.92	3511	71.14	3510	81.17	3510	83.21	3511
85.26	3512	87.93	3513	97.23	3513				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	28.9	.035	81.17	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
28.9	81.17	67.92	67.92	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3400

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3511	20.93	3511	24.06	3510	27.19	3509	31.14	3508.09
35.96	3508	42.52	3508	51.69	3508	59.41	3507	63.54	3506
67.06	3506	79.36	3506	81.16	3507	83.14	3508	85.11	3509
87.09	3510	96.9	3510						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	31.14	.035	79.36	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
31.14	79.36	67.51	67.51	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3300

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3507	8.54	3507	17.8	3506	20.83	3505	23.85	3504
45.96	3503	60.63	3502	65.72	3502	72.77	3502	74.99	3503
77.35	3504	79.6	3505	82.04	3506	86.26	3507	96.51	3507

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	23.85	.035	74.99	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
23.85	74.99	76.84	76.84	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3250

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3502	3.38	3502	16.43	3501	18.36	3500	20.28	3499
22.22	3498	26.68	3498	43.27	3498	56.99	3498	63.93	3498
74.66	3499	77.84	3500	81.04	3501	84.23	3502	91.49	3502

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	22.22	.035	74.66	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
22.22	74.66	36.75	36.75	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3200

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3500	14.04	3500	19.54	3499	21.52	3498	23.51	3497
38.81	3496	46.8	3496	65.1	3496	69.43	3496	75.65	3496
77.9	3497	80.24	3498	82.59	3499	91.08	3499		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	23.51	.035	75.65	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
23.51	75.65	39.53	39.53	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3170

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3497	14.82	3497	17.63	3496	20.3	3495	22.74	3494
31.81	3494	46.09	3494	55.85	3494	74.26	3494	76.26	3495
78.25	3496	80.25	3497	91.97	3497				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	22.74	.035	74.26	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
22.74	74.26	71.98	71.98	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3100

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3493	12.23	3493	14.83	3492	16.87	3491	18.89	3490

35.44	3490	42.12	3490	46.48	3490	54.12	3490	58.61	3490
69.93	3489	69.99	3489	70.91	3489.46	72	3490	74.04	3491
76.1	3492	93.14	3492						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	18.89	.035	69.93	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
18.89	69.93	32.02	32.02	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3075

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3491	10.51	3491	14.49	3490	18.46	3489	22.3	3488
42.29	3488	44.13	3488	49.66	3488	55.81	3488	63.2	3488
75.52	3488	77.6	3489	79.76	3490	84.67	3491	96.45	3491

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	22.3	.035	75.52	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
22.3	75.52	35.45	35.45	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3050

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3488	20.16	3488	23.77	3487	27.41	3486	31.07	3485
31.58	3485	31.62	3485	58.85	3485.54	82.5	3486	85.45	3487
88.45	3488	91.45	3489	101.25	3489				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	31.07	.035	82.5	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
31.07	82.5	45.57	45.57	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 3000

INPUT
Description:
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3488	5.19	3488	24.53	3487	33.02	3486	35.05	3485
37.09	3484	39	3483	43	3482	44.3	3482	57.35	3482
65.54	3482	69.69	3482	84.54	3482	92.82	3482	95.89	3483
98.92	3484	101.95	3485	114.75	3485				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	39	.035	92.82	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
39	92.82	59.55	59.55	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2950

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3484	25.5	3484	27.51	3483	29.53	3482	31.54	3481
37.72	3480	39.56	3479	47.02	3479	79.65	3479	83.7	3480
85.69	3481	87.68	3482	99.28	3482				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	31.54	.035	83.7	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
31.54	83.7	38.42	38.42	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2900

INPUT
Description:
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
.42	3482	24.57	3482	26.57	3481	28.56	3480	28.58	3479.99
30.55	3479	30.58	3478.99	30.59	3478.99	34.03	3478	50.69	3477
50.7	3477	50.87	3477	75.59	3477	81.6	3477	83.86	3478
84.12	3478.11	86.26	3479	88.65	3480	96.77	3480		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
.42	.04	30.59	.035	84.12	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
30.59	84.12	49.06	49.06	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2850

INPUT
Description:
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
2.44	3478	22.32	3478	24.3	3477	26.29	3476	28.28	3475
38.32	3474.59	52.75	3474	63.44	3474	63.46	3474	66.1	3474
66.11	3474	80.99	3474	81	3474	84.38	3475	84.39	3475
87.76	3476	92.13	3477	97.41	3477				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
2.44	.04	28.28	.035	81	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
28.28	81	48.33	48.33	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2800

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3475	18.73	3475	20.78	3474	22.85	3473	24.92	3472
45.05	3471.47	62.84	3471	75.85	3471	77.9	3472	79.92	3473
81.94	3474	94.3	3474						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	24.92	.035	75.85	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
24.92	75.85	48.59	48.59	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2750

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3473	15.79	3473	18.81	3472	21.82	3471	24.75	3470
35.68	3469	49.2	3469	76.8	3469	78.84	3470	80.88	3471
86.36	3472	95.18	3472						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	24.75	.035	76.8	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
24.75	76.8	54.42	54.42	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2700

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3470	16.25	3470	19.26	3469	22.26	3468	25.27	3467
43.58	3466	62.11	3466	76.11	3466	78.34	3467	80.38	3468
82.42	3469	97.59	3469						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

```
      0     .04   25.27    .035   78.34     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        25.27   78.34             35.3    35.3    35.3           .05       .1

CROSS SECTION


RIVER: river
REACH: river              RS: 2675

INPUT
Description:
Station Elevation Data    num=      16
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3468    19.38     3468    21.51     3467    23.58     3466    25.64     3465
   47.62     3464    49.02     3464    52.44     3464    62.96     3464    67.72     3464
   74.58     3464    77.61     3464    80.64     3465    83.68     3466    86.82     3467
    95.4     3467

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   25.64    .035   77.61     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        25.64   77.61            43.49   43.49   43.49           .05       .1

CROSS SECTION


RIVER: river
REACH: river              RS: 2650

INPUT
Description:
Station Elevation Data    num=      15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3465     19.5     3465    22.08     3464    24.68     3463    27.31     3462
   42.15     3462    49.87     3462     54.5     3461     58.5     3461    61.41     3461
   79.53     3462    82.53     3463    85.64     3464    90.22     3465       96     3465

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   27.31    .035   79.53     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        27.31   79.53            58.43   58.43   58.43           .05       .1

CROSS SECTION


RIVER: river
REACH: river              RS: 2550

INPUT
Description:
Station Elevation Data    num=      17
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3463    13.93     3463    22.14     3462    24.29     3461    26.41     3460
   28.96  3459.18    34.73     3459     40.6     3458     49.7     3458    55.01     3458
   73.75     3458    77.81     3458    78.19     3458    80.18     3459    82.17     3460
   84.19     3461    99.32     3461

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   28.96    .035   78.19     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        28.96   78.19            64.05   64.05   64.05           .05       .1

CROSS SECTION


RIVER: river
REACH: river              RS: 2500

INPUT
Description:
Station Elevation Data    num=      15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0     3458    13.34     3458    15.36     3457    17.37     3456    20.31  3455.12
   25.22     3455    29.18     3454    37.22     3454    40.02     3454    50.07     3454
   69.71     3454    71.93     3455    74.16     3456    76.39     3457    99.77     3457

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .04   20.31    .035   69.71     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        20.31   69.71            33.42   33.42   33.42           .05       .1

CROSS SECTION


RIVER: river
REACH: river              RS: 2475

INPUT
Description:
```

Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1.12	3457	3.42	3457	8.94	3456	8.99	3455.98	12.14	3455
15.34	3454	15.36	3454	15.4	3453.99	18.21	3453.22	19.03	3453
19.07	3453	21.2	3453	23.43	3453	25.34	3453	32.25	3452
38.94	3452	43.21	3452	48.85	3452	55.4	3452	64.69	3453
69.16	3454	69.18	3454.01	71.39	3455	73.63	3456	78.77	3456.41
86.01	3457	99.37	3457						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1.12	.04	18.21	.035	69.18	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
18.21	69.18	34.13	34.13	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2450

INPUT
Description:
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1.03	3455	8.93	3455	10.96	3454	10.98	3453.99	13.02	3453
13.03	3453	15.17	3452	15.18	3452	33.25	3451.17	37.04	3451
40.08	3450	45.55	3450	57.79	3450	66.06	3451	66.07	3451
69.13	3452	72.19	3453	75.25	3454	95.82	3454		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1.03	.04	15.18	.035	66.07	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
15.18	66.07	36.04	36.04	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2400

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3453	2.29	3453	9.8	3452	12.46	3451	34.02	3450
37.25	3449	37.26	3449	41.96	3448	47.88	3448	66.55	3448
69.32	3449	71.88	3450	74.39	3451	94.71	3451		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	12.46	.035	66.55	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
12.46	66.55	48.05	48.05	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2350

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3449	19.46	3449	21.47	3448	23.48	3447	25.48	3446
52.12	3445	55.27	3445	74.02	3445	74.1	3445	79.6	3446
82.91	3447	86.23	3448	107.47	3448				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	25.48	.035	79.6	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
25.48	79.6	60.78	60.78	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2275

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
.95	3446	14.36	3446	27.5	3446	40.68	3445	44.02	3444
47.34	3443	50.63	3442	83.62	3441.31	98.46	3441	103.64	3441
106.35	3442	108.89	3443	111.43	3444	140.69	3444		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
.95	.04	50.63	.035	103.64	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.

50.63	103.64		76.35	76.35	76.35	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2200

INPUT
Description:

Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-86.59	3442	-31.85	3442	-8.24	3441	-8.23	3441	-5.28	3440
-5.26	3439.99	-3.25	3439	-1.21	3438	-1.2	3438	21.33	3437
31.87	3437	52.68	3437	52.69	3437	54.84	3438	57	3439
75.94	3439	105.75	3439	127.24	3440	149.06	3441	151.26	3441

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-86.59	.04	-1.21	.035	52.68	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-1.21	52.68	21.66 21.66	21.66	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2055

INPUT
Description:

Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3442.47	19.08	3442	21	3441	22.85	3440	24.75	3439
26.61	3438	28.56	3437	30.41	3436	32.32	3435	61.13	3434
95.25	3435	100.74	3436	100.74	3439				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.047	0	.047	100.74	.047

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	100.74	30.81 30.81	30.81	.05	.1

CROSS SECTION

RIVER: river
REACH: river RS: 2054

INPUT
Description:

Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3441.99	.71	3441.98	1.4	3441.98	4.42	3441.95	6.08	3441.94
7.77	3441.92	7.93	3441.92	10.74	3441.9	10.94	3441.9	13.66	3441.88
15.4	3441.86	17.18	3441.85	18.47	3441.83	20.06	3441.82	21.89	3441.81
22.88	3441.8	24.7	3441.78	25.23	3441.78	30.5	3430	52.6	3430
56.5	3430	64.1	3430	71.7	3430	79.3	3430	86.9	3430
94.4	3430	98.1	3430	98.1	3440.73				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.047	0	.047	98.1	.013

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	98.1	113.61 113.61	113.61	.05	.1

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	30.5	3441.7	F
113.8	98.1	3440.7	F

CULVERT

RIVER: river
REACH: river RS: 2053

INPUT
Description:
Distance from Upstream XS = .1
Deck/Roadway Width = 113.5
Weir Coefficient = 2.7
Upstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
24.7	3441.71		128.78	3440.7	

Upstream Bridge Cross Section Data
Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3441.99	.71	3441.98	1.4	3441.98	4.42	3441.95	6.08	3441.94
7.77	3441.92	7.93	3441.92	10.74	3441.9	10.94	3441.9	13.66	3441.88
15.4	3441.86	17.18	3441.85	18.47	3441.83	20.06	3441.82	21.89	3441.81
22.88	3441.8	24.7	3441.78	25.23	3441.78	30.5	3430	52.6	3430
56.5	3430	64.1	3430	71.7	3430	79.3	3430	86.9	3430
94.4	3430	98.1	3430	98.1	3440.73				

```
Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .047        0    .047     98.1    .013

Bank Sta: Left   Right    Coeff Contr.   Expan.
             0    98.1            .05       .1
Ineffective Flow     num=        2
   Sta L   Sta R    Elev  Permanent
       0    30.5  3441.7       F
   113.8    98.1  3440.7       F

Downstream  Deck/Roadway Coordinates
    num=        2
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
    5.54  3440.1           155.95 3441.27

Downstream Bridge Cross Section Data
Station Elevation Data     num=       12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    34.5  3440.5    34.5    3425    53.1    3425    56.6    3425    63.5    3425
    70.5    3425    77.6    3425    84.6    3425    91.6    3425      95    3425
  113.65    3425  113.65 3441.25

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
    34.5    .013    34.5    .013  113.65    .013

Bank Sta: Left   Right    Coeff Contr.   Expan.
          34.5  113.65            .05       .1
Ineffective Flow     num=        2
   Sta L   Sta R    Elev  Permanent
    34.5    52.1  3440.1       F
      96  113.65 3441.27       F

Upstream Embankment side slope                =       3 horiz. to 1.0 vertical
Downstream Embankment side slope              =       3 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =      .98
Elevation at which weir flow begins           =  3440.7
Energy head used in spillway design           =
Spillway height used in design                =
Weir crest shape                              = Broad Crested

Number of Culverts =  1

Culvert Name      Shape      Rise    Span
Crossbridge          Box        5       5
FHWA Chart # 59- Rectangular concrete
FHWA Scale # 1 - Slope tapered; Less favorable edges
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                 .1   113.5     .015     .015        0                    1                 1
Number of Barrels =  6
Upstream   Elevation =  3430
Centerline Stations
    Sta.    Sta.    Sta.    Sta.    Sta.    Sta.
    56.5    64.1    71.7    79.3    86.9    94.4
Downstream Elevation =  3425
Centerline Stations
    Sta.    Sta.    Sta.    Sta.    Sta.    Sta.
    56.6    63.5    70.5    77.6    84.6    91.6

CROSS SECTION


RIVER: river
REACH: river                RS: 2052

INPUT
Description:
Station Elevation Data     num=       12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    34.5  3440.5    34.5    3425    53.1    3425    56.6    3425    63.5    3425
    70.5    3425    77.6    3425    84.6    3425    91.6    3425      95    3425
  113.65    3425  113.65 3441.25

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
    34.5    .013    34.5    .013  113.65    .013

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          34.5  113.65                0       0       0             .05       .1
Ineffective Flow     num=        2
   Sta L   Sta R    Elev  Permanent
    34.5    52.1  3440.1       F
      96  113.65 3441.27       F


SUMMARY OF MANNING'S N VALUES

River:river

      Reach          River Sta.       n1        n2        n3        n4        n5

 river                4325              .037      .037      .037
 river                4250               .04      .035       .04
 river                4200               .04      .035       .04
 river                4175               .04      .035       .04
 river                4150               .04      .035       .04
```

river	4125	.04	.035	.04		
river	4100	.04	.035	.04		
river	4050	.04	.035	.04		
river	4000	.04	.035	.04		
river	3950	.04	.035	.04		
river	3900	.04	.035	.04		
river	3875	.04	.035	.04		
river	3850	.04	.035	.04		
river	3825	.04	.035	.04	.03	.04
river	3800	.04	.035	.03	.04	
river	3750	.04	.035	.04		
river	3700	.04	.035	.04		
river	3675	.04	.035	.04		
river	3650	.04	.035	.04		
river	3600	.04	.035	.03	.04	
river	3550	.04	.035	.04		
river	3450	.04	.035	.04		
river	3400	.04	.035	.04		
river	3300	.04	.035	.04		
river	3250	.04	.035	.04		
river	3200	.04	.035	.04		
river	3170	.04	.035	.04		
river	3100	.04	.035	.04		
river	3075	.04	.035	.04		
river	3050	.04	.035	.04		
river	3000	.04	.035	.04		
river	2950	.04	.035	.04		
river	2900	.04	.035	.04		
river	2850	.04	.035	.04		
river	2800	.04	.035	.04		
river	2750	.04	.035	.04		
river	2700	.04	.035	.04		
river	2675	.04	.035	.04		
river	2650	.04	.035	.04		
river	2550	.04	.035	.04		
river	2500	.04	.035	.04		
river	2475	.04	.035	.04		
river	2450	.04	.035	.04		
river	2400	.04	.035	.04		
river	2350	.04	.035	.04		
river	2275	.04	.035	.04		
river	2200	.04	.035	.04		
river	2055	.047	.047	.047		
river	2054	.047	.047	.013		
river	2053	Culvert				
river	2052	.013	.013	.013		

SUMMARY OF REACH LENGTHS

River: river

Reach	River Sta.	Left	Channel	Right
river	4325	50.54	50.54	50.54
river	4250	39.88	39.88	39.88
river	4200	17.86	17.86	17.86
river	4175	34.43	34.43	34.43
river	4150	34.58	34.58	34.58
river	4125	58.09	58.09	58.09
river	4100	35.31	35.31	35.31
river	4050	39.1	39.1	39.1
river	4000	40.37	40.37	40.37
river	3950	33.66	33.66	33.66
river	3900	55	55	55
river	3875	46.87	46.87	46.87
river	3850	40.21	40.21	40.21
river	3825	30.81	30.81	30.81
river	3800	36.29	36.29	36.29
river	3750	48.04	48.04	48.04
river	3700	49.84	49.84	49.84
river	3675	53.18	53.18	53.18
river	3650	47.43	47.43	47.43
river	3600	50.22	50.22	50.22
river	3550	46.03	46.03	46.03
river	3450	67.92	67.92	67.92
river	3400	67.51	67.51	67.51
river	3300	76.84	76.84	76.84
river	3250	36.75	36.75	36.75
river	3200	39.53	39.53	39.53
river	3170	71.98	71.98	71.98
river	3100	32.02	32.02	32.02
river	3075	35.45	35.45	35.45
river	3050	45.57	45.57	45.57
river	3000	59.55	59.55	59.55
river	2950	38.42	38.42	38.42
river	2900	49.06	49.06	49.06
river	2850	48.33	48.33	48.33
river	2800	48.59	48.59	48.59
river	2750	54.42	54.42	54.42
river	2700	35.3	35.3	35.3
river	2675	43.49	43.49	43.49
river	2650	58.43	58.43	58.43
river	2550	64.05	64.05	64.05
river	2500	33.42	33.42	33.42
river	2475	34.13	34.13	34.13
river	2450	36.04	36.04	36.04

river	2400	48.05	48.05	48.05
river	2350	60.78	60.78	60.78
river	2275	76.35	76.35	76.35
river	2200	21.66	21.66	21.66
river	2055	30.81	30.81	30.81
river	2054	113.61	113.61	113.61
river	2053	Culvert		
river	2052	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: river

Reach	River Sta.	Contr.	Expan.
river	4325	.05	.1
river	4250	.05	.1
river	4200	.05	.1
river	4175	.05	.1
river	4150	.05	.1
river	4125	.05	.1
river	4100	.05	.1
river	4050	.05	.1
river	4000	.05	.1
river	3950	.05	.1
river	3900	.05	.1
river	3875	.05	.1
river	3850	.05	.1
river	3825	.05	.1
river	3800	.05	.1
river	3750	.05	.1
river	3700	.05	.1
river	3675	.05	.1
river	3650	.05	.1
river	3600	.05	.1
river	3550	.05	.1
river	3450	.05	.1
river	3400	.05	.1
river	3300	.05	.1
river	3250	.05	.1
river	3200	.05	.1
river	3170	.05	.1
river	3100	.05	.1
river	3075	.05	.1
river	3050	.05	.1
river	3000	.05	.1
river	2950	.05	.1
river	2900	.05	.1
river	2850	.05	.1
river	2800	.05	.1
river	2750	.05	.1
river	2700	.05	.1
river	2675	.05	.1
river	2650	.05	.1
river	2550	.05	.1
river	2500	.05	.1
river	2475	.05	.1
river	2450	.05	.1
river	2400	.05	.1
river	2350	.05	.1
river	2275	.05	.1
river	2200	.05	.1
river	2055	.05	.1
river	2054	.05	.1
river	2053	Culvert	
river	2052	.05	.1

HEC-RAS Plan: COS1_ULT River: river Reach: river Profile: PF 1

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)	
river	4325	PF 1	554.00	3559.20	3561.44	3561.44	3562.40	0.014363	8.23	73.18	39.42	0.97
river	4250	PF 1	554.00	3558.00	3560.13	3560.44	3561.40	0.027836	9.09	62.35	45.75	1.33
river	4200	PF 1	554.00	3557.00	3558.30	3558.77	3559.89	0.052621	10.17	55.25	53.39	1.73
river	4175	PF 1	554.00	3556.00	3557.26	3557.74	3558.90	0.057824	10.35	54.24	54.56	1.80
river	4150	PF 1	554.00	3554.00	3555.19	3555.68	3556.86	0.060424	10.46	53.75	55.17	1.84
river	4125	PF 1	554.00	3552.00	3553.09	3553.58	3554.75	0.061733	10.40	54.11	57.00	1.85
river	4100	PF 1	554.00	3548.00	3549.97	3550.44	3551.56	0.048826	10.13	54.66	48.44	1.68
river	4050	PF 1	554.00	3546.00	3547.44	3548.03	3549.45	0.073578	11.39	49.06	51.91	2.02
river	4000	PF 1	554.00	3544.00	3545.21	3545.74	3546.94	0.054946	10.67	52.94	49.34	1.78
river	3950	PF 1	554.00	3542.00	3543.02	3543.51	3544.66	0.058075	10.38	54.83	56.71	1.81
river	3900	PF 1	554.00	3540.00	3541.28	3541.76	3542.85	0.049575	10.12	55.65	51.59	1.69
river	3875	PF 1	554.00	3537.00	3538.38	3538.92	3540.17	0.047344	10.81	52.17	42.40	1.69
river	3850	PF 1	554.00	3535.00	3536.22	3536.70	3537.81	0.052511	10.23	55.16	52.80	1.74
river	3825	PF 1	554.00	3533.00	3534.58	3534.96	3535.80	0.046313	9.19	64.28	76.05	1.61
river	3800	PF 1	554.00	3531.00	3532.33	3532.83	3534.02	0.071624	10.15	53.46	64.66	1.95
river	3750	PF 1	554.00	3529.00	3530.11	3530.58	3531.69	0.057095	10.15	55.31	56.77	1.79
river	3700	PF 1	554.00	3526.00	3527.00	3527.52	3528.77	0.064594	10.77	52.47	54.75	1.90
river	3675	PF 1	554.00	3523.00	3524.44	3524.88	3525.93	0.049629	9.83	56.74	55.39	1.68
river	3650	PF 1	554.00	3520.00	3521.23	3521.75	3522.96	0.062326	10.56	52.56	53.77	1.86
river	3600	PF 1	554.00	3517.00	3517.85	3518.35	3519.57	0.082768	10.70	53.07	70.55	2.08
river	3550	PF 1	554.00	3513.00	3514.80	3515.27	3516.39	0.049503	10.15	55.37	52.14	1.68
river	3450	PF 1	554.00	3510.00	3511.98	3512.50	3513.72	0.068667	10.66	52.60	55.80	1.94
river	3400	PF 1	554.00	3506.00	3508.22	3508.65	3509.72	0.050281	9.97	56.46	52.97	1.69
river	3300	PF 1	554.00	3502.00	3503.74	3504.34	3505.77	0.068059	11.47	48.70	47.10	1.96
river	3250	PF 1	554.00	3498.00	3499.10	3499.60	3500.79	0.061051	10.46	53.49	54.89	1.85
river	3200	PF 1	554.00	3496.00	3497.20	3497.64	3498.72	0.051447	9.95	56.43	55.24	1.71
river	3170	PF 1	554.00	3494.00	3495.03	3495.50	3496.62	0.055147	10.18	55.55	56.11	1.77
river	3100	PF 1	554.00	3489.00	3490.88	3491.34	3492.48	0.059711	10.30	54.97	56.68	1.82
river	3075	PF 1	554.00	3488.00	3488.99	3489.46	3490.58	0.058740	10.22	55.57	59.08	1.81
river	3050	PF 1	554.00	3485.00	3486.43	3486.96	3488.24	0.073667	10.97	51.75	57.90	2.01
river	3000	PF 1	554.00	3482.00	3482.96	3483.51	3484.83	0.075770	11.04	50.79	56.57	2.03
river	2950	PF 1	554.00	3479.00	3480.34	3480.73	3481.71	0.037558	9.38	59.14	48.76	1.49
river	2900	PF 1	554.00	3477.00	3478.26	3478.76	3479.93	0.056929	10.39	53.32	51.33	1.79
river	2850	PF 1	554.00	3474.00	3475.19	3475.70	3476.92	0.066381	10.64	53.02	57.14	1.91
river	2800	PF 1	554.00	3471.00	3472.41	3472.89	3474.00	0.054601	10.19	55.25	54.67	1.76
river	2750	PF 1	554.00	3469.00	3470.21	3470.61	3471.60	0.044241	9.52	58.91	55.12	1.60
river	2700	PF 1	554.00	3466.00	3467.21	3467.69	3468.85	0.057750	10.28	54.00	54.13	1.80
river	2675	PF 1	554.00	3464.00	3465.23	3465.70	3466.82	0.056745	10.22	55.16	56.16	1.79
river	2650	PF 1	554.00	3461.00	3462.67	3463.16	3464.32	0.058340	10.35	54.30	55.97	1.81
river	2550	PF 1	554.00	3458.00	3459.24	3459.74	3460.93	0.057139	10.50	53.43	51.89	1.80
river	2500	PF 1	554.00	3454.00	3455.15	3455.70	3456.99	0.066127	10.95	51.23	52.07	1.92
river	2475	PF 1	554.00	3452.00	3453.50	3453.97	3455.08	0.048730	10.11	54.92	49.71	1.68
river	2450	PF 1	554.00	3450.00	3451.80	3452.28	3453.42	0.048531	10.25	54.64	49.00	1.68
river	2400	PF 1	554.00	3448.00	3449.61	3450.33	3451.67	0.046803	11.71	48.81	35.58	1.71
river	2350	PF 1	554.00	3445.00	3446.14	3446.78	3448.44	0.103885	12.17	45.55	54.85	2.34
river	2275	PF 1	554.00	3441.00	3442.47	3442.91	3443.96	0.053328	9.91	57.10	58.44	1.73
river	2200	PF 1	554.00	3437.00	3438.21	3438.67	3439.77	0.056303	10.08	55.63	56.94	1.78
river	2055	PF 1	554.00	3434.00	3435.22	3435.83	3437.53	0.238551	12.20	45.41	64.55	2.56
river	2054	PF 1	554.00	3430.00	3434.34	3431.28	3434.39	0.000549	1.89	293.13	69.54	0.16
river	2053		Culvert									
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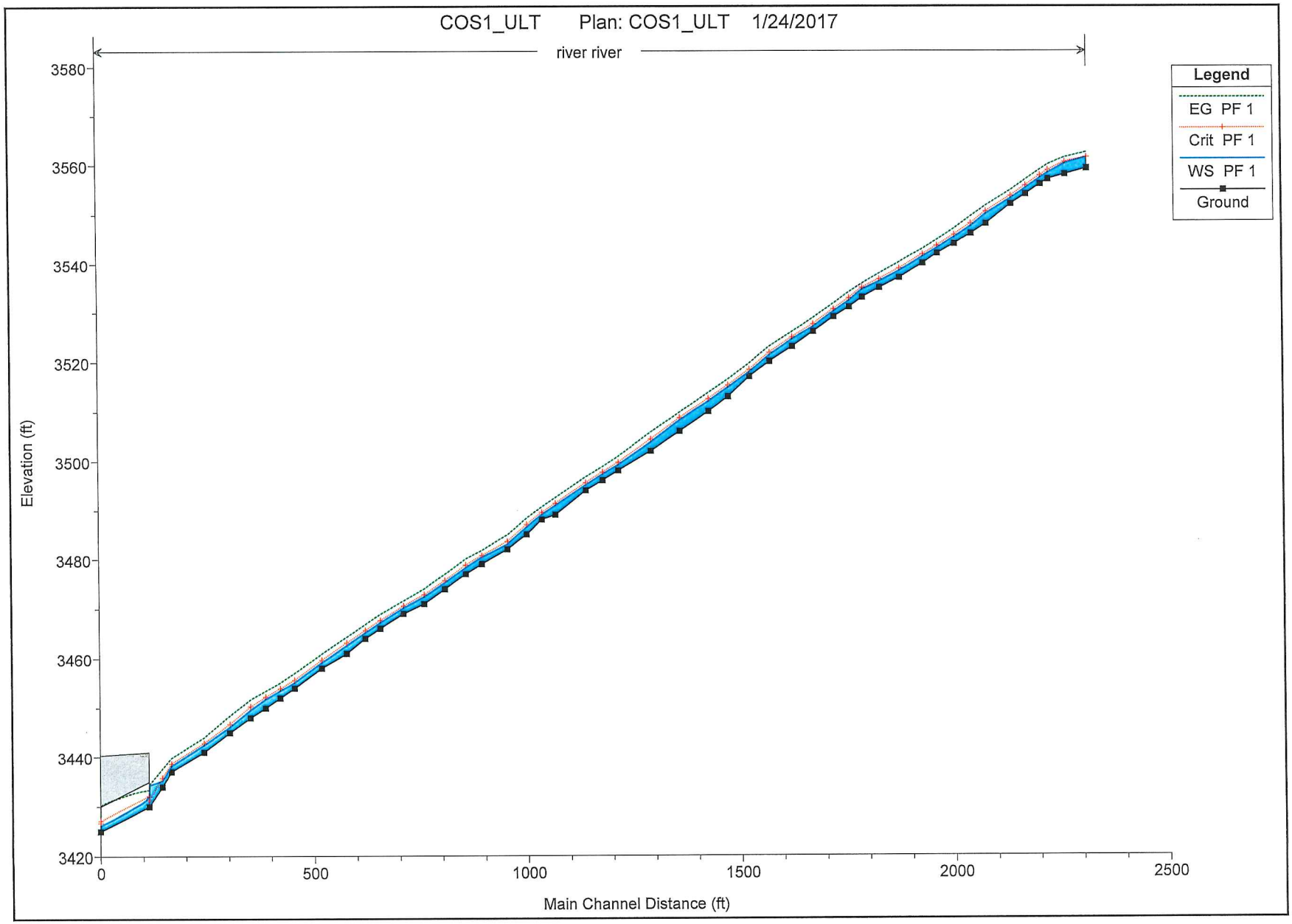
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river river
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Crit PF 1
WS PF 1
Ground
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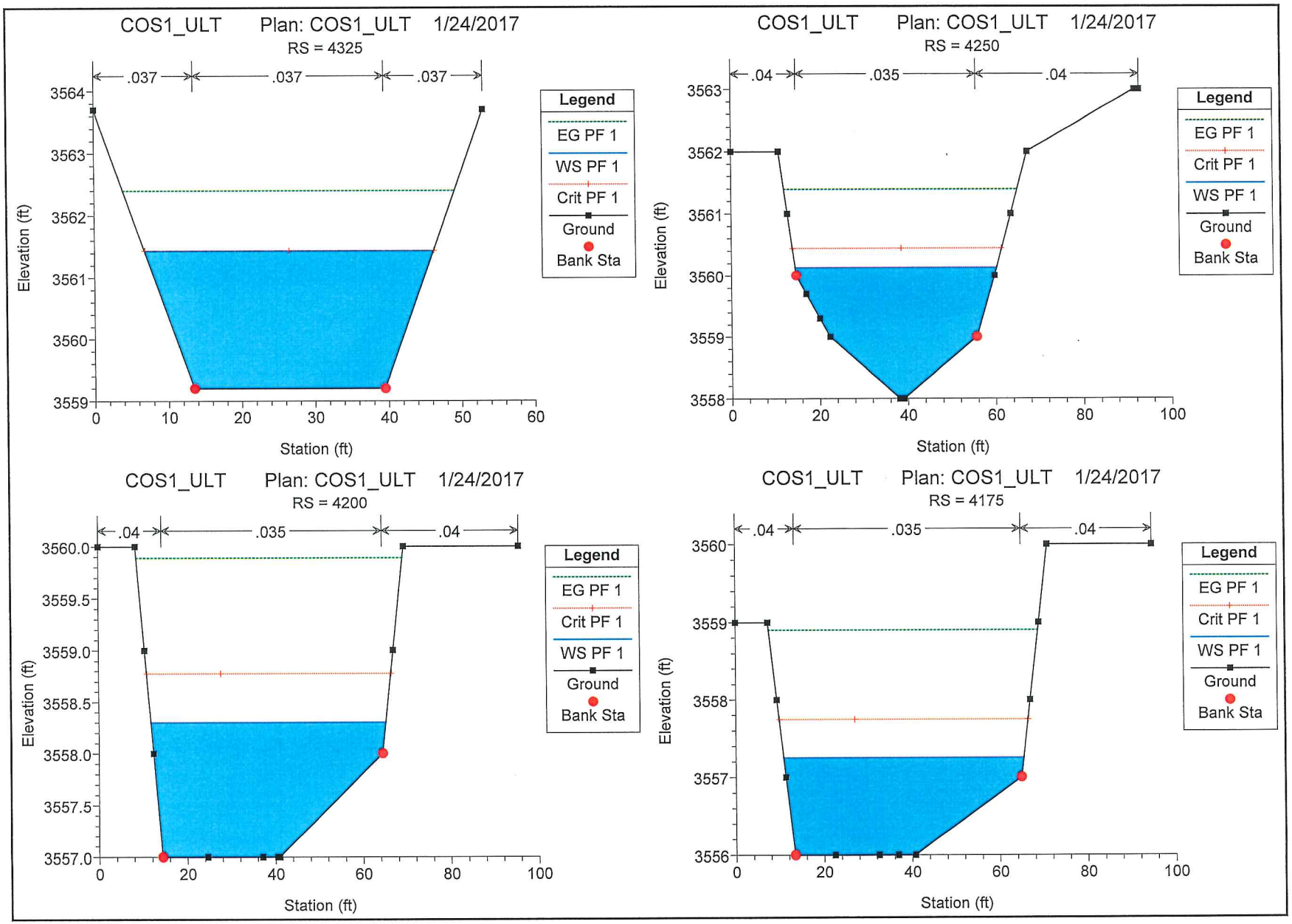
3540
3520
3500
3480
3460
3440
3420
0
500
1000
1500
2000
2500
Main Channel Distance (ft)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Crit PF 1
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Station (ft)
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WS PF 1
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Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
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Station (ft)
Legend
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WS PF 1
Ground
Bank Sta
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Station (ft)
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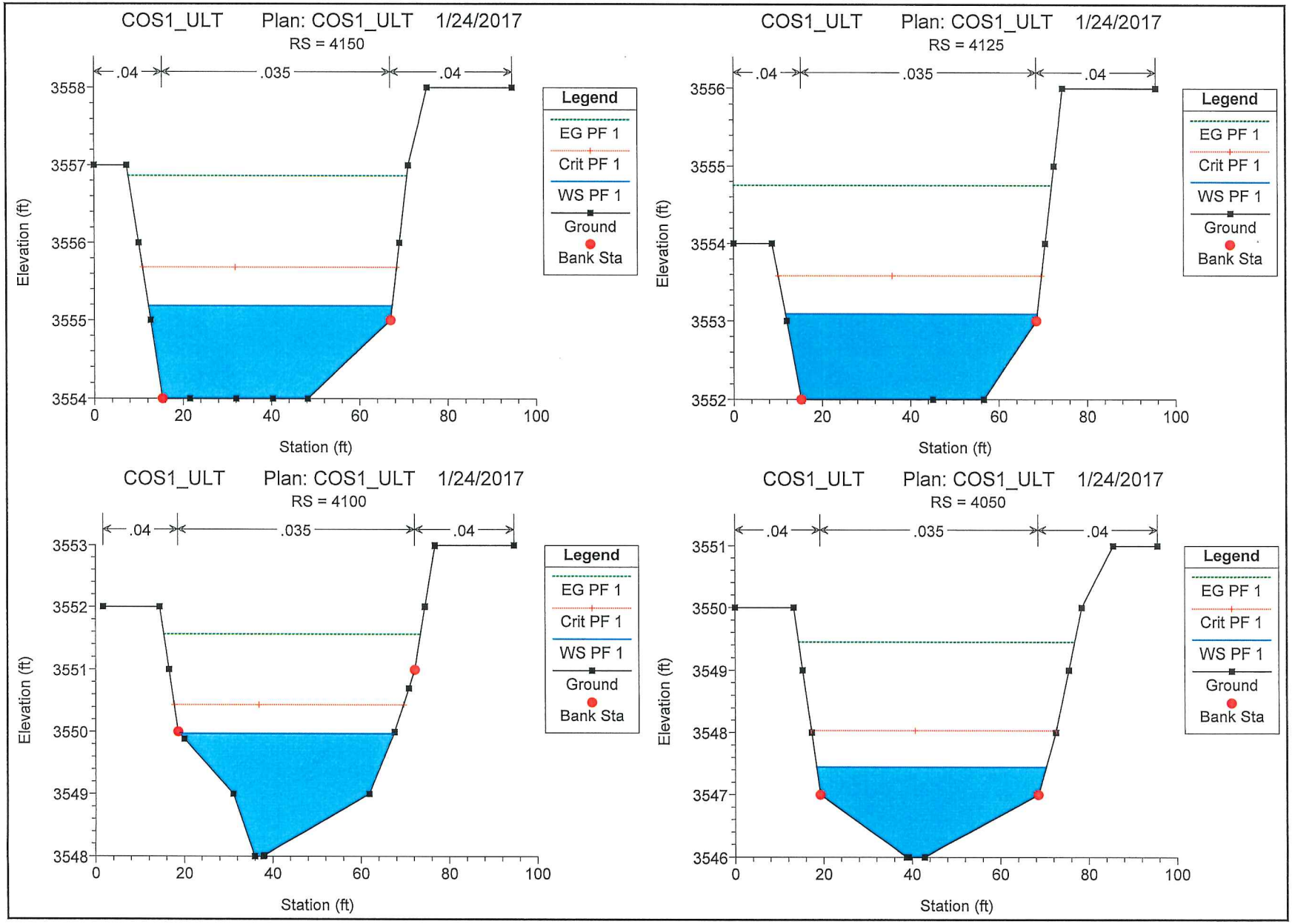
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Bank Sta
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COS1_ULT Plan: COS1_ULT 1/24/2017
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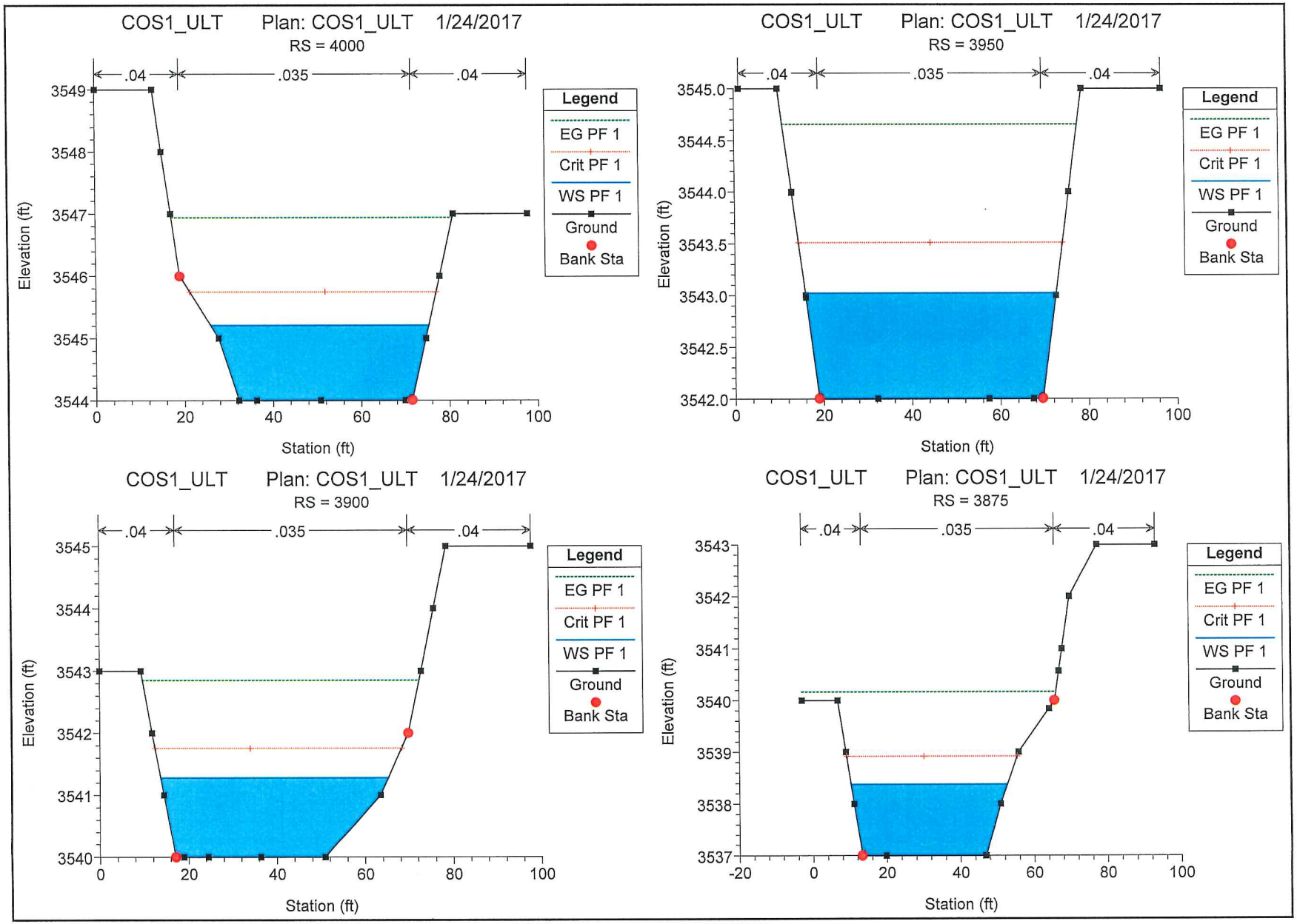
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WS PF 1
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Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3950
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Elevation (ft)
Station (ft)
Legend
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Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
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Elevation (ft)
Station (ft)
Legend
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Crit PF 1
WS PF 1
Ground
Bank Sta
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Station (ft)
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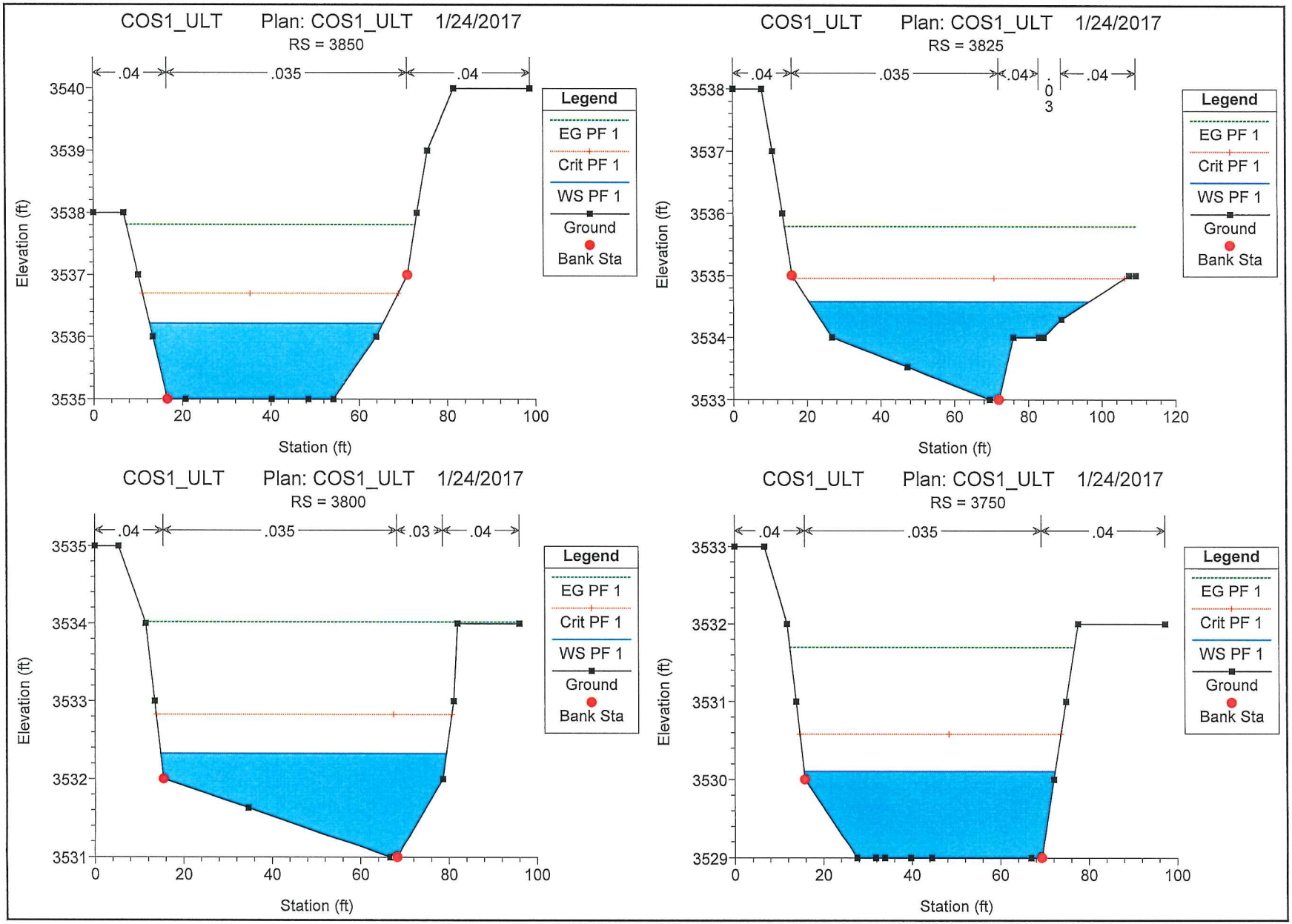
Ground
Bank Sta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Ground
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Station (ft)
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.04
.03
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Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1_ULT Plan: COS1_ULT 1/24/2017
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.035
.03
.04
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1_ULT Plan: COS1_ULT 1/24/2017
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.04
Legend
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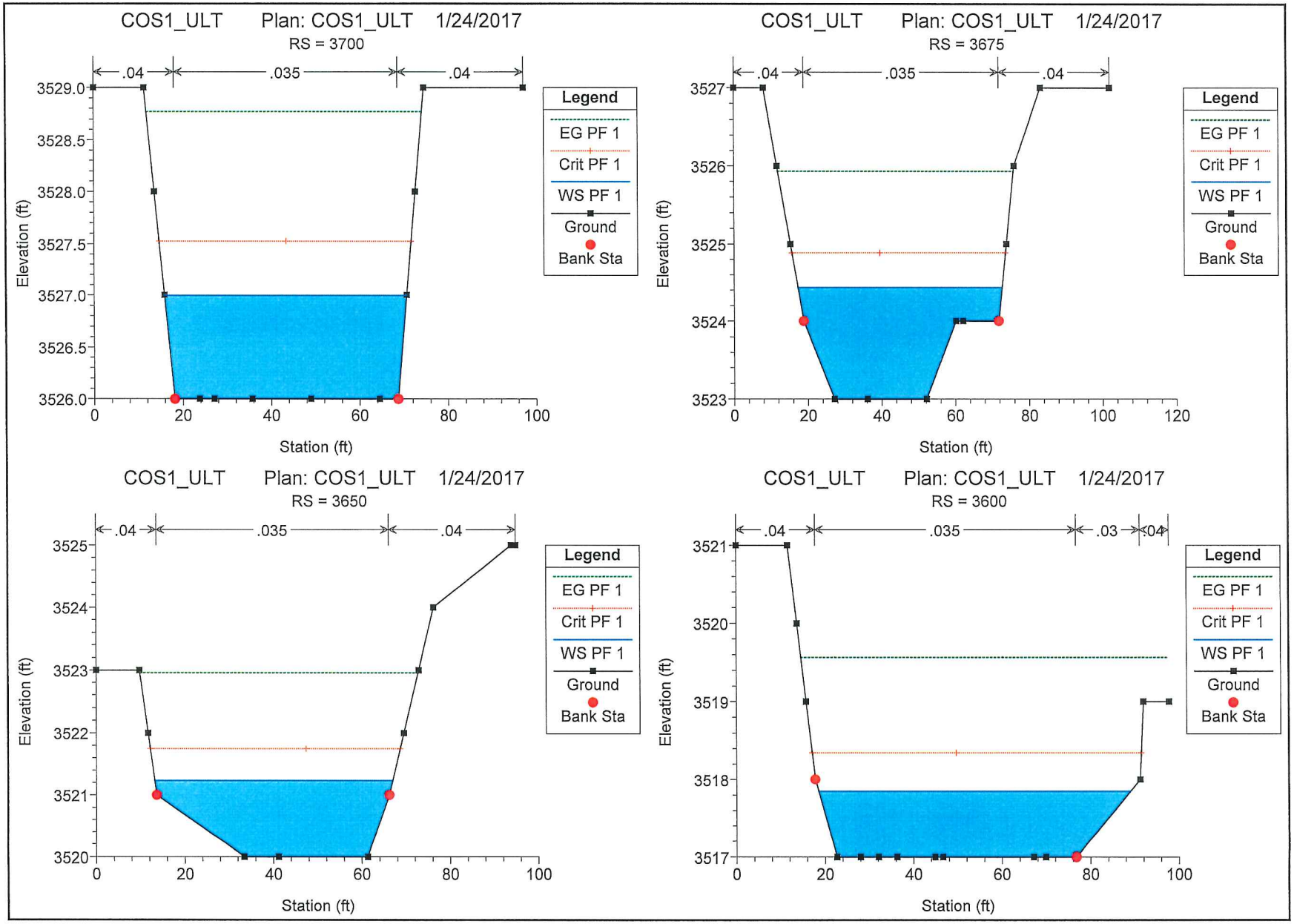
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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WS PF 1
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Bank Sta
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.04
Elevation (ft)
Station (ft)
Legend
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Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 3650
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.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
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Elevation (ft)
Station (ft)
Legend
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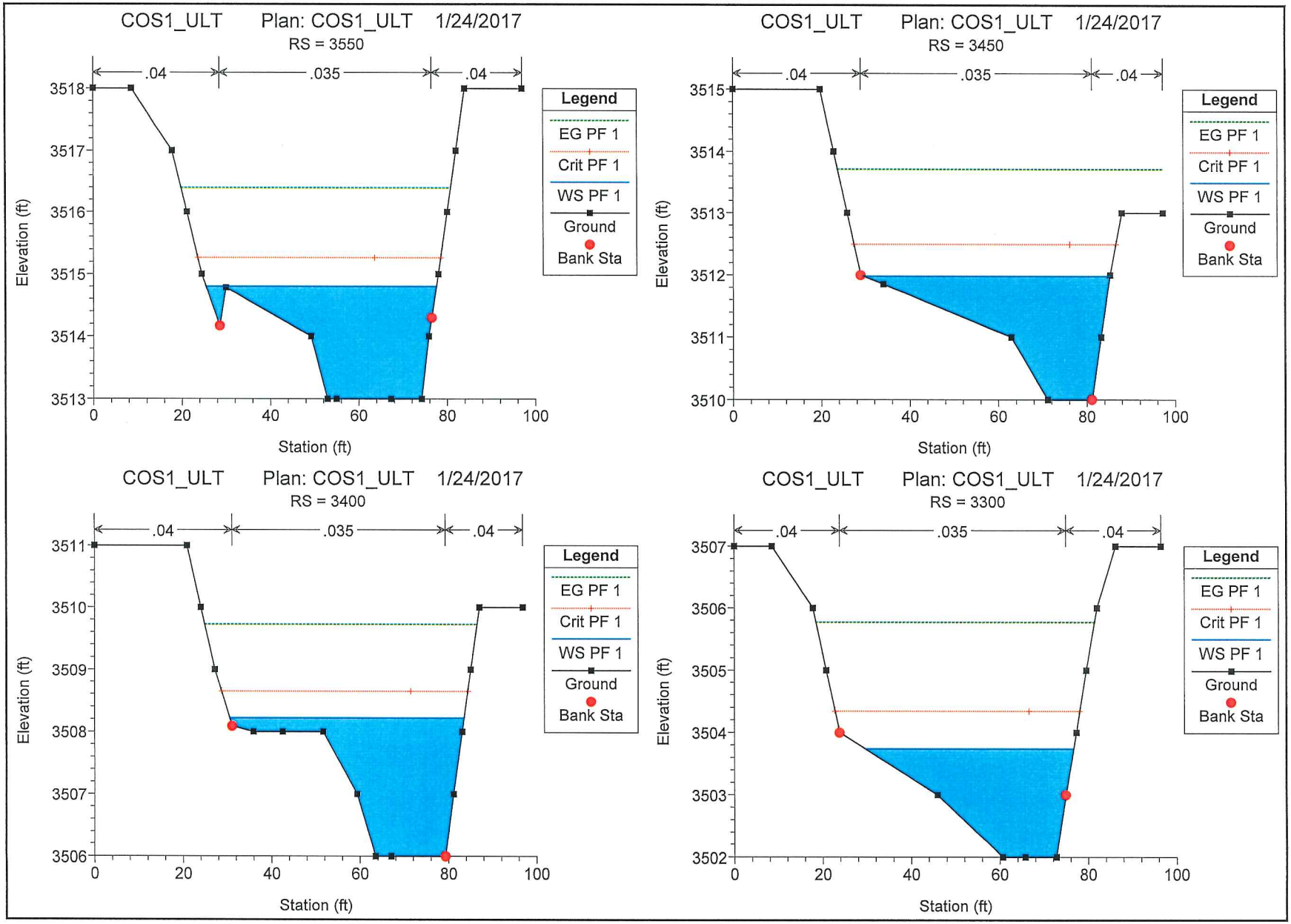
WS PF 1
Ground
Bank Sta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Station (ft)
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WS PF 1
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Station (ft)
Legend
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Ground
Bank Sta
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Station (ft)
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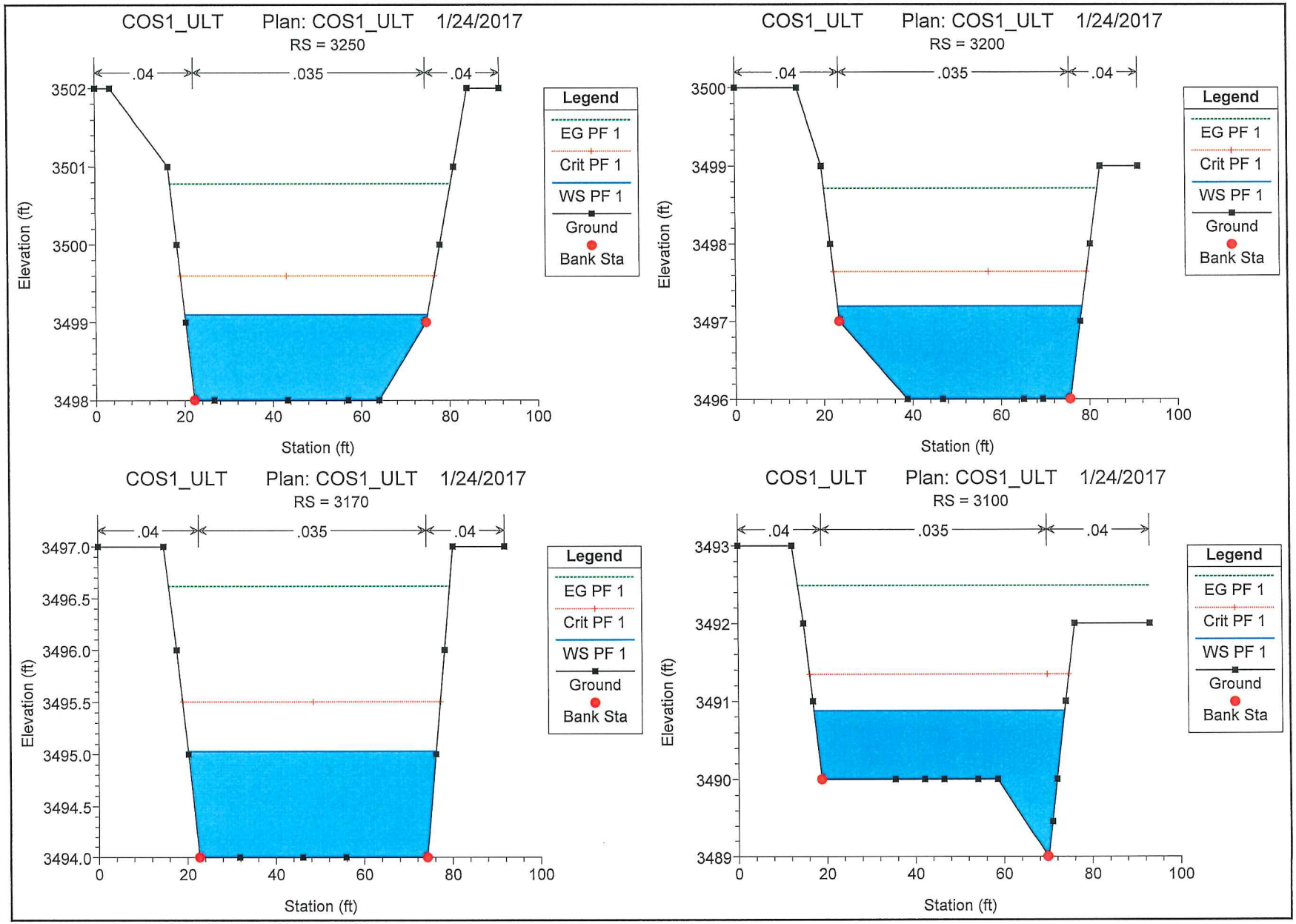
Bank Sta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Station (ft)
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Crit PF 1
WS PF 1
Ground
Bank Sta
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Crit PF 1
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Station (ft)
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Crit PF 1
WS PF 1
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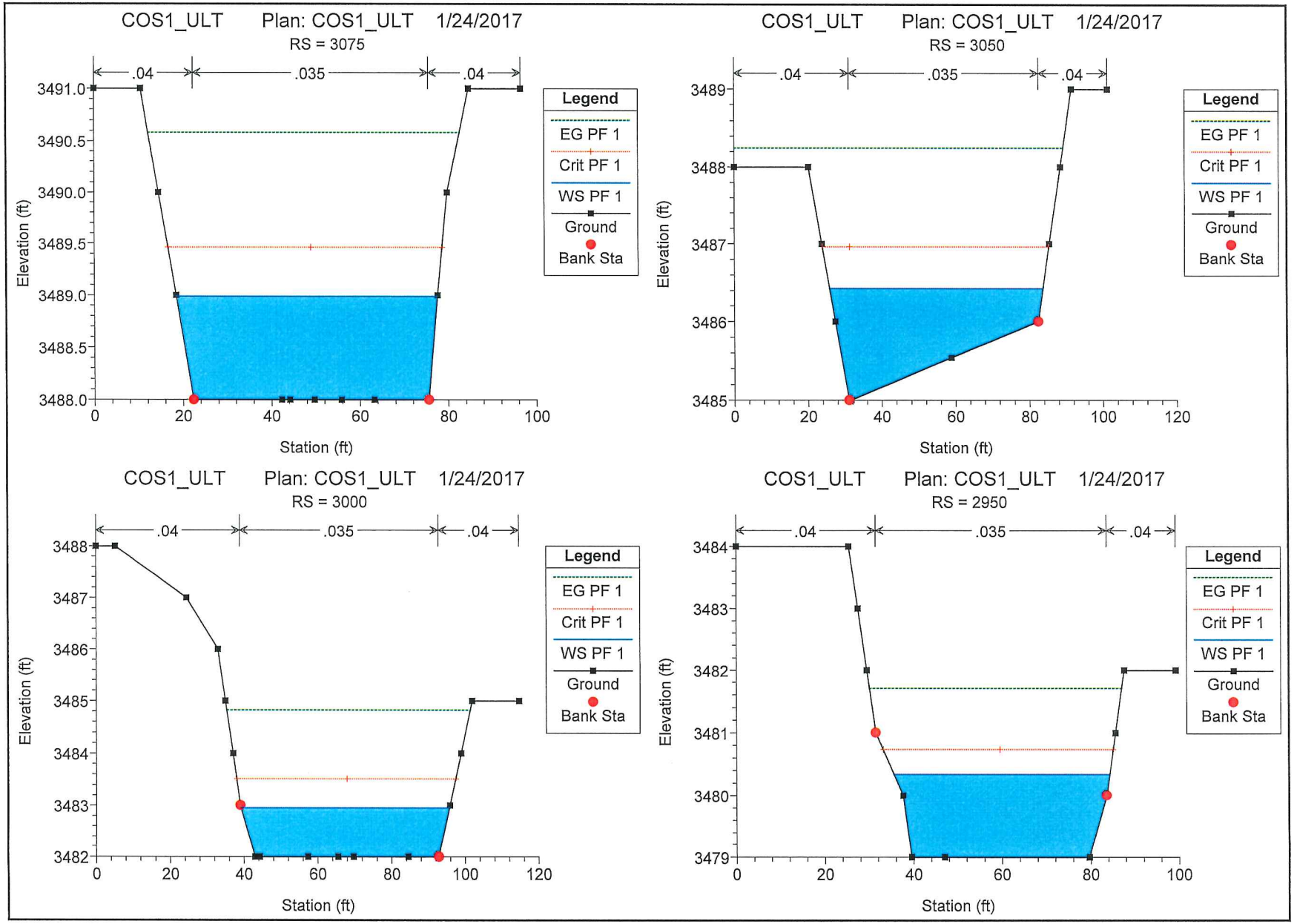
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WS PF 1
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RS = 3050
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Elevation (ft)
Station (ft)
Legend
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Crit PF 1
WS PF 1
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Bank Sta
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Station (ft)
Legend
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WS PF 1
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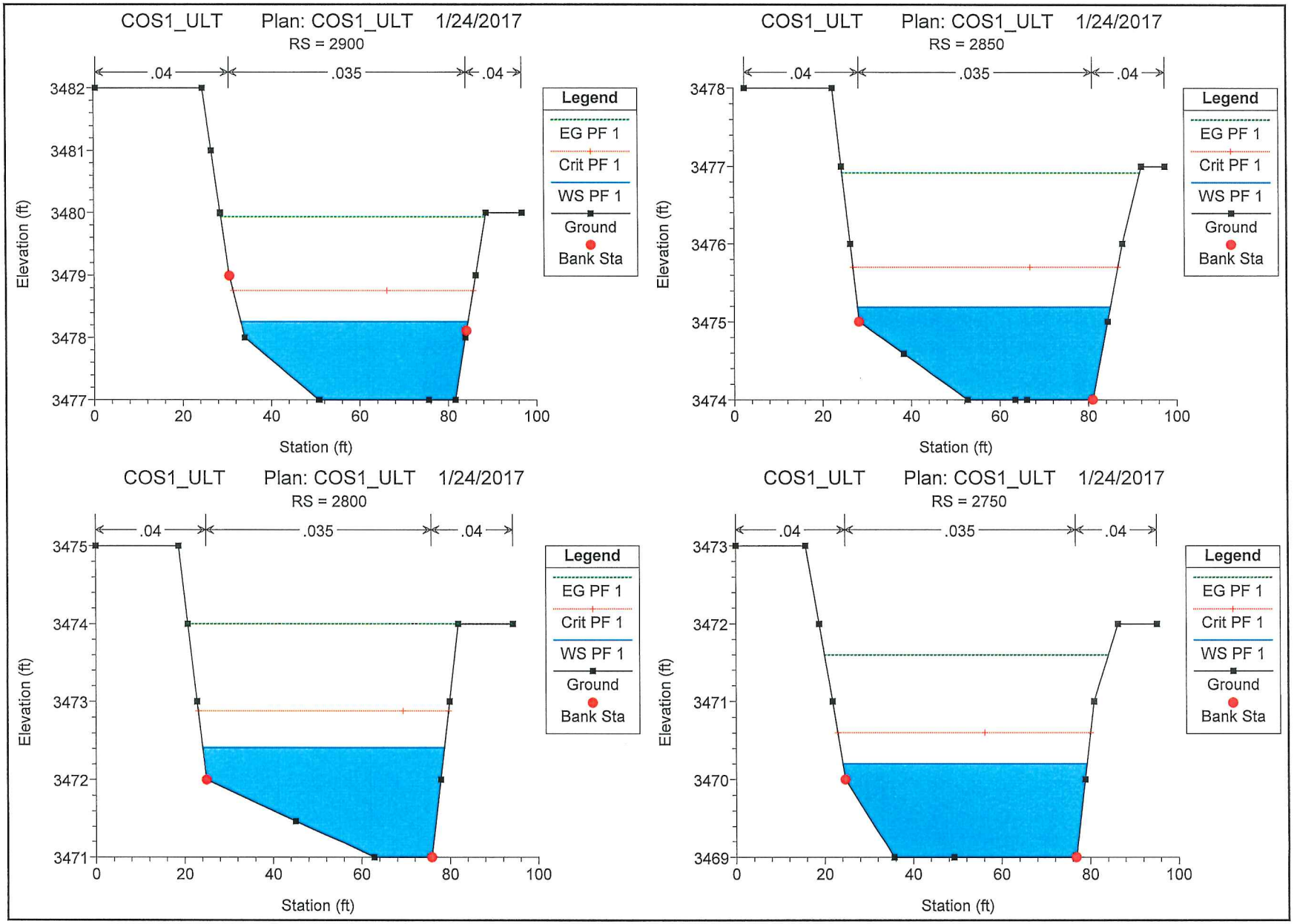
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta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Elevation (ft)
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Station (ft)
Legend
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Crit PF 1
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Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
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Elevation (ft)
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Station (ft)
Legend
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Crit PF 1
WS PF 1
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Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
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Elevation (ft)
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100
Station (ft)
Legend
EG PF 1
Crit PF 1
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Ground
Bank Sta
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3470
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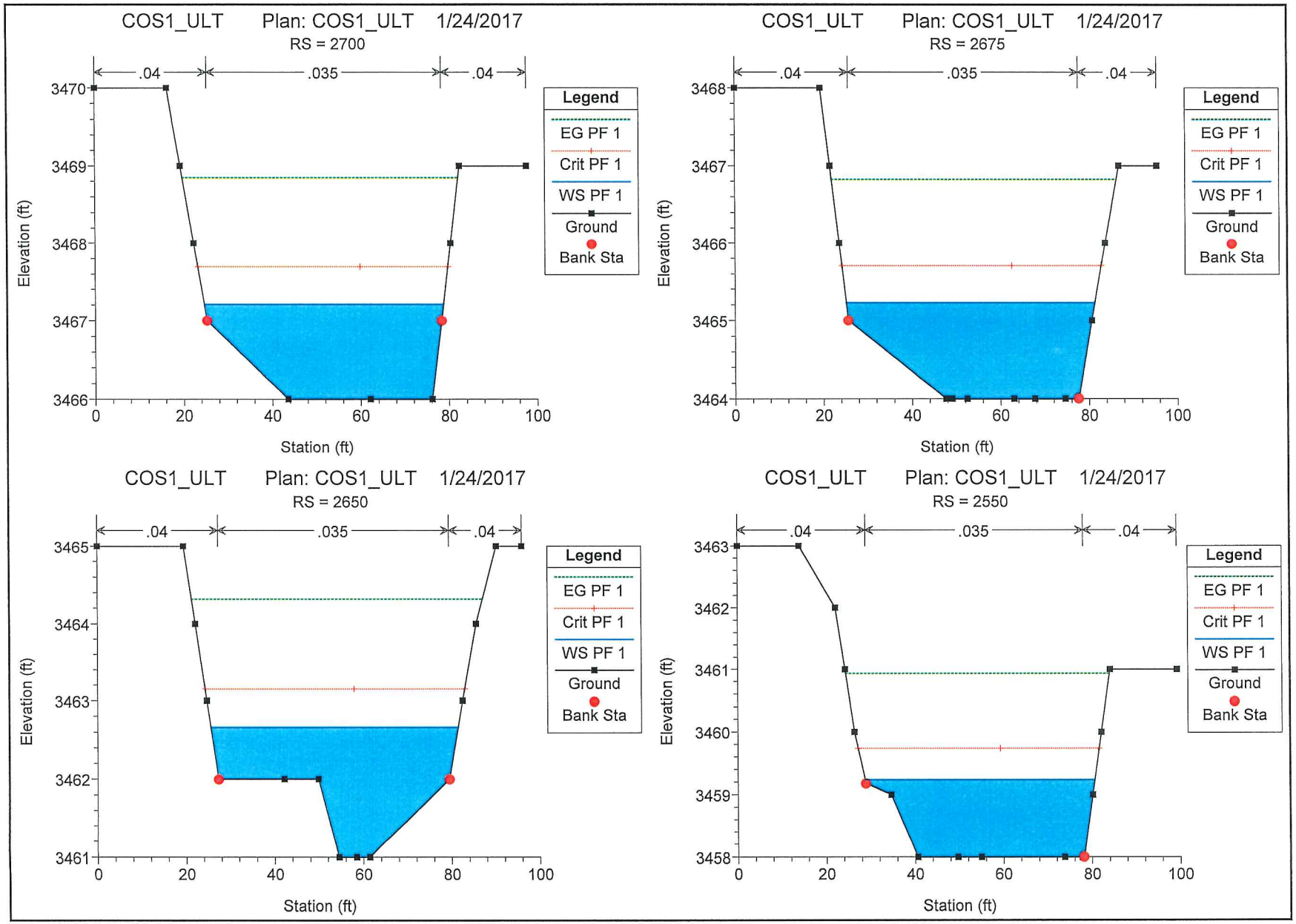
Bank Sta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Bank Sta
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Station (ft)
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Ground
Bank Sta
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Elevation (ft)
Station (ft)
Legend
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Ground
Bank Sta
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Elevation (ft)
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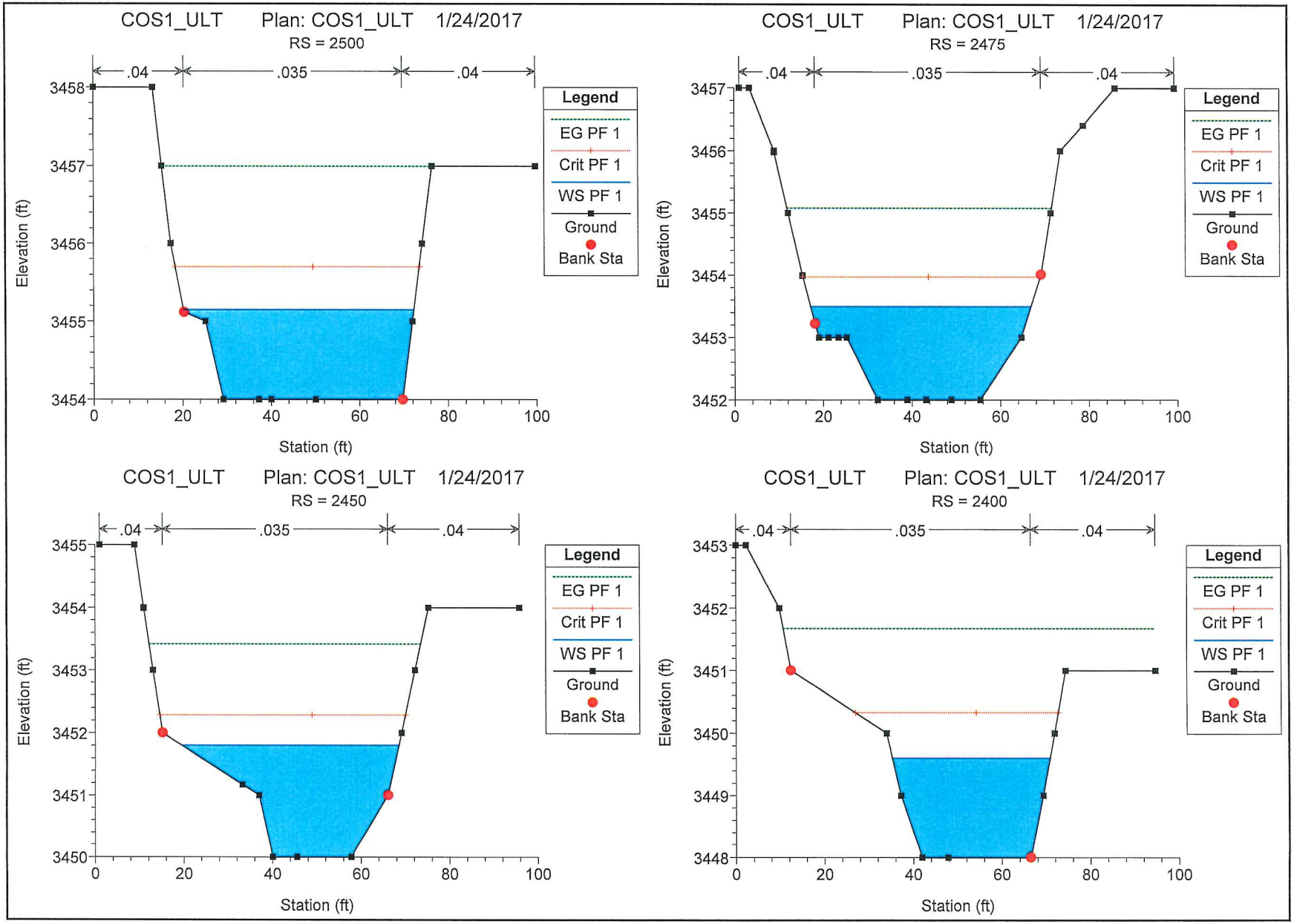
Bank Sta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Station (ft)
Legend
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Bank Sta
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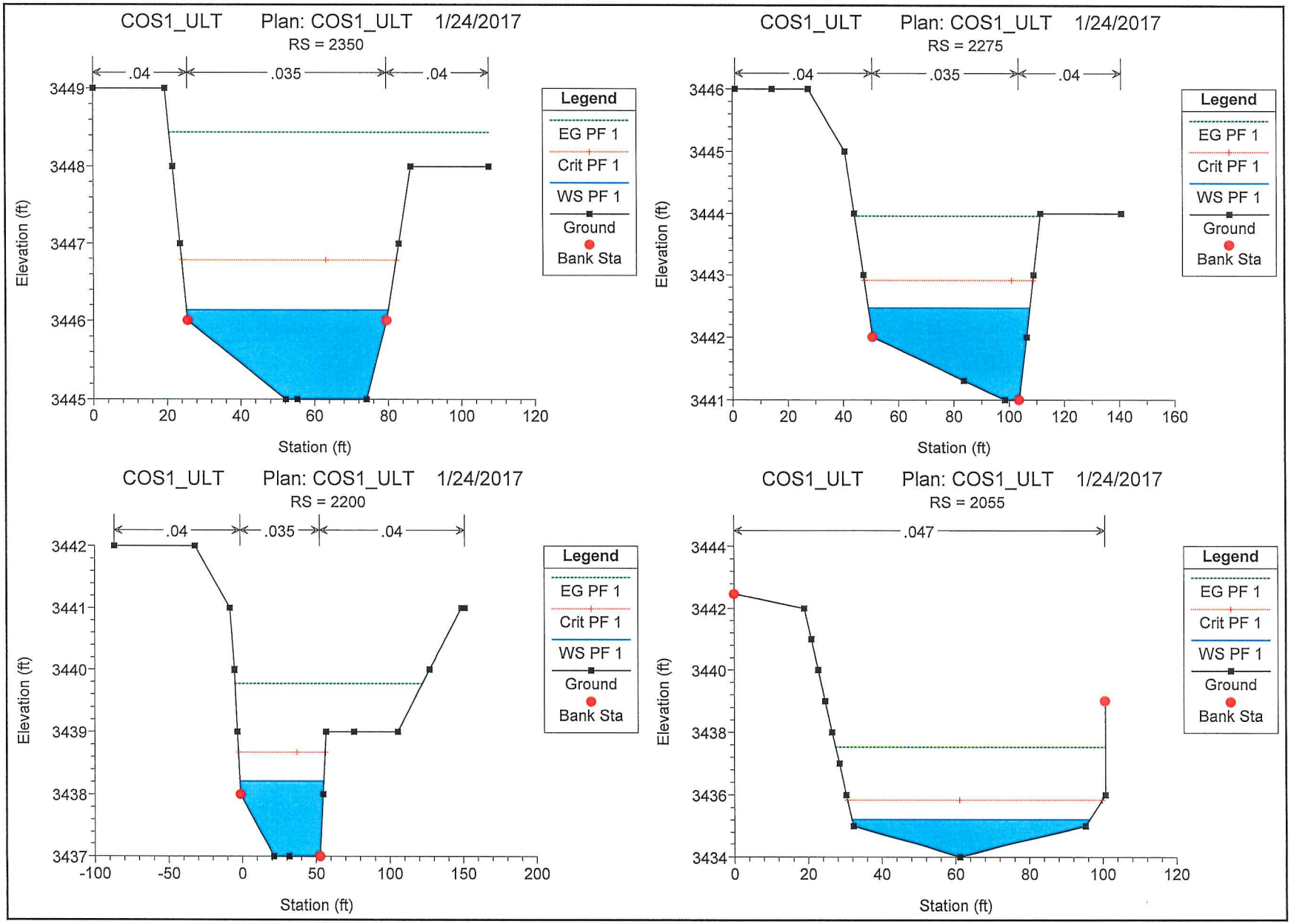
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Station (ft)
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Station (ft)
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Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
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Station (ft)
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WS PF 1
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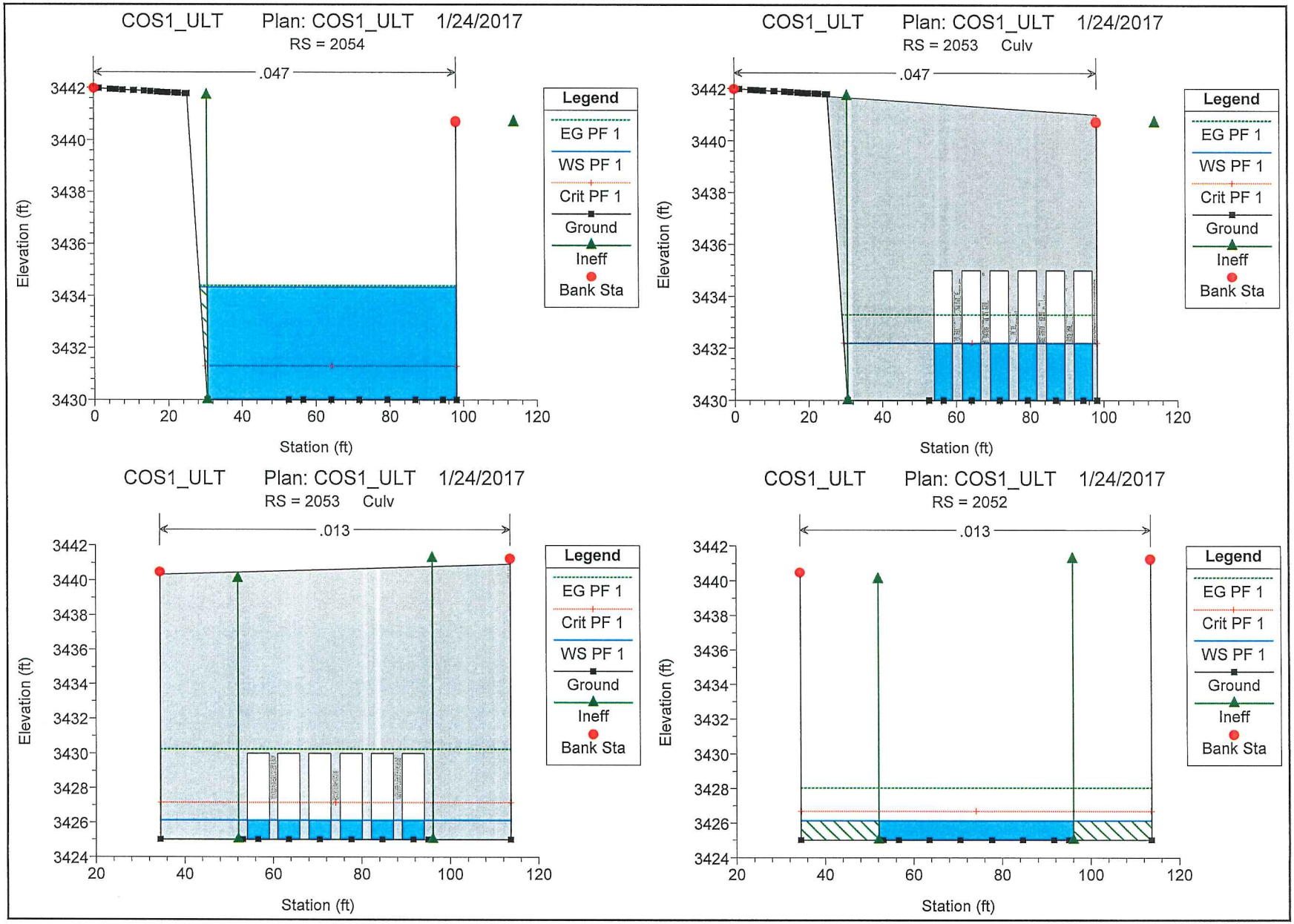
Bank Sta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Bank Sta
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Elevation (ft)
Station (ft)
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Ineff
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 2053 Culv
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Station (ft)
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Ineff
Bank Sta
COS1_ULT Plan: COS1_ULT 1/24/2017
RS = 2052
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Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Ineff
Bank Sta

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design data 7

american concrete pipe association

CONCRETE PIPE SELECTION: Trench Installations

Trench conduits are usually installed in relatively narrow trenches excavated in undisturbed soil and backfilled to the original ground surface.

When a rigid conduit is installed in a narrow trench and backfilled, the backfill material will tend to settle. This downward movement generates frictional forces along the trench walls, which act upward to help support the weight of the backfill material. The magnitude of the frictional forces depends on the unit weight of the backfill material w, the value of Rankine's lateral pressure ratio K, and the coefficient of sliding friction μ' between the backfill material and the trench walls.

The backfill load on a conduit installed in a trench condition is equal to the weight of the mass of fill material within the trench less the summation of the frictional load transfers, and is expressed by the equation:

$$W_d = C_d \, w \, B_d^2$$

where

W_d=backfill load, pounds per linear foot
C_d=load coefficient for trench condition
w=unit weight of backfill material, pounds per cubic foot
B_d=width of trench at the top of the conduit, feet

Figures 2 through 5, based on the above equation, enable a direct determination of backfill load for a given trench width and depth of cover. As the trench width increases for a given depth of cover and pipe diameter, a point is reached at which an embankment condition develops. The curves showing pipe size indicate the limiting trench width for each pipe diameter beyond which greater trench widths will not affect the load. When this condition occurs, the load on the conduit remains constant. This load should be determined by the intersection of the vertical line representing the depth of cover and the dashed line representing the particular pipe diameter under consideration. For intermediate pipe sizes not shown in *Figures 2 through 5,* interpolation should be used.

The field supporting strength of a concrete pipe line is dependent on the inherent strength of the pipe, the type of foundation on which the pipe is installed and the compaction of the sidefill material adjacent to the pipe. A common method used to determine the inherent strength of a pipe is the three-edge bearing test, in which the pipe is subjected to concentrated loads at the crown and invert. The load that a pipe will support under this condition of loading is called the *three-edge bearing strength* and is expressed in pounds per linear foot.

ASTM Specification C14 covers three strength classes for non-reinforced concrete pipe — Class 1, 2 and 3. These three classes are specified to meet ultimate loads, expressed in terms of minimum strength in three-edge-bearing as listed in *Table I.*

TABLE I: Strength Requirements Non-reinforced Concrete Pipe ASTM C14

Pipe Diameter, Inches	Minimum Three-Edge Bearing Strengths, Pounds per Linear Foot		
	Class 1	Class 2	Class 3
4	1500	2000	2400
6	1500	2000	2400
8	1500	2000	2400
10	1600	2000	2400
12	1800	2250	2600
15	2000	2600	2900
18	2200	3000	3300
21	2400	3300	3850
24	2600	3600	4400
27	2800	3950	4600
30	3000	4300	4750
33	3150	4400	4875
36	3300	4500	5000

Another means of expressing pipe strength is in terms of D-load. The D-load of a pipe is the supporting strength of a pipe loaded under three-edge-bearing test conditions expressed in pounds per linear foot per foot of inside diameter. Thus the bearing strength may be converted to D-load by dividing by the inside diameter in feet.

ASTM Specification C76 specifies five strength classes reinforced concrete pipe. These strength classes are expressed in terms of D-load at 0.01-inch crack and for ultimate load. The D-load to produce the 0.01-inch crack $D_{0.01}$ is the maximum load applied to the concrete pipe before a crack occurs having a width of 0.01-inch measured at close intervals, throughout a length of at least 1-foot. The D-load to produce ultimate load D_u is the maximum three-edge-bearing test load carried by a pipe, expressed as D-load. *Table II* lists 0.01-inch crack and ultimate D-loads for the strength classes covered by ASTM Specification C76.

TABLE II: Strength Requirements Reinforced Concrete Pipe ASTM C76

Strength Class	Minimum D-Load in Three-Edge Bearing Pounds per Linear Foot per Foot of Internal Diameter	
	0.01 Inch Crack-$D_{0.01}$	Ultimate-D_u
I	800	1200
II	1000	1500
III	1350	2000
IV	2000	3000
V	3000	3750

PROGRAM SAMM
D-LOAD REQUIREMENTS FOR A 48 IN. DIAMETER CIRCULAR PIPE

****

P I P E D A T A

DIAMETER (in.)	48.00
WALL B, THICKNESS (in.)	5.000

I N S T A L L A T I O N C O N D I T I O N S

MINIMUM DEPTH OF FILL (ft.)	0.50
MAXIMUM DEPTH OF FILL (ft.)	20.00
SOIL DENSITY (lb/cu. ft.)	140.0
SPECIFIED BEDDING FACTOR	1.90
INSTALLATION TYPE	TRENCH
TRENCH WIDTH (ft.)	8.83
SOIL LATERAL PRESSURE/FRICTION TERM (KMU')	0.1650
PARAMETERS TO COMPUTE TRANSITION WIDTH	
POSITIVE PROJECTION RATIO	1.00
POSITIVE SETTLEMENT RATIO	0.50
SOIL LATERAL PRESSURE/FRICTION TERM (KMU)	0.1924
SOIL LATERAL PRESSURE COEFICIENT	0.33

A D D I T I O N A L L O A D S

LIVE LOAD	AASHTO HS-20
NO SURCHARGE LOAD	

F A C T O R S O F S A F E T Y

FACTOR OF SAFETY ON 0.01 INCH CRACK D-LOAD (EARTH,LIVE)	1.00; 1.00
FACTOR OF SAFETY ON ULTIMATE LOAD (EARTH,LIVE) IN ACCORDANCE WITH ASTM C 76	
DL.01 LESS THAN 2000 LBS/FT/FT	1.5
DL.01 GREATER THAN 3000 LBS/FT/FT	1.25
DL.01 BETWEEN 2000 AND 3000 LBS/FT/FT	INTERPOLATED

: E S U L T S O F A N A L Y S I S

```
SSSSSSSSS   AAAAAAAAA   MMM    MMM   MMM    MMM
SS          AA     AA   MM M M MM   MM M M MM
SSSSSSSSS   AAAAAAAAA   MM  M  MM   MM  M  MM
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SSSSSSSSS   AA     AA   MM     MM   MM     MM
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P R O G R A M S A M M

AMERICAN CONCRETE PIPE ASSOCIATION
VERSION 2.0 - 1 SEPTEMBER 1990

Program SAMM computes earth loads on concrete pipe in accordance with the methods presented in the Concrete Pipe Design Manual (March 1990) and the Concrete Pipe Handbook (January 1988), published by the American Concrete Pipe Association. The user must select input values suitable to his specific installation. The information presented in the computer output is for review, interpetation, application and approval by a qualified engineer who must assume full responsibility for verifying that said output is appropriate and correct. There are no express or implied warranties. The use of this product does not constitute endorsement by ACPA or any other agents.

PIPE DEPTH (ft.)	EARTH LOAD ARCHING FACTOR	>TRANS	EARTH LOAD (lb/ft)	LIVE LOAD (lb/ft)	SURCH LOAD (lb/ft)	TOTAL LOAD (lb/ft)	BED FACT	REQUIRED D-LOAD 0.01 in. (lb/ft/ft)	ULT. (lb/ft/ft)
0.5	1.02	Y	345.	2584.	0.	2929.	1.90	385.	578.
1.0	1.04	Y	704.	2331.	0.	3035.	1.90	399.	599.
1.5	1.06	Y	1078.	2623.	0.	3701.	1.90	487.	731.
2.0	1.08	Y	1467.	2475.	0.	3942.	1.90	519.	778.
2.5	1.11	Y	1872.	1994.	0.	3866.	1.90	509.	763.
3.0	1.13	Y	2293.	1474.	0.	3766.	1.90	496.	743.
3.5	1.15	Y	2731.	1226.	0.	3957.	1.90	521.	781.
4.0	1.18	Y	3187.	1039.	0.	4226.	1.90	556.	834.
4.5	1.20	Y	3662.	893.	0.	4555.	1.90	599.	899.
5.0	1.23	Y	4156.	778.	0.	4933.	1.90	649.	974.
5.5	1.25	Y	4670.	684.	0.	5353.	1.90	704.	1057.
6.0	1.28	Y	5204.	606.	0.	5811.	1.90	765.	1147.
6.5	1.31	Y	5761.	542.	0.	6303.	1.90	829.	1244.
7.0	1.34	Y	6340.	487.	0.	6827.	1.90	898.	1348.
7.5	1.37	Y	6943.	441.	0.	7384.	1.90	972.	1457.
8.0	1.40	Y	7570.	401.	0.	7971.	1.90	1049.	1573.
8.5	1.43	Y	8222.	366.	0.	8589.	1.90	1130.	1695.
9.0	1.46	Y	8884.	336.	0.	9220.	1.90	1213.	1820.
9.5	1.46	Y	9394.	309.	0.	9703.	1.90	1277.	1915.
10.0	1.47	Y	9917.	286.	0.	10203.	1.90	1343.	2014.
10.5	1.47	Y	10429.	265.	0.	10694.	1.90	1407.	2111.
11.0	1.47	Y	10940.	246.	0.	11187.	1.90	1472.	2208.
11.5	1.47	Y	11452.	230.	0.	11681.	1.90	1537.	2306.
12.0	1.47	N	11954.	215.	0.	12169.	1.90	1601.	2402.
12.5	1.46	N	12345.	201.	0.	12546.	1.90	1651.	2476.
13.0	1.45	N	12729.	189.	0.	12918.	1.90	1700.	2550.

13.5	1.43	N	13106.	177.	0.	13283.	1.90	1748.	2622.
14.0	1.42	N	13475.	167.	0.	13643.	1.90	1795.	2693.
14.5	1.41	N	13838.	158.	0.	13996.	1.90	1842.	2762.
15.0	1.40	N	14195.	149.	0.	14344.	1.90	1887.	2831.
15.5	1.39	N	14544.	141.	0.	14685.	1.90	1932.	2898.
16.0	1.38	N	14887.	134.	0.	15021.	1.90	1976.	2965.
16.5	1.36	N	15224.	127.	0.	15351.	1.90	2020.	3020.
17.0	1.35	N	15555.	121.	0.	15676.	1.90	2063.	3062.
17.5	1.34	N	15879.	115.	0.	15994.	1.90	2105.	3102.
18.0	1.33	N	16197.	110.	0.	16307.	1.90	2146.	3140.
18.5	1.32	N	16510.	105.	0.	16615.	1.90	2186.	3177.
19.0	1.31	N	16817.	100.	0.	16917.	1.90	2226.	3213.
19.5	1.30	N	17118.	96.	0.	17213.	1.90	2265.	3247.
20.0	1.29	N	17413.	92.	0.	17505.	1.90	2303.	3280.

APPENDIX C

Reference Materials

LIMITED GEOTECHNICAL EVALUATION
US WATERS – WASH COS-1 AND COS-2
SUMMERLIN VILLAGE 24
LAS VEGAS, NEVADA

PROJECT NO.: E-15-086
MAY 21, 2015

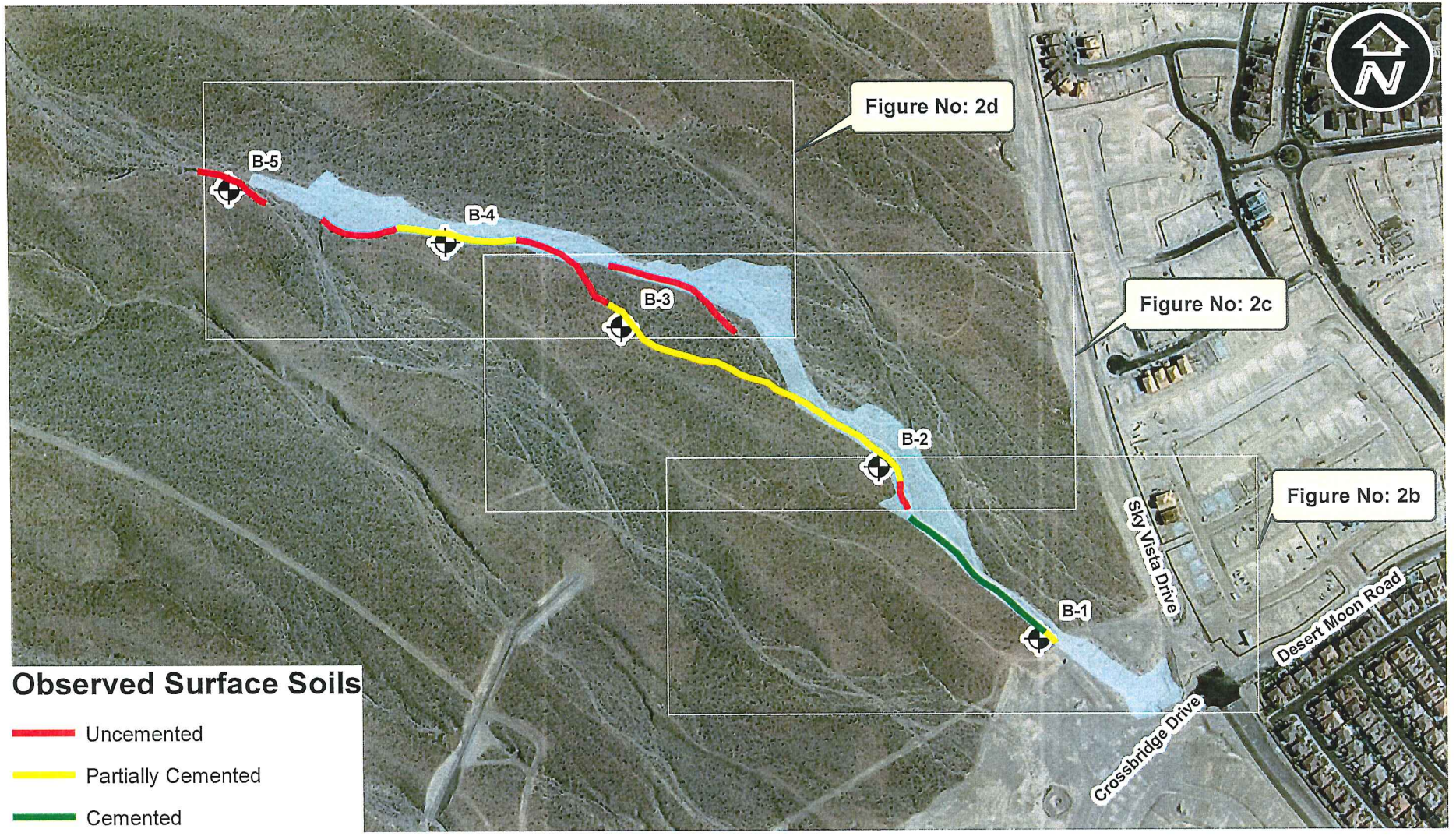
Prepared for:

Howard Hughes®
THE HOWARD HUGHES CORPORATION

Prepared by:

NOVA GEOTECHNICAL
& inspection services

NOVA GEOTECHNICAL & INSPECTION SERVICES
4480 WEST HACIENDA AVENUE
SUITE 104
LAS VEGAS, NEVADA 89118
Phone: (702) 873-3478
Fax: (702) 873-2199



Legend

B-5 Approximate Boring Location

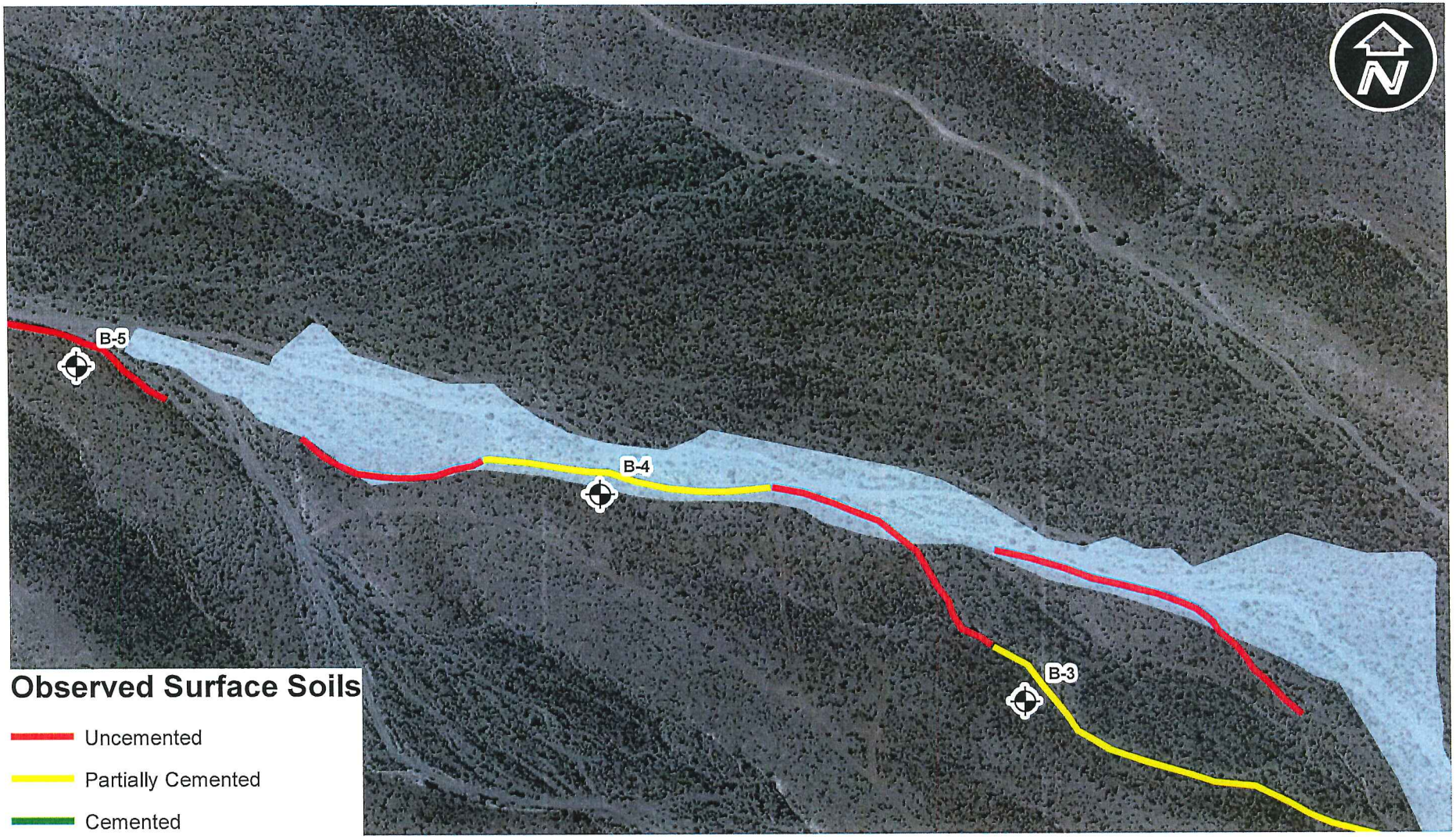
Approximate Area of Inundation (by others)

Feet

0 150 300 600 900 1,200

The presented layers were obtained from various sources including ESRI, USGS, USDA, CCBD GIZMO, CCFCD, GIS User Community among others. The GIS information is presented for reference only. No warranties, either expressed or implied, are intended or made. If you have any questions regarding this information, please contact NOVA.

NOVA Geotechnical & Inspection Services	PROJECT: Limited Geotechnical Evaluation Summerlin Village 24 US Waters - Wash COS-1 and COS-2 Las Vegas, Nevada	ALIGNMENT OVERVIEW MAP	
	CLIENT: The Howard Hughes Corporation	PROJECT NO: **E-15-086**	FIGURE NO: **2a**



Legend

B-5 Approximate Boring Location

Approximate Area of Inundation (by others)

Feet
0 62.5 125 250 375 500

The presented layers were obtained from various sources including ESRI, USGS, USDA, CCBD GIZMO, CCFCD, GIS User Community among others. The GIS information is presented for reference only. No warranties, either expressed or implied, are intended or made. If you have any questions regarding this information, please contact NOVA.

NOVA Geotechnical & Inspection Services	PROJECT:	Limited Geotechnical Evaluation Summerlin Village 24 US Waters - Wash COS-1 and COS-2 Las Vegas, Nevada	ALIGNMENT MAP
	CLIENT:	The Howard Hughes Corporation	PROJECT NO: **E-15-086** / FIGURE NO: **2d**

BORING LOG B-3

CLIENT:	PROJECT:
THE HOWARD HUGHES CORPORATION	V-24 US WATERS COS-1 AND COS-2 EVALUATION

BORING LOCATION:	ELEVATION (ft):	SITE:
SEE SITE MAP	NA	NWC CHARLESTON BLVD AND SKY VISTA DRIVE

MOISTURE CONTENT %	DRY DENSITY PCF	SAMPLE TYPE*	SAMPLE	BLOWS/FT	DEPTH, FT	USCS SYMBOL	GRAPHIC	SOIL DESCRIPTION	CONSISTENCY
					0	SM		Silty SAND with gravel, caliche debris, slightly moist	Loose
		SPT		50/1"	1			CALICHE (Cemented sand & gravel), light brown, dry	Hard
					2				
		B			3				M.Hard-Hard
					4				
		SPT		50/1"	5				
					6				
					7	GM		Silty GRAVEL with sand, cobbles, light brown, with thin cemented layers, slightly moist	V.Dense
					8				
					9				
					10				
		SPT		73/9"	11				
					12			CALICHE (Cemented sand & gravel), light brown, dry	M.Hard
		B			13	GM		Silty GRAVEL with sand, partially cemented, light brown, dry	V.Dense-M.Hard
					14				
		SPT		50/2"	15			CALICHE (Cemented sand & gravel), light brown, dry	M.Hard-

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

* SAMPLE TYPE: R = RING B = BAG SPT = STANDARD PENETRATION BN = BULL NOSE C = CORE

NOVA GEOTECHNICAL AND INSPECTION SERVICES

NOTES:
Groundwater not encountered within the depths drilled

DATE DRILLED:	PAGE NO:
5/7/15	1 of 2
PROJECT NO.:	PLATE NO.:
E-15-086	3

THIS SUMMARY APPLIES ONLY AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME AND AT OTHER LOCATIONS.

BORING LOG B-3

CLIENT:	PROJECT:
THE HOWARD HUGHES CORPORATION	V-24 US WATERS COS-1 AND COS-2 EVALUATION
BORING LOCATION: SEE SITE MAP	**ELEVATION (ft):** NA
SITE: NWC CHARLESTON BLVD AND SKY VISTA DRIVE	

MOISTURE CONTENT %	DRY DENSITY PCF	SAMPLE TYPE*	SAMPLE	BLOWS/FT	DEPTH, FT	USCS SYMBOL	GRAPHIC	SOIL DESCRIPTION	CONSISTENCY
					16			CALICHE (Cemented sand & gravel), lightbrown, dry	Hard
					17				
					18	GM		Silty Gravel with sand, cobbles, brown, slightly moist	Dense
					19				
					20			Bottom of Boring at 20 feet	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

* SAMPLE TYPE: R = RING B = BAG SPT = STANDARD PENETRATION BN = BULL NOSE C = CORE

NOVA GEOTECHNICAL AND INSPECTION SERVICES

NOTES:
Groundwater not encountered within the depths drilled

DATE DRILLED:	PAGE NO:
5/7/15	2 of 2
PROJECT NO.:	**PLATE NO.:**
E-15-086	3

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME AND AT OTHER LOCATIONS.

BORING LOG B-4

CLIENT:	PROJECT:
THE HOWARD HUGHES CORPORATION	V-24 US WATERS COS-1 AND COS-2 EVALUATION
BORING LOCATION: SEE SITE MAP	**ELEVATION (ft):** NA
	SITE: NWC CHARLESTON BLVD AND SKY VISTA DRIVE

MOISTURE CONTENT %	DRY DENSITY PCF	SAMPLE TYPE*	SAMPLE	BLOWS/FT	DEPTH, FT	USCS SYMBOL	GRAPHIC	SOIL DESCRIPTION	CONSISTENCY
					0	SM		Silty SAND with gravel, caliche debris, brown, slightly moist	Loose
					1			-increase in gravel fraction	V.Dense-M.Hard
					2				
					3	GM		Silty GRAVEL with sand, partially cemented, cobbles, light brown, dry	V.Dense-M.Hard
		SPT		90/10"	4				
					5			-very thin cemented layers	
		B			6				
					7				V.Dense
					8				
					9				
		SPT		82/12"	10				
					11			CALICHE (Cemented sand & gravel), light brown, dry	M.Hard
					12				
					13				M.Hard-Hard
		SPT		50/2"	14				
					15			Bottom of Boring at 15 feet	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

* SAMPLE TYPE: R = RING B = BAG SPT = STANDARD PENETRATION BN = BULL NOSE C = CORE

NOVA GEOTECHNICAL AND INSPECTION SERVICES

NOTES:
Groundwater not encountered within the depths drilled

DATE DRILLED:	PAGE NO:
5/7/15	1 of 1
PROJECT NO.:	**PLATE NO.:**
E-15-086	4

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME AND AT OTHER LOCATIONS.

SUMMARY OF TEST RESULTS

Boring & Depth	B-2 @ 3-8 ft.	B-3 @ 10-15 ft.	B-4 @ 4-9 ft.
Sieve	% PASSING		
1 1/2in.	100.0	100.0	100.0
1in.	100.0	95.1	97.9
3/4in.	98.2	90.3	94.0
1/2in.	89.4	77.3	86.6
3/8in.	80.5	68.6	79.0
#4	53.7	48.6	59.5
#8	37.7	33.7	45.0
#10	35.1	31.4	42.4
#16	29.8	26.3	36.6
#30	25.3	22.4	31.2
#40	23.8	21.1	29.3
#50	22.2	20.0	27.4
#100	17.8	17.1	22.2
#200	12.1	12.8	15.3
LL*	NV	NV	NV
PI**	NP	NP	NP
USCS	GM	GM	SM
OMC, %	8	6	6
MDD, pcf	146	134	145
ϕ, °	51	—	60
C, psf	1400	—	978
SO_4, %* **	0.00	0.00	0.00
Solubility,% * **	0.03	0.05	0.04

* NV = No Value (soil did not exhibit a liquid limit)

** NP = Non-Plastic

*** Performed by others



South containment: exposed cemented sand and gravel



South containment: approximately in the middle of wash alignment, facing south; pictures shows relatively shallow containment

NOVA Geotechnical & Inspection Services	PROJECT: **Limited Geotechnical Evaluation Summerlin Village 24 US Waters – Wash COS-1 and COS-2 Las Vegas, Nevada**	**PHOTOGRAPHS**	
	CLIENT: **The Howard Hughes Corporation**	PROJECT NO: **E-15-086**	PLATE NO: **B3**



South containment: close-up of the sand and gravel matrix cemented by calcium carbonate



South containment: close-up of exposed cemented and partially cemented materials exposed along the south containment

NOVA Geotechnical & Inspection Services	PROJECT: **Limited Geotechnical Evaluation Summerlin Village 24 US Waters – Wash COS-1 and COS-2 Las Vegas, Nevada**	**PHOTOGRAPHS**	
	CLIENT: **The Howard Hughes Corporation**	PROJECT NO: **E-15-086**	PLATE NO: **B4**

UPDATE #2 TO THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24

62024-320

September 2014

Prepared for:

The Howard Hughes Company, LLC
10801 W. Charleston Blvd., 3rd Floor
Las Vegas, Nevada 89135
Phone: (702) 791-4300
Fax: (702) 791-4450

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM				DATE: October 9, 2014
TO: Land Development Services Department of Public Works				FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for: Summerlin Village 24 – Conceptual – Update #2			COPIES TO: G.C. Wallace
Cross Streets:	NWC of Charleston Blvd. & Sky Vista Drive			Howard Hughes Corp.
File Number:	F:\Depot\DSMEMOS\DS3505F.doc			Bart Anderson, P.E., DevCo
Parcel Number:	137-22-000-010			CCRFCD
Zoning Action:				CCPW
FEMA Flood Zone	YES	NO X		
Proposed Storm Drain	YES X	NO		

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Trn. No.
1st Submittal	2/13/2004	2/27/2004	Not Approved	$400.00	119424: $400
2nd Submittal	3/19/2004	4/2/2004	Conditional Approval	$400.00	121560: $400
CCRFCD	5/18/2004	6/1/2004	Concurrence	N/C	N/C
CCPW	5/27/2004	6/10/2004	Concurrence	N/C	N/C
3rd Submittal	6/11/2014	6/24/2014	Approved	$100.00	359768: $100
4th Submittal	9/30/2014	10/9/2014	See Comments Below	$100.00	371844: $100
			TOTAL FEES (LDDRS):	**$1,000.00**	---

REMARKS:

4th Submittal: Update #2 for Minor Revision of site layout and storm drains facilities

3rd Submittal: Update to re-vitalize the conceptual drainage study for Summerlin Village 24

The Drainage Study for the subject project has been reviewed and:

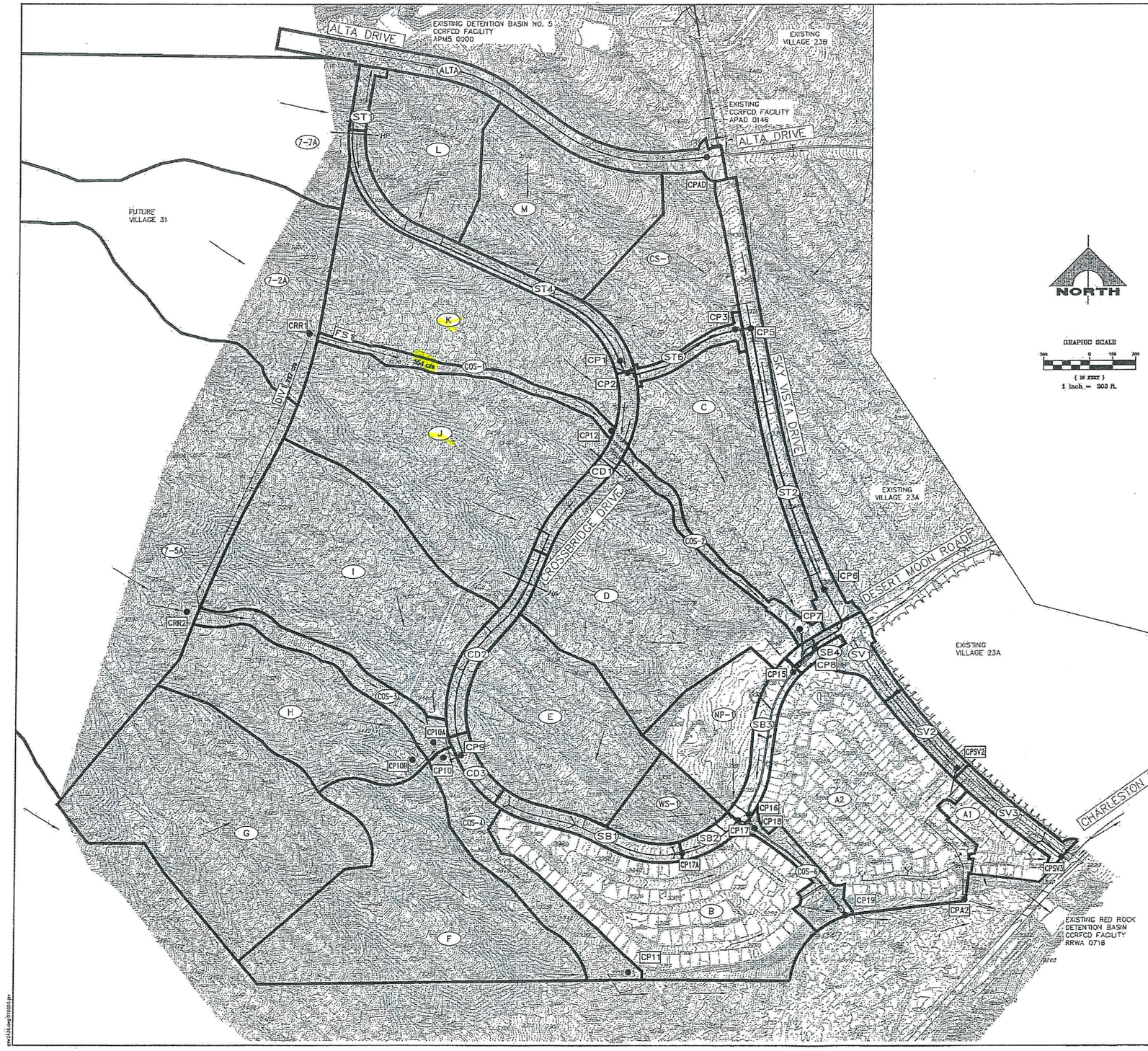
X	is approved subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.
	must have Clark County Department of Development Services concurrence

NOTE: Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the Nevada Division of Environmental Protection a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site; for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until all stripped or disturbed surface areas have been covered by paving, building construction or planting. For more information, including forms and applications see http://ndep.nv.gov/bwpc/storm01.htm or call (775) 687-9429.

NOTE: Any future changes to the proposed design (or design assumptions) as outlined in the approved drainage study and attached preliminary grading plan which affect drainage must be addressed in a Drainage Study Amendment and accepted by the City of Las Vegas Flood Control Section. Additionally, conditional acceptance of a drainage study is valid for a period of one (1) year. If the proposed construction has not been completed in that time period, the City of Las Vegas reserves the right to require additional conditions and/or submission and acceptance of a complete drainage study update prior to further construction of a project.

END OF REMARKS
B&H/ays

T/R/S: T20S/R59E/22
AREA K-22



SUMMARY OF ULTIMATE CONDITIONS
HEC-1 MODEL

SC OR CP	AREA (sq.mi.)	Q100 (cfs)	Q10 (cfs)
ALTA	0.5	35	16
-	-	-	-
7-2A	288.8	687	315
7-2B	69.4	182	82
7-5A	130.0	309	225
7-7A	51.8	153	70
A1	4.8	14	6
A2	33.9	100	47
B	30.1	90	43
C	24.9	61	26
CD1	3.7	15	6
CD2	3.8	13	7
CD3	1.4	6	3
COS-1	3.2	8	3
COS-2	3.1	7	3
COS-3	6.5	14	6
COS-4	9.4	22	8
COS-5	3.3	8	3
CP1	-	262	125
CP10	-	1031	452
CP10A	-	769	350
CP10B	-	155	63
CP11	-	1120	490
CP12	-	543	251
CP15	-	1024	479
CP16	-	1020	480
CP17	-	102	46
CP17A	-	76	34
CP18	-	1102	526
CP19	-	1172	558
CP2	-	354	164
CP3	-	358	165
CP5	-	403	192
CP6	-	435	204
CP7	-	595	274
CP8	-	949	449
CP9	-	123	52
CPA2	-	114	54
CPAD	-	40	21
CPSV2	-	23	12
CPSV3	-	25	12
CRR1	-	841	388
CRR2	-	730	313
CS-1	16.8	55	27
D	34.8	88	37
DIV1	-	287	132
E	24.1	64	27
F	97.8	92	36
FS1	-	554	255
G	42.8	100	39
H	22.1	58	24
I	38.6	102	45
J	43.6	110	46
K	29.8	80	34
L	15.5	53	26
M	22.0	73	36
NP-1	10.5	22	8
RETD1	-	287	132
SB1	3.5	14	7
SB2	1.2	5	3
SB3	3.9	13	7
SB4	0.5	2	1
ST1	1.1	5	2
ST2	3.3	33	17
ST4	6.0	22	12
ST5	1.3	8	4
SV1	3.2	14	8
SV2	2.1	9	4
SV3	2.7	11	6
WS-1	8.0	19	9

LEGEND

- SUBBASIN BOUNDARY
- (ST1) SUBBASIN DESIGNATION
- (CP1) COMBINATION POINT
- FLOW DIRECTION/DIVERSION

% COMPLETE

REV	DATE	DESCRIPTION	DATE	AGENT APP	DATE	GCW APP	DATE

PROJECT NO.
62024-320

DESIGN: _____ BRD, DRG: _____
DRAWN: _____
CHECKED: _____
PLOT DATE: 09-25-14
PLOT TIME: 14:46:16

G.C. WALLACE COMPANIES
ENGINEERS · PLANNERS · SURVEYORS
5371 RIETH AVENUE · LAS VEGAS, NEVADA 89139
T: (702) 896-2000 · F: (702) 896-2299 · GCWALLACE.COM

LAS VEGAS

P:\Projects\600\62024-320\Division VI\e\Figure VI\6U2.dwg
Suzanne Trebis

THE HOWARD HUGHES COMPANY, LLC

SUMMERLIN VILLAGE 24

FIGURE 6U2
ULTIMATE CONDITIONS DRAINAGE MAP

DRAWING
FIG 6U2
OF XX SHTS

HTE: 00-00000

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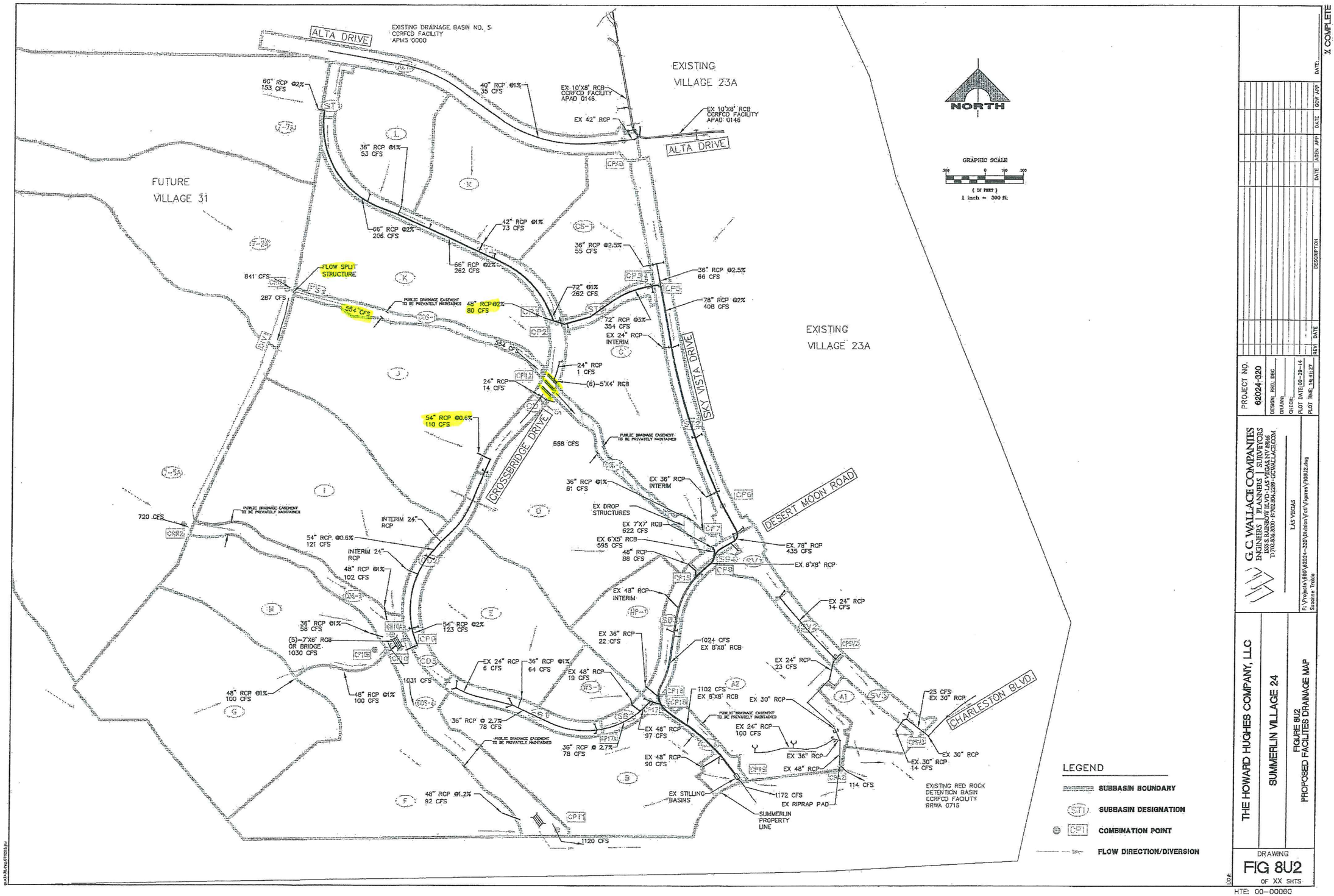

% COMPLETE

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	DGW APP	DATE

PROJECT NO.
62024-320
DESIGN_RSD_RBC
DRAWN_
CHECK_
PLOT DATE:09-29-16
PLOT TIME:_14:41:27

G.C. WALLACE COMPANIES
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1555 S. RAINBOW BLVD. LAS VEGAS, NV 89146
T:(702.804.2000 · F:(702.804.2299 · GCWALLACE.COM
LAS VEGAS
F:\Projects\6000\62024-320\Exhibits\Fy\Figures\Fig8U2.dwg
Sisatsina • Trobio

THE HOWARD HUGHES COMPANY, LLC

SUMMERLIN VILLAGE 24

FIGURE 8U2
PROPOSED FACILITIES DRAINAGE MAP

DRAWING
FIG 8U2
OF XX SHTS

HTE: 00-00000

UPDATE TO THE TECHNICAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24 PARCEL COS-2

62024-232

December 2016

GCW
ENGINEERS \ SURVEYORS

Prepared for:

The Howard Hughes Company, LLC
10801 W. Charleston Blvd., 3rd Floor
Las Vegas, Nevada 89135
Phone: (702) 791-4300
Fax: (702) 791-4450

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM				DATE: December 22, 2016
TO: **Land Development Services** Department of Building & Safety				FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for: **Summerlin Village 24 – Parcel COS-2 Wash - Update**			**COPIES TO:** GCW Engineers & Surveyors
Cross Streets:	Open Space between Parcel C and Parcel D			Howard Hughes Company, LLC
File Number:	F:\Depot\DSMemos\DS4774C.doc			Bart Anderson, P.E., DevCo
Parcel Number:	137-33-801-002			
Zoning Action:	FMP-62680			
FEMA Flood Zone	YES	NO	X	
Proposed Storm Drain	YES	NO	X	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1st Submittal	12/30/2015	1/21/2016	Not Approved	$400.00	427966: $400
2nd Submittal	3/10/2016	4/6/2016	Approved	$400.00	436538: $400
3rd Submittal	12/5/2016	12/22/2016	See Comments Below	$100.00	467659: $100
			TOTAL FEES (LDDRS):	**$900.00**	----

REMARKS:

3rd Submittal: Update to revise the side slope of channel at various locations from 2:1 to 3:1, 4:1 or 5:1

The Drainage Study for the subject project has been reviewed and:

X	is approved subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.
	is conditionally approved subject to Clark County Public Works Department concurrence.

1. The subject "COS-2" parcel is a common lot and public drainage easement to be privately maintained by the developer and future *Homeowners Association*. Record as such in the final map.

NOTE: Any future changes to the proposed design (or design assumptions) as outlined in the approved drainage study and attached preliminary grading plan which affect drainage must be addressed in a Drainage Study Update and accepted by the *City of Las Vegas Flood Control Section*. Additionally, conditional acceptance of a drainage study is valid for a period of one (1) year. If the proposed construction has not been completed in that time period, the *City of Las Vegas* reserves the right to require additional conditions and/or submission and acceptance of a complete drainage study update prior to further construction of a project.

NOTE: Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the *Nevada Division of Environmental Protection* a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site; for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until all stripped or disturbed surface areas have been covered by paving, building construction or planting. For more information, including forms and applications see http://ndep.nv.gov/bwpc/storm01.htm or call (775) 687-9429.

END OF REMARKS

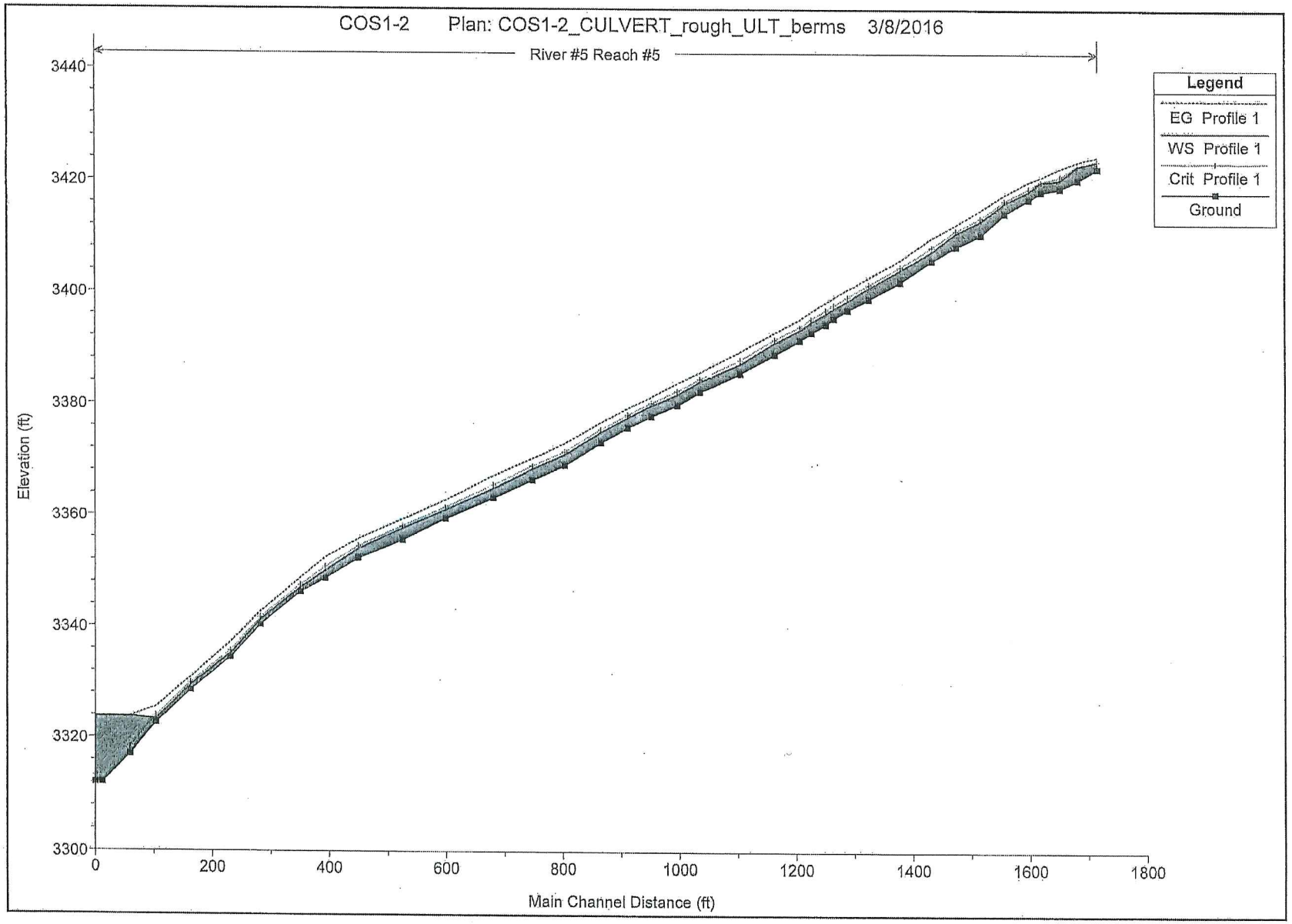
ays

T/R/S: T20S/R59E/33

AREA K-33

HEC-RAS Plan: ult_berms River: River #5 Reach: Reach #5 Profile: Profile 1

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 #5	2051.55	Profile 1	554.00	3422.27	3423.69	3423.69	3424.36	0.031257	6.56	84.46	64.00	1.01
Reach #5	2051	Profile 1	554.00	3420.21	3422.79	3422.86	3423.53	0.019780	6.93	80.82	67.70	1.08
Reach #5	1950	Profile 1	554.00	3418.67	3420.27	3420.87	3422.34	0.097895	11.53	48.13	59.82	2.25
Reach #5	1925	Profile 1	554.00	3418.08	3419.92	3420.07	3420.75	0.025997	7.39	76.24	70.16	1.23
Reach #5	1900	Profile 1	554.00	3415.68	3418.22	3418.72	3419.90	0.062665	10.48	53.60	55.35	1.86
Reach #5	1875	Profile 1	554.00	3414.26	3416.10	3416.53	3417.58	0.049814	9.86	57.09	54.20	1.68
Reach #5	1825	Profile 1	554.00	3410.33	3412.90	3413.45	3414.86	0.092282	10.78	49.86	60.91	2.17
Reach #5	1800	Profile 1	554.00	3408.24	3410.73	3411.20	3412.24	0.042653	10.01	56.39	45.44	1.59
Reach #5	1750	Profile 1	554.00	3405.74	3407.40	3408.13	3409.80	0.083607	12.45	44.52	43.38	2.16
Reach #5	1675	Profile 1	554.00	3401.92	3404.10	3404.62	3405.89	0.061565	10.76	51.80	50.68	1.85
Reach #5	1600	Profile 1	554.00	3398.81	3400.93	3401.46	3402.72	0.056376	10.74	51.56	45.94	1.79
Reach #5	1510	Profile 1	554.00	3396.83	3398.51	3399.19	3400.62	0.057416	11.66	47.74	39.18	1.85
Reach #5	1500	Profile 1	554.00	3395.29	3397.14	3397.76	3399.15	0.065485	11.39	48.70	45.10	1.93
Reach #5	1485	Profile 1	554.00	3394.22	3396.18	3396.81	3398.25	0.068210	11.59	48.23	45.53	1.97
Reach #5	1475	Profile 1	554.00	3392.76	3394.67	3395.23	3396.57	0.067785	11.09	49.97	49.19	1.94
Reach #5	1460	Profile 1	554.00	3391.37	3393.24	3393.81	3395.18	0.069941	11.19	49.56	49.71	1.97
Reach #5	1450	Profile 1	554.00	3388.84	3390.92	3391.52	3392.72	0.046907	10.79	51.88	41.33	1.67
Reach #5	1350	Profile 1	554.00	3385.52	3387.17	3387.84	3389.36	0.069006	11.94	47.13	43.99	1.99
Reach #5	1300	Profile 1	554.00	3382.23	3384.14	3384.60	3385.73	0.040317	10.18	55.52	45.46	1.57
Reach #5	1275	Profile 1	554.00	3379.81	3381.75	3382.37	3383.79	0.061358	11.46	48.35	42.14	1.89
Reach #5	1225	Profile 1	554.00	3377.86	3379.79	3380.24	3381.33	0.047723	9.99	56.11	51.67	1.66
Reach #5	1200	Profile 1	554.00	3375.82	3377.63	3378.12	3379.30	0.053293	10.49	54.18	50.69	1.75
Reach #5	1150	Profile 1	554.00	3373.09	3375.02	3375.53	3376.74	0.057791	10.59	53.29	52.31	1.81
Reach #5	1125	Profile 1	554.00	3368.96	3370.95	3371.53	3372.93	0.064341	11.36	49.60	47.68	1.91
Reach #5	1000	Profile 1	554.00	3366.41	3368.39	3368.91	3370.21	0.038243	11.04	52.30	36.95	1.57
Reach #5	900	Profile 1	554.00	3363.16	3364.88	3365.57	3367.16	0.054476	12.19	46.75	37.74	1.83
Reach #5	850	Profile 1	554.00	3359.34	3360.99	3361.51	3362.76	0.051663	10.74	52.57	46.91	1.74
Reach #5	775	Profile 1	554.00	3355.47	3357.61	3358.07	3359.17	0.045632	10.17	55.82	47.91	1.64
Reach #5	700	Profile 1	554.00	3352.26	3353.97	3354.46	3355.64	0.047428	10.37	53.49	45.09	1.67
Reach #5	660	Profile 1	554.00	3348.65	3350.02	3350.70	3352.35	0.071655	12.25	45.24	40.09	2.03
Reach #5	620	Profile 1	554.00	3346.20	3346.95	3347.44	3348.63	0.105609	10.48	53.46	82.46	2.27
Reach #5	550	Profile 1	554.00	3340.30	3341.13	3341.54	3342.51	0.075867	9.41	58.87	81.47	1.95
Reach #5	475	Profile 1	554.00	3334.40	3335.05	3335.57	3337.02	0.155469	11.26	49.13	88.83	2.67
Reach #5	400	Profile 1	595.00	3328.50	3329.38	3329.76	3330.68	0.062744	9.16	64.97	81.16	1.80
Reach #5	350	Profile 1	595.00	3322.60	3323.31	3323.89	3325.43	0.130321	11.68	50.93	76.41	2.52
Reach #5	300	Profile 1	595.00	3317.00	3323.75	3318.17	3323.75	0.000020	0.55	1083.47	216.83	0.04
Reach #5	260	Profile 1	595.00	3312.00	3323.75		3323.75	0.000004	0.35	1699.45	186.00	0.02
Reach #5	250	Profile 1	595.00	3312.00	3323.75	3313.30	3323.75	0.000004	0.35	1676.89	197.16	0.02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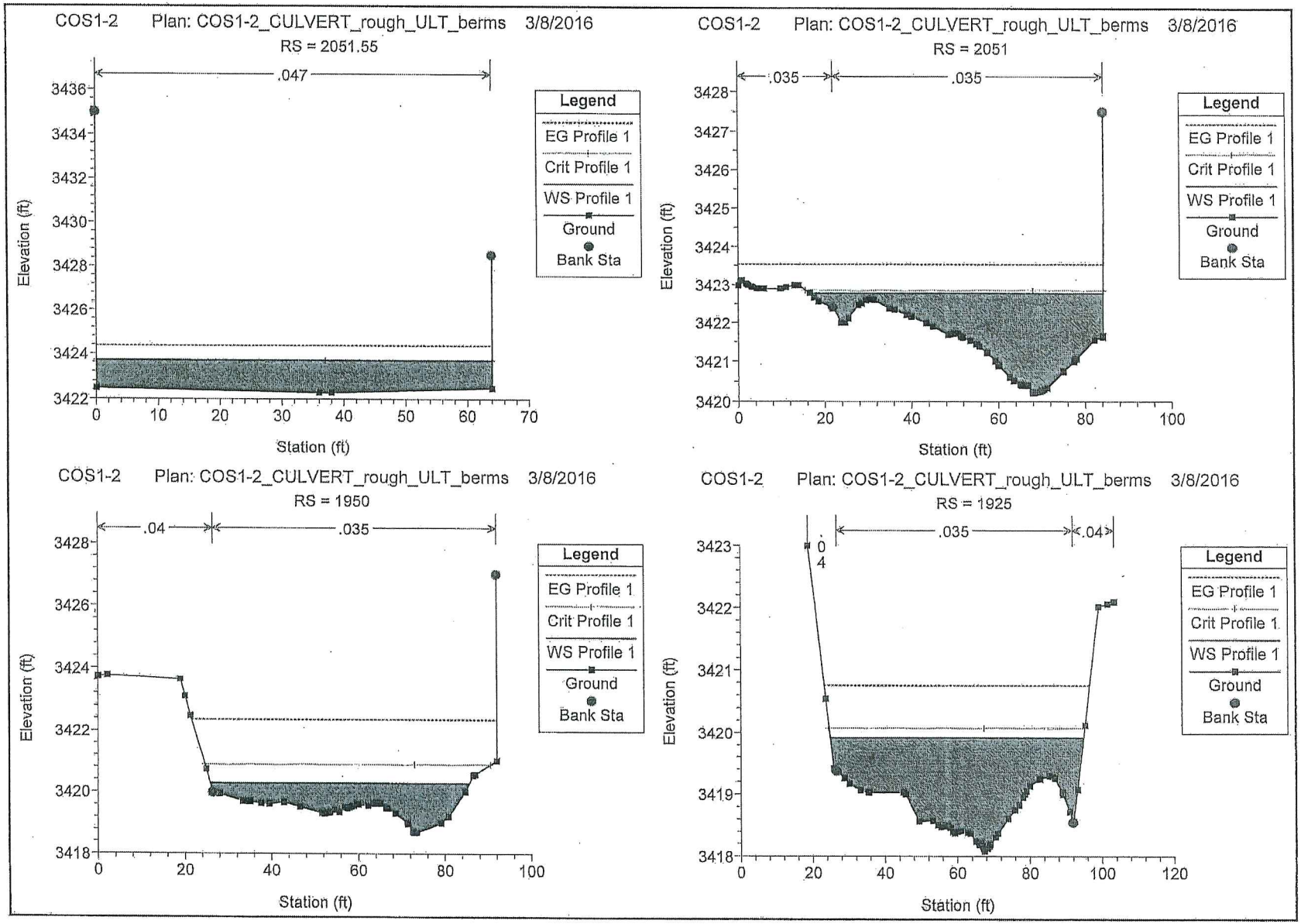
River #5 Reach #5
Legend
EG Profile 1
WS Profile 1
Crit Profile 1
Ground
Elevation (ft)
3440
3420
3400
3380
3360
3340
3320
3300
0
200
400
600
800
1000
1200
1400
1600
1800
Main Channel Distance (ft)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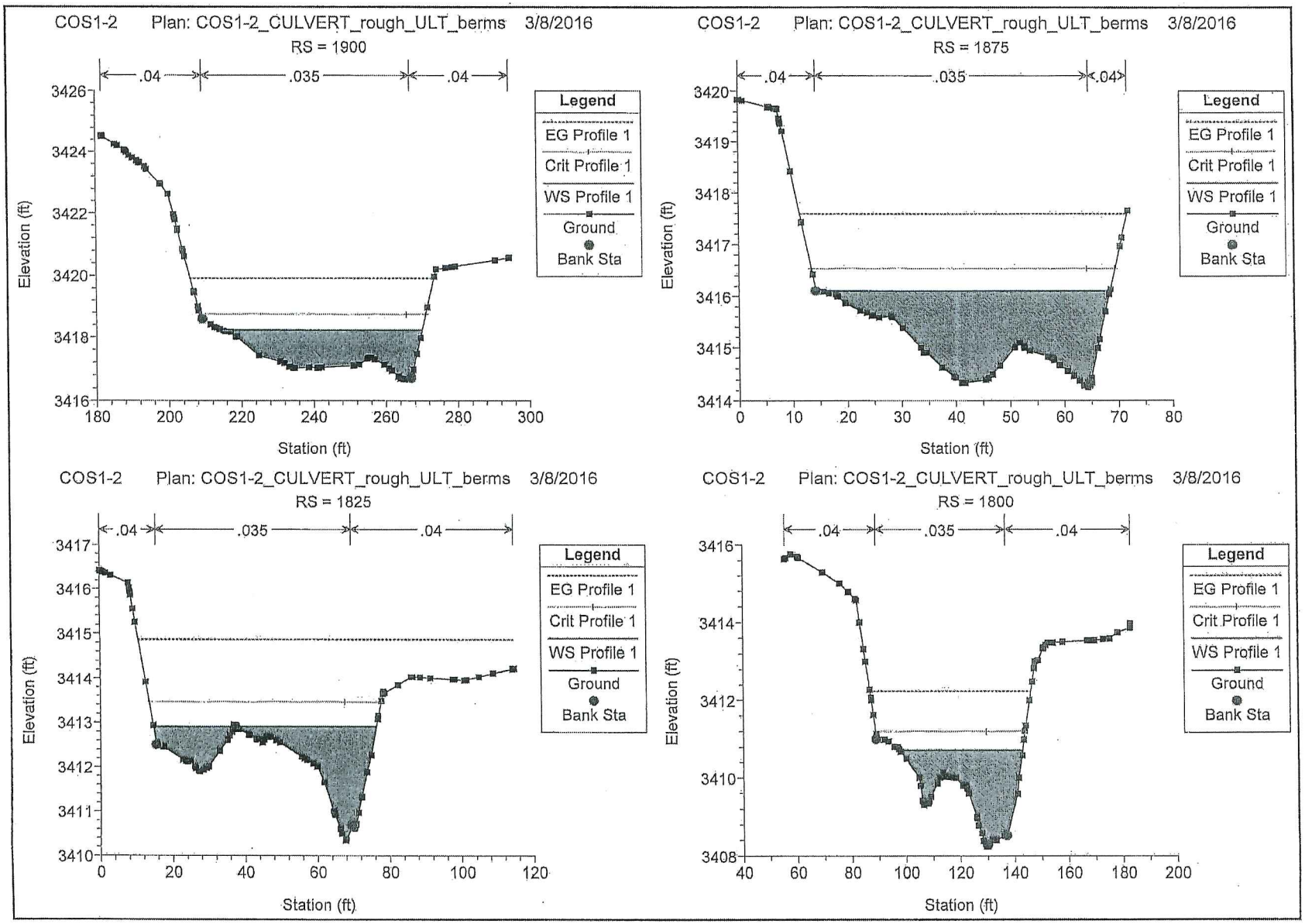
.047
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 2051
.035
.035
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1950
.04
.035
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1925
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta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.04
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1875
.04
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1825
.04
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
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.035
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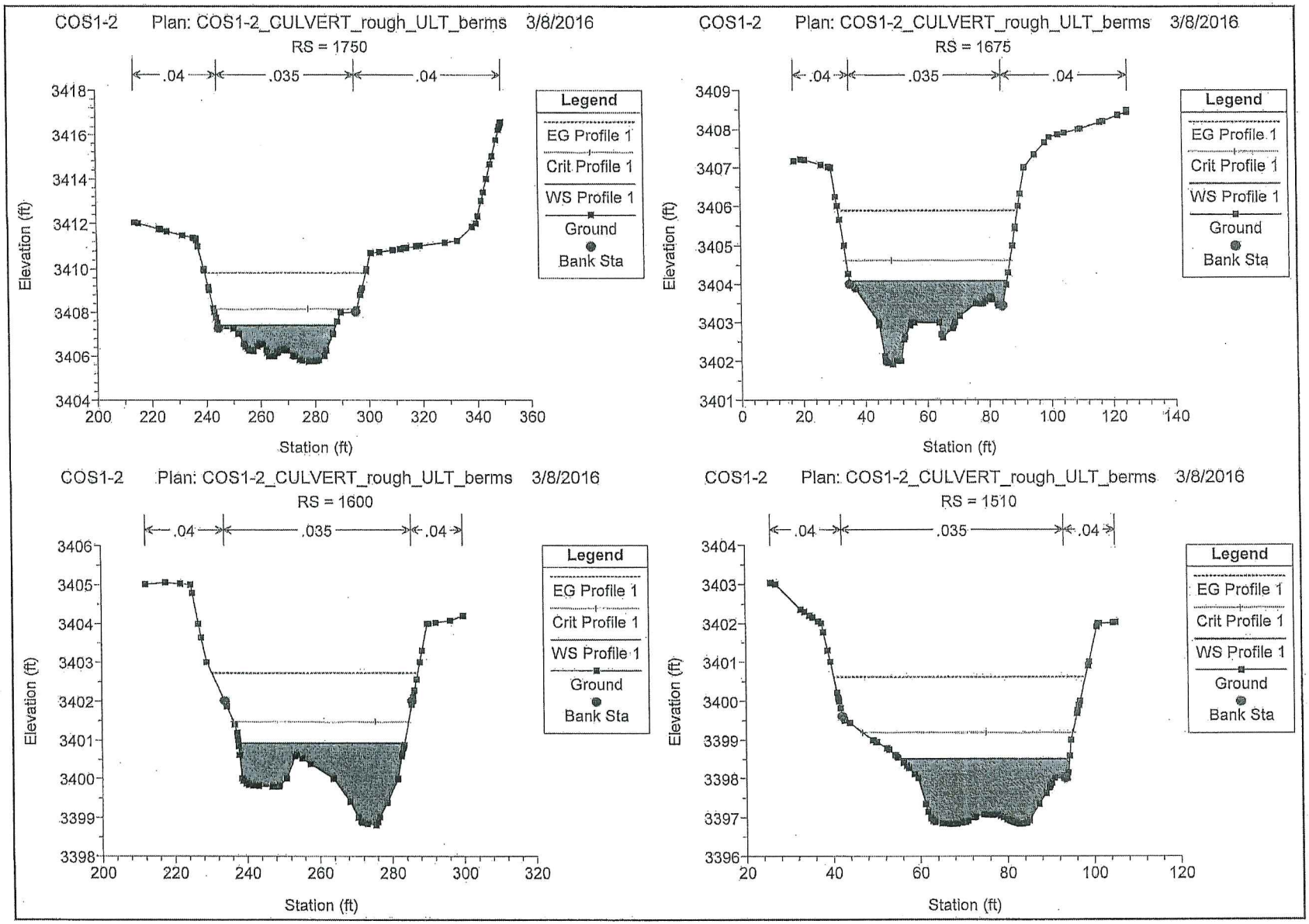
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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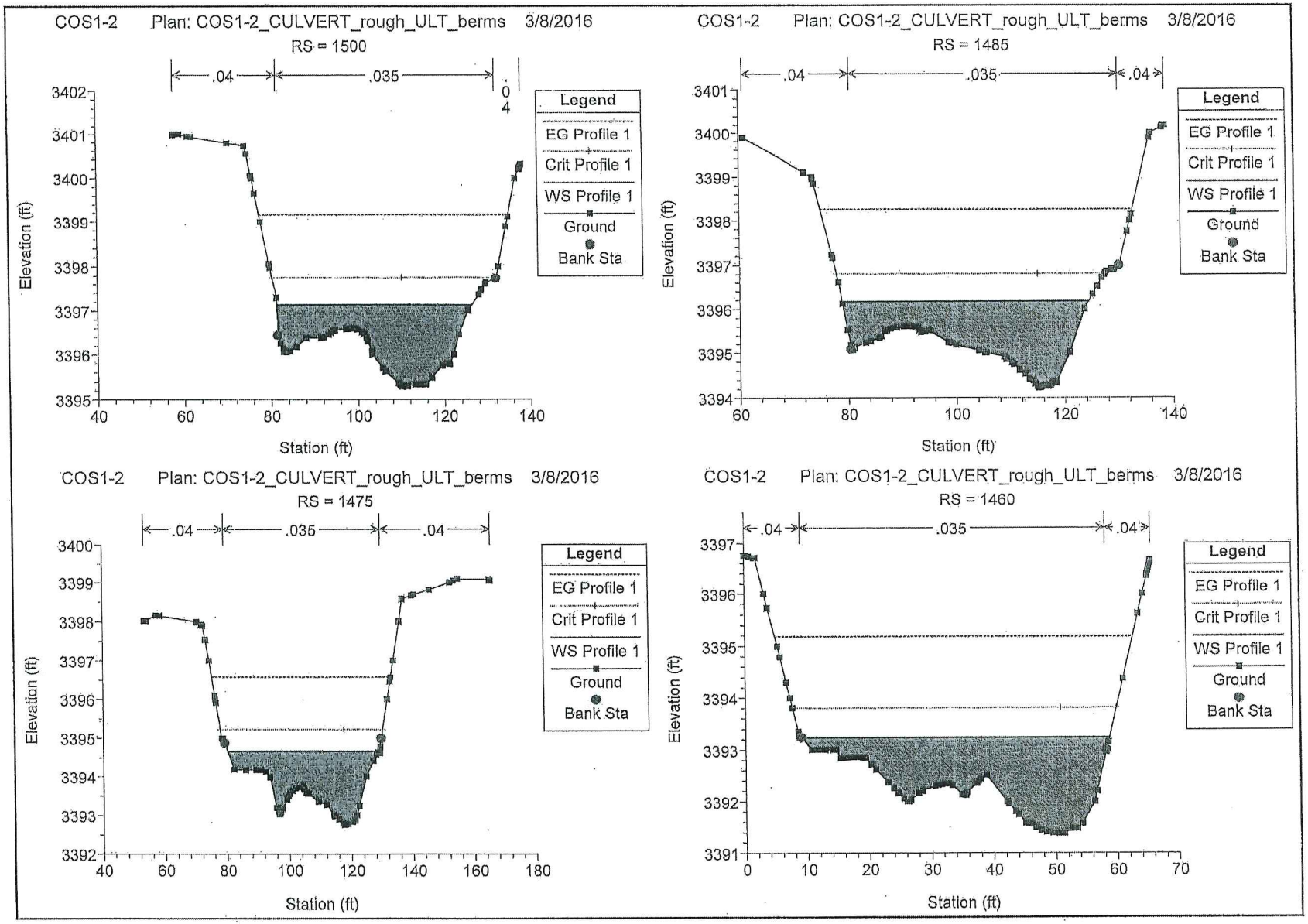
RS = 1750
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1675
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1600
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1510
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta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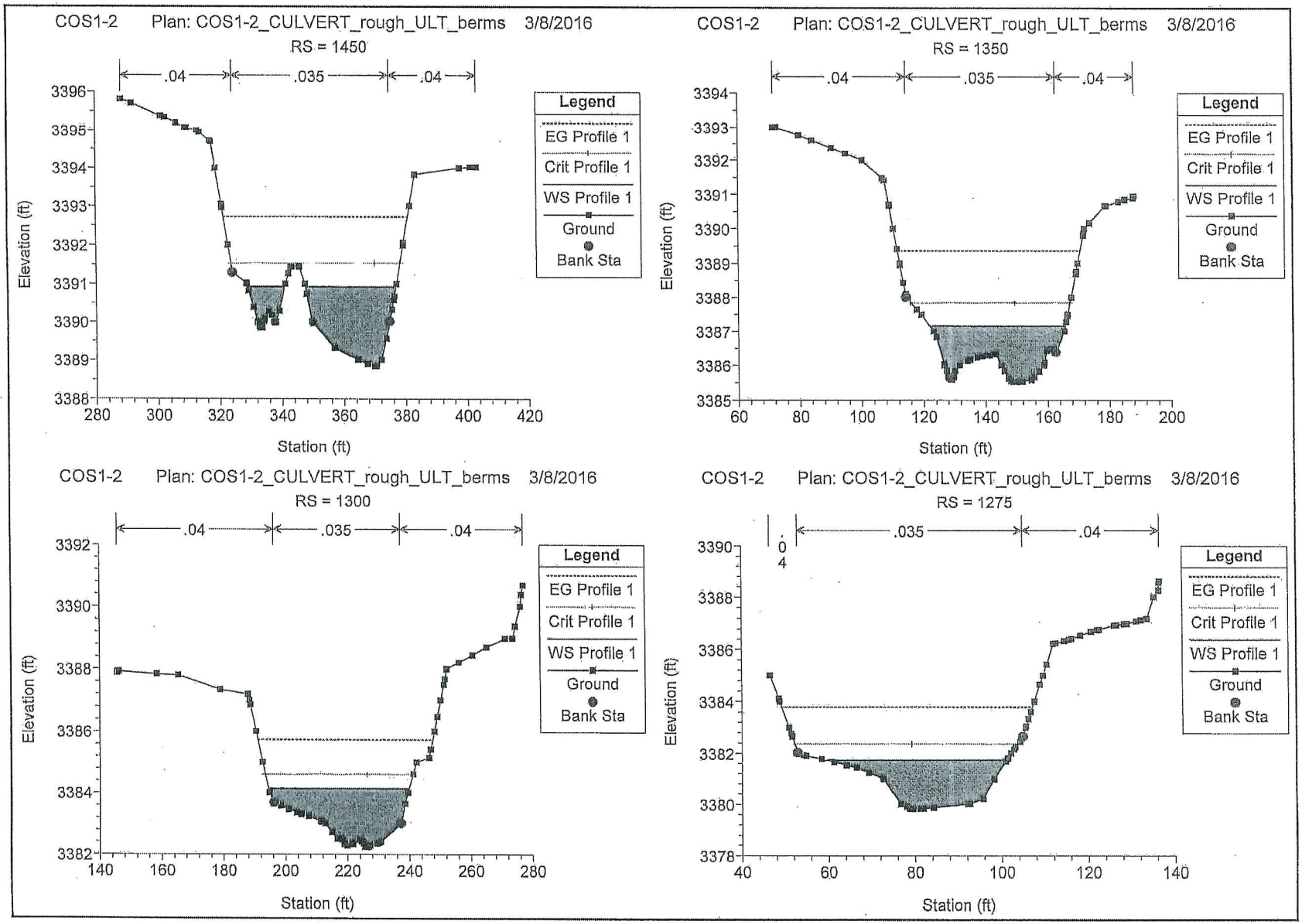
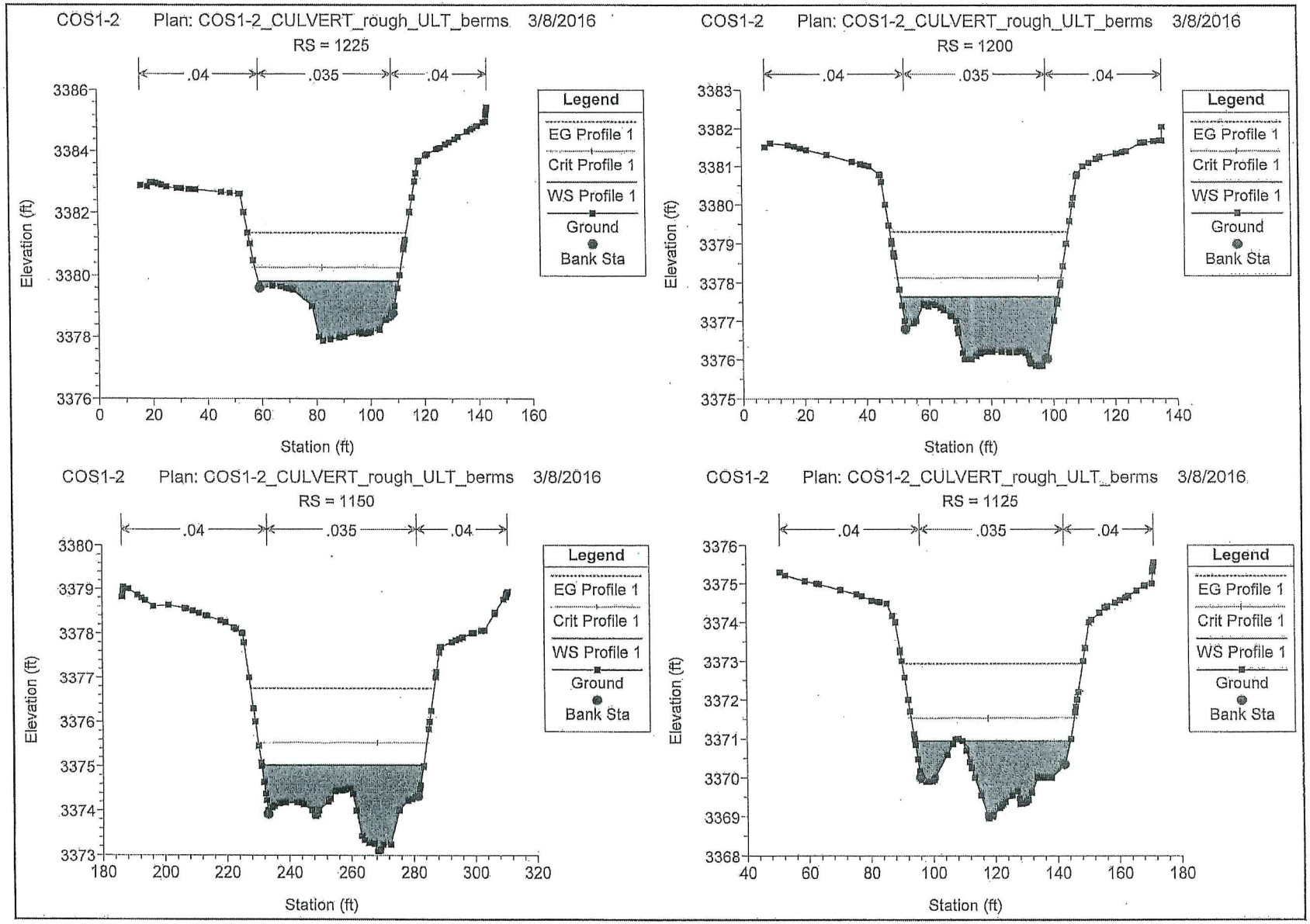
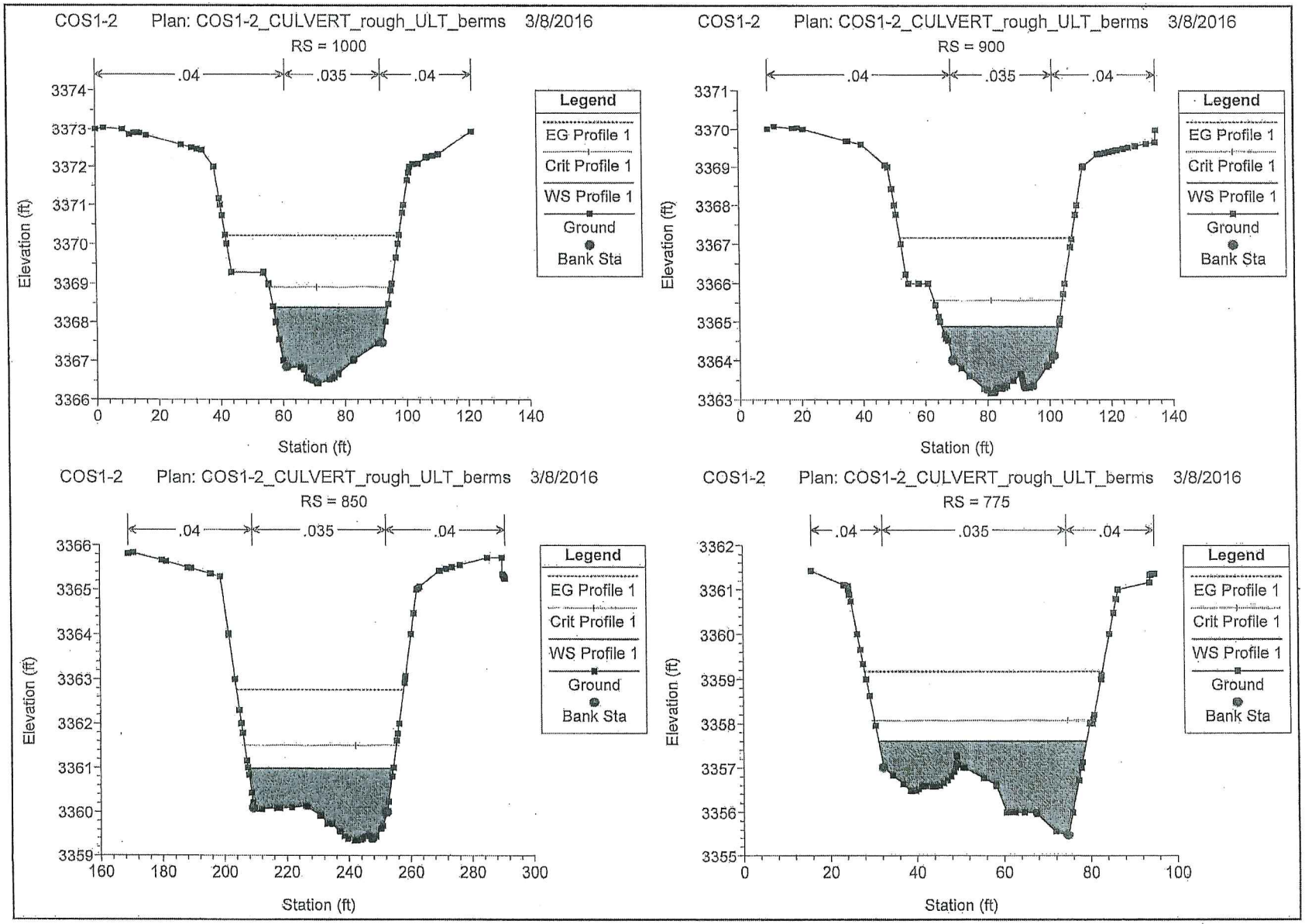
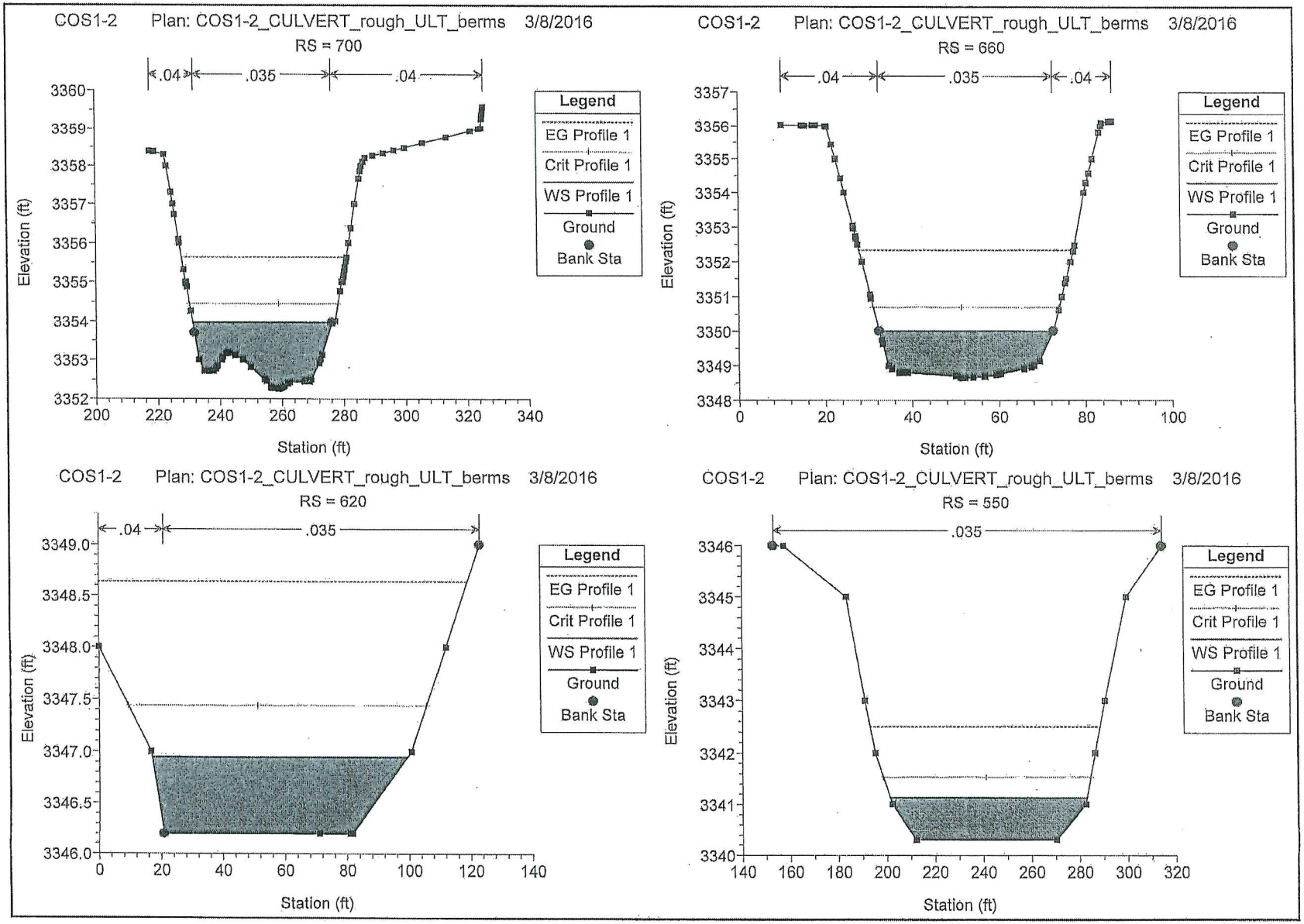
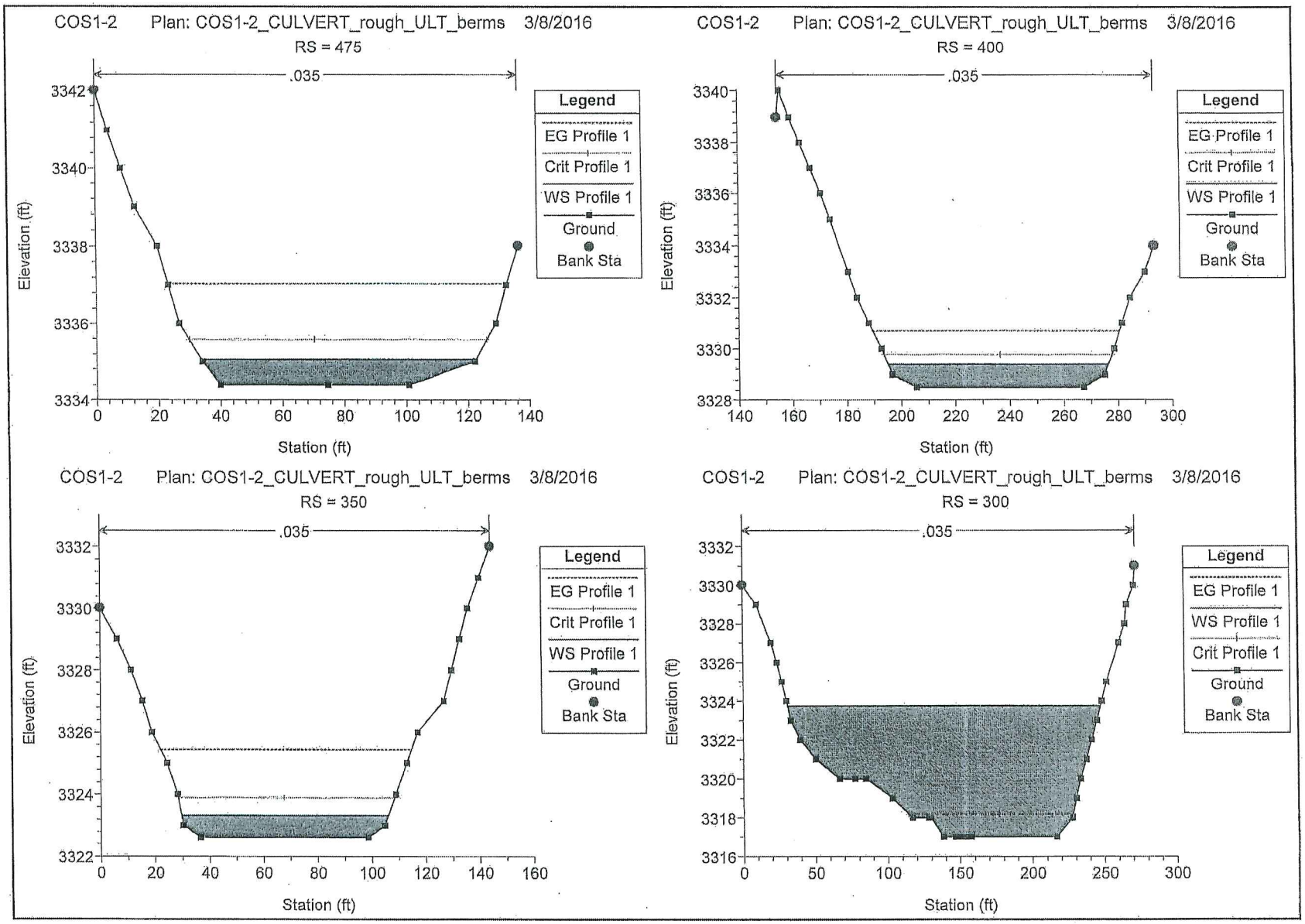
RS = 1500
.04
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1485
.04
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1475
.04
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1460
.04
.035
.04
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

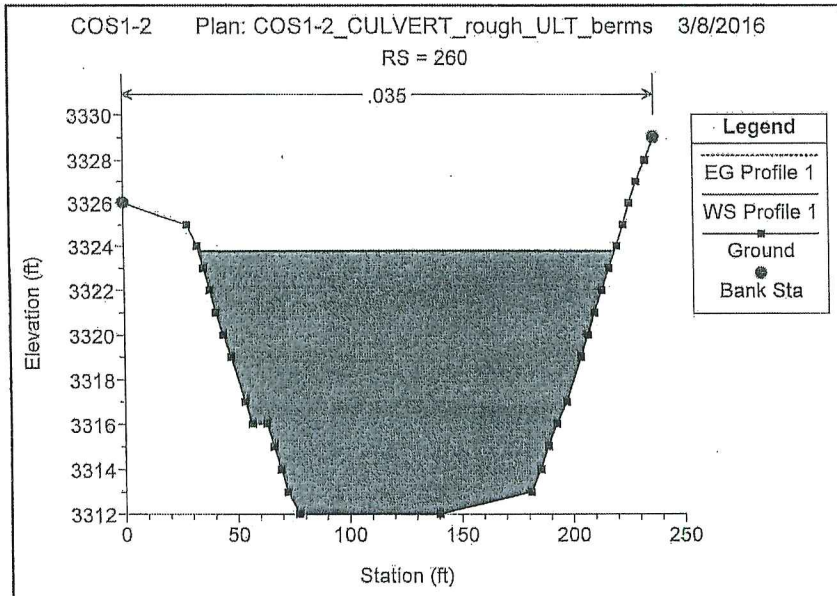

COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1450
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1350
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1300
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1275
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta

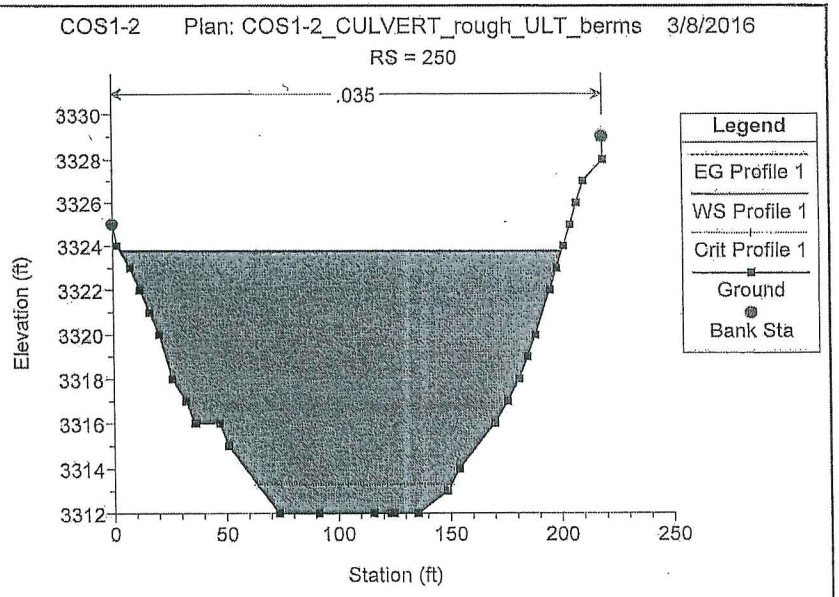

COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1225
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1200
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1150
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1125
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta


COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 1000
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 900
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 850
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 775


COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 700
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 660
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 620
.04
.035
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 550
.035
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta


COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 475
.035
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 400
.035
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 350
.035
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 300
.035
Legend
EG Profile 1
WS Profile 1
Crit Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


COS1-2 Plan: COS1-2_CULVERT_rough_ULT_berms 3/8/2016
RS = 260
.035
Elevation (ft)
3330
3328
3326
3324
3322
3320
3318
3316
3314
3312
0
50
100
150
200
250
Station (ft)
Legend
EG Profile 1
WS Profile 1
Ground
Bank Sta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RS = 250
.035
Elevation (ft)
3330
3328
3326
3324
3322
3320
3318
3316
3314
3312
0
50
100
150
200
250
Station (ft)
Legend
EG Profile 1
WS Profile 1
Crit Profile 1
Ground
Bank Sta

UPDATE #6 TO THE TECHNICAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24 UNIT 2 IMPROVEMENTS - CROSSBRIDGE DRIVE (CROSSBRIDGE UNIT 1 TO SUNCREEK ROAD)

62024-222

March 2016

GCW
ENGINEERS \ SURVEYORS

Prepared by:

GCW, Inc.
1555 S. Rainbow Blvd.
Las Vegas, Nevada 89146
Phone: (702) 804-2000
Fax: (702) 804-2299

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM			DATE: March 24, 2016
TO: **Land Development Services** Department of Public Works			FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:		**COPIES TO:**
Summerlin Village 24 Unit 2 Improvements – Update #6 **Crossbridge Drive Improvements** **(from Crossbridge Unit 1 to Sun Creek Road)**			GCW Engineers/Surveyors
Cross Streets:	SWC of Sky Vista Drive & Alta Drive		Howard Hughes Corp.
File Number:	F:\Depot\DSMemos\DS4136L.doc		Bart Anderson, P.E., DevCo
Parcel Number:	137-22-000-015		
Zoning Action:	N/A		
FEMA Flood Zone	YES	NO X	
Proposed Storm Drain	YES X	NO	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Transaction #
1st Submittal	2/21/2007	3/29/2007	Not Approved	$400.00	63487: $400
2nd Submittal	5/4/2007	5/29/2007	Not Approved	$400.00	68552: $400
3rd Submittal	5/15/2014 & 6/5/2014	6/9/2014	Conditional Approval	$400.00	357117: $400
4th Submittal	9/22/2014	10/7/2014	Approved	$100.00	371022: $100
5th Submittal	11/6/2014	11/26/2014	Approved	$100.00	376121: $100
6th Submittal	2/10/2015	2/24/2015	Not Approved	$100.00	385212: $100
7th Submittal	5/14/2015	6/15/2015	Not Approved	$400.00	397629: $400
8th Submittal	6/22/2015	7/7/2015	Approved	$100.00	402841: $100
9th Submittal	10/6/2015	10/22/2015	Not Approved	$400.00	417806: $400
10th Submittal	11/4/2015	11/18/2015	Approved	$400.00	421434: $400
11th Submittal	3/7/2016	3/24/2016	See Comments Below	$100.00	435704: $100
			TOTAL FEES (LDDRS):	$2,900.00	----

REMARKS:

11th Submittal: Update #6 to remove two previously proposed 24"-stub

10th Submittal: Addendum #3 to Update #3

9th Submittal: Addendum #2 to Update #3

8th Submittal: Update #4 for Sky Vista Drive Improvements – Revise the connection angle of a 48"-Stub to Future Parcel K at the intersection of Crossbridge Drive and Suncreek Road

6th & 7th Submittals: Update #3 and Addendum to construct a channel along the west boundary of *Village 24* and Extend *Crossbridge Drive* beyond *Suncreek Road*

The Drainage Study for the subject project has been reviewed and:

X	is approved subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.



LEGEND

- SUBBASIN BOUNDARY
- PRORATED SUBBASIN BOUNDARY
- ON8R — DRAINAGE SUBBASIN
- ON8R-1 — PRORATED DRAINAGE SUBBASIN
- CRR1 — CONCENTRATION POINT
- FLOW DIRECTION

SUMMARY OF HEC-1 MODEL INTERIM CONDITION

Basin	Remarks	Area (ac)	Q_{100} (cfs)	Q_{10} (cfs)
ADS	Roads circled Alta and offsite to north	40.2	122	56
F2B	Offsite area west of Summerlin tributary	92.4	152	52
F2A*	Offsite area west of Village 24 drains south within western boundary channel	280.5	635	287
CRR1*	Combine flows at Village 24 boundary at northerly existing wash, F2B+F2A	—	768	331
DVS*	Flow diverts to the south	—	239	113
DCRR1	Remaining flow that continues to culverts at Crossridge	—	701	218
RG6C	Offsite area draining to multiple culverts under Crossridge	30.7	85	38
CP12A*	Combine flows at upstream side of culverts under Crossridge	—	547	224
CD1*	Portion of Crossbridge Drive draining to culverts under Crossridge	3.7	13	7
CP12B*	Combine flows at downstream side of culverts, CD1+CP12A	—	563	227
F*	Future parcel CS-1	24.9	51	20
OFF7S	Offsite area southwest of multiple culverts at Crossbridge	85.4	56	26
CPRCB*	Combine flows at existing 7' x 3' open inlet in Unit 1	—	633	269
CBRC	Roughly paved Crossbridge Drive	12.0	24	17
SR6	Suncreek Road	1.6	7	4
SR6D	Area southwest of Alta and Sky Vista	4.8	14	6
RG6A	Area west of Crossridge, crosses Crossridge at sag section	16.2	75	13
RG6B	Area west of Crossridge, crosses Crossridge at sag section	44.3	116	31
RG6E	Area bounded by Alta, Crossridge, Suncreek, Sky Vista	44.8	123	54
CP8	Combine flows in Sky Vista storm drain at intersection with Suncreek	—	269	125
SR5	Sky Vista between Alta and Crossridge	10.0	33	11
RG6F	Area south of Suncreek and west of Sky Vista; drains to open inlet in Sky Vista storm drain	17.2	48	21
CP10	Combine flows in Sky Vista storm drain CP8+ST2+RG6F	—	364	160
CP1B	Combine flows at existing 7' x 3' open inlet in Unit 1 and flows in Sky Vista storm drain	—	961	432
CBRC	Offsite area west of Village 24 and drains south within western boundary channel	3.5	13	6
CBRC*	Offsite area west of Village 24 drains south within western boundary channel	76.1	263	61
CBRC	Offsite area west of Village 24 drains south within western boundary channel	13.8	40	18
CBRC	Offsite area west of Village 24 drains south within western boundary channel	4.4	15	7
CBRC	Offsite area west of Village 24 drains south within western boundary channel	7.4	24	11
CBRC	Offsite area west of Village 24, drains south within western boundary channel	91.6	262	113
CBRC	Offsite area west of Village 24, drains south within western boundary channel	—	723	325
CRR2	ON5+CBRC+OFF11A	34.5	97	44
ON11	Onsite area west of existing berm	7.3	21	9
ON7R	Onsite area draining south to RG6 stub	27.2	77	34
ON8R*	Onsite area west of Crossridge	—	97	44
CP1	Combine portions of onsite area west of Crossridge; ON7R + ON8R	—	97	44
CD2*	Portion of Crossbridge Drive	3.8	13	7
ON10R	Onsite area between existing berm and Crossridge	5.1	16	7
CP2	Combine flows in Crossridge storm drain CP1 + ON10R + CD2	—	126	57
OFF11B*	Offsite area south of Crossridge	95.8	1530	648
CP11	Combine offsite area west of Village 24+CRR2+ON11+OFF11B	—	1655	692
RG7*	Portion of Unit 2 Crossridge improvements that drains to existing Unit 1 improvements	1.4	6	3

* Revised with Update #3.
** Referenced from the Update #2 Conceptual Study.

SUMMARY OF PRORATED STORM FLOWS INTERIM CONDITION
100-Year and 10-Year Runoff

Parent Basin	Area (ac)	Q_{100} (cfs)	Unit Flow (cfs/ac)	Q_{10} (cfs)	Unit Flow (cfs/ac)
RG6	40.16	122	3.04	56	1.39
RG5D	4.79	14	2.92	6	1.25
RG6E	44.8	123	2.75	54	1.21
RG6F	17.2	48	2.79	21	1.22
ON8R*	24.9	76	3.05	34	1.37
Prorated Subbasins					
SubBasin	Area (ac)	Unit Flow (cfs/ac)	Q_{100} (cfs)	Unit Flow (cfs/ac)	Q_{10} (cfs)
RG6-1	24.42	3.04	74	1.39	34
D1A	1.62	2.92	5	1.25	2
D1B	2.42	2.92	7	1.25	3
D2	0.75	2.92	2	1.25	1
E1	2.34	2.75	7	1.21	4
E2A	8.53	2.75	23	1.21	10
E2B	7.06	2.75	19	1.21	9
E3A	23.03	2.75	63	1.21	28
E3B	3.84	2.75	11	1.21	5
F1	1.55	2.79	4	1.22	2
F2	3.87	2.79	11	1.22	5
F3	11.79	2.79	33	1.22	14
ON8R-1	3.77	3.05	12	1.37	5

CROSS SECTION	DISCHARGE (cfs)	ACTUAL DEPTH (ft)	VELOCITY (ft/s)	SCOUR PROTECTION REQUIRED
CH1	1900	0.9	9.2	Gabions/6-foot cutoff wall
CH2	1900	1.2	11.2	Gabions/6-foot cutoff wall
CH3	1900	0.8	8.9	Gabions/6-foot cutoff wall

Note: Table is referenced from the Unit 1 improvements

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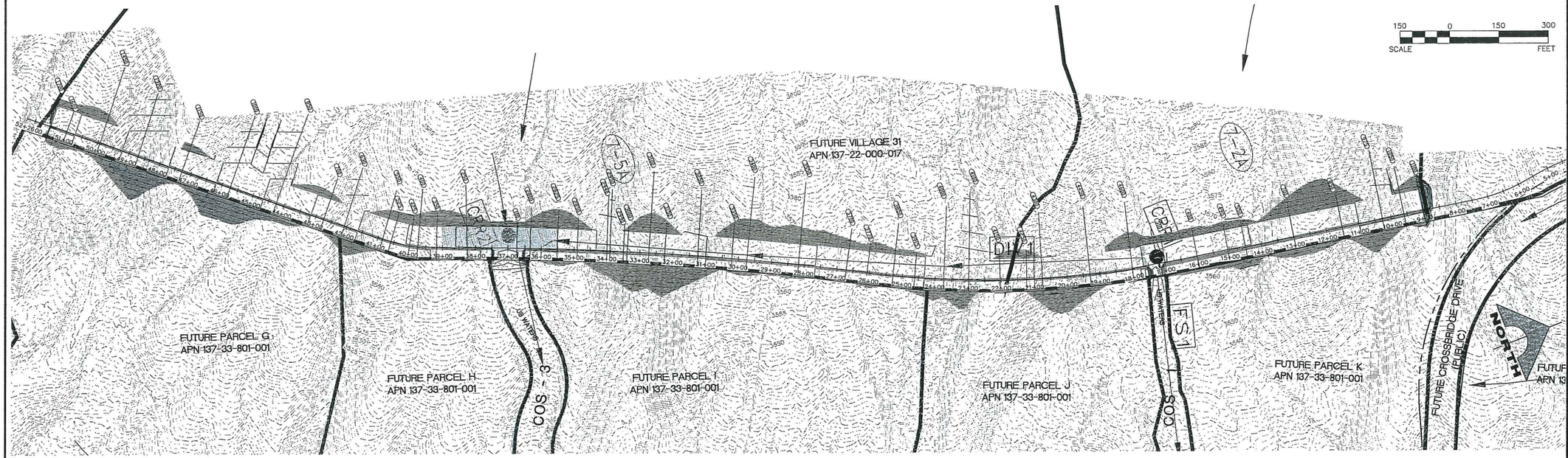
SUMMERLIN VILLAGE 24
UNIT 2 IMPROVEMENTS
FIGURE 7U3R
INTERIM CONDITION DRAINAGE MAP

DRAWING
FIG7U3R
QF SHT5



CRR2B - HYDRAULIC MODELS RESULTS SUMMARY AND SUPER-ELEVATION CALCULATIONS

Sta	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Freeboard	Superelevation	Total Depth	Actual Depth	Riprap
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)	(ft)	(D50- inches)
1700	51+50.00	253	3562.50	3563.42	0.92	4.39	65.52	0.83	0	1.0	0.0	1.9	3.0	-
1600	51+00.00	253	3562.19	3563.18	0.99	4.04	66.08	0.73	0	1.0	0.0	2.0	3.0	-
1450	49+90.40	253	3561.52	3562.33	0.81	5.03	64.83	1.01	0	1.1	0.0	1.9	3.0	-
1320	48+67.16	253	3560.69	3561.61	0.92	3.25	109.26	0.68	0	1.0	0.0	1.9	3.0	-
1150	47+25.00	253	3559.76	3560.68	0.92	4.40	65.51	0.83	0	1.0	0.0	1.9	3.0	-
1000	45+70.96	253	3558.75	3559.51	0.76	4.13	100.83	0.93	0	1.0	0.0	1.8	3.0	-
850	44+22.48	253	3557.76	3558.73	0.97	3.03	111.63	0.62	0	1.0	0.0	2.0	3.0	-
700	42+71.49	253	3556.76	3557.57	0.81	5.02	64.97	1.01	0	1.1	0.0	1.9	3.0	-
630	42+04.74	253	3556.24	3557.25	1.01	3.01	109.36	0.60	0	1.0	0.0	2.0	3.0	-
550	40+83.66	253	3555.49	3557.15	1.66	2.03	81.48	0.29	500	1.0	0.0	2.7	3.0	-
525	40+56.00	253	3555.31	3557.08	1.77	2.19	70.63	0.30	500	1.0	0.0	2.8	3.5	-
425	40+00.00	253	3554.93	3557.07	2.14	1.78	72.92	0.22	500	1.0	0.0	3.1	3.5	-
400	39+72.21	253	3554.77	3557.07	2.30	1.63	75.14	0.20	500	1.0	0.0	3.3	3.5	-
350	39+14.98	720	3554.38	3556.62	2.24	4.83	73.39	0.60	11926	1.0	0.0	3.2	3.5	12
250	38+23.68	720	3553.79	3556.00	2.21	4.86	73.34	0.61	11926	1.0	0.0	3.2	3.5	12
100	36+32.08	720	3553.33	3555.35	2.02	5.42	71.31	0.70	11926	1.0	0.0	3.0	3.5	12, 24 (LOB)

CRR2A - HYDRAULIC MODELS RESULTS SUMMARY AND SUPER-ELEVATION CALCULATIONS

Sta	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Freeboard	Superelevation	Total Depth	Actual Depth	Riprap
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)	(ft)	(D50- inches)
4600	18+00.00	287	3558.90	3560.60	1.70	2.60	70.22	0.37	11926	1.0	0.0	2.7	3.0	-
4450	19+28.47	540	3558.51	3560.27	1.76	3.73	93.60	0.51	11926	1.0	0.0	2.8	3.0	-
4300	20+74.12	540	3558.07	3559.91	1.84	4.20	88.08	0.56	11926	1.0	0.0	2.8	3.0	-
4250	21+22.19	540	3557.93	3559.67	1.74	4.76	70.46	0.66	11926	1.0	0.0	2.7	3.0	-
4150	22+02.06	540	3557.69	3559.24	1.55	5.33	69.92	0.78	11926	1.0	0.0	2.6	3.0	-
4100	22+97.42	540	3557.40	3559.22	1.82	2.73	156.71	0.43	11926	1.0	0.0	2.8	3.0	-
4000	23+72.68	540	3557.17	3559.07	1.90	3.18	107.98	0.42	11926	1.0	0.0	2.9	3.0	-
3915	24+60.08	540	3556.91	3558.70	1.79	4.81	70.76	0.63	11926	1.0	0.0	2.8	3.0	-
3850	25+27.17	540	3556.71	3558.54	1.83	4.39	75.10	0.56	11926	1.0	0.0	2.8	3.0	-
3770	26+07.18	540	3556.47	3558.28	1.81	4.59	70.17	0.62	2964	1.0	0.0	2.8	3.0	-
3700	26+68.77	540	3556.28	3558.09	1.81	4.56	70.82	0.62	2964	1.0	0.0	2.8	3.0	-
3550	28+15.85	540	3555.83	3557.63	1.80	4.57	70.86	0.62	2964	1.0	0.0	2.8	3.0	-
3400	29+72.06	540	3555.38	3557.15	1.77	4.69	70.60	0.65	2964	1.0	0.0	2.8	3.0	-
3350	30+18.41	540	3555.23	3556.96	1.73	4.80	70.35	0.67	2964	1.0	0.0	2.7	3.0	-
3250	31+22.61	540	3554.92	3556.87	1.95	3.32	94.64	0.43	2964	1.0	0.0	3.0	3.0	-
3150	32+23.12	540	3554.62	3556.58	1.96	4.18	71.76	0.55	2964	1.0	0.0	3.0	3.0	-
3100	32+71.05	540	3554.48	3556.49	2.01	4.07	72.06	0.53	2964	1.0	0.0	3.0	3.0	-
3000	33+36.60	540	3554.40	3556.44	2.04	4.00	72.27	0.52	2964	1.0	0.0	3.0	3.5	-
2990	33+50.00	540	3554.25	3556.36	2.11	3.86	73.81	0.49	2964	1.0	0.0	3.1	3.5	-
2950	33+88.92	540	3554.13	3556.44	2.31	1.92	181.38	0.27	2964	1.0	0.0	3.3	3.5	-
2850	34+88.28	540	3553.83	3556.23	2.40	3.36	73.46	0.40	2964	1.0	0.0	3.4	3.5	-
2825	35+50.00	540	3553.65	3556.15	2.50	3.20	75.00	0.38	2964	1.0	0.0	3.5	3.5	12
2800	36+32.16	720	3553.39	3555.35	1.96	5.58	71.72	0.73	2964	1.0	0.0	3.0	3.5	12

CRR1 - HYDRAULIC MODELS RESULTS SUMMARY AND SUPER-ELEVATION CALCULATIONS

Sta	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Freeboard	Superelevation	Total Depth	Actual Depth	Riprap
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)	(ft)	(D50- inches)
1100	9+00.00	344	3561.59	3563.50	1.91	2.74	71.45	0.36	0	1.0	0.0	2.9	4.0	-
1050	9+59.36	344	3561.41	3563.46	2.05	2.55	72.28	0.33	0	1.0	0.0	3.1	4.0	-
975	10+26.73	344	3561.21	3563.48	2.27	1.30	155.50	0.17	0	1.0	0.0	3.3	4.0	-
850	11+49.84	344	3560.84	3563.41	2.57	1.98	75.41	0.23	0	1.0	0.0	3.6	4.0	-
700	12+99.60	841	3560.39	3562.87	2.48	5.02	74.89	0.59	0	1.0	0.0	3.5	4.0	-
550	14+50.00	841	3559.94	3562.55	2.61	4.94	75.65	0.56	0	1.0	0.0	3.6	4.0	24 (ROB)
455	15+00.00	841	3559.78	3562.45	2.67	4.81	75.89	0.53	0	1.0	0.0	3.7	4.5	24 (ROB)
400	15+99.60	841	3559.50	3562.32	2.82	4.54	76.92	0.49	0	1.0	0.0	3.8	4.5	24 (ROB)
310	17+00.00	841	3559.20	3562.20	3.00	4.24	78.00	0.45	2964	1.0	0.0	4.0	4.5	24 (ROB)

DATE:
GCW APP
DATE
AGEN APP
DATE
DESCRIPTION
REV DATE

PROJECT NO. 62024-221
DESIGN: GCW
DRAWN: GCW
CHECK: JJ
PLOT DATE: 05-11-15
PLOT TIME: 17:53:21

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F:\Projects\620\62024-221\Division V\civil\Figures\Fig_8U3R.dwg
Michelle Castell

THE HOWARD HUGHES COMPANY, LLC

SUMMERLIN VILLAGE 24

FIGURE 8U3R
HEC-RAS CROSS SECTION EXHIBIT

DRAWING
FIG 8U3R
1 OF 8 SHTS

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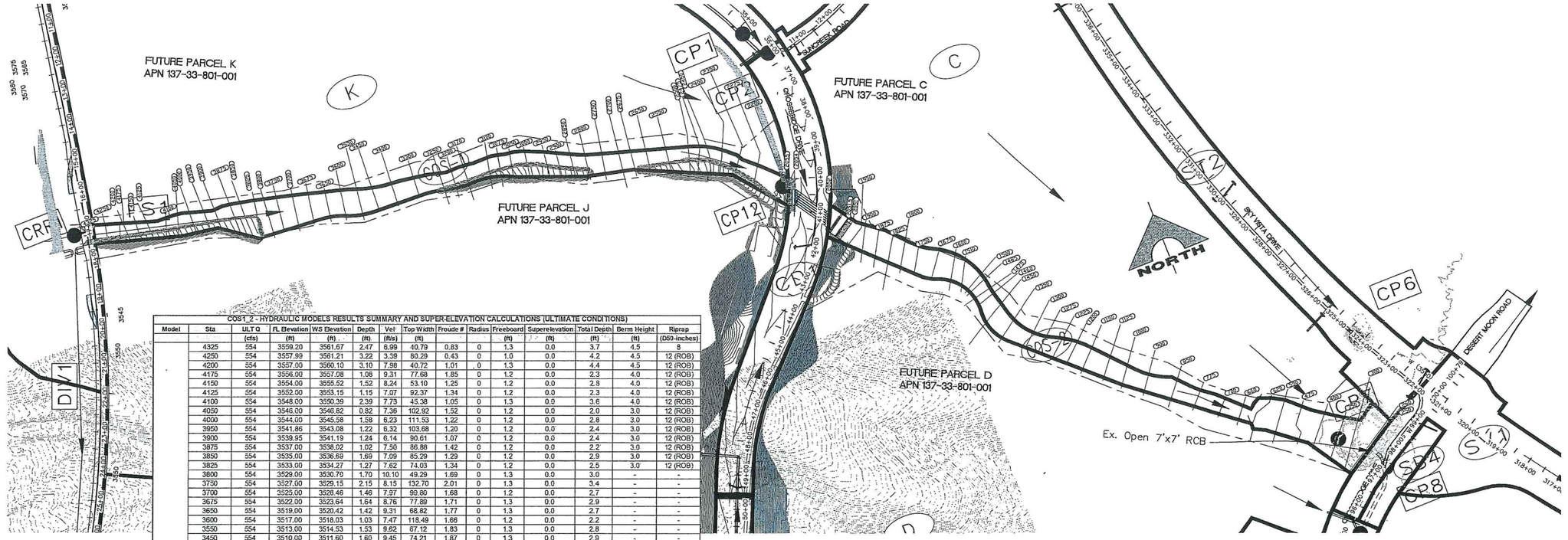

COST_2 - HYDRAULIC MODELS RESULTS SUMMARY AND SUPER-ELEVATION CALCULATIONS (ULTIMATE CONDITIONS)

Model	Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Freeboard	Superelevation	Total Depth	Berm Height	Riprap
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)	(ft)	(D50-inches)
	4325	554	3559.20	3561.67	2.47	6.99	40.79	0.83	0	1.3	0.0	3.7	4.5	8
	4250	554	3557.99	3561.21	3.22	3.39	80.29	0.43	0	1.0	0.0	4.2	4.5	12 (ROB)
	4200	554	3557.00	3560.10	3.10	7.98	40.72	1.01	0	1.3	0.0	4.4	4.5	12 (ROB)
	4175	554	3556.00	3557.08	1.08	9.31	77.68	1.85	0	1.2	0.0	2.3	4.0	12 (ROB)
	4150	554	3554.00	3555.52	1.52	8.24	53.10	1.25	0	1.2	0.0	2.8	4.0	12 (ROB)
	4125	554	3552.00	3553.15	1.15	7.07	92.37	1.34	0	1.2	0.0	2.3	4.0	12 (ROB)
	4100	554	3548.00	3550.39	2.39	7.73	45.38	1.05	0	1.3	0.0	3.6	4.0	12 (ROB)
	4050	554	3546.00	3546.82	0.82	7.36	102.92	1.52	0	1.2	0.0	2.0	3.0	12 (ROB)
	4000	554	3544.00	3545.58	1.58	6.23	111.53	1.22	0	1.2	0.0	2.8	3.0	12 (ROB)
	3950	554	3541.86	3543.08	1.22	6.32	103.68	1.20	0	1.2	0.0	2.4	3.0	12 (ROB)
	3900	554	3539.95	3541.19	1.24	6.14	90.61	1.07	0	1.2	0.0	2.4	3.0	12 (ROB)
	3875	554	3537.00	3538.02	1.02	7.50	86.88	1.42	0	1.2	0.0	2.2	3.0	12 (ROB)
	3850	554	3535.00	3536.69	1.69	7.09	85.29	1.29	0	1.2	0.0	2.9	3.0	12 (ROB)
	3825	554	3533.00	3534.27	1.27	7.62	74.03	1.34	0	1.2	0.0	2.5	3.0	12 (ROB)
	3800	554	3529.00	3530.70	1.70	10.10	49.29	1.69	0	1.3	0.0	3.0	-	-
	3750	554	3527.00	3529.15	2.15	8.15	132.70	2.01	0	1.3	0.0	3.4	-	-
	3700	554	3525.00	3528.46	1.46	7.97	99.80	1.68	0	1.2	0.0	2.7	-	-
	3675	554	3522.00	3523.64	1.64	8.76	77.89	1.71	0	1.3	0.0	2.9	-	-
	3650	554	3519.00	3520.42	1.42	9.31	68.82	1.77	0	1.3	0.0	2.7	-	-
	3600	554	3517.00	3518.03	1.03	7.47	118.49	1.66	0	1.2	0.0	2.2	-	-
	3550	554	3513.00	3514.53	1.53	9.62	67.12	1.83	0	1.3	0.0	2.8	-	-
	3450	554	3510.00	3511.60	1.60	9.45	74.21	1.87	0	1.3	0.0	2.9	-	-
	3400	554	3506.00	3508.11	2.11	8.04	107.10	1.76	0	1.3	0.0	3.4	-	-
	3300	554	3502.00	3503.79	1.79	9.29	66.13	1.72	0	1.3	0.0	3.1	-	-
COS-1	3250	554	3499.00	3500.32	1.32	6.74	84.31	1.18	0	1.2	0.0	2.5	3.5	12 (ROB)
	3200	554	3496.00	3497.56	1.56	7.41	73.19	1.27	0	1.2	0.0	2.8	3.5	12 (ROB)
	3170	554	3493.00	3494.61	1.61	8.62	66.99	1.54	0	1.3	0.0	2.9	3.5	12 (ROB)
	3100	554	3489.00	3490.85	1.85	7.43	74.13	1.26	0	1.2	0.0	3.1	3.5	12 (ROB)
	3075	554	3487.00	3488.89	1.89	8.27	59.05	1.34	0	1.3	0.0	3.1	3.5	12 (ROB)
	3050	554	3485.00	3486.52	1.52	9.09	49.25	1.40	0	1.3	0.0	2.8	3.5	12 (ROB)
	3000	554	3482.00	3483.80	1.80	9.73	37.78	1.32	0	1.3	0.0	3.1	3.5	12 (ROB)
	2950	554	3479.00	3481.41	2.41	9.09	40.26	1.22	0	1.3	0.0	3.7	4.0	12 (ROB)
	2900	554	3477.00	3478.83	1.83	10.51	37.90	1.49	0	1.3	0.0	3.2	4.0	12 (ROB)
	2850	554	3474.00	3475.97	1.97	10.31	43.87	1.58	0	1.3	0.0	3.3	4.0	12 (ROB)
	2800	554	3471.00	3473.13	2.13	9.70	48.72	1.52	0	1.3	0.0	3.4	4.0	12 (ROB)
	2750	554	3469.00	3470.18	1.18	7.23	83.72	1.33	0	1.2	0.0	2.4	-	-
	2700	554	3466.00	3467.14	1.14	8.74	77.76	1.71	0	1.2	0.0	2.4	-	-
	2675	554	3463.85	3465.00	1.15	8.77	86.39	1.78	0	1.2	0.0	2.4	-	-
	2650	554	3461.00	3462.85	1.85	6.97	86.19	1.26	0	1.2	0.0	3.1	3.5	12 (ROB)
	2550	554	3457.75	3459.41	1.66	6.78	100.47	1.32	0	1.2	0.0	2.9	3.5	12 (ROB)
	2500	554	3454.00	3455.22	1.22	5.65	168.34	1.30	0	1.2	0.0	2.4	3.5	12 (ROB)
	2475	554	3452.00	3453.85	1.85	5.83	108.17	1.09	0	1.2	0.0	3.0	3.5	12 (ROB)
	2450	554	3450.00	3452.80	2.80	5.13	143.91	1.04	0	1.2	0.0	4.0	4.0	12 (ROB)
	2400	554	3448.00	3449.22	1.22	6.53	127.86	1.41	0	1.2	0.0	2.4	4.0	12 (ROB)
	2350	554	3445.00	3446.90	1.90	4.77	146.82	0.94	0	1.0	0.0	2.9	4.0	12 (ROB)
	2275	554	3442.00	3443.32	1.32	5.34	142.72	1.10	0	1.1	0.0	2.5	4.0	12 (ROB)
	2200	554	3437.00	3438.45	1.45	4.65	115.47	0.68	0	1.0	0.0	2.4	4.0	12 (ROB)
	2055	554	3434.00	3435.83	1.83	6.42	69.07	1.01	0	1.2	0.0	3.0	4.0	36
	2054	554	3430.00	3433.67	3.67	3.32	56.50	0.31	0	1.0	0.0	4.7	5.0	Concrete
	2053	Culvert				16.26			-	-	-	-	-	-
	2052	554	3425.00	3426.14	1.14	11.09	79.15	1.83	0	1.3	0.0	2.4	-	Stilling Basin
	2051.55	554	3422.27	3426.77	4.50	4.73	64.00	0.62	0	1.0	0.0	5.5	-	36
	2051	554	3420.30	3422.66	2.36	7.40	72.69	1.29	0	1.2	0.0	3.6	-	-
	1950	554	3419.00	3420.95	1.95	3.26	184.32	0.60	0	1.0	0.0	2.9	-	-
	1900	554	3417.34	3419.60	2.26	6.32	71.56	1.01	0	1.2	0.0	3.5	-	-
	1875	554	3414.43	3416.61	2.18	8.56	55.31	1.40	0	1.3	0.0	3.5	-	-
	1825	554	3411.57	3413.17	1.60	8.93	60.17	1.55	0	1.3	0.0	2.9	-	-
	1800	554	3409.75	3410.74	0.99	6.15	125.83	1.28	0	1.2	0.0	2.1	-	-
	1750	554	3406.00	3408.23	2.23	7.53	58.19	1.18	200	1.2	0.3	3.7	-	-
	1675	554	3403.00	3404.57	1.57	8.28	64.96	1.44	200	1.2	0.3	3.2	-	-
	1600	554	3399.00	3401.23	2.23	8.73	51.66	1.39	200	1.3	0.3	3.8	-	-
	1510	554	3398.00	3399.35	1.35	9.37	50.97	1.56	200	1.3	0.4	3.0	-	-
	1500	554	3394.00	3394.99	0.99	14.17	44.43	2.86	200	1.4	0.7	3.0	-	-
	1485	554	3393.00	3394.06	1.06	12.53	48.73	2.32	200	1.3	0.6	3.0	-	-
	1475	554	3390.00	3391.90	1.90	11.85	51.85	2.20	200	1.4	0.6	3.8	-	-
	1460	554	3389.00	3391.09	2.09	10.07	54.28	1.76	146	1.3	0.6	4.0	-	-
	1450	554	3388.00	3389.53	1.53	5.12	144.29	1.04	146	1.1	0.4	3.1	-	-
	1350	554	3385.00	3386.67	1.67	7.27	98.87	1.46	146	1.2	0.6	3.4	-	-
	1300	554	3382.00	3383.50	1.50	6.73	113.73	1.39	146	1.2	0.5	3.2	-	-
COS-2	1275	554	3380.00	3381.82	1.82	7.43	88.10	1.42	0	1.2	0.0	3.0	-	-
	1225	554	3378.00	3379.13	1.13	7.29	122.38	1.63	0	1.2	0.0	2.3	-	-
	1200	554	3376.00	3377.03	1.03	7.78	93.74	1.57	0	1.2	0.0	2.2	-	-
	1150	554	3373.00	3374.90	1.90	7.94	74.24	1.44	0	1.2	0.0	3.1	-	-
	1125	554	3369.00	3371.12	2.12	9.77	56.50	1.72	0	1.3	0.0	3.4	-	-
	1000	554	3367.00	3368.49	1.49	10.50	43.31	1.68	0	1.3	0.0	2.8	-	-
	900	554	3364.00	3365.41	1.41	10.84	40.96	1.71	0	1.3	0.0	2.7	-	-
	850	554	3360.00	3361.31	1.31	10.02	55.66	1.77	0	1.3	0.0	2.6	-	-
	775	554	3356.00	3357.57	1.57	9.72	56.29	1.70	0	1.3	0.0	2.9	-	-
	700	554	3353.00	3354.22	1.22	9.74	50.79	1.62	0	1.3	0.0	2.5	-	-
	660	554	3349.00	3350.10	1.10	10.60	60.28	2.01	0	1.3	0.0	2.4	-	-
	620	554	3346.20	3347.00	0.80	9.28	88.71	2.00	0	1.2	0.0	2.0	-	-
	550	554	3340.30	3341.10	0.80	9.83	81.13	2.08	0	1.2	0.0	2.0	-	-
	475	554	3334.40	3335.09	0.69	10.55	89.37	2.42	0	1.2	0.0	1.9	-	-
	400	595	3328.50	3329.33	0.83	9.72	80.82	1.97	0	1.2	0.0	2.1	-	-
	350	595	3322.60	3323.37	0.77	10.70	76.77	2.22	0	1.2	0.0	2.0	-	-
	300	595	3317.00	3323.75	6.75	0.55	216.83	0.04	0	1.0	0.0	7.8	-	-
	260	595	3312.00	3323.75	11.75	0.35	185.00	0.02	0	1.0	0.0	12.8	-	-
	250	595	3312.00	3323.75	11.75	0.35	197.16	0.02	0	1.0	0.0	12.8	-	-

150 0 150 300
SCALE FEET

LEGEND

- COS-1 — DRAINAGE SUBBASIN
- CP1 — CONCENTRATION POINT
- SUBBASIN BOUNDARY
- 850 — HEC-RAS CROSS SECTION

DATE: | DESCRIPTION | DATE | AGEN APP | DATE | GCW APP | REV | DATE

PROJECT NO. 62024-221
DESIGN: GCW
DRAWN: GCW
CHECK: SJ
PLOT DATE: 10-06-15
PLOT TIME: 14:43:41

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD - LAS VEGAS, NV 89146
T: 702.804.2000 - F: 702.804.2299 - GCWALLACE.COM
LAS VEGAS

F:\Projects\600\62024-221\Division\Civil\Figures\Fig_9U3R.dwg
David Clark

THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24
HEC-RAS CROSS SECTION EXHIBIT (PARCELS COS-1 + COS-2)

DRAWING
FIG 9U3R
2 OF 8 SHTS

gce2430.dwg 07/02/03 jw

HYDROLOGIC CRITERIA AND DESIGN MANUAL

TIME OF CONCENTRATION

G. C. WALLACE, INC.
Engineers/Planners/Surveyors

SUMMERLIN VILLAGE 24
UNIT 2 IMPROVEMENTS
PROPOSED/INTERIM CONDITIONS

Project No: 62024-221
Date: 23-Feb-15
Calculated by: JYA/MMC

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc CHECK URBANIZED BASINS		Tc	Tlag	REMARKS
DESIG: (1)	DEV./EX. (D or E)	CN (16)	K (2)	AREA Ac (3)	AREA Sq Mi (4)	INITIAL LENGTH Feet (5)	SLOPE % (6)	Ti Min (7)	TRAVEL LENGTH Feet (8)	SLOPE % (9a)	V1 VELOCITY fps (9b)	V2 VELOCITY fps (10)	Tt Min (11)	TOTAL LENGTH Feet (12)	Tc = (L/180)+10 Min (13)	Min (14)	Tlag = 0.6Tc/60 Hours (15)	Rainfall (In)
Precipitaion values for basins are referenced from the *Conceptual Drainage Study*. OFF11A includes the areas for OFF12 through OFF17; OFF11B includes a portion of the area for ON12.																		3.43
OFF11A	E	88	0.7716	91.8	0.14306	500	8.0	6.9	3975	7.3	2.0	7.8	5.4	4475	N/A	16.0	0.160	3.34
OFF11B	E	88	0.7716	56.8	0.08867	500	7.2	6.8	3410	6.1	3.7	7.8	5.9	3910	N/A	16.8	0.168	
Parameters are referenced from the *SWPA Update* and the *Conceptual Drainage Study*. For the proposed/interim conditions, the subbasin is assumed undeveloped; therefore the CN used is for subbasin OFF5 from the *Conceptual Drainage Study*; precipitation value is from subbasin 7-2A from the *SWPA Update*. The area and lag time have been revised for the present study.																		3.50
7-2A*	E	88	0.7716	283.5	0.44300	500	9.0	6.4	9490	7.2	4.0	7.8	24.2	9990	N/A	27.5	0.275	
Crossbridge Drive and onsite areas draining towards Crossbridge Drive; precipitation value for all basins and CN for Crossbridge Drive are taken from the *Conceptual Drainage Study Update #2*.																		3.34
ON7R*	E	88	0.7716	7.3	0.01145	500	7.2	6.8	1165	5.2	3.4	6.7	4.7	1665	N/A	16.0	0.110	3.34
ON8R*	E	88	0.7716	27.2	0.04245	500	7.0	6.9	1430	6.1	3.5	7.15	4.4	1930	N/A	16.0	0.116	3.34
ON10R	E	88	0.7716	5.4	0.00845	65	10.8	2.2	190	7.4	4.0	8.0	0.3	255	N/A	2.9	0.100	3.34
CD1	D	94	0.8508	3.7	0.00578	25	2.0	1.8	870	0.6	1.0	2.4	0.778	895	15.0	9.7	0.097	3.38
CD2	D	94	0.8508	3.8	0.00594	25	2.0	1.8	1100	0.6	1.0	2.4	0.9	1125	16.3	11.3	0.113	3.37
CD3	D	94	0.8508	1.4	0.00219	35	2.0	2.1	490	6.3	5.1	7.71	1.16	525	12.9	9.7	0.050	3.36
Offsite area draining towards existing Unit 1 Improvements; precipitation value and CN are taken from the *Conceptual Drainage Study*																		3.34
ON7R2	E	88	0.7716	20.4	0.03191	500	9.4	6.9	1260	6.4	3.6	7.5	4.9	1760	N/A	10.2	0.102	
Rough-graded Cossbridge Drive and Alta Drive with offsite (RG6); precipitation for RG6 is a portion of basin RG6 in the *Village 23A Rough Grade Study*																		3.29
RG6	E	90.2	0.8006	40.2	0.06275	500	6.6	6.6	1230	5.2	3.4	6.7	3.6	1730	N/A	10.7	0.107	3.34
CBRG	E	94	0.8508	12.2	0.01909	45	2.0	2.4	2090	0.5	1.0	2.0	2.1	2135	N/A	23.5	0.235	
These subbasins are subdivided from Basin RG6 which is from the *Village 23A Rough Grade Study*; areas and lag times are revised; precipitation and CN are from the *Village 23A Rough Grade Study*																		3.29
RG6A	E	88	0.7716	10.2	0.01597	500	7.0	6.9	1925	7.6	4.0	8.0	5.0	2425	N/A	15.8	0.158	3.29
RG6B	E	88	0.7716	44.3	0.06920	500	6.4	7.1	3735	6.8	3.9	7.8	9.2	4235	N/A	15.3	0.153	3.29
RG6C*	E	88	0.7716	30.7	0.04793	240	8.0	4.8	2450	5.3	3.4	6.8	7.8	3690	N/A	11.6	0.116	3.29
RG6D	E	88	0.7716	4.8	0.00749	500	7.4	6.8	425	6.6	3.8	7.5	1.8	925	N/A	9.6	0.100	3.29
RG6E	E	88	0.7716	44.8	0.07000	500	9.2	6.3	2450	5.0	Sta	8.5	7.4	2950	N/A	13.6	0.136	3.29
RG6F	E	88	0.7716	17.2	0.02689	500	5.8	7.4	1205	5.4	3.4	6.8	2.9	1705	N/A	11.6	0.116	

Tc = Ti + Tt Tlag = 0.6 Tc

$Ti = 1.8\ (1.1 - K)\ L^{1/2} / S^{1/3}$

K = 0.0132 (CN) - 0.39

For the travel time (Tt) calculations,
V1 applies to the first 500 feet of travel distance;
V2 applies to the remaining travel distance.

Existing: $V1 = 14.8*(S/100)^{1/2}$ $V2 = 29.4*(S/100)^{1/2}$

Developed: $V1 = 20.2*(S/100)^{1/2}$ $V2 = 30.6*(S/100)^{1/2}$

REFERENCE:

STANDARD FORM 4

*Revised as part of *Update #3 to the Unit 2 Study due to added offsite channel and flow split weirs*.

File: SF4-V24-Int.xls Printed: 5/11/2015 7:29 PM

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*          VERSION 4.1                  *
*                                       *
*  RUN DATE   17MAR15  TIME  15:28:15   *
*                                       *
*****************************************
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*            (916) 756-1104             *
*                                       *
*****************************************
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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

HEC-1 INPUT

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

              *DIAGRAM
              ID  ************************************************************
              ID  * ..................................................... : *
              ID  * :                SUMMERLIN VILLAGE 24                 : *
              ID  * :                  UNIT 2 IMPROVEMENTS                : *
              ID  * :              PROPOSED/INTERIM CONDITIONS            : *
              ID  * :         PROPOSED FLOW SPLIT AT VILLAGE 24 BOUNDARY  : *
              ID  * :.....................................................: *
              ID  * :  RETURN PERIOD_ _ _ _100/10-YEAR                    : *
              ID  * :  DISTRIBUTUION_ _ _ _6-HOUR SDN3                    : *
              ID  * :  PROJECT NO_ _ _ _ _ 62024-221                      : *
              ID  * :  FILENAME_ _ _ _ _ _ INT-V24-PRSPLIT.H1             : *
              ID  * :  DATE_ _ _ _ _ _ _ 3/04/15                         : *
              ID  * :.....................................................: *
              ID
              ID
              ID          DEPTH AREA REDUCTION FACTOR
              ID    DARFS RERERENCED FROM THE CONCEPTUAL DRAINAGE STUDY
              ID        SQ MILES              DARF
              ID          0-.1                1.0
              ID          .1-.3               .988
              ID          .3-.5               .980
              ID          .5-.7               .976
              ID          .7-.9               .972
              ID          .9-2.0              .950
              ID         10-YEAR              .575
              ID
              ID
              IT     5       0       0     300
              IO     5
              IN     5       0       0
              JR   PREC      1    .988    .980    .976    .972    .950    .575
              *

              KK   RG6*
              KM   SUBBASIN RG6*
              KM   A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
              KM   AREA AND CURVE NUMBER REVISED TO INCLUDE UNIT 2 IMPROVEMENTS
              KM   INCLUDES ROUGH-GRADED ALTA AND SKY VISTA DRIVES AND OFFSITE AREA TO THE NORT
              BA  .06275
              PB   3.29
              PC   .000   .020   .057   .070   .087   .108   .124   .130   .130   .130
              PC   .130   .130   .130   .133   .140   .142   .148   .158   .172   .181
              PC   .190   .197   .199   .200   .201   .204   .214   .229   .241   .249
              PC   .251   .256   .270   .278   .281   .283   .295   .322   .352   .409
              PC   .499   .590   .710   .744   .781   .812   .819   .835   .851   .856
              PC   .860   .868   .876   .888   .910   .926   .937   .950   .970   .976
              PC   .982   .985   .987   .989   .990   .993   .993   .994   .995   .998
              PC   .998   .999  1.00
              LS     0   90.2
              UD   .107
              *
              * END RUNOFF TO ALTA DRIVE
              *
              * BEGIN RUNOFF TO MULTIPLE CULVERTS AT CROSSBRIDGE DRIVE
              *
```


HEC-1 INPUT

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

  48          KK   7-2B
```

```
49          KM   SUBBASIN 7-2B
            *  REFERENCED FROM THE 2006 SUMMERLIN WEST PLANNING AREA FLOOD CONTROL MASTER PL
50          BA  0.0944
51          PB    3.58
52          LS       0       88
53          UD   0.149
            *

54          KK   7-2Br
55          KM   ROUTE 7-2Br TO CP12
56          RD    9490    .072    .025            TRAP       0       50
            *

57          KK   7-2A*
58          KM   SUBBASIN 7-2A* (SUBBASIN OFF5 IN THE CONCEPTUAL DRAINAGE STUDY)
            *  REFERENCED FROM THE 2006 SUMMERLIN WEST PLANNING AREA FLOOD CONTROL MASTER PL
            *  FOR INTERIM CONDTION, THIS BASIN ASSUMED UNDEVELOPED
            *  AREA AND LAG TIME HAVE BEEN REVISED FOR INTERIM, UNDEVLOPED CONDITIONS
59          BA  .44300
60          PB    3.50
61          LS       0       88
62          UD   0.275
            *

63          KK    CRR1
64          KM   CONCENTRATION POINT CRR1
65          KM   COMBINE 7-2B AND 7-2A* NEAR VILLAGE 24 BOUNDARY
66          HC       2
            *

67          KK   DCRR1
68          KM   DIVERT FLOW FROM EXISTING WASH AT VILLAGE 24 BOUNDARY
69          KM   DIVERTED FLOW (DIVS) TURNS SOUTH
70          DT    DIVS
71          DI       0      760
72          DQ       0      259
            *

73          KK    RG6C
74          KM   SUBBASIN RG6C
75          KM    A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
76          BA  .04793
77          PB    3.29
78          LS       0       88
79          UD   0.118
            *

80          KK   CP12A
81          KM   CONCENTRATION POINT CP12 (AT UPSTREAM SIDE OF BRIDGE)
82          KM   COMBINE CRR1 AND RG6C AT CULVERTS CROSSING CROSSBRIDGE DRIVE
83          HC       2
            *
```



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                                    HEC-1 INPUT

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

84          KK     CD1
85          KM   SUBBASIN CD1
86          KM   PORTION OF CROSSBRIDGE DRIVE
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY UPDATE #2
87          BA  .00578
88          PB    3.38
89          LS       0       94
90          UD   0.097
            *

91          KK   CP12B
92          KM   CONCENTRATION POINT CP12 (AT DOWNSTREAM SIDE OF BRIDGE)
93          KM   COMBINE CP12A AND CD1
94          HC       2
            *
            * END RUNOFF TO CULVERTS AT CROSSBRIDGE DRIVE
            * BEGIN RUNOFF TO EXISTING 7' BY 7' RCB - PART OF UNIT 1 IMPROVEMENTS
            *

95          KK       C
96          KM   SUBBASIN PARCEL C
97          KM   DEVELOPED SUBBASIN ADDED TO THIS FILE TO FIND WORST-CASE FLOW AT
98          KM   EXISTING 7' BY 7' RCB - PARCEL C IS NOT PROPOSED FOR DEVELOPMENT AT THIS TIME
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY UPDATE #2
99          BA  .03888
100         PB    3.37
101         LS       0       85.7
102         UD   0.165
            *

103         KK   ON7R2
104         KM   SUBBASIN ON7R2
105         BA  .03191
106         PB    3.34
107         LS       0       88
108         UD   0.102
            *

109         KK   CPRCB
110         KM   CONCENTRATION POINT CPRCB AT EXISTING RCB AT CROSSBRIDGE
111         KM   COMBINE CP12B, FUTURE PARCEL C AND ON7R2
112         HC       3
```

```
                *
                * BEGIN RUNOFF TO PROPOSED STORM DRAIN STARTING IN CROSSBRIDGE DRIVE, EXTENDING
                * EAST IN SUNCREEK AND SOUTH IN SKY VISTA AND
                * CONNECTING TO EXISTING STORM DRAIN IN SKY VISTA
                *

113             KK    CBRG
114             KM   SUBBASIN CBRG
115             KM    A PORTION OF ROUGH GRADED CROSSBRIDGE DRIVE
116             BA  .01909
117             PB    3.34
118             LS       0       94
                                                                                                PAGE  4
                                          HEC-1 INPUT
1
LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

119             UD   0.235
                *

120             KK    ST6*
121             KM   SUBBASIN ST6
122             KM   SUNCREEK ROAD
                *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
                *  AREA SLIGHTLY REVISED
123             BA  .00284
124             PB    3.34
125             LS       0       94
126             UD   0.075
                *

127             KK     CP5
128             KM   CONCENTRATION POINT CP5
129             KM   COMBINE ST6 AND CBRG IN STORM DRAIN AT INTERSECTION OF
130             KM   SUNCREEK ROAD AND SKY VISTA DRIVE
131             HC       2
                *
                * BEGIN RUNOFF TO PROPOSED STORM DRAIN IN SKY VISTA
                *

132             KK    RG6D
133             KM   SUBBASIN RG6D
134             KM    A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
135             BA  .00748
136             PB    3.29
137             LS       0       88
138             UD   0.100
                *

139             KK    RG6A
140             KM   SUBBASIN RG6A
141             KM    A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
142             BA  .01597
143             PB    3.29
144             LS       0       88
145             UD   0.119
                *

146             KK   RG6Ar
147             KM   ROUTE RG6A TO CP6
148             RD    2880    .056    .025            TRAP       0       50
                *

149             KK    RG6B
150             KM   SUBBASIN RG6B
151             KM    A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
152             BA  .06920
153             PB    3.29
154             LS       0       88
155             UD   0.163
                *
                                                                                                PAGE  5
                                          HEC-1 INPUT
1
LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

156             KK   RG6Br
157             KM   ROUTE RG6B TO CP6
158             RD    2740    .055    .025            TRAP       0       50
                *

159             KK    RG6E
160             KM   SUBBASIN RG6E
161             KM    A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
162             BA  .07000
163             PB    3.29
164             LS       0       88
165             UD   0.138
                *

166             KK     CP6
167             KM   CONCENTRATION POINT CP6
168             KM   COMBINE RG6A, RG6B AND RG6E AT STUB TO SKY VISTA STORM DRAIN
169             HC       3
                *

170             KK     CP7
171             KM   CONCENTRATION POINT CP7
172             KM   COMBINE RG6D AND CP6 IN STORM DRAIN UPSTREAM OF INTERSECTION OF
173             KM   SUNCREEK ROAD AND SKY VISTA DRIVE
```

```
174         HC       2
            *

175         KK     CP8
176         KM    CONCENTRATION POINT CP8
177         KM    COMBINE CP5 AND CP7 IN STORM DRAIN AT INTERSECTION OF
178         KM    SUNCREEK ROAD AND SKY VISTA DRIVE
179         HC       2
            *

180         KK     ST2
181         KM    SUBBASIN ST2
182         KM    SKY VISTA DRIVE FROM ALTA DRIVE TO CROSSBRIDGE DRIVE
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
183         BA   .01563
184         PB    3.34
185         LS       0       94
186         UD    0.140
            *

187         KK     RG6F
188         KM    SUBBASIN RG6F
189         KM    A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
190         KM    DRAINS TO TEMPORARY STUB TO THE SKY VISTA STORM DRAIN
191         BA   .02689
192         PB    3.29
193         LS       0       88
194         UD    0.115
            *
```



```
1                                    HEC-1 INPUT

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

195         KK     CP9
196         KM    CONCENTRATION POINT CP9
197         KM    COMBINE CP8, RG6F AND ST2 IN SKY VISTA STORM DRAIN
198         HC       3
            *

199         KK     CP9B
200         KM    COMBINE CPRCB AND CP9 IN UNIT 1 CROSSBRIDGE DRIVE STORM DRAIN
201         HC       2
            *
            * BEGIN OFFSITE WESTERN BOUNDARY AND ONSITE RUNOFF TO EXISTING WASH SOUTH OF UNI
            *

202         KK    RETDS
203         KM    RETRIEVE DIVERTED FLOW
204         DR     DIVS
            *

205         KK     OFF6
206         KM    SUBBASIN OFF6
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
207         BA   .00550
208         PB    3.43
209         LS       0       88
210         UD    0.050
            *

211         KK     OFF7
212         KM    OFFSITE SUBBASIN OFF7
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
213         BA   .11888
214         PB    3.43
215         LS       0       88
216         UD    0.174
            *

217         KK     OFF8
218         KM    OFFSITE SUBBASIN OFF8
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
219         BA   .02153
220         PB    3.43
221         LS       0       88
222         UD    0.113
            *

223         KK     OFF9
224         KM    OFFSITE SUBBASIN OFF9
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
225         BA   .00694
226         PB    3.43
227         LS       0       88
228         UD    0.077
            *
```



```
1                                    HEC-1 INPUT

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

229         KK    OFF10
230         KM    OFFSITE SUBBASIN OFF10
            *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
231         BA   .01161
232         PB    3.43
233         LS       0       88
234         UD    0.088
```

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                *
235             KK  COFF10
236             KM   DUMMY
237             KM   COMBINE DIVS, OFF6, OFF7, OFF8, OFF9 AND OFF10
238             HC       6
                *
239             KK  OFF11A
240             KM   SUBBASIN OFF11A
                *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
                *  CONSISTS OF THE AREA FOR SUBBASINS OFF12 THROUGH OFF17
241             BA  .14308
242             PB    3.43
243             LS       0       88
244             UD   0.160
                *
245             KK    CRR2
246             KM   CONCENTRATION POINT CRR2
247             KM   COMBINE COFF10 AND OFF11-A
248             HC       2
                *
249             KK    ON11
250             KM   ONSITE SUBBASIN ON11
                *  REFERENCED FROM THE TECHNICAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24 UNIT 1
                *  IMPROVEMENTS INCLUDING PARCELS "A" AND "B" MASS GRADING
251             BA  .05391
252             PB    3.34
253             LS       0       88
254             UD   0.115
                *
255             KK    ON7R
256             KM   SUBBASIN ON7R
257             BA  .01145
258             PB    3.34
259             LS       0       88
260             UD   0.110
                *
                                    HEC-1 INPUT                                                    PAGE  8
1
LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

261             KK    ON8R
262             KM   SUBBASIN ON8R
263             BA  .04245
264             PB    3.34
265             LS       0       88
266             UD   0.113
                *
267             KK    CP1
268             KM   CONCENTRATION POINT CP1
269             KM   COMBINE ON7R AND ON8R AT STORM DRAIN STUB
270             HC       2
                *
271             KK     CD2
272             KM   SUBBASIN CD2
273             KM   PORTION OF CROSSBRIDGE DRIVE
                *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY UPDATE #2
274             BA  .00594
275             PB    3.37
276             LS       0       94
277             UD   0.113
                *
278             KK   ON10R
279             KM   SUBBASIN ON10R
280             KM   AREA BETWEEN EXISTING BERM AND CROSSBRIDGE DRIVE
281             BA  .00845
282             PB    3.34
283             LS       0       88
284             UD   0.100
                *
285             KK    CP2
286             KM   CONCENTRATION POINT CP2
287             KM   COMBINE CP1, CD2 AND ON10R IN STORM DRAIN IN CROSSBRIDGE
288             HC       3
                *
289             KK    CP2r
290             KM   ROUTE CP2 TO CP11
291             RD    1885    .056    .025            TRAP       0       50
                *
292             KK  OFF11B
293             KM   SUBBASIN OFF11B
294             BA  .08867
295             PB    3.34
296             LS       0       88
297             UD   0.158
                *
                                    HEC-1 INPUT                                                    PAGE  9
1
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LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

298           KK    CP11
299           KM   CONCENTRATION POINT CP11
300           KM   COMBINE CRR2, ON11, CP2 AND OFF11B
301           HC       4
              *
              * END RUNOFF TO EXISTING WASH SOUTH OF UNIT 2 IMPROVEMENTS
              *
              * BEGIN RUNOFF TO UNIT 1 IMPROVEMENTS
              *
302           KK     CD3
303           KM   SUBBASIN CD3
304           KM   PORTION OF CROSSBRIDGE DRIVE
              *  REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY UPDATE #2
305           BA  .00219
306           PB    3.36
307           LS       0       94
308           UD   0.050
              *
              *
              * END FILE
              *
309           ZZ
```
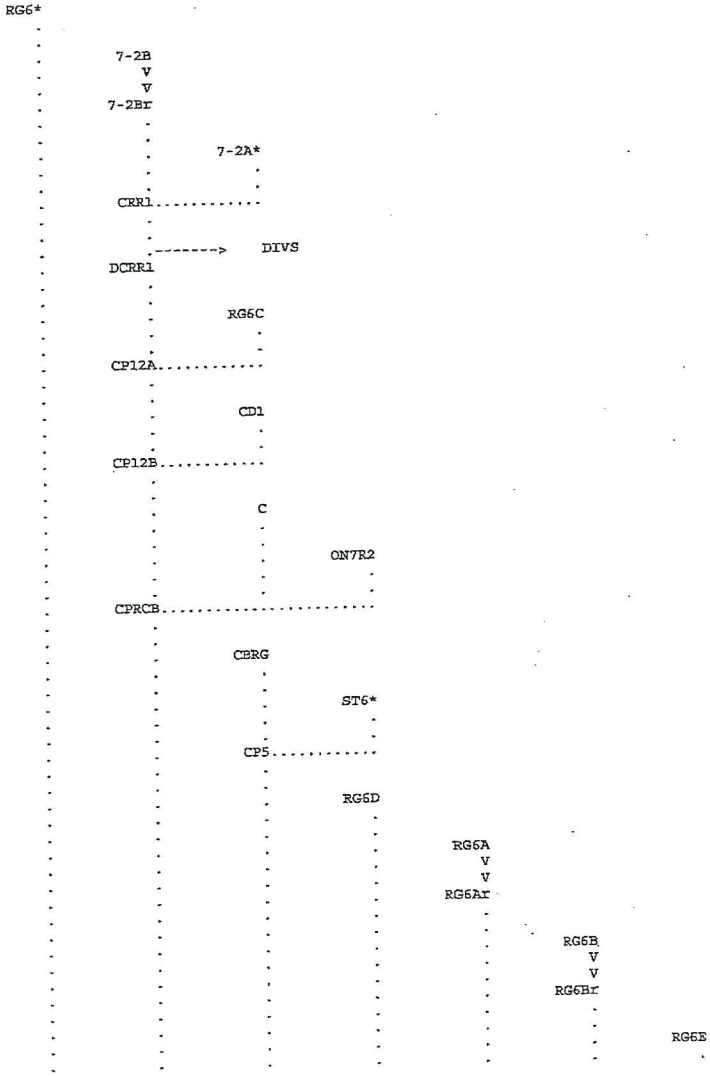
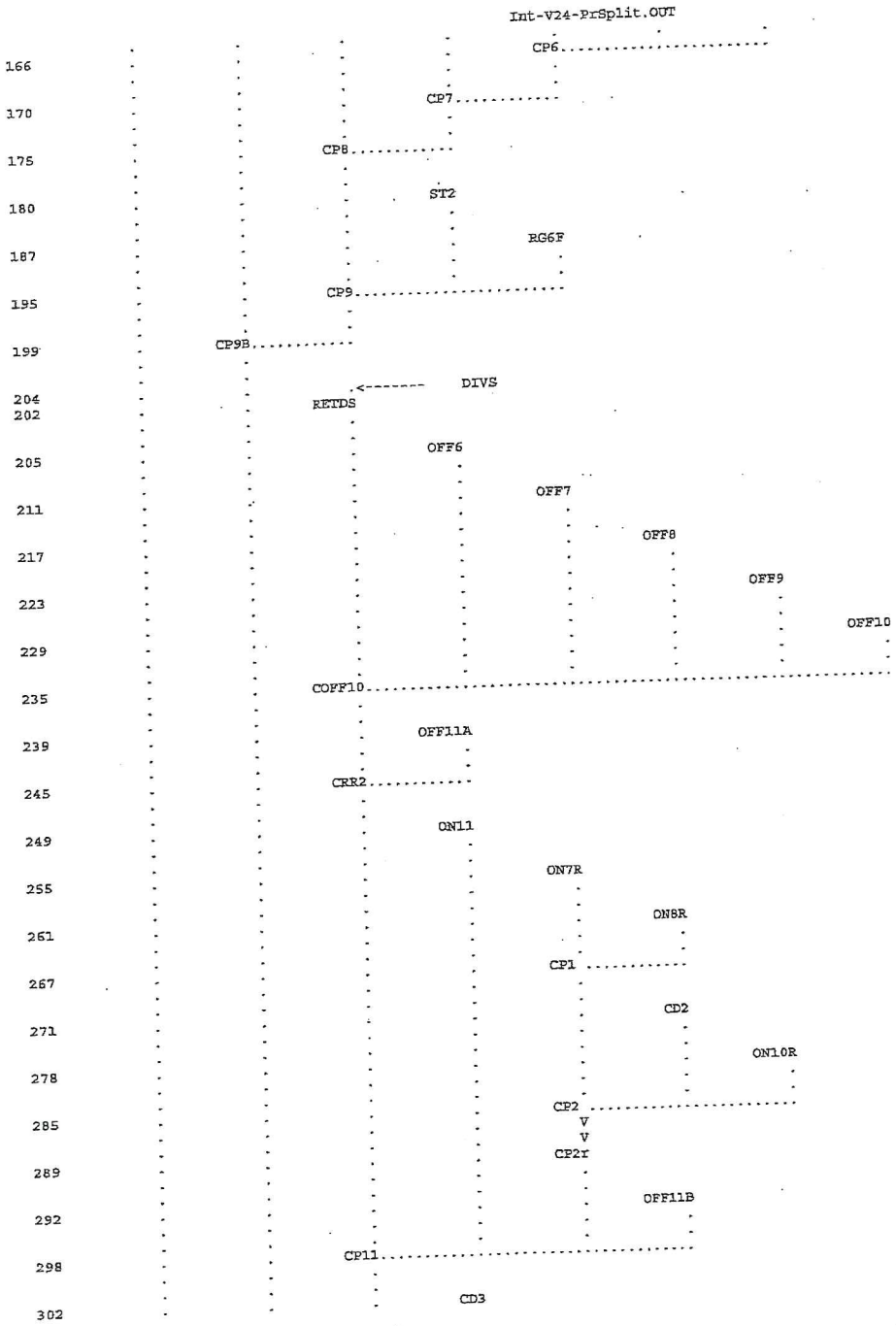

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING
(.) CONNECTOR
(---->) DIVERSION OR PUMP FLOW
(<----) RETURN OF DIVERTED OR PUMPED FLOW





(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   17MAR15  TIME  15:28:15   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*            (916) 756-1104             *
*                                       *
*****************************************
```

SUMMERLIN VILLAGE 24
UNIT 2 IMPROVEMENTS
PROPOSED/INTERIM CONDITIONS
PROPOSED FLOW SPLIT AT VILLAGE 24 BOUNDARY

RETURN PERIOD	100/10-YEAR
DISTRIBUTUION	6-HOUR SDN3
PROJECT NO	62024-221
FILENAME	INT-V24-PRSPLIT.H1
DATE	3/04/15

DEPTH AREA REDUCTION FACTOR
DARFS RERERENCED FROM THE CONCEPTUAL DRAINAGE STUDY

SQ MILES	DARF
0-.1	1.0
.1-.3	.988
.3-.5	.980
.5-.7	.976
.7-.9	.972
.9-2.0	.950
10-YEAR	.575

28 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	1	0	STARTING DATE
ITTIME		0000	STARTING TIME
NQ		300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	2	0	ENDING DATE
NDTIME		0055	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 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

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1.00 .99 .98 .98 .97 .95 .57

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION						
OPERATION	STATION	AREA	PLAN		RATIO 1 1.00	RATIO 2 .99	RATIO 3 .98	RATIO 4 .98	RATIO 5 .97	RATIO 6 .95	RATIO 7 .57
HYDROGRAPH AT +	RG6*	.06	1	FLOW	122.	120.	118.	118.	117.	114.	56.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT +	7-2B	.09	1	FLOW	182.	179.	177.	176.	175.	170.	82.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO +	7-2Br	.09	1	FLOW	174.	172.	170.	169.	168.	163.	82.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT +	7-2A*	.44	1	FLOW	653.	643.	636.	632.	629.	609.	287.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT +	CRR1	.54	1	FLOW	786.	773.	764.	760.	756.	732.	331.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.83
DIVERSION TO +	DIVS	.54	1	FLOW	268.	264.	261.	259.	258.	249.	113.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT +	DCRR1	.54	1	FLOW	518.	510.	504.	501.	498.	482.	218.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT +	RG6C	.05	1	FLOW	85.	84.	83.	82.	82.	79.	38.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58

2 COMBINED AT	CP12A	.59	1	FLOW	566.	556.	550.	547.	544.	527.	234.
+				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT	CD1	.01	1	FLOW	13.	13.	13.	13.	13.	13.	7.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT	CP12B	.59	1	FLOW	572.	562.	556.	553.	550.	532.	237.
+				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	C	.04	1	FLOW	61.	60.	59.	59.	58.	56.	25.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	ON7R2	.03	1	FLOW	60.	59.	58.	58.	58.	56.	26.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	CPRCB	.66	1	FLOW	656.	644.	637.	633.	629.	609.	269.
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.75
HYDROGRAPH AT	CBRG	.02	1	FLOW	34.	33.	33.	33.	33.	32.	17.
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT	ST6*	.00	1	FLOW	7.	7.	7.	7.	7.	7.	4.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT	CP5	.02	1	FLOW	38.	37.	37.	37.	36.	35.	19.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	RG6D	.01	1	FLOW	14.	14.	13.	13.	13.	13.	6.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	RG6A	.02	1	FLOW	28.	28.	28.	27.	27.	26.	13.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO	RG6Ar	.02	1	FLOW	27.	27.	26.	26.	26.	25.	12.
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.75
HYDROGRAPH AT	RG6B	.07	1	FLOW	116.	114.	113.	113.	112.	108.	51.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO	RG6Br	.07	1	FLOW	111.	109.	108.	108.	107.	104.	48.
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.75
HYDROGRAPH AT	RG6E	.07	1	FLOW	123.	121.	119.	119.	118.	114.	54.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT	CP6	.16	1	FLOW	239.	235.	232.	230.	229.	222.	102.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.67	3.67
2 COMBINED AT	CP7	.16	1	FLOW	252.	247.	245.	243.	242.	234.	106.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.67
2 COMBINED AT	CP8	.18	1	FLOW	289.	284.	281.	280.	278.	269.	125.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT	ST2	.02	1	FLOW	33.	32.	32.	32.	32.	31.	17.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	RG6F	.03	1	FLOW	48.	47.	46.	46.	46.	44.	21.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT	CP9	.23	1	FLOW	370.	364.	360.	358.	356.	344.	160.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	CP9B	.89	1	FLOW	1000.	983.	973.	967.	961.	931.	422.
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT	RETDS	.00	1	FLOW	268.	264.	261.	259.	258.	249.	113.
+				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT	OFF6	.01	1	FLOW	13.	13.	13.	13.	13.	12.	6.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	OFF7	.12	1	FLOW	206.	203.	201.	199.	198.	192.	91.
+											

				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	OFF8	.02	1	FLOW	40.	40.	39.	39.	39.	38.	18.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	OFF9	.01	1	FLOW	15.	15.	14.	14.	14.	14.	7.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	OFF10	.01	1	FLOW	24.	23.	23.	23.	23.	22.	11.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
6 COMBINED AT	COFF10	.16	1	FLOW	498.	489.	484.	481.	478.	463.	212.
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.58
HYDROGRAPH AT	OFF11A	.14	1	FLOW	256.	252.	249.	248.	246.	239.	113.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	CRR2	.31	1	FLOW	749.	736.	728.	724.	720.	697.	325.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	ON11	.05	1	FLOW	97.	96.	95.	94.	94.	91.	44.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	ON7R	.01	1	FLOW	21.	20.	20.	20.	20.	19.	9.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.58
HYDROGRAPH AT	ON8R	.04	1	FLOW	77.	75.	75.	74.	74.	72.	34.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	CP1	.05	1	FLOW	97.	96.	95.	94.	94.	91.	44.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	CD2	.01	1	FLOW	13.	13.	13.	12.	12.	12.	7.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	ON10R	.01	1	FLOW	16.	16.	16.	15.	15.	15.	7.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	CP2	.07	1	FLOW	126.	124.	122.	122.	121.	117.	57.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.58
ROUTED TO	CP2r	.07	1	FLOW	123.	121.	120.	119.	118.	114.	57.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT	OFF11B	.09	1	FLOW	153.	151.	149.	149.	148.	143.	68.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
4 COMBINED AT	CP11	.52	1	FLOW	1123.	1104.	1092.	1086.	1080.	1045.	492.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	CD3	.00	1	FLOW	6.	6.	6.	6.	6.	6.	3.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50

1 SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO=	.00								
7-2Br MANE	4.00	174.34	232.00	2.35	5.00	174.33	230.00	2.35	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1178E+02 EXCESS= .0000E+00 OUTFLOW= .1181E+02 BASIN STORAGE= .4691E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO=	.00							
7-2Br MANE	4.00	171.85	232.00	2.31	5.00	171.52	230.00	2.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1158E+02 EXCESS= .0000E+00 OUTFLOW= .1161E+02 BASIN STORAGE= .4663E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO=	.00							
7-2Br MANE	4.00	170.18	232.00	2.28	5.00	169.65	230.00	2.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1145E+02 EXCESS= .0000E+00 OUTFLOW= .1148E+02 BASIN STORAGE= .4643E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00
7-2Br MANE 4.00 169.35 232.00 2.27 5.00 168.71 230.00 2.27

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1139E+02 EXCESS= .0000E+00 OUTFLOW= .1141E+02 BASIN STORAGE= .4634E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00
7-2Br MANE 4.00 168.52 232.00 2.25 5.00 167.77 230.00 2.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1132E+02 EXCESS= .0000E+00 OUTFLOW= .1135E+02 BASIN STORAGE= .4624E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00
7-2Br MANE 4.00 163.92 232.00 2.18 5.00 162.58 230.00 2.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1096E+02 EXCESS= .0000E+00 OUTFLOW= .1099E+02 BASIN STORAGE= .4519E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00
7-2Br MANE 5.00 81.92 235.00 1.02 5.00 81.92 235.00 1.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5098E+01 EXCESS= .0000E+00 OUTFLOW= .5120E+01 BASIN STORAGE= .3825E-02 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.25 27.73 221.00 2.08 5.00 27.10 220.00 2.08

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1766E+01 EXCESS= .0000E+00 OUTFLOW= .1768E+01 BASIN STORAGE= .1546E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.25 27.28 221.00 2.04 5.00 26.65 220.00 2.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1736E+01 EXCESS= .0000E+00 OUTFLOW= .1738E+01 BASIN STORAGE= .1534E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.50 26.88 220.50 2.02 5.00 26.47 220.00 2.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1718E+01 EXCESS= .0000E+00 OUTFLOW= .1720E+01 BASIN STORAGE= .1509E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.50 26.73 220.50 2.01 5.00 26.32 220.00 2.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1708E+01 EXCESS= .0000E+00 OUTFLOW= .1710E+01 BASIN STORAGE= .1505E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.50 26.58 220.50 2.00 5.00 26.17 220.00 2.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1697E+01 EXCESS= .0000E+00 OUTFLOW= .1700E+01 BASIN STORAGE= .1501E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.25 25.85 221.00 1.93 5.00 25.22 220.00 1.93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1641E+01 EXCESS= .0000E+00 OUTFLOW= .1643E+01 BASIN STORAGE= .1497E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00
RG6Ar MANE 4.25 12.14 225.25 .88 5.00 12.12 225.00 .88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7467E+00 EXCESS= .0000E+00 OUTFLOW= .7478E+00 BASIN STORAGE= .1509E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.50 112.81 220.50 2.08 5.00 111.33 220.00 2.08

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7667E+01 EXCESS= .0000E+00 OUTFLOW= .7672E+01 BASIN STORAGE= .1184E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.50 110.95 220.50 2.04 5.00 109.48 220.00 2.05

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7536E+01 EXCESS= .0000E+00 OUTFLOW= .7541E+01 BASIN STORAGE= .1174E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.50 109.72 220.50 2.02 5.00 108.25 220.00 2.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7448E+01 EXCESS= .0000E+00 OUTFLOW= .7453E+01 BASIN STORAGE= .1167E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.50 109.10 220.50 2.01 5.00 107.63 220.00 2.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7405E+01 EXCESS= .0000E+00 OUTFLOW= .7410E+01 BASIN STORAGE= .1164E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.50 108.48 220.50 2.00 5.00 107.01 220.00 2.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7361E+01 EXCESS= .0000E+00 OUTFLOW= .7366E+01 BASIN STORAGE= .1160E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.50 105.07 220.50 1.93 5.00 103.62 220.00 1.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7121E+01 EXCESS= .0000E+00 OUTFLOW= .7126E+01 BASIN STORAGE= .1142E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RG6Br MANE 4.75 49.71 223.25 .88 5.00 47.83 225.00 .88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3241E+01 EXCESS= .0000E+00 OUTFLOW= .3244E+01 BASIN STORAGE= .1381E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 4.00 125.91 216.00 2.17 5.00 122.95 215.00 2.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7905E+01 EXCESS= .0000E+00 OUTFLOW= .7910E+01 BASIN STORAGE= .8482E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 4.00 123.91 216.00 2.14 5.00 120.97 215.00 2.14

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7772E+01 EXCESS= .0000E+00 OUTFLOW= .7777E+01 BASIN STORAGE= .8409E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 4.00 122.58 216.00 2.11 5.00 119.65 215.00 2.11

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7683E+01 EXCESS= .0000E+00 OUTFLOW= .7688E+01 BASIN STORAGE= .8359E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 4.00 121.92 216.00 2.10 5.00 118.99 215.00 2.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7639E+01 EXCESS= .0000E+00 OUTFLOW= .7644E+01 BASIN STORAGE= .8335E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 4.00 121.25 216.00 2.09 5.00 118.33 215.00 2.09

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7595E+01 EXCESS= .0000E+00 OUTFLOW= .7600E+01 BASIN STORAGE= .8310E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 4.25 117.43 216.75 2.02 5.00 113.57 215.00 2.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7352E+01 EXCESS= .0000E+00 OUTFLOW= .7356E+01 BASIN STORAGE= .9335E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
CP2r MANE 5.00 57.17 220.00 .94 5.00 57.17 220.00 .94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3422E+01 EXCESS= .0000E+00 OUTFLOW= .3425E+01 BASIN STORAGE= .1241E-02 PERCENT ERROR= -.1

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

Storm Drain Hydraulics Calculations

G.C. Wallace, Inc. | Suncreek (Parcel K) 48-inch RCP Lateral | DATE 02/09/15 | FILE: SF6.xls

Storm Drain Manning's n (typ=0.013)= 0.013 | Inlet Structure Type or K_i= 0 | Headwall:Square Edge (cut concrete and CMP)

	CONDUIT DATA									FLOW DATA								ENERGY LOSS DATA																			EGL & HGL				COMMENTS	
																		PIPE	TRANSITION																						
	STATION			PIPE	BOX		IRREG		INVERT ELEV	L	S	A	Φ	Q	V	V2/2g	Sf	Ave.	Fric	Fric	Manhole			Junction			Contraction/ Inlet			Expansion/Outlet			Bend				Misc		CONDUIT		TRANSITION		FULL/	
	FROM (ft)	TO (ft)	T/R	D (in)	SPAN (ft)	RISE (ft)	AREA (ft^2)	HYD RAD (ft)	#	D/S (ft)	U/S (ft)	(ft)		(ft^2)		(cfs)	(ft/s)	(ft)	(S_f)	(S_f)	H_f (ft)	H_f (ft)	Θ (deg)	K_{mh}	H_{mh} (ft)	Θ (deg)	K_j	H_j (ft)	Inlet/ Cont	K_j	H_c (ft)	Θ (deg)	K_e	H_o (ft)	R_{bend} (ft)	Θ (deg)	K_b	H_b (ft)	H_m (ft)	Total (ft)	U/S EGL	U/S HGL	U/S EGL	U/S HGL	PART FLOW	CRTL
1		1000.00		48							3434.36																			Outlet K_o=	1.0												
2	1000.00	1016.50	R	48					1	3434.36	3434.69	16.5	2.00%	12.57	0.0049	84	6.64	0.69	0.0034	0.0034	0.06																	0.00	3442.57	3441.89			FULL	U/S
3	1016.50	1021.50	T	48					1	3434.69	3434.79	5.0	2.00%	12.57	0.0049	80	6.37	0.63	0.0031	0.0032		0.02	0	0.02	0.01	45	0.50	0.37											0.40			3442.97	3442.34	FULL	U/S
4	1021.50	1081.00	R	48					1	3434.79	3435.98	59.5	2.00%	12.57	0.0049	80	6.37	0.63	0.0031	0.0031	0.18																	0.00	3443.16	3442.53			FULL	U/S
5	1081.00									3435.98																																	

Summary of Results

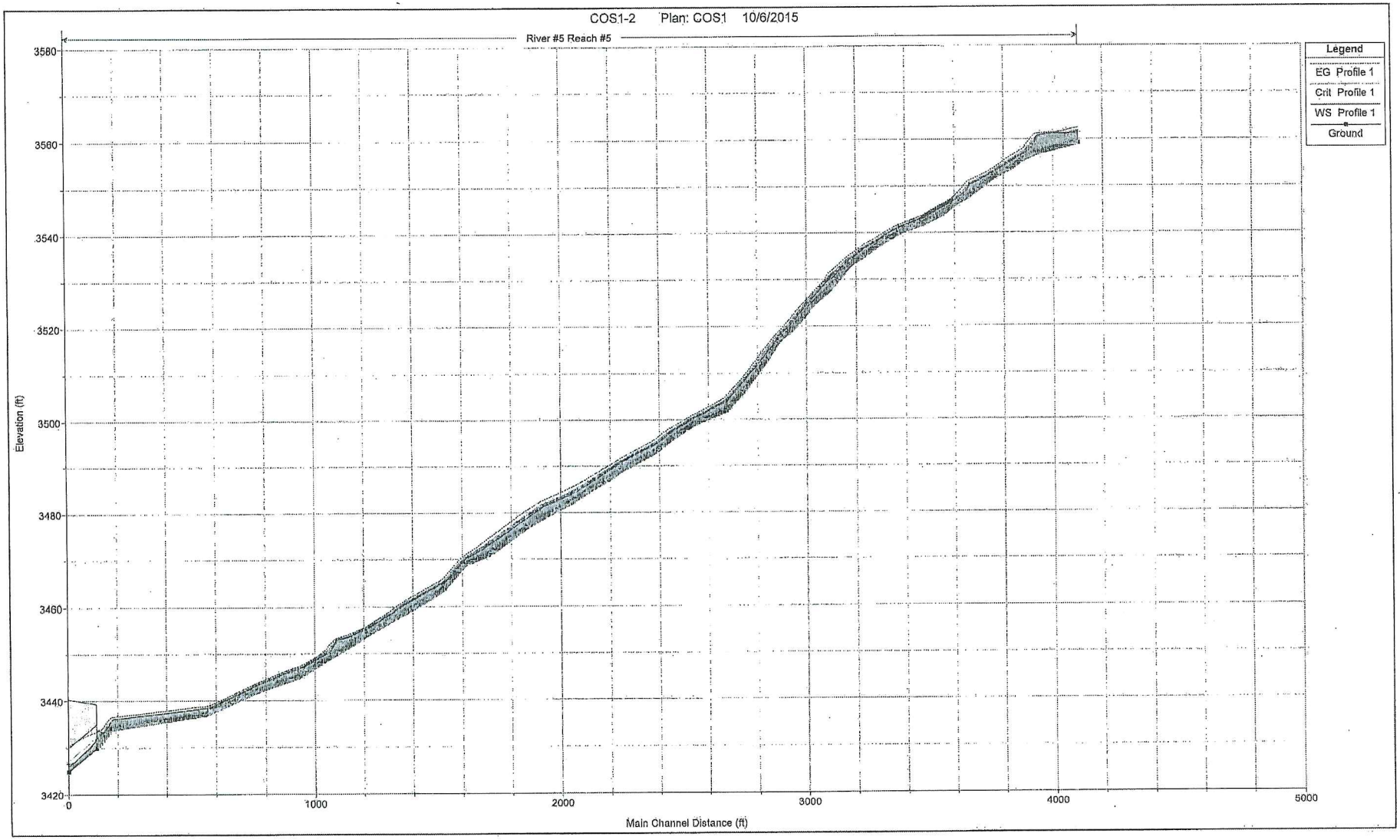
	STATION	INVERT	SOFFIT	EGL	HGL	(Optional) GRADE	(Optional) LOCATION	(Optional) DESCRIPTION	HGL with respect to FG	Pressure Gasket Required?
1	1000.00	3434.36	3438.36	3442.52	3441.83	3444.50			OK	NO
2	1016.50	3434.69	3438.69	3442.57	3441.89	3444.86			OK	NO
3	1021.50	3434.79	3438.79	3442.97	3442.34	3444.86			OK	NO
4	1081.00	3435.98	3439.98	3443.16	3442.53	3445.36			OK	NO

HEC-RAS Plan: COS1 River: River #5 Reach: Reach #5 Profile: Profile 1

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 #5	4325	Profile 1	554.00	3559.20	3561.67	3561.41	3562.39	0.010803	6.99	82.34	40.79	0.83
Reach #5	4250	Profile 1	554.00	3557.99	3561.21		3561.39	0.002730	3.39	163.69	80.29	0.43
Reach #5	4200	Profile 1	554.00	3557.00	3560.10	3560.10	3561.04	0.014727	7.98	73.12	40.72	1.01
Reach #5	4175	Profile 1	554.00	3556.00	3557.08	3557.48	3558.42	0.066507	9.31	59.93	77.68	1.85
Reach #5	4150	Profile 1	554.00	3554.00	3555.52	3555.74	3556.56	0.025882	8.24	68.41	53.10	1.25
Reach #5	4125	Profile 1	554.00	3552.00	3553.15	3553.33	3553.92	0.033486	7.07	79.11	92.37	1.34
Reach #5	4100	Profile 1	554.00	3548.00	3550.39	3550.46	3551.31	0.017363	7.73	72.70	45.38	1.05
Reach #5	4050	Profile 1	554.00	3546.00	3546.62	3547.06	3547.66	0.045670	7.36	75.26	102.92	1.52
Reach #5	4000	Profile 1	554.00	3544.00	3545.58	3545.70	3546.18	0.028578	6.23	89.58	111.53	1.22
Reach #5	3950	Profile 1	554.00	3541.86	3543.08	3543.19	3543.69	0.026954	6.32	88.48	103.68	1.20
Reach #5	3900	Profile 1	554.00	3539.95	3541.19	3541.24	3541.77	0.020546	6.14	90.59	90.61	1.07
Reach #5	3875	Profile 1	554.00	3537.00	3538.02	3538.27	3538.89	0.037485	7.50	74.55	86.88	1.42
Reach #5	3850	Profile 1	554.00	3535.00	3536.69	3536.85	3537.45	0.030546	7.09	79.10	85.29	1.29
Reach #5	3825	Profile 1	554.00	3533.00	3534.27	3534.48	3535.17	0.032313	7.62	73.07	74.03	1.34
Reach #5	3800	Profile 1	554.00	3529.00	3530.70	3531.31	3532.28	0.049439	10.10	54.88	49.29	1.69
Reach #5	3750	Profile 1	554.00	3527.00	3529.15	3529.45	3530.18	0.090505	8.15	67.95	132.70	2.01
Reach #5	3700	Profile 1	554.00	3525.00	3526.46	3526.75	3527.45	0.057452	7.97	69.48	99.80	1.58
Reach #5	3675	Profile 1	554.00	3522.00	3523.64	3524.02	3524.84	0.056616	8.76	63.24	77.89	1.71
Reach #5	3650	Profile 1	554.00	3519.00	3520.42	3520.83	3521.77	0.058551	9.31	59.49	68.82	1.77
Reach #5	3600	Profile 1	554.00	3517.00	3518.03	3518.28	3518.89	0.057851	7.47	74.21	118.49	1.66
Reach #5	3550	Profile 1	554.00	3513.00	3514.53	3515.14	3515.97	0.063701	9.62	57.57	67.12	1.83
Reach #5	3450	Profile 1	554.00	3510.00	3511.60	3512.13	3512.99	0.068511	9.46	58.60	74.21	1.87
Reach #5	3400	Profile 1	554.00	3506.00	3508.11	3506.40	3509.11	0.065090	8.04	68.95	107.10	1.76
Reach #5	3300	Profile 1	554.00	3502.00	3503.79	3504.25	3505.13	0.055613	9.29	59.63	66.13	1.72
Reach #5	3250	Profile 1	554.00	3499.00	3500.32	3500.44	3501.01	0.025105	6.74	83.44	84.31	1.18
Reach #5	3200	Profile 1	554.00	3496.00	3497.56	3497.75	3498.40	0.028328	7.41	75.91	73.19	1.27
Reach #5	3170	Profile 1	554.00	3493.00	3494.61	3494.94	3495.76	0.042775	8.62	64.45	66.99	1.54
Reach #5	3100	Profile 1	554.00	3489.00	3490.85	3491.04	3491.70	0.029294	7.43	75.55	74.13	1.28
Reach #5	3075	Profile 1	554.00	3487.00	3488.89	3489.16	3489.95	0.030824	8.27	67.51	59.05	1.34
Reach #5	3050	Profile 1	554.00	3485.00	3486.52	3486.86	3487.79	0.032474	9.09	61.87	49.25	1.40
Reach #5	3000	Profile 1	554.00	3482.00	3483.80	3484.19	3485.22	0.026575	9.73	59.23	37.78	1.32
Reach #5	2950	Profile 1	554.00	3479.00	3481.41	3481.72	3482.62	0.022922	9.09	64.04	40.26	1.22
Reach #5	2900	Profile 1	554.00	3477.00	3478.83	3479.33	3480.50	0.034673	10.51	54.43	37.90	1.49
Reach #5	2850	Profile 1	554.00	3474.00	3475.97	3476.46	3477.58	0.040710	10.31	55.12	43.87	1.58
Reach #5	2800	Profile 1	554.00	3471.00	3473.13	3473.56	3474.56	0.038158	9.70	58.64	48.72	1.52
Reach #5	2750	Profile 1	554.00	3469.00	3470.18	3470.38	3471.00	0.032806	7.23	76.58	83.72	1.33
Reach #5	2700	Profile 1	554.00	3466.00	3467.14	3467.51	3468.32	0.055858	8.74	63.38	77.76	1.71
Reach #5	2675	Profile 1	554.00	3463.85	3465.00	3465.37	3466.17	0.061808	8.77	64.07	86.39	1.78
Reach #5	2650	Profile 1	554.00	3461.00	3462.85	3463.00	3463.59	0.029079	6.97	80.44	86.19	1.26
Reach #5	2550	Profile 1	554.00	3457.75	3459.41	3459.56	3460.11	0.033238	6.78	82.38	100.47	1.32
Reach #5	2500	Profile 1	554.00	3454.00	3455.22	3455.33	3455.71	0.036236	5.65	98.15	158.34	1.30
Reach #5	2475	Profile 1	554.00	3452.00	3453.85	3453.90	3454.38	0.022384	5.83	95.02	108.17	1.09
Reach #5	2450	Profile 1	554.00	3450.00	3452.80	3452.80	3453.21	0.021164	5.13	108.50	143.91	1.04
Reach #5	2400	Profile 1	554.00	3448.00	3449.22	3449.40	3449.88	0.041141	6.53	84.80	127.86	1.41
Reach #5	2350	Profile 1	554.00	3445.00	3446.90	3446.86	3447.25	0.017090	4.77	116.39	146.82	0.94
Reach #5	2275	Profile 1	554.00	3442.00	3443.32	3443.35	3443.76	0.023792	5.34	104.28	142.72	1.10
Reach #5	2200	Profile 1	554.00	3437.00	3438.45		3438.75	0.003746	4.65	137.28	115.47	0.68
Reach #5	2055	Profile 1	554.00	3434.00	3435.83	3435.83	3436.47	0.030900	6.42	86.23	69.07	1.01
Reach #5	2054	Profile 1	554.00	3430.00	3433.67	3431.67	3433.84	0.000165	3.32	166.85	56.50	0.31
Reach #5	2053		Culvert									
Reach #5	2052	Profile 1	554.00	3425.00	3426.14	3426.71	3428.05	0.007912	11.09	49.98	79.15	1.83

Plan: COS1 River #5 Reach #5 RS: 2053 Culv Group: Crossbridge Profile: Profile 1

Q Culv Group (cfs)	554.00	Culv Full Len (ft)	
# Barrels	6	Culv Vel US (ft/s)	8.41
Q Barrel (cfs)	92.33	Culv Vel DS (ft/s)	16.26
E.G. US. (ft)	3433.84	Culv Inv El Up (ft)	3430.00
W.S. US. (ft)	3433.67	Culv Inv El Dn (ft)	3425.00
E.G. DS (ft)	3427.56	Culv Frctn Ls (ft)	3.05
W.S. DS (ft)	3426.71	Culv Exit Loss (ft)	2.69
Delta EG (ft)	6.29	Culv Entr Loss (ft)	0.55
Delta WS (ft)	6.95	Q Weir (cfs)	
E.G. IC (ft)	3433.49	Weir Sta Lft (ft)	
E.G. OC (ft)	3433.84	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	3432.20	Weir Max Depth (ft)	
Culv WS Outlet (ft)	3426.14	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	1.08	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.20	Min El Weir Flow (ft)	3441.01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River #5 Reach #5
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Crit Profile 1
WS Profile 1
Ground
Elevation (ft)
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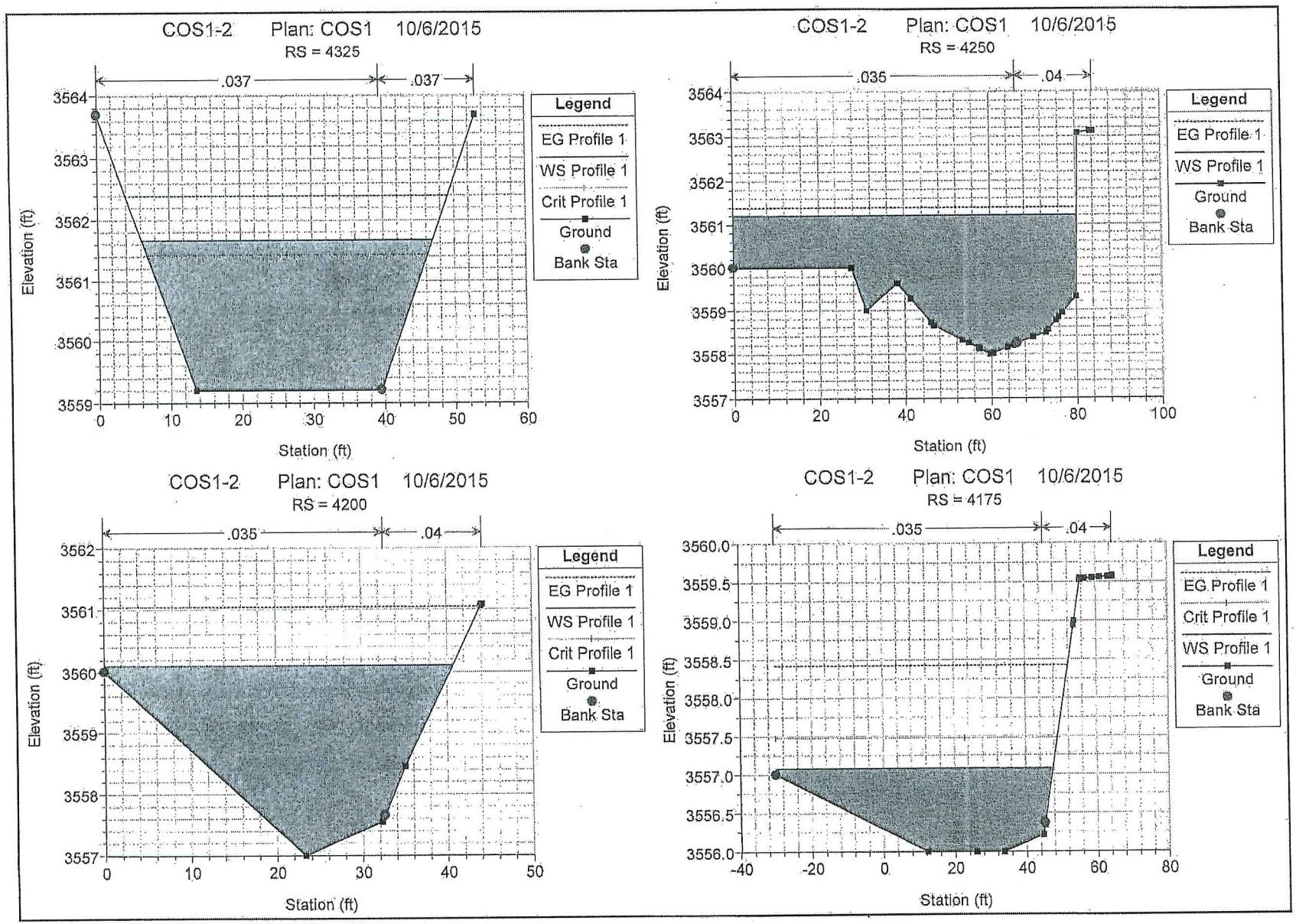
3560
3540
3520
3500
3480
3460
3440
3420
0
1000
2000
3000
4000
5000
Main Channel Distance (ft)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Station (ft)
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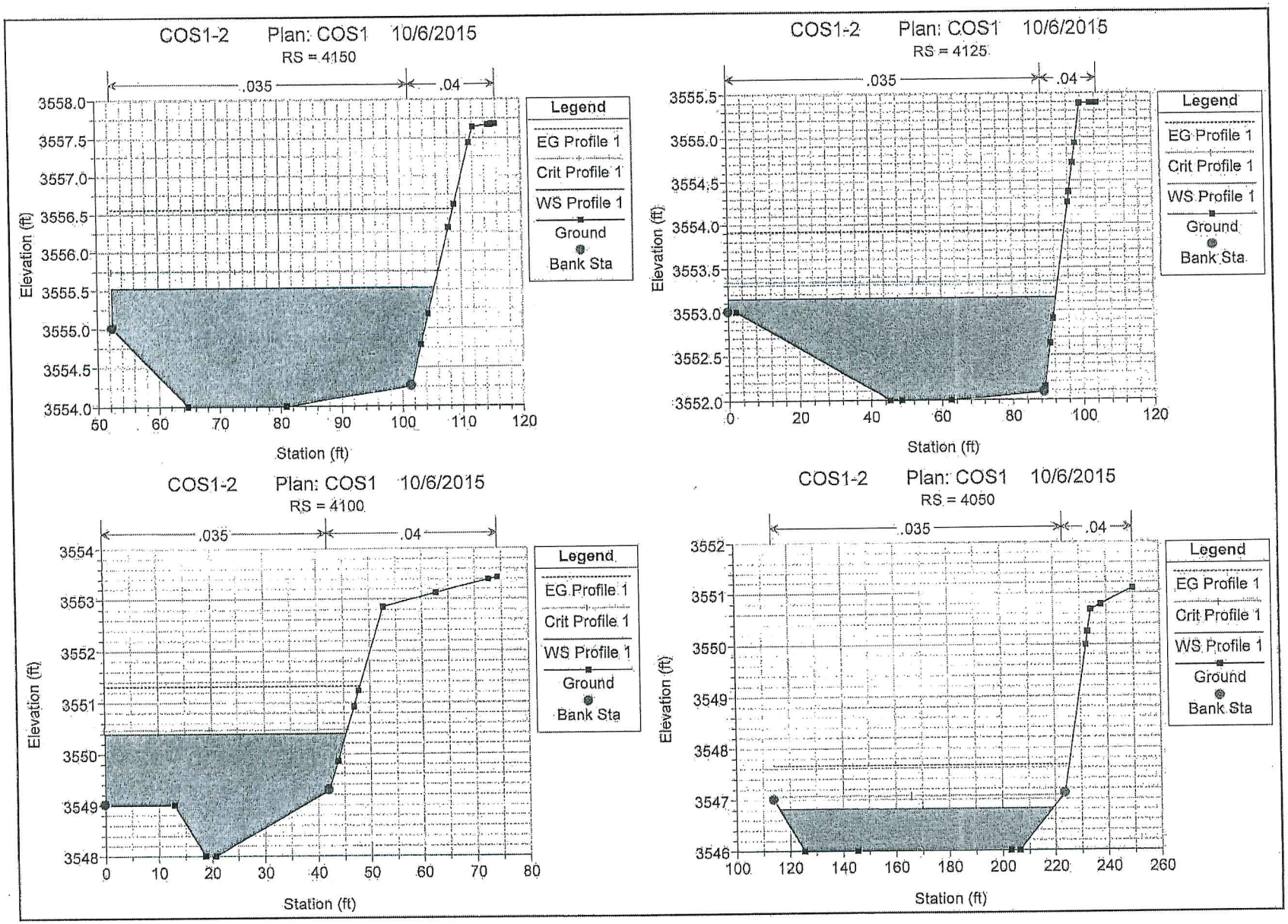
Station (ft)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Station (ft)
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Station (ft)
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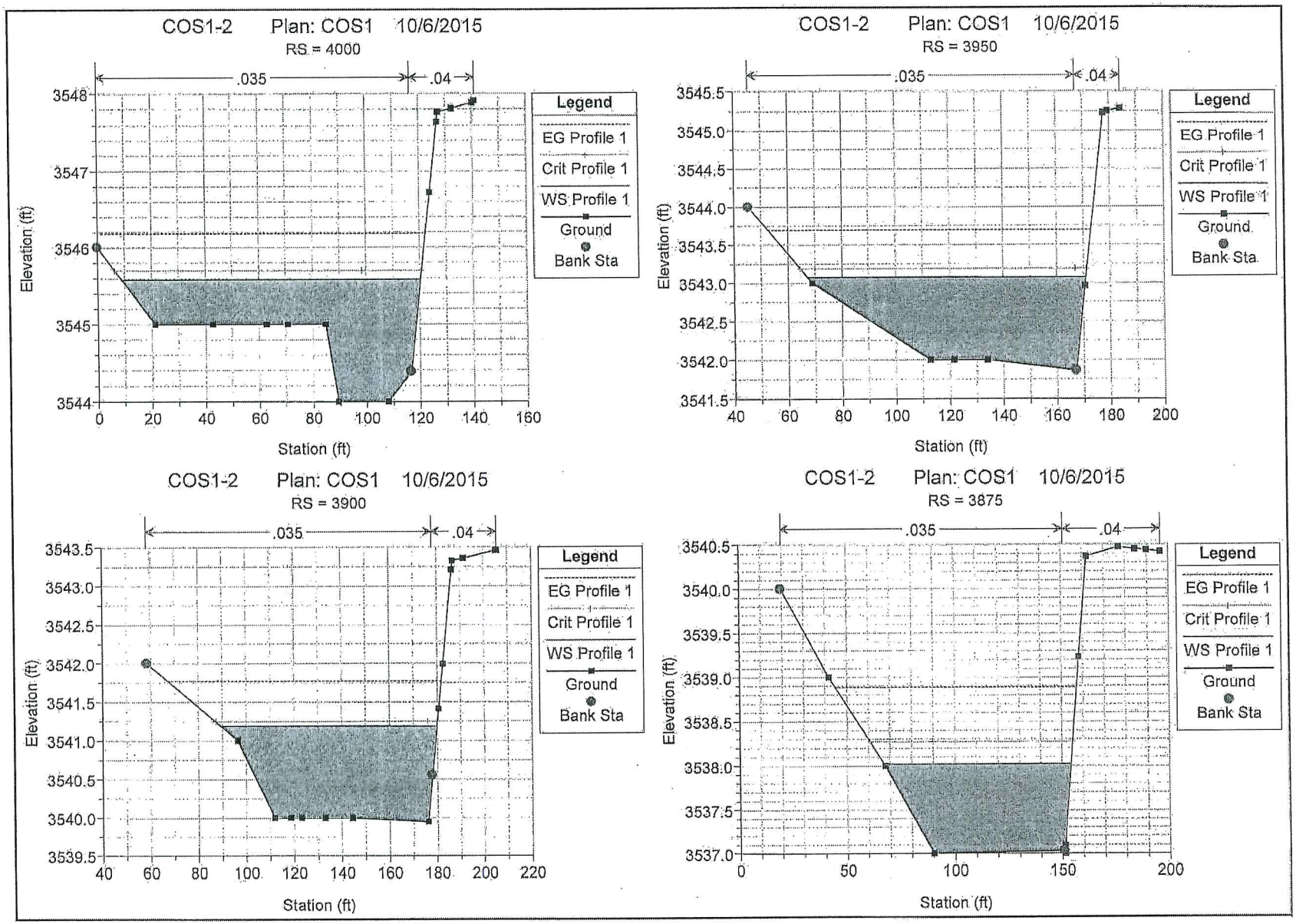
WS Profile 1
Ground
Bank Sta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Bank Sta
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Station (ft)
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Bank Sta
COS1-2 Plan: COS1 10/6/2015
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Elevation (ft)
Station (ft)
Legend
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Crit Profile 1
WS Profile 1
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Bank Sta
COS1-2 Plan: COS1 10/6/2015
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Station (ft)
Legend
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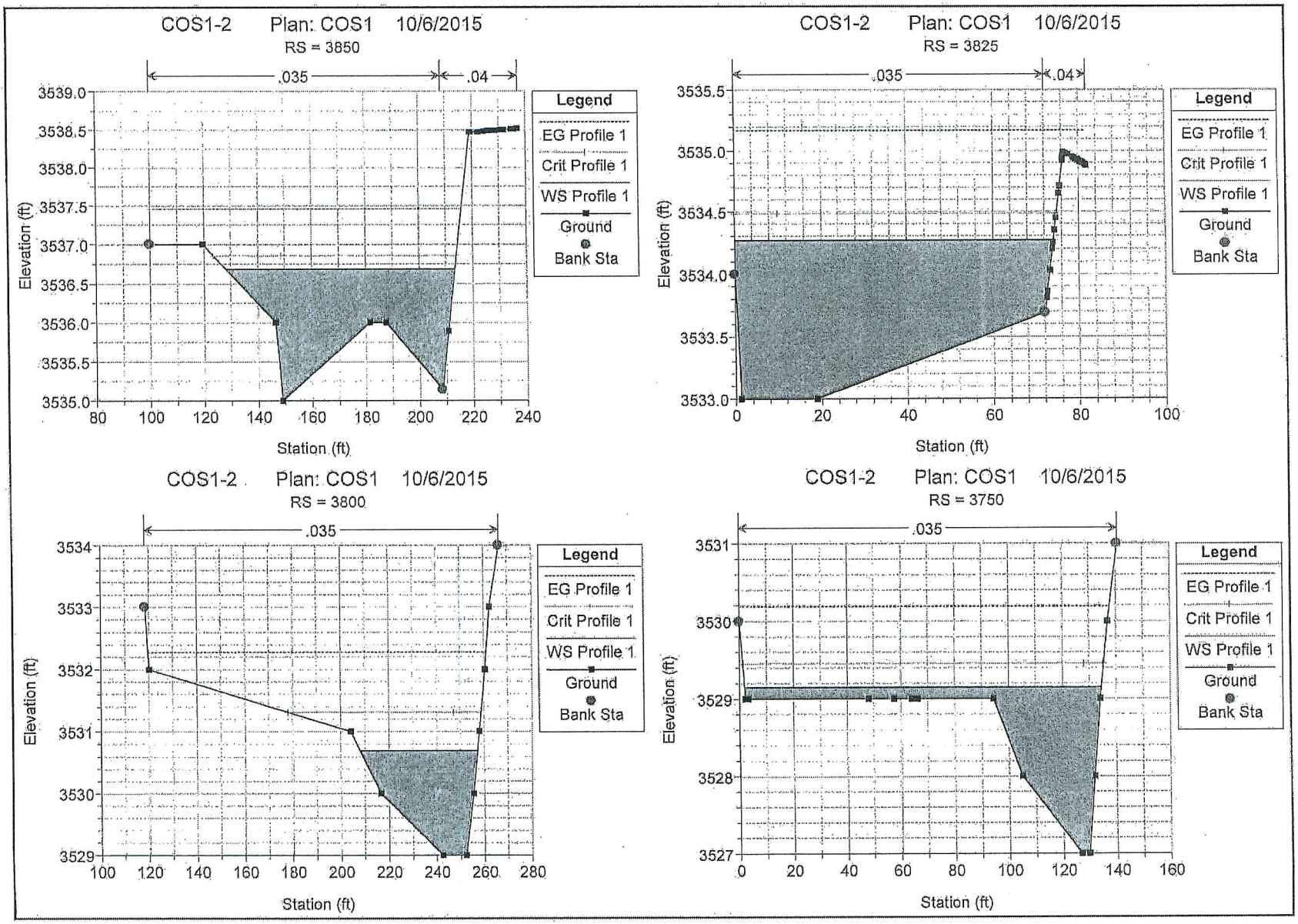
Bank Sta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Station (ft)
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WS Profile 1
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Station (ft)
Legend
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WS Profile 1
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Bank Sta
COS1-2 Plan: COS1 10/6/2015
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Station (ft)
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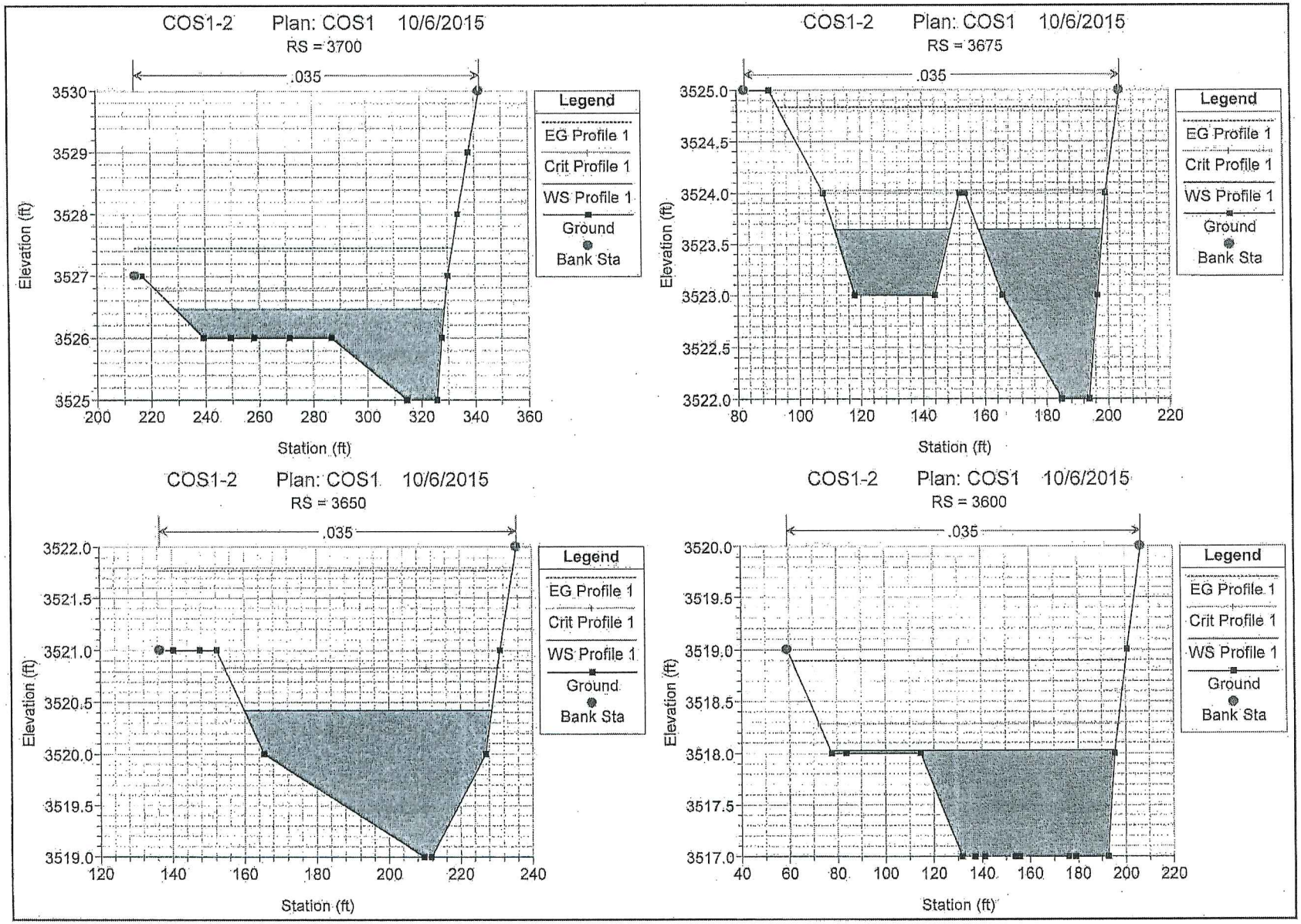
Ground
Bank Sta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Bank Sta
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Station (ft)
COS1-2 Plan: COS1 10/6/2015
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Legend
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Crit Profile 1
WS Profile 1
Ground
Bank Sta
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Station (ft)
COS1-2 Plan: COS1 10/6/2015
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Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
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Legend
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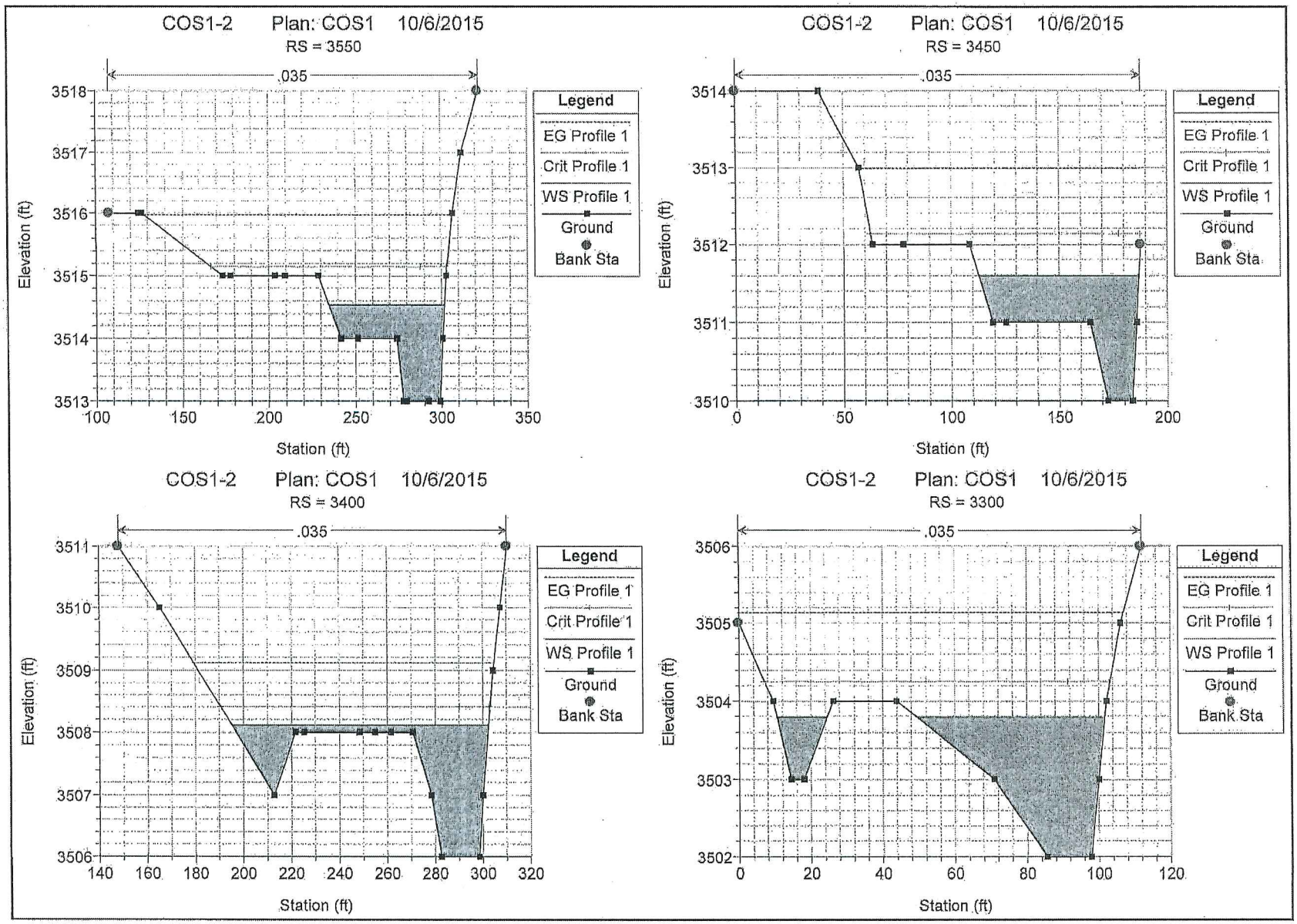
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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Bank Sta
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Station (ft)
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Crit Profile 1
WS Profile 1
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Bank Sta
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Station (ft)
Legend
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Crit Profile 1
WS Profile 1
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Bank Sta
COS1-2 Plan: COS1 10/6/2015
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Station (ft)
Legend
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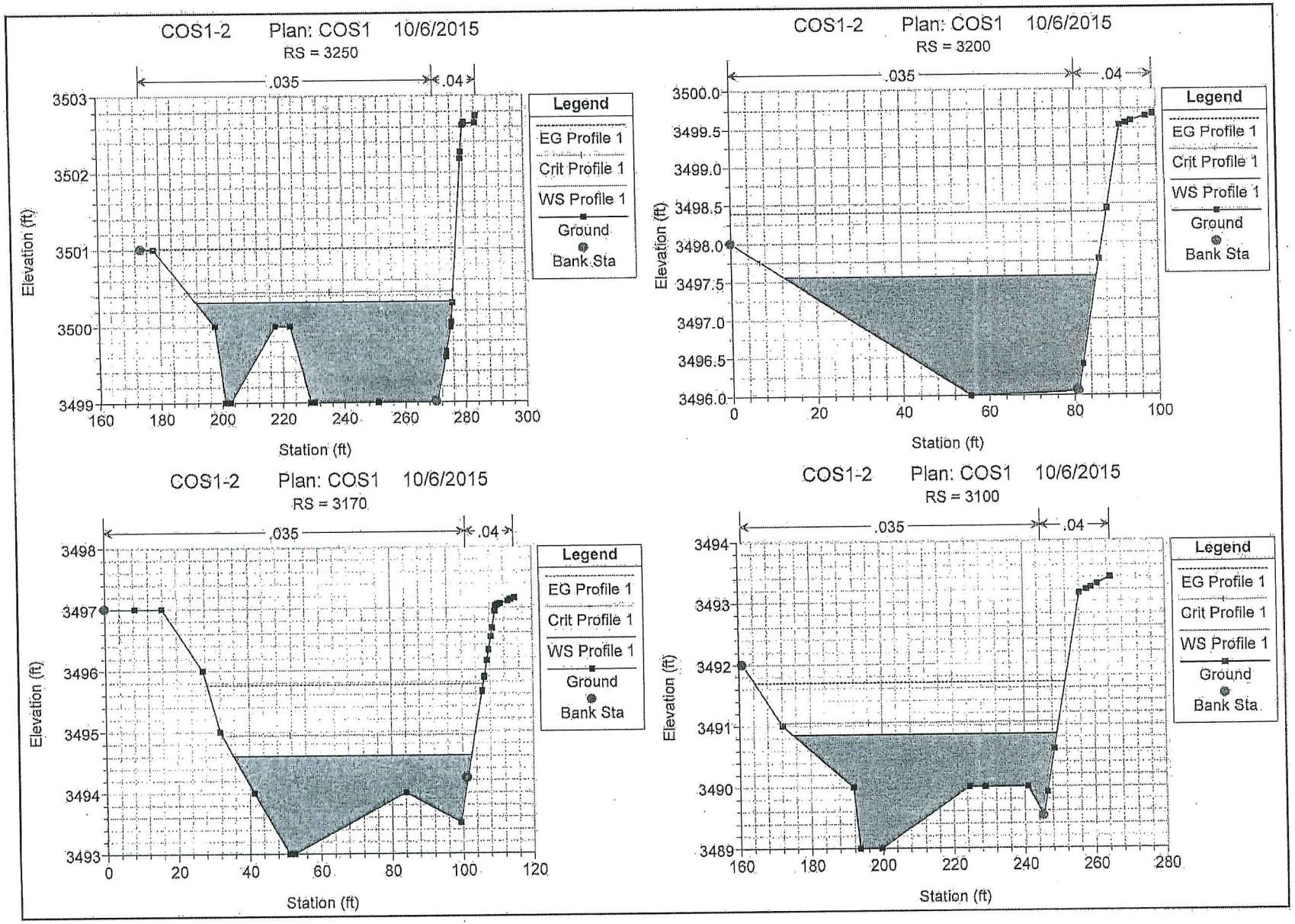
Crit Profile 1
WS Profile 1
Ground
Bank Sta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Station (ft)
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Crit Profile 1
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
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WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
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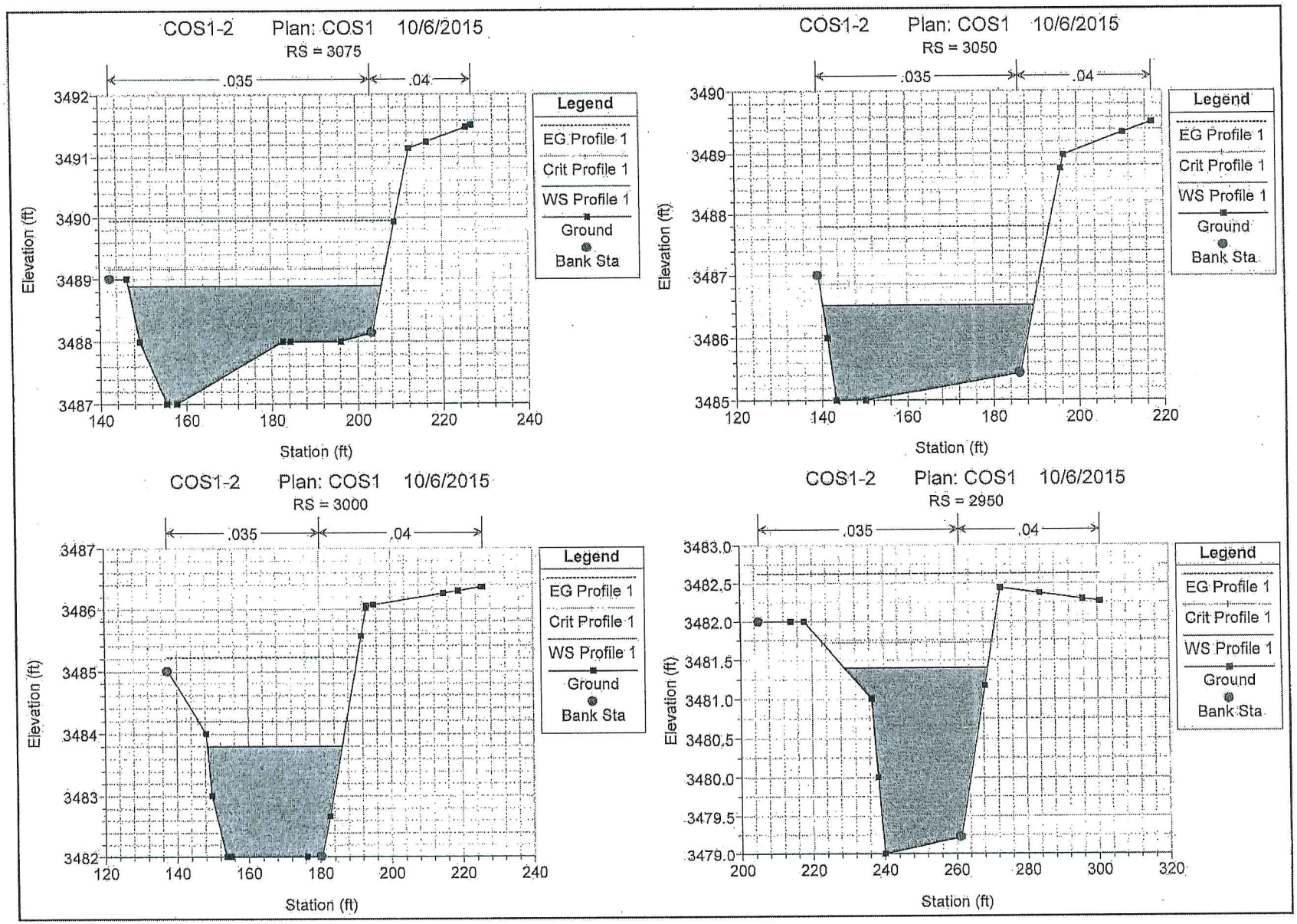
Bank Sta
Elevation (ft)
Station (ft)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Station (ft)
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Legend
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WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
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Legend
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Bank Sta
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Station (ft)
COS1-2 Plan: COS1 10/6/2015
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Legend
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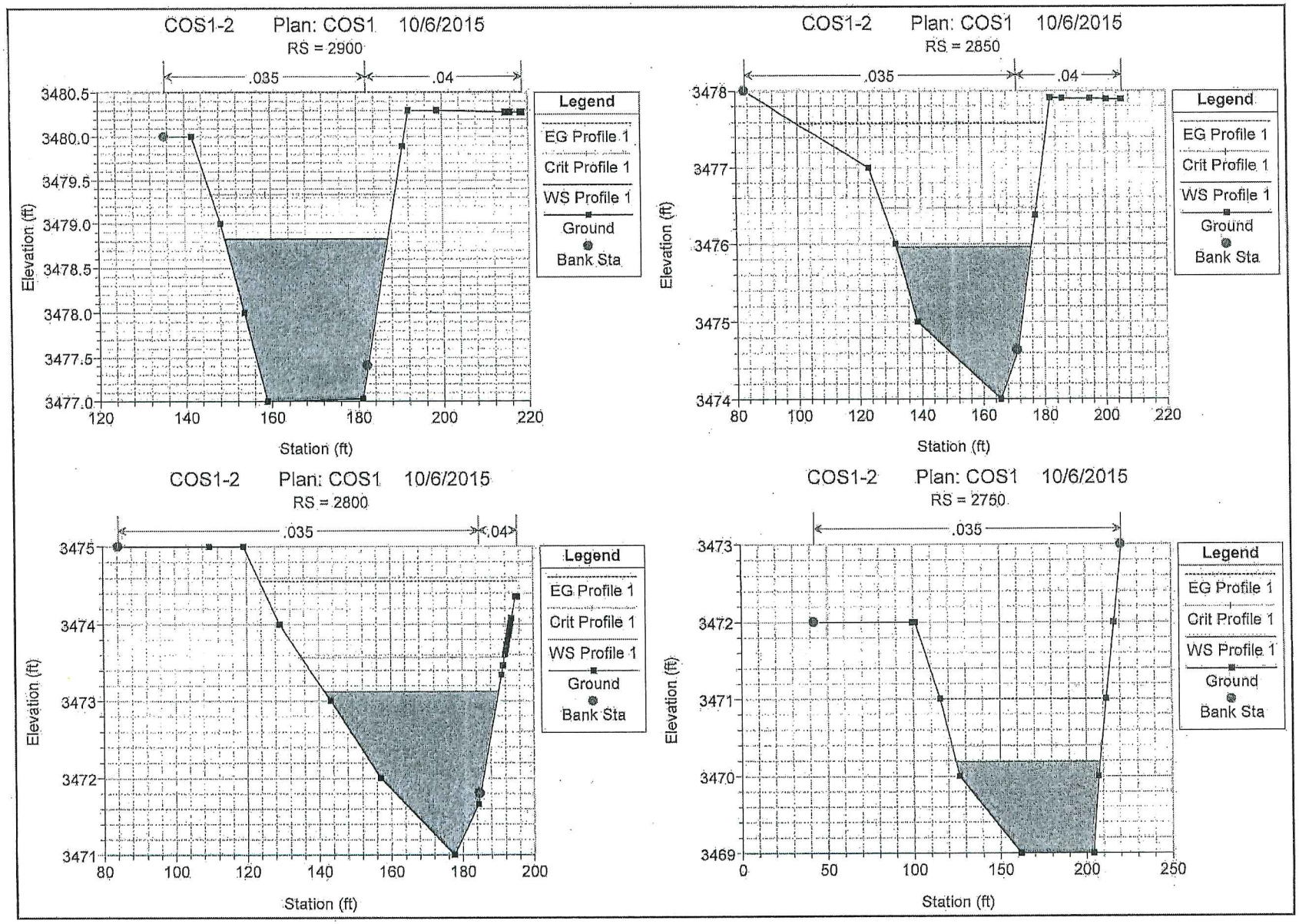
WS Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 2850
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.04
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
RS = 2800
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Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta
COS1-2 Plan: COS1 10/6/2015
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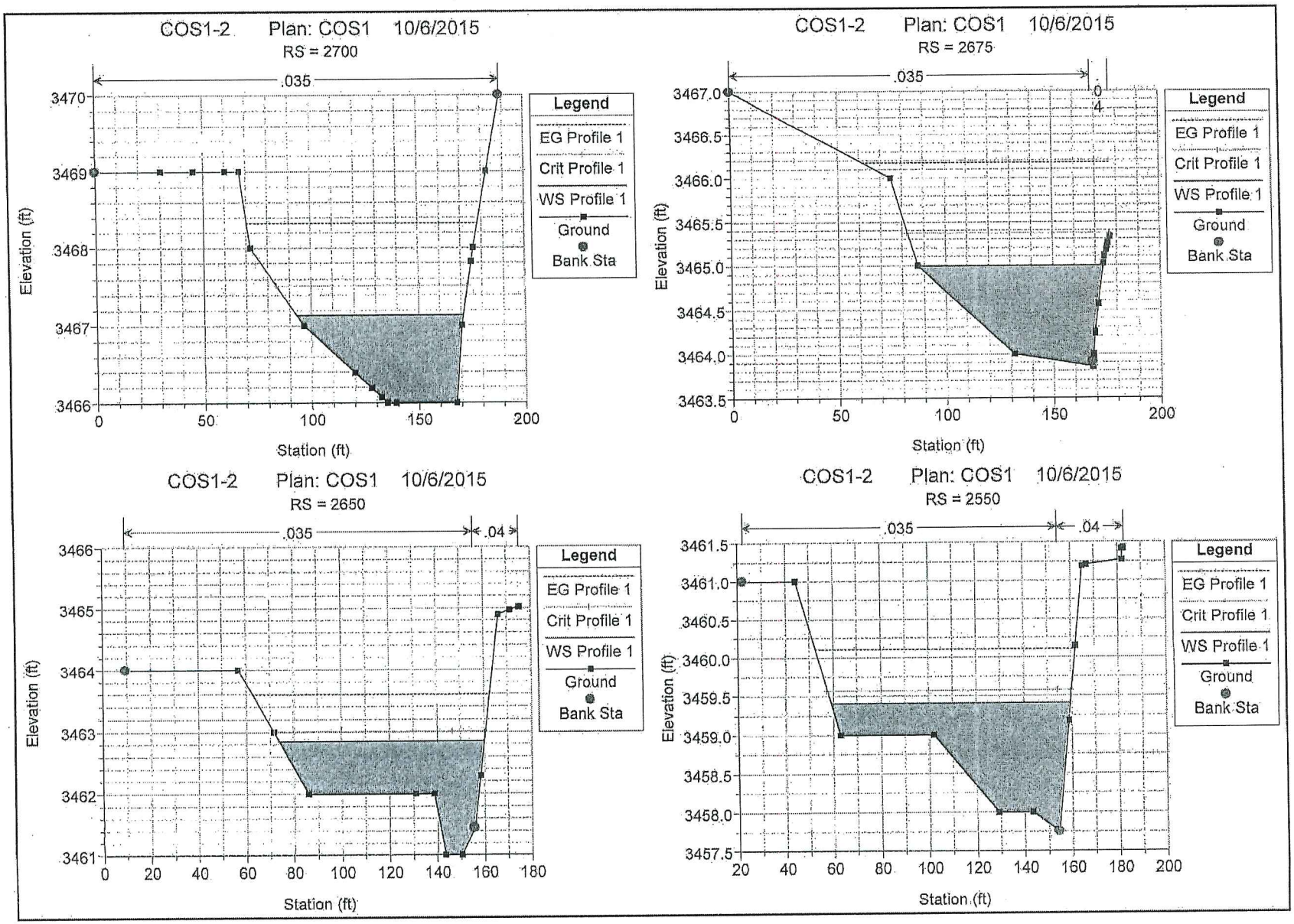
Elevation (ft)
Station (ft)
Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Bank Sta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Ground
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
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WS Profile 1
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Bank Sta
Elevation (ft)
Station (ft)
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Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
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WS Profile 1
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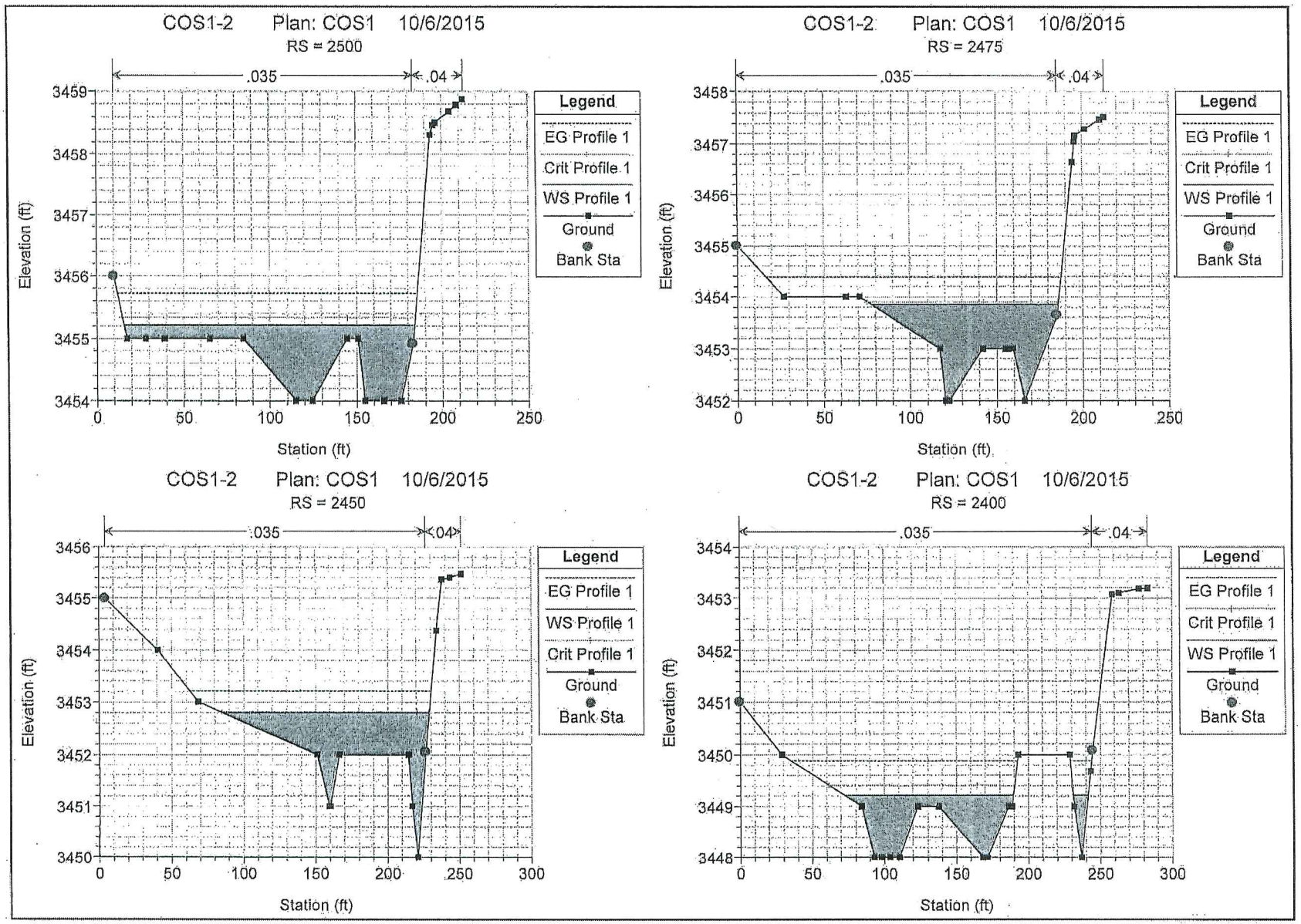
Bank Sta
Elevation (ft)
Station (ft)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Bank Sta
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Station (ft)
COS1-2 Plan: COS1 10/6/2015
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Crit Profile 1
WS Profile 1
Ground
Bank Sta
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Station (ft)
COS1-2 Plan: COS1 10/6/2015
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Legend
EG Profile 1
WS Profile 1
Crit Profile 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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Bank Sta
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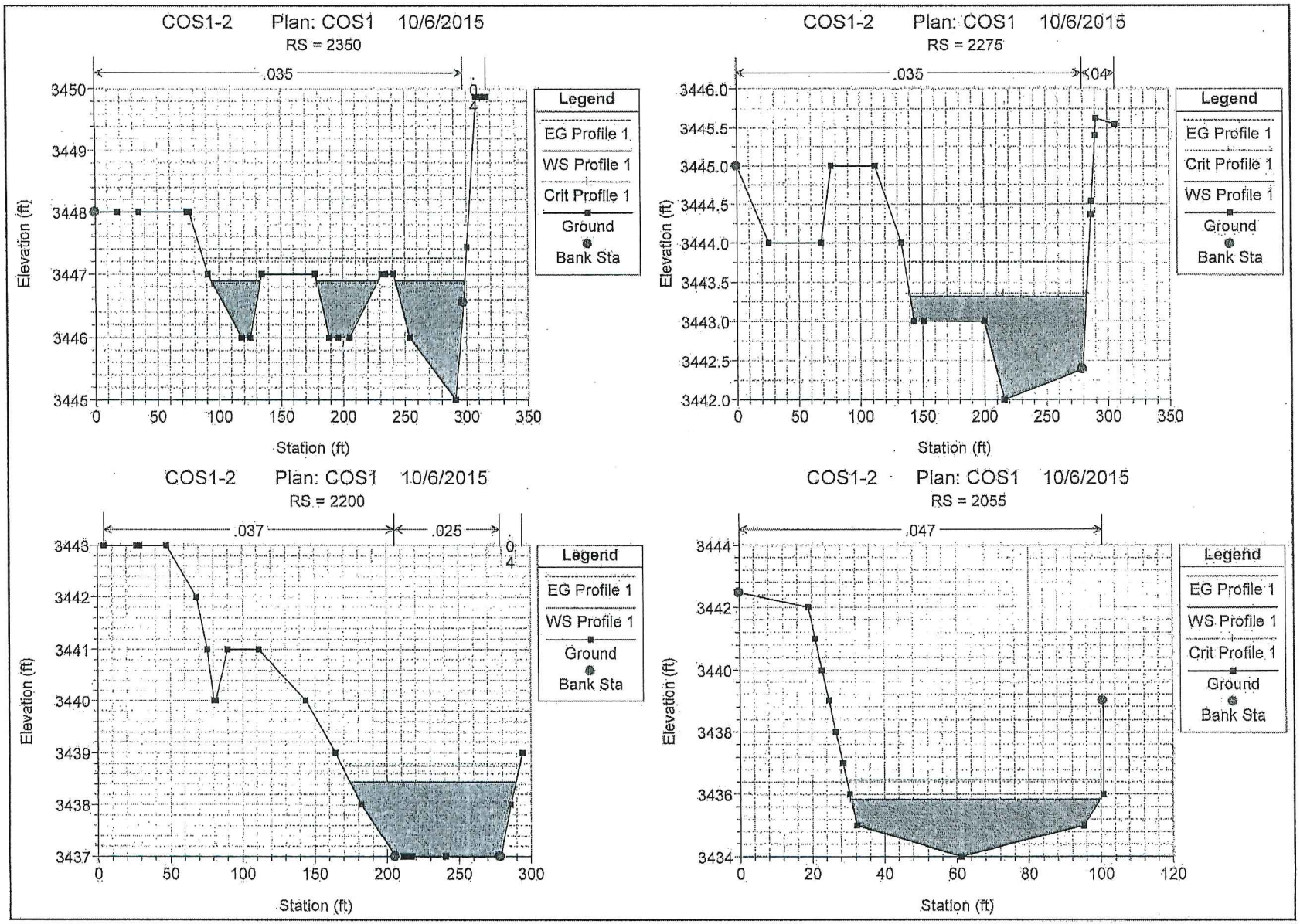
Station (ft)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Bank Sta
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Station (ft)
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Bank Sta
Elevation (ft)
Station (ft)
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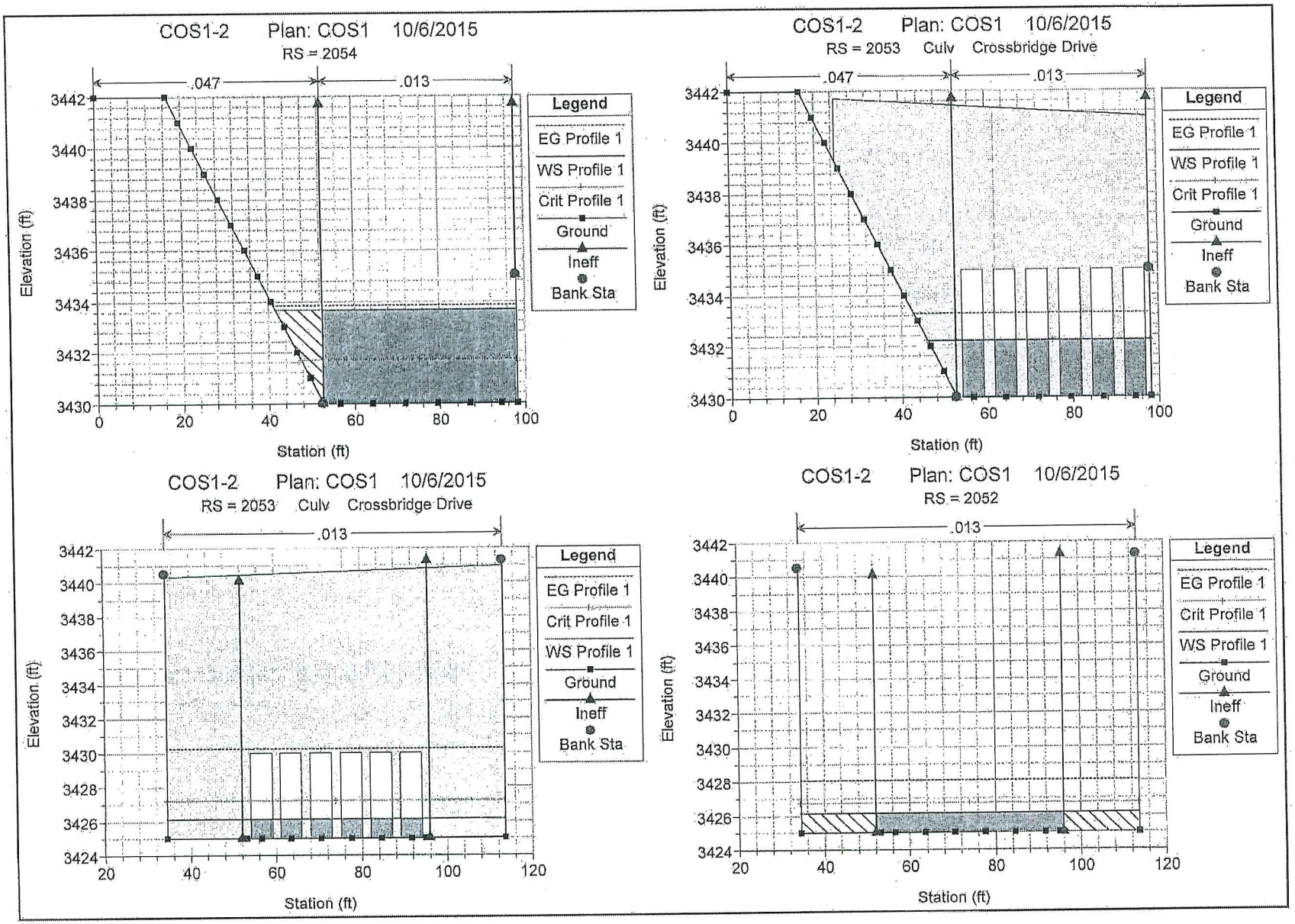
Station (ft)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Station (ft)
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Station (ft)
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Ineff
Bank Sta
Elevation (ft)
Station (ft)
COS1-2 Plan: COS1 10/6/2015
RS = 2052
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Legend
EG Profile 1
Crit Profile 1
WS Profile 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

BOX CULVERT

Crossbridge Drive Sta 41+00 (Inlet)

INPUT

Width of Box	5.00	ft
Height of Box	5.00	ft
Number of Barrels	6	
Length	100.00	ft
Slope	4.36	%
Manning's 'n'	0.015	
Flow "Q"	554	cfs
Entrance Coef.	0.35	
Tail Water	0	ft

INLET

45d WWall	3.40	ft
Sq. Edge	3.63	ft
Beveled	3.46	ft
Tapered	3.32	ft

OUTLET

Head Water	N/A	ft
Critical	5.00	ft
Velocity	3.69	ft/s

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS

Channel Protection Sizing Using Equation 718

Known:

d50=	Riprap size (in)	36
Sg=	Specific Gravity of Rock (typ=2.5)	2.5
s=	Longitudinal Channel Slope (ft/ft)	0.040

$$Vel=3*(d_{50}^{0.5})*(Sg-1)/(S^{0.17})$$

Solve For:

Max Allowable Velocity= 13.47 fps

USBR TYPE IV STILLING BASIN

Flow Characteristics				Chute Blocks			Sill	Basin			Total	
US Depth (d_1,ft)	US Froude # (F_1,ft)	DS Depth[1] (d_2,ft)	T.W.[2] (ft)	Height (ft)	Width (ft)	Spacing (ft)	Height (ft)	L_j/d_2[3] (ft/ft)	Length (ft)	Width (ft)	Cells (#)	Width (ft)
1.1	2.9	3.9	4.3	2.2	1.1	2.7	1.4	5.2	20	9	6	54

[1] From equation $d_2/d_1=0.5*((1+8F^2)^{0.5}-1)$

[2] Tailwater Depth, from equation $T.W./d_2=1.1$

[3] Basin length to downstream depth ratio, from Figure 9-39

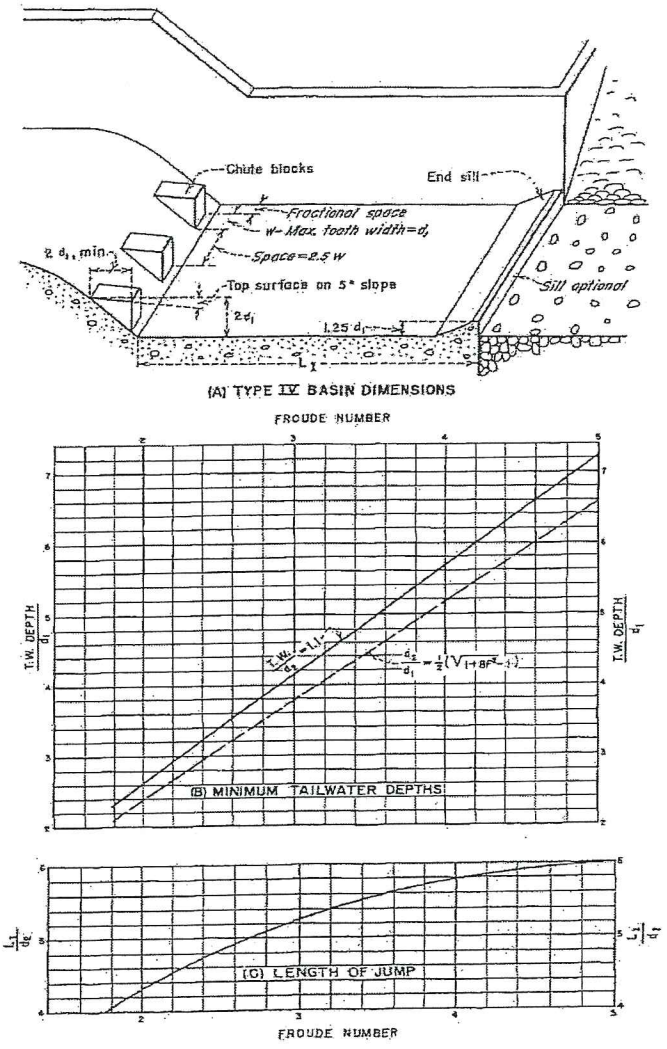


Figure 9-39.—Stilling basin characteristics for Froude numbers between 2.5 and 4.5. 288-D-2425.

Design information taken from Design of Small Dams by the US Bureau of Reclamation, pg. 390.

Worksheet for (6) - 5x5 Crossbridge Drive Sta 41+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.015	
Channel Slope	4.36000	%
Height	5.00	ft
Bottom Width	5.00	ft
Discharge	93.00	ft^3/s

Results

Normal Depth	1.08	ft
Flow Area	5.42	ft^2
Wetted Perimeter	7.17	ft
Hydraulic Radius	0.76	ft
Top Width	5.00	ft
Critical Depth	2.21	ft
Percent Full	21.7	%
Critical Slope	0.00585	ft/ft
Velocity	17.16	ft/s
Velocity Head	4.58	ft
Specific Energy	5.66	ft
Froude Number	2.91	
Discharge Full	600.06	ft^3/s
Slope Full	1.81511	ft/ft
Flow Type	Supercritical	

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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	21.67	%
Downstream Velocity	Infinity	ft/s

Worksheet for (6) - 5x5 Crossbridge Drive Sta 41+00

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.08	ft
Critical Depth	2.21	ft
Channel Slope	4.36000	%
Critical Slope	0.00585	ft/ft

Cross Section for (6) - 5x5 Crossbridge Drive Sta 41+00

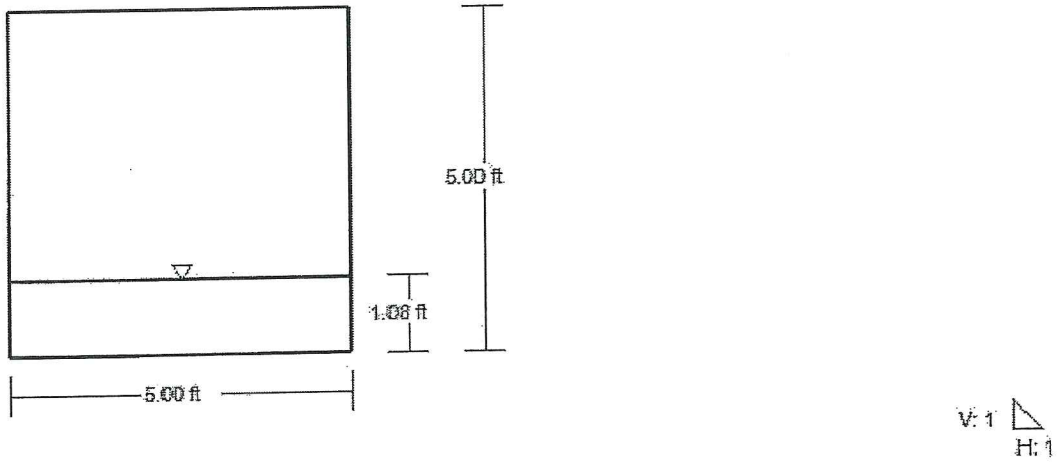
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.015	
Channel Slope	4.36000	%
Normal Depth	1.08	ft
Height	5.00	ft
Bottom Width	5.00	ft
Discharge	93.00	ft³/s

Cross Section Image



provide sufficient maintenance access to the culvert cells. A concrete pad has been provided in lieu of riprap at the upstream and downstream end of the cells to provide a buffer to turn. Additionally, the access ramp on the west side of Crossbridge Drive has been shifted to avoid the drop inlet at approximate Station 42+00.

Comment: "3. **Sheet 40:**

"The proposed 12"-high tumbling blocks within the 6# 5'x4' RCBs appear to pose difficulty for maintenance crew when they need repair in the future. This may merit taller and wider boxes. Also, the 30"-d_{50} riprap at the downstream ends of the culverts appear not drivable for the maintenance vehicles. These concerns must be discussed and resolved with the *City Street & Sanitation Department* prior to the final approval of the drainage study."

Response: Based on discussions with CLV Flood and Streets and Sanitation Department, it was determined that a stilling basin for energy dissipation should be located at the downstream end of the culverts outside of the RCBs for ease of maintenance. Additionally, the culverts have been revised to six (6) - 5-foot wide by 5- foot high RCBs to address maintenance access concerns. In order to provide the additional 1-foot of height, the profile of the RCBs was revised. Revised hydraulic calculations have been included in Appendix B. Section 1002.3 of the Manual specifies that an energy dissipater be provided for outlet velocities greater than 15 fps. Based on a maximum discharge of 93 cfs (554 cfs / 6 RCB cells = 93 cfs / RCB cell) from one 5-foot wide by 5-foot high RCB cell at the outlet, the exit velocity is approximately 17.2 fps under a supercritical flow regime. Therefore, a USBR Type IV Stilling Basin has been provided at the culvert crossing outlet for energy dissipation. Calculations used to determine the dimensions for the USBR Type IV Stilling Basin have been included in Appendix B. The dimensions have been labeled on the improvement plans. Structural calculations for the stilling basin will be submitted hereafter. We request that the structural calculations for the USBR Type IV Stilling Basin be a condition of approval. Copies of the normal depth calculations have been included in Appendix B.

Culverts @ Crossbridge w/Stilling Basin

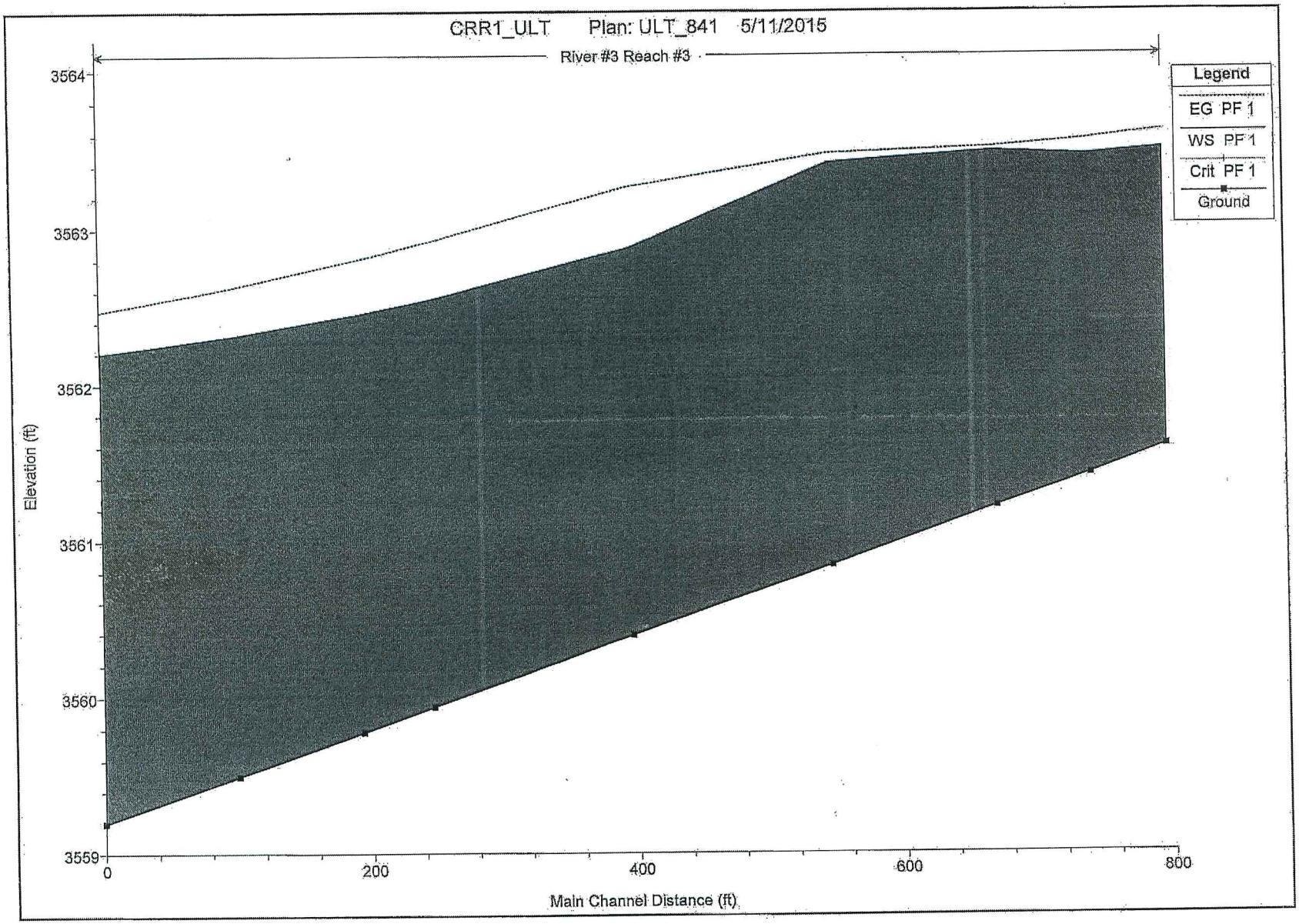
Due to the revised culvert crossing and stilling basin, the hydraulic models and calculations have been updated to account for the revised culvert slopes. The hydraulic model for COS-1 and COS-2 was previously submitted as one model and has been re-analyzed as two separate models (COS1 and COS2) with this report. The COS1 HEC-RAS Model runs from the western boundary channel and ends at the outlet of the proposed culvert upstream of the stilling basin. The COS2 HEC-RAS Model begins at the downstream end of the stilling basin and ends at the existing downstream facilities located at the intersection of Sky Vista and Crossbridge Drive. Copies of the revised models have been included Appendix B. Digital copies of the models and reports have been included on CD in Appendix B.

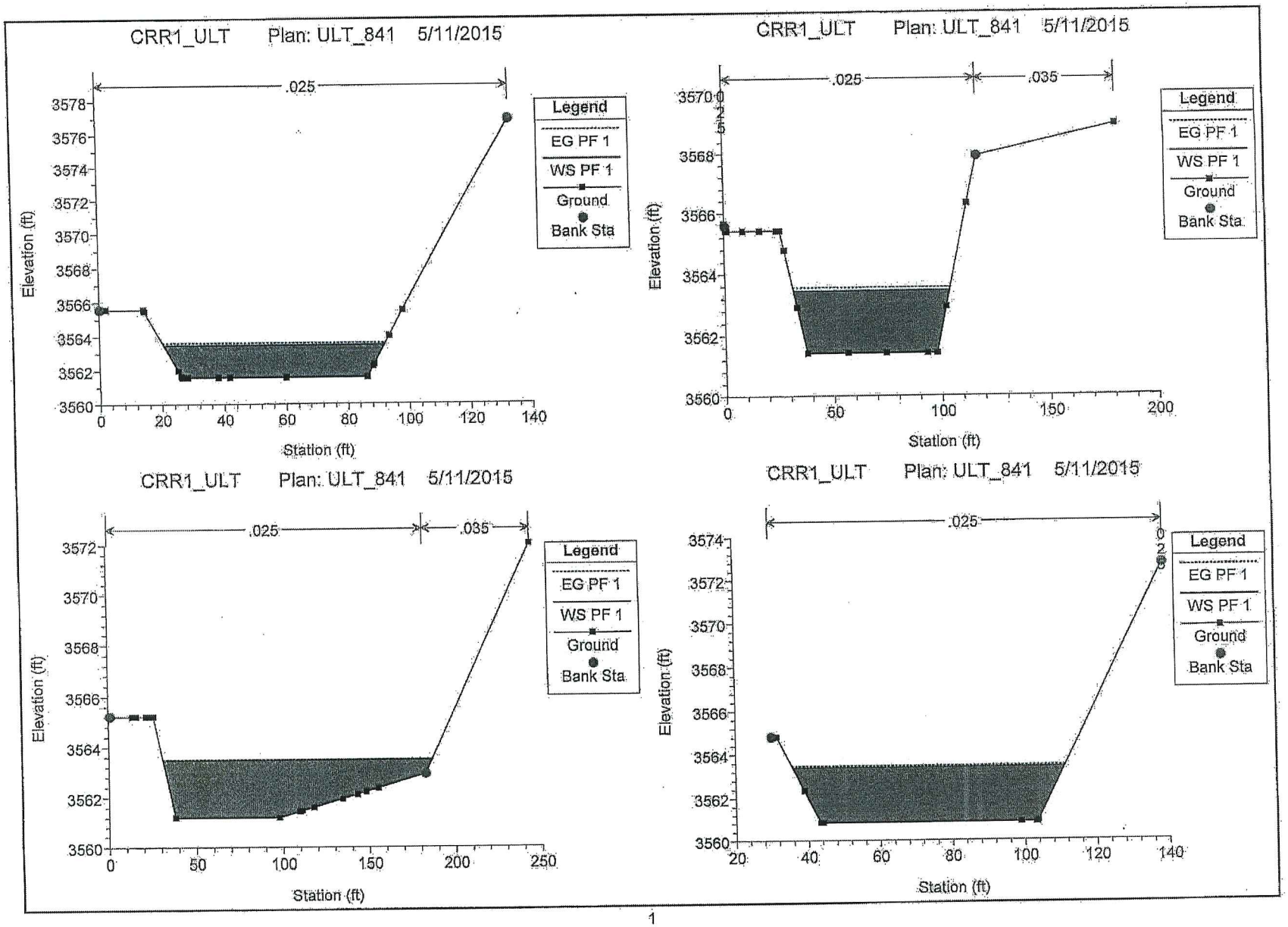
A 9-foot wide concrete pad has been provided at the upstream and downstream ends of the culvert to provide drivable access from the access ramps to the culverts. The width and location of the drivable access ramps and concrete pads have been coordinated with the CLV Streets and Sanitation department.

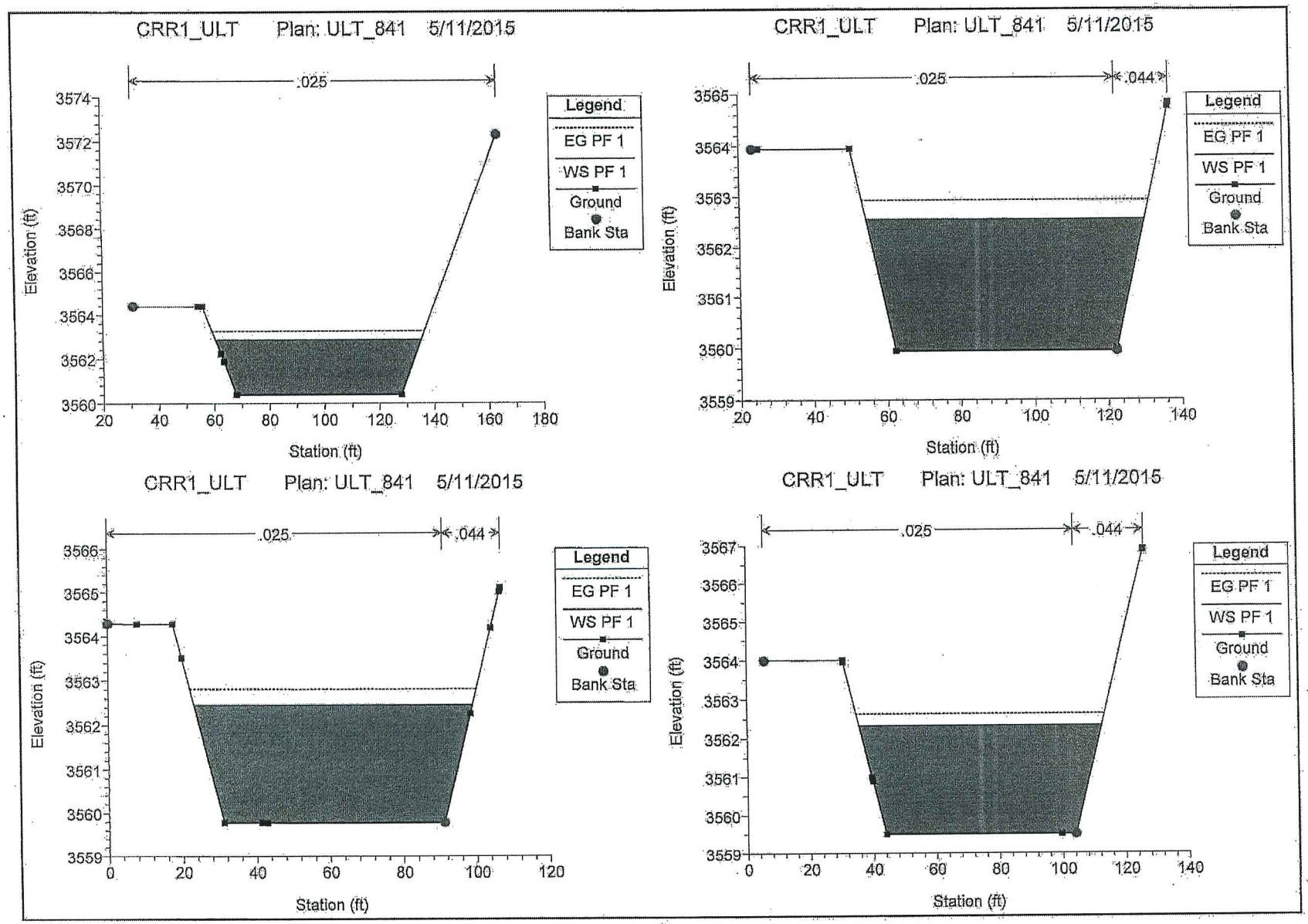
HEC-RAS Plan: ULT_841 River: River #3 Reach: Reach #3 Profile: PF 1

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 #3	1100	PF 1	344.00	3561.59	3563.50		3563.62	0.001015	2.74	125.50	71.45	0.36
Reach #3	1050	PF 1	344.00	3561.41	3563.46		3563.56	0.000808	2.55	135.06	72.28	0.33
Reach #3	975	PF 1	344.00	3561.21	3563.48		3563.51	0.000228	1.30	265.76	155.50	0.17
Reach #3	850	PF 1	344.00	3560.84	3563.41		3563.47	0.000368	1.98	174.08	75.41	0.23
Reach #3	700	PF 1	841.00	3560.39	3562.87		3563.27	0.002472	5.02	167.55	74.89	0.59
Reach #3	550	PF 1	841.00	3559.94	3562.55		3562.92	0.002099	4.94	176.88	75.65	0.56
Reach #3	495	PF 1	841.00	3559.78	3562.45		3562.81	0.001930	4.81	181.59	75.89	0.53
Reach #3	400	PF 1	841.00	3559.50	3562.32		3562.63	0.001613	4.54	192.77	76.92	0.49
Reach #3	310	PF 1	841.00	3559.20	3562.20	3560.98	3562.47	0.001298	4.24	207.02	78.00	0.45

Referenced Starting WSE


CRR1_ULT Plan: ULT_841 5/11/2015
River #3 Reach #3
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
3564
3563
3562
3561
3560
3559
0
200
400
600
800
Main Channel Distance (ft)


CRR1_ULT Plan: ULT_841 5/11/2015
.025
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
CRR1_ULT Plan: ULT_841 5/11/2015
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
CRR1_ULT Plan: ULT_841 5/11/2015
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
CRR1_ULT Plan: ULT_841 5/11/2015
.025
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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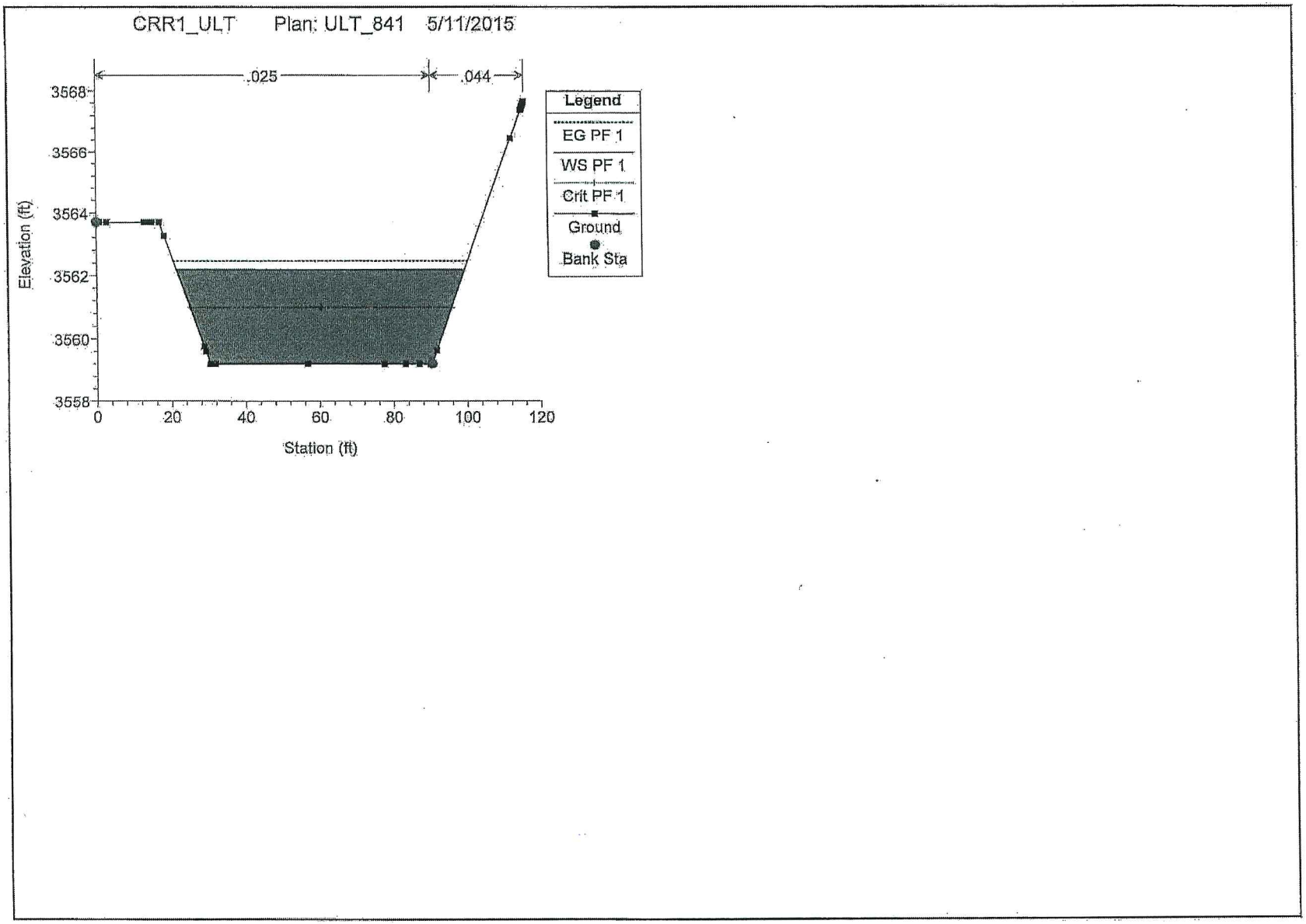
.025
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
3574
3572
3570
3568
3566
3564
3562
3560
20 40 60 80 100 120 140 160 180
CRR1_ULT Plan: ULT_841 5/11/2015
.025
.044
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
3565
3564
3563
3562
3561
3560
3559
20 40 60 80 100 120 140
CRR1_ULT Plan: ULT_841 5/11/2015
.025
.044
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
3566
3565
3564
3563
3562
3561
3560
3559
0 20 40 60 80 100 120
CRR1_ULT Plan: ULT_841 5/11/2015
.025
.044
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
3567
3566
3565
3564
3563
3562
3561
3560
3559
0 20 40 60 80 100 120 140


CRR1_ULT Plan: ULT_841 5/11/2015
.025
.044
3568
3566
3564
3562
3560
3558
Elevation (ft)
0
20
40
60
80
100
120
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

Worksheet for Rectangular Weir - 26 COS-1

Project Description

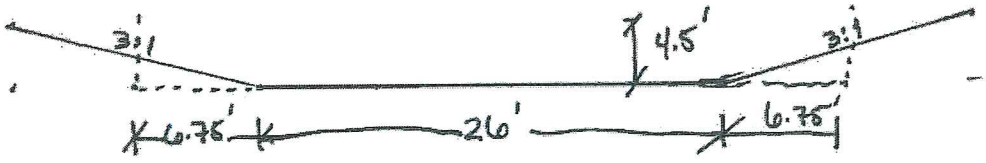
Solve For	Headwater Elevation

Input Data

Discharge		554.00	ft³/s
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Weir Coefficient		2.70	US
Crest Length		39.50	ft
Number Of Contractions	0		

Results

Headwater Elevation	3.00	ft
Headwater Height Above Crest	3.00	ft
Tailwater Height Above Crest	0.00	ft
Flow Area	118.48	ft²
Velocity	4.68	ft/s
Wetted Perimeter	45.50	ft
Top Width	39.50	ft



Cross Section for Rectangular Weir - 26 COS-1

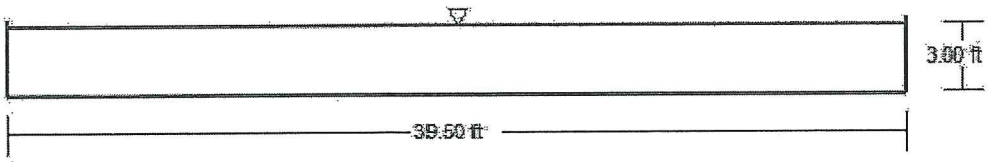
Project Description

Solve For	Headwater Elevation

Input Data

Discharge		554.00	ft³/s
Headwater Elevation		3.00	ft
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Weir Coefficient		2.70	US
Crest Length		39.50	ft
Number Of Contractions	0		

Cross Section Image



V: 1
H: 1

Worksheet for Rectangular Weir - 7 DIV1

Project Description

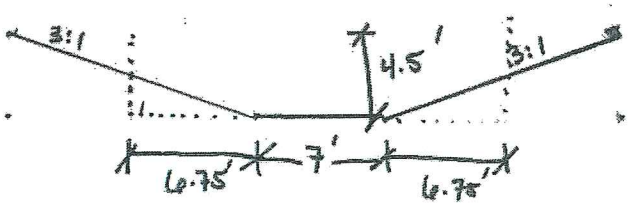
Solve For	Crest Length

Input Data

Discharge	287.00	ft³/s
Headwater Elevation	3.00	ft
Crest Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Weir Coefficient	2.70	US
Number Of Contractions	0	

Results

Crest Length	20.46	ft
Headwater Height Above Crest	3.00	ft
Tailwater Height Above Crest	0.00	ft
Flow Area	61.37	ft²
Velocity	4.68	ft/s
Wetted Perimeter	26.46	ft
Top Width	20.46	ft



Cross Section for Rectangular Weir - 7 DIV1

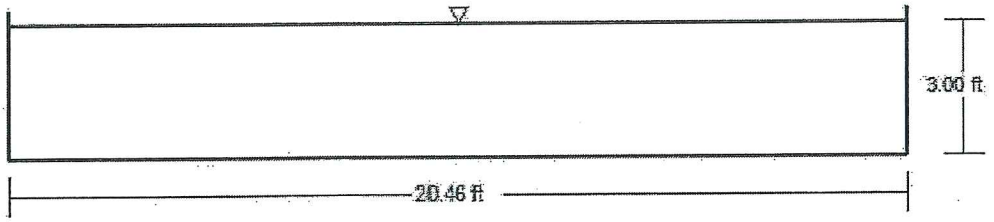
Project Description

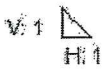
Solve For	Crest Length

Input Data

Discharge		287.00	ft³/s
Headwater Elevation		3.00	ft
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Weir Coefficient		2.70	US
Crest Length		20.46	ft
Number Of Contractions	0		

Cross Section Image





SUMMERLIN

SM

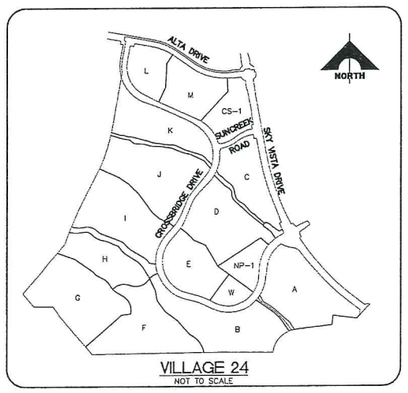
VILLAGE 24
CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

FROM CROSSBRIDGE UNIT 1 TO SUNCREEK ROAD

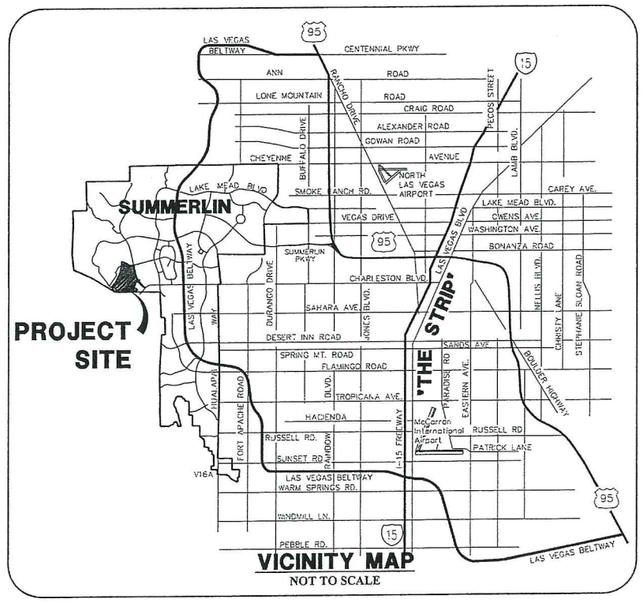
SID # 812 PROJECT 2

2014

A.P.N. 137-33-801-001



VILLAGE 24
NOT TO SCALE



VICINITY MAP
NOT TO SCALE

SHEET INDEX	
SHT #	DESCRIPTION
1	COVER SHEET
2	PROJECT DATA SHEET
3	NOTE SHEET
4	HORIZONTAL CONTROL PLAN
5	WATER MASTER PLAN
6	STORM DRAIN MASTER PLAN
7	SEWER MASTER PLAN
8	ROADWAY PLAN AND PROFILE 1
9	ROADWAY PLAN AND PROFILE 2
10	ROADWAY PLAN AND PROFILE 3
11	ROADWAY PLAN AND PROFILE 4
12	ROADWAY PLAN AND PROFILE 5
13	ROADWAY PLAN AND PROFILE 6
14	ROADWAY PLAN AND PROFILE 7
15	ROADWAY PLAN AND PROFILE 8
16	UTILITY PLAN AND PROFILE 1
17	UTILITY PLAN AND PROFILE 2
18	UTILITY PLAN AND PROFILE 3
19	UTILITY PLAN AND PROFILE 4
20	UTILITY PLAN AND PROFILE 5
21	UTILITY PLAN AND PROFILE 6
22	UTILITY PLAN AND PROFILE 7
23	UTILITY PLAN AND PROFILE 8
24	GRADING AT DRAINAGE CORRIDOR CROSSING
25	WESTERN BORDER CHANNEL 1
26	WESTERN BORDER CHANNEL 2
27	WESTERN BORDER CHANNEL 3
28	CROSSBRIDGE DRIVE ROUGH GRADE 1
29	CROSSBRIDGE DRIVE ROUGH GRADE 2
30	CROSSBRIDGE DRIVE ROUGH GRADE 3
31	COS-1 BERM GRADING
32	ADDITONAL LIMITS OF GRADING
33	TYPICAL SECTIONS
34	UTILITY DETAILS 1
35	UTILITY DETAILS 2
36	CONSTRUCTION DETAILS
37	LATERAL DETAILS 1
38	LATERAL DETAILS 2
39	LATERAL DETAILS 3
40	DRAINAGE CORRIDOR CROSSING DETAILS 1
41	DRAINAGE CORRIDOR CROSSING DETAILS 2
N.I.C.	~~42~~ ~~STRIPING AND SIGNAGE PLAN 1~~
N.I.C.	~~43~~ ~~STRIPING AND SIGNAGE PLAN 2~~
N.I.C.	~~44~~ ~~STREETLIGHT AND ELECTRICAL NOTES~~
N.I.C.	~~45~~ ~~MASTER CONDUIT AND ELECTRICAL PLAN 1~~
N.I.C.	~~46~~ ~~MASTER CONDUIT AND ELECTRICAL PLAN 2~~
47	TYPICAL STRUCTURAL DETAILS AND NOTES
48	DRAINAGE CORRIDOR STRUCTURAL DETAILS 1
49	DRAINAGE CORRIDOR STRUCTURAL DETAILS 2
50	DRAINAGE CORRIDOR STRUCTURAL DETAILS 3
51	DRAINAGE CORRIDOR STRUCTURAL DETAILS 4
52	OUTLET STRUCTURE PLAN AND DETAILS
N.I.C.	~~53~~ ~~FLOW CONTROL VALVE DETAILS~~

DRAINAGE CERTIFICATION

I CERTIFY THAT THE GRADING PLANS ARE IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

JOSHUA L. JOHNSON P.E. 15789 DATE

ALLEN PAVELKA: PE, PE# 9029 DATE
CITY ENGINEER
CITY OF LAS VEGAS, NEVADA

APPROVAL OF THESE PLANS IS LIMITED TO THOSE IMPROVEMENTS CONSTRUCTED IN THE DEDICATED RIGHTS-OF-WAY AND/OR DEDICATED EASEMENTS. THIS APPROVAL DOES NOT AUTHORIZE THE CONSTRUCTION OF ANY IMPROVEMENTS THAT DEVIATE FROM ADOPTED STANDARDS AND/OR SPECIFICATIONS, EXCEPT THOSE SPECIFICALLY LISTED UNDER "DEVIATIONS FROM STANDARDS". THE ENGINEER SHALL RESOLVE ANY DEVIATION OTHER THAN THOSE LISTED IN "DEVIATIONS FROM STANDARDS" IN FAVOR OF THE UNIFORM STANDARD DRAWINGS AND SPECIFICATIONS CLARK COUNTY AREA NEVADA.

CLV PLANNING DEPARTMENT

THIS PLAN MEETS THE APPLICABLE STANDARDS OF THE CITY OF LAS VEGAS PLANNING DEPARTMENT

CHRIS KNIGHT, DIRECTOR BUILDING AND SAFETY DATE

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123547 DATE:
DRAWINGS: 1-3, 5-7, 16-23, 35, 37-41 & 52

THE HOWARD HUGHES COMPANY, LLC

KEVIN ORROCK DATE
VICE PRESIDENT

PLAN APPROVAL

NOTE: THIS PROJECT PLAN APPROVAL CONTINGENT ON

LVVWD #123259 VILLAGE 23A/24 SKY VISTA IMPROVEMENT PLANS

UTILITY/AGENCY APPROVALS

COX COMMUNICATIONS LAS VEGAS, INC. DATE

CENTRAL TELEPHONE CO., DBA CENTURYLINK DATE

THE AFFIXED CENTURYLINK APPROVAL DOES NOT ASSUME OR GUARANTEE LIABILITY FOR KNOWN OR UNKNOWN CONFLICTS WITH EXISTING OR PROPOSED IMPROVEMENTS. RESOLUTION OF ANY CONFLICT WILL BE ACCOMPLISHED PURSUANT TO LOCAL ORDINANCES, NEVADA REVISED STATUTES AND/OR PUBLIC UTILITY COMMISSION RULES AND REGULATIONS.

NV ENERGY DATE

NEVADA POWER COMPANY ACKNOWLEDGES THAT WE HAVE RECEIVED YOUR PLANS AND WILL PROVIDE SERVICE TO ALL ELECTRICAL NEEDS ASSOCIATED WITH THIS PROJECT. NEVADA POWER COMPANY RESERVES THE RIGHT TO ADDRESS ANY EXISTING OR FUTURE CONFLICTS ONCE THE FINAL DESIGN IS COMPLETED. THE NEW SERVICE AND THE RESOLUTION OF ANY CONFLICTS WILL BE ACCOMPLISHED PURSUANT TO THE NEVADA PUBLIC UTILITY COMMISSION'S RULES AND REGULATIONS.

NV ENERGY - TRANSMISSION ENGINEERING DATE

SOUTHWEST GAS CORP. DATE

OWNER/DEVELOPER

THE HOWARD HUGHES COMPANY, LLC
10801 W. CHARLESTON BLVD., 3RD FLOOR
LAS VEGAS, NEVADA 89146
OFFICE PHONE NO. (702) 791-4300

ENGINEER

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD · LAS VEGAS, NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM

Call before you Dig
Avoid cutting underground utility lines. It's easy.
Call 811
1-800-227-2600
OR
CLARK COUNTY TRAFFIC OPERATIONS
1-702-455-6000

CALL BEFORE YOU DIG OVERHEAD
AVOID HITTING OVERHEAD POWER LINES. IT'S EASY!

FAST
Call before you UnderGround
1-702-432-5300
FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

DATE: 10/01/2015
TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	CCW APP

PROJECT NO. 62024-222
DESIGN: CCW
DRAWN: CCW
CHECK: JJJ
PLOT DATE: 10-01-15
PLOT TIME: 13:18:04

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD · LAS VEGAS, NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-222\GWC\Production\24CB2sc01_CV.dwg
Paul Brennord

THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS
COVER SHEET

DRAWING 1
1 OF 53 SHTS

SID NO. 812 PROJECT 2

sv24-2sc.dwg 070203.lsv

LEGEND

- PROPOSED UTILITIES
- EXISTING UTILITIES
- FUTURE UTILITIES
- SECTION LINE
- EASEMENT LINE
- RIGHT-OF-WAY LINE
- PROPERTY LINE
- CENTERLINE
- 100 YR HYDRAULIC GRADE LINE (ULT)
- 100 YR HYDRAULIC GRADE LINE (INT)
- PROPOSED UTILITY (BY OTHERS)
- PROPOSED SEWER LINE W/MH
- FUTURE SEWER LINE W/MH
- EXISTING SEWER LINE W/MH
- EXISTING WATER LINE & GATE VALVE
- PROPOSED WATER LINE & GATE VALVE
- FUTURE WATER LINE & GATE VALVE
- 2" G — EXISTING GAS LINE
- 2-6" E — EXISTING UNDERGROUND ELECTRICAL
- CATV — EXISTING CABLE TV
- TEL — EXISTING TELEPHONE
- OHP — EXISTING OVERHEAD AND POWER POLES
- PROPOSED STORM DRAIN W/MH
- EXISTING STORM DRAIN W/MH
- FUTURE STORM DRAIN W/MH
- EXISTING SIDEWALK AND RAMP
- CONSTRUCT CURB DEPRESSION FOR FUTURE HANDICAP RAMP
- VIEW FENCE
- NEW ABANDONED PIPE
- EXISTING ABANDONMENT
- SAWCUT
- STEEL CASING
- APPROXIMATE PAVEMENT RESTORATION
- TO BE ABANDONED PROFILE HATCH
- WATER STUB WITH BLOW-OFF
- FUTURE WATER STUB WITH BLOW-OFF
- SEWER STUB WITH CAP
- FUTURE SEWER STUB WITH CAP
- EDGE OF PAVEMENT
- OUTSIDE EDGE
- C — C — CUT LIMIT LINE
- F — F — FILL LIMIT LINE

- 1 / CD1 — DRAWING NUMBER FOR DETAIL W/ REF. TO THE SHEET WHERE IT IS SHOWN
- XX / YYY — STANDARD DRAWING NUMBER / GOVERNING AGENCY
- BENCHMARK
- POTHOLE LOCATION
- EXISTING NVR RS-100
- EXISTING DROP INLET
- PROPOSED DROP INLET
- FUTURE DROP INLET
- EXISTING GATE VALVE
- PROPOSED GATE VALVE
- FUTURE GATE VALVE
- EXISTING WATER METER
- PROPOSED WATER METER
- EXISTING TRAFFIC SIGNAL PULL BOX
- PROPOSED SIGNAL PULLBOX
- EXISTING TELEPHONE MANHOLE
- EXISTING POWER POLE
- EXISTING ELEC MARKER
- EXISTING TRAFFIC SIGNAL
- PROPOSED TRAFFIC SIGNAL
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT
- FUTURE FIRE HYDRANT
- EXISTING UTILITY BOX
- EXISTING METER BOX
- 3005 — PROPOSED CONTOUR
- (3005) — EXISTING CONTOUR
- 60.50 TC — SPOT ELEVATION
- (50.50) TC — EXISTING SPOT ELEVATION
- (50.50) TC — FUTURE SPOT ELEVATION
- EXISTING CLARK COUNTY STREET LIGHT (STLT)
- 1.00% — ROAD SLOPE
- EXISTING SUMMERLIN STREET LIGHT (STLT)
- PROPOSED SUMMERLIN STREET LIGHT (STLT)
- TOP SLOPE / TOE SLOPE — 3:1 SLOPE UNLESS OTHERWISE NOTED ON PLAN

ABBREVIATIONS

A	AIR	FH	FIRE HYDRANT	RCB	REINFORCED CONCRETE BOX
AC	ASPHALT CONCRETE, ACRE	FL	FLOW LINE	RCP	REINFORCED CONCRETE PIPE
ACP	ASBESTOS CEMENT PIPE	FO	FIBER OPTIC	RD	ROAD
ADD'L	ADDITIONAL	FRP	FIBERGLASS REINFORCED PLASTIC	RDWY	ROADWAY
AP	ANGLE POINT	FS	FINISH SURFACE	REC	RECTANGULAR
APN	ASSESSOR'S PARCEL NUMBER	FT	FOOT/FEET	REF	REFERENCE
APPROX	APPROXIMATELY	FTG	FOOTING	REINF	REINFORCED
AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS	FUT	FUTURE	REQD	REQUIRED
		G	GAS	RIM	TOP OF RIM ELEVATION
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS	GA	GAGE, GUY ANCHOR	RND	ROUND
		GB	GRADE BREAK	ROW,R/W	RIGHT OF WAY
AVE	AVENUE	GND	GROUND	RP	RADIUS POINT
AVAR	AIR VALVE, AIR RELEASE ASSEMBLY	GRD	GRADE, GROUND	RPM	RAISED PAVEMENT MARKERS
AWWA	AMERICAN WATER WORKS ASSOCIATION	H, HGT	HEIGHT	RSGV	RESILIENT SEAT GATE VALVE
		HDWL	HEADWALL	S	SOUTH
BC	BACK OF CURB	HGL	HYDRAULIC GRADE LINE	SCH	SCHEDULE
BCR	BEGIN CURB RETURN	HORIZ	HORIZONTAL	SD	STORM DRAIN
BLM	BUREAU OF LAND MANAGEMENT	HP	HIGH POINT, HIGH PRESSURE	SDMH	STORM DRAIN MANHOLE
BLVD	BOULEVARD	HPS	HIGH PRESSURE SODIUM	SECT	SECTION
BM	BENCHMARK	IBC	INTERNATIONAL BUILDING CODE	SF	SQUARE FOOT/FEET
BO	BLOW-OFF	INV	INVERT	SHLDR	SHOULDER
BVCE	BEGIN VERTICAL CURVE ELEVATION	INT	INTERIM	SHT	SHEET
BVCS	BEGIN VERTICAL CURVE STATION	JT	JOINT	SIS	SUMMERLIN IMPROVEMENT STANDARDS
BW	BACK OF SIDEWALK	L	LENGTH		
C, ℄	CENTERLINE	L, LT	LEFT	SL	STREET LIGHT
C&G	CURB AND GUTTER	LF	LINEAR FEET	SP	SERVICE POINT
CATV	UNDERGROUND CABLE TV	LIP	LIP OF GUTTER	SQ	SQUARE
CCBM	CLARK COUNTY BENCH MARK	LN	LANE	SR	SEWER RECLAIM MAIN
CCPW	CLARK COUNTY PUBLIC WORKS	LP	LIGHT POLE	SS	SANITARY SEWER
CCTV	CLOSED-CIRCUIT TELEVISION	LSCP	LANDSCAPE	SSMH	SANITARY SEWER MANHOLE
CCWRD	CLARK COUNTY WATER RECLAMATION DISTRICT	LVVWD	LAS VEGAS VALLEY WATER DISTRICT	STA	STATION
		MAX	MAXIMUM	ST	STREET
CFS	CUBIC FEET PER SECOND	MH	MANHOLE	STD	STANDARD
CIP	CAPITAL IMPROVEMENTS PROJECT, CORRUGATED IRON PIPE	MIN	MINIMUM	STL	STEEL
		MLCP	MORTAR LINED AND COATED PIPE	STRUCT	STRUCTURE
	CAST IN PLACE	MP	MESA PARK	SVZ	SIGHT VISIBILITY ZONE
CIPM	CAST-IN-PLACE MANHOLE	MOD	MODIFY/MODIFIED	SW	SIDEWALK
CIPP	CAST-IN-PLACE PIPE	MON	MONUMENT	SWG	SOUTHWEST GAS
CIR	CIRCLE	MPH	MILES PER HOUR	T	TELEPHONE OR TOP
CLR	CLEAR OR CLEARANCE	N	NORTH	TAN	TANGENT
CLSM	CONTROLLED LOW STRENGTH MATERIAL	NDOT	NEVADA DEPARTMENT OF TRANSPORTATION	TB	TOP OF BERM
				TC	TOP OF CURB
CLV	CITY OF LAS VEGAS	NO	NUMBER	TCE	TEMPORARY CONSTRUCTION ESMT
CMP	CORRUGATED METAL PIPE	NOSHA	STATE OF NEVADA OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION	TEL,TELE	TELEPHONE
CMU	CONCRETE MASONRY UNIT			TEMP	TEMPORARY
CNLV	CITY OF NORTH LAS VEGAS	NVE	NEVADA ENERGY	TF	TOP OF FOOTING
CO	CLEANOUT	NTS	NOT TO SCALE	TG	TOP OF GRATE
CONC	CONCRETE	OB	OVERBUILD	TMH	TOP OF MANHOLE
COND	CONDUIT	OC	ON CENTER	TOP	TOP OF PIPE
CONST	CONSTRUCT OR CONSTRUCTION	OHC	OVERHEAD COX COMMUNICATION	TP	TELEPHONE POLE
COORD	COORDINATE	OHP	OVERHEAD POWER LINE	TRANS	TRANSITION
COR	CORNER	P	POWER LINE	TRW	TOP OF RETAINING WALL
CPEP	CORRUGATED POLYETHELYNE PIPE	PB	PULL BOX	TS	TRAFFIC SIGNAL
CT	COURT	PBS	PLANTMIX BITUMINOUS SURFACE	TW	TOP OF WALL
CY	CUBIC YARD(S)	PC	POINT OF CURVE, PRESSURE CLASS	TYP,(TYP)	TYPICAL
Δ	DELTA	PCC	POINT OF COMPOUND CURVE	UDACS	UNIFORM DESIGN AND CONSTRUCTION STANDARDS FOR WATER DISTRIBUTION SYSTEMS (LATEST EDITION)
DBL	DOUBLE	PE	PROJECT ENGINEER OR POLYETHYLENE		
DCSWCS	DESIGN AND CONSTRUCTION STANDARDS FOR WASTEWATER COLLECTION SYSTEM (LATEST EDITION)	PED	PEDESTRIAN	UG	UNDERGROUND
		PGL	PROFILE GRADE LINE	ULT	ULTIMATE
		PH	POTHOLE	USD	UNIFORM DESIGN AND CONSTRUCTION STANDARDS
DEFL	DEFLECTION	PI	POINT OF INTERSECTION	USDCCA	UNIFORM STD. DRAWINGS FOR PUBLIC WORKS' CONSTRUCTION OFF-SITE IMPROVEMENTS CLARK COUNTY AREA, NEVADA (LATEST EDITION)
DG	DESIGN GRADE	PIV	POST INDICATOR VALVE		
DIA, ⌀	DIAMETER	R	PROPERTY LINE		
DIP	DUCTILE IRON PIPE	PLCP	POLYURETHANE LINED AND COATED STEEL PIPE		
DIST	DISTANCE	PMF	PAVEMENT MARKING FILM	UT	UNDERGROUND TELEPHONE
DR	DRIVE	POB	POINT OF BEGINNING	VAR	VARIABLE/VARIES
DS	DOWNSPOUT	POC	POINT ON CURVE	VC	VERTICAL CURVE
DTL	DETAIL	P.O.C.	POINT OF CONNECTION	VCP	VITRIFIED CLAY PIPE
DW	DRIVEWAY	POT	POINT ON TANGENT	VERT	VERTICAL
DWG	DRAWING	PP	POWER POLE	VG	VALLEY GUTTER
E	EAST	PROP	PROPOSED	VOL	VOLUME
ECR	END CURB RETURN	PRC	POINT OF REVERSE CURVE	W	WATER, WEST
ELE,ELEC	ELECTRICAL	PRVC	POINT OF REVERSE VERTICAL CURVE	W/	WITH
ELEV	ELEVATION			WS	WATER SUPPLY
EP, EOP	EDGE OF PAVEMENT	PSI	POUNDS PER SQUARE INCH	WT	WEIGHT
ESMT	EASEMENT	PT	POINT OF TANGENCY	WTR	WATER
EVC	END VERTICAL CURVE	PVC	POLYVINYL CHLORIDE	XING	CROSSING
EXIST,EX	EXISTING	PVI	POINT OF VERTICAL INTERSECTION	YD	YARD, YARD DRAIN
EXP	EXPANSION JOINT	PVMT	PAVEMENT	Z	PRESSURE ZONE
FC	FACE OF CURB	PZ	PRESSURE ZONE		
FF, FFE	FINISH FLOOR ELEVATION	R, RAD	RADIAL, RADIUS		
FG	FINISH GRADE	R, RT	RIGHT		

IMPROVEMENT NOTES:

1. INSTALL "A" TYPE ISLAND CURB PER USD DWG NO. 219
2. INSTALL "L" TYPE CURB & GUTTER PER USD DWG NO. 216
3. INSTALL A.C. PAVEMENT PER TYPICAL STREET SECTION DETAILS
4. INSTALL HANDICAP RAMP CURB DEPRESSION (BY OTHERS)
5. VERIFY LOCATION AND ELEVATION OF EXISTING IMPROVEMENT. IF DISCREPANCY EXISTS, NOTIFY ENGINEER PRIOR TO CONSTRUCTION
6. SAWCUT AND REPLACE EXISTING A.C. PAVEMENT
7. INSTALL CONCRETE ENCASEMENT
8. EXISTING RIPRAP TO BE REMOVED AND STOCKPILED
9. INSTALL "L" TYPE ISLAND CURB PER USD DWG NO. 219
10. RELOCATE WATER APPURTENANCES (VALVES TO REMAIN ACCESSIBLE AT ALL TIMES)

WATER CONSTRUCTION NOTES:

1. INSTALL FIRE HYDRANT & ASSEMBLY PER UDACS PLT. NO. 39 & 40
2. INSTALL TEE/CROSS PER UDACS PLT. NO. 31 (*)
3. INSTALL BEND PER UDACS PLT. NO. 31. (SEE PLAN FOR ∠) (*)
4. INSTALL GATE VALVE PER UDACS PLT. NO. 30 AND 39 (*)
5. INSTALL REDUCER PER UDACS PLT. NO. 30 (*)
6. INSTALL CAP W/ 2" BLOW-OFF ASSY PER UDACS PLT. NO. 36 (*)
7. 1" MAX. DEFLECTION (PVC), 2.5° MAX. DEFLECTION (DIP)
8. INSTALL STEEL CASING PER UDACS PLT. 22 & 23
9. INSTALL VERT. 45° BEND PER UDACS PLT. NO. 31 (*)
10. REMOVE CAP & BLOWOFF PER UDACS PLT. NO. 36 AND CONNECT TO EXISTING WATER LINE
11. INSTALL 6" MANUAL BLOW OFF ASSY PER UDACS PLT. NO. 37
12. INSTALL 4" COMBINATION AIR VALVE PER UDACS PLT. NO. 38
13. INSTALL 1 1/2" TYPE K COPPER W/SERVICE SADDLE, 1 1/2" METER & 1 1/2 RPPA PER UDACS PLATE NO. 4 & 8.

* SEE PLANS AND WAKE NOTE OF ATTACHED PIPE SIZE FOR TEE, BEND, GATE VALVE, REDUCER AND CAP SIZES

SEWER CONSTRUCTION NOTES:

1. INSTALL 48" SEWER MANHOLE
2. INSTALL 60" SEWER MANHOLE
3. INSTALL TEMPORARY PLUG AND CAP SEWER STUB
4. REMOVE EXISTING PLUG AND CONNECT TO EXISTING SEWER LINE
5. INSTALL CORROSION PROTECTION PER DCSWCS 3.16.8B AND 4.9.9

STORM DRAIN CONSTRUCTION NOTES:

1. INSTALL TYPE "CM2" DROP INLET PER USD DWG. NO. 412.1 AND 421
2. INSTALL TYPE I 60" MANHOLE PER USD DWG. NO. 403
3. INSTALL TYPE III MANHOLE PER USD DWG. NO. 406
4. INSTALL TYPE II-SD MANHOLE PER USD DWG. NO. 405.2
5. INSTALL WATER TIGHT ELASTOMERIC JOINTS PER UDACS 2.22.02
6. INSTALL TEMPORARY PLUG AND CAP STORM DRAIN LINE
7. CULVERT HEADWALL (SEE DETAIL XX ON SHEET X)
8. REMOVE EXISTING PLUG AND CONNECT TO EXISTING STORM DRAIN LINE

** CONTRACTOR TO VERIFY SIZE, INVERT, AND LOCATION OF EXISTING STORM DRAIN LINE

IRRIGATION CONSTRUCTION NOTES:

1. BANK "A": 1-6" & 2-4" SCH 40 PVC PER DETAIL 1 ON SHEET 29
2. BANK "B" : 2-4" SCHD. 40 PVC PER DETAIL 2 ON SHEET 29

DEVIATIONS FROM STANDARDS

1. ADD RAISED MEDIAN TO NEIGHBORHOOD COLLECTOR LEVEL 2 (PER S.I.S. DWG NO S-6) TO ENHANCE MARKETING AND SALES ENTRIES INTO VILLAGE 24. RIGHT-OF-WAY (BC-BC) EXPANDS TO 67.34 FEET TO 84.00 FEET (AS MEDIAN ISLAND VARIES), IN LIEU OF 54.00 FEET. TRAVEL LANES REMAIN UNCHANGED.
2. REDUCE LANDSCAPE MEDIAN ISLAND IN FUTURE "GATED" PARCEL ENTRIES (PER S.I.S. DWG NO S-12A) FROM 15.00 FEET TO 13.34 FEET, IN EXCHANGE FOR WIDER COMMON AREAS WHICH ARE PROPOSED 20 FEET WIDE IN LIEU OF 15 FEET. THIS ADDITIONAL AREA WILL BE UTILIZED FOR GRADING AND SLOPE ADJUSTMENTS. CORRESPONDINGLY, THE RIGHT-OF-WAY IS REDUCED FROM 84.00 FEET TO 61.34 FEET. TRAVEL LANES REMAIN UNCHANGED.
3. STREET LIGHTS, AT ALL FUTURE PARCEL ENTRIES, WILL BE SET AT 10 FEET OUTSIDE OF BCR AND 2.5 FEET OF BC (IN LIEU OF LOCATIONS SET PER S.I.S. E-16 FOR MEANDERING SIDEWALK). THIS WILL ALLOW ADJUSTMENTS TO PARCEL ENTRIES WITHOUT AFFECTING STREET LIGHT LOCATIONS.

NOTES TO CONTRACTOR:

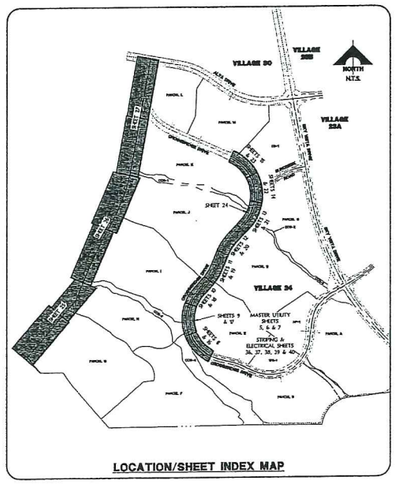
1. ALL EXISTING UTILITY CROSSINGS MUST BE VERIFIED PRIOR TO CONSTRUCTION OF ANY MAIN LINES OR LATERALS THAT MAY BE ADVERSELY AFFECTED. ANY DISCREPANCIES IN LOCATION AND/OR ELEVATION MUST BE PROVIDED TO THE ENGINEER FOR ACCEPTANCE PRIOR TO CONSTRUCTION.
2. ALL COMMON LOTS AS SHOWN HEREIN TO BE PRIVATELY MAINTAINED BY THE SUMMERLIN H.O.A. A FUTURE MEANDERING SIDEWALK WILL BE INSTALLED BY SUMMERLIN AS REQUIRED TO SERVICE THE DEVELOPMENT OF EACH PARCEL.
3. ALL WATER LINE GATE VALVES, SERVICE GATE VALVES, AND FIRE HYDRANT GATE VALVES ARE TO BE CONSTRUCTED UNDER A.C. PAVEMENT. IT IS THE CONTRACTORS RESPONSIBILITY TO VERIFY THAT ALL WATER VALVE CANS DO NOT CREATE CONFLICTS WITH THE PROPOSED CURB LINE PRIOR TO PLACEMENT OF CONCRETE. ALL WATER FACILITIES SHOWN IN THESE DRAWINGS HAVE BEEN "SCALED-UP" FOR CLARITY ONLY.

SUMMERLIN STREET CLASSIFICATION

CROSSBRIDGE DRIVE: NEIGHBORHOOD COLLECTOR LEVEL 1 AND LEVEL 2 WITH SHARED BIKE LANES

STREET QUANTITIES (PUBLIC)

STREETS	
3" A.C. PAVEMENT	22,131 S.Y.
4" TYPE II AGGREGATE	2,871 C.Y.
8" TYPE "A" ISLAND CURB	3,883 L.F.
6" TYPE "L" CURB & GUTTER	7,466 L.F.
EXCAVATION	10,990 C.Y.
EMBANKMENT	133,591 C.Y.
ADJUST EXISTING FACILITIES TO GRADE	0 EA.
STREET LIGHTS	
SINGLE ARM ST. LT.	14 EA.
DOUBLE ARM ST. LT.	11 EA.
CONDUIT	5,108 L.F.
IRRIGATION	
IRRIGATION SLEEVES – BANK "A"	271 L.F.
IRRIGATION SLEEVES – BANK "B"	138 L.F.



LOCATION/SHEET INDEX MAP

FAST — Call before you Underground 1-702-432-5300 FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

Call before you Dig — Avoid cutting underground utility lines. It's easy. Call 811 or 1-800-227-2600 OR CLARK COUNTY TRAFFIC OPERATIONS 1-702-455-6000

AVOID HITTING OVERHEAD POWER LINES IT'S EASY — CALL BEFORE YOU DIG OVERHEAD — 1-702-227-2929

NOTE

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BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER

PROJECT NO. 123547 DATE:

ENGINEER - STATE OF NEVADA — JOSHUA M. HUGHES — No. 15788 — PROFESSIONAL ENGINEER — DATE: 10/09/2015

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

PROJECT NO. 62024-222

DESIGN: GCW
DRAWN: GCW
CHECK: JMJ
PLOT DATE: 10-05-15
PLOT TIME: 11:25:24

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD. LAS VEGAS, NEVADA 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-222\DWG\production\24x36x02_P0.dwg
Michael Fong

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2 IMPROVEMENT PLANS

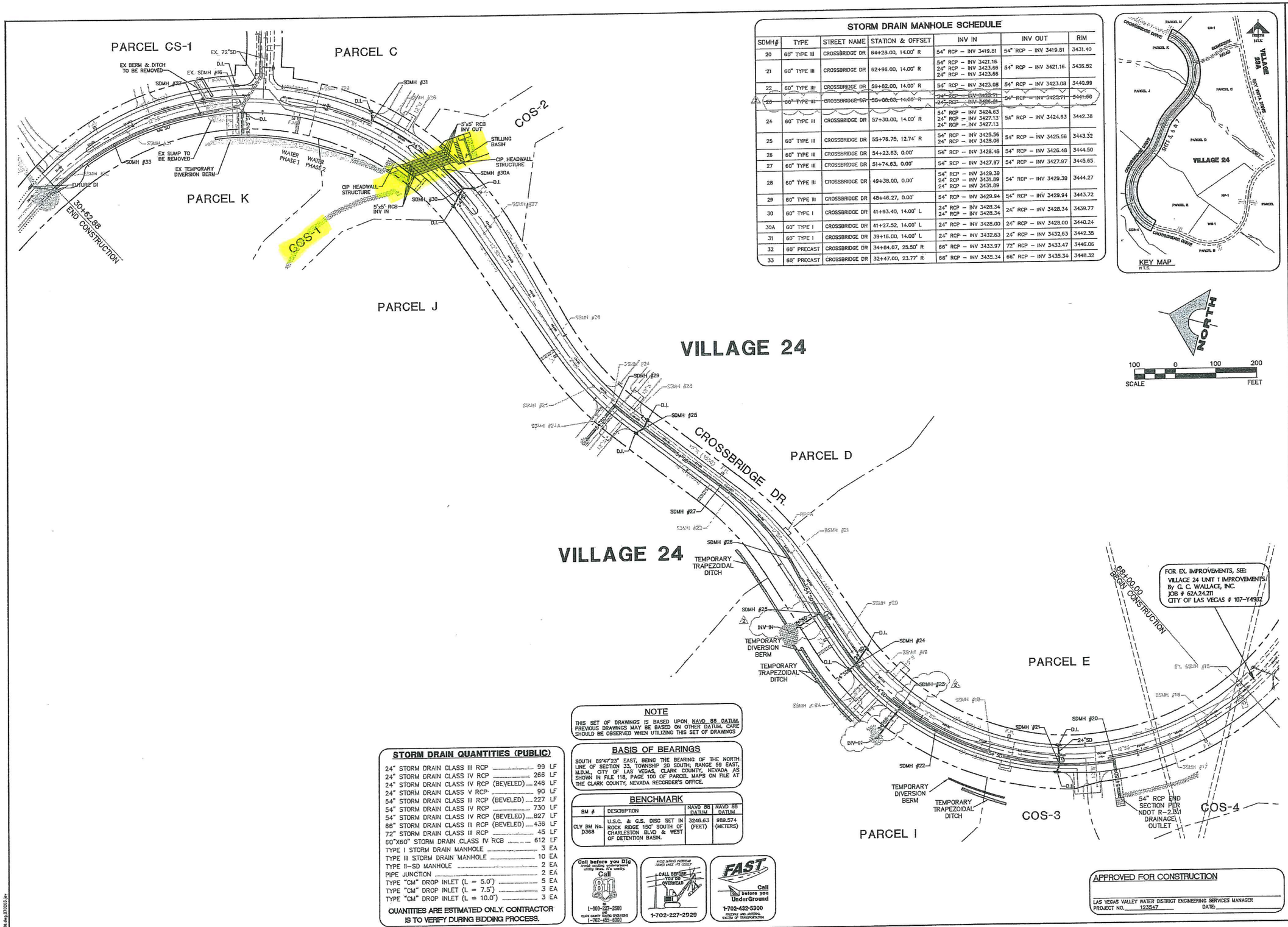
PROJECT DATA SHEET

DRAWING 2

2 OF 53 SHTS

SID NO. 812 PROJECT 2

sm24.36.dwg 070103.pr



STORM DRAIN MANHOLE SCHEDULE

SDMH#	TYPE	STREET NAME	STATION & OFFSET	INV IN	INV OUT	RIM
20	60" TYPE III	CROSSBRIDGE DR	64+28.00, 14.00' R	54" RCP – INV 3419.81	54" RCP – INV 3419.81	3431.40
21	60" TYPE III	CROSSBRIDGE DR	62+96.00, 14.00' R	54" RCP – INV 3421.16 24" RCP – INV 3423.66 24" RCP – INV 3423.66	54" RCP – INV 3421.16	3436.52
22	60" TYPE III	CROSSBRIDGE DR	59+82.00, 14.00' R	54" RCP – INV 3423.08	54" RCP – INV 3423.08	3440.99
23	60" TYPE III	CROSSBRIDGE DR	58+08.00, 14.00' R	54" RCP – INV 3423.71 24" RCP – INV 3426.21	54" RCP – INV 3423.71	3441.98
24	60" TYPE III	CROSSBRIDGE DR	57+30.00, 14.00' R	54" RCP – INV 3424.63 24" RCP – INV 3427.13 24" RCP – INV 3427.13	54" RCP – INV 3424.63	3442.38
25	60" TYPE III	CROSSBRIDGE DR	55+76.75, 12.74' R	54" RCP – INV 3425.56 24" RCP – INV 3428.06	54" RCP – INV 3425.56	3443.32
26	60" TYPE III	CROSSBRIDGE DR	54+23.63, 0.00'	54" RCP – INV 3426.48	54" RCP – INV 3426.48	3444.50
27	60" TYPE III	CROSSBRIDGE DR	51+74.63, 0.00'	54" RCP – INV 3427.97	54" RCP – INV 3427.97	3445.65
28	60" TYPE III	CROSSBRIDGE DR	49+38.00, 0.00'	54" RCP – INV 3429.39 24" RCP – INV 3431.89 24" RCP – INV 3431.89	54" RCP – INV 3429.39	3444.27
29	60" TYPE III	CROSSBRIDGE DR	48+46.27, 0.00'	54" RCP – INV 3429.94	54" RCP – INV 3429.94	3443.72
30	60" TYPE I	CROSSBRIDGE DR	41+93.40, 14.00' L	24" RCP – INV 3428.34 24" RCP – INV 3428.34	24" RCP – INV 3428.34	3439.77
30A	60" TYPE I	CROSSBRIDGE DR	41+27.52, 14.00' L	24" RCP – INV 3428.00	24" RCP – INV 3428.00	3440.24
31	60" TYPE I	CROSSBRIDGE DR	39+16.00, 14.00' L	24" RCP – INV 3432.63	24" RCP – INV 3432.63	3442.35
32	60" PRECAST	CROSSBRIDGE DR	34+84.07, 25.50' R	66" RCP – INV 3433.97	72" RCP – INV 3433.47	3446.06
33	60" PRECAST	CROSSBRIDGE DR	32+47.00, 23.77' R	66" RCP – INV 3435.34	66" RCP – INV 3435.34	3448.32

STORM DRAIN QUANTITIES (PUBLIC)

24" STORM DRAIN CLASS III RCP	99 LF
24" STORM DRAIN CLASS IV RCP	266 LF
24" STORM DRAIN CLASS IV RCP (BEVELED)	246 LF
24" STORM DRAIN CLASS V RCP	90 LF
54" STORM DRAIN CLASS III RCP (BEVELED)	227 LF
54" STORM DRAIN CLASS IV RCP	730 LF
54" STORM DRAIN CLASS IV RCP (BEVELED)	827 LF
66" STORM DRAIN CLASS III RCP (BEVELED)	436 LF
72" STORM DRAIN CLASS III RCP	45 LF
60"X60" STORM DRAIN CLASS IV RCB	612 LF
TYPE I STORM DRAIN MANHOLE	3 EA
TYPE III STORM DRAIN MANHOLE	10 EA
TYPE II–SD MANHOLE	2 EA
PIPE JUNCTION	2 EA
TYPE "CM" DROP INLET (L = 5.0')	5 EA
TYPE "CM" DROP INLET (L = 7.5')	3 EA
TYPE "CM" DROP INLET (L = 10.0')	3 EA

QUANTITIES ARE ESTIMATED ONLY. CONTRACTOR IS TO VERIFY DURING BIDDING PROCESS.

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BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

Call before you Dig — Avoid cutting underground utility lines. It's costly. Call 811 or 1-800-227-2600 or CLARK COUNTY TRAFFIC OPERATIONS 1-702-455-6000

AVOID INITIAL OVERHEAD POWER LINES. IT'S COSTLY. CALL BEFORE YOU DIG OVERHEAD 1-702-227-2929

FAST — Call before you UnderGround 1-702-432-5300 CITIZENS AND INDUSTRIAL SECURITY OF TRANSPORTATION

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123547 DATE:

ENGINEER – STATE OF NEVADA – JOSHUA L. JOHNSON – No. 19764 – CIVIL – PROFESSIONAL ENGINEER – DATE: 03/10/2016

NO.	DATE	DESCRIPTION	DRAWN	APPD
2	10/16/15	SHEETED TO STUDY 18 PARCELS, MADE INTO PHASES		
1	8/24/15	SPOT CORRECTION OF SOME MINOR ITEMS		

PROJECT NO. 62024-222
DESIGN: GDW
DRAWN: GDW
CHECK: JLJ
PLOT DATE: 03-10-16
PLOT TIME: 10:01:16

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
3333 S. RAINBOW BLVD · LAS VEGAS, NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM
LAS VEGAS

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Lupe Garcia

THE HOWARD HUGHES COMPANY, LLC

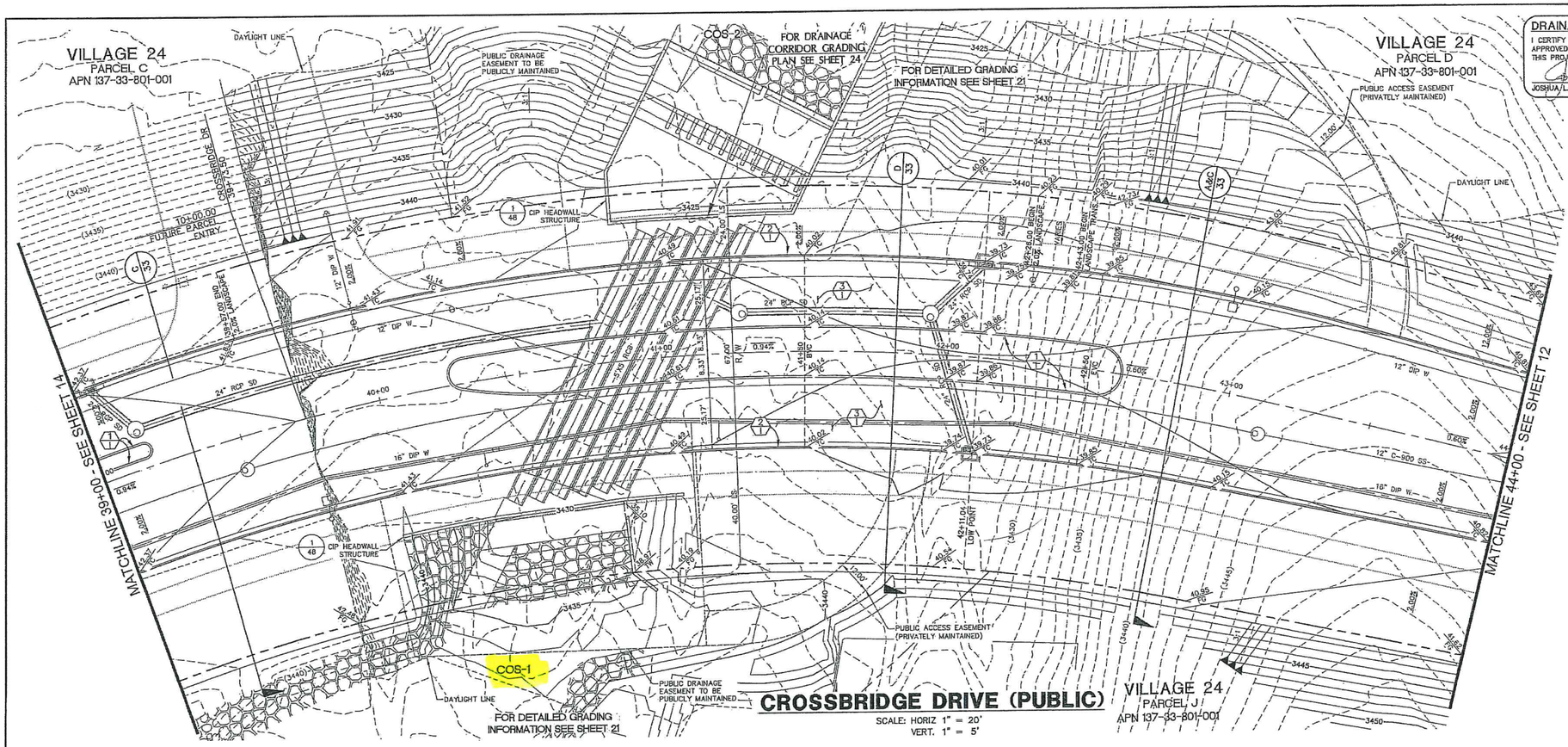
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2 IMPROVEMENT PLANS

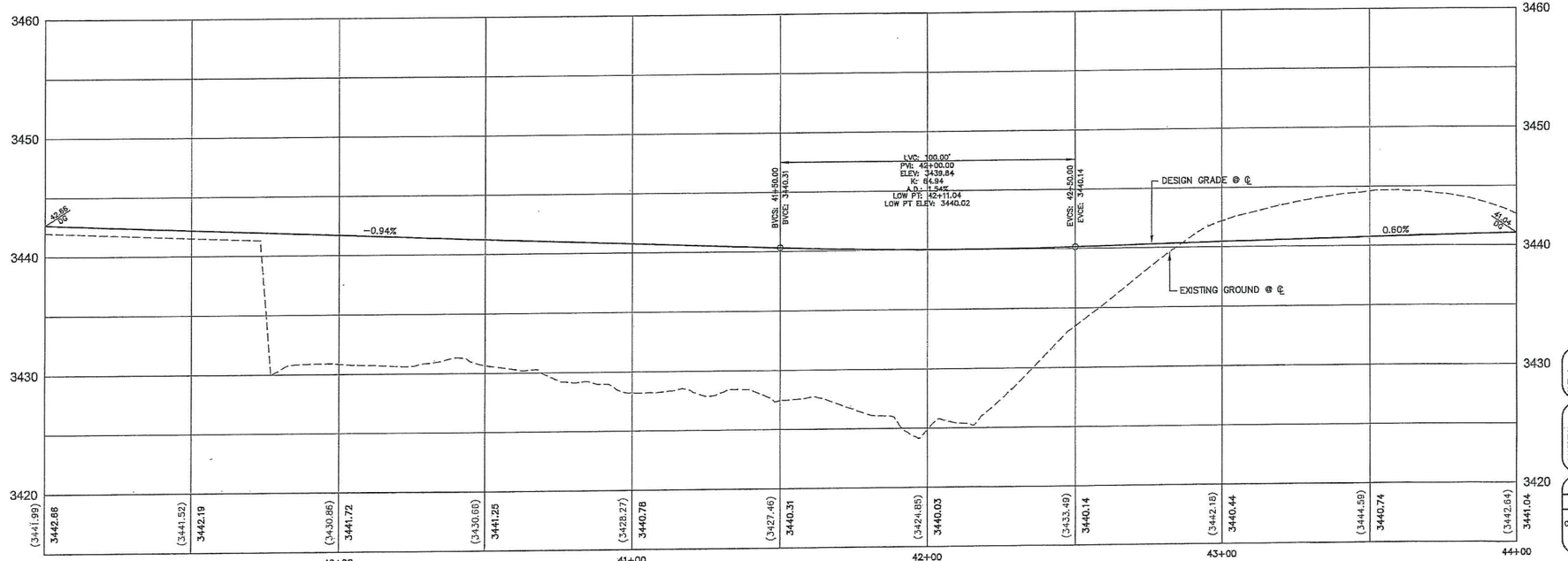
MASTER UTILITY PLAN – STORM DRAIN

DRAWING 6
6 OF 53 SHTS

SID NO. 812 PROJECT 9A, 9B AND 10A

dwg 24.36.dwg 070203.lay





DRAINAGE CERTIFICATION

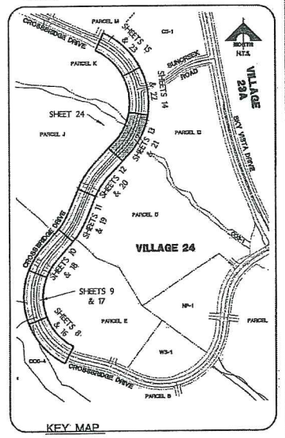
I CERTIFY THAT THE GRADING PLANS ARE IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

JOSHUA L. JOHNSON P.E. 15789 — DATE 10/28/15

NORTH

SCALE 20 0 20 40 FEET

KEY MAP



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BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM (FEET)	NAVD 88 DATUM (METERS)
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3248.83	989.574

FAST — Call before you UnderGround 1-702-432-5300 FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

Call before you Dig — Call 811 or 1-800-227-2600 or CLARK COUNTY TRAFFIC ENGINEERING 1-702-455-6000

CALL BEFORE YOU DIG POWER LINES ARE NOT BURIED — CALL BEFORE YOU DIG OVERHEAD 1-702-227-2929

ENGINEER - STATE OF NEVADA — JOSHUA L. JOHNSON — No. 15789 — EXPIRES 12-31-16 — DATE: 10/29/2015

REV	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP
	TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION				

PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JWJ
PLOT DATE: 10-28-15
PLOT TIME: 11:09:23

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD - LAS VEGAS, NV 89146
P: 702.804.2000 - F: 702.804.2299 - GCWALLACE.COM
LAS VEGAS

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Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

CROSSBRIDGE DRIVE
ROADWAY PLAN AND PROFILE 6

DRAWING 13
13 OF 53 SHTS

SID NO. 812 PROJECT 2

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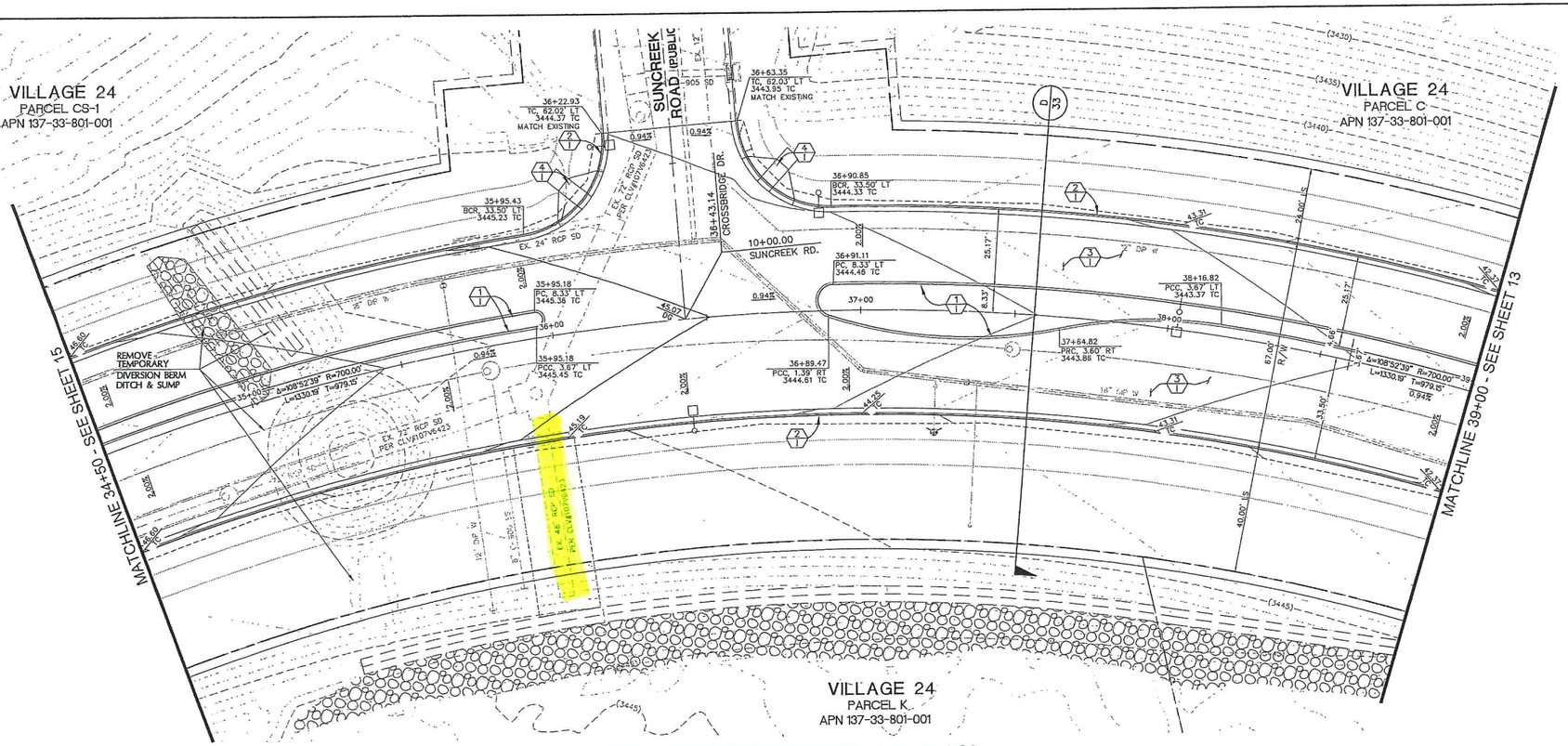
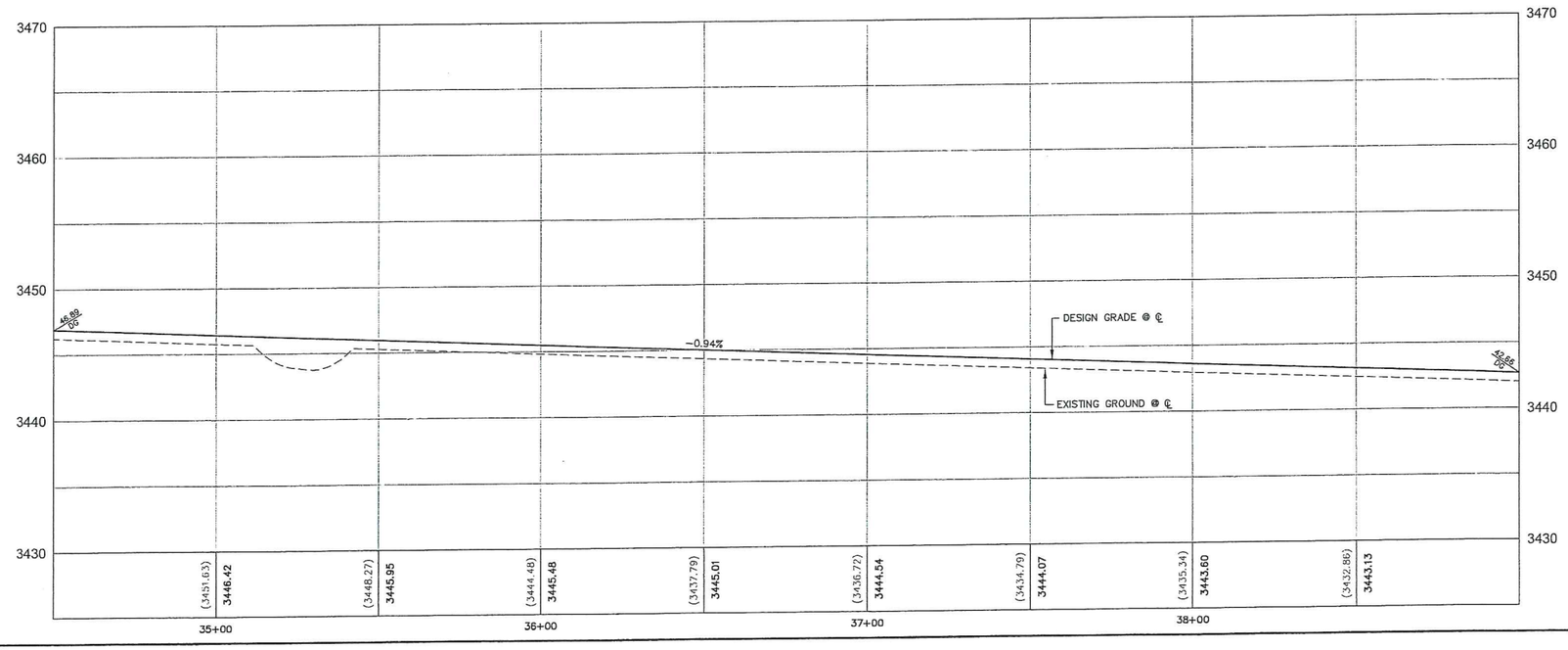


CROSSBRIDGE DRIVE (PUBLIC)

SCALE: HORIZ 1" = 20'
VERT. 1" = 5'



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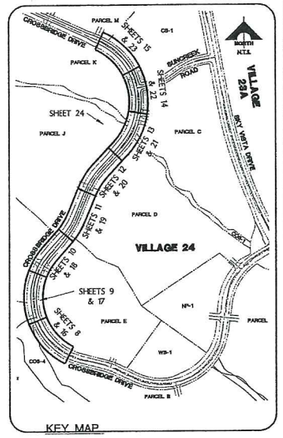
JOSHUA L. JOHNSON P.E. 15789 DATE

NORTH

SCALE: 20 0 20 40 FEET



KEY MAP

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CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

FAST Call before you UnderGround 1-702-432-5300 FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

Call before you Dig Avoid cutting or damaging utility lines underground. Call 811 or 1-800-227-2600 CLARK COUNTY WATER OPERATIONS 1-702-455-6000

AVOID POWER OVERHEAD POWER LINES, IT'S CRAZY! CALL BEFORE YOU DO OVERHEAD 1-702-227-2929

ENGINEER, STATE OF NEVADA, JOSHUA L. JOHNSON, No. 15789, PROFESSIONAL

DATE: 10/01/2015

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 10-01-15
PLOT TIME: 11:19:30

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD - LAS VEGAS, NV 89146
T: 702.804.2000 F: 702.804.2229 - GCWALLACE.COM
LAS VEGAS

F:\Projects\60\62024-222\DWG\Production\24CB2d14_PP7.dwg
Paul Brainerd

THE HOWARD HUGHES COMPANY, LLC

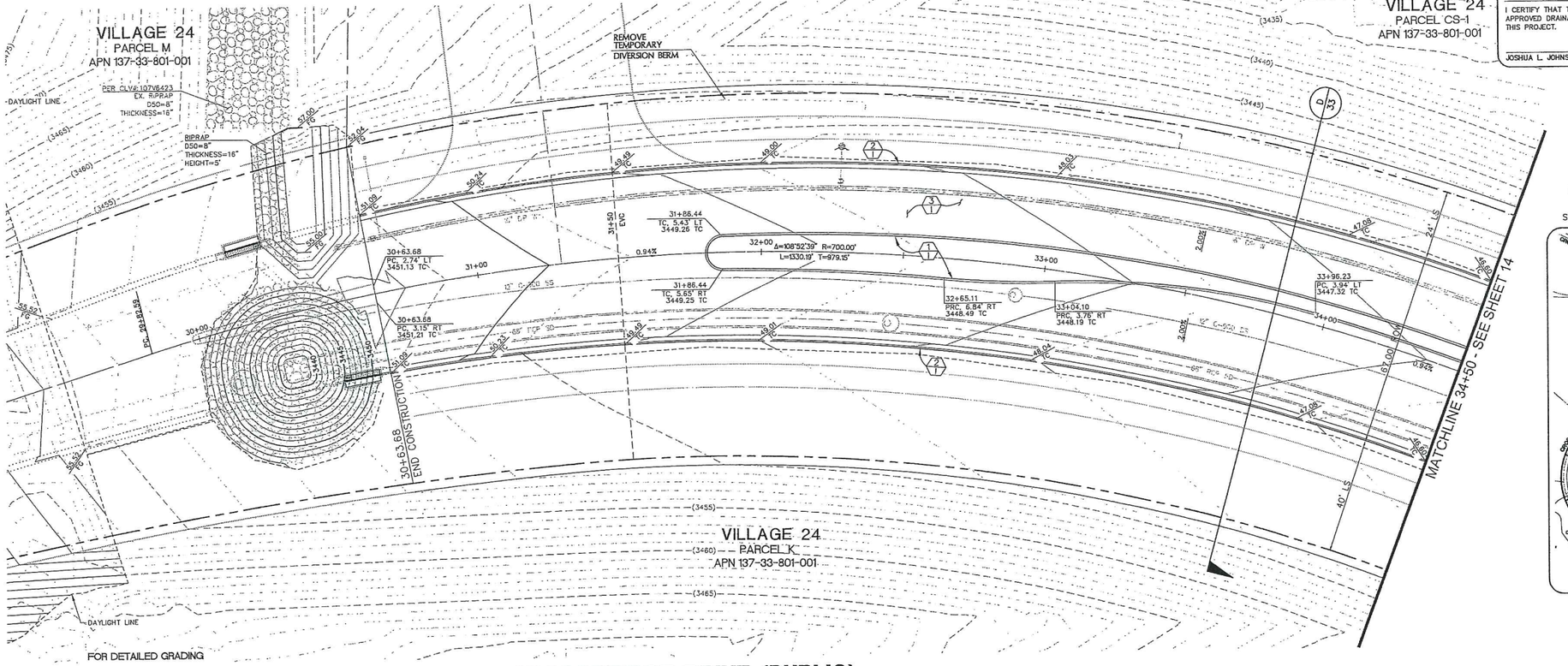
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

CROSSBRIDGE DRIVE
ROADWAY PLAN AND PROFILE 7

DRAWING 14
14 OF 53 SHTS

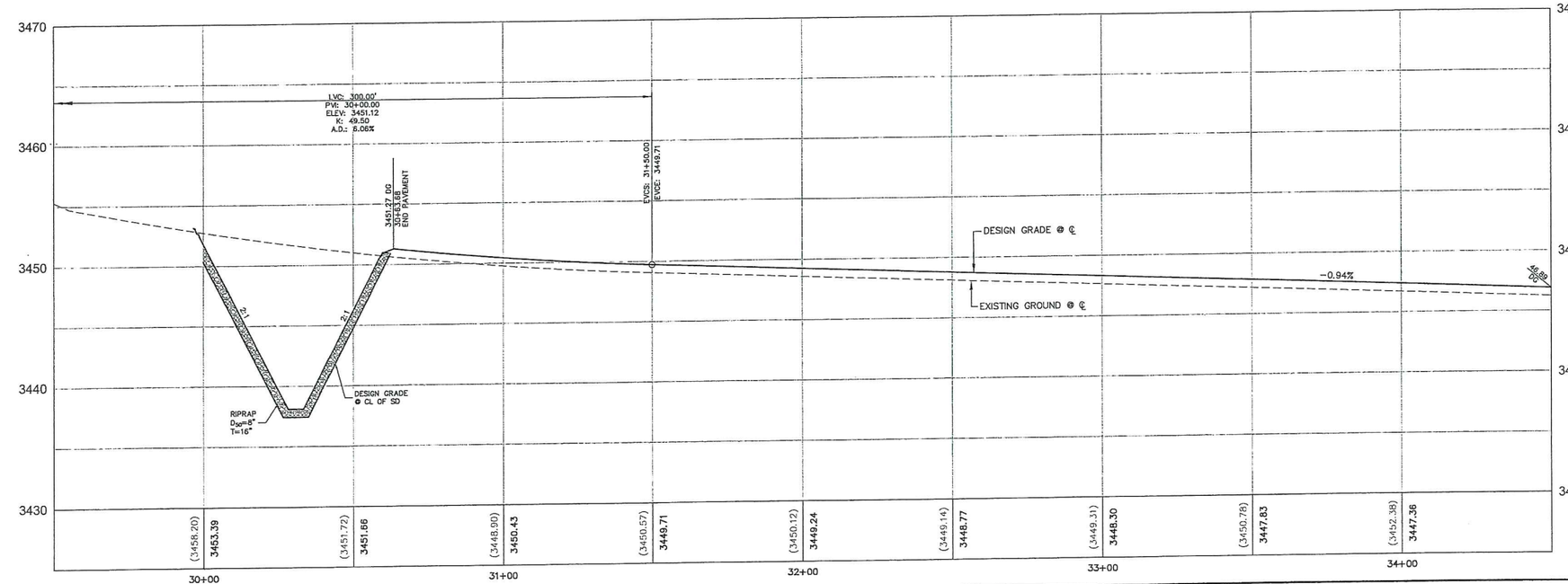
SID NO. 812 PROJECT 2

gw24136.dwg 070203.sv



CROSSBRIDGE DRIVE (PUBLIC)

SCALE: HORIZ 1" = 20'
VERT. 1" = 5'



DRAINAGE CERTIFICATION

I CERTIFY THAT THE GRADING PLANS ARE IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

JOSHUA L. JOHNSON P.E. 15789 DATE

FAST Call before you UnderGround 1-702-432-5300 (DEDAY AND ARTERIAL SYSTEM OF TRANSPORTATION)

Call before you Dig Avoid cutting underground utility lines, it's costly. Call 811 1-800-227-2600 OR CLARK COUNTY WASTEWATER OPERATIONS 1-702-455-6000

AVOID POTENTIAL ELECTROCUTION POWER LINES, IT'S COSTLY. CALL BEFORE YOU DIG OVERHEAD 1-702-227-2929

NOTE

THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS

BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

ENGINEER – STATE OF NEVADA – JOSHUA L. JOHNSON – No. 15789 – PROFESSIONAL ENGINEER – DATE: 10/01/2015

REV	DATE	DESCRIPTION	DATE	HGSN APP	DATE	GCW APP

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 10-01-15
PLOT TIME: 11:21:58

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD · LAS VEGAS, NV 89146
T: 702.804.2000 · F: 702.804.2399 · GCWALLACE.COM
LAS VEGAS
F:\Projects\G00\62024-222\DWG\Production\24CB2st15_PP8.dwg
Paul Brennord

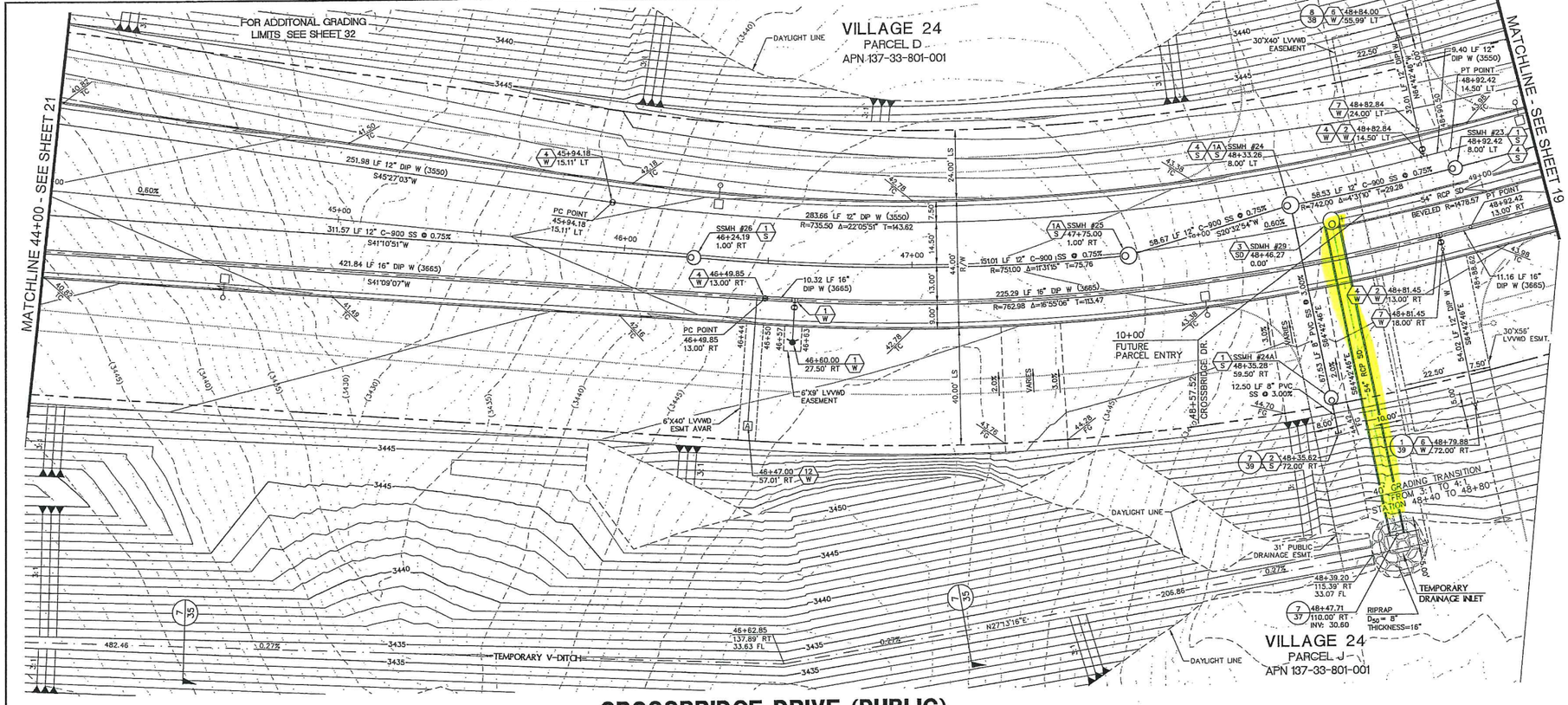
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 – CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

CROSSBRIDGE DRIVE
ROADWAY PLAN AND PROFILE 8

DRAWING 15
15 OF 53 SHTS

SID NO. 812 PROJECT 2


FOR ADDITONAL GRADING LIMITS SEE SHEET 32
MATCHLINE 44+00 - SEE SHEET 21
MATCHLINE - SEE SHEET 19
VILLAGE 24
PARCEL D
APN:137-33-801-001
VILLAGE 24
PARCEL J
APN 137-33-801-001
DAYLIGHT LINE
TEMPORARY V-DITCH
CROSSBRIDGE DR.
10+00 FUTURE PARCEL ENTRY
6'X40' LVVWD ESMT AVAR
6'X9' LVVWD EASEMENT
30'X40' LVVWD EASEMENT
30'X55' LVVWD ESMT.
31' PUBLIC DRAINAGE ESMT.
TEMPORARY DRAINAGE INLET
RIPRAP D50= 8" THICKNESS=16"
45+94.18 15.11' LT
PC POINT 45+94.18 15.11' LT
251.98 LF 12" DIP W (3550) S45°27'03"W
311.57 LF 12" C-900 SS @ 0.75% S41°10'51"W
421.84 LF 16" DIP W (3665) S41°09'07"W
283.66 LF 12" DIP W (3550) R=735.50 Δ=22°05'51" T=143.62
SSMH #26 46+24.19 1.00' RT
46+49.85 13.00' RT
PC POINT 46+49.85 13.00' RT
10.32 LF 16" DIP W (3665)
46+50.00 27.50' RT
46+47.00 57.01' RT
225.29 LF 16" DIP W (3665) R=762.98 Δ=16°55'06" T=113.47
151.01 LF 12" C-900 SS @ 0.75% R=751.00 Δ=11°31'15" T=75.76
SSMH #25 47+75.00 1.00' RT
58.67 LF 12" C-900 SS @ 0.75% R=742.00 Δ=4°31'40" T=29.28 S20°12'54"W
SSMH #24 48+33.26 8.00' LT
SDMH #29 48+46.27 0.00'
48+57.52 CROSSBRIDGE DR.
12.50 LF 8" PVC SS @ 3.00%
47.63 LF 8" PVC SS @ 3.00% S64°42'46"E
54" RCP SD @ 0.60% S64°42'46"E
48+84.00 55.99' LT
9.40 LF 12" DIP W (3550)
PT POINT 48+92.42 14.50' LT
48+82.84 24.00' LT
48+82.84 14.50' LT
SSMH #23 48+92.42 8.00' LT
54" RCP SD @ 0.75% S64°42'46"E
54" RCP SD BEVELED R=1478.57 PT POINT 48+92.42 13.00' RT
11.16 LF 16" DIP W (3665)
48+81.45 13.00' RT
48+81.45 18.00' RT
48+79.88 72.00' RT
48+35.62 72.00' RT
48+39.20 115.39' RT 33.07 FL
48+47.71 110.00' RT INV: 30.60
46+62.85 137.89' RT 33.63 FL
482.46
206.85
N27°13'16"E
0.60%
0.27%
0.75%
3.00%
2.00%
4.50%
4.18%
4.78%
4.88%
4.98%
4.38%
4.28%
4.58%
4.68%
4.70%
3.13%
3.14%
3.15%
3.16%
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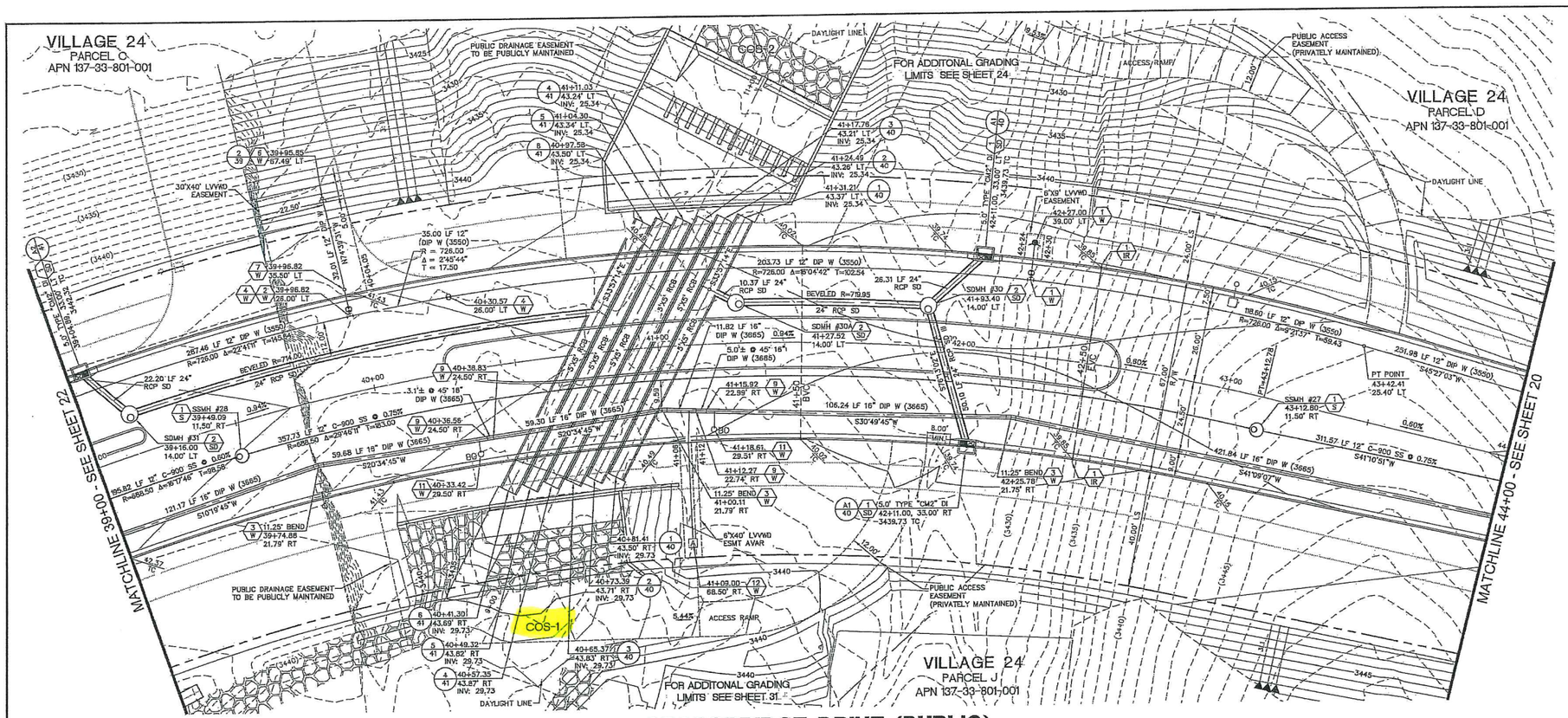
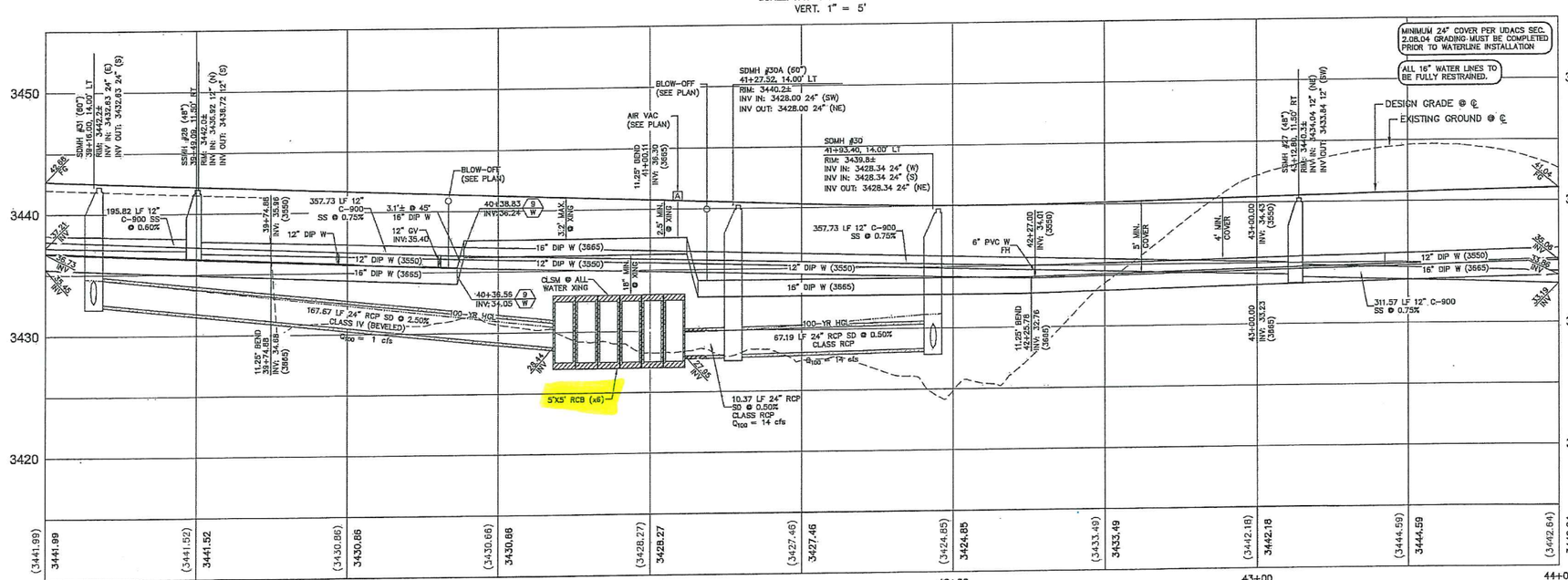
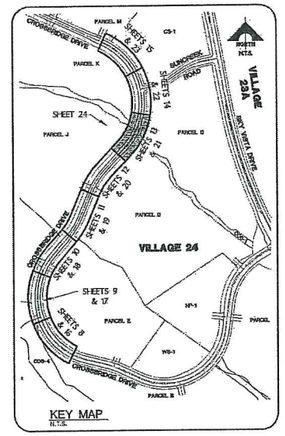
3.50%
3.51%
3.52%







SCALE: 20 0 20 40 FEET

FAST Call before you UnderGround 1-702-432-5300

Call before you Dig Call 811 or 1-800-227-2600 or CLARK COUNTY TRAFFIC OPERATIONS 1-702-455-6000

AVOID OVERHEAD POWER LINES, IT'S EASY. CALL BEFORE YOU DIG (OVERHEAD) 1-702-227-2929

NOTE

THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS

BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D358	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123547 DATE:

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	CCW APP
1	11/11/11					

PROJECT NO. 62024-222
DESIGN: CCW
DRAWN: CCW
CHECK: JLJ
PLOT DATE: 10-28-15
PLOT TIME: 11:11:11

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
3553 S. RAINBOW BLVD · LAS VEGAS, NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-222\DWG\Production\24CB2x21_U16.dwg
Matthew Burge

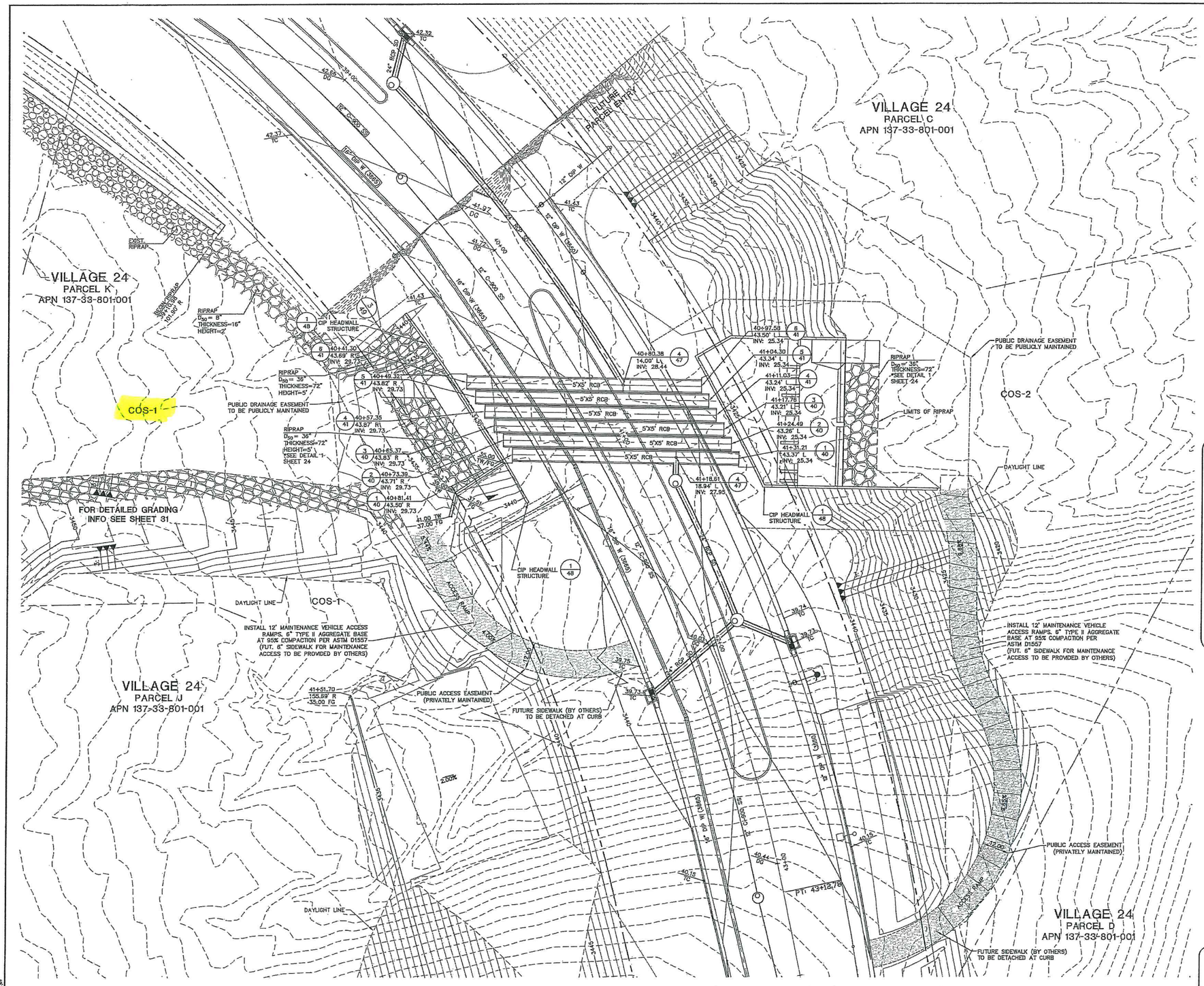
THE HOWARD HUGHES COMPANY, LLC

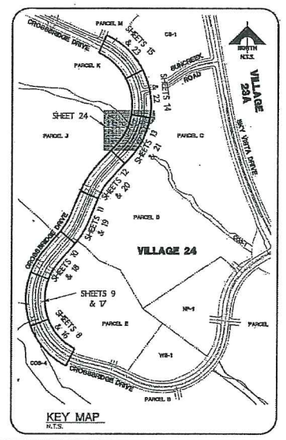
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

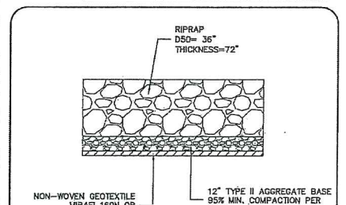
CROSSBRIDGE DRIVE
UTILITY PLAN AND PROFILE 6

DRAWING 21
21 OF 53 SHTS

SID NO. 812 PROJECT 2







RIPRAP DETAIL — 1 / NTS

NOTE

THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS

BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D358	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

Call before you Dig — Avoid cutting underground utility lines. It's costly. Call 811 or 1-800-227-2600 AND CLARK COUNTY TRAFFIC OPERATIONS 1-702-455-6000

CALL BEFORE YOU DIG OVERHEAD — AVOID UTILITY OVERHEAD POWER LINES IT'S COSTLY — 1-702-227-2929

FAST — Call before you UnderGround — 1-702-432-5300 — CLEETUS AND ASSOCIATED SYSTEM OF TRANSPORTATION

CROSSBRIDGE DRIVE (PUBLIC) - DRAINAGE CORRIDOR CROSSING

SCALE: HORIZ. 1" = 20'

ENGINEER - STATE OF NEVADA — JOSHUA M. JOHNSON — No. 15181 — PROFESSIONAL — 10/28/2015

DATE: 10/28/2015

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-222

DESIGN: GCW
DRAWN: GCW
CHECK: JMJ
PLOT DATE: 10-28-15
PLOT TIME: 11:14:20

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
3555 S. RAINBOW BLVD - LAS VEGAS NV 89146
P: 702.804.2000 - F: 702.804.2299 - GCWALLACE.COM

LAS VEGAS

F:\Projects\600\62024-222\DWG\Production\24CB2x24_G01.dwg
Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

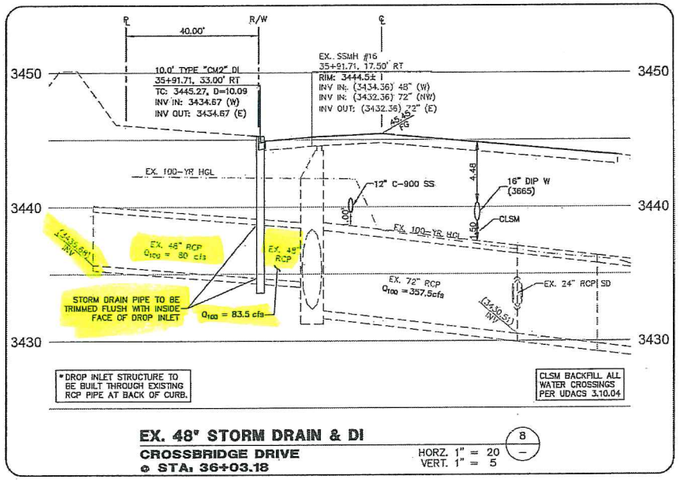
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2 IMPROVEMENT PLANS

CROSSBRIDGE DRIVE
GRADING AT DRAINAGE CORRIDOR CROSSING

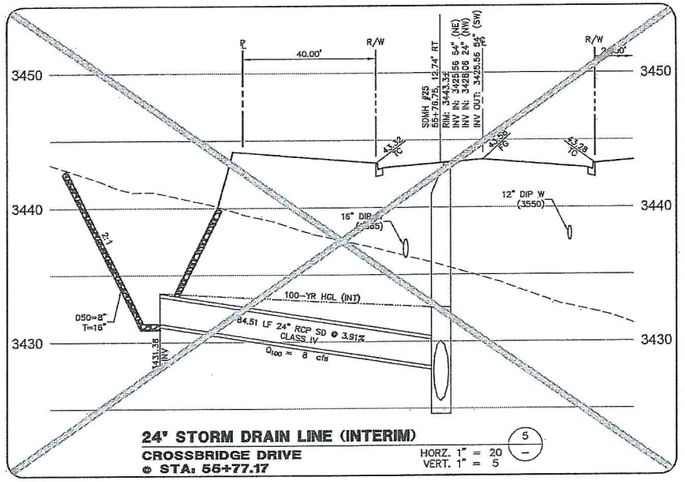
SID NO. 812 PROJECT 2

DRAWING 24
24 OF 53 SHTS

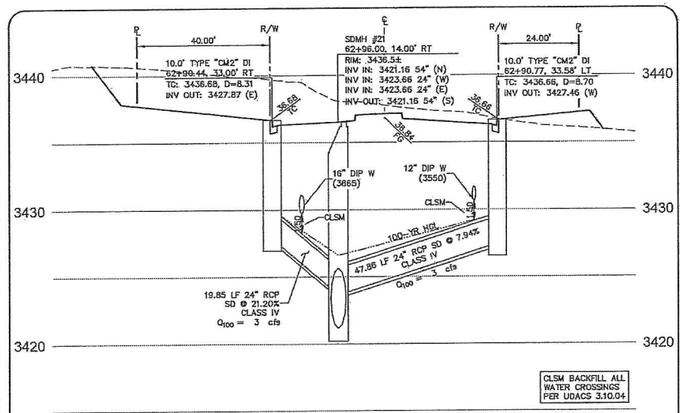
cw24x36.dwg,10/28/15,jw



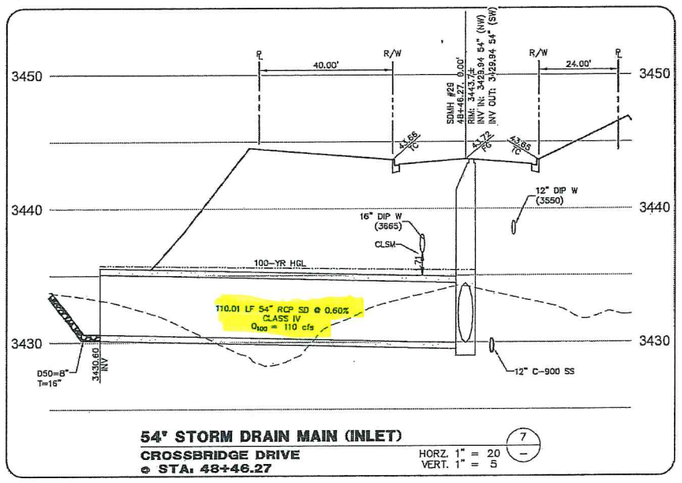
EX. 48" STORM DRAIN & DI
CROSSBRIDGE DRIVE
@ STA: 36+03.18
HORZ. 1" = 20
VERT. 1" = 5
8



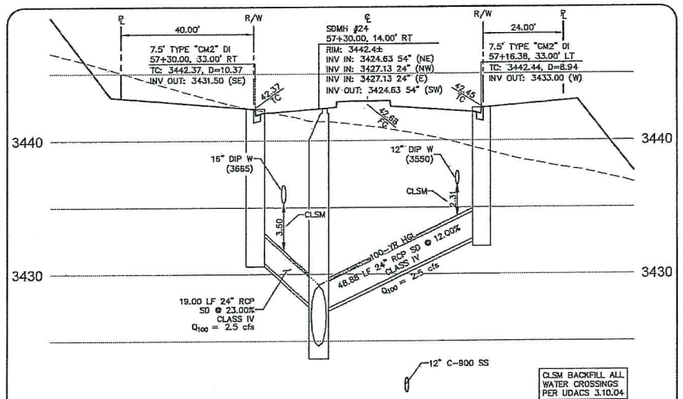
24" STORM DRAIN LINE (INTERIM)
CROSSBRIDGE DRIVE
@ STA: 56+77.17
HORZ. 1" = 20
VERT. 1" = 5
5



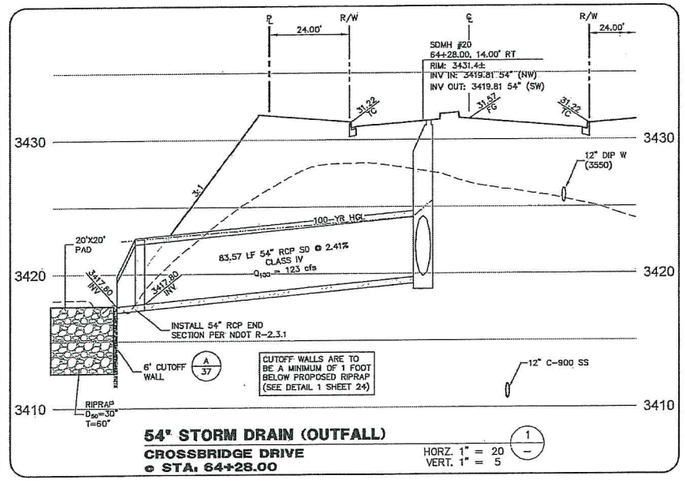
24" STORM DRAIN & DI
CROSSBRIDGE DRIVE
@ STA: 62+94.54
HORZ. 1" = 20
VERT. 1" = 5
2



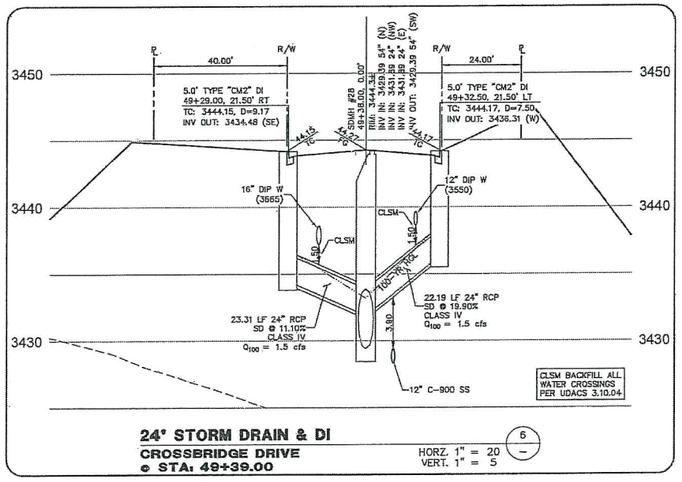
54" STORM DRAIN MAIN (INLET)
CROSSBRIDGE DRIVE
@ STA: 48+46.27
HORZ. 1" = 20
VERT. 1" = 5
7



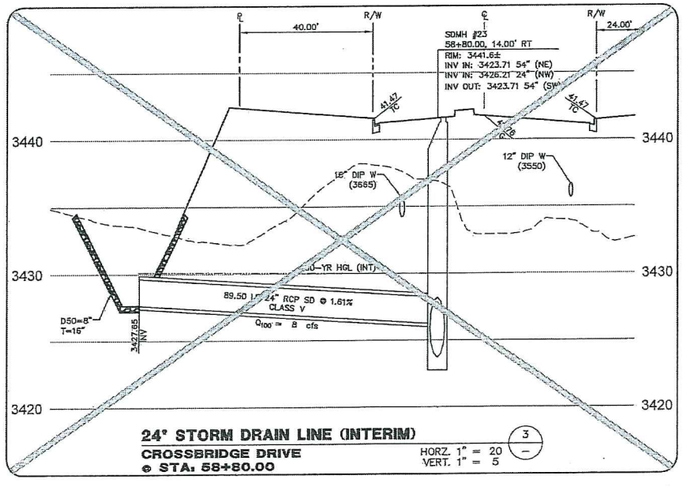
24" STORM DRAIN & DI
CROSSBRIDGE DRIVE
@ STA: 57+26.15
HORZ. 1" = 20
VERT. 1" = 5
4



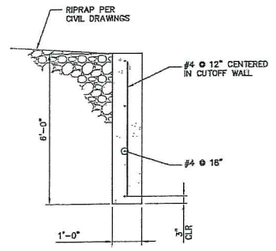
54" STORM DRAIN (OUTFALL)
CROSSBRIDGE DRIVE
@ STA: 64+28.00
HORZ. 1" = 20
VERT. 1" = 5
1



24" STORM DRAIN & DI
CROSSBRIDGE DRIVE
@ STA: 49+39.00
HORZ. 1" = 20
VERT. 1" = 5
6



24" STORM DRAIN LINE (INTERIM)
CROSSBRIDGE DRIVE
@ STA: 58+80.00
HORZ. 1" = 20
VERT. 1" = 5
3



SINGLE CUTOFFWALL DETAIL
NTS
A

DROP INLET NOTE

WHERE 10 FEET PARALLEL SEPARATION IS NOT PRACTICABLE:

CAST-IN-PLACE MONOLITHIC POUR WITH WATERSTOP BETWEEN SLAB AND WALLS, BASE, WALLS AND TOP TO BE CONSTRUCTED WITH WATERSTOPS, CENTER BULB, OR FLAT STRIP (VINYLEX, GREENSTREAK PLASTIC PRODUCTS OR APPROVED EQUAL).

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123547 DATE:

STATE OF NEVADA — PROFESSIONAL ENGINEER — JOHNSON — DATE: 03/07/2016

NO.	DATE	DESCRIPTION	DATE	AGEN. APP	DATE	CGW APP
1	05/2016	ADDED SIGNAGE & REVISED STUBS W/ PARCEL				

PROJECT NO. 62024-222
DESIGN: CGW
DRAWN: CGW
CHECK: JJJ
PLOT DATE: 03-07-16
PLOT TIME: 12:34:46

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
5555 S. RANDOM BLVD. LAS VEGAS, NV 89166
T: (702) 804-8000 F: (702) 804-8299 GCWALLACE.COM
LAS VEGAS

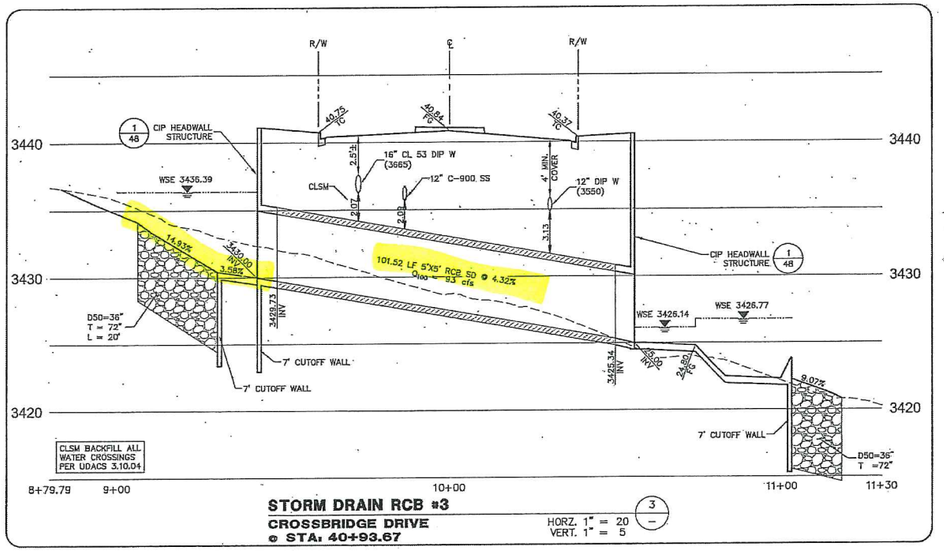
F:\Projects\6000\62024-222\GWC\Production\X45826J7_LAT1.dwg
Luis Criollo

THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS
LATERAL DETAILS 1

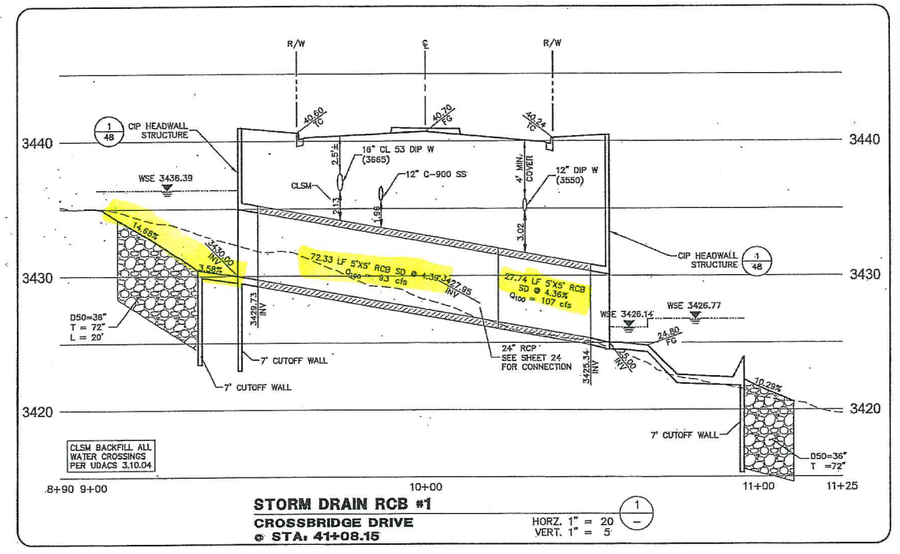
DRAWING 37
37 OF 53 SHTS

SID NO. 812 PROJECT 9A, 9B AND 10A

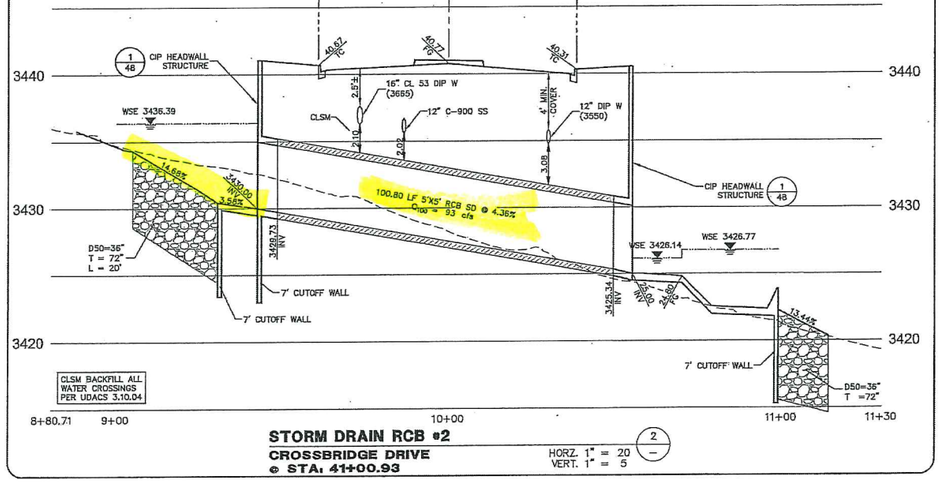
gwx4326.dwg,070203.jw



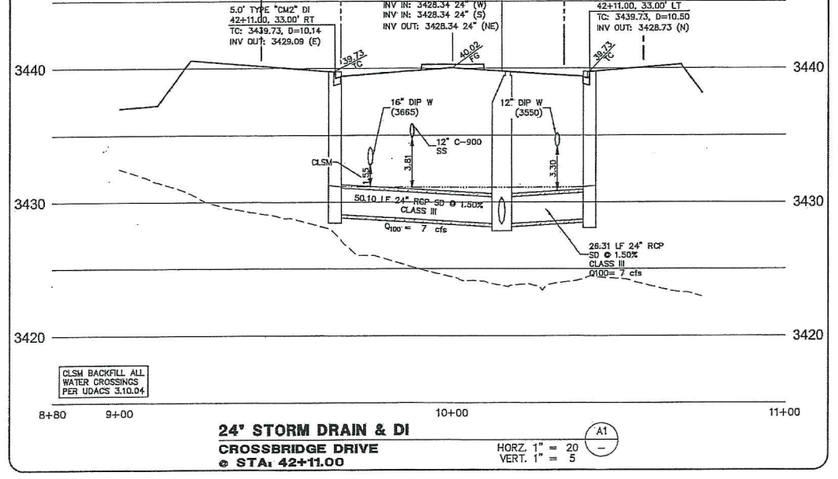
STORM DRAIN RCB #3
CROSSBRIDGE DRIVE
@ STA: 40+93.67
HORZ. 1" = 20
VERT. 1" = 5
3 / —



STORM DRAIN RCB #1
CROSSBRIDGE DRIVE
@ STA: 41+08.15
HORZ. 1" = 20
VERT. 1" = 5
1 / —



STORM DRAIN RCB #2
CROSSBRIDGE DRIVE
@ STA: 41+00.93
HORZ. 1" = 20
VERT. 1" = 5
2 / —



24' STORM DRAIN & DI
CROSSBRIDGE DRIVE
@ STA: 42+11.00
HORZ. 1" = 20
VERT. 1" = 5
A1 / —

DROP INLET NOTE

WHERE 10 FEET PARALLEL SEPARATION IS NOT PRACTICABLE:

CAST-IN-PLACE MONOLITHIC POUR WITH WATERSTOP BETWEEN SLAB AND WALLS. BASE, WALLS AND TOP TO BE CONSTRUCTED WITH WATERSTOPS, CENTER BULB, OR FLAT STRIP (VINYLEX, GREENSTREAK PLASTIC PRODUCTS OR APPROVED EQUAL).

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123547 DATE:

ENGINEER
JOSHUA L. JOHNSON
No. 19787
PROFESSIONAL
STATE OF NEVADA
DATE: 10/28/2015

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 10-29-15
PLOT TIME: 11:16:13

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 SOUTH RAINBOW BLVD. | LAS VEGAS, NEVADA 89146
T: 702.804.2000 • F: 702.804.2299 • GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-222\DWG\Production\24CB2+40_LAY1.dwg
Matthew Burga

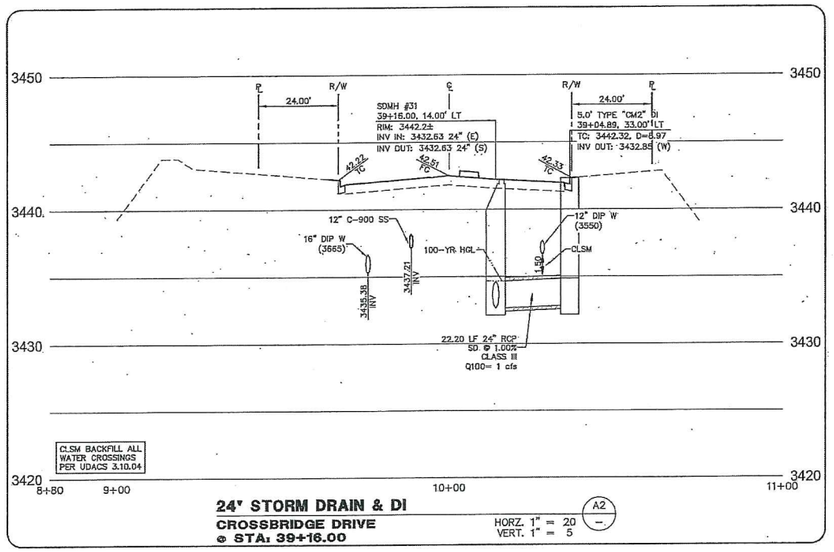
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

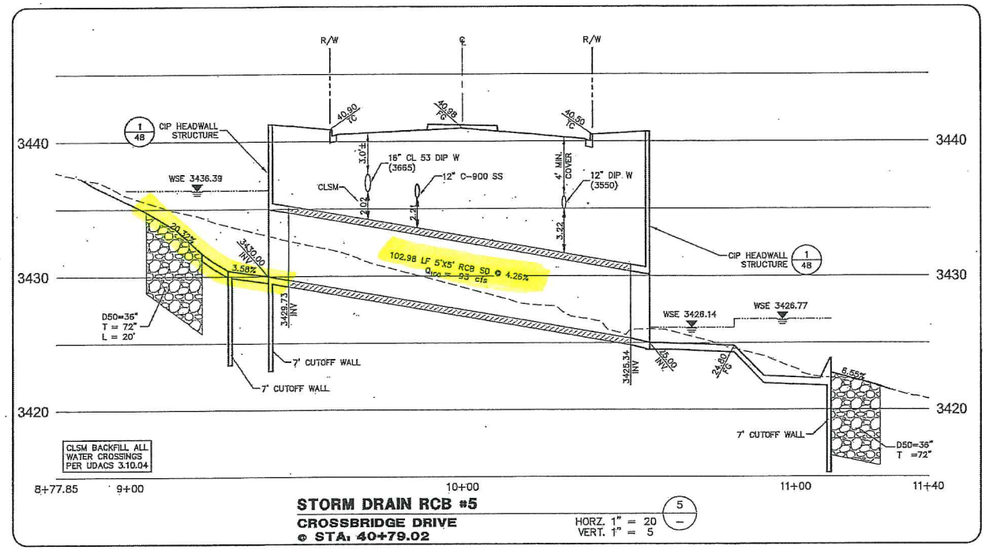
OFFSITE GRADING AND CROSSBRIDGE DRIVE
DRAINAGE CORRIDOR CROSSING DETAILS 1

DRAWING
40
40 OF 53 SHTS

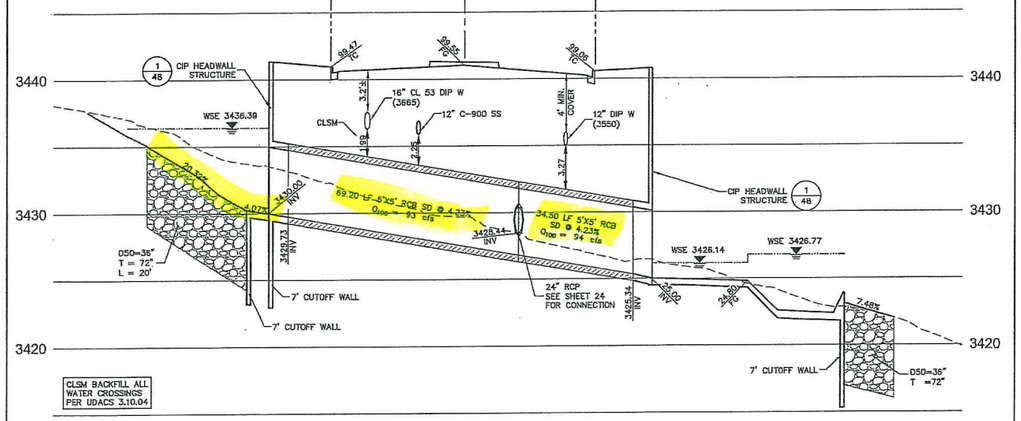
SID NO. 812 PROJECT 2



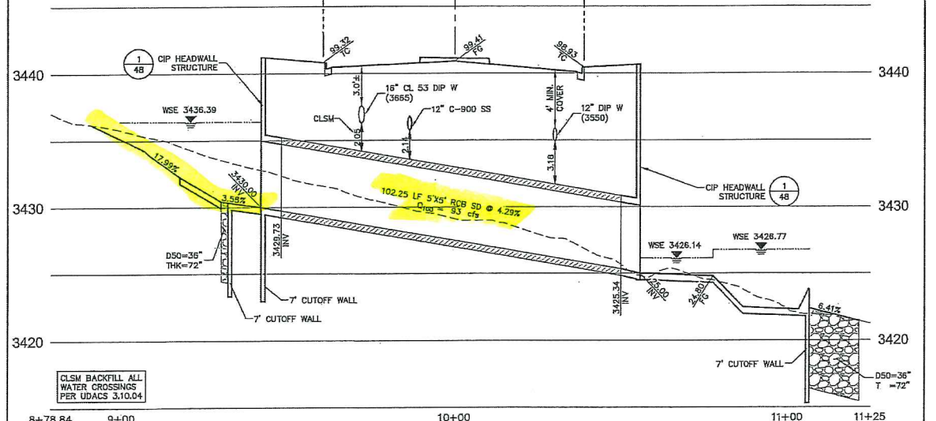
24" STORM DRAIN & DI
CROSSBRIDGE DRIVE
@ STA: 39+16.00
HORZ. 1" = 20
VERT. 1" = 5
A2 / –



STORM DRAIN RCB #5
CROSSBRIDGE DRIVE
@ STA: 40+79.02
HORZ. 1" = 20
VERT. 1" = 5
5 / –



STROM DRAIN RCB #6
CROSSBRIDGE DRIVE
@ STA: 40+71.62
HORZ. 1" = 20
VERT. 1" = 5
6 / –



STORM DRAIN RCB #4
CROSSBRIDGE DRIVE
@ STA: 40+86.37
HORZ. 1" = 20
VERT. 1" = 5
4 / –

DROP INLET NOTE

WHERE 10 FEET PARALLEL SEPARATION IS NOT PRACTICABLE:

CAST-IN-PLACE MONOLITHIC POUR WITH WATERSTOP BETWEEN SLAB AND WALLS. BASE, WALLS AND TOP TO BE CONSTRUCTED WITH WATERSTOPS, CENTER BULB, OR FLAT STRIP (VINYLEX, GREENSTREAK PLASTIC PRODUCTS OR APPROVED EQUAL).

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123647 DATE:

STATE OF NEVADA — JAMES M. HANSON — No. 9879 — PROFESSIONAL ENGINEER
DATE: 10/29/2015

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JMJ
PLOT DATE: 10-28-15
PLOT TIME: 11:17:08

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD - LAS VEGAS, NV 89146
T: 702.804.2000 - F: 702.804.2299 - GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-222\DWG\Production\24C02241_LA75.dwg
Matthew Burge

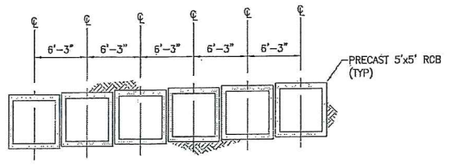
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

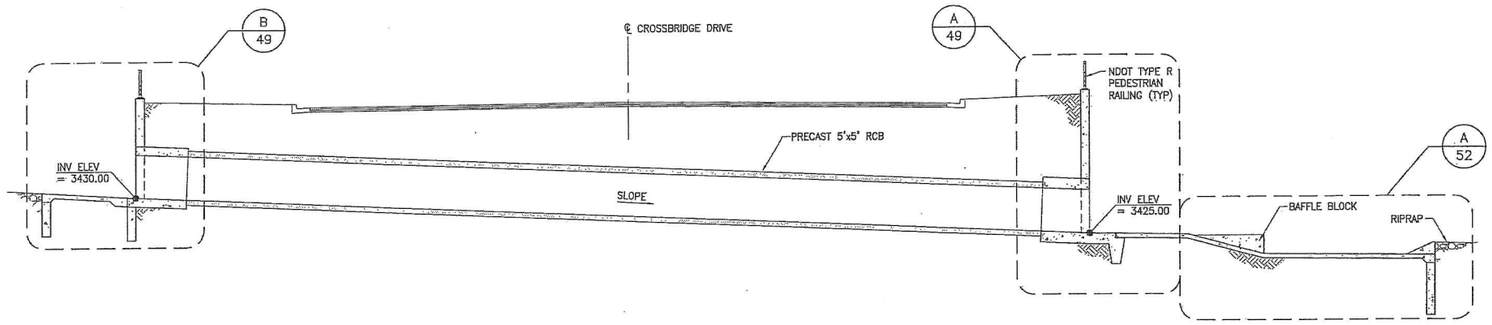
OFFSITE GRADING AND CROSSBRIDGE DRIVE
DRAINAGE CORRIDOR CROSSING DETAILS 2

DRAWING
41
41 OF 53 SHTS

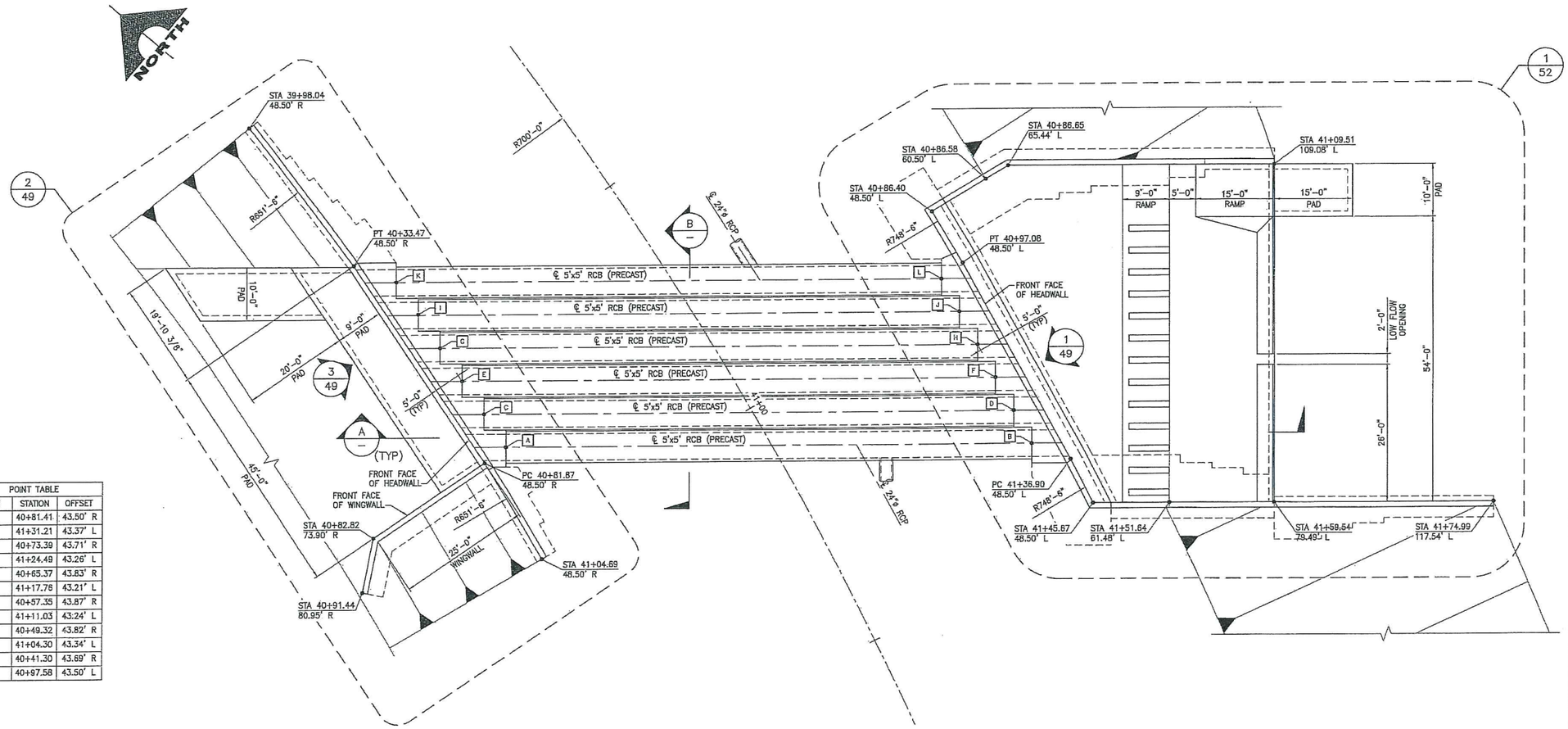
SID NO. 812 PROJECT 2



B TYP SECTION AT PRECAST (6)-5'x5' RCB
SCALE: 1/8" = 1'-0"



A PROFILE
SCALE: 1/8" = 1'-0"



POINT TABLE		
POINT	STATION	OFFSET
A	40+81.41	43.50' R
B	41+31.21	43.37' L
C	40+73.39	43.71' R
D	41+24.49	43.26' L
E	40+65.37	43.83' R
F	41+17.76	43.21' L
G	40+57.35	43.87' R
H	41+11.03	43.24' L
I	40+49.32	43.82' R
J	41+04.30	43.34' L
K	40+41.30	43.69' R
L	40+97.58	43.50' L

1 PLAN - DRAINAGE CORRIDOR CROSSING
SCALE: 3/32" = 1'-0"

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

DATE: 10/28/2015

REV	DATE	DESCRIPTION	DATE	AGEN. APP	DATE	GCW APP

PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 10-28-15
PLOT TIME: 11:17:23

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD · LAS VEGAS, NV 89146
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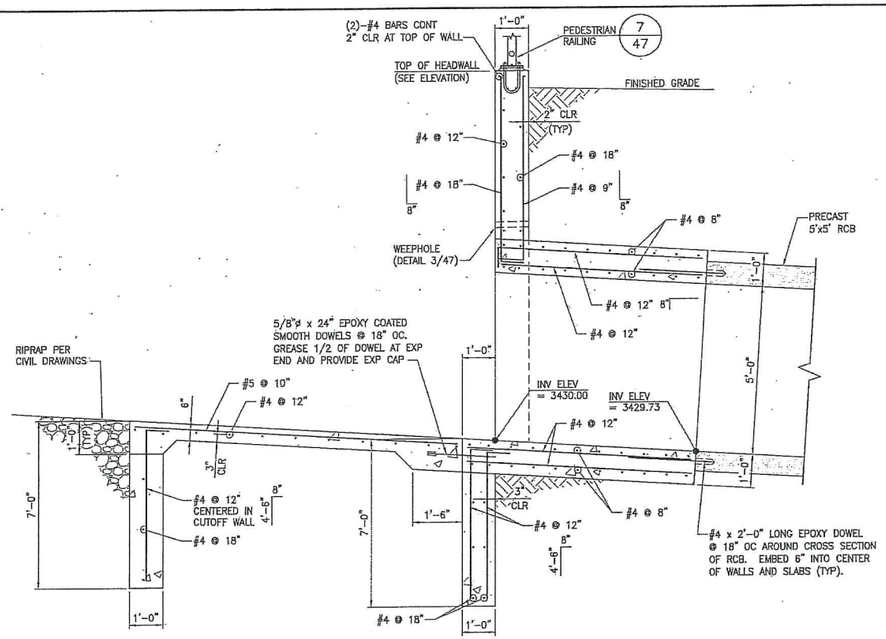
LAS VEGAS
F:\Projects\600\62024-222\DWG\Production\24CB2c48_SC2.dwg
Matthew Burge

THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS
DRAINAGE CORRIDOR STRUCTURAL DETAILS 1

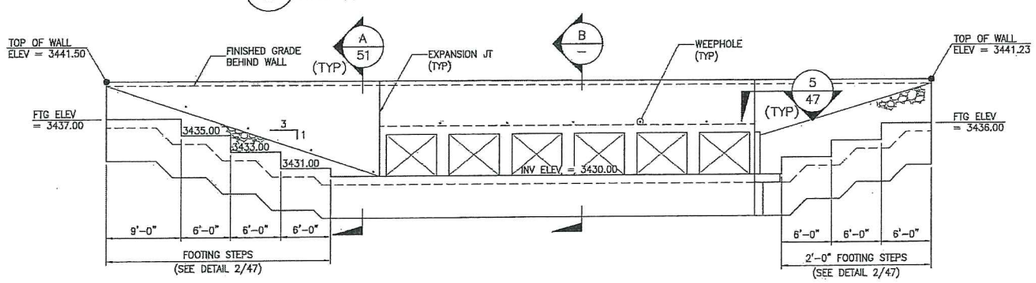
DRAWING
48
48 OF 53 SHTS

SID NO. 812 PROJECT 2



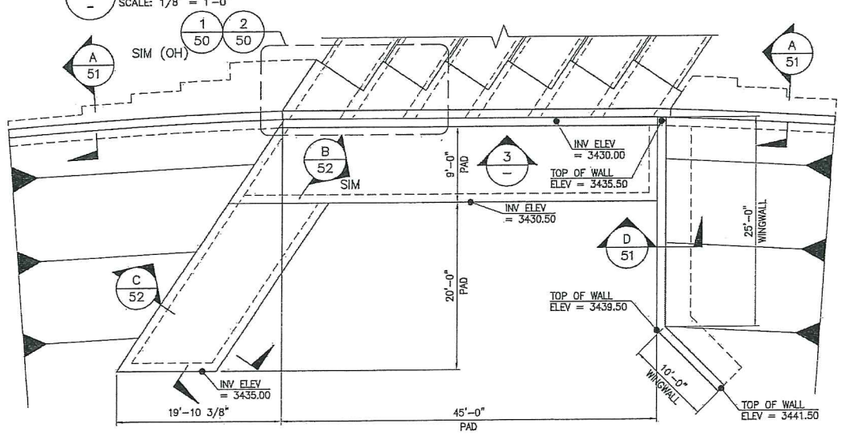
B UPSTREAM HEADWALL SECTION

SCALE: 1/2" = 1'-0"



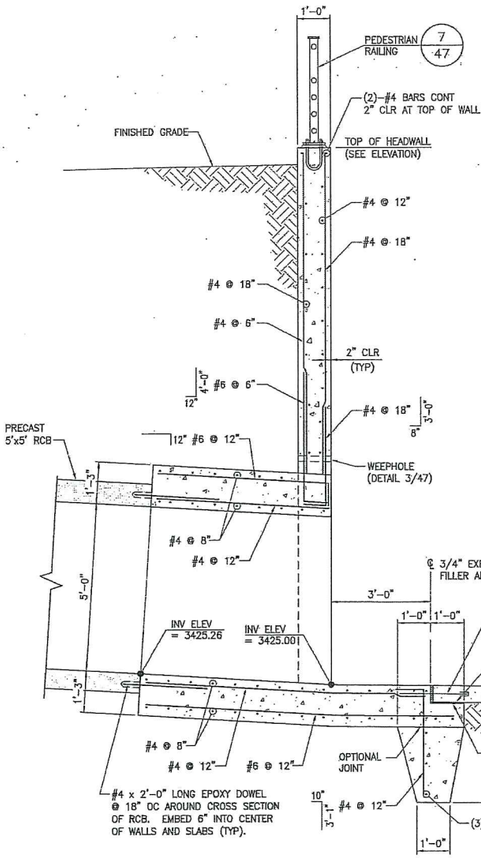
3 UPSTREAM HEADWALL ELEVATION

SCALE: 1/8" = 1'-0"



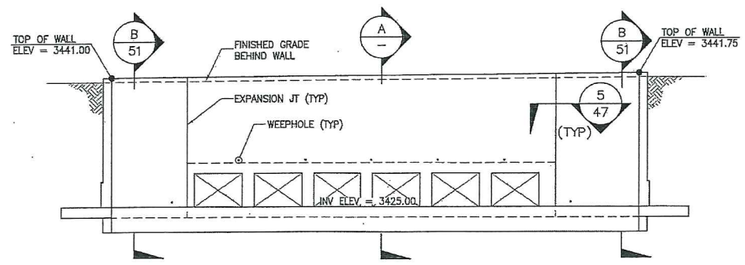
2 UPSTREAM HEADWALL ENLARGED PLAN

SCALE: 1/8" = 1'-0"



A DOWNSTREAM HEADWALL SECTION

SCALE: 1/2" = 1'-0"



1 DOWNSTREAM HEADWALL ELEVATION

SCALE: 1/8" = 1'-0"

STATE OF NEVADA
ENGINEER
ERIC G. GILES
No. 14010
PROFESSIONAL
DATE: 10/28/2015

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-222
DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 10-28-15
PLOT TIME: 11:44:59

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 SAN MIGUEL, LAS VEGAS, NEVADA 89102
T: 702.384.2000 · F: 702.384.2259 · GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-222\Civil\Production\24282s49_SC3.dwg
Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

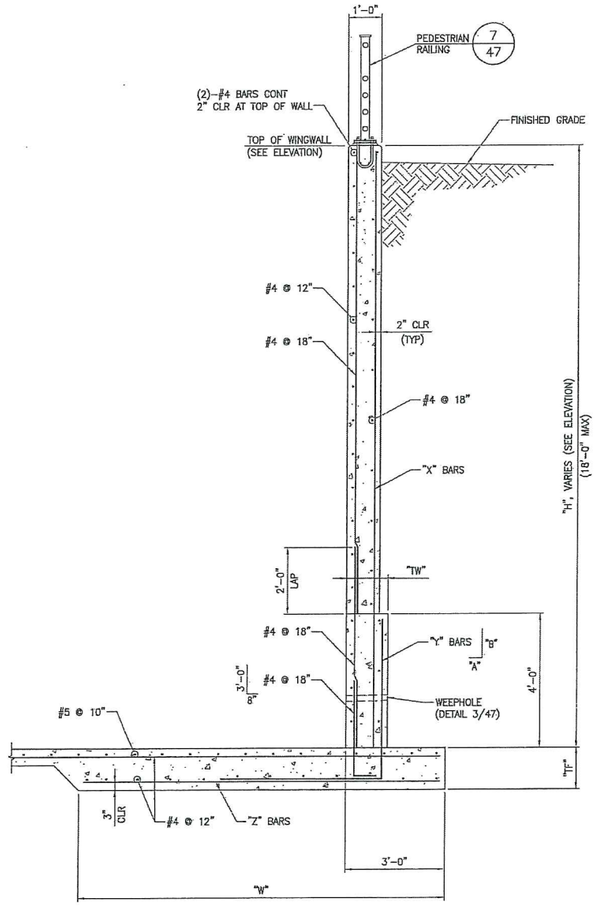
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2 IMPROVEMENT PLANS

DRAINAGE CORRIDOR STRUCTURAL DETAILS 2

DRAWING 49
49 OF 53 SHTS

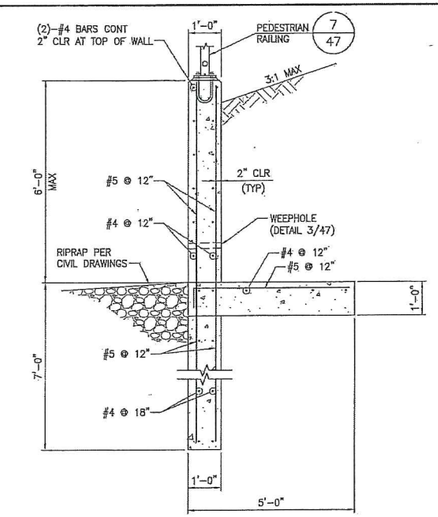
SID NO. 812 PROJECT 2

S:\Projects\600\62024-222\Civil\Production\24282s49_SC3.dwg 10/28/2015 3:44:

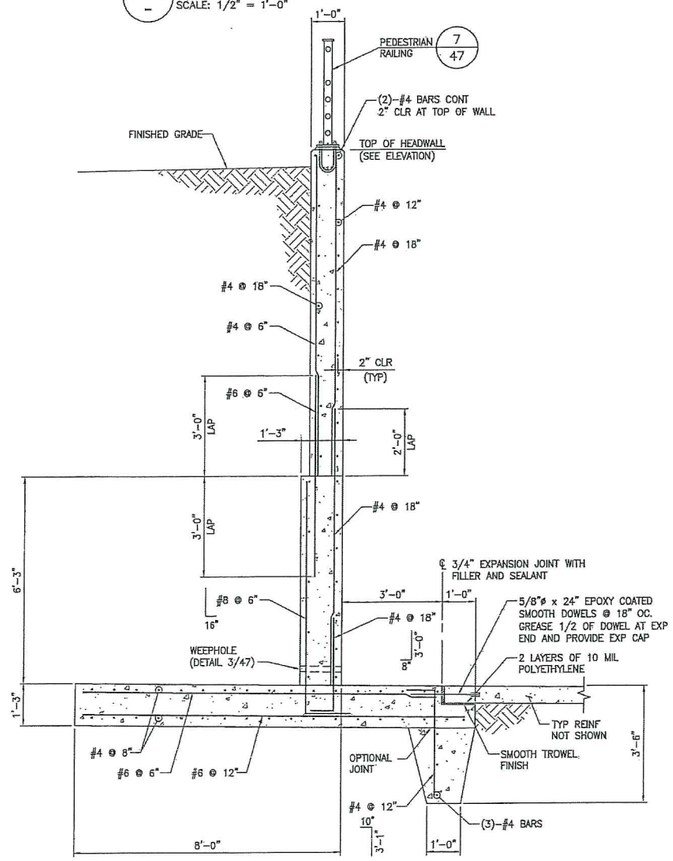


DIMENSIONS				"X"	"Y"	"Z"	"A"	"B"
H	W	TW	TF	BARS	BARS	BARS		
≤ 6'-0"	4'-0"	1'-0"	1'-0"	#4 @ 9"	#4 @ 9"	#4 @ 9"	8"	2'-9"
≤ 8'-0"	5'-6"	1'-0"	1'-0"	#4 @ 9"	#5 @ 9"	#4 @ 9"	10"	3'-3"
≤ 10'-0"	7'-0"	1'-0"	1'-0"	#4 @ 6"	#5 @ 6"	#4 @ 6"	10"	3'-3"
≤ 12'-0"	8'-3"	1'-0"	1'-0"	#4 @ 6"	#6 @ 6"	#5 @ 6"	12"	3'-9"
≤ 14'-0"	9'-6"	1'-3"	1'-3"	#5 @ 6"	#7 @ 6"	#5 @ 6"	4'-10"	4'-10"
≤ 16'-0"	10'-6"	1'-3"	1'-3"	#5 @ 6"	#8 @ 6"	#6 @ 6"	4'-10"	4'-10"
≤ 18'-0"	12'-0"	1'-3"	1'-3"	#7 @ 6"	#9 @ 6"	#7 @ 6"	4'-10"	4'-10"

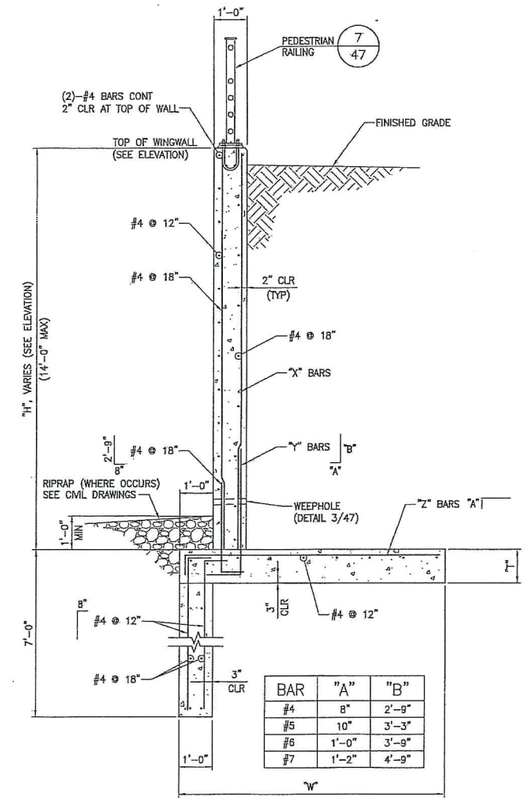
C TYPICAL OUTLET WALL SECTION
SCALE: 1/2" = 1'-0"



D TYPICAL WINGWALL SECTION
SCALE: 1/2" = 1'-0"



B WALL SECTION AT OUTLET
SCALE: 1/2" = 1'-0"



BAR	"A"	"B"
#4	8"	2'-9"
#5	10"	3'-3"
#6	1'-0"	3'-9"
#7	1'-2"	4'-9"

WINGWALL SCHEDULE ("H" ≤ 14'-0")					
DIMENSIONS			"X"*	"Y"	"Z"
H	W	T	BARS	BARS	BARS
≤ 4'-0"	3'-0"	1'-0"	#4 @ 12"	#4 @ 12"	#4 @ 12"
≤ 6'-0"	4'-0"	1'-0"	#4 @ 9"	#4 @ 9"	#4 @ 9"
≤ 8'-0"	5'-0"	1'-0"	#4 @ 9"	#5 @ 9"	#4 @ 9"
≤ 10'-0"	6'-0"	1'-0"	#4 @ 6"	#5 @ 6"	#4 @ 6"
≤ 12'-0"	8'-0"	1'-0"	#4 @ 6"	#6 @ 6"	#5 @ 6"
≤ 14'-0"	9'-6"	1'-3"	#5 @ 6"	#7 @ 6"	#7 @ 6"

*"X" BARS MAY BE ELIMINATED BY EXTENDING THE "Y" BARS TO THE TOP OF THE RETAINING WALL.

A TYPICAL WINGWALL SECTION
SCALE: 1/2" = 1'-0"

STATE OF NEVADA
ERIC G. GILES
No. 13600
STRUCTURAL
ENGINEER
DATE: 10/28/2015

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-222

DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 10-28-15
PLOT TIME: 11:45:19

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD - LAS VEGAS, NV 89146
T: 702.804.2000 - F: 702.804.2299 - GCWALLACE.COM
LAS VEGAS
F:\Projects\600\62024-222\DWG\Production\24x36x51_Sc5.dwg
Matthew Burge

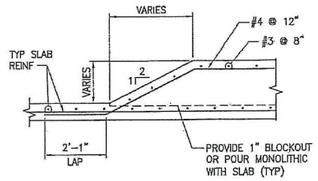
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

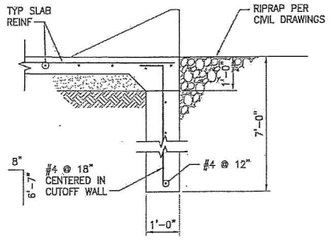
DRAINAGE CORRIDOR STRUCTURAL DETAILS 4

DRAWING 51
51 OF 53 SHTS

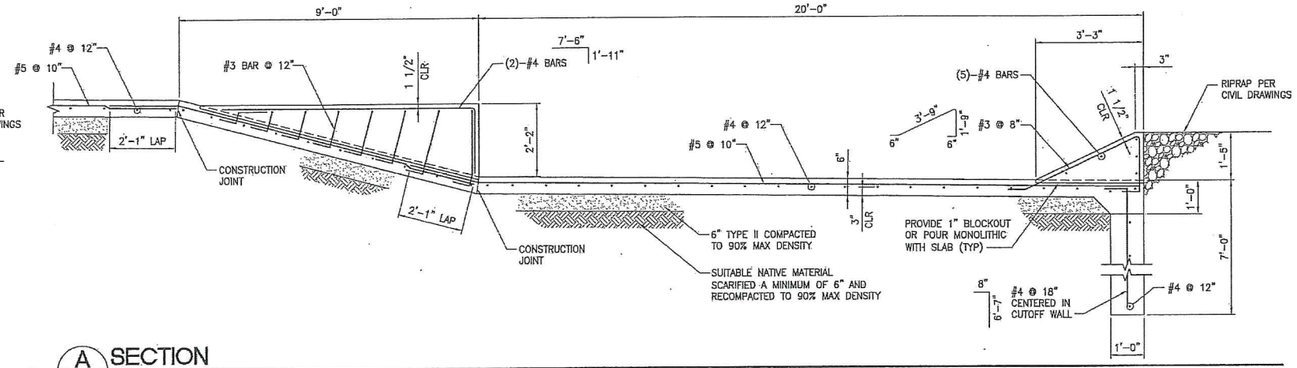
SID NO. 812 PROJECT 2



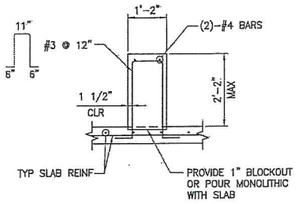
F SECTION
SCALE: 1/2" = 1'-0"



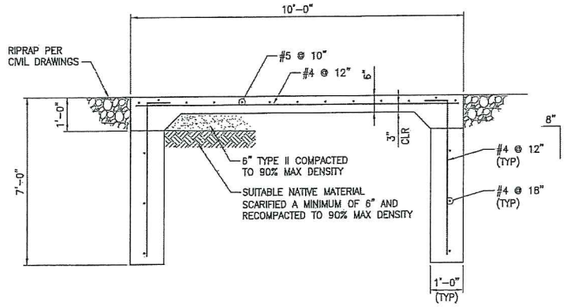
E SECTION
SCALE: 1/2" = 1'-0"



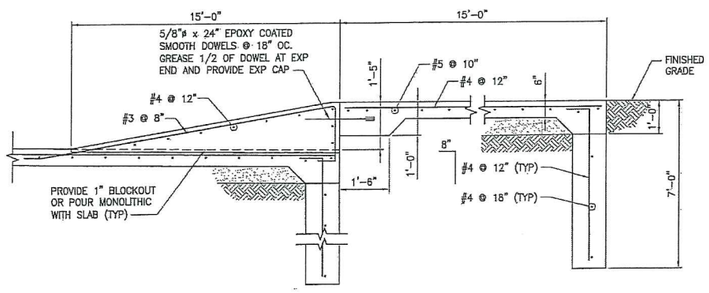
A SECTION
SCALE: 1/2" = 1'-0"



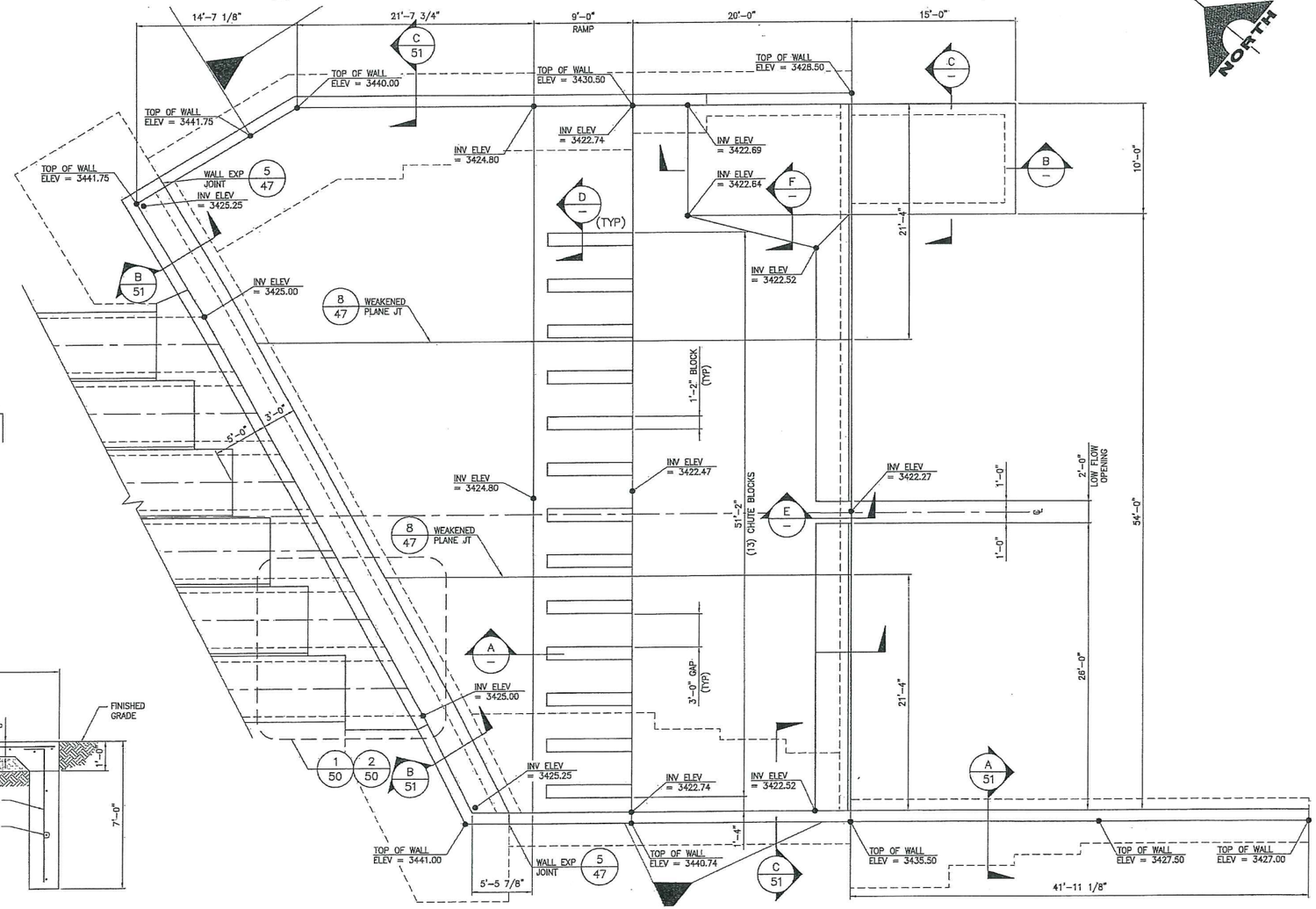
D SECTION
SCALE: 1/2" = 1'-0"



C SECTION
SCALE: 1/2" = 1'-0"



B SECTION
SCALE: 1/2" = 1'-0"



1 ENLARGED PLAN - DRAINAGE CORRIDOR CROSSING OUTLET STRUCTURE
SCALE: 3/16" = 1'-0"

NORTH

STATE OF NEVADA — ERIC G. GILES — No. 14370 — PROFESSIONAL ENGINEER — CIVIL, STRUCTURAL — DATE: 10/28/2015

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

TDS UPDATE - 10/01/2015 - NOT FOR CONSTRUCTION

PROJECT NO. 62024-222

DESIGN: GCW
DRAWN: GCW
CHECK: JJJ
PLOT DATE: 10-28-15
PLOT TIME: 11:17:37

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD. LAS VEGAS, NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM
LAS VEGAS

F:\Projects\600\62024-222\DWG\Production\24x36x52_Sc5.dwg
Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2 IMPROVEMENT PLANS

OUTLET STRUCTURE PLAN AND DETAILS

DRAWING 52
52 OF 53 SHTS

SID NO. 812 PROJECT 2

pw24x36.dwg 07/2015.tbl

UPDATE #4 TO THE TECHNICAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24 UNIT 2 IMPROVEMENTS- SKY VISTA IMPROVEMENTS (DESERT MOON DRIVE TO ALTA DRIVE INCLUDING SUNCREEK ROAD)

62024-221

June 2015

Prepared for:

The Howard Hughes Company, LLC
10801 W. Charleston Blvd., 3rd Floor
Las Vegas, Nevada 89135
Phone: (702) 791-4300
Fax: (702) 791-4450

Prepared by:

G. C. Wallace Companies
1555 S. Rainbow Blvd.
Las Vegas, Nevada 89146
Phone: (702) 804-2000
Fax: (702) 804-2299

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM				DATE: July 7, 2015
TO: **Land Development Services** Department of Public Works				FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:			**COPIES TO:**
Summerlin Village 24 Unit 2 Improvements – Update #4 Sky Vista Drive Improvements (Desert Moon Drive to Alta Drive including Sun Creek Road)				G.C. Wallace, Inc.
Cross Streets:	Sky Vista & Alta Drive			Howard Hughes Corp.
File Number:	F:\Depot\DSMemos\DS4136H.doc			Bart Anderson, P.E., DevCo
Parcel Number:	137-22-000-015			
Zoning Action:				
FEMA Flood Zone	YES	NO X		
Proposed Storm Drain	YES X	NO		

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Transaction #
1st Submittal	2/21/2007	3/29/2007	Not Approved	$400.00	63487: $400
2nd Submittal	5/4/2007	5/29/2007	Not Approved	$400.00	68552: $400
3rd Submittal	5/15/2014 & 6/5/2014	6/9/2014	Conditional Approval	$400.00	357117: $400
4th Submittal	9/22/2014	10/7/2014	Approved	$100.00	371022: $100
5th Submittal	11/6/2014	11/26/2014	Approved	$100.00	376121: $100
6th Submittal	2/10/2015	2/24/2015	Not Approved	$100.00	385212: $100
7th Submittal	5/14/2015	6/15/2015	Not Approved	$400.00	397629: $400
8th Submittal	6/22/2015	7/7/2015	See Comments Below	$100.00	402841: $100
			TOTAL FEES (LDDRS):	$2,000.00	----

REMARKS:

8th Submittal: Update #4 for Sky Vista Drive Improvements – Revise the connection angle of a 48"-Stub to Future Parcel K at the Intersection of Crossbridge Drive and Suncreek Road

6th & 7th Submittals: Updaet #3 and Addendum for Crossbridge Drive Improvements

5th Submittal: Update #2 for Sky Vista Drive Improvements

The Drainage Study for the subject project has been reviewed and:

X	is approved subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.
	is conditionally approved subject to Clark County Public Works Department concurrence.

1. Please note that any future technical drainage study submittals that differ from the Master Drainage Study (ie. Changes in pods, infrastructure, flows etc.) will require an update to the Master Drainage Study and this update must be approved by the *City of Las Vegas Flood Control Section* prior to final approval of technical drainage study.

2. Structural plans for the storm drain improvements must be submitted for review. Provide a soils report, structural calculations and specifications, two wet stamped structural sets, and a grading plan to the *Building Department* for processing. The engineer must provide a copy of *Building Department* approval of the structures to *Flood Control* prior to final acceptance of the improvement plans.

3. The project proposes to build temporary drainage facilities. Prior to final plan approval the developer must complete a maintenance and liability agreement for the interim drainage improvements and post a minimum maintenance bond of $25,000 or 25-percent of the construction cost for the improvements, whichever is greater. The engineer must submit an estimate of the quantities for constructing the facility and an 8.5-inch by 11-inch exhibit that adequately shows the location and limits of the drainage facility to *Flood Control* for approval. Once the drainage study is conditionally approved, the engineer should contact the City's Land Development Section (229-6371) to begin the agreement process.

4. Please obtain necessary 404 permits from Army Corps of Engineers and provide a copy of the permit to Flood Control prior to issuance of the grading permit. The contact information for Army Corps of Engineers is listed below:

   Steven W. Roberts
   Chief, Regulatory Field Office
   US Army Corps of Engineers
   321 North Mall Drive
   Suite L-101
   St. George, UT 84790

   (435) 986-3979 (Office)
   (435) 986-3981 (FAX)
   steven.w.roberts@usace.army.mil

NOTE: Any future changes to the proposed design (or design assumptions) as outlined in the approved drainage study and attached preliminary grading plan which affect drainage must be addressed in a Drainage Study Update and accepted by the *City of Las Vegas Flood Control Section*. Additionally, conditional acceptance of a drainage study is valid for a period of one (1) year. If the proposed construction has not been completed in that time period, the *City of Las Vegas* reserves the right to require additional conditions and/or submission and acceptance of a complete drainage study update prior to further construction of a project.

NOTE: Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the Nevada Division of Environmental Protection a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site; for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until all stripped or disturbed surface areas have been covered by paving, building construction or planting. For more information, including forms and applications see http://ndep.nv.gov/bwpc/storm01.htm or call (775) 687-9429.

END OF REMARKS
Osk/ays

T/R/S: T20S/R59E/33 and 34
AREA K-22

Storm Drain Hydraulics Calculations

G.C. Wallace, Inc. | Hydraulic Calculations for Main Line No. 2: From existing SD at Sky Vista/Crossbridge north to Suncreek west to Crossbridge and Parcel K (Ultimate) | DATE 06/09/15 | FILE: SF6.xls

Storm Drain Manning's n (typ=0.013)= 0.013 | Inlet Structure Type or K_i= A | Headwall; Grooved Edge

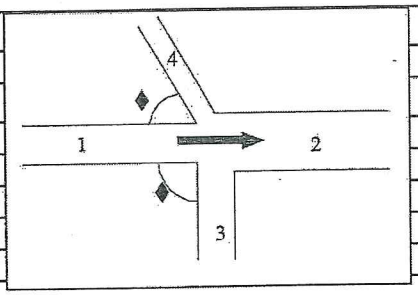
CONDUIT DATA										FLOW DATA									ENERGY LOSS DATA																	EGL & HGL				COMMENTS	
																			PIPE	TRANSITION																					
STATION			PIPE	BOX		IRREG		#	INVERT ELEV	L	S	A	Φ	Q	V	V2/2g	Sf	Ave.	Frict	Frict	Manhole			Junction			Contraction/ Inlet			Expansion/Outlet			Bend				Misc		CONDUIT		TRANSITION		FULL/	
FROM (ft)	TO (ft)	T/R	D (in)	SPAN (ft)	RISE (ft)	AREA (ft^2)	HYD RAD (ft)		D/S (ft)	U/S (ft)	(ft)	(%)	(ft^2)		(cfs)	(ft/s)	(ft)	(S_f)	(S_f)	H_f (ft)	H_f (ft)	Θ (deg)	K_{mh}	H_{mh} (ft)	Θ (deg)	K_j	H_j (ft)	Inlet/ Cont	K_i	H_e (ft)	Θ (deg)	K_e	H_e (ft)	R_{bend} (ft)	Θ (deg)	K_b	H_b (ft)	H_m (ft)	Total (ft)	U/S EGL	U/S HGL	U/S EGL	U/S HGL	PART FLOW	CRTL
	0.00		78							19.61																													28.97	26.11		
																															Outlet K_o=	1.0										
0.00	37.74	R	78					1	19.61	20.67	37.7	2.80%	33.18	0.0049	450	13.56	2.86	0.0074	0.0074	0.28																	0.00	30.02	27.17			FULL	D/S
37.74	49.67	R	78					1	20.67	20.91	11.9	2.05%	33.18	0.0049	450	13.56	2.86	0.0074	0.0074	0.09																	0.00	30.27	27.41			FULL	D/S
49.67	135.46	R	78					1	20.91	22.63	85.8	2.00%	33.18	0.0049	450	13.56	2.86	0.0074	0.0074	0.63															6007	1	0.03	0.08		0.08	31.99	29.13	31.99	29.13	FULL	D/S
135.46	138.46	R	78					1	22.63	22.69	3.0	2.00%	33.18	0.0049	447	13.47	2.82	0.0073	0.0073	0.02															6007	1	0.03	0.07		0.07	32.01	29.19	32.08	29.26	FULL	U/S
138.46	170.01	R	78					1	22.69	23.33	31.6	2.03%	33.18	0.0049	447	13.47	2.82	0.0073	0.0073	0.23															6007	1	0.02	0.05		0.05	32.65	29.83	32.65	29.83	FULL	D/S
170.01	175.01	R	78					1	23.33	23.51	5.0	3.60%	33.18	0.0049	447	13.47	2.82	0.0073	0.0073	0.04																			0.00	32.83	30.01			FULL	D/S
175.01	569.94	R	78					1	23.51	45.02	394.9	5.45%	33.18	0.0049	447	13.47	2.82	0.0073	0.0073	2.87															6007	4	0.05	0.14		0.14	54.34	51.52	54.34	51.52	PART	D/S
569.94	574.94	R	78					1	45.02	45.21	5.0	3.74%	33.18	0.0049	447	13.47	2.82	0.0073	0.0073	0.04																			0.00	54.52	51.71			FULL	D/S
574.94	583.13	R	78					1	45.21	45.60	8.2	4.80%	33.18	0.0049	447	13.47	2.82	0.0073	0.0073	0.06																			0.00	54.92	52.10			FULL	D/S
583.13	585.13	R	78					1	45.60	45.70	2.0	4.80%	33.18	0.0049	440	13.26	2.73	0.0070	0.0072		0.01																	0.01			54.93	52.20	FULL	U/S
585.13	586.13	R	78					1	45.70	45.74	1.0	4.80%	33.18	0.0049	440	13.26	2.73	0.0070	0.0070	0.01																			0.00	54.97	52.24			FULL	D/S
586.13	953.86	R	78					1	45.74	63.41	367.7	4.80%	33.18	0.0049	440	13.26	2.73	0.0070	0.0070	2.59															4436	5	0.06	0.16		0.16	72.64	69.91	72.64	69.91	PART	D/S
953.86	958.86	R	78					1	63.41	63.56	5.0	3.08%	33.18	0.0049	440	13.26	2.73	0.0070	0.0070	0.04																			0.00	72.79	70.06			FULL	D/S
958.86	1289.51	R	78					1	63.56	73.75	330.7	3.08%	33.18	0.0049	440	13.26	2.73	0.0070	0.0070	2.33															4436	4	0.05	0.14		0.14	82.98	80.25	82.98	80.25	PART	D/S
1289.51	1299.57	R	78					1	73.75	74.01	10.1	2.60%	33.18	0.0049	440	13.26	2.73	0.0070	0.0070	0.07																			0.00	83.24	80.51			FULL	D/S
1299.57	1301.57	R	78					1	74.01	74.06	2.0	2.60%	33.18	0.0049	419	12.63	2.48	0.0064	0.0067	0.01																			0.37	0.37	83.26	80.78	83.63	81.15	FULL	U/S
1301.57	1302.57	R	78					1	74.06	74.09	1.0	2.60%	33.18	0.0049	419	12.63	2.48	0.0064	0.0064	0.01																			0.00	83.63	81.16			FULL	U/S
1302.57	1537.01	R	78					1	74.09	80.17	234.4	2.60%	33.18	0.0049	419	12.63	2.48	0.0064	0.0064	1.50																			0.00	89.15	86.67			PART	D/S
1537.01	1542.01	R	78					1	80.17	80.40	5.0	4.52%	33.18	0.0049	419	12.63	2.48	0.0064	0.0064	0.03																			0.00	89.38	86.90			FULL	D/S
1542.01	1769.51	R	78					1	80.40	90.42	227.5	4.40%	33.18	0.0049	419	12.63	2.48	0.0064	0.0064	1.45																			0.00	99.40	96.92			PART	D/S
1769.51	1780.51	R	72					1	90.42	90.90	11.0	4.40%	28.27	0.0049	356	12.59	2.46	0.0071	0.0067		0.07	45	0.46	1.14	0													1.21			100.61	98.15	FULL	U/S
1780.51	1806.50	R	72					1	90.90	91.43	26.0	2.00%	28.27	0.0049	356	12.59	2.46	0.0071	0.0071		0.18															3	45	0.35	0.86		1.05			101.65	99.19	FULL	U/S
1806.50	1831.80	R	72					1	91.43	91.93	25.3	2.00%	28.27	0.0049	356	12.59	2.46	0.0071	0.0071	0.18																			0.00	101.83	99.37			FULL	U/S
1831.80	1836.80	R	72					1	91.93	92.03	5.0	2.00%	28.27	0.0049	356	12.59	2.46	0.0071	0.0071	0.04																			0.00	101.87	99.41			FULL	U/S
1836.80	1845.30	R	72					1	92.03	92.20	8.5	2.00%	28.27	0.0049	356	12.59	2.46	0.0071	0.0071	0.06																			0.00	101.93	99.47			FULL	U/S
1845.30	1847.30	R	72					1	92.20	92.24	2.0	2.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.01																			0.00	101.94	99.51			FULL	U/S
1847.30	1902.97	R	72					1	92.24	93.36	55.7	2.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.39																			0.00	102.33	99.90			FULL	U/S
1902.97	1907.97	R	72					1	93.36	93.50	5.0	2.90%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070		0.03																			0.03			102.37	99.93	FULL	U/S
1907.97	2185.32	R	72					1	93.50	109.86	277.4	5.90%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	1.94															654	24	0.13	0.31		0.31	118.29	115.86	118.29	115.86	PART	D/S
2185.32	2190.32	R	72					1	109.86	110.16	5.0	5.90%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070		0.03																			0.03			118.59	116.16	FULL	D/S
2190.32	2290.06	R	72					1	110.16	116.04	99.7	5.90%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.70																			0.00	124.48	122.04			PART	D/S
2290.06	2295.06	R	72					1	116.04	116.31	5.0	5.44%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070		0.03																			0.03			124.75	122.31	FULL	D/S
2295.06	2505.32	R	72					1	116.31	126.81	210.3	4.99%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	1.47															654	19	0.11	0.28		0.28	135.24	132.81	135.24	132.81	PART	D/S
2505.32	2510.32	R	72					1	126.81	127.01	5.0	4.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070		0.03																			0.03			135.44	133.01	FULL	D/S
2510.32	2579.20	R	72					1	127.01	129.07	68.9	3.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.48																			0.00	137.50	135.07			PART	D/S
2579.20	2591.20	R	72					1	129.07	129.43	12.0	3.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.08																			0.00	137.86	135.43			FULL	D/S
2591.20	2603.20	R	72					1	129.43	129.79	12.0	3.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070		0.08	34	0.22	0.54															0.62			138.48	136.05	FULL	U/S
2603.20	2626.20	R	72					1	129.79	130.48	23.0	3.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.16																			0.00	138.91	136.48			FULL	D/S
2626.20	2628.20	R	72					1	130.48	130.54	2.0	3.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.01																			0.00	138.97	136.54			FULL	D/S
2628.20	2686.43	R	72					1	130.54	132.29	58.2	3.00%	28.27	0.0049	354	12.52	2.43	0.0070	0.0070	0.41																			0.00	140.72	138.29			PART	D/S
2686.43	2691.43	T	72					1	132.29	132.39	5.0	2.03%	28.27	0.0049	262	9.27	1.33	0.0038	0.0054		0.03	48	0.46	1.12	33	0.65	1.57											2.71			143.43	142.10	FULL	U/S
2691.43	2749.15	R	72					1	132.39	133.00	57.7	1.06%	28.27	0.0049	262	9.27	1.33	0.0038	0.0038	0.22																			0.00	143.65	142.32			FULL	U/S
2749.15									133.00																																	

Starting WSE

Junction Head Loss Calculation

SV Sta 336+94

Known	
Diameter of Pipe 1 (in)	78.0
Diameter of Pipe 2 (in)	78.0
Diameter of Pipe 3 (in)	24.0
Diameter of Pipe 4 (in)*	
Flow in Pipe 1 (cfs)	426
Flow in Pipe 2 (cfs)	441
Flow in Pipe 3 (cfs)	15
Flow in Pipe 4 (cfs)*	
Angle of Pipe 3	90
Angle of Pipe 4*	



*Optional

Headloss is applied at Entrance to Junction

Insert Loss in Misc. Loss Column and leave Junction Loss Column Blank

Solve For	
Area of Pipe 1 (ft^2)	33.18
Area of Pipe 2 (ft^2)	33.18
Area of Pipe 3 (ft^2)	3.14
Area of Pipe 4 (ft^2)	
Head Loss at Junction (ft)	**0.37**

Equation Used:

Incorporates Pressure plus Momentum Laws

$$Hj=((Q_2^2/A_{2*g}-Q_1^2/A_{1*g}-Q_3^2*\cos(Ang3)/A_{3*g}-Q_4^2*\cos(Ang4)/A_{4*g})*2/(A_1+A_2)-D_1+D_2)$$

Summary of Results: Main Line 2 - From existing SD at Sky Vista/Crossbridge north to Suncreek west to Crossbridge and Parcel K (Ultimate)											
						(Optional)				HGL with respect	Pressure Gasket
STATION	INVERT	SOFFIT	EGL	HGL	GRADE	LOCATION	DESCRIPTION	FREEBOARD	COVER	to FG	Required?
0.00	19.61	26.11	28.97	26.11	29.90	SV Sta 324+00	Connect to existing SD	3.79	3.79	OK	NO
37.74	20.67	27.17	30.02	27.17	31.30	SV Sta 324+37.53	PC and vertical angle point	4.14	4.14	OK	NO
49.67	20.91	27.41	30.27	27.41	31.80	SV Sta 324+49.46	MH#17	4.39	4.39	OK	NO
135.46	22.63	29.13	31.99	29.13	35.60	SV Sta 325+36.45	24" lateral to DI	6.47	6.47	OK	NO
138.46	22.69	29.19	32.08	29.26	35.60			6.34	6.41	OK	NO
170.01	23.33	29.83	32.65	29.83	37.50	SV Sta 325+72	MH#18 and vertical angle pt	7.67	7.67	OK	NO
175.01	23.51	30.01	32.83	30.01	37.50			7.49	7.49	OK	NO
569.94	45.02	51.52	54.34	51.52	58.30	SV Sta 329+70.31	MH#19 and PCC and vertical angle point	6.78	6.78	OK	NO
574.94	45.21	51.71	54.52	51.71	58.30			6.59	6.59	OK	NO
583.13	45.60	52.10	54.92	52.10	58.90	SV Sta 329+82	24" lateral to DIs	6.80	6.80	OK	NO
585.13	45.70	52.20	54.93	52.20	58.90			6.70	6.70	OK	NO
586.13	45.74	52.24	54.97	52.24	58.90	SV Sta 329+83	Reach	6.66	6.66	OK	NO
953.86	63.41	69.91	72.64	69.91	76.70	SV Sta 333+50	MH#20	6.79	6.79	OK	NO
958.86	63.56	70.06	72.79	70.06	76.70			6.64	6.64	OK	NO
1289.51	73.75	80.25	82.98	80.25	86.90	SV Sta 336+81.94	MH#21 and PT and vertical angle point	6.65	6.65	OK	NO
1299.57	74.01	80.51	83.24	80.51	87.20	SV Sta 336+94	24" lateral to DIs	6.69	6.69	OK	NO
1301.57	74.06	80.56	83.63	81.15	87.20			6.05	6.64	OK	NO
1302.57	74.09	80.59	83.63	81.16	87.20	SV Sta 337+94	Reach	6.04	6.61	OK	NO
1537.01	80.17	86.67	89.15	86.67	94.60	SV Sta 339+32	MH#22	7.93	7.93	OK	NO
1542.01	80.40	86.90	89.38	86.90	94.60			7.70	7.70	OK	NO
1769.51	90.42	96.92	99.40	96.92	104.60	SV Sta 341+65 SR 18+70.83	MH#7	7.68	7.68	OK	NO
1780.51	90.90	96.90	100.61	98.15	104.60			6.45	7.70	OK	NO
1806.50	91.43	97.43	101.65	99.19	104.20	SR Sta 18+46.80	Horizontal Angle Pt	5.01	6.78	OK	NO
1831.80	91.93	97.93	101.83	99.37	105.50	SR 18+19	MH#11	6.13	7.57	OK	NO
1836.80	92.03	98.03	101.87	99.41	105.50			6.09	7.47	OK	NO
1845.30	92.20	98.20	101.93	99.47	105.70	SR 18+07	24" laterals to DIs	6.23	7.50	OK	NO
1847.30	92.24	98.24	101.94	99.51	105.70			6.19	7.46	OK	NO
1902.97	93.36	99.36	102.33	99.90	106.90	SR Sta 17+50.33	MH#12 and PT and vertical angle point	7.00	7.55	OK	NO
1907.97	93.50	99.50	102.37	99.93	106.90			6.97	7.40	OK	NO
2185.32	109.86	115.86	118.29	115.86	123.10	SR Sta 14+78.33	MH#13 and PC	7.24	7.24	OK	NO
2190.32	110.16	116.16	118.59	116.16	123.10			6.94	6.94	OK	NO
2290.06	116.04	122.04	124.48	122.04	131.00	SR Sta 13+71.59	MH#14	8.96	8.96	OK	NO
2295.06	116.31	122.31	124.75	122.31	131.00			8.69	8.69	OK	NO
2505.32	126.81	132.81	135.24	132.81	141.10	SR 11+51.61	MH#14A	8.29	8.29	OK	NO
2510.32	127.01	133.01	135.44	133.01	141.10			8.09	8.10	OK	NO
2579.20	129.07	135.07	137.50	135.07	143.70	SR 10+67.47	MH#15	8.63	8.63	OK	NO
2591.20	129.43	135.43	137.86	135.43	143.70			8.27	8.27	OK	NO
2603.20	129.79	135.79	138.48	136.05	144.00	SR Sta 10+55.51	Horizontal Angle Pt	7.95	8.21	OK	NO
2626.20	130.48	136.48	138.91	136.48	144.80	SR 10+34.56	24" lateral to DI	8.32	8.32	OK	NO
2628.20	130.54	136.54	138.97	136.54	144.80			8.26	8.26	OK	NO
2686.43	132.29	138.29	140.72	138.29	144.50	SR Sta 9+80.66 CD 35+91.71	MH#16	6.21	6.21	OK	NO
2691.43	132.39	138.39	143.43	142.10	144.50			2.40	6.11	OK	NO

Storm Drain Hydraulics Calculations

G.C. Wallace, Inc. | Suncreek (Parcel K) 48-inch RCP Lateral | DATE 06/09/15 | FILE: SF6.xls

Storm Drain Manning's n (typ=0.013)= 0.013 | Inlet Structure Type or K_i= d | Headwall:Square Edge (cut concrete and CMP)

	CONDUIT DATA										FLOW DATA									ENERGY LOSS DATA																				EGL & HGL				COMMENTS	
																				PIPE	TRANSITION																									
	STATION			PIPE	BOX		IRREG		#	INVERT ELEV	L	S	A	Φ	Q	V	V2/2g	Sf	Ave.	Frict	Frict	Manhole			Junction			Contraction/ Inlet			Expansion/Outlet			Bend			Misc			CONDUIT		TRANSITION		FULL/	
	FROM (ft)	TO (ft)	T/R	D (in)	SPAN (ft)	RISE (ft)	AREA (ft^2)	HYD RAD (ft)		D/S (ft)	U/S (ft)	(ft)	(%)	(ft^2)		(cfs)	(ft/s)	(ft)	(ft^2/ft)	(ft^3/ft)	H_f (ft)	H_f (ft)	Θ (deg)	K_{mh}	H_{mh} (ft)	Θ (deg)	K_j	H_j (ft)	Inlet/ Cont	K_i	H_c (ft)	Θ (deg)	K_o	H_e (ft)	R_{bend} (ft)	Θ (deg)	K_b	H_b (ft)	H_m (ft)	Total (ft)	U/S EGL	U/S HGL	U/S EGL	U/S HGL	PART FLOW	CRTL
1		1000.00		48						3434.36																				Outlet K_o=	1.0													
2	1000.00	1066.00	R	48					1	3434.36	3435.68	66.0	2.00%	12.57	0.0049	60	6.37	0.63	0.0031	0.0031	0.20																			0.00	3442.93	3442.30			FULL	U/S
3	1066.00								1	3435.68																																		
4																																												

SUMMERLIN

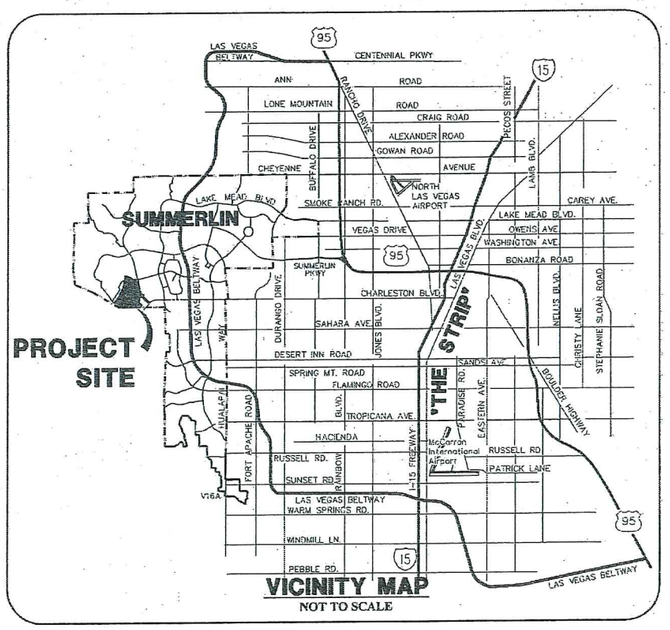
SM

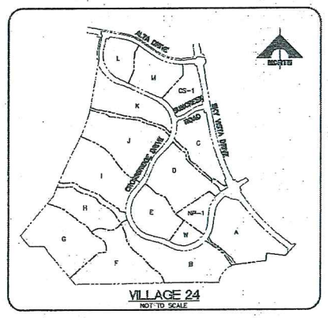
VILLAGE 23A/24
SKY VISTA IMPROVEMENT PLANS

FROM DESERT MOON DRIVE TO ALTA DRIVE
INCLUDING SUNCREEK ROAD

SID #812 PROJECTS 5 & 12, 2 & 13
#809 PROJECT 13 & #810 PROJECT 8

A.P.N. 137-33-801-001
2015





OWNER/DEVELOPER

THE HOWARD HUGHES COMPANY, LLC
10801 W. CHARLESTON BLVD., 3RD FLOOR
LAS VEGAS, NEVADA 89146
OFFICE PHONE NO. (702) 791-4300

ENGINEER

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD · LAS VEGAS, NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM

Call before you Dig
Avoid existing underground utility lines. It's costly.
Call 811 or 1-800-227-2500 or CLARK COUNTY WATER AUTHORITIES 1-702-455-6000

ABOVE VEGAS ADVANCED POWER LINES. IT'S COSTLY.
CALL BEFORE YOU DIG YOU'RE OVERHEAD
1-702-227-2929

FAST
Call before you UnderGround
1-702-432-5300
FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

SHEET INDEX

SHT. #	DESCRIPTION
1	COVER SHEET
2	LEGEND AND ABBREVIATIONS
3	GENERAL NOTES
4	HORIZONTAL CONTROL
5	MASTER UTILITY PLAN – WATER
6	MASTER UTILITY PLAN – STORM DRAIN
7	MASTER UTILITY PLAN – SEWER
8	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 1
9	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 2
10	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 3
11	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 4
12	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 5
13	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 6
14	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 7
15	SKY VISTA DRIVE – ROADWAY PLAN AND PROFILE 8
16	ALTA DRIVE – ROADWAY PLAN AND PROFILE 9
17	SUNCREEK ROAD – ROADWAY PLAN AND PROFILE 10
18	SUNCREEK ROAD – ROADWAY PLAN AND PROFILE 11
19	CONSTRUCTION DETAILS
20	SKY VISTA DRIVE – ROUGH GRADING PLAN 1
21	ALTA DRIVE – ROUGH GRADING PLAN 2
22	ALTA DRIVE – ROUGH GRADING PLAN 3
23	ALTA DRIVE – ROUGH GRADING PLAN 4
24	CROSSBRIDGE DRIVE – ROUGH GRADING PLAN 5
25	CS-1 BOUNDARY – ROUGH GRADING PLAN 6
26	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 1
27	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 2
28	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 3
29	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 4
30	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 5
31	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 6
32	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 7
33	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 8
34	SKY VISTA DRIVE – UTILITY PLAN AND PROFILE 9
35	ALTA DRIVE – ROADWAY PLAN AND PROFILE 10
36	SUNCREEK ROAD – UTILITY PLAN AND PROFILE 11
37	SUNCREEK ROAD – UTILITY PLAN AND PROFILE 12
38	LATERAL PROFILES 1
39	LATERAL PROFILES 2
40	LATERAL PROFILES 3
41	ROADWAY SECTIONS
42	UTILITY DETAILS 1
43	UTILITY DETAILS 2
44	GRADING DETAILS
45	SKY VISTA DRIVE – STRIPING AND SIGNAGE PLAN 1
46	SKY VISTA DRIVE – STRIPING AND SIGNAGE PLAN 2
47	SUNCREEK ROAD – STRIPING AND SIGNAGE PLAN 3
48	STREET LIGHT NOTES AND DETAILS
49	STREET LIGHT, MASTER CONDUIT AND ELECTRICAL PLAN 1
50	STREET LIGHT, MASTER CONDUIT AND ELECTRICAL PLAN 2
51	STREET LIGHT, MASTER CONDUIT AND ELECTRICAL PLAN 3
52	STRUCTURAL DETAILS 1
53	STRUCTURAL DETAILS 2
54	STRUCTURAL DETAILS 3

DRAINAGE CERTIFICATION

I CERTIFY THAT THE GRADING PLANS ARE IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

JOSHUA L. JOHNSON P.E. 15789 DATE

ALLEN PAVELKA: PE # 9029 DATE
CITY ENGINEER
CITY OF LAS VEGAS, NEVADA

APPROVAL OF THESE PLANS IS LIMITED TO THOSE IMPROVEMENTS CONSTRUCTED IN THE DEDICATED RIGHTS-OF-WAY AND/OR DEDICATED EASEMENTS. THIS APPROVAL DOES NOT AUTHORIZE THE CONSTRUCTION OF ANY IMPROVEMENTS THAT DEVIATE FROM ADOPTED STANDARDS AND/OR SPECIFICATIONS, EXCEPT THOSE SPECIFICALLY LISTED UNDER "DEVIATIONS FROM STANDARDS". THE ENGINEER SHALL RESOLVE ANY DEVIATION OTHER THAN THOSE LISTED IN "DEVIATIONS FROM STANDARDS" IN FAVOR OF THE UNIFORM STANDARD DRAWINGS AND SPECIFICATIONS CLARK COUNTY AREA NEVADA.

CLV PLANNING DEPARTMENT

THIS PLAN MEETS THE APPLICABLE STANDARDS OF THE CITY OF LAS VEGAS PLANNING DEPARTMENT

CHRIS KNIGHT, DIRECTOR BUILDING AND SAFETY DATE

APPROVED FOR CONSTRUCTION 1ST APPD. 03/24/15

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. #123259 DATE:
DRAWINGS: 1–3, 5–18, 20–40, & 43

THE HOWARD HUGHES COMPANY, LLC

KEVIN ORROCK DATE
VICE PRESIDENT

APPROVED FOR CONSTRUCTION

CITY OF LAS VEGAS FIRE DEPARTMENT DATE

UTILITY/AGENCY APPROVALS

COX COMMUNICATIONS LAS VEGAS, INC. DATE

CENTRAL TELEPHONE CO., DBA CENTURYLINK DATE

THE AFFIXED CENTURYLINK APPROVAL DOES NOT ASSUME OR GUARANTEE LIABILITY FOR KNOWN OR UNKNOWN CONFLICTS WITH EXISTING OR PROPOSED IMPROVEMENTS. RESOLUTION OF ANY CONFUCT WILL BE ACCOMPLISHED PURSUANT TO LOCAL ORDINANCES, NEVADA REVISED STATUTES AND/OR PUBLIC UTILITY COMMISSION RULES AND REGULATIONS.

NV ENERGY DATE

NEVADA POWER COMPANY ACKNOWLEDGES THAT WE HAVE RECEIVED YOUR PLANS AND WILL PROVIDE SERVICE TO ALL ELECTRICAL NEEDS ASSOCIATED WITH THIS PROJECT. NEVADA POWER COMPANY RESERVES THE RIGHT TO ADDRESS ANY EXISTING OR FUTURE CONFLICTS ONCE THE FINAL DESIGN IS COMPLETED. THE NEW SERVICE AND THE RESOLUTION OF ANY CONFLICTS WILL BE ACCOMPLISHED PURSUANT TO THE NEVADA PUBLIC UTILITY COMMISSION'S RULES AND REGULATIONS.

NV ENERGY – TRANSMISSION ENGINEERING DATE

SOUTHWEST GAS CORP. DATE

PROFESSIONAL ENGINEER STATE OF NEVADA — No. 15789 — JOSHUA L. JOHNSON — DATE: 6/18/15

ISSUE FOR BID - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP
1	5/29/15	REVISED SHEETS: 4-7, 19-20, 24-43, 51, 53				

PROJECT NO. 62024-221
DESIGN: GCW
DRAWN: GCW
CHECK: JLJ
PLOT DATE: 06-19-15
PLOT TIME: 14:35:37

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD · LAS VEGAS NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM
LAS VEGAS
F:\Projects\600\V2024-221\DWG\Production\V24-221_01-CV.dwg
Paul Brenner

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 23A/24 - SKY VISTA IMPROVEMENT PLANS
DESERT MOON DR TO ALTA DR INCLUDING SUNCREEK RD

COVER SHEET

DRAWING 1
1 OF 54 SHTS

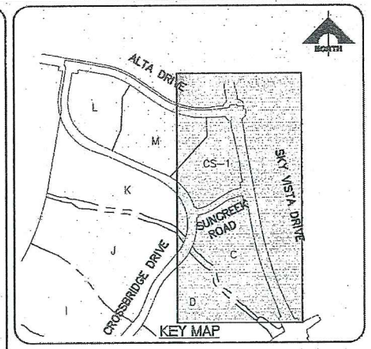
SID NO. 812 PROJECT 5 AND 12
SID NO. 809 PROJECT 13 AND 810 PROJECT 8

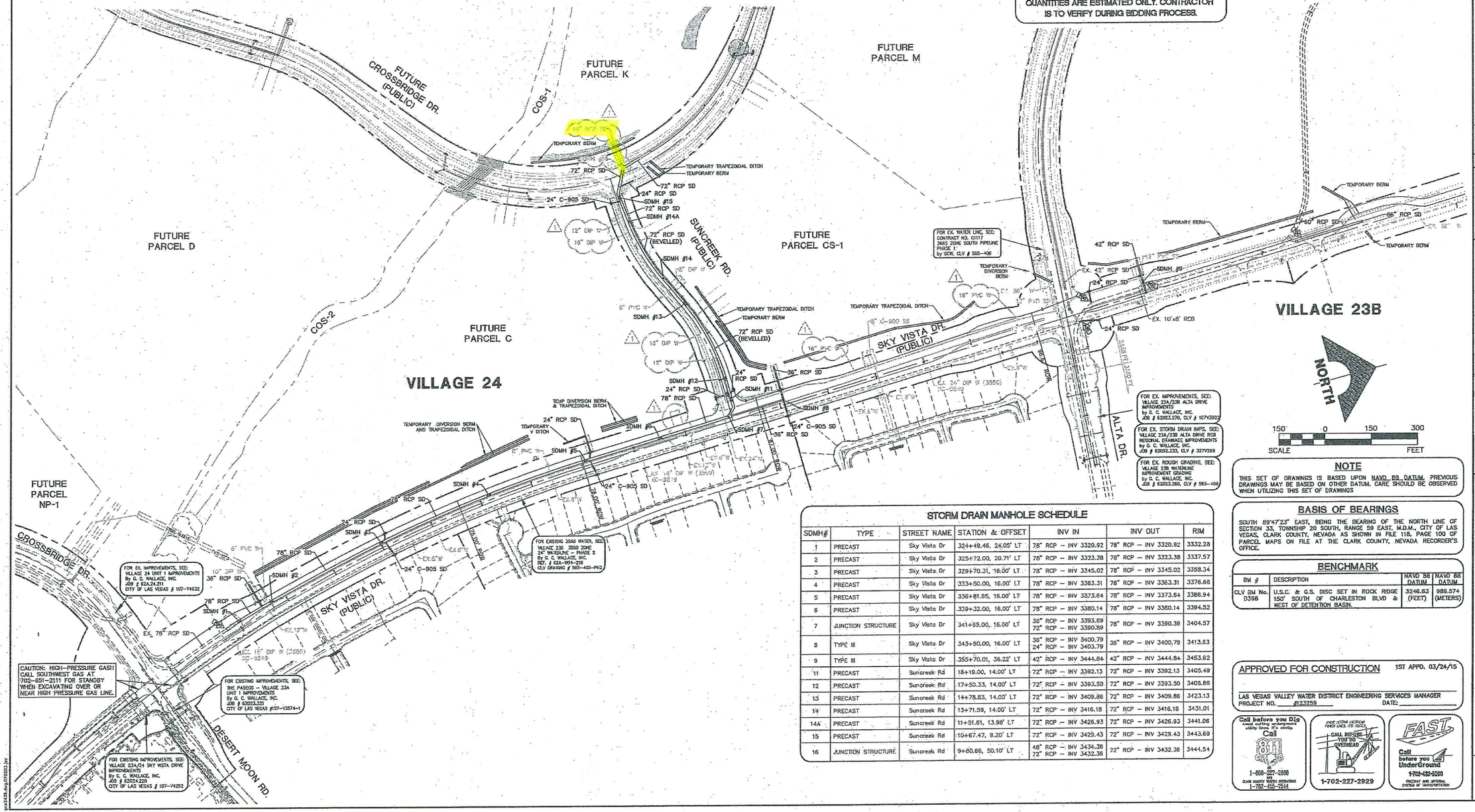
cswf439.dwg 070203.jhr

STORM DRAIN QUANTITIES (PUBLIC)

24" STORM DRAIN CLASS III RCP	393 LF
24" STORM DRAIN C-905	100 LF
36" STORM DRAIN CLASS III RCP	383 LF
42" STORM DRAIN CLASS III RCP	73 LF
48" STORM DRAIN CLASS III RCP	66 LF
60" STORM DRAIN CLASS III RCP	196 LF
66" STORM DRAIN CLASS III RCP	4 LF
72" STORM DRAIN CLASS III RCP	479 LF
72" STORM DRAIN CLASS III RCP (BEVELED)	493 LF
78" STORM DRAIN CLASS III RCP	656 LF
78" STORM DRAIN CLASS III RCP (BEVELED)	1,114 LF
JUNCTION STRUCTURE	2 EA
TYPE III STORM DRAIN MANHOLE	2 EA
48" PRECAST MANHOLE TEE W/ RISER	10 EA
60" PRECAST MANHOLE TEE W/ RISER	2 EA
PRECAST ELBOW	3 EA
PIPE JUNCTION	6 EA
TYPE "CM" DROP INLET (L = 5.0')	4 EA
TYPE "CM" DROP INLET (L = 10.0')	7 EA
TYPE "CM" DROP INLET (L = 12.5')	4 EA
TYPE "CM" DROP INLET (L = 15.0')	1 EA
CONCRETE COLLAR	5 EA
TEMPORARY PLUG	2 EA

QUANTITIES ARE ESTIMATED ONLY. CONTRACTOR IS TO VERIFY DURING BIDDING PROCESS.





STORM DRAIN MANHOLE SCHEDULE

SDMH#	TYPE	STREET NAME	STATION & OFFSET	INV IN	INV OUT	RIM
1	PRECAST	Sky Vista Dr	324+49.46, 24.05' LT	78" RCP – INV 3320.92	78" RCP – INV 3320.92	3332.28
2	PRECAST	Sky Vista Dr	325+72.60, 20.71' LT	78" RCP – INV 3323.38	78" RCP – INV 3323.38	3337.57
3	PRECAST	Sky Vista Dr	329+70.31, 16.00' LT	78" RCP – INV 3345.02	78" RCP – INV 3345.02	3358.34
4	PRECAST	Sky Vista Dr	333+50.00, 16.00' LT	78" RCP – INV 3363.31	78" RCP – INV 3363.31	3376.66
5	PRECAST	Sky Vista Dr	336+81.95, 16.00' LT	78" RCP – INV 3373.64	78" RCP – INV 3373.64	3386.94
6	PRECAST	Sky Vista Dr	339+32.00, 16.00' LT	78" RCP – INV 3380.14	78" RCP – INV 3380.14	3394.52
7	JUNCTION STRUCTURE	Sky Vista Dr	341+85.00, 16.00' LT	36" RCP – INV 3393.89 72" RCP – INV 3390.89	78" RCP – INV 3390.39	3404.57
8	TYPE III	Sky Vista Dr	343+50.00, 16.00' LT	36" RCP – INV 3400.79 24" RCP – INV 3403.79	36" RCP – INV 3400.79	3413.53
9	TYPE III	Sky Vista Dr	355+70.01, 36.22' LT	42" RCP – INV 3444.84	42" RCP – INV 3444.84	3453.62
11	PRECAST	Suncreek Rd	18+19.00, 14.00' LT	72" RCP – INV 3392.13	72" RCP – INV 3392.13	3405.49
12	PRECAST	Suncreek Rd	17+50.33, 14.00' LT	72" RCP – INV 3393.50	72" RCP – INV 3393.50	3408.86
13	PRECAST	Suncreek Rd	14+78.83, 14.00' LT	72" RCP – INV 3409.86	72" RCP – INV 3409.86	3423.13
14	PRECAST	Suncreek Rd	13+71.59, 14.00' LT	72" RCP – INV 3416.18	72" RCP – INV 3416.18	3431.01
14A	PRECAST	Suncreek Rd	11+51.61, 13.98' LT	72" RCP – INV 3426.93	72" RCP – INV 3426.93	3441.06
15	PRECAST	Suncreek Rd	10+67.47, 9.20' LT	72" RCP – INV 3429.43	72" RCP – INV 3429.43	3443.69
16	JUNCTION STRUCTURE	Suncreek Rd	9+80.66, 50.10' LT	48" RCP – INV 3434.36 72" RCP – INV 3432.36	72" RCP – INV 3432.36	3444.54

NOTE

THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS

BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 85 DATUM	NAVD 88 DATUM
CLV BM No. D35B	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.83 (FEET)	989.574 (METERS)

APPROVED FOR CONSTRUCTION — 1ST APPD. 03/24/15

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. #123259 DATE:

Call before you Dig — Two working days before you dig, avoid hitting underground utility lines. It's costly. Call 811 or 1-800-227-2600 or Clark County Water Reclamation 1-702-455-7564

Caution: Keep Visible Power Lines, It's Safe! — Call Before You Dig Overhead — 1-702-227-2929

FAST — Call before you UnderGround 1-702-452-5000 Freeway and Arterial System of Transportation

ISSUE FOR BID - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN. APP	DATE	CCW APP
1	6/16/15	REVISED 48" & 24" WATERLINE LOCATION PER AS-BUILTS				

ENGINEER - STATE OF NEVADA — JOSHUA L. JOHNSON — No. 15681 — PROFESSIONAL ENGINEER — DATE: 6/16/2015

PROJECT NO. 62024-221
DESIGN: GCW
DRAWN: GCW
CHECK: AJJ
PLOT DATE: 06-18-15
PLOT TIME: 15:30:54

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
6330 S. RAINBOW BLVD. LAS VEGAS, NEVADA 89118
T: 702.896.2000 F: 702.896.2299 GCWALLACE.COM
LAS VEGAS

F:\Projects\600\62024-221\DWG Production\V24-221_06-MU2.dwg
Paul Brennard

THE HOWARD HUGHES COMPANY, LLC

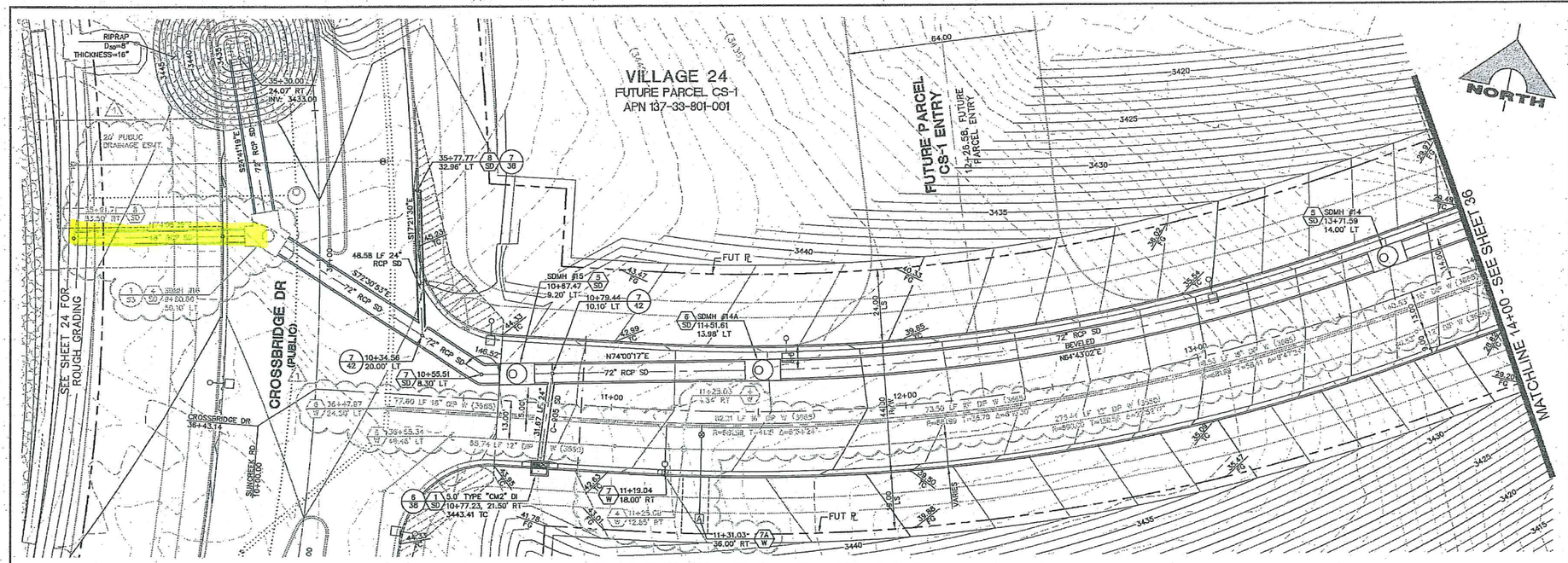
VILLAGE 23A/24 - SKY VISTA IMPROVEMENT PLANS
DESERT MOON DR TO ALTA DR INCLUDING SUNCREEK RD

STORM DRAIN MASTER PLAN

DRAWING 6
6 OF 54 SHTS

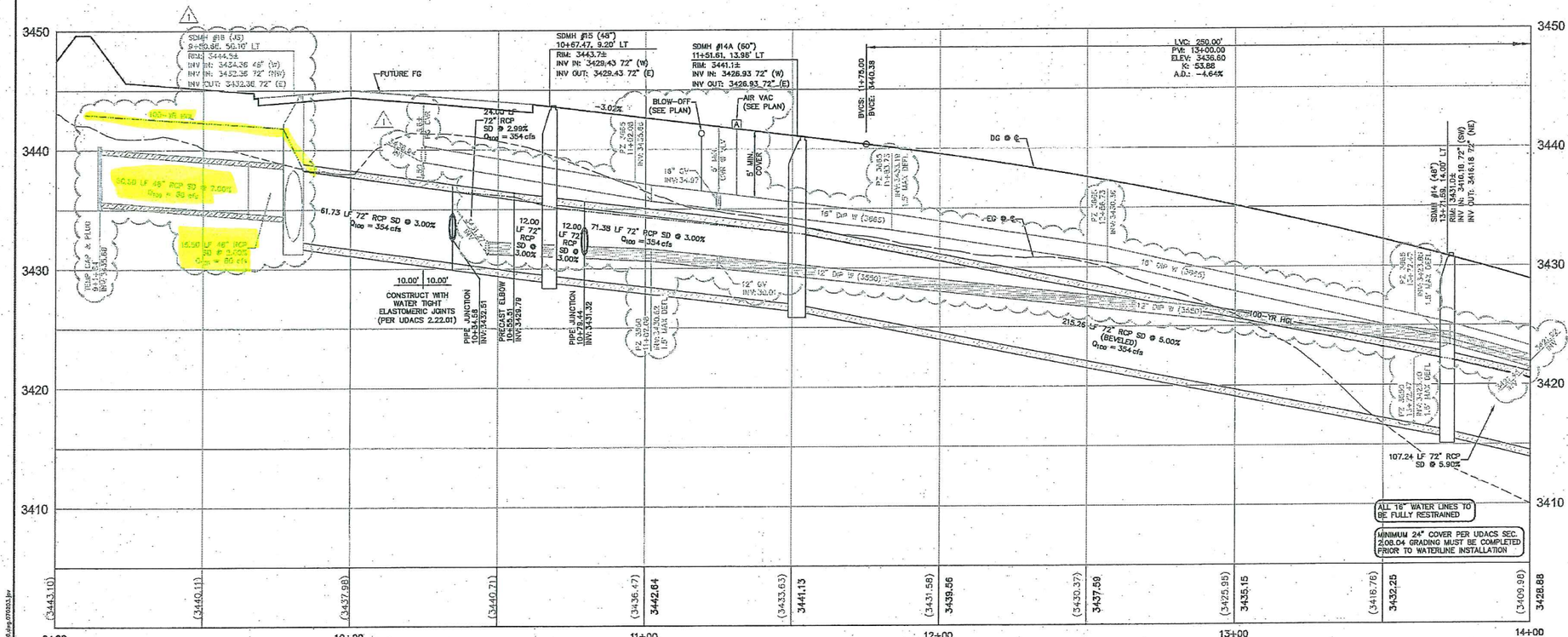
SID NO. 812 PROJECT 5 AND 12
SID NO. 809 PROJECT 13 AND 810 PROJECT 8

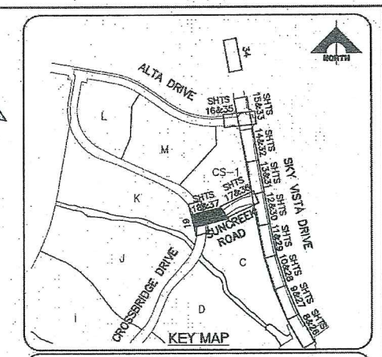
vp24.55.dwg 07/02/15 sw



SUNCREEK ROAD (PUBLIC)

HORIZ SCALE: 1" = 20'
VERT SCALE: 1" = 5'





IMPROVEMENT NOTES:

1. PROTECT IN PLACE AND ADJUST TO GRADE AS REQUIRED
2. RELOCATE WATER APPURTENANCES (VALVES TO REMAIN ACCESSIBLE AT ALL TIMES)

WATER CONSTRUCTION NOTES:

1W. INSTALL FIRE HYDRANT PER UDACS PLT. NO. 39 & 40
1AW. INSTALL FIRE HYDRANT ASSEMBLY PER UDACS PLT. NO. 39 & 40
2W. INSTALL TEE/CROSS PER UDACS PLT. NO. 31
3W. INSTALL BEND PER UDACS PLT. NO. 31. (SEE PLAN FOR ∠)
4W. INSTALL GATE VALVE PER UDACS PLT. NO. 30 AND 39
5W. INSTALL REDUCER PER UDACS PLT. NO. 30
6W. INSTALL CAP W/ 2" BLOW-OFF ASSEMBLY PER UDACS PLT. NO. 36
7W. INSTALL 6" MANUAL BLOW OFF ASSY PER UDACS PLT. NO. 37
7AW. INSTALL 4" COMBINATION AIR VALVE PER UDACS PLT. NO. 38
8W. INSTALL STEEL CASING PER UDACS PLATE 22 & 23
9W. INSTALL VERT. 45° BEND PER UDACS PLT. NO. 31
10W. REMOVE CAP & BLOWOFF PER UDACS PLT. NO. 36 AND CONNECT TO EXISTING WATER LINE

SEWER CONSTRUCTION NOTES:

1S. INSTALL 48" SEWER MANHOLE
1AS. INSTALL 60" SEWER MANHOLE
2S. INSTALL TEMPORARY PLUG AND CAP SEWER STUB
3S. INSTALL ELASTOMERIC JOINT SEALANT AT ALL MANHOLE JOINTS
4S. REMOVE EXISTING PLUG AND CONNECT TO EXISTING SEWER LINE

STORM DRAIN CONSTRUCTION NOTES:

5SD. INSTALL TYPE "CM2" DROP INLET PER USD DWG. NO. 412.1 AND 421
6SD. NOT USED
7SD. INSTALL TYPE III MANHOLE PER USD DWG. NO. 406
8SD. INSTALL JUNCTION STRUCTURE
9SD. INSTALL PRECAST MANHOLE TEE W/ 48" DIA. RISER
10SD. INSTALL PRECAST MANHOLE TEE W/ 60" DIA. RISER
11SD. INSTALL PRECAST ELBOW (SEE PLAN FOR ∠)
12SD. INSTALL TEMPORARY PLUG AND CAP STORM DRAIN LINE
13SD. INSTALL CONCRETE COLLAR PER DETAIL 5 ON SHEET 42
14SD. REMOVE EXISTING PLUG AND CONNECT TO EXISTING STORM DRAIN LINE

IRRIGATION CONSTRUCTION NOTES:

1IR. BANK "A": 1-6" & 2-4" SCH 40 PVC PER DETAIL 1 ON SHEET 42
2IR. BANK "B" : 2-4" SCHD. 40 PVC PER DETAIL 2 ON SHEET 42

* CONTRACTOR TO VERIFY SIZE AND LOCATION OF EXISTING UTILITIES PRIOR TO CONSTRUCTION

SCALE 40 0 40 80 FEET

NOTE

THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS

BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. 0368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

APPROVED FOR CONSTRUCTION

CITY OF LAS VEGAS FIRE DEPARTMENT DATE

APPROVED FOR CONSTRUCTION

1ST APPD. 03/24/15

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. #123259 DATE:

Call before you Dig — Avoid cutting underground utility lines. It's costly. Call 811 or 1-800-227-2600 (CLARK COUNTY RIGHTS-OF-WAYS) 1-702-455-6000

CALL BEFORE YOU DIG — AVOID HITTING OVERHEAD POWER LINES. IT'S COSTLY. 1-702-227-2929

FAST — Call before you UnderGround 1-702-432-6300 FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

LDF:

HTE: 00-00000

ENGINEER - STATE OF NEVADA — CHRISTOPHER G. WALLACE — No. 15788 — PROFESSIONAL ENGINEER

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	CCW APP	DATE
2	6/18/2015	ADDED 24" SANITARY SEWER & MANHOLE, REVISED STORM DRAIN					
1	4/24/2015	REVISED STORM DRAIN					

ISSUE FOR BID - NOT FOR CONSTRUCTION

PROJECT NO. 62024-221

DESIGN: CCW
DRAWN: CCW
CHECK: AJJ
PLOT DATE: 06-18-15
PLOT TIME: 15:36:02

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD · LAS VEGAS NV 89146
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM
LAS VEGAS
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Paul Bremard

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 23A/24 - SKY VISTA IMPROVEMENT PLANS
DESERT MOON DR TO ALTA DR INCLUDING SUNCREEK RD

SUNCREEK ROAD
UTILITY PLAN AND PROFILE 12

DRAWING 37
37 OF 54 SHTS

SID NO. 812 PROJECT 5 AND 12
SID NO. 809 PROJECT 18 AND 810 PROJECT 8

SUMMERLIN

SM

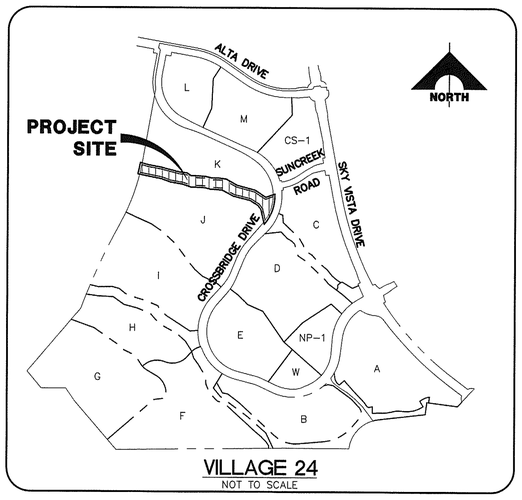
VILLAGE 24
COS 1 WASH IMPROVEMENT PLANS

2017

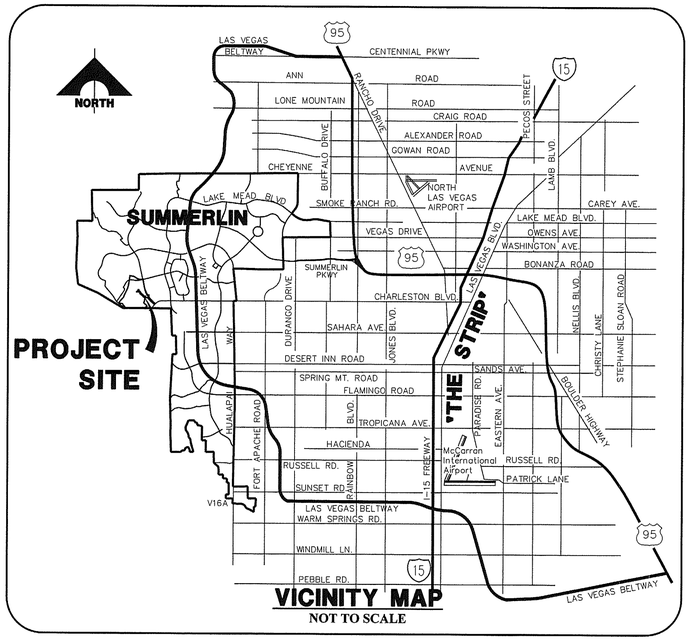
A.P.N. 137-33-710-002

NON-SID

INDEX OF SHEETS		
SHT. #	DWG. #	DESCRIPTION
1	1	COVER SHEET
2	2	GENERAL NOTES
3	3	EXISTING BERM DEMOLITION PLAN
4	4	HORIZONTAL CONTROL 1
5	5	HORIZONTAL CONTROL 2
6	6	HORIZONTAL CONTROL 3
7	7	GRADING PLAN – OVERVIEW
8	8	GRADING PLAN 1
9	9	GRADING PLAN 2
10	10	GRADING PLAN 3
11	11	GRADING PLAN 4
12	12	GRADING PLAN 5
13	13	GRADING PLAN 6
14	14	GRADING PLAN 7
15	15	GRADING PLAN 8
16	16	DETAIL SHEET 1
17	17	DETAIL SHEET 2



VILLAGE 24
NOT TO SCALE



VICINITY MAP
NOT TO SCALE

OWNER/DEVELOPER

THE HOWARD HUGHES COMPANY, LLC
10801 W. CHARLESTON BLVD., 3RD FLOOR
LAS VEGAS, NEVADA 89146
OFFICE PHONE NO. (702) 791-4300

ENGINEER

GCW ENGINEERS \ SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com

Call before you Dig
Avoid cutting underground utility lines. It's easy.
Call 811
OR
1-800-227-2600
AND
CLARK COUNTY RURAL JURISDICTIONS
1-702-455-6000

AVOID HITTING OVERHEAD POWER LINES. IT'S COOL!
CALL BEFORE YOU DO OVERHEAD
1-702-227-2929

FAST
Call before you UnderGround
1-702-432-5300
FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

DRAINAGE CERTIFICATION

I CERTIFY THAT THE GRADING PLANS ARE IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY _____ ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

JOSHUA L. JOHNSON P.E. 15789 DATE

ALLEN PAVELKA: PE, PE# 9029 DATE
CITY ENGINEER
CITY OF LAS VEGAS, NEVADA

APPROVAL OF THESE PLANS IS LIMITED TO THOSE IMPROVEMENTS CONSTRUCTED IN THE DEDICATED RIGHTS-OF-WAY AND/OR DEDICATED EASEMENTS. THIS APPROVAL DOES NOT AUTHORIZE THE CONSTRUCTION OF ANY IMPROVEMENTS THAT DEVIATE FROM ADOPTED STANDARDS AND/OR SPECIFICATIONS, EXCEPT THOSE SPECIFICALLY LISTED UNDER "DEVIATIONS FROM STANDARDS". THE ENGINEER SHALL RESOLVE ANY DEVIATION OTHER THAN THOSE LISTED IN "DEVIATIONS FROM STANDARDS" IN FAVOR OF THE UNIFORM STANDARD DRAWINGS AND SPECIFICATIONS CLARK COUNTY AREA NEVADA.

CLV PLANNING DEPARTMENT

THIS PLAN MEETS THE APPLICABLE STANDARDS OF THE CITY OF LAS VEGAS PLANNING DEPARTMENT

CHRIS KNIGHT, DIRECTOR BUILDING AND SAFETY DATE

THE HOWARD HUGHES COMPANY, LLC

KEVIN ORROCK DATE
VICE PRESIDENT

CLV #

PROFESSIONAL ENGINEER STATE OF NEVADA JOSHUA L. JOHNSON No. 15789 DATE: 1/25/17

FOR AGENCY REVIEW – NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	AGEN APP	DATE	GOW APP

PROJECT NO. 62024-226-1
DESIGN: MDB
DRAWN: MDB
CHECK: JLJ
PLOT DATE: 01-25-17
PLOT TIME: 09:40:27

GCW ENGINEERS \ SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com

F:\Projects\600\62024-226-1\DWG\Production\V24-226-1_CV-NT.dwg
Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 – US WATERS
COS-1 WASH IMPROVEMENT PLANS

COVER SHEET

DRAWING 1
1 OF 17 SHTS

CITY OF LAS VEGAS GRADING NOTES

1. IN THE EVENT THAT ANY UNFORESEEN CONDITIONS NOT COVERED BY THESE NOTES ARE ENCOUNTERED DURING GRADING OPERATIONS, THE OWNER/ENGINEER SHALL BE IMMEDIATELY NOTIFIED FOR DIRECTION.
2. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO PERFORM ALL NECESSARY CUTS AND FILLS WITHIN THE LIMITS OF THIS PROJECT AND THE RELATED OFF-SITE WORK, SO AS TO GENERATE THE DESIRED SUBGRADE, FINISH GRADES AND SLOPES SHOWN.
3. CONTRACTOR SHALL TAKE FULL RESPONSIBILITY FOR ALL EXCAVATION. ADEQUATE SHORING SHALL BE DESIGNED AND PROVIDED BY THE CONTRACTOR TO PREVENT UNDERMINING OF ANY ADJACENT FEATURES OR FACILITIES AND/OR CAVING OF THE EXCAVATION.
4. THE CONTRACTOR IS WARNED THAT AN EARTHWORK BALANCE WAS NOT NECESSARILY THE INTENT OF THIS PROJECT. ANY ADDITIONAL MATERIAL REQUIRED OR LEFTOVER MATERIAL FOLLOWING EARTHWORK OPERATIONS BECOMES THE RESPONSIBILITY OF THE CONTRACTOR.
5. THE GRADING CONTRACTOR IS RESPONSIBLE TO COORDINATE WITH THE OWNER TO PROVIDE FOR THE REQUIREMENTS OF THE PROJECT STORM WATER POLLUTION PREVENTION PLAN (SWPPP) AND ASSOCIATED PERMIT.
6. CONTRACTOR SHALL GRADE TO THE LINES AND ELEVATIONS SHOWN ON THE PLANS WITHIN THE FOLLOWING HORIZONTAL AND VERTICAL TOLERANCES AND DEGREES OF COMPACTION, IN THE AREAS INDICATED:

	HORIZONTAL	VERTICAL	COMPACTION
A. PAVEMENT AREA SUBGRADE	0.1'±	+0.0" TO -0.1"	SEE SOILS REPORT
B. ENGINEERED FILL	0.5'±	+0.1" TO -0.1"	SEE SOILS REPORT

COMPACTION TESTING WILL BE PERFORMED BY THE OWNER OR HIS REPRESENTATIVE. COMPACTION SHALL COMPLY WITH THE REQUIREMENTS OF THE ENGINEER.

7. ALL CUT AND FILL SLOPES SHALL BE PROTECTED UNTIL EFFECTIVE EROSION CONTROL HAS BEEN ESTABLISHED.
8. THE USE OF POTABLE WATER WITHOUT A SPECIAL PERMIT FOR BUILDING OR CONSTRUCTION PURPOSES INCLUDING CONSOLIDATION OF BACKFILL OR DUST CONTROL IS PROHIBITED. THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS FOR CONSTRUCTION WATER.
9. THE CONTRACTOR SHALL MAINTAIN THE STREETS, SIDEWALKS AND ALL OTHER PUBLIC RIGHT-OF-WAY IN A CLEAN, SAFE AND USABLE CONDITION. ALL SPILLS OF SOIL, ROCK OR CONSTRUCTION DEBRIS SHALL BE PROMPTLY REMOVED FROM THE PUBLICLY OWNED PROPERTY DURING CONSTRUCTION AND UPON COMPLETION OF THE PROJECT. ALL ADJACENT PROPERTY, PRIVATE OR PUBLIC SHALL BE MAINTAINED IN A CLEAN, SAFE AND USABLE CONDITION.
10. IN THE EVENT THAT ANY TEMPORARY CONSTRUCTION ITEM IS REQUIRED THAT IS NOT SHOWN ON THESE DRAWINGS, SUCH ITEM SHALL BE PROVIDED, AS DIRECTED BY THE CITY ENGINEER, AT NO EXPENSE TO THE CITY OF LAS VEGAS. TEMPORARY CONSTRUCTION INCLUDES DITCHES, BERMS, ROAD SIGNS AND BARRICADES, ETC.

REVISED 4/15/10

STORMWATER RUNOFF MANAGEMENT

1. THE OWNER, SITE DEVELOPER, CONTRACTOR AND/OR THEIR AUTHORIZED AGENTS SHALL EACH DAY REMOVE ALL SEDIMENT, MUD, CONSTRUCTION DEBRIS, OR OTHER POTENTIAL POLLUTANTS THAT MAY HAVE BEEN DISCHARGED TO, OR ACCUMULATE IN, THE PUBLIC RIGHTS OF WAYS OF THE CITY OF LAS VEGAS AS A RESULT OF CONSTRUCTION ACTIVITIES ASSOCIATED WITH THIS SITE DEVELOPMENT OR CONSTRUCTION PROJECT. SUCH MATERIALS SHALL BE PREVENTED FROM ENTERING THE STORM SEWER SYSTEM.
2. ADDITIONAL CONSTRUCTION SITE DISCHARGE BEST MANAGEMENT PRACTICES MAY BE REQUIRED OF THE OWNER AND HIS OR HER AGENTS DUE TO UNFORESEEN EROSION PROBLEMS OR IF THE SUBMITTED PLAN DOES NOT MEET THE PERFORMANCE STANDARDS SPECIFIED IN THE CITY OF LAS VEGAS AND THE LAS VEGAS VALLEY CONSTRUCTION SITE BEST MANAGEMENT PRACTICES MANUAL.
3. TEMPORARY OR PERMANENT STABILIZATION PRACTICES WILL BE INSTALLED ON DISTURBED AREAS AS SOON AS PRACTICABLE AND NO LATER THAN 14 DAYS AFTER THE CONSTRUCTION ACTIVITY IN THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED. SOME EXCEPTIONS MAY APPLY. REFER TO NEVADA STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NVR100000, SECTION III.A.5.
4. AT A MINIMUM, THE CONTRACTOR OR HIS AGENT SHALL INSPECT ALL DISTURBED AREAS, AREAS USED FOR STORAGE OF MATERIALS AND EQUIPMENT THAT ARE EXPOSED TO PRECIPITATION, VEHICLE ENTRANCE AND EXIT LOCATIONS AND ALL BMPS WEEKLY, AND WITHIN 24 HOURS AFTER ANY ACTUAL RAIN EVENT OF 0.5 INCHES OR MORE. THE CONTRACTOR OR HIS AGENT SHALL UPDATE OR MODIFY THE STORMWATER POLLUTION PREVENTION PLAN AS NECESSARY. SOME EXCEPTIONS TO WEEKLY INSPECTIONS MAY APPLY, SUCH AS SUSPENSION OF LAND DISTURBANCE ACTIVITIES. REFER TO NEVADA STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NVR100000, SECTION III.A.12.
5. ACCUMULATED SEDIMENT IN BMPS SHALL BE REMOVED WITHIN SEVEN DAYS AFTER A STORMWATER RUNOFF EVENT OR PRIOR TO THE NEXT ANTICIPATED STORM EVENT, WHICHEVER IS EARLIER. SEDIMENT MUST BE REMOVED WHEN BMP DESIGN CAPACITY HAS BEEN REDUCED BY 50 PERCENT OR MORE.

CITY OF LAS VEGAS GENERAL NOTES

1. ALL CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION OFFSITE IMPROVEMENTS, CLARK COUNTY AREA NEVADA", LATEST ISSUE; THE "UNIFORM STANDARD DRAWINGS FOR PUBLIC WORKS CONSTRUCTION, CLARK COUNTY AREA NEVADA", LATEST REVISED EDITION; THE "SUMMERLIN IMPROVEMENT STANDARDS" FOR WORK IN THE SUMMERLIN AREA; AND OTHER APPLICABLE APPROVED STANDARDS ISSUED BY THE CONTROLLING AGENCY; THE UNIFORM BUILDING CODE; AND ALL LOCAL CITY CODES AND ORDINANCES APPLICABLE, EXCEPT AS NOTED ON THIS SHEET AS "DEVIATIONS FROM STANDARDS".
2. THE EXISTENCE AND LOCATION OF ANY OVERHEAD OR UNDERGROUND UTILITY LINES, PIPES, OR STRUCTURES SHOWN ON THESE PLANS ARE OBTAINED BY A RESEARCH OF THE AVAILABLE RECORDS. EXISTING UTILITIES AS SHOWN FROM CLV PLANS LIBRARY ARE APPROXIMATE AND FOR RECORD PURPOSES. EXISTING UTILITIES ARE LOCATED ON PLANS ONLY FOR THE CONVENIENCE OF THE CONTRACTOR. EXISTING UTILITY SERVICE LATERALS MAY NOT BE SHOWN ON THE PLANS. THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, LOCATE ALL UNDERGROUND AND OVERHEAD INTERFERENCE'S WHICH MAY AFFECT HIS OPERATION DURING CONSTRUCTION AND SHALL TAKE ALL NECESSARY PRECAUTIONS TO AVOID DAMAGE TO SAME. THE CONTRACTOR SHALL USE EXTREME CAUTION WHEN WORKING NEAR OVERHEAD UTILITIES SO AS TO SAFELY PROTECT ALL PERSONNEL AND EQUIPMENT, AND SHALL BE RESPONSIBLE FOR ALL COST AND LIABILITY IN CONNECTION THEREWITH.
3. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT EXISTING UTILITY LINES, STRUCTURES AND STREET IMPROVEMENTS WHICH ARE TO REMAIN IN PLACE, FROM DAMAGE, AND ALL SUCH IMPROVEMENTS OR STRUCTURES DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE REPAIRED OR REPLACED SATISFACTORILY TO THE CITY ENGINEER AND OWNING UTILITY COMPANY AT THE EXPENSE OF THE CONTRACTOR.
4. ALL CONSTRUCTION SHALL BE AS SHOWN ON THESE PLANS. ANY REVISIONS SHALL HAVE THE PRIOR WRITTEN APPROVAL OF THE CITY ENGINEER.
5. TYPE V CEMENT SHALL BE USED IN ALL OFF-SITE CONCRETE WORK. CONCRETE TO BE 3000 P.S.I. MINIMUM @ 28 DAYS. MIX DESIGNS TO BE APPROVED BY THE CITY, PRIOR TO THE USE ON THE PROJECT.
6. PERMITS ARE REQUIRED FOR ANY WORK IN THE PUBLIC RIGHT-OF-WAY. THE CONTRACTOR SHALL SECURE ALL PERMITS AND INSPECTIONS REQUIRED FOR THIS CONSTRUCTION.
7. EXPANSION JOINTS REQUIRED, MAXIMUM EVERY 300' IN EXTRUDED-TYPE CURB.
8. AC PAVEMENT TO BE ONE-HALF INCH (½") ABOVE LIP OF ALL GUTTERS AFTER COMPACTION, EXCEPT AT SIDEWALK RAMPS AND CROSS GUTTERS.
9. CURB AND GUTTER FOUND TO BE UNACCEPTABLE TO THE CITY OF LAS VEGAS SHALL BE REMOVED AND REPLACED PER STANDARD DRAWING 216.
10. SIDEWALK RAMPS SHALL BE CONSTRUCTED IN EACH QUADRANT OF AN INTERSECTION PER STANDARD DRAWING 235. EXACT LOCATION OF RAMPS MAY BE ADJUSTED IN THE FIELD BY A CITY INSPECTOR.
11. CONTRACTOR SHALL PROVIDE ALL NECESSARY HORIZONTAL AND VERTICAL TRANSITIONS BETWEEN NEW CONSTRUCTION AND EXISTING SURFACES TO PROVIDE FOR PROPER DRAINAGE AND FOR INGRESS AND EGRESS TO NEW CONSTRUCTION. THE EXTENT OF THE TRANSITIONS TO BE AS SHOWN ON PLANS.
12. ALL GRADING WORK SHALL CONFORM TO THE SOILS REPORT AS PREPARED BY NOVA GEOTECHNICAL & INSPECTION SERVICES, PROJECT NUMBER E-15-086, MAY 21, 2015, APPROVED BY THE CITY ENGINEER, AND AS SHOWN ON THESE PLANS.
13. EXACT LOCATION OF ALL SAWCUT LINES MAY BE ADJUSTED OR DETERMINED IN THE FIELD BY A CITY OF LAS VEGAS ENGINEER IF LOCATION ON PLANS IS NOT CLEARLY SHOWN, OR EXISTING PAVEMENT CONDITION REQUIRES RELOCATIONS.
14. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONS NECESSARY TO PROTECT EXISTING PERMANENT SURVEY MONUMENTS. ANY MONUMENTS DISTURBED SHALL BE REPLACED AND ADJUSTED PER AVAILABLE RECORDS IN ACCORDANCE WITH N.R.S. STATUTE NO. 625.350 & CITY OF LAS VEGAS TITLE 18, APPENDIX D.
15. UTILITY COMPANY METER BOXES, MANHOLE LIDS, VALVE COVERS, ETC., SHALL BE LOCATED OUT OF DRIVEWAYS, DRIVEWAY APRONS, FLOWLINES, AND CROSS GUTTERS UNLESS WRITTEN APPROVAL IS GRANTED BY THE UTILITY COMPANY AND THE CITY ENGINEER.

WALL NOTES:

16. ALL WALLS, NEW OR EXISTING, ARE ONLY SHOWN ON CIVIL PLANS FOR THE PURPOSE OF REVIEWING GRADING RELATIONSHIPS; FLOOD CONTROL AND SIGHT DISTANCE AT INTERSECTIONS. NEW WALLS REQUIRE A SEPARATE PERMIT AND INSPECTION BY THE BUILDING DEPARTMENT.
17. ASPHALT MIX DESIGN MUST BE SUBMITTED AND APPROVED BY THE CITY ENGINEER PRIOR TO THE PLACEMENT OF ASPHALT WITHIN CITY RIGHT OF WAY.
18. CONTRACTOR SHALL ADJUST ALL NEW AND EXISTING INLETS, VALVE BOXES, MANHOLE RIMS, AND SEWER CLEAN OUTS, ETC. TO FINISH GRADE AS APPLICABLE WHETHER OR NOT THEY ARE SHOWN ON THE PLANS.
19. MATERIALS, HANDLING AND PLACEMENT OF PORTLAND CEMENT CONCRETE SHALL BE IN ACCORDANCE WITH APPLICABLE SECTIONS OF NDOT OR THE CLARK COUNTY AREA SPECIFICATIONS (AS APPLICABLE) AND THE PLANS AND DETAILS SHOWN HEREON.
20. WHEN INSTALLING UNDERGROUND FACILITIES THAT REQUIRE UNDERGROUND LOCATING DEVICES SUCH AS MARKER BALLS, LOCATING RIBBON, ETC, THE CONTRACTOR SHALL PROVIDE WRITTEN DOCUMENTATION TO THE OFFSITE INSPECTION AND TESTING CERTIFYING THAT ALL DEVICES HAVE BEEN PLACED AND VERIFIED TO BE IN GOOD WORKING CONDITION PRIOR TO THE CONSTRUCTION OF ANY ROAD BASE.
21. SANITARY SEWER AND STORM DRAIN FINAL LOCATION MAP(S) SHALL BE PROVIDED TO THE CITY PRIOR TO ACCEPTANCE OF FACILITY VIDEO INSPECTION. THE MAP(S) SHALL INCLUDE THE HORIZONTAL AND VERTICAL (INVERT) LOCATION OF PUBLIC SEWER MANHOLES, STORM DRAIN MANHOLES AND TRANSITION STRUCTURES, STORM DRAIN LATERALS AT THE CONNECTION TO THE STORM DRAIN MAIN AND AT THE CONNECTION TO A DROP INLET, THE CONNECTION OF SEWER SERVICE LATERALS TO THE SEWER MAIN AND WHERE THE SEWER SERVICE LATERALS EXIT THE PUBLIC RIGHT-OF-WAY, AND STORM DRAIN MAIN ALIGNMENT, INCLUDING DEFLECTION POINTS. THE LOCATION SHALL BE DESCRIBED BY COORDINATES WHICH SHALL BE BASED ON THE OFFICIAL HORIZONTAL AND VERTICAL CONTROL NETWORKS OF THE CITY OF LAS VEGAS. A SEPARATE ELECTRONIC COMMA DELIMITED FILE FOR THE SANITARY SEWER AND STORM DRAIN COORDINATES SHALL ALSO ACCOMPANY THE SANITARY SEWER AND STORM DRAIN FINAL LOCATION MAP(S).

OR

~~SANITARY SEWER AND STORM DRAIN FACILITIES SHOWN ON THESE PLANS SHALL BE USED TO MEET THE REQUIREMENTS ON NRS 455 AND SHALL SHOW AT A MINIMUM THE HORIZONTAL AND VERTICAL (INVERT) LOCATION OF PUBLIC SEWER MANHOLES, STORM DRAIN MANHOLES, STORM DRAIN LATERALS AT THE CONNECTION TO THE STORM DRAIN MAIN AND AT THE CONNECTION TO A DROP INLET, AND THE CONNECTION OF SEWER SERVICE LATERALS TO THE SEWER MAIN AND WHERE THE SEWER SERVICE LATERALS EXIT THE PUBLIC RIGHT-OF-WAY. ANY DEVIATIONS FROM THE INFORMATION SHOWN SHALL BE NOTED AND SUBMITTED AS A REVISION TO THE PLANS AND APPROVED PRIOR TO ACCEPTANCE OF FACILITY VIDEO INSPECTION.~~

22. CCTV VIDEO INSPECTION IS REQUIRED FOR ALL SEWER AND STORM DRAINS. THE CCTV VIDEO INSPECTIONS NEED TO BE PERFORMED PER THE DESIGN AND CONSTRUCTION STANDARDS FOR WASTEWATER COLLECTION SYSTEMS LATEST EDITION.
23. A SEPARATE BORING PERMIT IS REQUIRED FOR ALL BORING ACTIVITIES.

REVISED 02/03/15

FLOOD ZONE NOTE

NO PORTION OF THE SITE FALLS WITHIN A FEMA DESIGNATED SPECIAL FLOOD HAZARD AREA. SITE LOCATED ON PANEL 32003C2150E, DATED SEPTEMBER 27, 2002, TO REFLECT A LOMR. THIS PANEL SHOWS THAT THE PROJECT IS LOCATED WITHIN A ZONE X AND NOT LOCATED WITHIN A FEMA DESIGNATED 100-YEAR ZONE A OR SPECIAL FLOOD HAZARD AREA.

LEGEND

- PROPOSED UTILITIES
- EXISTING UTILITIES
- FUTURE UTILITIES
- SECTION LINE
- EASEMENT LINE
- RIGHT-OF-WAY LINE
- PROPERTY LINE
- CENTERLINE
- 100 YR HYDRAULIC GRADE LINE (ULT)
- 100 YR HYDRAULIC GRADE LINE (INT)
- PROPOSED UTILITY (BY OTHERS)
- PROPOSED SEWER LINE W/MH
- FUTURE SEWER LINE W/MH
- EXISTING SEWER LINE W/MH
- EXISTING WATER LINE & GATE VALVE
- PROPOSED WATER LINE & GATE VALVE
- FUTURE WATER LINE & GATE VALVE
- 2" G — EXISTING GAS LINE
- 2-6" E — EXISTING UNDERGROUND ELECTRICAL
- CATV — EXISTING CABLE TV
- TEL — EXISTING TELEPHONE
- OHP — EXISTING OVERHEAD AND POWER POLES
- PROPOSED STORM DRAIN W/MH
- EXISTING STORM DRAIN W/MH
- FUTURE STORM DRAIN W/MH
- EXISTING SIDEWALK AND RAMP
- CONSTRUCT CURB DEPRESSION FOR FUTURE HANDICAP RAMP
- VIEW FENCE
- NEW ABANDONED PIPE
- EXISTING ABANDONMENT
- SAWCUT
- STEEL CASING
- APPROXIMATE PAVEMENT RESTORATION
- TO BE ABANDONED PROFILE HATCH
- WATER STUB WITH BLOW-OFF
- FUTURE WATER STUB WITH BLOW-OFF
- SEWER STUB WITH CAP
- FUTURE SEWER STUB WITH CAP
- EDGE OF PAVEMENT / OUTSIDE EDGE
- —O— CUT LIMIT LINE
- —F— FILL LIMIT LINE

- 1 / CD1 — DRAWING NUMBER FOR DETAIL W/ REF. TO THE SHEET WHERE IT IS SHOWN
- XX / YYY — STANDARD DRAWING NUMBER / GOVERNING AGENCY
- BENCHMARK
- POTHOLE LOCATION
- EXISTING NVR RS-100
- EXISTING DROP INLET
- PROPOSED DROP INLET
- FUTURE DROP INLET
- EXISTING GATE VALVE
- PROPOSED GATE VALVE
- FUTURE GATE VALVE
- EXISTING WATER METER
- PROPOSED WATER METER
- EXISTING TRAFFIC SIGNAL PULL BOX
- PROPOSED SIGNAL PULLBOX
- EXISTING TELEPHONE MANHOLE
- EXISTING POWER POLE
- EXISTING ELEC MARKER
- EXISTING TRAFFIC SIGNAL
- PROPOSED TRAFFIC SIGNAL
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT
- FUTURE FIRE HYDRANT
- EXISTING UTILITY BOX
- EXISTING METER BOX
- 3005 — PROPOSED CONTOUR
- (3005) — EXISTING CONTOUR
- 60.50 TC — SPOT ELEVATION
- (60.50) TC — EXISTING SPOT ELEVATION
- FUTURE SPOT ELEVATION
- EXISTING CLARK COUNTY STREET LIGHT (STLT)
- 1.00% — ROAD SLOPE
- EXISTING SUMMERLIN STREET LIGHT (STLT)
- PROPOSED SUMMERLIN STREET LIGHT (STLT)
- TOP SLOPE / TOE SLOPE — 3:1 SLOPE UNLESS OTHERWISE NOTED ON PLAN

ABBREVIATIONS

A	AIR	FH	FIRE HYDRANT	RCB	REINFORCED CONCRETE BOX
AC	ASPHALT CONCRETE, ACRE	FL	FLOW LINE	RCP	REINFORCED CONCRETE PIPE
ACP	ASBESTOS CEMENT PIPE	FO	FIBER OPTIC	RD	ROAD
ADD'L	ADDITIONAL	FRP	FIBERGLASS REINFORCED PLASTIC	RDWY	ROADWAY
AP	ANGLE POINT	FS	FINISH SURFACE	REC	RECTANGULAR
APN	ASSESSOR'S PARCEL NUMBER	FT	FOOT/FEET	REF	REFERENCE
APPROX	APPROXIMATELY	FTG	FOOTING	REINF	REINFORCED
AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS	FUT	FUTURE	REQD	REQUIRED
		G	GAS	RIM	TOP OF RIM ELEVATION
		GA	GAGE, GUY ANCHOR	RND	ROUND
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS	GB	GRADE BREAK	ROW,R/W	RIGHT OF WAY
		GND	GROUND	RP	RADIUS POINT
AVE	AVENUE	GRD	GRADE, GROUND	RPM	RAISED PAVEMENT MARKERS
AVAR	AIR VALVE, AIR RELEASE ASSEMBLY	H, HGT	HEIGHT	RSGV	RESILIENT SEAT GATE VALVE
		HDWL	HEADWALL	S	SOUTH
AWWA	AMERICAN WATER WORKS ASSOCIATION	HGL	HYDRAULIC GRADE LINE	SCH	SCHEDULE
		HORIZ	HORIZONTAL	SD	STORM DRAIN
BC	BACK OF CURB	HP	HIGH POINT, HIGH PRESSURE	SDMH	STORM DRAIN MANHOLE
BCR	BEGIN CURB RETURN	HPS	HIGH PRESSURE SODIUM	SECT	SECTION
BLM	BUREAU OF LAND MANAGEMENT	IBC	INTERNATIONAL BUILDING CODE	SF	SQUARE FOOT/FEET
BLVD	BOULEVARD	INV	INVERT	SHLDR	SHOULDER
BM	BENCHMARK	INT	INTERIM	SHT	SHEET
BO	BLOW-OFF	JT	JOINT	SIS	SUMMERLIN IMPROVEMENT STANDARDS
BVCE	BEGIN VERTICAL CURVE ELEVATION	L	LENGTH		
BVCS	BEGIN VERTICAL CURVE STATION	L, LT	LEFT	SL	STREET LIGHT
BW	BACK OF SIDEWALK	LF	LINEAR FEET	SP	SERVICE POINT
C, ℄	CENTERLINE	LIP	LIP OF GUTTER	SQ	SQUARE
C&G	CURB AND GUTTER	LN	LANE	SR	SEWER RECLAIM MAIN
CATV	UNDERGROUND CABLE TV	LP	LIGHT POLE	SS	SANITARY SEWER
CCBM	CLARK COUNTY BENCH MARK	LSCP	LANDSCAPE	SSMH	SANITARY SEWER MANHOLE
CCPW	CLARK COUNTY PUBLIC WORKS	LVWD	LAS VEGAS VALLEY WATER DISTRICT	STA	STATION
CCTV	CLOSED-CIRCUIT TELEVISION	MAX	MAXIMUM	ST	STREET
CCWRD	CLARK COUNTY WATER RECLAMATION DISTRICT	MH	MANHOLE	STD	STANDARD
		MIN	MINIMUM	STL	STEEL
CFS	CUBIC FEET PER SECOND	MLCP	MORTAR LINED AND COATED PIPE	STRUCT	STRUCTURE
CIP	CAPITAL IMPROVEMENTS PROJECT, CORRUGATED IRON PIPE	MP	MESA PARK	SVZ	SIGHT VISIBILITY ZONE
		MOD	MODIFY/MODIFIED	SW	SIDEWALK
	CAST IN PLACE	MON	MONUMENT	SWG	SOUTHWEST GAS
CIPM	CAST-IN-PLACE MANHOLE	MPH	MILES PER HOUR	T	TELEPHONE OR TOP
CIPP	CAST-IN-PLACE PIPE	N	NORTH	TAN	TANGENT
CIR	CIRCLE	NDOT	NEVADA DEPARTMENT OF TRANSPORTATION	TB	TOP OF BERM
CLR	CLEAR OR CLEARANCE			TC	TOP OF CURB
CLSM	CONTROLLED LOW STRENGTH MATERIAL	NO	NUMBER	TCE	TEMPORARY CONSTRUCTION ESMT
		NOSHA	STATE OF NEVADA OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION	TEL,TELE	TELEPHONE
CLV	CITY OF LAS VEGAS			TEMP	TEMPORARY
CMP	CORRUGATED METAL PIPE	NVE	NEVADA ENERGY	TF	TOP OF FOOTING
CMU	CONCRETE MASONRY UNIT	NTS	NOT TO SCALE	TG	TOP OF GRATE
CNLV	CITY OF NORTH LAS VEGAS	OB	OVERBUILD	TMH	TOP OF MANHOLE
CO	CLEANOUT	OC	ON CENTER	TOP	TOP OF PIPE
CONC	CONCRETE	OHC	OVERHEAD COX COMMUNICATION	TP	TELEPHONE POLE
COND	CONDUIT	OHP	OVERHEAD POWER LINE	TRANS	TRANSITION
CONST	CONSTRUCT OR CONSTRUCTION	P	POWER LINE	TRW	TOP OF RETAINING WALL
COORD	COORDINATE	PB	PULL BOX	TS	TRAFFIC SIGNAL
COR	CORNER	PBS	PLANTMIX BITUMINOUS SURFACE	TW	TOP OF WALL
CPEP	CORRUGATED POLYETHELYNE PIPE	PC	POINT OF CURVE, PRESSURE	TYP,(TYP)	TYPICAL
CT	COURT			UDACS	UNIFORM DESIGN AND CONSTRUCTION STANDARDS FOR WATER DISTRIBUTION SYSTEMS (LATEST EDITION)
CY	CUBIC YARD(S)	PCC	POINT OF COMPOUND CURVE		
Δ	DELTA	PE	PROJECT ENGINEER OR POLYETHYLENE		
DBL	DOUBLE			UG	UNDERGROUND
DES	DESIGN AND CONSTRUCTION STANDARDS FOR WASTEWATER COLLECTION SYSTEM (LATEST EDITION)	PED	PEDESTRIAN	ULT	ULTIMATE
		PGL	PROFILE GRADE LINE	USD	UNIFORM DESIGN AND CONSTRUCTION STANDARDS
		PH	POTHOLE		
DEFL	DEFLECTION	PI	POINT OF INTERSECTION	USDCCA	UNIFORM STD. DRAWINGS FOR PUBLIC WORKS' CONSTRUCTION OFF-SITE IMPROVEMENTS CLARK COUNTY AREA, NEVADA (LATEST EDITION)
DG	DESIGN GRADE	PIV	POST INDICATOR VALVE		
DIA, ø	DIAMETER	PL	PROPERTY LINE		
DIP	DUCTILE IRON PIPE	PLCP	POLYURETHANE LINED AND COATED STEEL PIPE		
DIST	DISTANCE				
DR	DRIVE	PMF	PAVEMENT MARKING FILM	UT	UNDERGROUND TELEPHONE
DS	DOWNSPOUT	POB	POINT OF BEGINNING	VAR	VARIABLE/VARIES
DTL	DETAIL	POC	POINT ON CURVE	VC	VERTICAL CURVE
DW	DRIVEWAY	P.O.C.	POINT OF CONNECTION	VCP	VITRIFIED CLAY PIPE
DWG	DRAWING	POT	POINT ON TANGENT	VERT	VERTICAL
E	EAST	PP	POWER POLE	VG	VALLEY GUTTER
ECR	END CURB RETURN	PROP	PROPOSED	VOL	VOLUME
ELE,ELEC	ELECTRICAL	PRC	POINT OF REVERSE CURVE	W	WATER, WEST
ELEV	ELEVATION	PRVC	POINT OF REVERSE VERTICAL CURVE	W/	WITH
EP, EOP	EDGE OF PAVEMENT			WOTUS	WATERS OF THE UNITED STATES
ESMT	EASEMENT	PSI	POUNDS PER SQUARE INCH	WS	WATER SUPPLY
EVC	END VERTICAL CURVE	PT	POINT OF TANGENCY	WT	WEIGHT
EXIST,EX	EXISTING	PVC	POLYVINYL CHLORIDE	WTR	WATER
EXP	EXPANSION JOINT	PVI	POINT OF VERTICAL INTERSECTION	XING	CROSSING
FC	FACE OF CURB	PVMT	PAVEMENT	YD	YARD, YARD DRAIN
FF, FFE	FINISH FLOOR ELEVATION	PZ	PRESSURE ZONE	Z	PRESSURE ZONE
FG	FINISH GRADE	R, RAD	RADIAL, RADIUS		
		R, RT	RIGHT		

DEVIATIONS FROM STANDARDS

1. NONE

NOTE

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BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

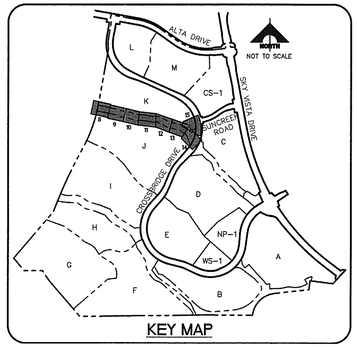
Call before you Dig — Avoid cutting underground utility lines, it's costly. Call 811 or 1-800-227-2600 and CLARK COUNTY NUCLEI OPERATIONS 1-702-455-6000

AVOID HITTING OVERHEAD POWER LINES IT'S COSTLY — CALL BEFORE YOU DO OVERHEAD — 1-702-227-2929

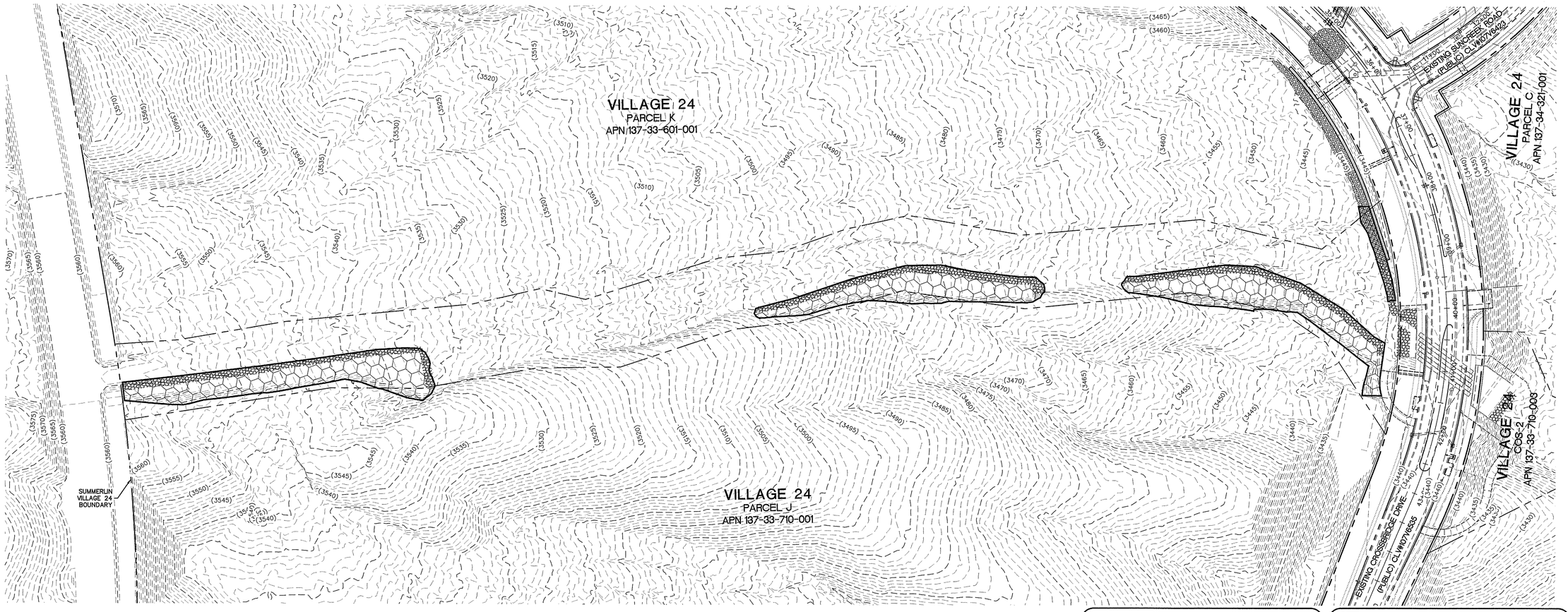
FAST — Call before you UnderGround — 1-702-432-5300 FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

CLV

NO.	DESCRIPTION	DATE	APP



KEY MAP



COS-1 (WATERS OF THE US)

HORIZ SCALE: 1" = 80'

NORTH

80 0 80 160

SCALE FEET

DEMOLITION QUANTITIES

CUT	7,446	CY
RIPRAP (D50=12")	1,208	CY
RIPRAP (D50=8")	173	CY

REMOVAL HATCH NOTE

EXISTING RIPRAP AND BERMS TO BE REMOVED AND GRADED BACK TO ORIGINAL GRADING.

EXISTING 8" RIPRAP TO BE REMOVED.

RIPRAP GENERAL NOTE:
ALL RIPRAP, SHALL ADHERE TO REQUIREMENTS OF UNIFORM STANDARD SPECIFICATION SECTION 610 "SLOPE AND CHANNEL PROTECTION."

FOR GROUTED RIPRAP LARGE ROCK, SEE ADDITIONAL REQUIREMENTS TO SECTION 610 "SLOPE AND CHANNEL PROTECTION ADDITIONAL NOTES" PER DETAIL 3 SHEET 16.

COS WASH MAINTENANCE GENERAL NOTE:

HOA TO MAINTAIN DESIGN GRADES AND RIPRAP ALONG CUTOFF WALLS AFTER EVERY MEASURABLE STORM EVENT. IF THERE IS MEASURABLE RAINFALL DEPTH IN THE CCRFCD GAUGES 4329 AND 4344, THE COS WASH SHOULD BE INSPECTED BY HOA AFTER CESSATION OF THE STORM EVENT.

CCRFCD RAINFALL GAUGE 4329 IS LOCATED IN BROWNSTONE CANYON UPSTREAM OF VILLAGE 24.

CCRFCD RAINFALL GAUGE 4344 IS LOCATED IN THE RED ROCK DETENTION BASIN DOWNSTREAM OF VILLAGE 24.

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FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

CLV #

ENGINEER - STATE OF NEVADA
JOSHUA L. JOHNSON
Exp. 06/30/2017
CIVIL
No. 15789
PROFESSIONAL ENGINEER

DATE: 1/25/17

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

FOR AGENCY REVIEW - NOT FOR CONSTRUCTION

PROJECT NO. 62024-226-1

DESIGN: MDB
DRAWN: MDB
CHECK: JLJ
PLOT DATE: 01-25-17
PLOT TIME: 09:40:31

GCW ENGINEERS & SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com

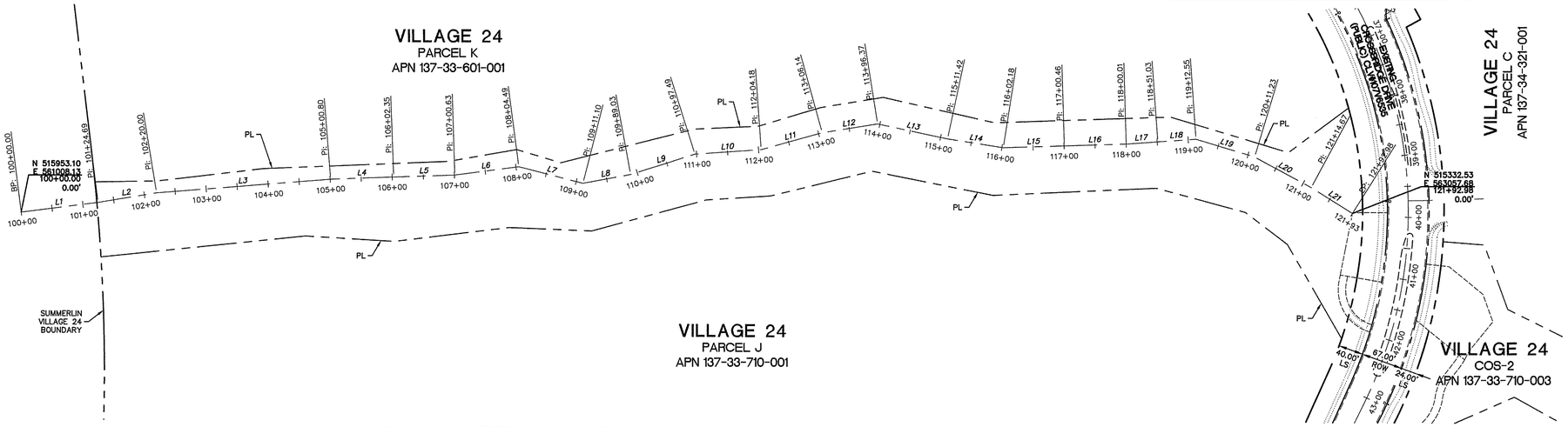
F:\Projects\600\62024-226-1\DWG\Production\V24-226-1_DEMO.dwg
Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

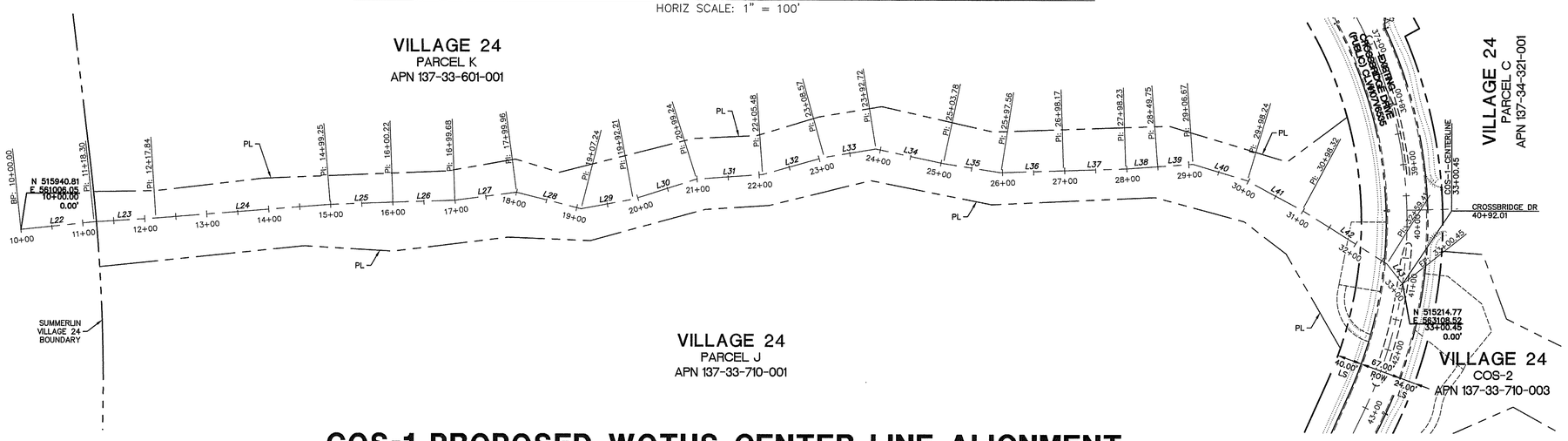
EXISTING BERM DEMOLITION PLAN

DRAWING
3
3 OF 17 SHTS



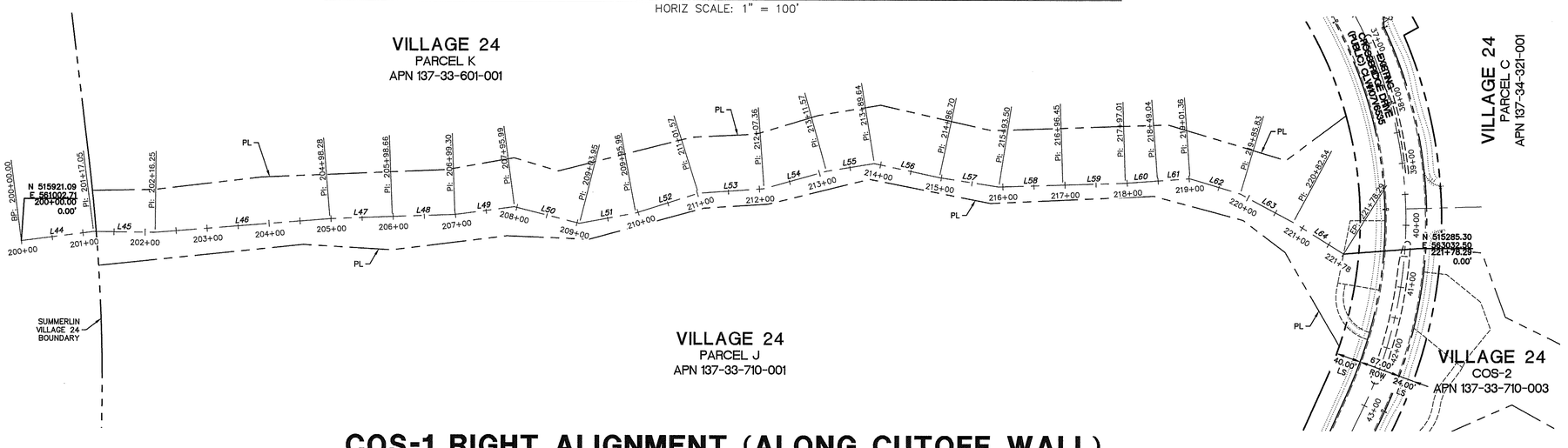
COS-1 LEFT ALIGNMENT (ALONG CUTOFF WALL)

HORIZ SCALE: 1" = 100'



COS-1 PROPOSED WOTUS CENTER LINE ALIGNMENT

HORIZ SCALE: 1" = 100'



COS-1 RIGHT ALIGNMENT (ALONG CUTOFF WALL)

HORIZ SCALE: 1" = 100'

LINE TABLE		
LINE #	LENGTH	DIRECTION
L1	124.69'	S80°22'50"E
L2	95.31'	S82°34'46"E
L3	280.79'	S77°41'57"E
L4	101.55'	S75°16'23"E
L5	98.29'	S75°00'31"E
L6	103.86'	S80°38'58"E
L7	106.61'	S58°51'17"E
L8	77.92'	S83°37'04"E
L9	108.46'	N89°16'53"E
L10	106.69'	S77°09'39"E
L11	101.96'	S88°40'38"E
L12	90.23'	S82°17'05"E
L13	115.06'	S61°03'44"E
L14	90.76'	S64°11'23"E
L15	98.27'	S74°53'07"E
L16	99.55'	S74°49'59"E
L17	51.03'	S77°14'51"E
L18	61.52'	S77°07'07"E
L19	98.67'	S56°24'39"E
L20	103.44'	S44°49'42"E
L21	78.31'	S41°01'26"E
L22	118.30'	S79°10'11"E
L23	99.55'	S76°45'07"E
L24	281.41'	S77°41'57"E
L25	100.96'	S75°16'23"E
L26	99.46'	S75°00'31"E
L27	100.28'	S80°38'58"E
L28	107.29'	S58°51'17"E
L29	84.96'	S83°37'04"E
L30	107.04'	N89°16'53"E
L31	106.24'	S77°09'39"E
L32	103.09'	S88°40'38"E

LINE TABLE		
LINE #	LENGTH	DIRECTION
L33	84.15'	S82°17'05"E
L34	111.05'	S61°03'44"E
L35	93.78'	S64°11'23"E
L36	100.61'	S74°53'07"E
L37	100.06'	S74°49'59"E
L38	51.52'	S77°14'51"E
L39	56.92'	S77°07'07"E
L40	91.57'	S56°24'39"E
L41	100.08'	S44°49'42"E
L42	161.09'	S41°01'26"E
L43	41.04'	S21°09'36"E
L44	117.05'	S80°22'50"E
L45	99.20'	S72°25'52"E
L46	282.03'	S77°41'57"E
L47	100.38'	S75°16'23"E
L48	100.63'	S75°00'31"E
L49	96.70'	S80°38'58"E
L50	107.96'	S58°51'17"E
L51	92.00'	S83°37'04"E
L52	105.62'	N89°16'53"E
L53	105.79'	S77°09'39"E
L54	104.21'	S88°40'38"E
L55	78.07'	S82°17'05"E
L56	107.05'	S61°03'44"E
L57	96.80'	S64°11'23"E
L58	102.95'	S74°53'07"E
L59	100.56'	S74°49'59"E
L60	52.02'	S77°14'51"E
L61	52.33'	S77°07'07"E
L62	84.47'	S56°24'39"E
L63	96.71'	S44°49'42"E
L64	95.75'	S41°01'26"E

NORTH

100 0 100 200
SCALE FEET

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CLV #

GCW
ENGINEERS \ SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com

F:\Projects\600\62024-226-1\DWG\Production\V24-226-1_HC.dwg
Matthew Burge

PROJECT NO. 62024-226-1
DESIGN: MDB
DRAWN: MDB
CHECK: JLJ
PLOT DATE: 01-25-17
PLOT TIME: 08:40:36

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GOV APP

FOR AGENCY REVIEW - NOT FOR CONSTRUCTION

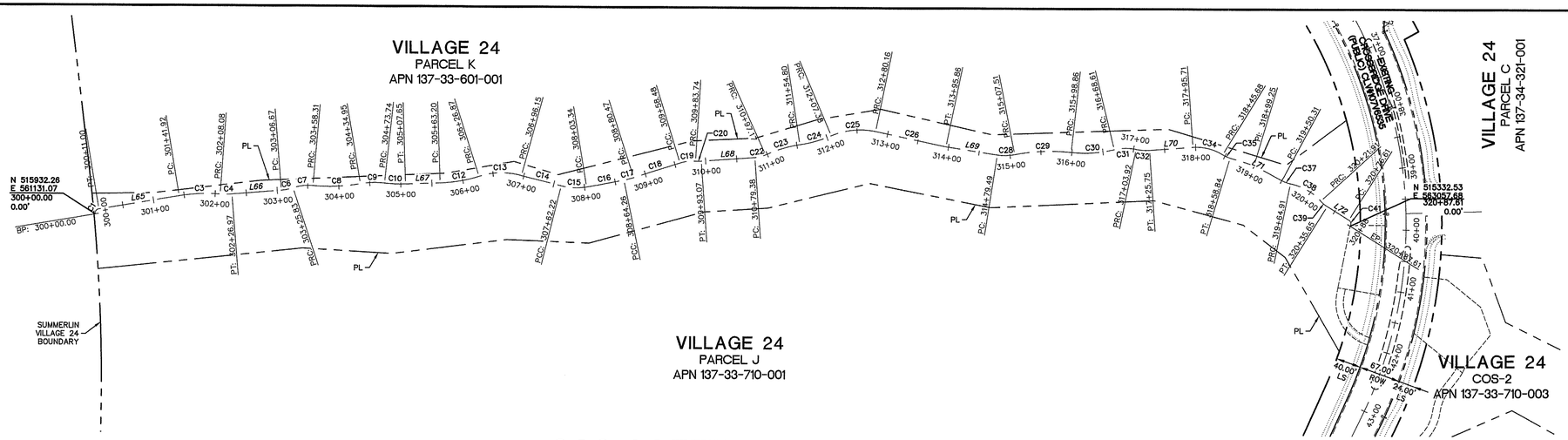
DATE: 1/25/17

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

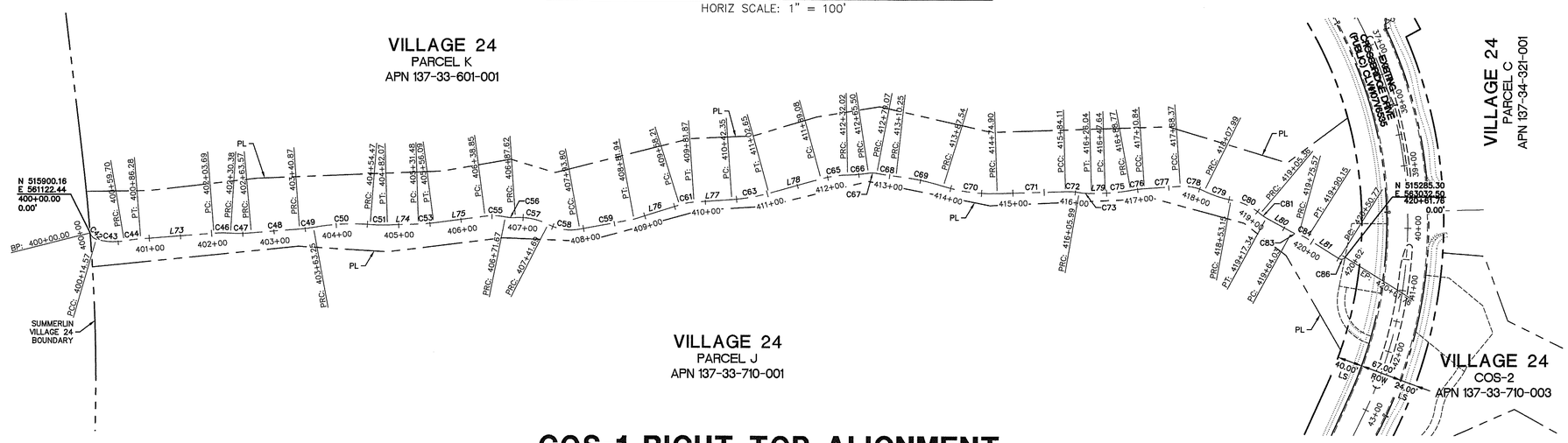
HORIZONTAL CONTROL 1

DRAWING-
4
4 OF 17 SHTS



COS-1 LEFT TOP ALIGNMENT

HORIZ SCALE: 1" = 100'



COS-1 RIGHT TOP ALIGNMENT

HORIZ SCALE: 1" = 100'

LINE TABLE		
LINE #	LENGTH	DIRECTION
L65	130.92'	S82°34'46"E
L66	79.70'	S77°41'57"E
L67	55.55'	S75°00'31"E
L68	86.31'	S77°09'39"E
L69	83.63'	S64°11'23"E
L70	69.96'	S77°08'06"E
L71	91.01'	S49°56'37"E
L72	40.96'	S41°01'26"E
L73	117.41'	S77°41'57"E
L74	49.40'	S75°00'31"E
L75	82.76'	S80°38'58"E
L76	76.27'	N89°16'53"E
L77	60.48'	S77°09'39"E
L78	86.43'	S88°40'38"E
L79	21.61'	S74°49'59"E
L80	46.68'	S44°30'35"E
L81	60.61'	S41°01'26"E

CURVE TABLE				
CURVE #	LENGTH	RADIUS	TANGENT	DELTA
C1	11.00'	7.00'	7.00'	90°00'00"
C3	66.16'	280.00'	33.23'	13°32'18"
C4	18.89'	125.00'	9.46'	8°39'28"
C6	19.15'	80.00'	9.62'	13°43'02"
C7	32.49'	80.00'	16.47'	23°15'58"
C8	76.64'	300.00'	38.53'	14°38'14"
C9	38.79'	140.00'	19.52'	15°52'29"
C10	33.91'	240.00'	16.98'	8°05'45"
C12	63.67'	230.00'	32.04'	15°51'37"
C13	69.29'	120.00'	35.64'	33°04'59"
C14	66.07'	16686.81'	33.03'	0°13'37"
C15	41.12'	100.00'	20.85'	23°33'30"
C16	60.92'	1509.94'	30.46'	2°18'42"
C17	16.21'	150.00'	8.11'	6°11'35"
C18	78.01'	5505.40'	39.00'	0°48'43"
C19	25.27'	70.00'	12.77'	20°40'52"
C20	9.33'	70.00'	4.67'	7°38'14"
C22	17.79'	50.00'	8.99'	20°22'57"

CURVE TABLE				
CURVE #	LENGTH	RADIUS	TANGENT	DELTA
C23	57.64'	210.00'	29.00'	15°43'33"
C24	52.58'	210.00'	26.43'	14°20'41"
C25	72.78'	120.00'	37.55'	34°45'01"
C26	115.70'	14463.73'	57.85'	0°27'30"
C28	28.02'	80.00'	14.15'	20°03'58"
C29	91.35'	300.00'	46.03'	17°26'47"
C30	69.75'	200.00'	35.23'	19°58'58"
C31	35.31'	80.00'	17.95'	25°17'21"
C32	21.83'	80.00'	10.98'	15°37'55"
C34	49.98'	80.00'	25.84'	35°47'41"
C35	13.15'	50.00'	6.61'	15°04'14"
C37	14.61'	50.00'	7.36'	16°44'14"
C38	57.00'	90.00'	29.49'	36°17'11"
C39	13.74'	50.00'	6.91'	15°44'42"
C41	11.00'	7.00'	7.00'	90°00'00"
C42	14.57'	14.00'	8.02'	59°38'31"
C43	45.12'	100.00'	22.95'	25°51'11"
C44	26.59'	300.00'	13.30'	5°04'41"

CURVE TABLE				
CURVE #	LENGTH	RADIUS	TANGENT	DELTA
C46	26.69'	190.00'	13.37'	8°02'53"
C47	33.19'	220.00'	16.63'	8°38'42"
C48	77.30'	4042.05'	38.65'	1°05'44"
C49	22.39'	200.00'	11.21'	6°24'48"
C50	91.21'	350.00'	45.87'	14°55'55"
C51	27.61'	250.00'	13.82'	6°19'36"
C53	24.61'	250.00'	12.32'	5°38'27"
C55	32.82'	100.00'	16.56'	18°48'14"
C56	15.96'	60.00'	8.02'	15°14'10"
C57	54.06'	100.00'	27.71'	30°58'33"
C58	52.11'	80.00'	27.02'	37°19'23"
C59	88.14'	12568.35'	44.07'	0°24'06"
C61	23.66'	100.00'	11.89'	13°33'28"
C63	60.30'	300.00'	30.25'	11°30'58"
C65	42.95'	170.00'	21.59'	14°28'30"
C66	33.48'	250.00'	16.76'	7°40'21"
C67	13.57'	40.00'	6.85'	19°26'15"
C68	31.18'	400.00'	15.60'	4°27'58"

CURVE TABLE				
CURVE #	LENGTH	RADIUS	TANGENT	DELTA
C69	77.29'	400.00'	38.77'	11°04'17"
C70	87.36'	260.00'	44.10'	19°15'04"
C71	109.21'	15393.44'	54.60'	0°24'23"
C72	21.88'	100.00'	10.98'	12°32'08"
C73	20.05'	100.00'	10.06'	11°29'11"
C75	41.12'	270.00'	20.60'	8°43'37"
C76	22.07'	200.00'	11.05'	6°19'24"
C77	57.53'	20883.77'	28.76'	0°09'28"
C78	39.62'	75.00'	20.28'	30°16'06"
C79	45.16'	160.00'	22.73'	16°10'20"
C80	52.21'	100.00'	26.71'	29°54'50"
C81	11.98'	60.00'	6.01'	11°26'29"
C83	11.54'	50.00'	5.80'	13°13'38"
C84	14.58'	50.00'	7.34'	16°42'46"
C86	11.00'	7.00'	7.00'	90°00'00"

NORTH

100 0 100 200
SCALE FEET

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FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

CLV

ENGINEER - STATE OF NEVADA
JOSHUA L. MILLER
No. 15788
DATE: 1/25/17

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

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GCW
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T: 702.804.2000
F: 702.804.2299
gcwengineering.com

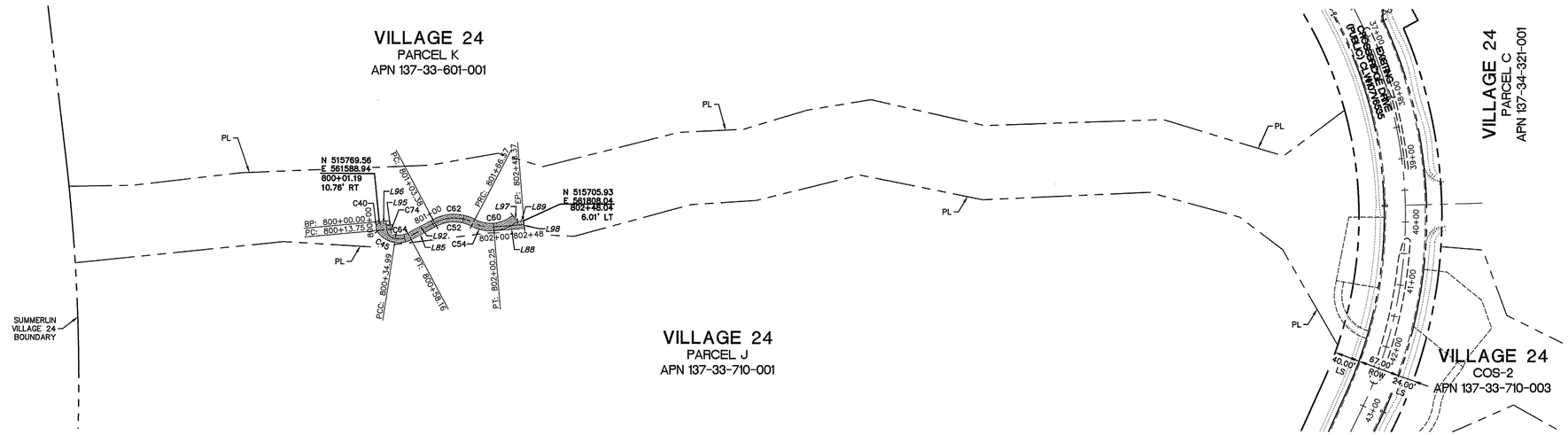
F:\Projects\600\62024-226-1\DWG\Production\V24-226-1_HC.dwg
Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

HORIZONTAL CONTROL 2

DRAWING
5
5 OF 17 SHTS



COS-1 MAINTENANCE ROAD ALIGNMENT

HORIZ SCALE: 1" = 100'

LINE TABLE		
LINE #	LENGTH	DIRECTION
L85	45.22'	N78°45'05"E
L88	48.45'	S77°41'57"E
L89	9.59'	N76°40'00"W
L92	45.22'	S78°45'05"W
L95	6.63'	N11°41'05"E
L96	17.78'	N58°48'19"W
L97	12.00'	N23°04'36"W
L98	12.03'	N9°10'40"E

CURVE TABLE				
CURVE #	LENGTH	RADIUS	TANGENT	DELTA
C40	16.96'	10.00'	11.34'	97°10'52"
C45	60.71'	42.00'	37.04'	82°49'09"
C52	57.36'	59.00'	31.17'	55°42'04"
C54	37.04'	66.00'	19.02'	32°09'06"
C60	63.64'	54.00'	36.10'	67°31'46"
C62	69.02'	71.00'	37.51'	55°42'04"
C64	19.31'	30.00'	10.00'	36°52'12"
C74	13.28'	10.00'	7.82'	76°03'48"

NORTH

100 0 100 200
SCALE FEET

NOTE

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BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

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or
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AND
CLARK COUNTY TRAFFIC OPERATIONS
1-702-455-6000

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1-702-227-2929

FAST
Call before you UnderGround
1-702-432-5300
FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

CLV #

ENGINEER - STATE OF NEVADA
JOSHUA L. JOHNSON
No. 15769
PROFESSIONAL ENGINEER
CIVIL
DATE: 1/25/17

FOR AGENCY REVIEW - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GOV APP

PROJECT NO. 62024-226-1
DESIGN: MDB
DRAWN: MDB
CHECK: JLJ
PLOT DATE: 01-25-17
PLOT TIME: 09:40:41

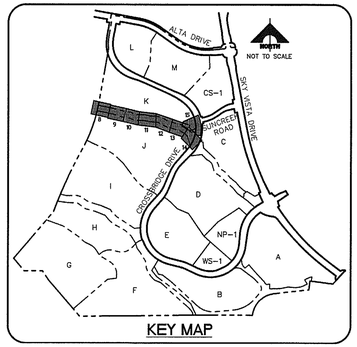
GCW
ENGINEERS \ SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com
F:\Projects\600\62024-226-1\GW\Production\V24-226-1_HC.dwg
Matthew Burge

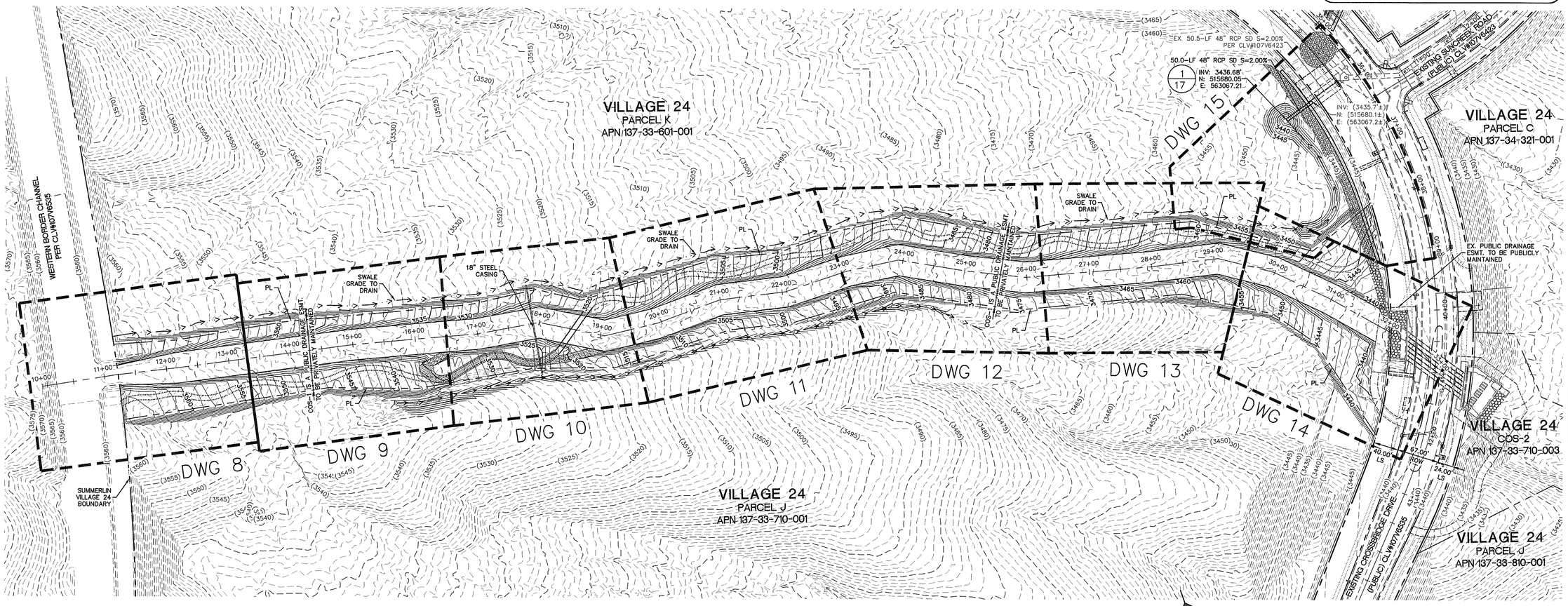
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

HORIZONTAL CONTROL 3

DRAWING
6
6 OF 17 SHTS





COS-1 (WATERS OF THE US)

HORIZ SCALE: 1" = 80'

GRAVEL MAINTENANCE ROAD
2" THICK CRUSHED ROCK/GRAVEL @ 95%

CONCRETE RAMP
6" THICK CONCRETE RAMP PER DETAIL 3 DRAWING 17

NORTH

80 0 80 160
SCALE FEET

EARTHWORK QUANTITIES

CUT	2,885	CY
FILL	11,324	CY

QUANTITIES

48" RCP	50	LF
RIPRAP (D50=12")	634	CY
1' TO 4' GROUTED RIPRAP LARGE ROCK	4,003	CY
5' DEEP CUTOFF WALL	4,127	LF
12'X2' ROCK/GRAVEL MAINTENANCE ROAD	365	SY
CONCRETE RAMPS	21	CY
18" STEEL CASING	145	LF

RIPRAP GENERAL NOTE:
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FOR GROUTED RIPRAP LARGE ROCK, SEE ADDITIONAL REQUIREMENTS TO SECTION 610 "SLOPE AND CHANNEL PROTECTION ADDITIONAL NOTES" PER DETAIL 3 SHEET 16.

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BENCHMARK

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FAST
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FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

CLV #

ENGINEER - STATE OF NEVADA
JOSHUA L. JONAS
No. 15781
DATE: 1/29/17

FOR AGENCY REVIEW - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GOV APP

PROJECT NO. 62024-226-1
DESIGN: MDB
DRAWN: MDB
CHECK: JLJ
PLOT DATE: 01-25-17
PLOT TIME: 08:40:45

GCW
ENGINEERS \ SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com

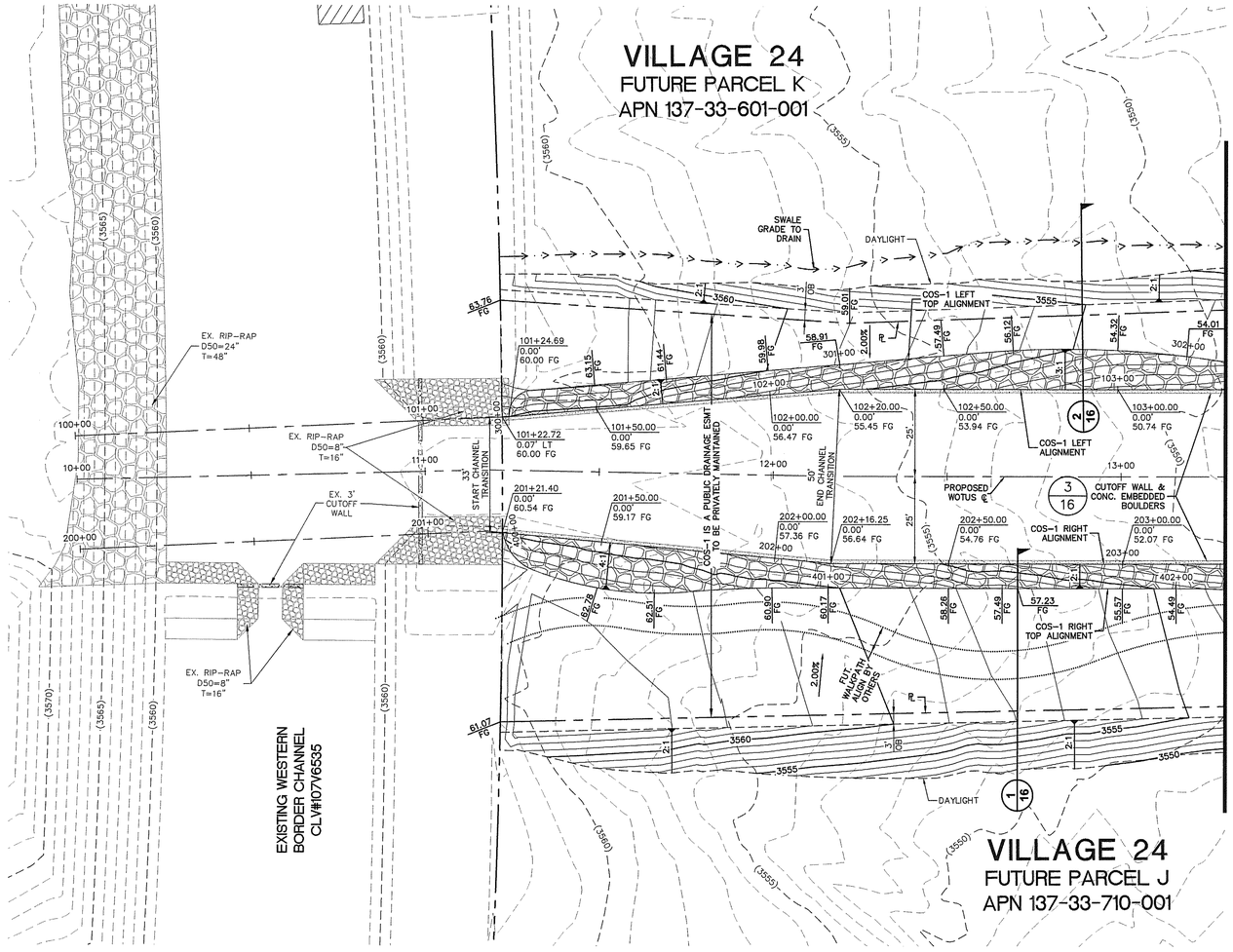
F:\Projects\600\62024-226-1\UWS\Production\V24-226-1_GD-OVR.dwg
Matthew Burge

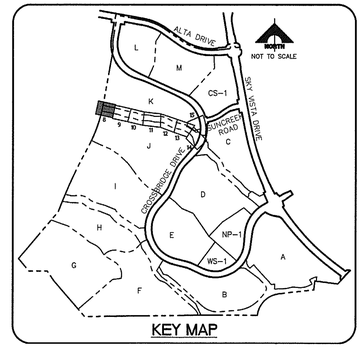
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

GRADING PLAN - OVERVIEW

DRAWING 7
7 OF 17 SHTS

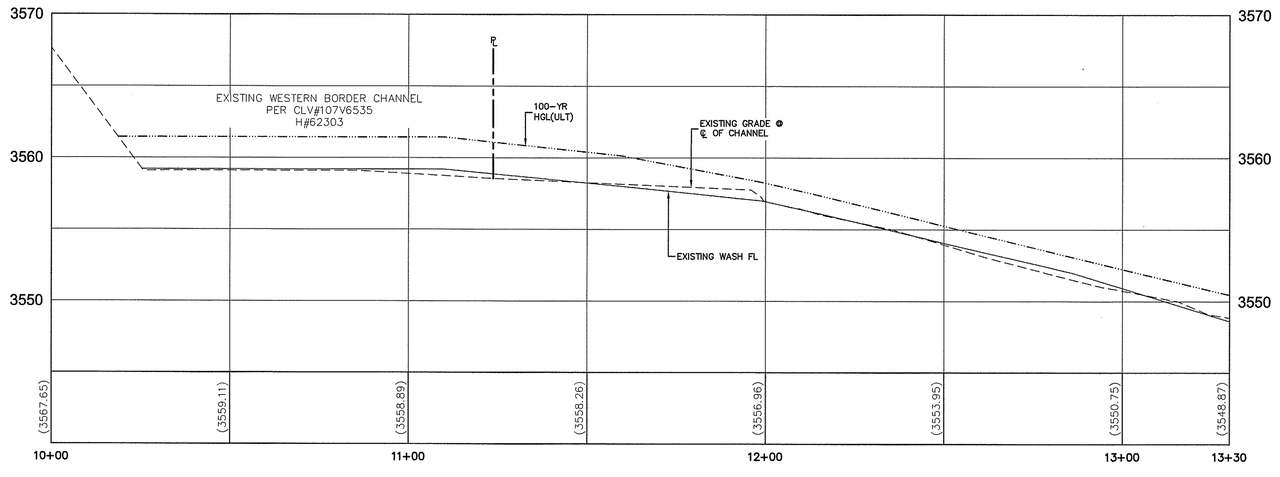


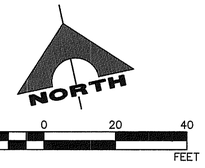


KEY MAP

COS-1 (WATERS OF THE US)

HORIZ SCALE: 1" = 20'
VERT SCALE: 1" = 5'





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BENCHMARK

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FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

CLV #

ENGINEER - STATE OF NEVADA
MATTHEW JAMES BURGE
No. 15748
DATE: 1/29/17

REV	DATE	DESCRIPTION	AGEN APP	DATE	GCW APP	DATE

PROJECT NO. 62024-226-1
DESIGN: MDB
DRAWN: MDB
CHECK: JLJ
PLOT DATE: 01-25-17
PLOT TIME: 09:41:10

GCW
ENGINEERS \ SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com

F:\Projects\600\62024-226-1\DWG\Production\V24-226-1_GD.dwg
Matthew Burge

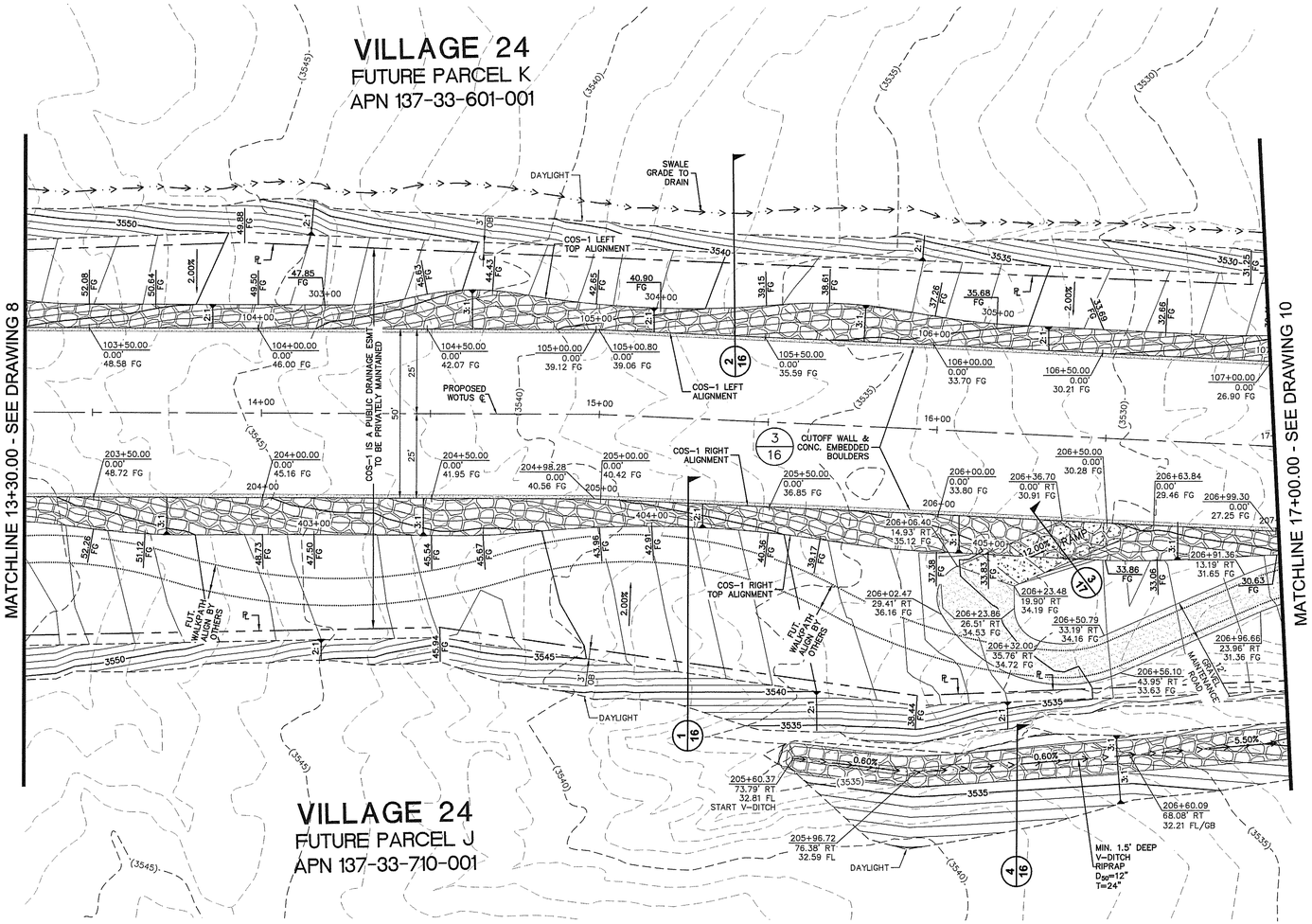
THE HOWARD HUGHES COMPANY, LLC

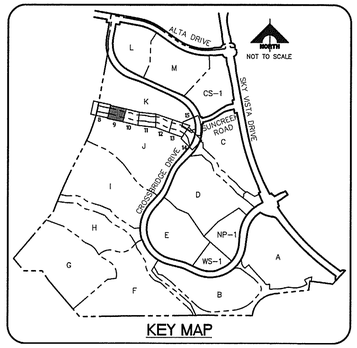
VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

GRADING PLAN 1

DRAWING
8
8 OF 17 SHTS

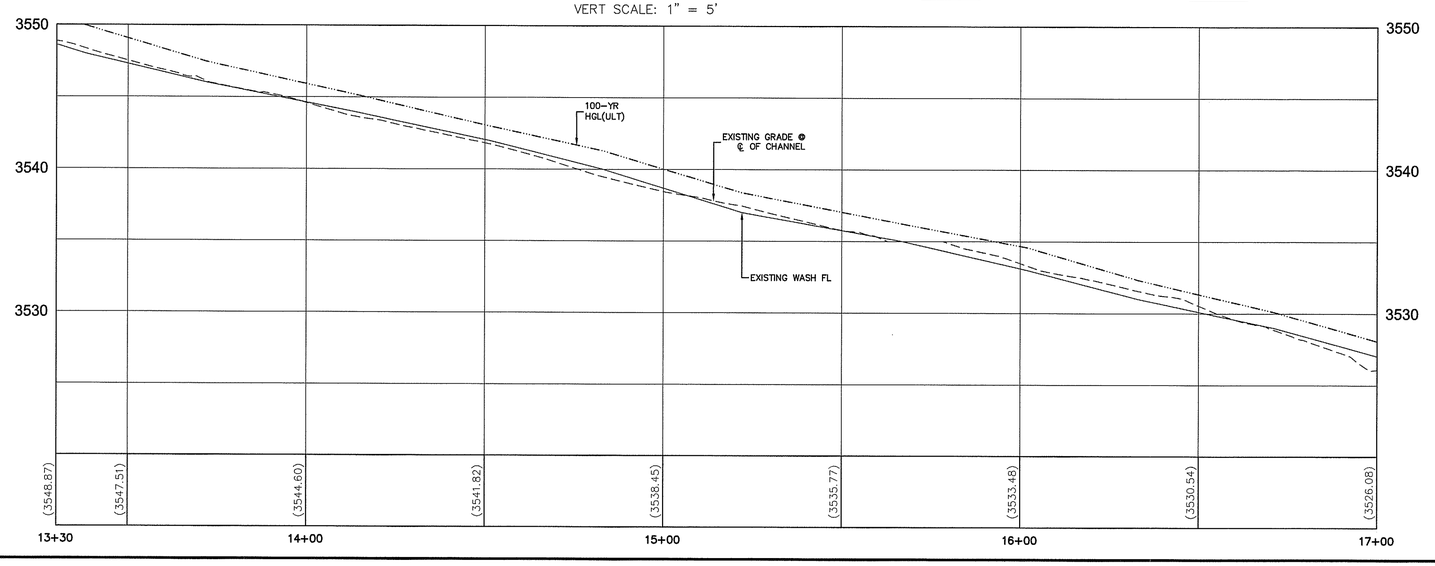
FOR AGENCY REVIEW - NOT FOR CONSTRUCTION





COS-1 (WATERS OF THE US)

HORIZ SCALE: 1" = 20'
VERT SCALE: 1" = 5'



GRAVEL MAINTENANCE ROAD
2" CRUSHED ROCK/GRAVEL @ 95%

CONCRETE RAMP
6" THICK CONCRETE RAMP PER DETAIL 3 DRAWING 17

NORTH
SCALE 20 0 20 40 FEET

RIPRAP GENERAL NOTE:
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FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

CLV #

ENGINEER - STATE OF NEVADA
JOSHUA J. MASTEN
No. 15706
PROFESSIONAL ENGINEER
DATE: 1/25/17

REV	DATE	DESCRIPTION	AGEN APP	DATE	GOW APP

FOR AGENCY REVIEW - NOT FOR CONSTRUCTION

PROJECT NO. 62024-226-1
DESIGN: MDB
DRAWN: MDB
CHECK: JLJ
PLOT DATE: 01-25-17
PLOT TIME: 08:41:30

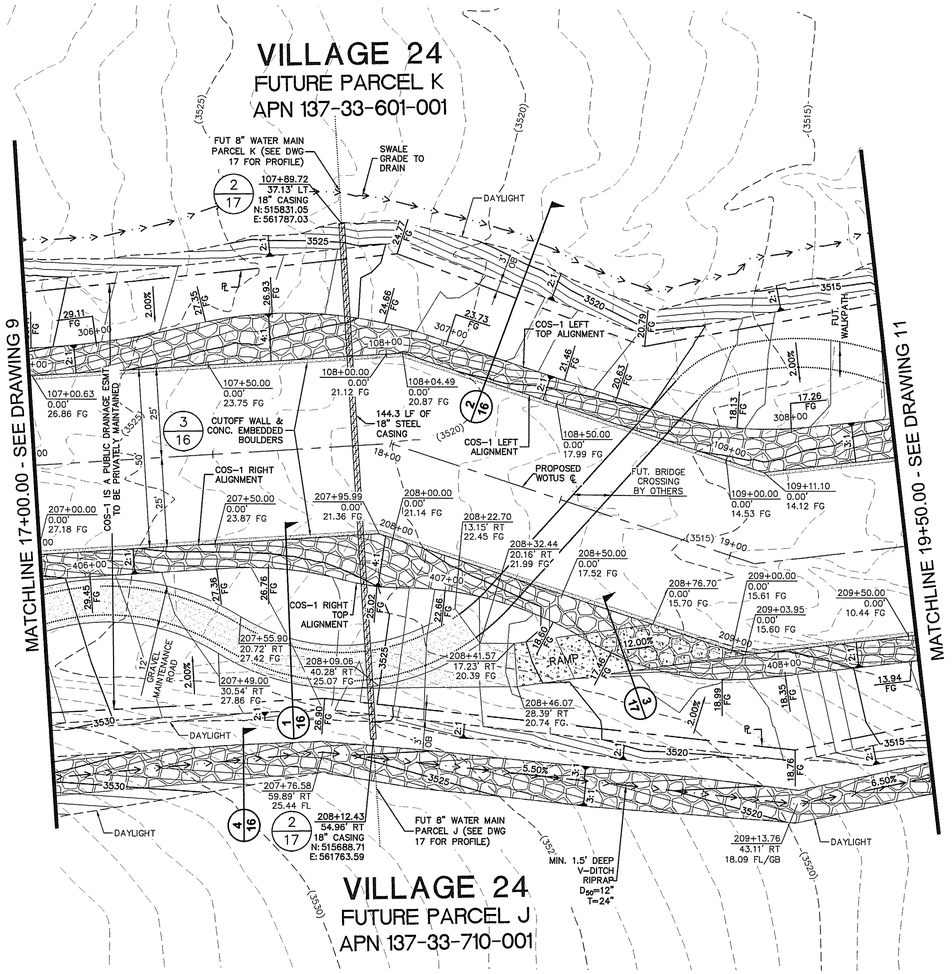
GCV
ENGINEERS \ SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com
F:\Projects\600\62024-226-1\DWG\Production\V24-226-1_GD.dwg
Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

GRADING PLAN 2

DRAWING 9 OF 17 SHTS



COS-1 (WATERS OF THE US)

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VERT SCALE: 1" = 5'

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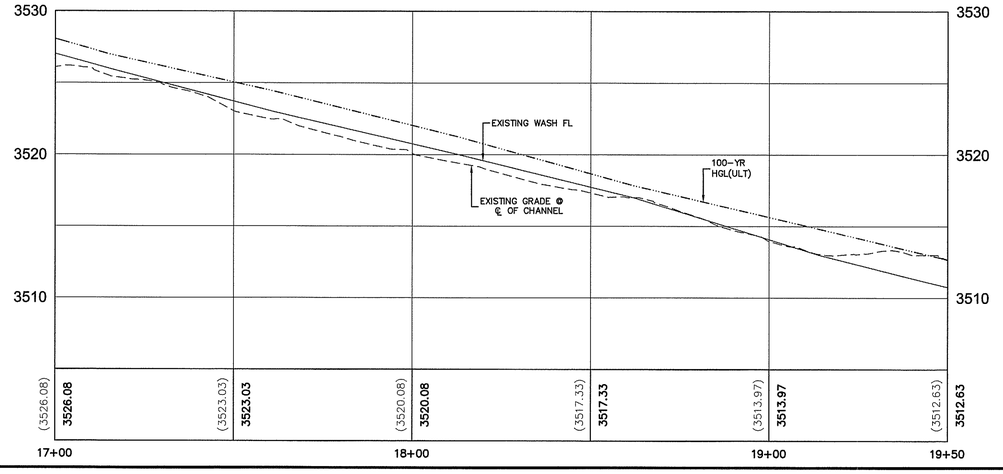
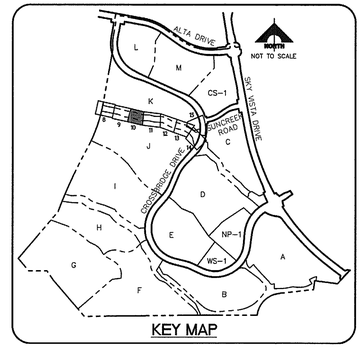
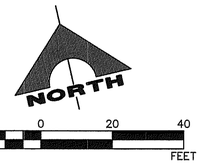
2" CRUSHED ROCK/GRAVEL @ 95%

CONCRETE RAMP
6" THICK CONCRETE RAMP PER DETAIL 3 DRAWING 17





KEY MAP



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BENCHMARK

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CLV #

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F: 702.804.2299
gowenginering.com
F:\Projects\600\62024-226-1\DWG\Production\V24-226-1_GD.dwg
Matthew Burge

PROJECT NO. 62024-226-1
DESIGN: MDB
DRAWN: MDB
CHECK: dJJ
PLOT DATE: 01-25-17
PLOT TIME: 08:41:50

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

ENGINEER - STATE OF NEVADA
JOSHUA J. JOHNSON
No. 15768
CIVIL
DATE: 1/25/17

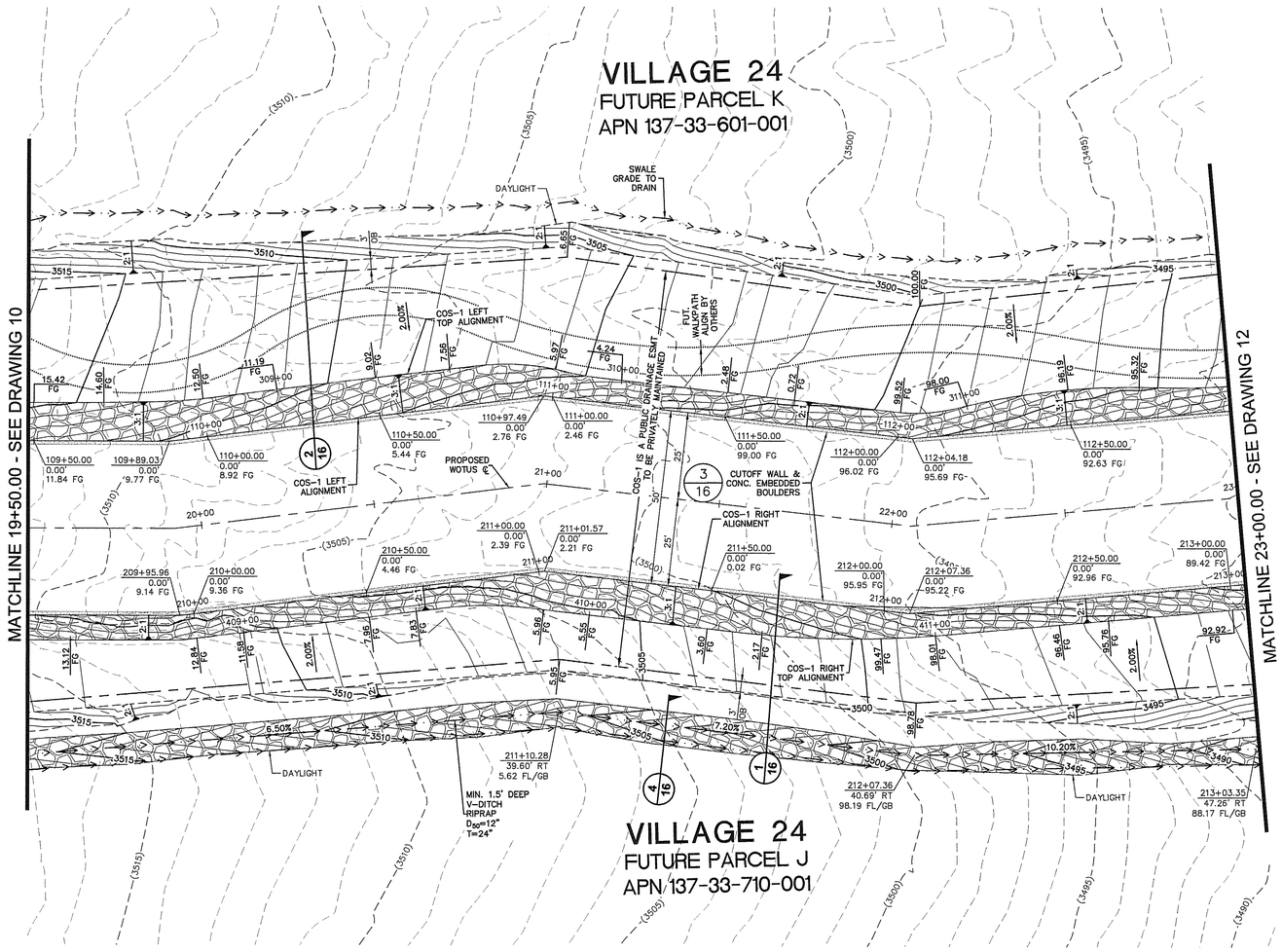
FOR AGENCY REVIEW - NOT FOR CONSTRUCTION

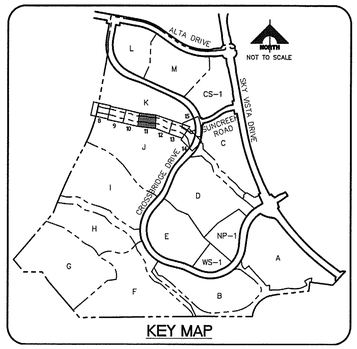
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

GRADING PLAN 3

DRAWING 10
10 OF 17 SHTS





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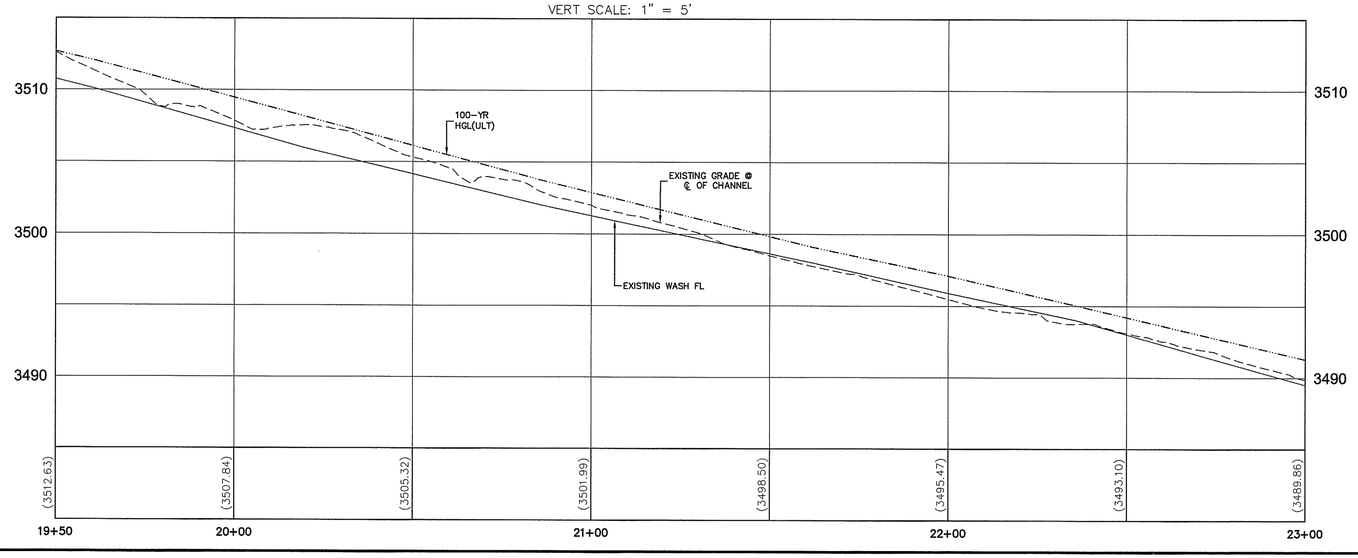

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CLV #

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gcvengineering.com

F:\Projects\600\62024-226-1\DWG\Production\V24-226-1_GD.dwg
Matthew Burge

PROJECT NO. 62024-226-1
DESIGN: MDB
DRAWN: MDB
CHECK: JLJ
PLOT DATE: 01-25-17
PLOT TIME: 03:42:10

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GOV APP

DATE: 1/25/17

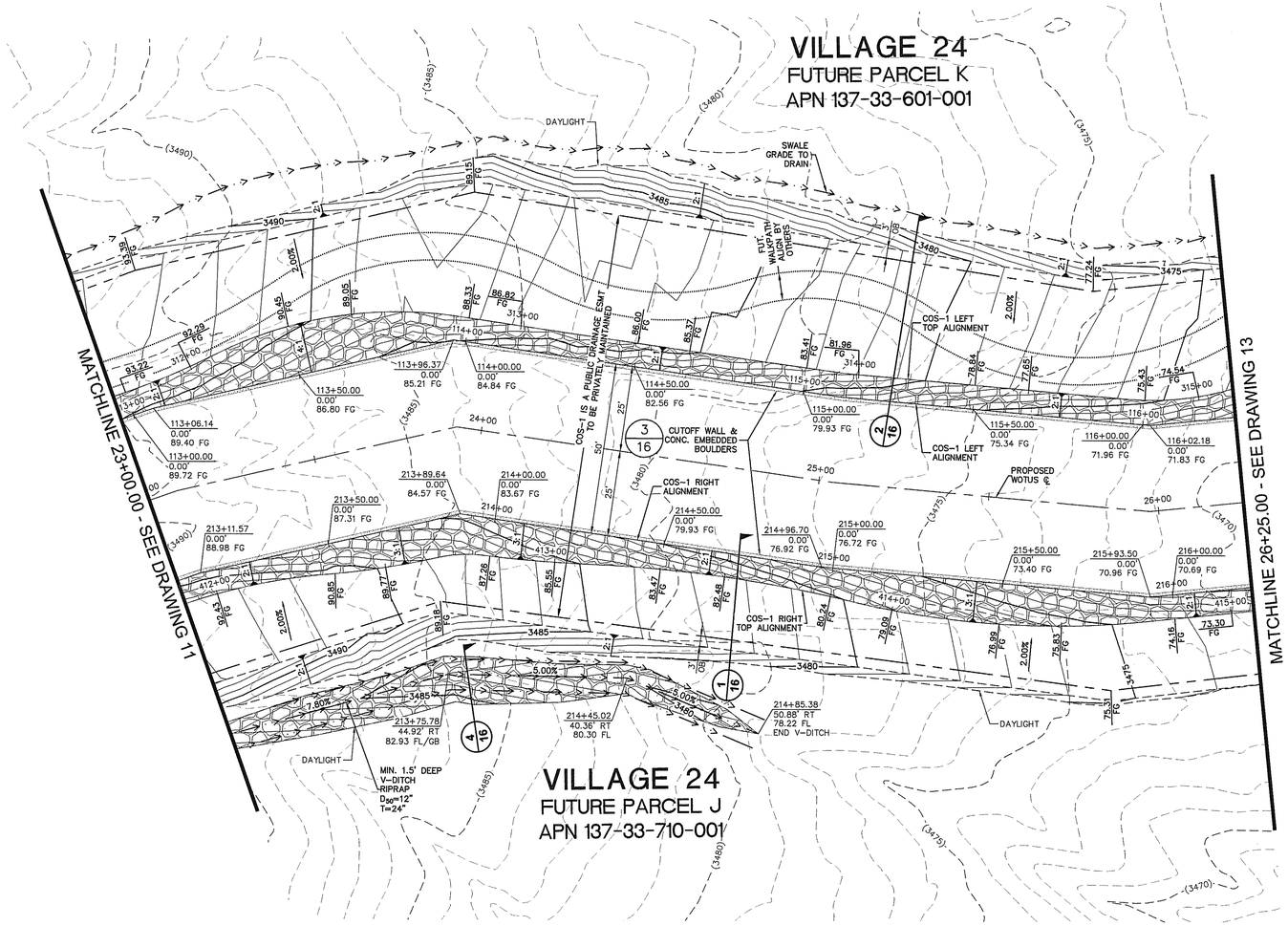
FOR AGENCY REVIEW - NOT FOR CONSTRUCTION

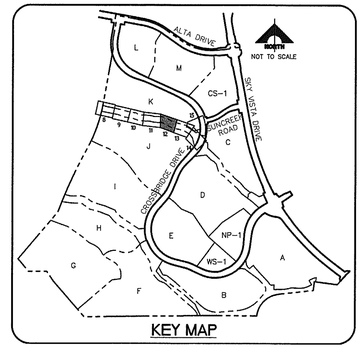
THE HOWARD HUGHES COMPANY, LLC

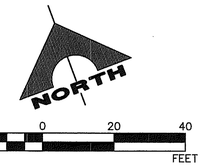
VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

GRADING PLAN 4

DRAWING 11
11 OF 17 SHTS

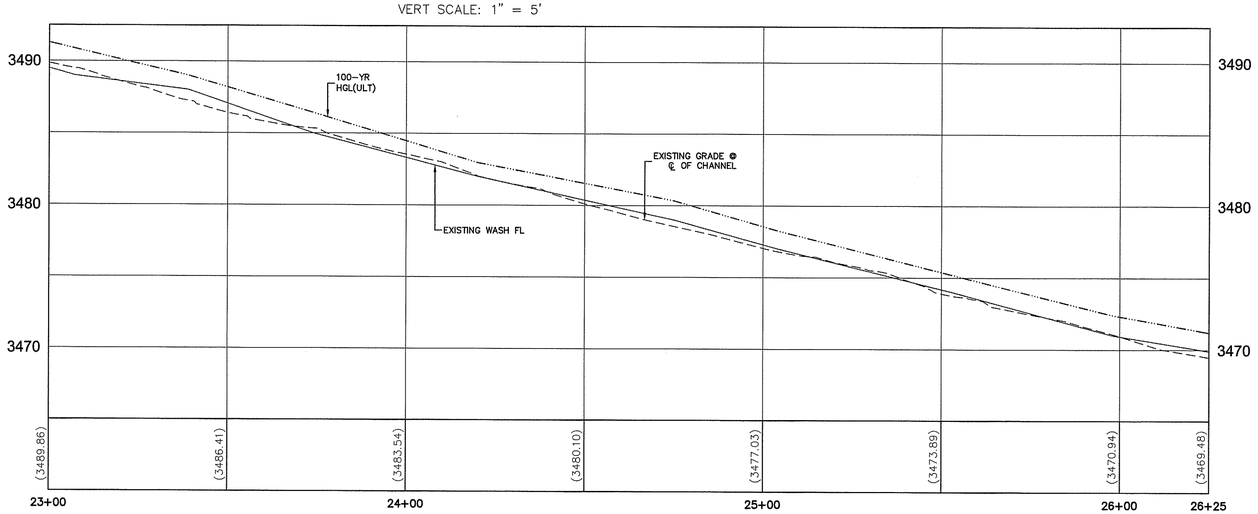






COS-1 (WATERS OF THE US)

HORIZ SCALE: 1" = 20'
VERT SCALE: 1" = 5'



RIPRAP GENERAL NOTE:
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FOR GROUTED RIPRAP LARGE ROCK, SEE ADDITIONAL REQUIREMENTS TO SECTION 610 "SLOPE AND CHANNEL PROTECTION ADDITIONAL NOTES" PER DETAIL 3 SHEET 16.

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BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63 (FEET)	989.574 (METERS)

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CLV #

ENGINEER - STATE OF NEVADA
JOSHUA J. MOSHIER
No. 15788
PROFESSIONAL ENGINEER
DATE: 1/29/17

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

FOR AGENCY REVIEW - NOT FOR CONSTRUCTION

PROJECT NO. 62024-226-1
DESIGN: MDB
DRAWN: MDB
CHECK: JLJ
PLOT DATE: 01-25-17
PLOT TIME: 09:42:29

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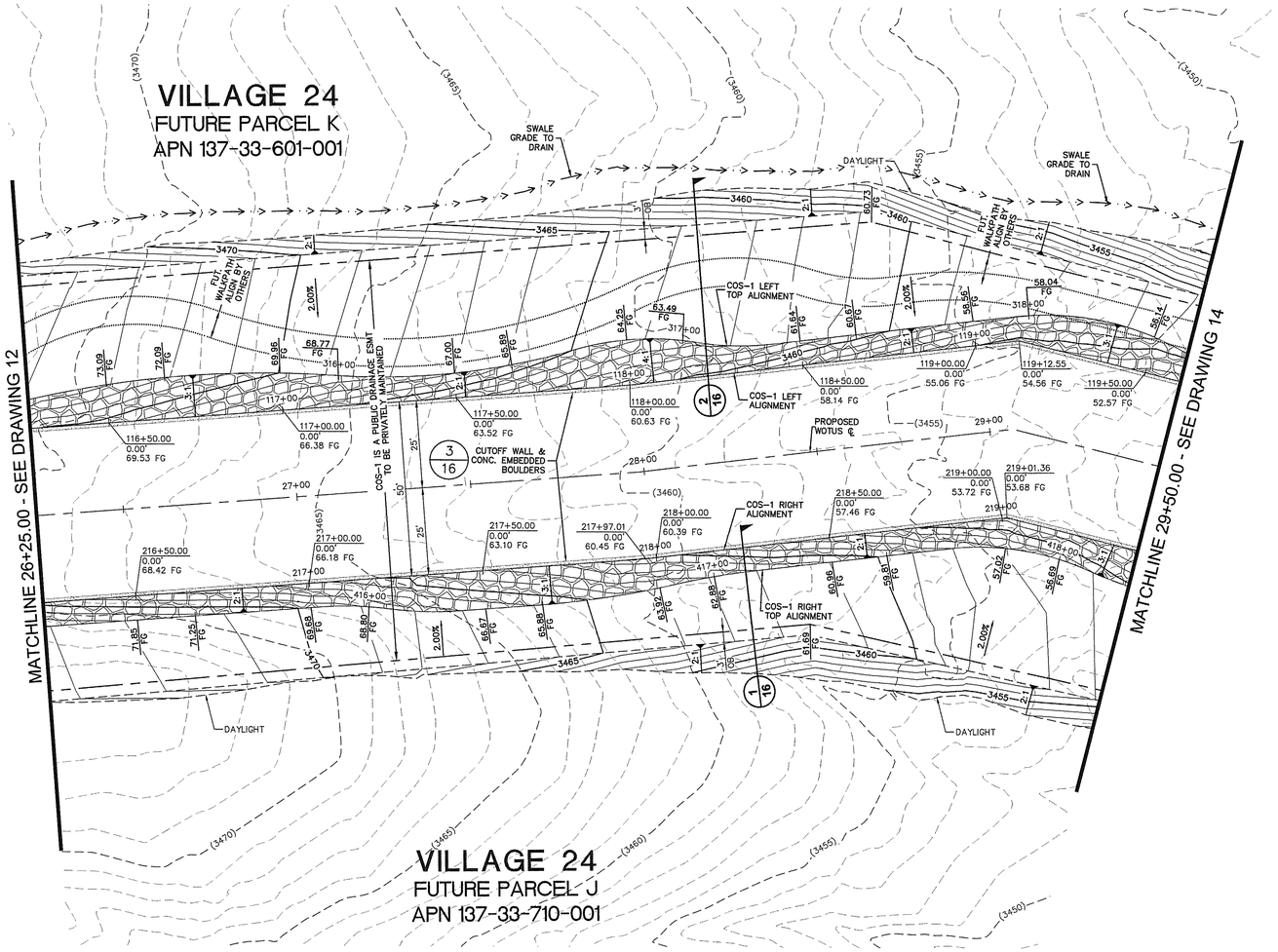
Matthew Burge

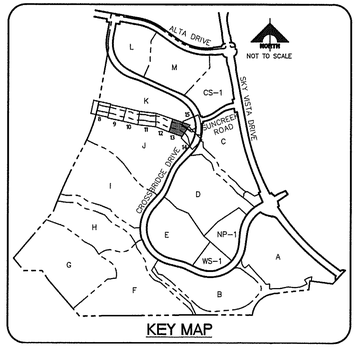
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

GRADING PLAN 5

DRAWING 12
12 OF 17 SHTS





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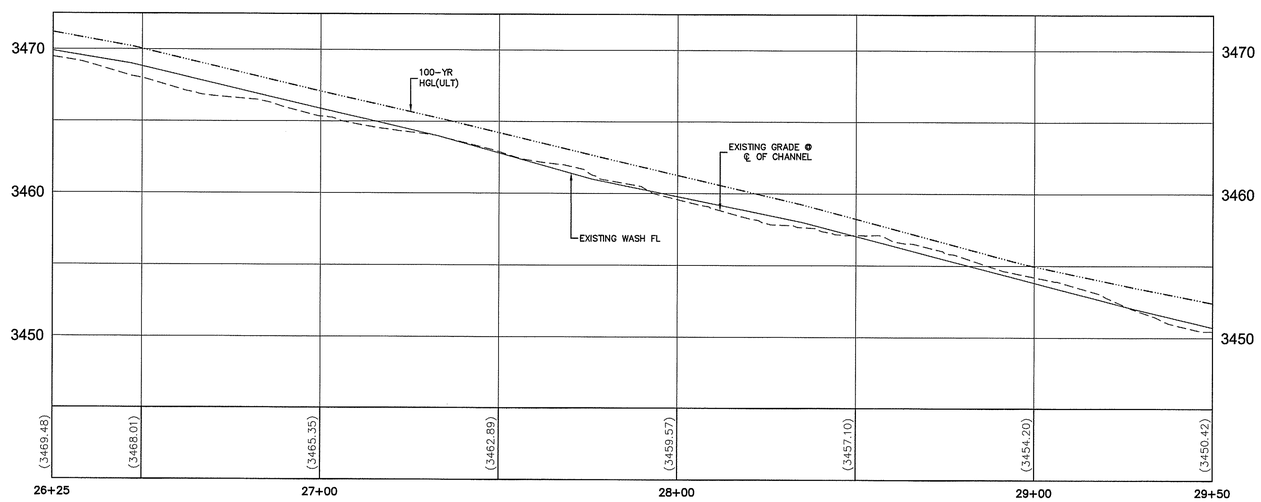

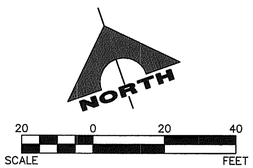

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Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

GRADING PLAN 6

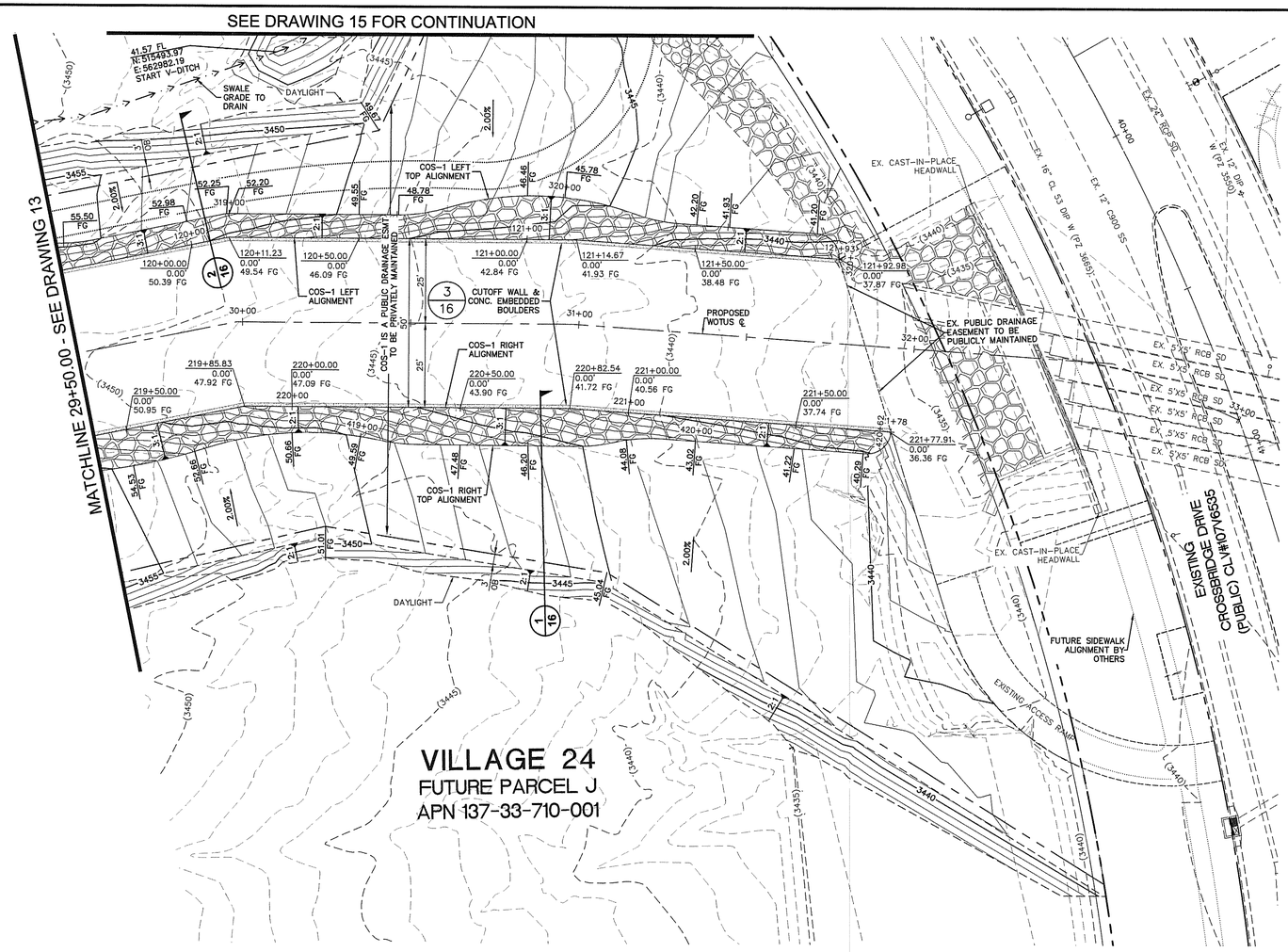
DRAWING
13
13 OF 17 SHTS

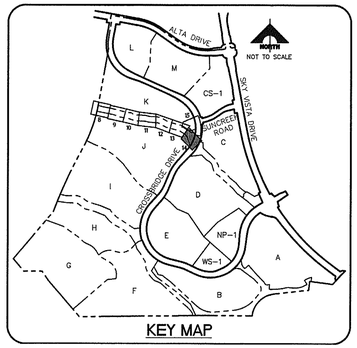
PROJECT NO. 62024-226-1
DESIGN: MDB
DRAWN: MDB
CHECK: JLJ
PLOT DATE: 01-25-17
PLOT TIME: 09:42:49

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP	DATE: 1/25/17

PROFESSIONAL ENGINEER - STATE OF NEVADA
JOSHUA J. LAMSON
No. 15769
DATE OF SIGNATURE 1/25/17

FOR AGENCY REVIEW - NOT FOR CONSTRUCTION





KEY MAP

COS-1 (WATERS OF THE US)

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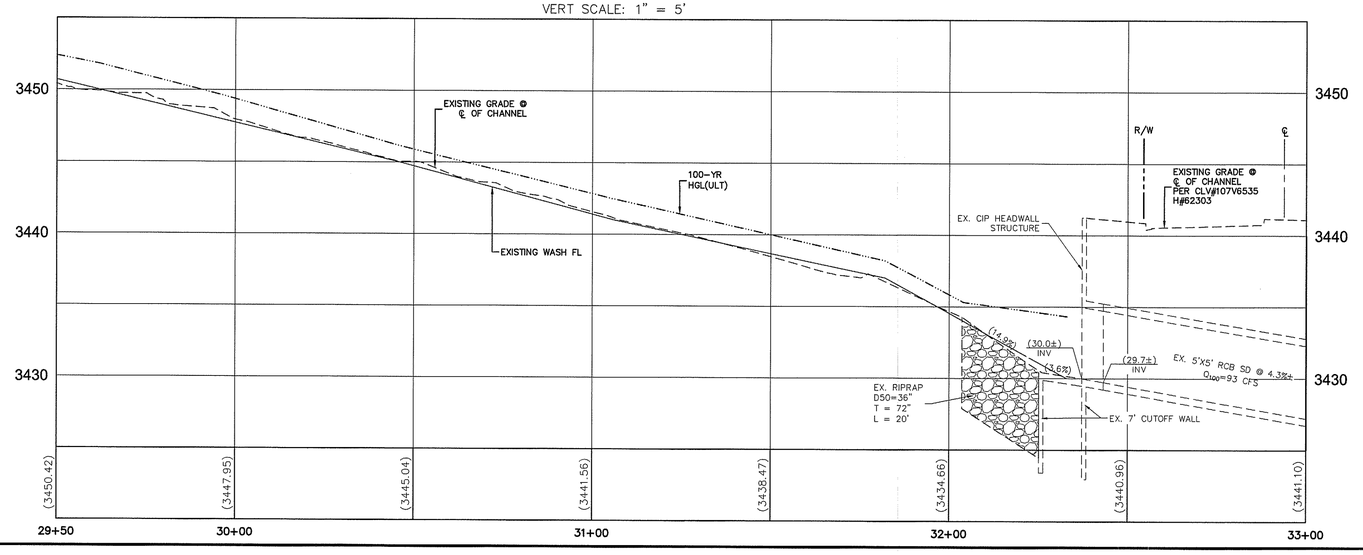

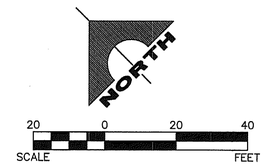

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CLV #

ENGINEER - STATE OF NEVADA — JOSHUA L. MOSBY — No. 15789 — PROFESSIONAL ENGINEER — DATE: 1/25/17

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REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-226-1
DESIGN: MDB
DRAWN: MDB
CHECK: JLJ
PLOT DATE: 01-25-17
PLOT TIME: 08:43:09

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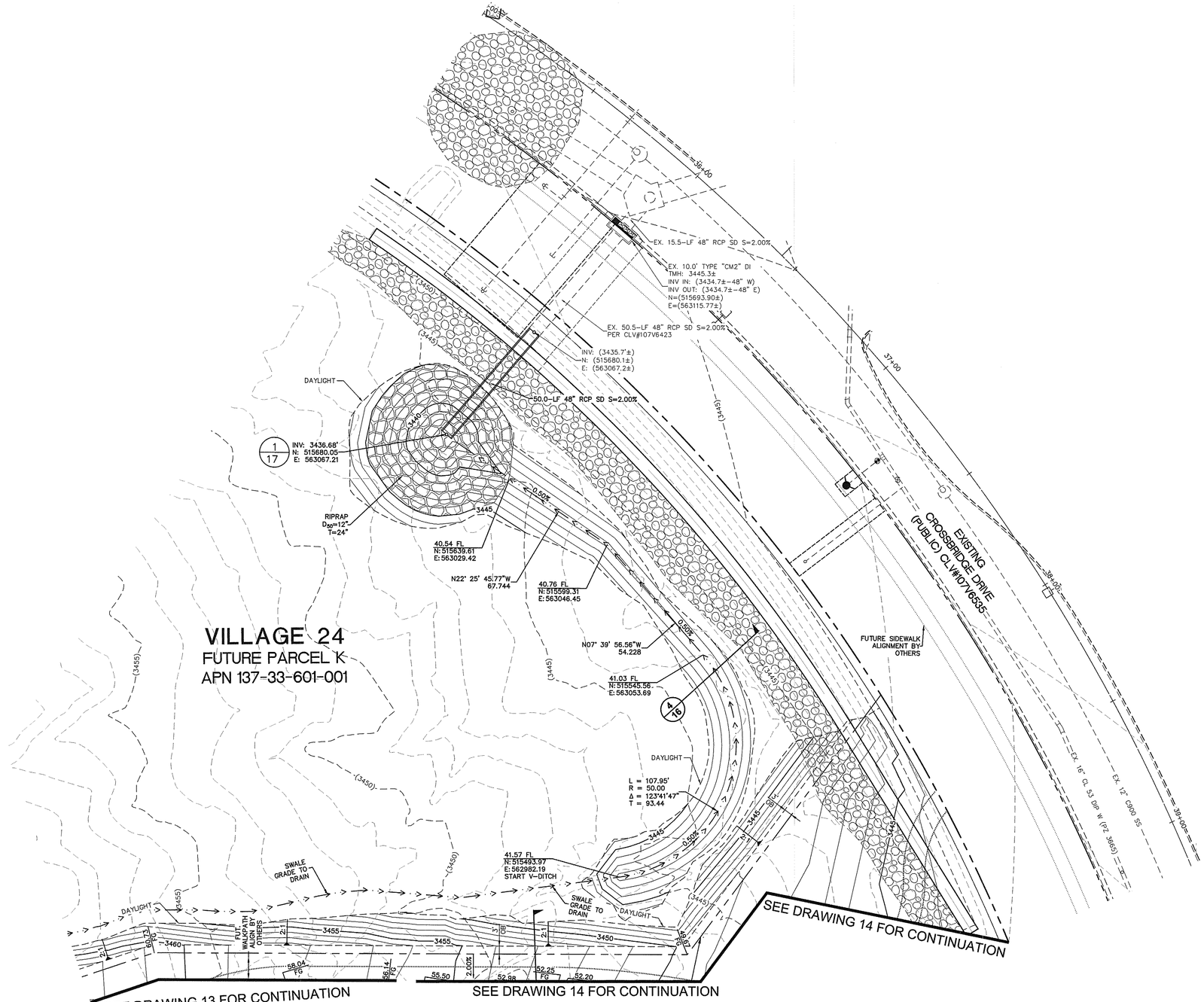
Matthew Burge

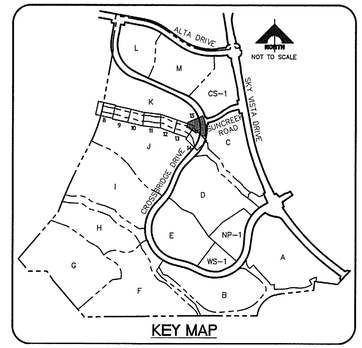
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

GRADING PLAN 7

DRAWING 14
14 OF 17 SHTS





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Matthew Burge

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VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

GRADING PLAN 8

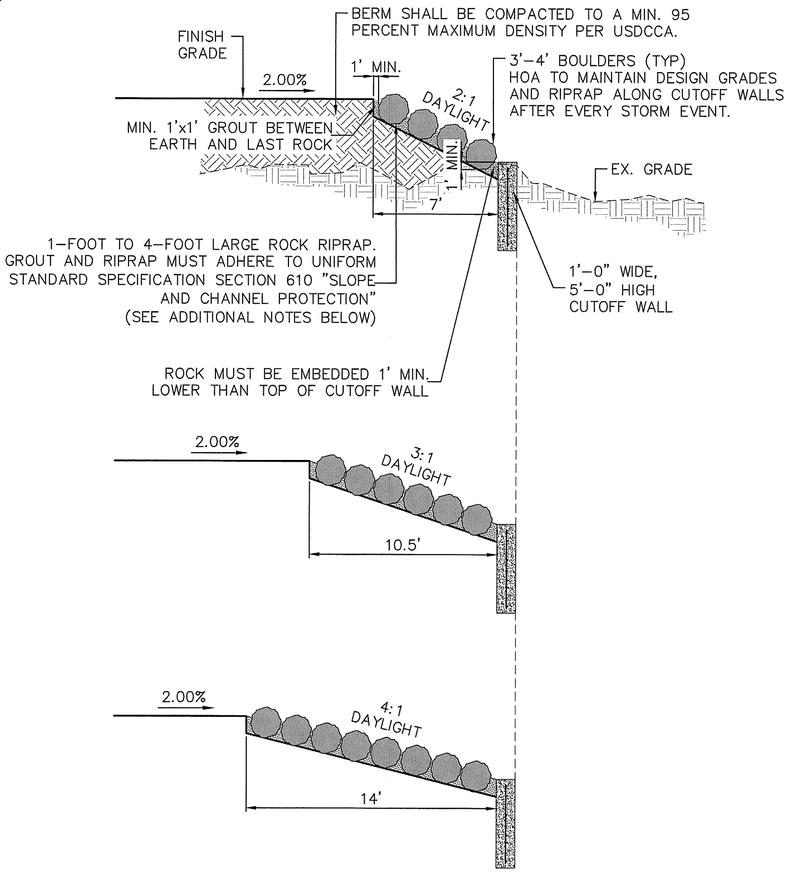
PROJECT NO. 62024-226-1
DESIGN: MDB
DRAWN: MDB
CHECK: JLJ
PLOT DATE: 01-25-17
PLOT TIME: 09:43:22

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

DATE: 1/25/17

FOR AGENCY REVIEW - NOT FOR CONSTRUCTION

DRAWING 15
15 OF 17 SHTS



GROUTED RIPRAP LARGE ROCK — NOT TO SCALE — 3/–

NOTES:

1. WASHES MUST BE INSPECTED AND MAINTAINED AFTER EACH STORM EVENT. IF THE CUT–OFF WALL IS EXPOSED, BACKFILL MUST BE PLACED TO THE TOP OF CUT–OFF WALL, BENCHED 1–FOOT HORIZONTALLY AND GRADED TO A 3:1 SLOPE.
2. CONTRACTOR SHALL USE PRIMARILY 3–FOOT AND 4–FOOT LARGE ROCK (BOULDER) RIPRAP FOR SLOPE PROTECTION, WITH 1–FOOT AND 2–FOOT ROCK USED TO FILL VOIDS BETWEEN THE 3–FOOT AND 4–FOOT BOULDERS.
3. ALL VOIDS SHALL BE FILLED WITH GROUT TO A MINIMUM DEPTH OF HALF THE DEPTH OF THE ROCK/BOULDER.
4. BOTTOM ROW OF ROCK/BOULDER ADJACENT TO THE CUT–OFF WALL MUST BE EMBEDDED 1–FOOT BELOW THE TOP OF THE CUT–OFF WALL.
5. EXCLUDING THE BOTTOM ROW OF ROCK/BOULDER, THE BOTTOM OF ALL 3–FOOT AND 4–FOOT ROCK/BOULDER MUST BE A MINIMUM OF 1–FOOT BELOW THE TOP OF THE LOWER ROCK, AND 1–FOOT AND 2–FOOT ROCK MUST BE A MINIMUM OF 6" BELOW THE TOP OF THE LOWER ROCK.

SECTION 610
SLOPE AND CHANNEL PROTECTION ADDITIONAL NOTES

610.02.04 STONES FOR RIPRAP

A. STONES USED FOR RIPRAP SHALL BE HARD, DURABLE, ANGULAR IN SHAPE, RESISTANT TO WEATHERING AND EROSION, AND FREE FROM SPOILS, CRACKS, AND ORGANIC MATTER.

ADD 4 AND 5 TO THIS SUBSECTION:

4. THE SPECIFIC GRAVITY OF THE CONCRETE EMBEDDED RIPRAP SHALL NOT BE LESS THAN 2.45.
5. THE NOMINAL STONE SIZE FOR THE GROUTED RIPRAP LARGE ROCK SHALL BE 3–FOOT TO 4–FOOT, WITH 1–FOOT TO 2–FOOT FILLER ROCK.

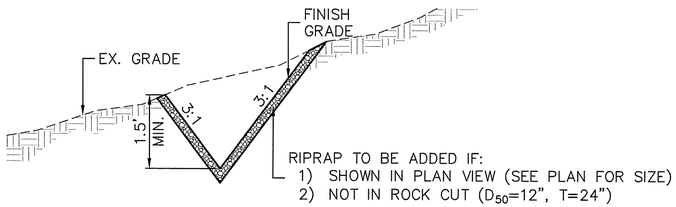
C. CONTROL OF GRADATION WILL BE BY VISUAL INSPECTION.

REVISE SUBSECTION AS FOLLOWS:

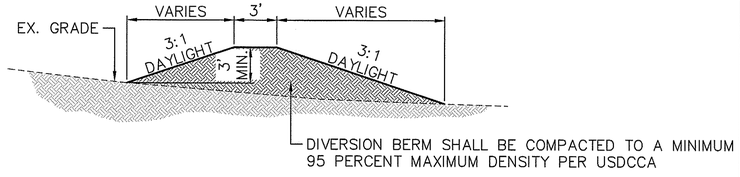
1. THE CONTRACTOR SHALL PROVIDE A SAMPLE OF STONE OF AT LEAST 5 TONS MEETING THE GRADATION FOR GROUTED RIPRAP LARGE ROCK.

REVISE SUBSECTION D. AS FOLLOWS:

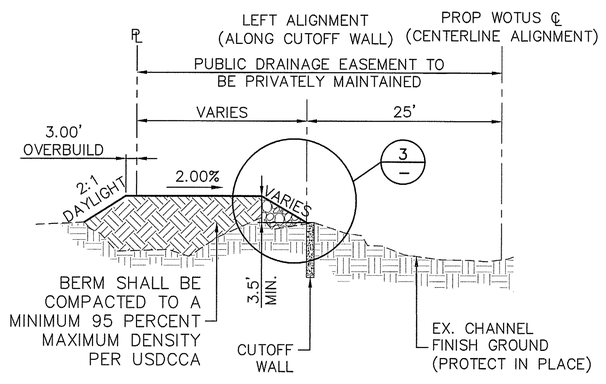
D. CALICHE STONE OR CEMENTITIOUS MATERIALS MEETING THE REQUIREMENTS OF THIS SECTION MAY BE USED AS RIPRAP WITH PRIOR APPROVAL OF THE ENGINEER. CALICHE STONE OR CEMENTITIOUS MATERIAL MAY NOT BE USED FOR GROUTED RIPRAP LARGE ROCK.



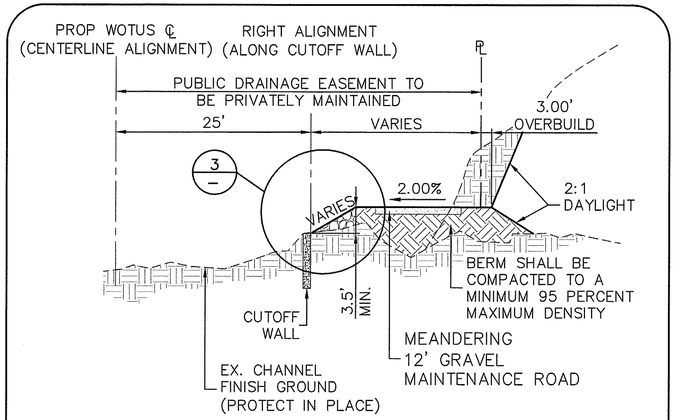
TYPICAL V-DITCH SECTION — NOT TO SCALE — 4/–



TYPICAL UNLINED BERM SECTION — NOT TO SCALE — 5/–



TYPICAL COS-1 LEFT ALIGNMENT BERM
STATION 101+22.72 TO 121+92.98 — NOT TO SCALE — 2/–



TYPICAL COS-1 RIGHT ALIGNMENT BERM
STATION 201+21.40 TO 221+77.91 — NOT TO SCALE — 1/–

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CLV #

JOSHUA J. LAMBERT — STATE OF NEVADA — PROFESSIONAL ENGINEER — No. 15711 — DATE: 1/25/17

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Matthew Burge

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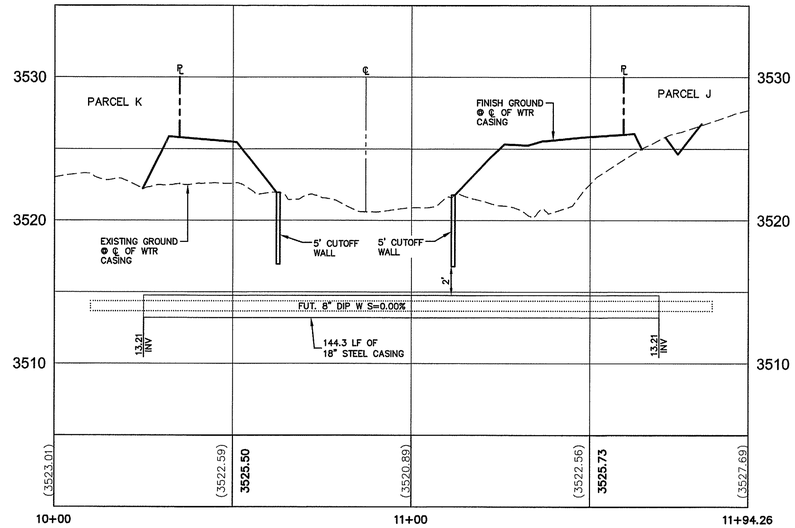
VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

DETAIL SHEET 1

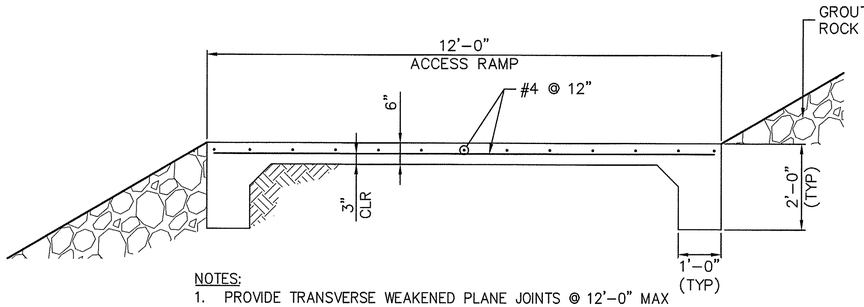
DRAWING 16
16 OF 17 SHTS



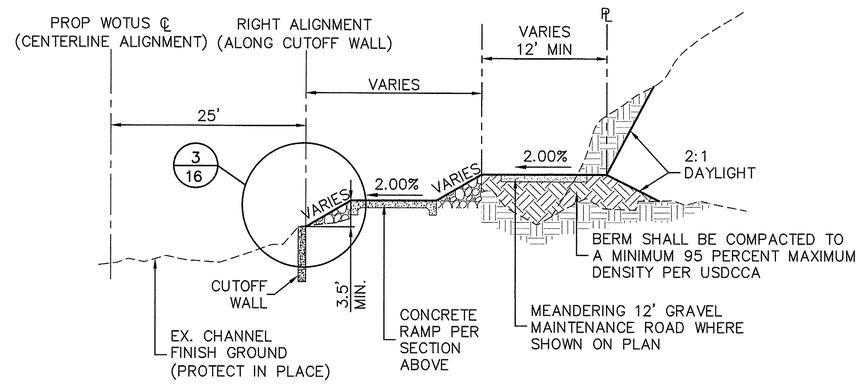
18" STEEL CASING PROFILE

HORIZ. SCALE: 1"= 20' VERT. SCALE: 1"= 5'

2 / –



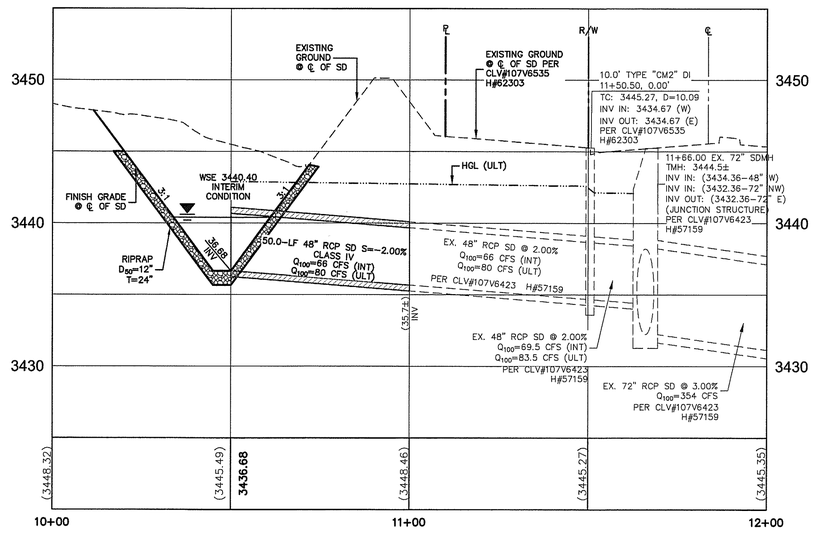
NOTES:
1. PROVIDE TRANSVERSE WEAKENED PLANE JOINTS @ 12'-0" MAX
2. CONCRETE: f'c=4,500 psi @ 28 DAYS
3. REINFORCING STEEL: ASTM A615



TYPICAL 12' CONCRETE RAMP SECTION

NOT TO SCALE

3 / –



48" RCP AND SUMP PROFILE

HORIZ. SCALE: 1"= 20' VERT. SCALE: 1"= 5'

1 / –

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Avoid cutting underground utility lines. It's costly.
Call 811
or 1-800-227-2600
CLARK COUNTY TRAFFIC OPERATIONS 1-702-455-6000

AVOID HITTING OVERHEAD POWER LINES. IT'S COSTLY
CALL BEFORE YOU DO OVERHEAD
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FAST
Call before you UnderGround
1-702-432-5300
FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

CLV

ENGINEER - STATE OF NEVADA
JOSHUA L. JOHNSON
No. 15787
PROFESSIONAL
DATE: 1/25/17

FOR AGENCY REVIEW - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP

PROJECT NO. 62024-226-1
DESIGN: MDB
DRAWN: MDB
CHECK: JLJ
PLOT DATE: 01-25-17
PLOT TIME: 10:21:15

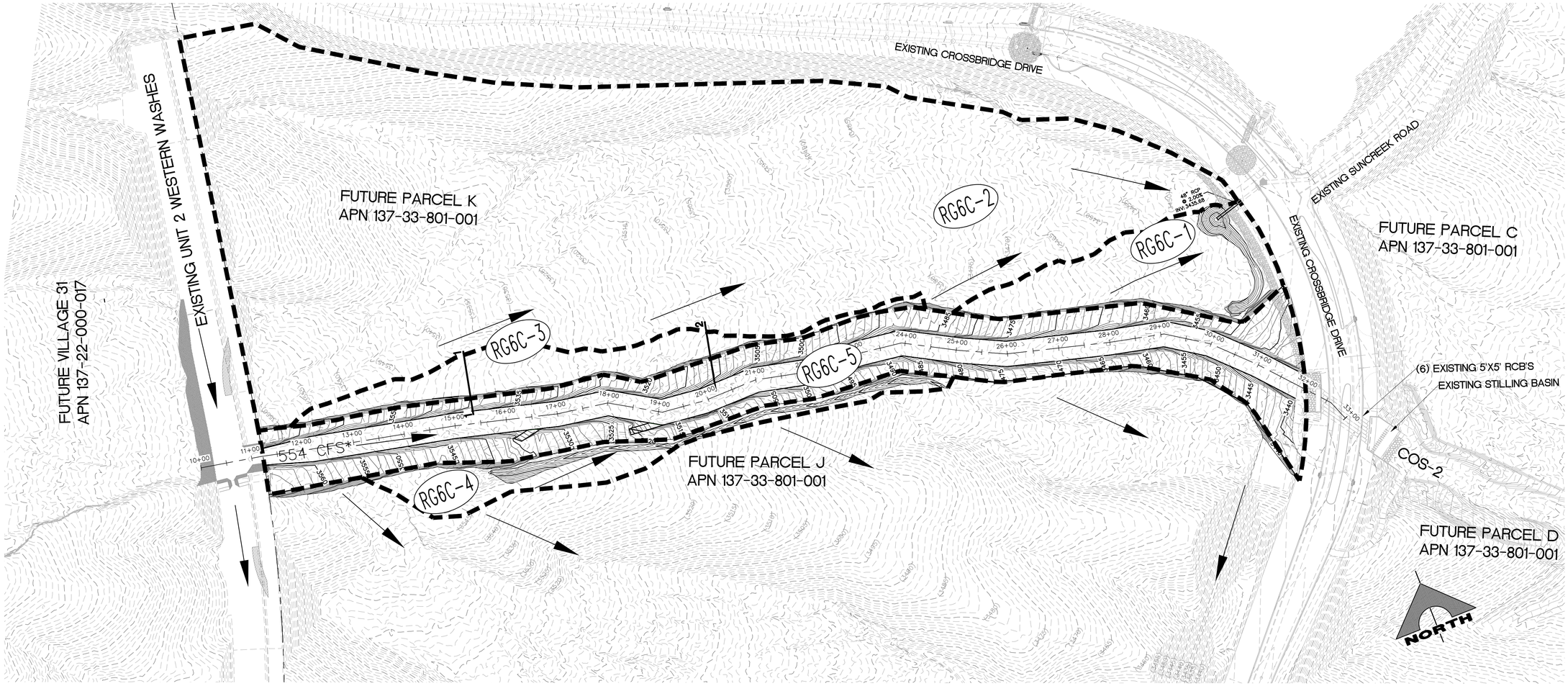
GCW ENGINEERS\SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com
F:\Projects\600\62024-226-1\GCW\Production\V24-226-1_DT.dwg
Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS-1 WASH IMPROVEMENT PLANS

DETAIL SHEET 2

DRAWING 17
17 OF 17 SHTS



100-YEAR DITCH/BERM CHARACTERISTICS									
Ditch	Slope (%)	Q_{100} (cfs)	Depth of flow (ft)	Velocity (ft/s)	Bottom Width (ft)	Type	Side Slopes	Reqd d_{50} (in)	Tributary Subbasin
RG6C-1	0.50	5	0.85	2.3	0	V	3:1 / 3:1	N/A	RG6C-1
RG6C-4 MAX	10.20	4	0.53	4.73	0	V	3:1 / 3:1	12	RG6C-4
RG6C-4 MIN	5.00	4	0.61	3.62	0	V	3:1 / 3:1	12	RG6C-4
1-1	5.80	4	0.25	3.60	0	V	2:1 / NATURAL	N/A	RG6C-3
2-2	5.70	4	0.30	3.97	0	V	2:1 / NATURAL	N/A	RG6C-3

SUMMARY OF PRORATED STORM FLOWS INTERIM CONDITION			
100-Year Runoff			
Parent Basin	Area (ac)	Q_{100} (cfs)	Unit Flow (cfs/ac)
RG6C*	30.7	85	2.77
Prorated Subbasins			
SubBasin	Area (ac)	Unit Flow (cfs/ac)	Q_{100} (cfs)
RG6C-1	1.82	2.77	5
RG6C-2	20.62	2.77	57
RG6C-3	1.37	2.77	4
RG6C-4	1.28	2.77	4
RG6C-5	6.14	2.77	17

*Referenced from the Unit 2 Study

100 0 100 200
SCALE FEET

LEGEND

RG6C-1 PRORATE SUBBASIN

PRORATE SUBBASIN BOUNDARY

1——1 DITCH CROSS SECTION

REV	DATE	DESCRIPTION	DATE	AGEN APP	DATE	GCW APP	DATE:

PROJECT NO. 62024-226-2
DESIGN:
DRAWN:
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PLOT TIME: 13:15:32

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F:\Projects\600\62024-226-2\Division\Fet\Figures\Fig_5USR_INTERIM.dwg
Nelson Boggs

THE HOWARD HUGHES COMPANY, LLC

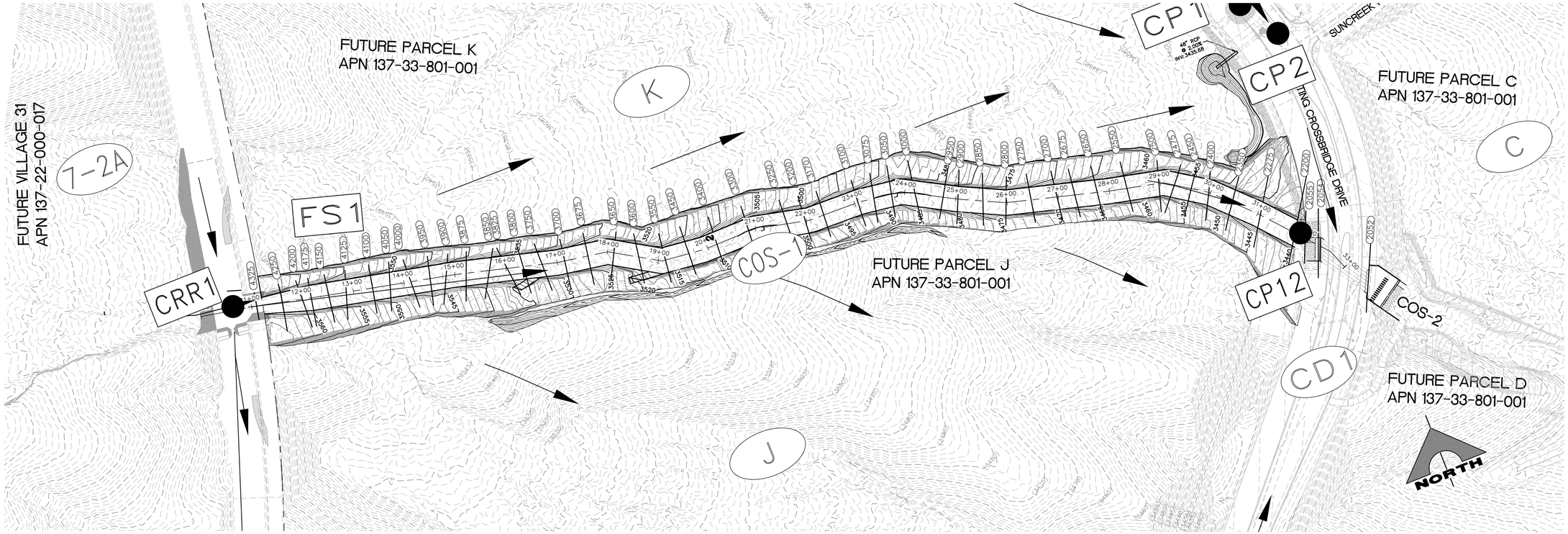
VILLAGE 24 PARCEL COS-1 WASH

INTERIM CONDITIONS DRAINAGE MAP

DRAWING
FIG 5
1 OF 1 SHTS

LDP#

HTE: 00-00000



COS1 - HYDRAULIC MODELS RESULTS SUMMARY AND SUPER-ELEVATION CALCULATIONS (ULTIMATE CONDITIONS)														
Sta	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Freeboard	Superelevation	Total Depth	Berm Height
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)	(ft)
4325	11+10	554	3559.20	3561.44	2.24	8.23	39.42	0.97	0	1.6	0.0	3.8	4.0
4250	11+60	554	3558.00	3560.13	2.13	9.09	45.75	1.33	0	1.3	0.0	3.4	4.0
4200	11+99	554	3557.00	3558.30	1.30	10.17	53.39	1.73	0	1.3	0.0	2.6	3.5
4175	12+17	554	3556.00	3557.26	1.26	10.35	54.56	1.80	0	1.3	0.0	2.5	3.5
4150	12+51	554	3554.00	3555.19	1.19	10.46	55.17	1.84	0	1.3	0.0	2.5	3.5
4125	12+86	554	3552.00	3553.09	1.09	10.40	57.00	1.85	0	1.3	0.0	2.4	3.5
4100	13+38	554	3548.00	3549.97	1.97	10.13	48.44	1.68	0	1.3	0.0	3.3	3.5
4050	13+72	554	3546.00	3547.44	1.44	11.39	51.91	2.02	0	1.3	0.0	2.8	3.5
4000	14+13	554	3544.00	3545.21	1.21	10.67	49.34	1.78	0	1.3	0.0	2.5	3.5
3950	14+51	554	3542.00	3543.02	1.02	10.38	56.71	1.81	0	1.3	0.0	2.3	3.5
3900	14+83	554	3540.00	3541.28	1.28	10.12	51.59	1.69	0	1.3	0.0	2.6	3.5
3875	15+22	554	3537.00	3538.38	1.38	10.81	42.40	1.69	0	1.3	0.0	2.7	3.5
3850	15+67	554	3535.00	3536.22	1.22	10.23	52.80	1.74	0	1.3	0.0	2.5	3.5
3825	16+02	554	3533.00	3534.58	1.58	9.19	76.05	1.61	0	1.3	0.0	2.8	3.5
3800	16+33	554	3531.00	3532.33	1.33	10.15	64.66	1.95	0	1.3	0.0	2.6	3.5
3750	16+71	554	3529.00	3530.11	1.11	10.15	56.77	1.79	0	1.3	0.0	2.4	3.5
3700	17+15	554	3526.00	3527.00	1.00	10.77	54.75	1.90	0	1.3	0.0	2.3	3.5
3675	17+61	554	3523.00	3524.44	1.44	9.83	55.39	1.68	0	1.3	0.0	2.7	3.5
3650	18+13	554	3520.00	3521.23	1.23	10.56	53.77	1.86	160	1.3	0.6	3.1	3.5
3600	18+62	554	3517.00	3517.85	0.85	10.70	70.55	2.08	0	1.3	0.0	2.1	3.5
3550	19+14	554	3513.00	3514.80	1.80	10.15	52.14	1.68	200	1.3	0.4	3.5	3.5
3450	19+62	554	3510.00	3511.98	1.98	10.66	55.80	1.94	0	1.3	0.0	3.3	3.5
3400	20+19	554	3506.00	3508.22	2.22	9.97	52.97	1.69	0	1.3	0.0	3.5	3.5
3300	20+86	554	3502.00	3503.74	1.74	11.47	47.10	1.96	590	1.3	0.2	3.2	3.5
3250	21+62	554	3498.00	3499.10	1.10	10.46	54.89	1.85	0	1.3	0.0	2.4	3.5
3200	21+98	554	3496.00	3497.20	1.20	9.95	55.24	1.71	565	1.3	0.2	2.6	3.5
3170	22+36	554	3494.00	3495.03	1.03	10.18	56.11	1.77	0	1.3	0.0	2.3	3.5
3100	23+07	554	3489.00	3490.88	1.88	10.30	56.68	1.82	0	1.3	0.0	3.2	3.5
3075	23+39	554	3488.00	3488.99	0.99	10.22	59.08	1.81	0	1.3	0.0	2.2	3.5
3050	23+74	554	3485.00	3486.43	1.43	10.97	57.90	2.01	165	1.3	0.7	3.4	3.5
3000	24+20	554	3482.00	3482.96	0.96	11.04	56.57	2.03	165	1.3	0.6	2.9	3.5
2950	24+75	554	3479.00	3480.34	1.34	9.38	48.76	1.49	0	1.3	0.0	2.6	3.5
2900	25+04	554	3477.00	3478.26	1.26	10.39	51.33	1.79	0	1.3	0.0	2.5	3.5
2850	25+53	554	3474.00	3475.19	1.19	10.64	57.14	1.91	0	1.3	0.0	2.5	3.5
2800	25+98	554	3471.00	3472.41	1.41	10.19	54.67	1.76	850	1.3	0.1	2.8	3.5
2750	26+47	554	3469.00	3470.21	1.21	9.52	55.12	1.60	0	1.3	0.0	2.5	3.5
2700	26+98	554	3466.00	3467.21	1.21	10.28	54.13	1.80	0	1.3	0.0	2.5	3.5
2675	27+33	554	3464.00	3465.23	1.23	10.22	56.16	1.79	0	1.3	0.0	2.5	3.5
2650	27+76	554	3461.00	3462.67	1.67	10.35	55.97	1.81	0	1.3	0.0	3.0	3.5
2550	28+35	554	3458.00	3459.24	1.24	10.50	51.89	1.80	0	1.3	0.0	2.5	3.5
2500	28+97	554	3454.00	3455.15	1.15	10.95	52.07	1.92	440	1.3	0.2	2.7	3.5
2475	29+28	554	3452.00	3453.50	1.50	10.11	49.71	1.68	440	1.3	0.2	3.0	3.5
2450	29+62	554	3450.00	3451.80	1.80	10.25	49.00	1.68	440	1.3	0.2	3.3	3.5
2400	29+97	554	3448.00	3449.61	1.61	11.71	35.58	1.71	440	1.3	0.2	3.1	3.5
2350	30+46	554	3445.00	3446.14	1.14	12.17	54.85	2.34	440	1.3	0.3	2.7	3.5
2275	31+06	554	3441.00	3442.47	1.47	9.91	58.44	1.73	440	1.3	0.2	3.0	3.5
2200	31+82	554	3437.00	3438.21	1.21	10.08	56.94	1.78	0	1.3	0.0	2.5	3.5
2055	32+04	554	3434.00	3435.22	1.22	12.20	64.55	2.56	0	1.3	0.0	2.5	5.0
2054	32+33	554	3430.00	3434.34	4.34	1.89	69.54	0.16	0	1.0	0.0	5.3	12.0
2053	-	Culvert			-				-	-	-	-	-
2052	-	554	3425.00	3426.14	1.14	11.09	79.15	1.83	0	1.3	0.0	2.4	-

100 0 100 200
SCALE FEET

LEGEND

- COS-1 — DRAINAGE SUBBASIN
- CP1 — CONCENTRATION POINT
- SUBBASIN BOUNDARY
- 2052 — HEC-RAS CROSS SECTION

DATE:
GCW APP
DATE
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DATE
DESCRIPTION
REV DATE

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Nelson Boggs

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 PARCEL COS-1 WASH

HEC-RAS CROSS SECTION EXHIBIT (PARCEL COS-1)

DRAWING
FIG 6
1 OF 1 SHTS

LD#:

HTE: 00-00000