# TECHNICAL DRAINAGE STUDY
# For
# SUMMERLIN VILLAGE 24 PARCEL FGH
# REDROCK WASH IMPROVMENTS AND MASS GRADING

**Prepared for:**

**Lennar Communities Nevada LLC**
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**August 1, 2019**

PROJECT 3040.0057

**RCI Engineering**
**500 South Rancho Drive, Suite 17 * Las Vegas, NV 89106**
**Tel: 702.453.0800 * Fax: 702.453.0801**
**www.rcinevada.com**

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

# DRAINAGE STUDY INFORMATION FORM

Name of Development: Summerlin Village 24 Parcels FGH Mass Grading and Redrock Wash Imp. Date: August 2019

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

East/West: Crossbridge Drive

b) Section: 33 Township: 20 South Range: 59 East

c) APN : 164-04-511-001

Name of Owner: Lennar Communities Nevada, LLC

Telephone No.: 702-739-9100 Fax No.: 702-739-9200 E-Mail Address:

Address: 2490 Paseo Verde Pkwy, Suite 120, Henderson, NV 89074

**Contact Person-Name:** Rick J Read, P.E. **Telephone No.:** 702-453-0800

*** E-Mail Address:** rread@rcinevada.com **Fax No.:** 702-453-0801

**Firm:** RCI Engineering

**Address:** 500 South Rancho Drive, Suite 17, Las Vegas, Nevada 89106

Type of Land Development/Land Disturbance Process:

| | | | | | |
|---|---|---|---|---|---|
| ☐ | Rezoning | ☐ | Subdivision Map | ☐ | Clearing and Grading Only |
| ☐ | Parcel Map | ☐ | Planned Unit Development | ☒ | Other (Please specify below) |
| ☐ | Large Parcel Map | ☐ | Building Permit | | Rough Grading and Wash Improvements |

1. Total Owned Land Area: At Site: 103.8 acres +/- Being Developed/Disturbed: 103.8 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.): Residential
5. Approximate upstream land area which drains to the subject site: 3,300 acres+/-
6. Has the site drainage been evaluated in the past? ☒ **YES** ☐ **NO** If yes, please identify documentation: Conceptual Study For Summerlin Village 24 (ds3505)
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: east and west into the COS-3 Wash, the COS-4 Wash and the Redrock Conservation Area
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.**

| Revision | Date |
|---|---|
| | |
| | |
| | |

Local Entity File No.

REFERENCE:

STANDARD FORM 1

Updated 05/01/2008

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

# DRAINAGE SUBMITTAL CHECKLIST

| | | | | |
|---|---|---|---|---|
| Project Name: Summerlin V 24 Parcels FGH Mass Grade and Redrock Wash Improvements | | | Map ID: | |
| Firm Name: | RCI Engineering | | Engineer: Rick Read, P.E. | |
| Address: | 500 South Rancho Drive, Suite 17 | | | |
| City: | Las Vegas | State: Nevada | | Zip: 89106 |
| Phone Number: | 453-0800 | Fax Number: 453-0801 | | |
| Property Owner: Lennar Homes | | | | |
| Address: 2490 Paseo Verde Pkwy, Suite 120 | | | | |
| City: Henderson | | State: Nevada | | Zip: 89074 |
| 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. |
| | N/A | A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge. |

| | |
|---|---|
| **Reference:** | **STANDARD FORM 2** |

# DRAINAGE SUBMITTAL CHECKLIST

## 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. |
| 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. |
| X | | Off-site drainage basin maps for existing, interim and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs. |

## 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. |

| REFERENCE: | STANDARD FORM 2 |
|---|---|

# DRAINAGE SUBMITTAL CHECKLIST

## III. DRAINAGE PLAN (Continued)

| Yes | No | |
|---|---|---|
| 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. |
| | 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. |
| | n/a | Concentration points and drainage flow direction with $Q_{100}$ and $V_{100}$ and $D_{100}$ 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. |
| X | | 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 is16"x48". Wrought iron gate is required for flows > 10 cfs. |
| X | | Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc. |

| REFERENCE: | STANDARD FORM 2 |
|---|---|

# DRAINAGE SUBMITTAL CHECKLIST

## III. DRAINAGE PLAN (Continued)

| Yes | No | |
|---|---|---|
| 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. |
| X | | Building and/or lot numbers. |
| | n/a | 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. |
| | n/a | 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. |
| | n/a | 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 $Q_{100}$ flows. |
| | n/a | Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent. |

## IV. HYDROLOGIC ANALYSIS

| Yes | No | |
|---|---|---|
| X | | Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated. |
| | n/a | 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 storm water flows showing basin area, $Q_{10}$ and $Q_{100}$ for both individual basins and combined basin flows, where acceptable. |
| 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. |

| REFERENCE: | STANDARD FORM 2 |
|---|---|

# DRAINAGE SUBMITTAL CHECKLIST

## V. HYDRAULIC ANALYSIS

| Yes | No | |
|---|---|---|
| | **n/a** | Flow split calculations and supporting documentation or reference for the method of flow split calculations used. |
| | n/a | Normal depth street flow calculations and cross section diagrams for all interior and perimeter streets. Provide "d x v" products for the $Q_{100}$ and $Q_{10}$ flows representing the worst case for interior and all perimeter streets. $Q_{100}$ d x v ≤ 8. $Q_{10}$ 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. |
| | n/a | A summary table of interior and exterior street capacity calculations showing the street name, $Q_{100}$ flow, slope, depth of flow, velocity and depth times velocity product and streets needing to meet 12 foot dry lane criteria. |
| | **n/a** | Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.) |
| | n/a | 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. |
| | n/a | 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 $Q_{100}$ weir height or flow depth, which ever is greater. |
| X | | A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones.<br>• Field survey data.<br>• Input and output information.<br>• Plotted cross-sections based on survey with proper encroachments.<br>• A map showing the location of the cross-sections.<br>• Analysis of both sub- and super-critical flow segments.<br>• A summary table and a discussion of the results in the text of the report. |
| X | | |
| | **n/a** | 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. |

| REFERENCE: | STANDARD FORM 2 |
|---|---|

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## I. INTRODUCTION

Lennar Communities is proposing to develop a 103.8 acre site as a single family residential project located on the west side of Crossbridge Drive. The site is bordered on the west by the Red Rock Conservation Area and on the north by existing improvements for the Summerlin West Village 24 Western Boundary Grading and Drainage Project. The COS-3 and COS-4 wash borders the project on the east. The USA Bureau of Land Management borders the Project on the south. The Project will be built in 4 phases. Phase 1 of the project will include rough grading the entire site and construction of improvements along the Red Rock Conservation Area. The Summerlin Village 24 Parcels FGH ultimate build out of the site will be constructed as 3 separate Units. The overall Project will consist of 421 single family residences a recreation area/clubhouse and open areas. The main entrance to the site will be from Crossbridge Drive with a secondary access from an unnamed street on the north.

This report will address the rough graded improvements and improvements along the west property line to protect the site from offsite storm flows in the natural wash on the west. Those improvements will include erosion protection, and a maintenance access road. This study will also include a hydrologic analysis for the ultimate build out of the Village 24 Parcels FGH site to be used at a later date for the Units 1 through 3 Residential and Recreation Center Projects. The purpose of this report is to accompany the civil improvement plans, to provide detailed hydrological 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.
- Identify the FEMA floodplain designation for the project site.
- Identify existing and proposed regional drainage facilities adjacent to the site.
- Estimate runoff generated for the peak onsite 10-year and 100-year return period storms for existing, proposed, and ultimate conditions (offsite flows are referenced).
- Provide a HecRas hydraulic analysis for existing and developed conditions for the Red Rock Conservation area natural wash.
- Recommend drainage facilities to protect the project from storm runoff in the Red Rock Conservation area.

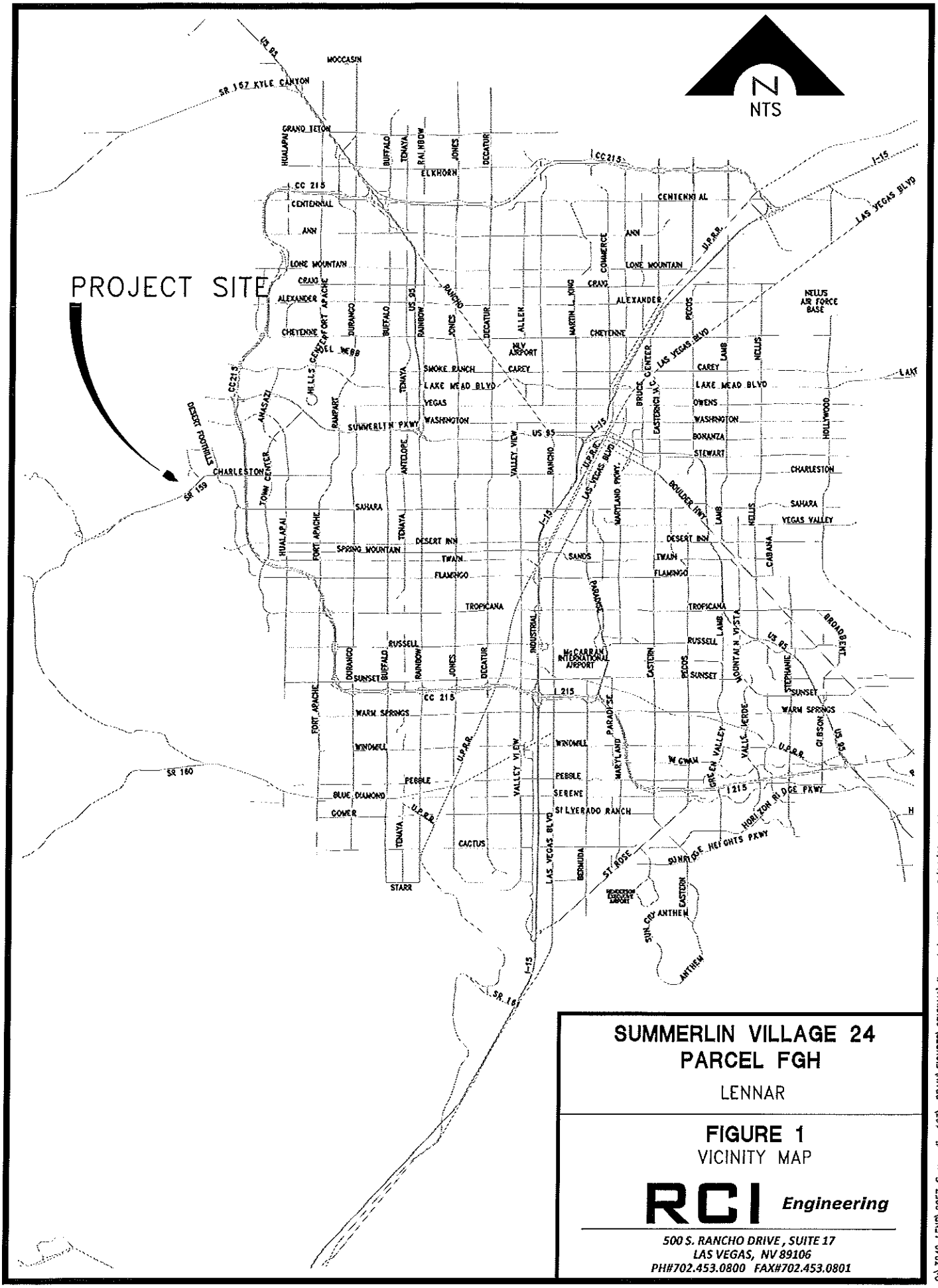
## II. LOCATION AND DESCRIPTION

The Project is located in Section 4 in Township 21 South, Range 59 East, M.D.M., and Section 33 in Township 20 South, Range 59 East, in Las Vegas, Nevada. The site is located on the west side of Crossbridge Drive and on the east and north side of the Red Rock Conservation Area. The Summerlin Village 24 COS-3 and COS-4 border the Project on the east.

Summerlin West Village 24 Western Boundary Grading on the north is currently under construction and will be completed prior to the start of construction for this project. Crossbridge Drive to the east is existing. The Village 24 COS-3 and COS-4 drainage wash on the east are completed. No improvements are planned on the south because that is the Red Rock Conservation Area. Please refer to Figures 1 and 2 for the vicinity and location maps.

The site is presently undeveloped with sparse vegetation. The proposed development will consist of residential housing with Type A drainage. The ultimate design of the project will include lots with 3 different lots sizes ranging from an average lot size of less than 6,000 square feet up to an average lot size of 9,000 square feet. The Project will have a gated entrance from Crossbridge Drive and a secondary gated entrance from an unnamed street on the north. Interior streets will be private with private surface maintenance. The entrance road (Waverly Bridge Drive) will be an 86-foot private roadway with a normal crown section, median island, a 4-foot detached sidewalk and landscaping on both sides. The interior residential streets will consist of a 42-foot wide private roadway with a normal crown section, "R" type curb and gutter, and a 4-foot wide sidewalk on one side.

The improvement plans for the first phase of the Summerlin Village 24 Parcels FGH Project include mass grading the overall site, onsite improvements along the natural wash that is in the Red Rock Conservation Area to protect the site from offsite flows, and two storm drain lines that will convey ultimate condition storm flows to the Red Rock Wash.




# SUMMERLIN VILLAGE 24
# PARCEL FGH

LENNAR

## FIGURE 1
VICINITY MAP

RCI Engineering

500 S. RANCHO DRIVE, SUITE 17
LAS VEGAS, NV 89106
PH#702.453.0800 FAX#702.453.0801

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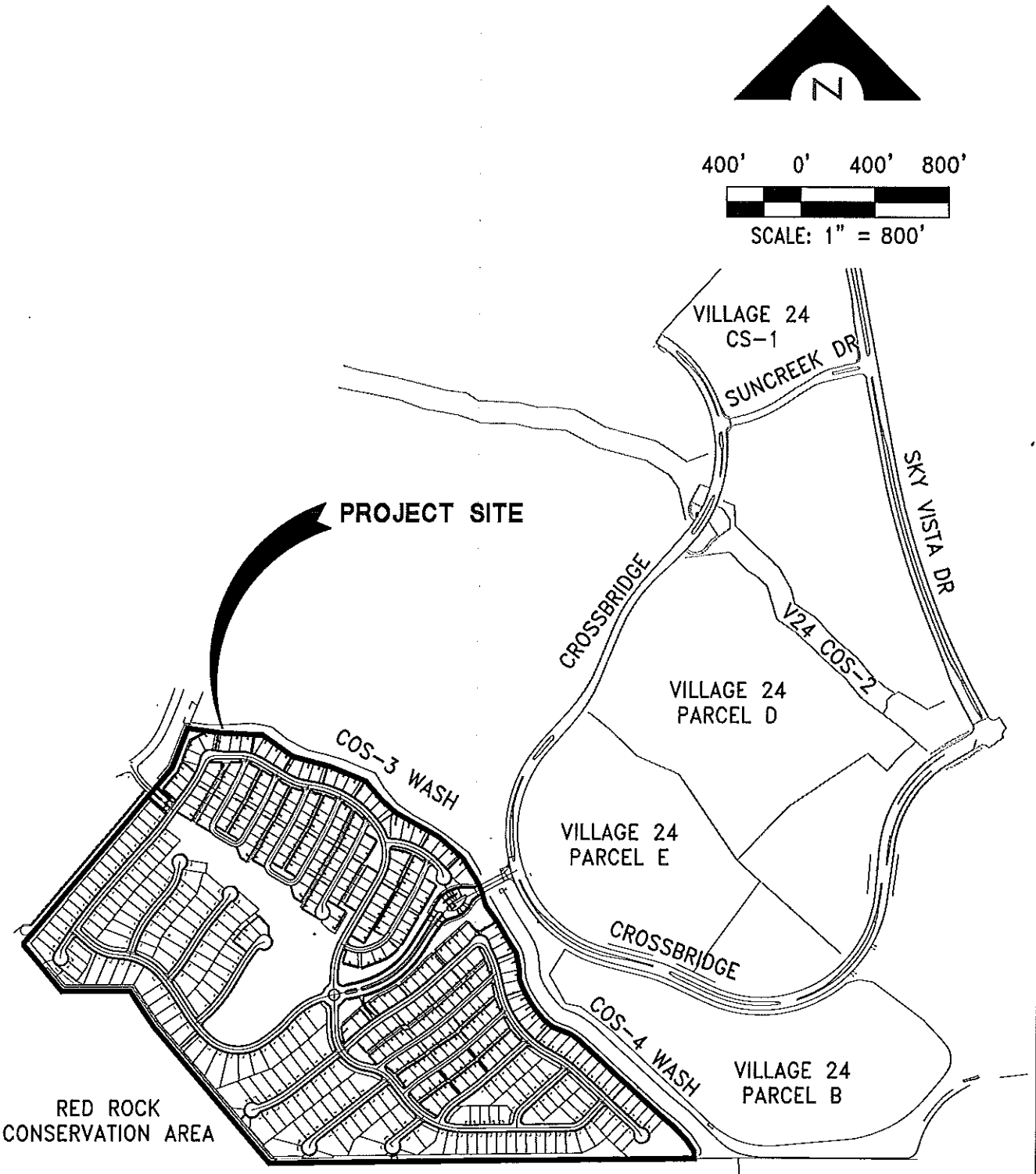



**SUMMERLIN VILLAGE 24**
**PARCEL FGH**
LENNAR

**FIGURE 2**
VICINITY MAP

RCI Engineering
500 S. RANCHO DRIVE, SUITE 17
LAS VEGAS, NV 89106
PH#702.453.0800 FAX#702.453.0801

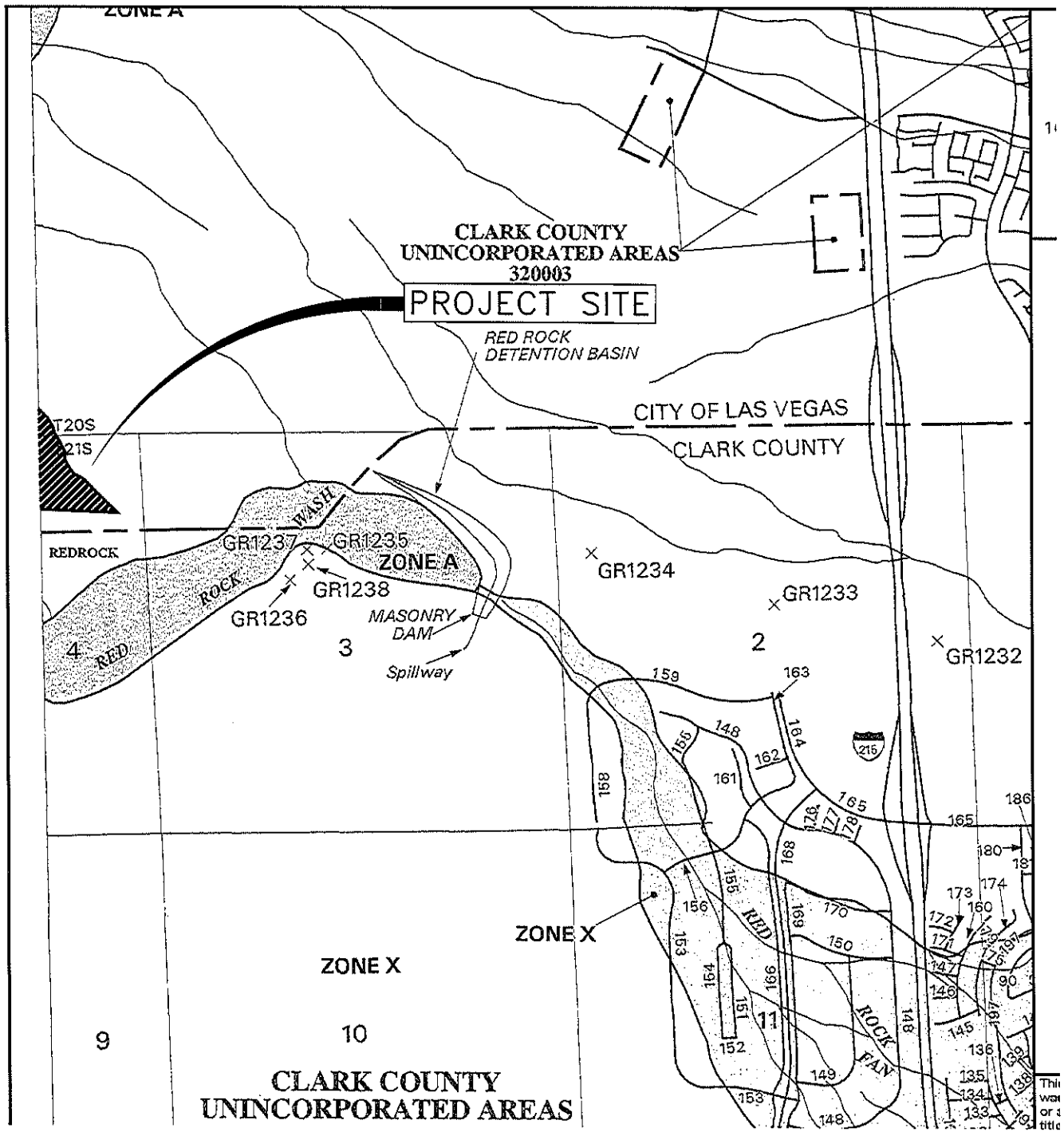
O:\3040_LENR\0057_Summerlin_103_DRAIN\FIGURES\ORIGINAL\figure2 (2).dwg resplin 6/07/19 8:12am

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

Figure 3A and Figure 3B were reproduced from the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) containing Community Panel Numbers 32003C2125E and 32003C2150E, dated September 27, 2002. Review of the FIRM shows that the Project is currently located within a Zone X. Zone X areas are determined to be outside of the 0.2% annual chance floodplain. Therefore, the project is not located within a FEMA-designated Special Flood Hazard Area (SFHA).

## IV. CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT FACILITIES

Figure 4 is reproduced from Figure F-27 of the 2018 *Clark County Regional Flood Control District (CCRFCD) Master Plan Update* (Reference 1, hereinafter referred to as the 2018 MPU). This figure depicts the project site in relation to existing and proposed CCRFCD facilities. As shown on the figure, the site is not adjacent to any CCRFCD Facilities. The nearest facility is RRWA 0716 which is approximately 3000 feet east of the project. Therefore, CCRFCD concurrence will not be required for this drainage study.




N

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 | 320276 | 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

**MAP SCALE 1" = 2000'**

1000 0 2000 4000 FEET

**SUMMERLIN VILLAGE 24 PARCEL FGH**
LENNAR

**FIGURE 3.A**
F.I.R.M. MAP

RCI Engineering
500 S. RANCHO DRIVE, SUITE 17 LAS VEGAS, NV 89106
PH#702.453.0800 FAX#702.453.0801

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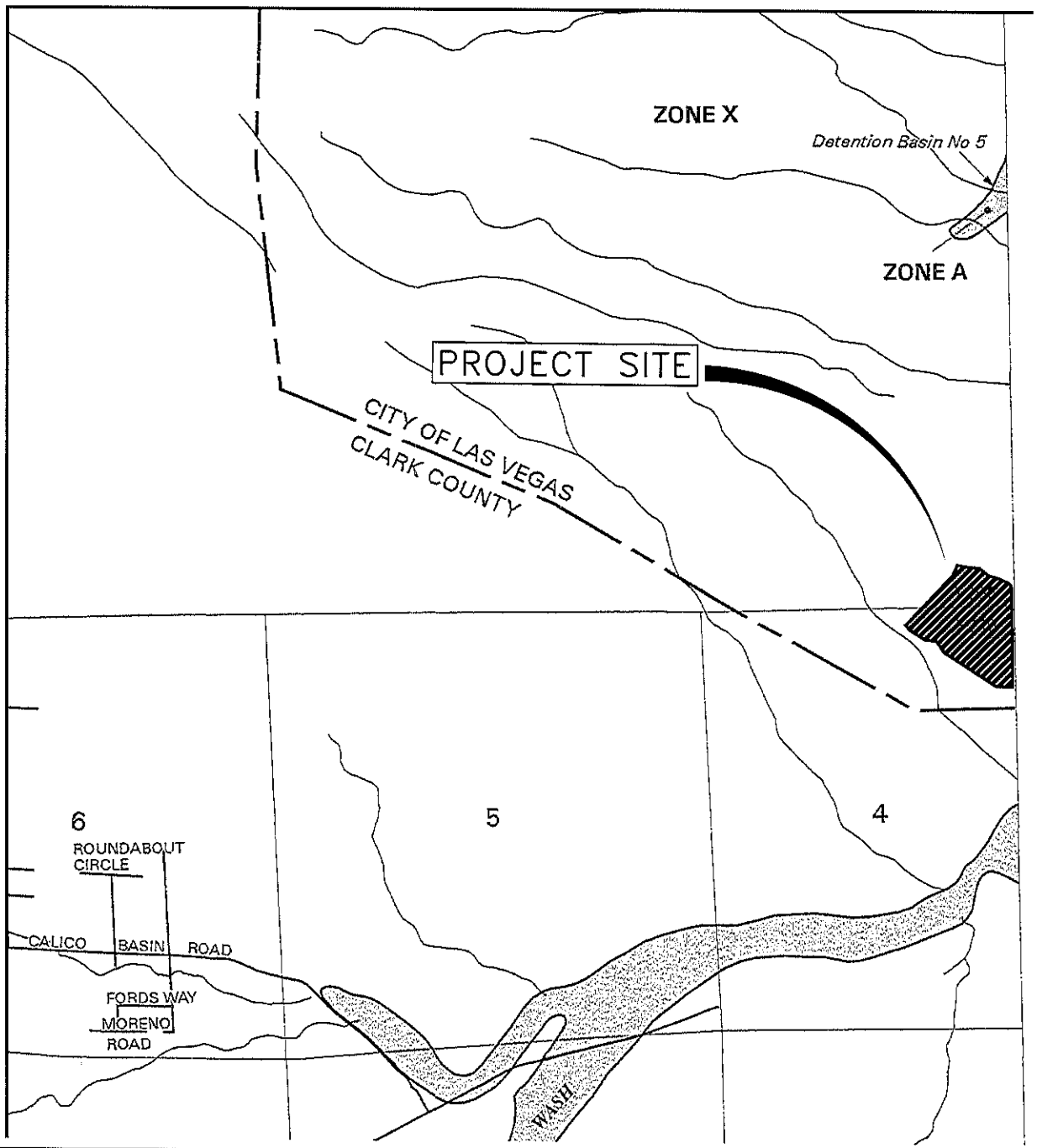



PANEL 2125 E

# 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

MAP SCALE 1" = 2000'

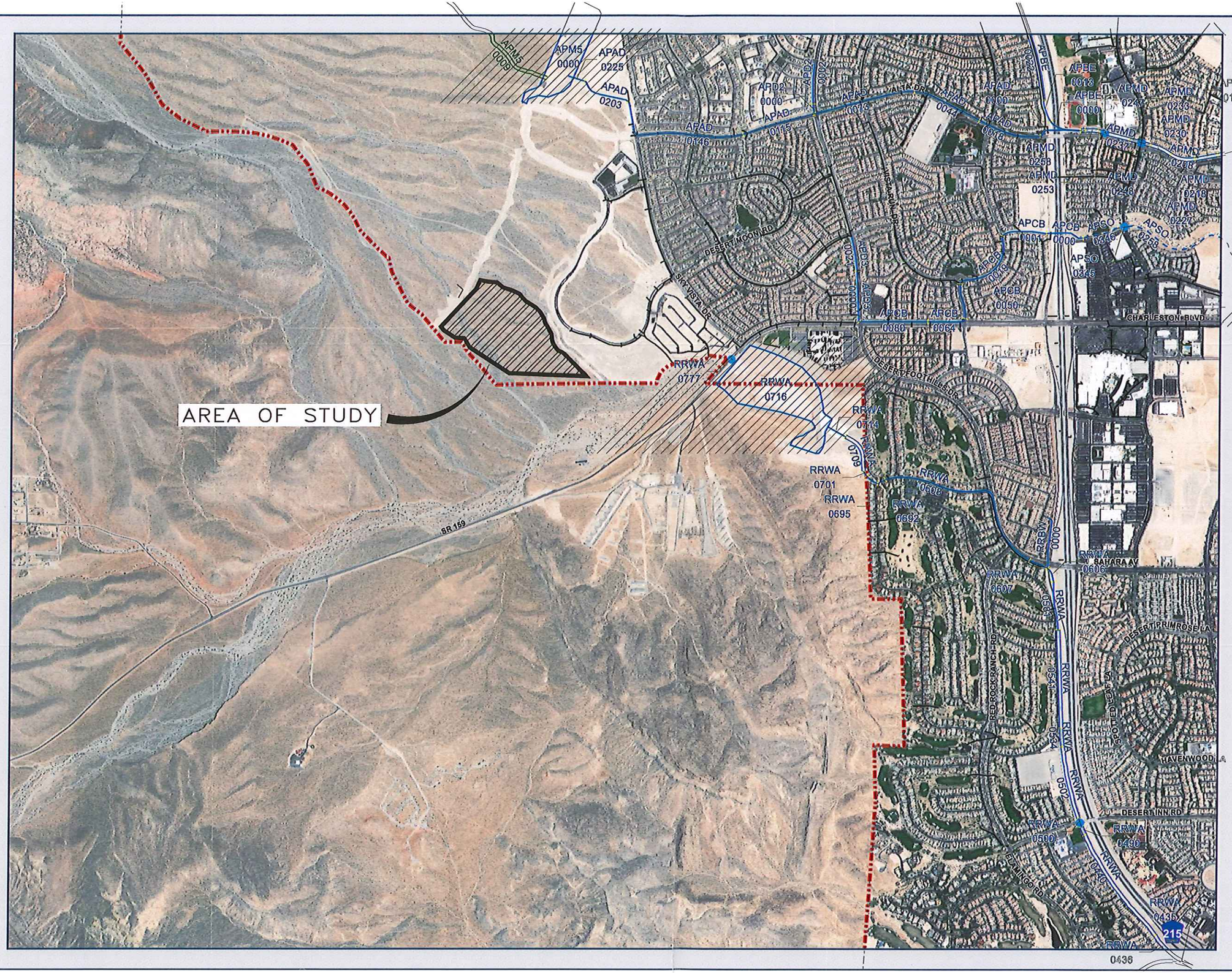
1000 0 2000 4000 FEET

**SUMMERLIN VILLAGE 24 PARCEL FGH**
LENNAR

**FIGURE 3.B**
F.I.R.M. MAP

RCI Engineering
500 S. RANCHO DRIVE, SUITE 17 LAS VEGAS, NV 89106
PH#702.453.0800 FAX#702.453.0801

G:\3040_LENNAR\0057_Summerlin_-_103_DRAIN\FIGURES\ORIGINAL\Figure3.B.dwg NDiana 2/14/19 1:33pm




REGIONAL FLOOD CONTROL DISTRICT

2018
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

**FIGURE F-27**
**FLOOD CONTROL FACILITIES**

**LEGEND**

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Detention Basin
- Culvert or Bridge Crossing
- 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 |
| Crossing | Crossing |

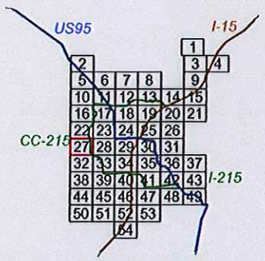
FIGURE 4

N

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

Scale: 1 inch = 2,000 feet

AerialSource:Esri World Imagery 2017




ATKINS
Member of the SNC-Lavalin Group

Louis Berger

## V. HYDROLOGY

The methodology presented in this study is in compliance with the *CCRFCD Hydrologic Criteria and Drainage Design Manual* (Reference 2, hereinafter referred to as the Manual).

**Model Description** - The watersheds were modeled using the SCS Unit Hydrograph method within the U.S. Army Corps of Engineers *HEC-1 Flood Hydrograph Package* (Reference 3).

The site hydrology has previously been modelled in the *Conceptual Drainage Study for Summerlin Village 24*, by GC Wallace, Inc. (Reference 4, hereinafter referred to as the Conceptual Study). The Conceptual Study was approved on June 10, 2004. Since the approval of the Conceptual Study there have been 2 Updates submitted and approved by the City Of Las Vegas. The Parcel FGH site hydrology was revised in the *Update to the Conceptual Study for Summerlin Village 24,* by GCW Engineers (Reference 5, hereinafter referred to as the Village 24 Update) The Village 24 Update was approved by the City of Las Vegas on June 24, 2014. The Village 24 Update addressed a higher densities for the Village 24 Parcels. The offsite 100-year storm flows draining along the Project site on the west were addressed in the *Summerlin West Planning Area Flood Control Master Plan Update,* by VTN, Nevada (Reference 6, hereinafter referred to as the West Planning Study. No approval letter could be found for that study, but there were no comments on the portion referenced for this study. Pertinent information from the Conceptual Study, the Village 24 Update, and the West Planning Study have been included in Appendix C.

**Precipitation** - The project site lies outside of the McCarran Rainfall Area as delineated in the Design Manual on Figures 503 and 506. The 10-year and 100-year point precipitation values for the project will be 1.96 inches and 3.39 inches during a 6-hour storm event, respectively. This equates to a 0.58 ratio between the 10-year and 100-year storm events. (See Appendix A)

Since the drainage area for the project will be less than 8 square miles, an SDN 3 design storm distribution per Table 503 of the Manual was selected for use in the HEC-1 computer model.

**Curve Numbers (CN)** –The soils information for this Project was referenced from the Conceptual Study and then checked with the NRCS Website. The site is comprised of soil type 731 (Purob-Irongold association). A soils map from the NRCS Website delineates soil type 731 as a mixture of HSG A, B, and D. For the given soils, CN values were determined from the appropriate columns of Tables 602 and 602A of the Manual. Existing conditions storm flows were referenced from the Conceptual Study and will be discussed in detail in the existing conditions section of this report. For the ultimate conditions, the developed site was modeled with a mixture of land uses and CN values. Portions of the site will be developed with lots that are less than 6,000 square feet and lots that have an average of 9,000 square feet. Portions of the site are also being developed with desert landscape, and a recreational center. CN values for those conditions are based on tables from Section 600 of the Manual. Please see the composite CN value calculations in Appendix A. The site will also be rough graded and the appropriate composite CN value for a newly graded site has been calculated and enclosed.

**Drainage Areas and Flow Patterns** - The subbasins and flow patterns used in the hydrologic modeling for proposed conditions used electronic files of the grading plans for the Project and for the surrounding improvements constructed by Summerlin.

**Lag Time** - The lag time (TLAG) is described as the time between the center of mass of rainfall and the time of peak discharge from a basin. Lag time can be related to time of concentration (Tc) by the following relationship: TLAG = 0.6(Tc). The time of concentration (Tc) is defined as the time required for runoff to flow from the most remote part of the basin area to the outlet of the basin or a design point under consideration. The procedure for calculating Tc is outlined in Section 602 of the Manual. Lag time calculations for the drainage subbasin has been included in Appendix A on Standard Form 4.

## VI. EXISTING CONDITIONS

Existing conditions for the site and surrounding area have been referenced from the Conceptual Study. A copy of Figure 5 from the Conceptual Study showing the site has been included in Appendix C. The site was modelled as a part of Subbasin ON12 and all of Subbasins ON13 through ON18 in the existing condition as shown on FIG5 from the Conceptual Study. Since the overall existing conditions for Village 24 has been approved with the Conceptual Study and is being referenced for this study, no existing condition hydrologic analysis has been provided.

## VII. ROUGH GRADING AND WASH IMPROVEMENTS

Figure 5 depicts the rough graded condition subbasin and drainage patterns for the Project. The rough graded condition HEC-1 model has been included in Appendix A. Table 1 summarizes the rough graded condition 100-year and 10-year flow rates for the site.

**TABLE 1**
**ROUGH GRADING CONDITIONS**
**HEC-1 MODEL SUMMARY**

| *SUBBASIN OR CP | BASIN AREA (AC) | 100 YR (cfs) | 10 YR (cfs) |
|---|---|---|---|
| RG-1 | 103.8 | 303 | 150 |

*See Figure 5

Subbasin RG-1 has been modelled to reflect the rough grading. The site was modelled with 100 percent of the site as rough graded with a composite CN value of 92. The HEC-1 model has been included in Appendix A. Subbasin RG-1 was delineated for the entire site and will generate 303 cfs during a 100-year storm event and 150 cfs during a 10-year storm event. The runoff produced by RG-1 will drain to three locations and the site has been delineated into 5 prorated subbasins to identify storm flows at those locations.

| ROUGH GRADING HEC-1 MODEL SUMMARY | | | |
|---|---|---|---|
| SUBBASIN | BASIN AREA (ACRES) | 100 YR (CFS) | 10 YR (CFS) |
| RG-1 | 103.8 | 303 | 150 |

| 100- YEAR PRORATE BASIN FLOWS | | | |
|---|---|---|---|
| PRORATED BASIN NAME | AREA (ACRES) | CFS/ACRE | TOTAL 100-YEAR FLOW (CFS) |
| PRG-1 | 25.04 | 2.92 | 73 |
| PRG-2 | 32.28 | 2.92 | 94 |
| PRG-3 | 36.30 | 2.92 | 106 |
| PRG-4 | 2.51 | 2.92 | 8 |
| PRG-5 | 7.60 | 2.92 | 22 |

**SUMMERLIN V24 PARCELS FGH**

LENNAR

**FIGURE 5**

ROUGH GRADED CONDITIONS MAP

RCI Engineering
500 SOUTH RANCHO DRIVE, SUITE 17 LAS VEGAS, NV 89106
PH#702.453.0800 FAX#702.453.0801

O:\1340_LENNAR\GFX\2_Summerlin_FGH_Drawings\Exhibits\FIGURE5-RG.dwg, mwall, 8/7/2019 7:34am

Prorated storm flows for the rough grading for this study were calculated to model the onsite discharges to design points. Table 2 summarizes the 100-year storm prorated basin calculations. Calculations are based on the overall 100-year storm flow from Subbasin RG-1 and then divided by the acreage to determine how much runoff per acre will be produced. The acreage of each Prorated Basin is then multiplied by the cfs/acre which equals the cfs per Prorated Basin. Subbasin RG-1 will generate an average 100-year storm flow of 2.92 cfs per acre (303 CFS/103.8 acres). The Prorated Basins 100-year storm flows have been shown on Figure 5.

**TABLE 2**
**ROUGH GRADED 100-YR PRORATED STORM FLOWS**

| PRORATED BASIN | BASIN AREA (AC) | CFS/ACRE | 100 YR (cfs) |
|---|---|---|---|
| PRG-1 | 25.04 | 2.92 | 73 |
| PRG-2 | 32.28 | 2.92 | 94 |
| PRG-3 | 36.30 | 2.92 | 106 |
| PRG-4 | 2.51 | 2.92 | 8 |
| PRG-5 | 7.60 | 2.92 | 22 |

Prorated basin PRG-1 and PRG-2 will drain as surface flow toward the future site entrance at the COS-3 Wash. At that location there is an existing 60-inch RCP storm drain stub that was designed to accept a 100-year storm flow of 190 cfs into the existing COS-4/COS-3 wash. That storm drain was designed as a part of the *Village 24-Parcel FGH Entry Road* improvement plans by GCW Engineering (Reference 7, hereinafter referred to as the Entry Road Plans). The Entry Road Plans have been approved by the City of Las Vegas (CLV). Sheet 9 from the Entry Road Plans have been included in Appendix C. There will be a 100-year storm flow in the interim rough graded condition of 167 cfs that drains to the existing 60-inch RCP. That is 23 cfs less than the design flows of 190 cfs.

Prorated basin PRG-3 will drain as surface flow toward the south corner of the project site at the COS-3 Wash. At that location there is an existing 48-inch RCP storm drain stub that was designed to accept a 100-year storm flow of 92 cfs into the existing COS-4/COS-3 wash. That storm drain was addressed as a part of the *Technical Drainage Study For Summerlin Village 24 Parcel COS-4 Wash* by GCW Engineering (Reference 8, hereinafter

referred to as the COS-4 Study). The COS-4 Study was approved by the City of Las Vegas (CLV) on October 17, 2017. Pertinent excerpts from the COS-4 Study have been enclosed in Appendix C.

There will be a 100-year storm flow in the interim rough graded condition of 106 cfs that drains to the existing 48-inch RCP. That is 14 cfs more than the design flows. Please refer to Subbasin F on FIG-7RU from the COS-4 Study in Appendix C. A Culvertmaster calculation shows that the culvert will operate under outlet control with a ponded water surface elevation of 43.63 which is 5.12 feet deep meeting the manual criteria for the water surface elevation to be less to be less than 1.5 times the height of the culvert.

Prorated basins PRG-4 will produce 8 cfs during a 100-year storm event. That prorated basin will drain west into the natural wash within the Red Rock Conservation area. That area closely matches the area that drains west in the existing condition and will not have a negative impact to the existing wash. Subbasin PRG-5 will produce 22 cfs during a 100-year storm event. That prorated basin will drain south to the natural wash. The 100-year storm flow of 22 cfs is much less than what drained to that location in the existing condition, since the majority of the 100-year tributary storm flows are being directed within the rough graded street sections to the existing 48-inch RCP and then into the COS-4 Wash.

## VIII. ULTIMATE CONDITIONS

Figure 6 depicts the ultimate condition subbasin and flow patterns for the Project. The ultimate condition HEC-1 model has been included in Appendix A. Table 2 summarizes the ultimate condition 100-year and 10-year flow rate for the project site. In the ultimate condition storm flows produce by the site will be directed via storm drain west into the Redrock Conservation Area, and east into the COS-4 and COS-3 Washes.

The fully developed site will be broken into 3 phases with separate improvement plans for each phase. This drainage study will not address the different phases of the Project, but an overall ultimate condition model was prepared for the site for preliminary sizes for storm drain and to be used as reference with future technical drainage studies for the Project. In the ultimate condition there will be a minimum of 44 cfs intercepted by drop inlets in Mayfield Manor Drive and discharged into the natural wash on the west. A divert card was

used in the HEC-1 model to divert 44 cfs out of the model for flow draining to Combination Point COM10. That will allow a 100-year storm flow of 155 cfs to drain to Combination Point COM10 which is 37 cfs less than what the existing 60-inch RCP at the entrance has been designed for. Please see the design flows for the existing 60-inch RCP on Sheet 9 from the Entry Road Plans in Appendix C. Preliminary storm drain sizes have been included on Figure 6 along with the HEC-1 Summary Table for the 100-year and 10-year storm flows.

There will be a 100-year storm flow of 136 cfs at the south end of the Project at Combination Point COM3. There is an existing 48-inch RCP storm drain at that location designed for a 100-year storm flow of 92 cfs. Please see the design flows for the existing 48-inch RCP in the COS-4 Study in Appendix C. The remaining storm flow at that location (136-92=44 cfs) will be intercepted into storm drain and then south into the natural wash on the south. The final design of Phase 1 through Phase 3 will be addressed in future technical drainage studies for the site.

**TABLE 3**
**ULTIMATE CONDITIONS**
**HEC-1 MODEL SUMMARY**

| SUBBASIN OR CP* | BASIN AREA (AC) | 100 YR (cfs) | 10 YR (cfs) |
|---|---|---|---|
| ULT-1 | 20.88 | 64 | 31 |
| DIV | N/A | 44 | 29 |
| SD | N/A | 20 | 2 |
| ULT-RC1 | 3.99 | 11 | 5 |
| ULT-RC2 | 8.55 | 30 | 15 |
| COM1 | N/A | 60 | 20 |
| ULT-2 | 15.64 | 58 | 30 |
| ULT-3 | 11.43 | 38 | 20 |
| COM2 | N/A | 96 | 50 |
| COM10 | N/A | 155 | 70 |
| ULT-4 | 12.83 | 36 | 16 |
| ULT-5 | 18.76 | 73 | 38 |
| ULT-6 | 7.59 | 28 | 15 |
| COM3 | N/A | 136 | 68 |

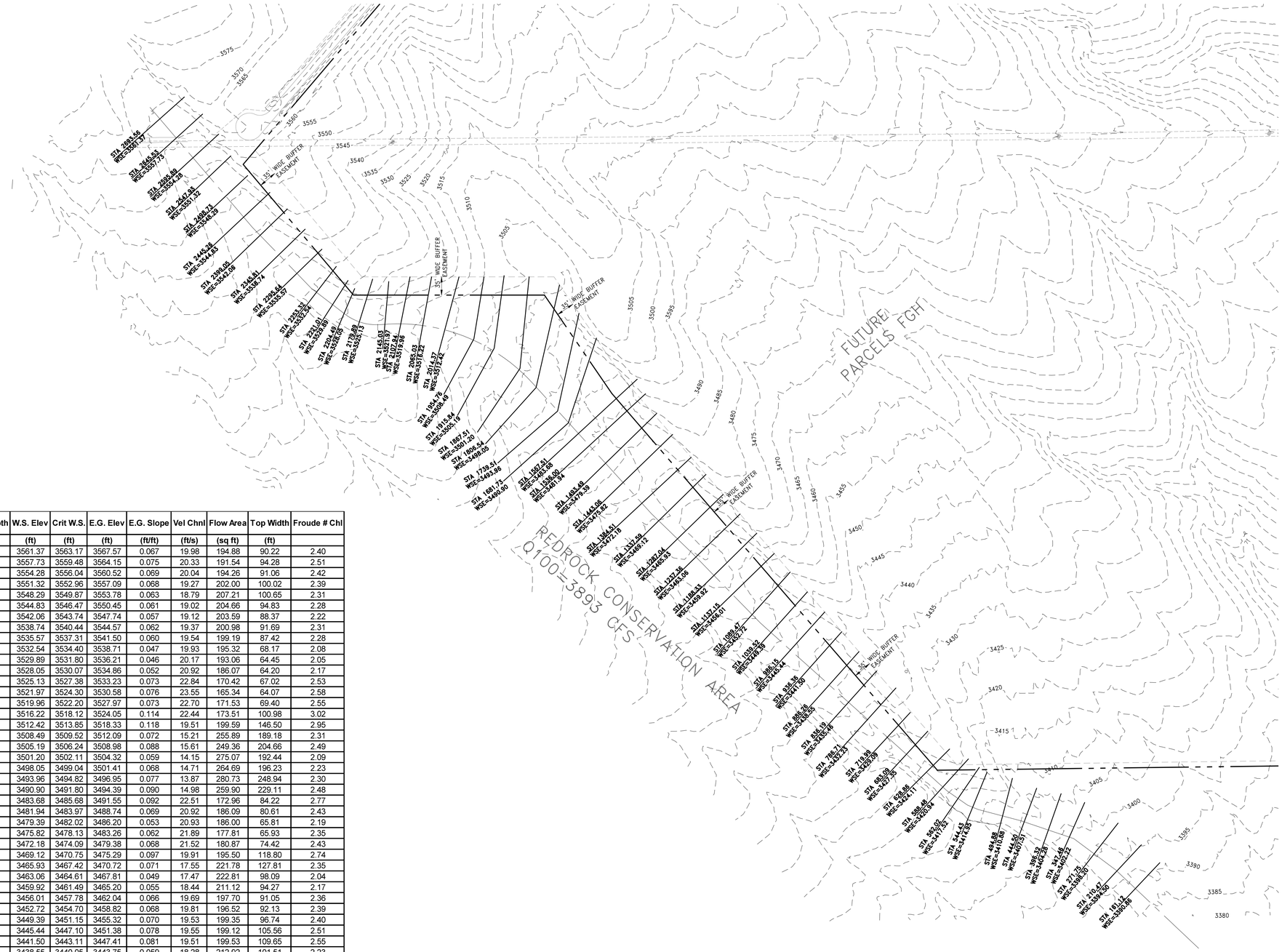
*See Figure 6

The site is being protected from offsite flows from the north by facilities that have been constructed with the *Technical Drainage Study for Summerlin West Village 24 Western Boundary Grading and Drainage*, by VTN Nevada Engineering (Reference 9, hereinafter referred to as the Western Boundary Study). The Western Boundary Study was approved on July 24, 2018. There will be a worst case storm flow of 129 cfs draining to the site in the interim condition. Please refer to Figure 9 from that study in Appendix C. There is a 48-inch RCP, a 3-foot high berm and a 7x6 RCB that have been constructed with Western Boundary Study to protect the site. Please refer to GR8 through GR9, and DT1 in Appendix C. Those facilities will be addressed in detail in a future technical drainage study for the onsite residential development.

## IX. HECRAS AND HYDRAULICS

Two HecRas models were prepared for the wash in the Red Rock Conservation Area. The first HecRas model was for the natural conditions in the wash to determine the hydraulic properties of the undisturbed wash. The second HecRas model was for the wash once the Parcel FGH Project has been developed. In the existing conditions there will be a 100-year storm flow of 3893 cfs in the wash. The existing conditions 100-year storm flows were referenced from the West Planning Study. Pertinent excerpts have been included in Appendix C. Figure A.6.4 in the reference study has been redlined with the Summerlin Village 24 FGH site. The 100-year storm flows used in the HecRas Model for existing conditions were referenced from Combination Point CP4.2. Also included in the reference is the HEC-1 Model for the wash from the West Planning Study. Please see Figure 7 on the following page for the HecRas cross sections and a summary of the output from the existing conditions HecRas Model. The existing condition HecRas results have been included in Appendix B. Under existing conditions the natural wash is stable with a super-critical flow regime.

Once the site is developed, a maximum of 44 cfs during a 100-year storm event will be directed to the wash through two storm drain systems. Those storm drains have been shown on Figure 6 Ultimate Conditions and on Sheets P-6 and P-7 of the improvement plans. The storm drain on Sheets P-6 and P-7 will be constructed with the rough grading plans and capped since they tie into the Red Rock Wash. Those laterals will to be tied




| Reach | River Sta | Profile | Q Total | Min Ch El | Max Chl Dpth | 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) | (ft/s) | (sq ft) | (ft) | |
| redrock | 2693.56 | PF 1 | 3893 | 3558.39 | 2.98 | 3561.37 | 3563.17 | 3567.57 | 0.067 | 19.98 | 194.88 | 90.22 | 2.40 |
| redrock | 2645.53 | PF 1 | 3893 | 3555.17 | 2.56 | 3557.73 | 3559.48 | 3564.15 | 0.075 | 20.33 | 191.54 | 94.28 | 2.51 |
| redrock | 2595.89 | PF 1 | 3893 | 3551.01 | 3.27 | 3554.28 | 3556.04 | 3560.52 | 0.069 | 20.04 | 194.26 | 91.06 | 2.42 |
| redrock | 2547.93 | PF 1 | 3893 | 3548.22 | 3.10 | 3551.32 | 3552.96 | 3557.09 | 0.068 | 19.27 | 202.00 | 100.02 | 2.39 |
| redrock | 2498.73 | PF 1 | 3893 | 3545.51 | 2.78 | 3548.29 | 3549.87 | 3553.78 | 0.063 | 18.79 | 207.21 | 100.65 | 2.31 |
| redrock | 2445.26 | PF 1 | 3893 | 3541.96 | 2.87 | 3544.83 | 3546.47 | 3550.45 | 0.061 | 19.02 | 204.66 | 94.83 | 2.28 |
| redrock | 2399.05 | PF 1 | 3893 | 3538.57 | 3.49 | 3542.06 | 3543.74 | 3547.74 | 0.057 | 19.12 | 203.59 | 88.37 | 2.22 |
| redrock | 2345.81 | PF 1 | 3893 | 3535.65 | 3.09 | 3538.74 | 3540.44 | 3544.57 | 0.062 | 19.37 | 200.98 | 91.69 | 2.31 |
| redrock | 2295.64 | PF 1 | 3893 | 3532.42 | 3.15 | 3535.57 | 3537.31 | 3541.50 | 0.060 | 19.54 | 199.19 | 87.42 | 2.28 |
| redrock | 2253.32 | PF 1 | 3893 | 3528.98 | 3.56 | 3532.54 | 3534.40 | 3538.71 | 0.047 | 19.93 | 195.32 | 68.17 | 2.08 |
| redrock | 2221.01 | PF 1 | 3893 | 3526.10 | 3.79 | 3529.89 | 3531.80 | 3536.21 | 0.046 | 20.17 | 193.06 | 64.45 | 2.05 |
| redrock | 2204.49 | PF 1 | 3893 | 3524.32 | 3.73 | 3528.05 | 3530.07 | 3534.86 | 0.052 | 20.92 | 186.07 | 64.20 | 2.17 |
| redrock | 2179.89 | PF 1 | 3893 | 3522.07 | 3.06 | 3525.13 | 3527.38 | 3533.23 | 0.073 | 22.84 | 170.42 | 67.02 | 2.53 |
| redrock | 2145.03 | PF 1 | 3893 | 3518.99 | 2.97 | 3521.97 | 3524.30 | 3530.58 | 0.076 | 23.55 | 165.34 | 64.07 | 2.58 |
| redrock | 2107.94 | PF 1 | 3893 | 3516.77 | 3.19 | 3519.96 | 3522.20 | 3527.97 | 0.073 | 22.70 | 171.53 | 69.40 | 2.55 |
| redrock | 2065.03 | PF 1 | 3893 | 3513.50 | 2.72 | 3516.22 | 3518.12 | 3524.05 | 0.114 | 22.44 | 173.51 | 100.98 | 3.02 |
| redrock | 2014.37 | PF 1 | 3893 | 3509.82 | 2.60 | 3512.42 | 3513.85 | 3518.33 | 0.118 | 19.51 | 199.59 | 146.50 | 2.95 |
| redrock | 1954.76 | PF 1 | 3893 | 3505.94 | 2.55 | 3508.49 | 3509.52 | 3512.09 | 0.072 | 15.21 | 255.89 | 189.18 | 2.31 |
| redrock | 1915.84 | PF 1 | 3893 | 3502.39 | 2.80 | 3505.19 | 3506.24 | 3508.98 | 0.088 | 15.61 | 249.36 | 204.66 | 2.49 |
| redrock | 1867.51 | PF 1 | 3893 | 3497.85 | 3.35 | 3501.20 | 3502.11 | 3504.32 | 0.059 | 14.15 | 275.07 | 192.44 | 2.09 |
| redrock | 1806.54 | PF 1 | 3893 | 3494.62 | 3.43 | 3498.05 | 3499.04 | 3501.41 | 0.068 | 14.71 | 264.69 | 196.23 | 2.23 |
| redrock | 1739.51 | PF 1 | 3893 | 3491.26 | 2.70 | 3493.96 | 3494.82 | 3496.95 | 0.077 | 13.87 | 280.73 | 248.94 | 2.30 |
| redrock | 1681.73 | PF 1 | 3893 | 3487.91 | 2.99 | 3490.90 | 3491.80 | 3494.39 | 0.090 | 14.98 | 259.90 | 229.11 | 2.48 |
| redrock | 1567.51 | PF 1 | 3893 | 3480.64 | 3.03 | 3483.68 | 3485.68 | 3491.55 | 0.092 | 22.51 | 172.96 | 84.22 | 2.77 |
| redrock | 1536.00 | PF 1 | 3893 | 3478.51 | 3.43 | 3481.94 | 3483.97 | 3488.74 | 0.069 | 20.92 | 186.09 | 80.61 | 2.43 |
| redrock | 1493.49 | PF 1 | 3893 | 3475.70 | 3.69 | 3479.39 | 3482.02 | 3486.20 | 0.053 | 20.93 | 186.00 | 65.81 | 2.19 |
| redrock | 1443.06 | PF 1 | 3893 | 3472.41 | 3.41 | 3475.82 | 3478.13 | 3483.26 | 0.062 | 21.89 | 177.81 | 65.93 | 2.35 |
| redrock | 1384.51 | PF 1 | 3893 | 3469.20 | 2.98 | 3472.18 | 3474.09 | 3479.38 | 0.068 | 21.52 | 180.87 | 74.42 | 2.43 |
| redrock | 1337.59 | PF 1 | 3893 | 3465.82 | 3.30 | 3469.12 | 3470.75 | 3475.29 | 0.097 | 19.91 | 195.50 | 118.80 | 2.74 |
| redrock | 1287.04 | PF 1 | 3893 | 3463.02 | 2.91 | 3465.93 | 3467.42 | 3470.72 | 0.071 | 17.55 | 221.78 | 127.81 | 2.35 |
| redrock | 1237.36 | PF 1 | 3893 | 3459.37 | 3.69 | 3463.06 | 3464.61 | 3467.81 | 0.049 | 17.47 | 222.81 | 98.09 | 2.04 |
| redrock | 1188.33 | PF 1 | 3893 | 3456.26 | 3.66 | 3459.92 | 3461.49 | 3465.20 | 0.055 | 18.44 | 211.12 | 94.27 | 2.17 |
| redrock | 1137.15 | PF 1 | 3893 | 3452.84 | 3.17 | 3456.01 | 3457.78 | 3462.04 | 0.066 | 19.69 | 197.70 | 91.05 | 2.36 |
| redrock | 1089.47 | PF 1 | 3893 | 3449.20 | 3.52 | 3452.72 | 3454.70 | 3458.82 | 0.068 | 19.81 | 196.52 | 92.13 | 2.39 |
| redrock | 1039.52 | PF 1 | 3893 | 3445.90 | 3.49 | 3449.39 | 3451.15 | 3455.32 | 0.070 | 19.53 | 199.35 | 96.74 | 2.40 |
| redrock | 986.15 | PF 1 | 3893 | 3442.53 | 2.91 | 3445.44 | 3447.10 | 3451.38 | 0.078 | 19.55 | 199.12 | 105.56 | 2.51 |
| redrock | 936.36 | PF 1 | 3893 | 3438.74 | 2.76 | 3441.50 | 3443.11 | 3447.41 | 0.081 | 19.51 | 199.53 | 109.65 | 2.55 |
| redrock | 886.26 | PF 1 | 3893 | 3435.40 | 3.15 | 3438.55 | 3440.05 | 3443.75 | 0.059 | 18.28 | 212.92 | 101.51 | 2.23 |
| redrock | 836.19 | PF 1 | 3893 | 3432.42 | 3.03 | 3435.46 | 3437.02 | 3440.84 | 0.056 | 18.62 | 209.12 | 93.22 | 2.19 |
| redrock | 786.71 | PF 1 | 3893 | 3428.47 | 3.76 | 3432.23 | 3433.82 | 3437.90 | 0.062 | 19.10 | 203.80 | 93.36 | 2.28 |
| redrock | 719.99 | PF 1 | 3893 | 3424.94 | 4.15 | 3429.09 | 3430.63 | 3434.27 | 0.045 | 18.26 | 213.20 | 82.38 | 2.00 |
| redrock | 683.09 | PF 1 | 3893 | 3422.19 | 5.16 | 3427.35 | 3429.18 | 3432.93 | 0.029 | 18.94 | 205.52 | 52.61 | 1.69 |
| redrock | 628.86 | PF 1 | 3893 | 3418.86 | 5.25 | 3424.11 | 3426.29 | 3430.99 | 0.039 | 21.04 | 185.02 | 49.98 | 1.93 |
| redrock | 588.48 | PF 1 | 3893 | 3415.97 | 4.97 | 3420.94 | 3423.28 | 3428.86 | 0.055 | 22.58 | 172.42 | 54.17 | 2.23 |
| redrock | 562.02 | PF 1 | 3893 | 3413.79 | 3.73 | 3417.52 | 3419.97 | 3426.39 | 0.073 | 23.89 | 162.96 | 58.65 | 2.53 |
| redrock | 544.43 | PF 1 | 3893 | 3411.54 | 3.41 | 3414.95 | 3417.32 | 3423.92 | 0.083 | 24.03 | 162.02 | 64.07 | 2.66 |
| redrock | 494.88 | PF 1 | 3893 | 3407.18 | 3.70 | 3410.88 | 3413.18 | 3419.01 | 0.074 | 22.87 | 170.19 | 62.56 | 2.45 |
| redrock | 444.50 | PF 1 | 3893 | 3404.00 | 3.51 | 3407.51 | 3409.61 | 3415.50 | 0.085 | 22.68 | 171.66 | 73.76 | 2.62 |
| redrock | 396.32 | PF 1 | 3893 | 3401.17 | 3.11 | 3404.28 | 3406.26 | 3411.44 | 0.071 | 21.47 | 181.31 | 78.36 | 2.49 |
| redrock | 347.46 | PF 1 | 3893 | 3398.35 | 3.87 | 3402.22 | 3403.99 | 3408.08 | 0.051 | 19.42 | 200.51 | 76.82 | 2.12 |
| redrock | 271.75 | PF 1 | 3893 | 3394.36 | 3.84 | 3398.20 | 3399.93 | 3404.69 | 0.072 | 20.44 | 190.50 | 87.82 | 2.45 |
| redrock | 210.47 | PF 1 | 3893 | 3390.90 | 3.60 | 3394.50 | 3396.26 | 3400.56 | 0.059 | 19.75 | 197.15 | 81.58 | 2.24 |
| redrock | 161.12 | PF 1 | 3893 | 3387.77 | 3.09 | 3390.86 | 3392.71 | 3397.50 | 0.062 | 20.67 | 188.31 | 76.10 | 2.32 |

**SUMMERLIN VILLAGE 24**
**PARCEL FGH**
LENNAR

**FIGURE 7**
EXISTING HEC RAS SECTION MAP

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O:\3140_LENR\0057_Summerlin_105_DRAIN\FIGURES\ORIGINAL\FIGURE7-HECRAS.dwg rredd 8/01/19 8:17am

into with future storm drain and drop inlets.

A HEC-1 model for the Red Rock Wash was developed to determine if development of the FGH Project site will have a negative impact to the wash. The HEC-1 model has been included in Appendix A. The HEC-1 model from the West Planning Study was revised to determine the impact that the developed conditions flows from Parcels FGH will have on the Red Rock Wash. Subbasin ULT1 was added to the HEC-1 model from the West Planning Study. Subbasin 4-3 was modified in the HEC-1 model to decrease the area that will drain to the wash. Development of Parcels FGH will reduce the size of Subbasin 4-3 to 83.89 acres. All of the other upstream subbasins from the West Planning Study model were not revised. Please see Figure A.6.4 in Appendix C and Figure 9 for a summary of the combined developed conditions flows in the Red Rock Wash. Subbasin ULT1 from the developed conditions was added to the model and the flows that are not being directed to the Red Rock Wash (Q100=20 cfs) were diverted out of the model. That leaves 44 cfs of 100-year storm flow in the storm drain to combine with offsite flows. Combination Point CP4.2A. Using the modified model from the West Planning Study determined that development of the site will decrease the flow in the developed conditions in the Red Rock Wash by 16 cfs during a 100-year storm event for a combined 100-year storm flow of 3877 cfs.

The developed conditions HecRas Model has been enclosed using the revised combined 100-year storm flows of 3877 cfs. Lateral inflows were not used in the developed conditions HecRas model since those lateral flows less than 1 percent of the total 100-year storm flow in the wash. Additionally, development of site does not encroach into the Red Rock Conservation Area and will not impede flows with minor onsite changes to the wash at a few locations. At those locations the grading was pulled back far enough to not encroach into the flow path of the 100-year storm flows. A 10-foot wide area has been provided between the development of the site and the property line where no construction will occur. There are a couple locations where the 100-year WSE in the Red Rock Wash has changed by a maximum of 0.09 feet. In most cases the 100-year WSE in the wash has been reduced due to the lower flows. Please see Figure 8 for the developed conditions HecRas cross section locations and Summary Table. There is also a table on Figure 8 for a comparison of storm drains depths in the Red Rock Wash.

| Reach | River Sta | Plan Station | Q Total | Min Ch El | Max Chl Dpth | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Freeboard | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | (ft) | |
| redrock | 2693.56 | - | 3877 | 3558.39 | 2.97 | 3561.36 | 3563.17 | 3567.55 | 0.067 | 19.95 | 194.37 | 1.71 | 90.19 | 2.40 |
| redrock | 2645.53 | - | 3877 | 3555.17 | 2.55 | 3557.72 | 3559.47 | 3564.12 | 0.075 | 20.30 | 191.03 | 1.69 | 94.25 | 2.51 |
| redrock | 2595.89 | - | 3877 | 3551.01 | 3.27 | 3554.28 | 3556.03 | 3560.50 | 0.069 | 20.01 | 193.75 | 1.74 | 91.02 | 2.42 |
| redrock | 2547.93 | - | 3877 | 3548.22 | 3.09 | 3551.31 | 3552.95 | 3557.07 | 0.068 | 19.24 | 201.46 | 1.70 | 99.97 | 2.39 |
| redrock | 2498.73 | 24+88.78 | 3877 | 3545.51 | 2.78 | 3548.29 | 3549.87 | 3553.76 | 0.063 | 18.76 | 206.67 | 1.66 | 100.60 | 2.31 |
| redrock | 2445.26 | 24+35.80 | 3877 | 3541.96 | 2.86 | 3544.82 | 3546.46 | 3550.43 | 0.061 | 18.99 | 204.11 | 1.67 | 94.77 | 2.28 |
| redrock | 2399.05 | 23+89.52 | 3877 | 3538.57 | 3.48 | 3542.05 | 3543.73 | 3547.72 | 0.057 | 19.10 | 203.03 | 1.72 | 88.32 | 2.22 |
| redrock | 2345.81 | 23+37.64 | 3877 | 3535.65 | 3.09 | 3538.74 | 3540.42 | 3544.55 | 0.062 | 19.34 | 200.45 | 1.70 | 91.62 | 2.31 |
| redrock | 2295.64 | 22+87.48 | 3877 | 3532.42 | 3.14 | 3535.56 | 3537.30 | 3541.48 | 0.060 | 19.52 | 198.63 | 1.71 | 87.35 | 2.28 |
| redrock | 2253.32 | 22+42.76 | 3877 | 3528.98 | 3.55 | 3532.53 | 3534.39 | 3538.69 | 0.047 | 19.91 | 194.76 | 1.76 | 68.14 | 2.08 |
| redrock | 2221.01 | 22+06.80 | 3877 | 3526.10 | 3.78 | 3529.88 | 3531.79 | 3536.18 | 0.046 | 20.14 | 192.50 | 1.78 | 64.42 | 2.05 |
| redrock | 2204.49 | 21+84.71 | 3877 | 3524.32 | 3.73 | 3528.05 | 3530.05 | 3534.83 | 0.052 | 20.90 | 185.53 | 1.81 | 64.17 | 2.17 |
| redrock | 2179.89 | 21+54.38 | 3877 | 3522.07 | 3.05 | 3525.12 | 3527.36 | 3533.21 | 0.073 | 22.81 | 169.93 | 1.82 | 67.00 | 2.53 |
| redrock | 2145.03 | 21+16.15 | 3877 | 3518.99 | 2.97 | 3521.96 | 3524.28 | 3530.55 | 0.076 | 23.52 | 164.87 | 1.84 | 64.05 | 2.58 |
| redrock | 2107.94 | 20+79.87 | 3877 | 3516.77 | 3.19 | 3519.96 | 3522.19 | 3527.94 | 0.073 | 22.66 | 171.07 | 1.83 | 69.36 | 2.54 |
| redrock | 2065.03 | 20+37.83 | 3877 | 3513.50 | 2.72 | 3516.22 | 3518.11 | 3524.03 | 0.115 | 22.42 | 172.94 | 1.78 | 100.91 | 3.02 |
| redrock | 2014.37 | 19+88.27 | 3877 | 3509.82 | 2.60 | 3512.42 | 3513.84 | 3518.31 | 0.118 | 19.47 | 199.12 | 1.67 | 146.46 | 2.94 |
| redrock | 1954.76 | 19+36.46 | 3877 | 3505.94 | 2.55 | 3508.49 | 3509.50 | 3512.07 | 0.072 | 15.18 | 255.34 | 1.52 | 189.16 | 2.30 |
| redrock | 1915.84 | 18+97.28 | 3877 | 3502.39 | 2.80 | 3505.19 | 3506.24 | 3508.97 | 0.088 | 15.59 | 248.71 | 1.55 | 204.55 | 2.49 |
| redrock | 1867.51 | 18+47.51 | 3877 | 3497.85 | 3.35 | 3501.20 | 3502.10 | 3504.31 | 0.059 | 14.14 | 274.18 | 1.53 | 191.94 | 2.09 |
| redrock | 1806.54 | 17+82.14 | 3877 | 3494.62 | 3.43 | 3498.05 | 3499.03 | 3501.41 | 0.068 | 14.70 | 263.78 | 1.55 | 195.85 | 2.23 |
| redrock | 1739.51 | 17+15.34 | 3877 | 3491.26 | 2.71 | 3493.97 | 3494.81 | 3496.92 | 0.077 | 13.77 | 281.53 | 1.48 | 250.81 | 2.29 |
| redrock | 1681.73 | 16+62.07 | 3877 | 3487.91 | 2.99 | 3490.90 | 3491.78 | 3494.32 | 0.091 | 14.85 | 261.15 | 1.53 | 232.51 | 2.47 |
| redrock | 1567.51 | 15+72.53 | 3877 | 3480.64 | 3.03 | 3483.67 | 3485.67 | 3491.48 | 0.090 | 22.42 | 172.93 | 1.81 | 84.40 | 2.76 |
| redrock | 1536.00 | 15+41.10 | 3877 | 3478.51 | 3.42 | 3481.94 | 3483.98 | 3488.71 | 0.069 | 20.88 | 185.64 | 1.78 | 80.58 | 2.43 |
| redrock | 1493.49 | 14+97.71 | 3877 | 3475.70 | 3.68 | 3479.38 | 3482.01 | 3486.17 | 0.053 | 20.90 | 185.52 | 1.80 | 65.77 | 2.19 |
| redrock | 1443.06 | 14+47.39 | 3877 | 3472.41 | 3.40 | 3475.81 | 3478.13 | 3483.24 | 0.062 | 21.87 | 177.31 | 1.82 | 65.89 | 2.35 |
| redrock | 1384.51 | 13+91.65 | 3877 | 3469.20 | 2.97 | 3472.17 | 3474.10 | 3479.37 | 0.068 | 21.53 | 180.11 | 1.77 | 74.03 | 2.43 |
| redrock | 1337.59 | 13+47.30 | 3877 | 3465.82 | 3.30 | 3469.12 | 3470.75 | 3475.28 | 0.097 | 19.91 | 194.68 | 1.74 | 118.27 | 2.74 |
| redrock | 1287.04 | 12+96.77 | 3877 | 3463.02 | 2.90 | 3465.92 | 3467.43 | 3470.70 | 0.071 | 17.54 | 221.04 | 1.62 | 127.72 | 2.35 |
| redrock | 1237.36 | 12+47.02 | 3877 | 3459.37 | 3.68 | 3463.05 | 3464.60 | 3467.79 | 0.049 | 17.45 | 222.14 | 1.67 | 97.95 | 2.04 |
| redrock | 1188.33 | 11+97.79 | 3877 | 3456.26 | 3.63 | 3459.89 | 3461.48 | 3465.18 | 0.055 | 18.44 | 210.19 | 1.71 | 96.27 | 2.20 |
| redrock | 1137.15 | 11+46.64 | 3877 | 3452.88 | 3.06 | 3455.94 | 3457.66 | 3461.90 | 0.072 | 19.58 | 198.03 | 1.71 | 94.54 | 2.38 |
| redrock | 1089.47 | 10+97.11 | 3877 | 3449.20 | 3.55 | 3452.76 | 3454.57 | 3458.62 | 0.065 | 19.42 | 199.60 | 1.74 | 92.56 | 2.33 |
| redrock | 1039.52 | 10+46.76 | 3877 | 3445.90 | 3.46 | 3449.36 | 3451.08 | 3455.26 | 0.070 | 19.48 | 199.06 | 1.73 | 98.26 | 2.41 |
| redrock | 986.15 | 9+95.82 | 3877 | 3442.53 | 3.00 | 3445.53 | 3447.24 | 3451.38 | 0.075 | 19.41 | 199.73 | 1.70 | 100.03 | 2.42 |
| redrock | 936.36 | 9+45.46 | 3877 | 3438.74 | 2.82 | 3441.56 | 3443.20 | 3447.49 | 0.082 | 19.53 | 198.55 | 1.69 | 107.07 | 2.53 |
| redrock | 886.26 | 8+95.03 | 3877 | 3435.40 | 3.12 | 3438.52 | 3440.02 | 3443.71 | 0.063 | 18.27 | 212.16 | 1.66 | 102.64 | 2.24 |
| redrock | 836.19 | 8+44.62 | 3877 | 3432.42 | 3.03 | 3435.45 | 3437.00 | 3440.77 | 0.055 | 18.49 | 209.64 | 1.67 | 94.48 | 2.19 |
| redrock | 786.71 | 7+94.77 | 3877 | 3428.47 | 3.75 | 3432.22 | 3433.82 | 3437.88 | 0.061 | 19.08 | 203.17 | 1.74 | 93.68 | 2.28 |
| redrock | 719.99 | 7+42.93 | 3877 | 3424.94 | 4.15 | 3429.09 | 3430.63 | 3434.22 | 0.046 | 18.18 | 213.25 | 1.73 | 83.47 | 2.01 |
| redrock | 683.09 | 6+93.43 | 3877 | 3422.19 | 5.17 | 3427.36 | 3429.14 | 3432.87 | 0.028 | 18.84 | 205.74 | 1.81 | 52.64 | 1.68 |
| redrock | 628.86 | 6+40.80 | 3877 | 3418.86 | 5.22 | 3424.08 | 3426.27 | 3431.01 | 0.036 | 21.10 | 183.71 | 1.91 | 49.78 | 1.94 |
| redrock | 588.48 | - | 3877 | 3415.97 | 4.93 | 3420.90 | 3423.26 | 3428.94 | 0.056 | 22.75 | 170.43 | 1.96 | 53.81 | 2.25 |
| redrock | 562.02 | - | 3877 | 3413.79 | 3.71 | 3417.50 | 3419.96 | 3426.43 | 0.074 | 23.97 | 161.75 | 1.92 | 58.54 | 2.54 |
| redrock | 544.43 | - | 3877 | 3411.54 | 3.40 | 3414.94 | 3417.29 | 3423.93 | 0.083 | 24.06 | 161.13 | 1.90 | 64.00 | 2.67 |
| redrock | 494.88 | - | 3877 | 3407.18 | 3.69 | 3410.87 | 3413.16 | 3418.99 | 0.075 | 22.86 | 169.61 | 1.88 | 62.43 | 2.44 |
| redrock | 444.50 | - | 3877 | 3404.00 | 3.50 | 3407.50 | 3409.60 | 3415.48 | 0.085 | 22.65 | 171.14 | 1.86 | 73.69 | 2.62 |
| redrock | 396.32 | - | 3877 | 3401.17 | 3.10 | 3404.27 | 3406.25 | 3411.42 | 0.071 | 21.44 | 180.79 | 1.78 | 78.27 | 2.49 |
| redrock | 347.46 | - | 3877 | 3398.35 | 3.86 | 3402.21 | 3403.98 | 3408.06 | 0.051 | 19.39 | 199.92 | 1.76 | 76.71 | 2.12 |
| redrock | 271.75 | - | 3877 | 3394.36 | 3.83 | 3398.19 | 3399.92 | 3404.67 | 0.072 | 20.42 | 189.88 | 1.80 | 87.50 | 2.44 |
| redrock | 210.47 | - | 3877 | 3390.90 | 3.59 | 3394.49 | 3396.25 | 3400.55 | 0.059 | 19.74 | 196.39 | 1.75 | 81.39 | 2.24 |
| redrock | 161.12 | - | 3877 | 3387.77 | 3.08 | 3390.85 | 3392.70 | 3397.48 | 0.063 | 20.66 | 187.66 | 1.75 | 75.99 | 2.32 |

**HEC-RAS COMPARISON TABLE**

| RIVER STATION | EXIST 100-YR (CFS) | EXIST WSE (FT) | DEVELOPED 100-YR (CFS) | DEVELOPED WSE (FT) | WSE DIFFERENCE |
|---|---|---|---|---|---|
| 2693.56 | 3893 | 3561.37 | 3877 | 3561.36 | -0.01 |
| 2645.53 | 3893 | 3557.73 | 3877 | 3557.72 | -0.01 |
| 2595.89 | 3893 | 3554.28 | 3877 | 3554.28 | 0 |
| 2547.93 | 3893 | 3551.32 | 3877 | 3551.31 | -0.01 |
| 2498.73 | 3893 | 3548.29 | 3877 | 3548.29 | 0 |
| 2445.26 | 3893 | 3544.83 | 3877 | 3544.82 | -0.01 |
| 2399.05 | 3893 | 3542.06 | 3877 | 3542.05 | -0.01 |
| 2345.81 | 3893 | 3538.74 | 3877 | 3538.74 | 0 |
| 2295.64 | 3893 | 3535.57 | 3877 | 3535.56 | -0.01 |
| 2253.32 | 3893 | 3532.54 | 3877 | 3532.53 | -0.01 |
| 2221.01 | 3893 | 3529.89 | 3877 | 3529.88 | -0.01 |
| 2204.49 | 3893 | 3528.05 | 3877 | 3528.05 | 0 |
| 2179.89 | 3893 | 3525.13 | 3877 | 3525.12 | -0.01 |
| 2145.94 | 3893 | 3521.97 | 3877 | 3521.96 | -0.01 |
| 2107.94 | 3893 | 3519.96 | 3877 | 3519.96 | 0 |
| 2065.03 | 3893 | 3516.22 | 3877 | 3516.22 | 0 |
| 2014.37 | 3893 | 3512.42 | 3877 | 3512.42 | 0 |
| 1954.76 | 3893 | 3508.49 | 3877 | 3508.49 | 0 |
| 1915.84 | 3893 | 3505.19 | 3877 | 3505.19 | 0 |
| 1867.51 | 3893 | 3501.2 | 3877 | 3501.2 | 0 |
| 1806.54 | 3893 | 3498.05 | 3877 | 3498.05 | 0 |
| 1739.51 | 3893 | 3493.96 | 3877 | 3493.97 | 0.01 |
| 1681.73 | 3893 | 3490.9 | 3877 | 3490.9 | 0 |
| 1567.51 | 3893 | 3483.68 | 3877 | 3483.67 | -0.01 |
| 1536 | 3893 | 3481.94 | 3877 | 3481.94 | 0 |
| 1493.49 | 3893 | 3479.39 | 3877 | 3479.38 | -0.01 |
| 1443.06 | 3893 | 3475.82 | 3877 | 3475.81 | -0.01 |
| 1384.51 | 3893 | 3472.18 | 3877 | 3472.17 | -0.01 |
| 1337.59 | 3893 | 3469.12 | 3877 | 3469.12 | 0 |
| 1287.04 | 3893 | 3465.93 | 3877 | 3465.92 | -0.01 |
| 1237.36 | 3893 | 3463.06 | 3877 | 3463.05 | -0.01 |
| 1188.33 | 3893 | 3459.92 | 3877 | 3459.89 | -0.03 |
| 1137.15 | 3893 | 3456.01 | 3877 | 3455.94 | -0.07 |
| 1089.47 | 3893 | 3452.72 | 3877 | 3452.76 | 0.04 |
| 1039.52 | 3893 | 3449.39 | 3877 | 3449.36 | -0.03 |
| 986.15 | 3893 | 3445.44 | 3877 | 3445.53 | 0.09 |
| 936.36 | 3893 | 3441.5 | 3877 | 3441.56 | 0.06 |
| 886.26 | 3893 | 3438.55 | 3877 | 3438.52 | -0.03 |
| 836.19 | 3893 | 3435.46 | 3877 | 3435.45 | -0.01 |
| 786.71 | 3893 | 3432.23 | 3877 | 3432.22 | -0.01 |
| 719.99 | 3893 | 3429.09 | 3877 | 3429.09 | 0 |
| 683.09 | 3893 | 3427.35 | 3877 | 3427.36 | 0.01 |
| 628.86 | 3893 | 3424.11 | 3877 | 3424.08 | -0.03 |
| 588.48 | 3893 | 3420.94 | 3877 | 3420.9 | -0.04 |
| 562.02 | 3893 | 3417.52 | 3877 | 3417.5 | -0.02 |
| 544.43 | 3893 | 3414.95 | 3877 | 3414.94 | -0.01 |
| 494.88 | 3893 | 3410.88 | 3877 | 3410.87 | -0.01 |
| 444.5 | 3893 | 3407.51 | 3877 | 3407.5 | -0.01 |
| 396.32 | 3893 | 3404.28 | 3877 | 3404.27 | -0.01 |
| 347.46 | 3893 | 3402.22 | 3877 | 3402.21 | -0.01 |
| 271.75 | 3893 | 3398.2 | 3877 | 3398.19 | -0.01 |
| 210.47 | 3893 | 3394.5 | 3877 | 3394.49 | -0.01 |
| 161.12 | 3893 | 3390.86 | 3877 | 3390.85 | -0.01 |

N

50' 0' 50' 100'

SCALE: 1" = 100'

## LEGEND

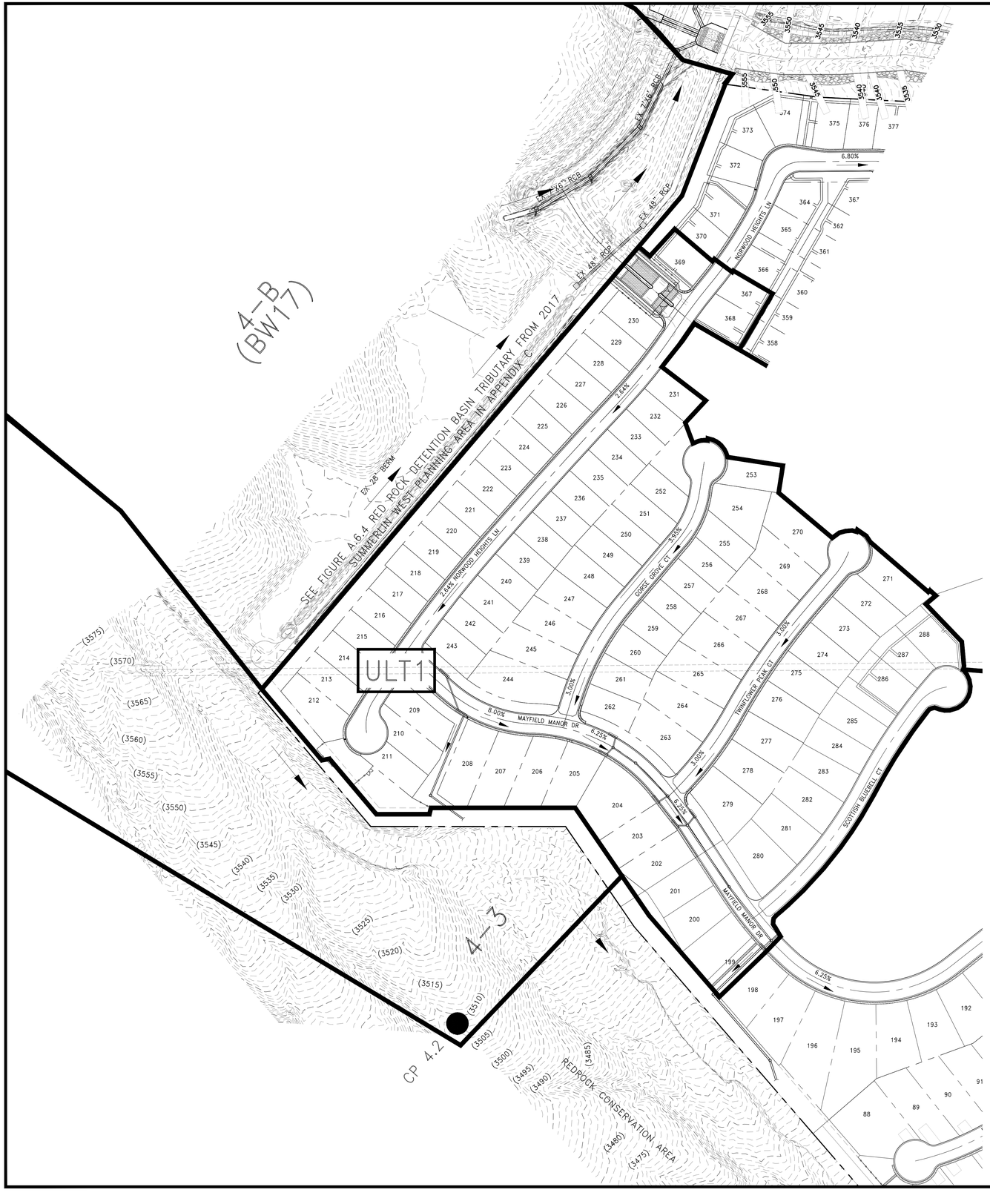
| | |
|---|---|
| STA 1383.6 | STATIONING |
| WSE=3471.9 | WATER SURFACE ELEVATION |
| FF=3490.5 | FINISHED FLOOR ELEVATION |
| 200 | LOT NUMBER |

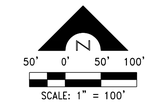
**SUMMERLIN VILLAGE 24**
**PARCEL FGH**
LENNAR

# FIGURE 8
ULTIMATE HEC RAS SECTION MAP

RCI Engineering
500 South Rancho Drive,suite 17
LAS VEGAS, NV 89106
PH#702.453.0800 FAX#702.453.0801

O:\3040_LENR\0057_Summerlin_103_DRAIN\FIGURES\ORIGINAL\FIGURE8-HECRAS.dwg rread 8/01/19 8:56am




## LEGEND

1 — LOT NUMBER

CP 4.2 — PROPOSED FLOW DIRECTION

PROPOSED SUBBASIN BOUNDARY

EXISTING STORM DRAIN PIPE

ULT1 — PROPOSED DRAINAGE SUBBASIN

| OFFSITE RED ROCK WASH HEC-1 MODEL SUMMARY | | |
|---|---|---|
| SUBBASIN | BASIN AREA (ACRES) | 100 YR (CFS) |
| 4-1 | 4.60 | 3825 |
| R4-1 | 4.60 | 3804 |
| CP4.1 | 4.97 | 3899 |
| RCP4.1 | 4.97 | 3875 |
| 4-3 | 135.55 | 192 |
| CP4.2 | 5.18 | 3876 |
| ULT-1 | 20.88 | 63 |
| DIV | 0.03 | 20 |
| SD | 0.03 | 43 |
| CP4.2A | 5.21 | 3877 |

**SUMMERLIN V24 PARCELS FGH**

LENNAR

**FIGURE 9**

OFFSITE CONDITIONS MAP

RCI Engineering
500 South Rancho Drive,suite 17
LAS VEGAS, NV 89106
PH#702.453.0800 FAX#702.453.0801

O:\3040_LENR\0057_Summerlin_103_DRAIN\FIGURES\ORIGINAL\FIGURE9.dwg rread 8/01/13 8:06am

The grading for the onsites has been about 90 percent completed and a technical drainage study will be submitted to accompany the onsite improvement plans. The finish floor elevations of the lots along the Redrock Wash have been shown on Figure 8. As shown all of the lots along the wash have finish floor elevations of at least 1.5 feet above the 100-year WSE. The only exception is Lot 212 and that finish floor elevation is 9.5 feet below the WSE in the Redrock Wash. Please refer to cross section 9 on Sheet D-1. That cross section shows a 7.5-foot deep cutoff wall that will be a minimum of 1-foot below the pad elevation. A similar table will be submitted for the COS-3 and COS-4 wash on the east with the technical drainage study for the onsite developed conditions.

Scour calculations have been performed for the project site along the Red Rock Wash. The total scour in the natural was determined using calculations from Section 704.2 of the Manual. The total scour in an open wash is equal to the combination of long term bed elevation change (Zlt), one half of the anti-dune trough depth (1/2Za), bend scour (Zbs), contraction scour (Zcs) and local scour (Zs) per equation 724 of the Manual. There are no contractions, piers or abutments that occur in the wash. Therefore, the long term bed elevation change (Zlt), one half of the anti-dune trough depth (1/2Za), and bend scour (Zbs) were used for this analysis.

Total Scour (Zt) = Zlt+1/2Za+Zbs+Zcs+Zs (Equation 724)

Equation 708 from the Manual was used for the Anti-Dune Trough Depth. Equation 707 was used for the Long-Term Degradation of Aggradation process, and Equation 709 was used for Bend Scour. There have been several borings drilled for the Project site by Access Consulting Engineers. Those boring locations and Particle Size Distribution Reports have been enclosed in Appendix B. The particle size fell outside the parameters for Table 703A of the Manual. Therefore, Table 704 was used to calculate the C values for the calculations. Please see the geotechnical report and referenced Table 704 in Appendix B. Hydraulic properties used in the scour calculations were taken from the HecRas Model cross sections.

There are 4 sections of wash with different characteristics that were looked at for the scour calculations. The first section of wash analyzed was for the area from HecRas Sta. 6+28.86 to Sta. 7+19.99. The wash through that area is narrow and has a slope of 6.41%.

The total scour through that section of wash will be 14 feet deep. A concrete cut-off wall will be extended 14-feet below the wash invert along that section of channel. Please see Detail Sheet D-1. The second section of wash analyzed was for the area from HecRas Sta. 7+19.99 to Sta. 15+67.51. The wash through that area has a uniform width and has a slope of 5.65%. The total scour through that section of wash will be 2.4 feet deep. A concrete cut-off wall will be extended 3-feet below the wash invert along that section. Please see Detail Sheet D-1.

The third section of wash analyzed was for the area from HecRas Sta. 15+67.51 to Sta. 21+45.03. The wash through that area is wide has an estimated radius of 350 feet and has a slope of 7.58%. Bend scour was included in the calculations for this section of channel since the developed site is on the outside of that radius. The total scour through that section of wash will be 3.7 feet deep. A concrete cut-off wall will be extended 4-feet below the wash invert along that section. The fourth section of wash analyzed was for the area from HecRas Sta. 21+45.03 to north end of the Project. The wash through that area is narrow and has a slope of 6.06%. The total scour through that section of wash will be 7.5 feet deep. A concrete cut-off wall will be extended 7.5-feet below the wash invert in that section. Please see Detail Sheet D-1.

The onsite erosion protection along the Red Rock Wash will be solid grouted large boulders that will be constructed from the concrete cut-off wall up the slope to a 12-foot wide maintenance road. The developed condition HecRas model 100-year WSE in the wash has been shown on Sheets P-1 through P-5. Freeboard in the wash is based on Equation 747 from the manual (Fb=1.0+0.025V(d)^1/3) for supercritical flow regime. Please see the amount of freeboard required in the table on Figure 8.

## X. CONCLUSIONS AND RECOMMENDATIONS

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

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

3. The proposed development does not alter existing peak flows or the character of flows downstream of the development.

4. Storm drain facilities proposed within the project and shown on the grading plans will be constructed with the Rough Grading.

5. Erosion protection will be constructed along the Redrock Conservation area with this set of plans.

6. Improvements on the north and east have been constructed by Summerlin that will protect the site from offsite storm flows.

7. The site is bordered by the Redrock Conservation area. A ten-foot wide buffer has been provided between all improvements and the Redrock Conservation Area to keep the conservation area from being disturbed.

## XI. REFERENCES

1. Clark County Regional Flood Control District, *Clark County Regional Flood Control District - The 2018 Las Vegas Valley Master Plan Update.*

2. Clark County Regional Flood Control District *Hydrologic Criteria and Drainage Design Manual*, updated August 1999.

3. U.S. Army Corps of Engineers, *HEC-1 Flood Hydrograph Package,* June 1998.

4. GC Wallace, Inc., *Conceptual Drainage Study for Summerlin Village 24,* June 2004.

5. GCW Engineering, *Update to the Conceptual Study for Summerlin Village 24,* June 2014.

6. VTN, Nevada, *Summerlin West Planning Area Flood Control Master Plan Update*

7. GCW Engineering, *Village 24-Parcel FGH Entry Road* improvement plans.

8. GCW Engineers, *Technical Drainage Study For Summerlin Village 24 Parcel COS-4 Wash* by GCW Engineering, October 2017.

9. VTN Nevada, *Technical Drainage Study for Summerlin West Village 24 Western Boundary Grading and Drainage*, July 2018.

# APPENDIX A – HYDROLOGIC CALCS

Tentative Map

Precipitation References

Soils Map

Soils References

Curve Number References

Rough (Newly Graded)

- Curve Number Calculations
- Standard Form 4 Calculations
- HEC-1 Models

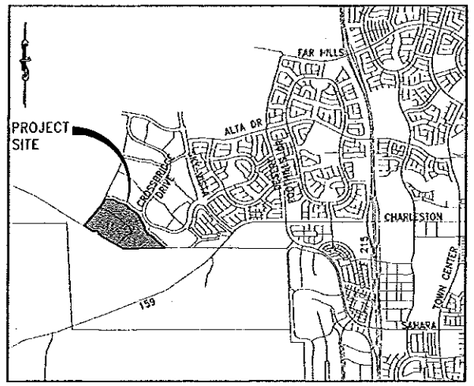
Ultimate

- Curve Number Calculations
- Standard Form 4 Calculations
- HEC-1 Models

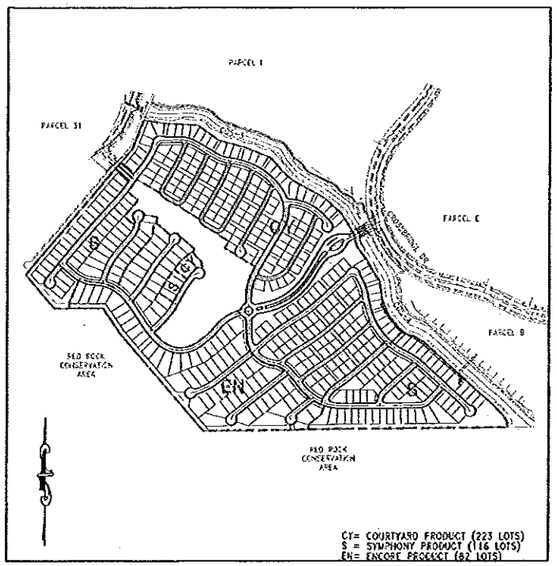
Offsite Model

- Standard Form 4 Calculations
- HEC-1 Models

# TENTATIVE MAP FOR
# SUMMERLIN VILLAGE 24 PARCEL FGH
## A SINGLE FAMILY RESIDENTIAL SUBDIVISION
APN: 164-04-511-001
CITY OF LAS VEGAS, NEVADA
103.82 +/- ACRES
BY
***GREYSTONE NEVADA LLC***




VICINITY MAP
NOT TO SCALE




SITE PLAN
NOT TO SCALE

## OWNER:
THE HOWARD HUGHES COMPANY, LLC
10801 W. CHARLESTON BLVD, 3RD FLOOR
LAS VEGAS, NEVADA 89135

## DEVELOPER:
***GREYSTONE NEVADA LLC***
*9275 W RUSSELL RD. LAS VEGAS, NV 89148*
*PHONE: (702) 736-9100 FAX:(702) 736-9200*

## DESIGN ENGINEER:
RCI Engineering
500 S. Rancho Dr, Suite E7 - Las Vegas, NV 89106 PH:702.453.0800
FAX:702.453.0601

## LEGAL DESCRIPTION
LOT F/G/H AS SHOWN ON THE FINAL MAP OF STONERIDGE UNIT 5 ON FILE IN BOOK 152 OF PLATS, PAGE 41, IN THE OFFICE OF THE COUNTY RECORDER OF CLARK COUNTY, NEVADA.

## BENCHMARK
CITY OF LAS VEGAS BENCHMARK 7LV03 345WB

BRASS AND ROUND PLATE IN THE TOP OF CURB AT THE SOUTHEAST CORNER OF DESERT MOON RD. AND SKY VISTA ER.

ELEVATION = 1011.422 METERS (NAVD '83)
ELEVATION = 3318.31 US SURVEY FEET (NAVD '88)

## BASIS OF BEARINGS
NORTH 05°36'00" WEST, BEING THE BEARING OF THE WEST LINE OF THE SOUTHWEST QUARTER (SW 1/4) OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDERS OFFICE

## DISCLAIMER NOTE:
UTILITY LOCATIONS SHOWN HEREON ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO DETERMINE THE EXACT HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UNDERGROUND OR OVERHEAD UTILITIES PRIOR TO COMMENCING CONSTRUCTION. NO REPRESENTATION IS MADE THAT ALL EXISTING UTILITIES ARE SHOWN HEREON. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR UTILITIES NOT SHOWN OR UTILITIES NOT SHOWN IN THEIR PROPER LOCATION. CONTRACTOR TO NOTIFY ENGINEER OF ANY CHANGES OR DISCREPANCIES.

## GENERAL NOTES
1. ALL IMPROVEMENTS SHALL CONFORM TO THE UNIFORM STANDARDS AND SPECIFICATIONS OF CLARK COUNTY, NEVADA, THE DESIGN GUIDELINES FOR STONERIDGE AT SUMMERLIN V24, AND SPECIFICATIONS OF THE CITY OF LAS VEGAS UNLESS NOTED OTHERWISE.
2. UTILITY SERVICES PROVIDED AS FOLLOWS:
   - WATER ..... LAS VEGAS VALLEY WATER DISTRICT
   - ELECTRIC ..... NV ENERGY
   - GAS ..... SOUTHWEST GAS CORPORATION
   - SEWER ..... CITY OF LAS VEGAS
   - SOLID WASTE DISPOSAL ..... REPUBLIC SERVICES
   - TELEPHONE ..... CENTURYLINK
3. UTILITY EASEMENTS TO BE DEDICATED TO RESPECTIVE AGENCIES.
4. SEWER CONTRIBUTION = 0.1055 M.G.D. AVG.
   SEWER CONTRIBUTION = 0.45 M.G.D. PEAK
5. BUILDING SETBACKS TO COMPLY WITH THE CITY OF LAS VEGAS DEVELOPMENT CODE OR APPROVED WAIVERS.
6. STORM WATER TO SURFACE DRAIN ON STREETS AND IN STORM DRAINS.
7. THIS DEVELOPMENT IS SHOWN IN ITS ENTIRETY ON THIS TENTATIVE MAP.
8. THIS DEVELOPMENT LIES WITHIN A ZONE "X" AS DESIGNATED BY FEMA FIRM MAP# 32003C2125E DATED SEPTEMBER 27, 2007.
9. ALL INTERIOR SEWER AND WATER MAINS ARE 8" AND 12" UNLESS OTHERWISE SHOWN.
10. ALL INTERIOR PRIVATE STREETS ARE 42' WIDE UNLESS OTHERWISE SHOWN.
11. ALL INTERIOR PRIVATE ALLEYS ARE 30' WIDE UNLESS OTHERWISE SHOWN.
12. ALL CURB RADIUS = 20' AT INTERSECTIONS UNLESS OTHERWISE SHOWN.
13. THIS SUBDIVISION WILL HAVE CC&R'S & TO MAINTAIN LANDSCAPING IN PERPETUITY BY THE HOME OWNER'S ASSOCIATION.
14. THERE ARE NO OBSERVABLE FAULTS OR FISSURES ON OR NEAR THIS SITE.
15. SEEPS, SPRINGS, OR OTHER INDICATIONS OF HIGH GROUND WATER LEVELS HAVE NOT BEEN LOCATED WITHIN 20 FEET OF THE EXISTING GROUND SURFACE.
16. PRIVATE INTERIOR STREETS ARE CITY OF LAS VEGAS PUBLIC SEWER EASEMENTS, PUBLIC UTILITY EASEMENTS, AND PUBLIC DRAINAGE EASEMENTS. SURFACE TO BE PRIVATELY MAINTAINED BY THE HOMEOWNERS ASSOCIATION.

## LAND USE INFORMATION:

| | |
|---|---|
| APN | = 164-04-511-001 |
| EXISTING ZONING | = PC/SF2 |
| PROPOSED ZONING | = PC/SFSD |
| TOTAL GROSS ACREAGE | = 103.82 AC |
| TOTAL SINGLE FAMILY NUMBERED LOTS | = 421 |
| D.U.A. | = 4.06 |
| NUMBER OF COMMON LOTS | = 42 |
| OPEN SPACE REQUIREMENT | = 0 Sq. Ft. |
| OPEN SPACE PROVIDED | = 1,065,168 Sq Ft. |
| LOT SIZE | |
| MINIMUM AREA | = 4,002 Sq. Ft. |
| MAXIMUM AREA | = 18,721 Sq. Ft. |
| AVERAGE AREA | = 8,127 Sq. Ft. |
| TYPICAL LOT SIZE | = 97' x 74' (COURTYARDS)<br>52' x 97' (SYMPHONY)<br>62' x 112' (ENCORE) |

## CONNECTIVITY TABLE

LINKS:
INTERNAL= 45
PEDESTRIAN ACCESS= 11 (0.5 EACH)
TOTAL OF LINKS= 51.5

NODES:
INTERNAL STREET INTERSECTIONS= 28
CUL-DE-SACS= 10
TOTAL OF NODES= 38

LINKS/NODES= 51.5/38

CONNECTIVITY SCORE TOTAL= 1.43

## SHEET INDEX



| SHT No. | DWG ID | DRAWING DESCRIPTION |
|---|---|---|
| 1 | TM-1 | COVER SHEET |
| 2 | TM-2 | TENTATIVE MAP (SHEET 1 OF 7) |
| 3 | TM-3 | TENTATIVE MAP (SHEET 2 OF 7) |
| 4 | TM-4 | TENTATIVE MAP (SHEET 3 OF 7) |
| 5 | TM-5 | TENTATIVE MAP (SHEET 4 OF 7) |
| 6 | TM-6 | TENTATIVE MAP (SHEET 5 OF 7) |
| 7 | TM-7 | TENTATIVE MAP (SHEET 6 OF 7) |
| 8 | TM-8 | TENTATIVE MAP (SHEET 7 OF 7) |
| 9 | TM-9 | DETAILS AND SECTIONS (SHEET 1 OF 2) |
| 10 | TM-10 | DETAILS AND SECTIONS (SHEET 2 OF 2) |
| 11 | TM-11 | CROSS SECTION (SHEET 1 OF 3) |
| 12 | TM-12 | CROSS SECTION (SHEET 2 OF 3) |
| 13 | TM-13 | CROSS SECTION (SHEET 3 OF 3) |



## LEGEND

| | |
|---|---|
| RIGHT-OF-WAY/BOUNDARY | |
| CENTERLINE | |
| EASEMENT | |
| PROPOSED PUBLIC SEWER LINE | 8" SWR |
| PROPOSED PUBLIC WATERLINE | 8" WTR |
| EXISTING PUBLIC SEWER LINE | EX. 8" SWR |
| EXISTING PUBLIC WATERLINE | EX. 8" WTR |
| PROPOSED SIDEWALK | |
| PROPOSED FIRE HYDRANT | |
| EXISTING STREET LIGHT | |
| INDEX CONTOUR | 2035 |
| INTERMEDIATE CONTOUR | |
| LOT NUMBER | 1 |
| RATE OF GRADE | 2.00% |
| RIGHT OF WAY | R/W |
| SIDEWALK | SW |
| SQUARE FEET | S.F. |
| COMMON ELEMENT | C.E. |
| POINT OF CONNECTION | POC |
| VISITOR PARKING STALLS | |

| REV | DESCRIPTION | BY | APPD | DATE |
|---|---|---|---|---|
| | | | | |

DATE: May 09, 2019
HORZ. SCALE: ____
VERT. SCALE: ____
DRAWN BY: CR
DESIGNED BY: AM
CHECKED BY: CPC
APPROVED BY: CPC
PROJECT #: 3040.0052

GREYSTONE NEVADA LLC
9275 W RUSSELL RD. LAS VEGAS, NV 89148
PHONE: (702) 736-9100 FAX:(702) 736-9200

RCI Engineering
500 S. Rancho Drive, Suite E7, Las Vegas, NV 89106
PH:702.453.0800 FAX:702.453.0601

TENTATIVE MAP
SUMMERLIN VILLAGE 24 PARCEL FGH
COVER SHEET
CITY OF LAS VEGAS NEVADA

CHRISTOPHER M. ZERVIS — No. 13978 — PROFESSIONAL ENGINEER — STATE OF NEVADA
Exp. 6/30/2020
CIVIL
5-10-19

DRAWING
TM-1
SHT 1 OF 13

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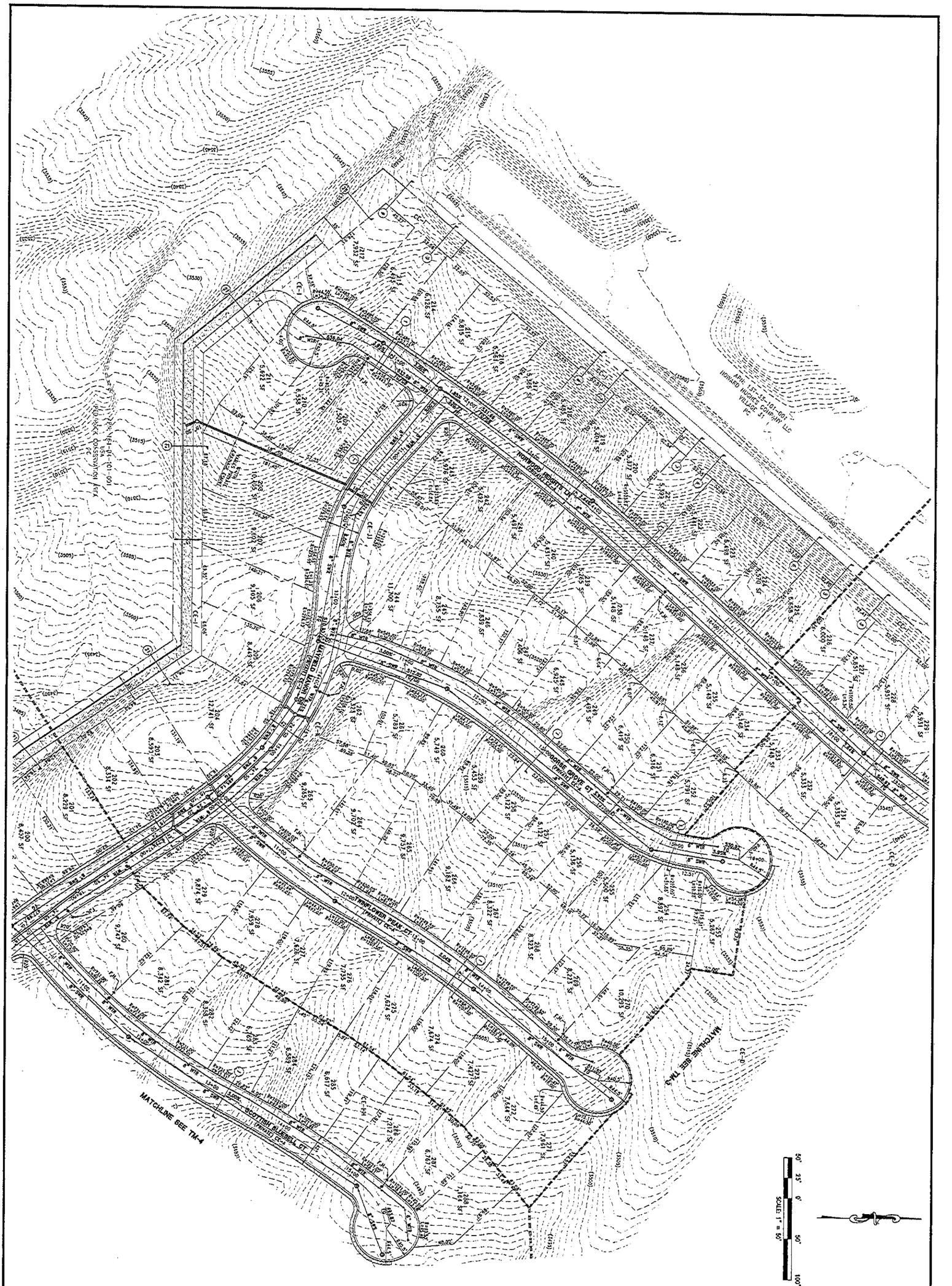


TENTATIVE MAP
SUMMERLIN VILLAGE 24 PARCEL FGH

TENTATIVE MAP (SHEET 1 OF 7)

CITY OF LAS VEGAS NEVADA

TM-2

SHT 2 OF 18

DRAWN: 4-10-19

GREYSTONE NEVADA LLC
9275 W RUSSELL RD. LAS VEGAS, NV 89148
PHONE: (702) 736-9100 FAX:(702) 736-9200

RCI Engineering
500 S. Rancho Drive, Suite 17, Las Vegas, NV 89106
PH#702.453.0800 FAX#702.453.0821

DATE: May 06, 2019
HORIZ. SCALE: 1"=50'
VERT. SCALE: N/A
DRAWN BY: DR
DESIGNED BY: AW
CHECKED BY: CRT
APPROVED BY: CRT
PROJECT #: 3040.0057

| REV | DESCRIPTION | BY | APPD | DATE |
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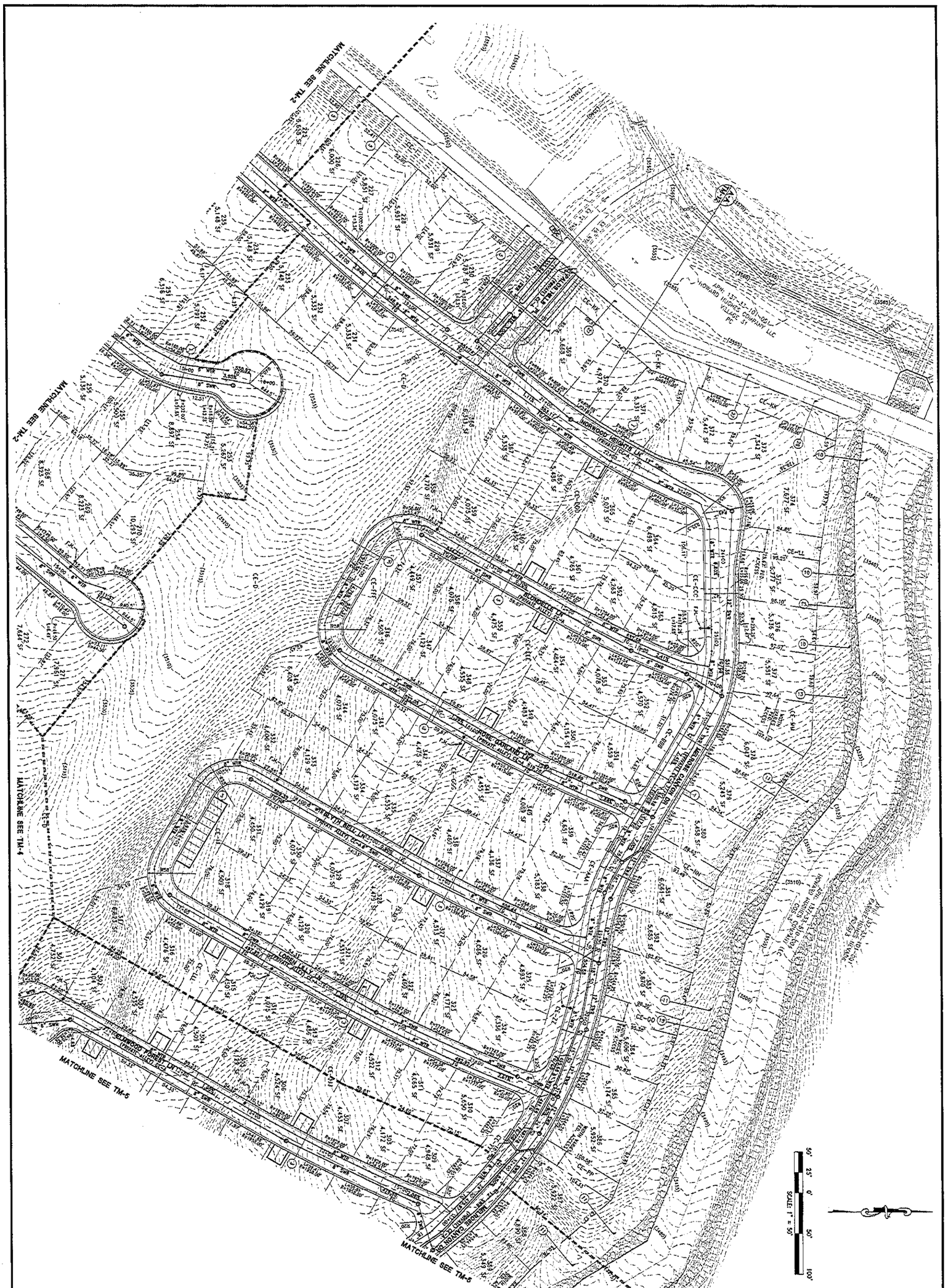


TENTATIVE MAP
SUMMERLIN VILLAGE 24 PARCEL FGH

TENTATIVE MAP (SHEET 2 OF 7)

CITY OF LAS VEGAS NEVADA

TM-3

SHT 3 OF 19

6/10/19

GREYSTONE NEVADA LLC
9275 W RUSSELL RD. LAS VEGAS, NV 89148
PHONE: (702) 736-9100 FAX: (702) 736-9200

RCI Engineering
500 S. Rancho Drive, Suite 27, Las Vegas, NV 89106
PH#702.453.0800 FAX#702.453.0801

DATE: Nov. 09, 2019
HORIZ. SCALE: 1"=50'
VERT. SCALE: N/A
DRAWN BY: EB
DESIGNED BY: AW
CHECKED BY: CRT
APPROVED BY: CRT
PROJECT #: 3040.0057

| REV | DESCRIPTION | BY | APP'D | DATE |
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CE-HHHHHHHHHHHHHHHHHHHHH

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CE-JJJJJJJJJJJJJJJJJJJJJ

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CE-LLLLLLLLLLLLLLLLLLLLL

CE-MMMMMMMMMMMMMMMMMMMMM

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CE-PPPPPPPPPPPPPPPPPPPPP

CE-QQQQQQQQQQQQQQQQQQQQQ

CE-RRRRRRRRRRRRRRRRRRRRR

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CE-TTTTTTTTTTTTTTTTTTTTT

CE-UUUUUUUUUUUUUUUUUUUUU

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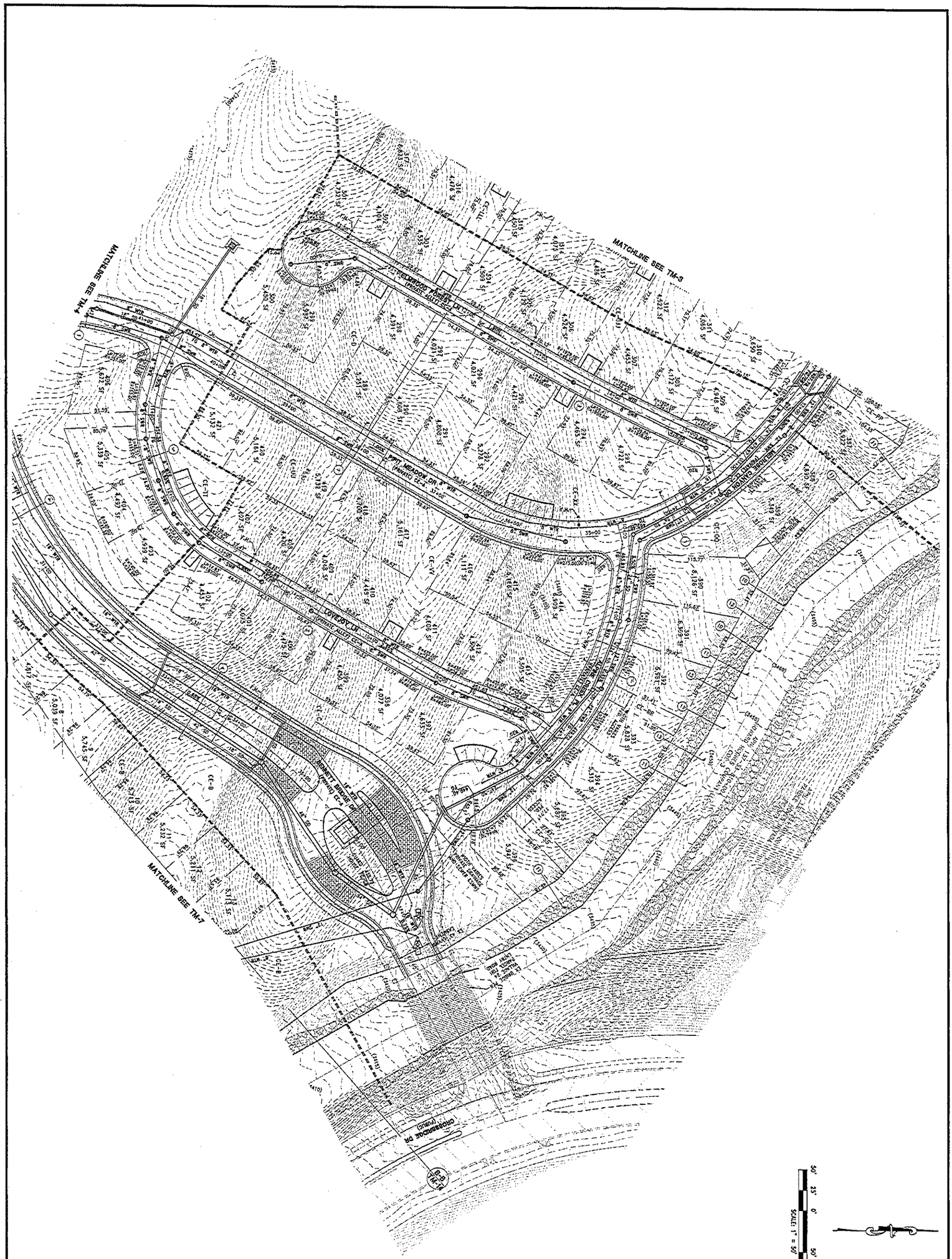
CE-Z




TENTATIVE MAP
SUMMERLIN VILLAGE 24 PARCEL FGH

TENTATIVE MAP (SHEET 4 OF 7)

CITY OF LAS VEGAS NEVADA

TM-5
SHT 5 OF 19

GREYSTONE NEVADA LLC
9275 W RUSSELL RD. LAS VEGAS, NV 89148
PHONE: (702) 736-9100 FAX: (702) 736-9200

RCI Engineering
500 S. Rancho Drive, Suite 17, Las Vegas, NV 89106
PH#702.455.0800 FAX#702.455.0801

DATE: May 09, 2019
HORIZ. SCALE: 1"=50'
VERT. SCALE: N/A
DRAWN BY: SB
DESIGNED BY: AW
CHECKED BY: CPZ
APPROVED BY: CPZ
PROJECT #: 3040.0057

| REV | DESCRIPTION | BY | APP'D | DATE |
|---|---|---|---|---|
| | | | | |

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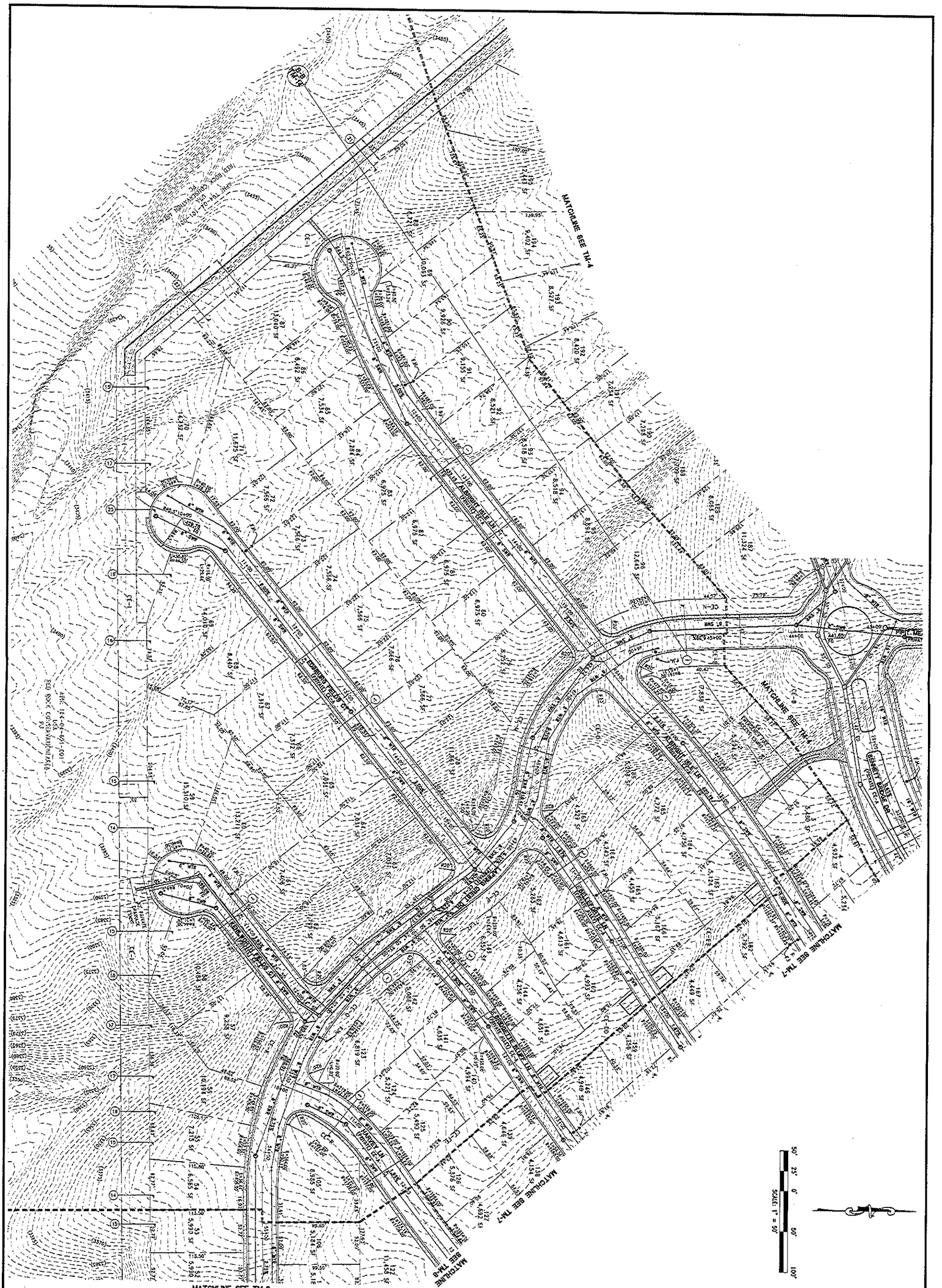


# TENTATIVE MAP
# SUMMERLIN VILLAGE 24 PARCEL FGH

## TENTATIVE MAP (SHEET 5 OF 7)

CITY OF LAS VEGAS — NEVADA

TM-6

SHT 6 OF 13

5-10-19 SIGNED


GREYSTONE NEVADA LLC
9275 W RUSSELL RD. LAS VEGAS, NV 89148
PHONE: (702) 796-9100 FAX:(702) 796-9200

RCI Engineering
500 S. Rancho Drive, Suite 17, Las Vegas, NV 89106
PH#702.453.0800 FAX#702.453.0821


| | |
|---|---|
| DATE: | May 09, 2019 |
| HORIZ. SCALE: | 1"=50' |
| VERT. SCALE: | N/A |
| DRAWN BY: | CB |
| DESIGNED BY: | AM |
| CHECKED BY: | GDZ |
| APPROVED BY: | GDZ |
| PROJECT #: | 3040.0057 |

| REV | DESCRIPTION | BY | APP'D | DATE |
|---|---|---|---|---|
| | | | | |

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TENTATIVE MAP
SUMMERLIN VILLAGE 24 PARCEL FGH

TENTATIVE MAP (SHEET 6 OF 7)

CITY OF LAS VEGAS NEVADA

TM-7

SHT 7 OF 18

5-10-19

**GREYSTONE NEVADA LLC**
9275 W RUSSELL RD. LAS VEGAS, NV 89148
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**RCI Engineering**
500 S. Rancho Drive, Suite 17, Las Vegas, NV 89106
PH:702.453.0800 FAX:702.453.0801

DATE: May 06, 2019
HORIZ. SCALE: 1"=50'
VERT. SCALE: N/A
DRAWN BY: CR
DESIGNED BY: KM
CHECKED BY: CRF
APPROVED BY: CRF
PROJECT #: 3040.0057

| REV | DESCRIPTION | BY | APPD | DATE |
|---|---|---|---|---|
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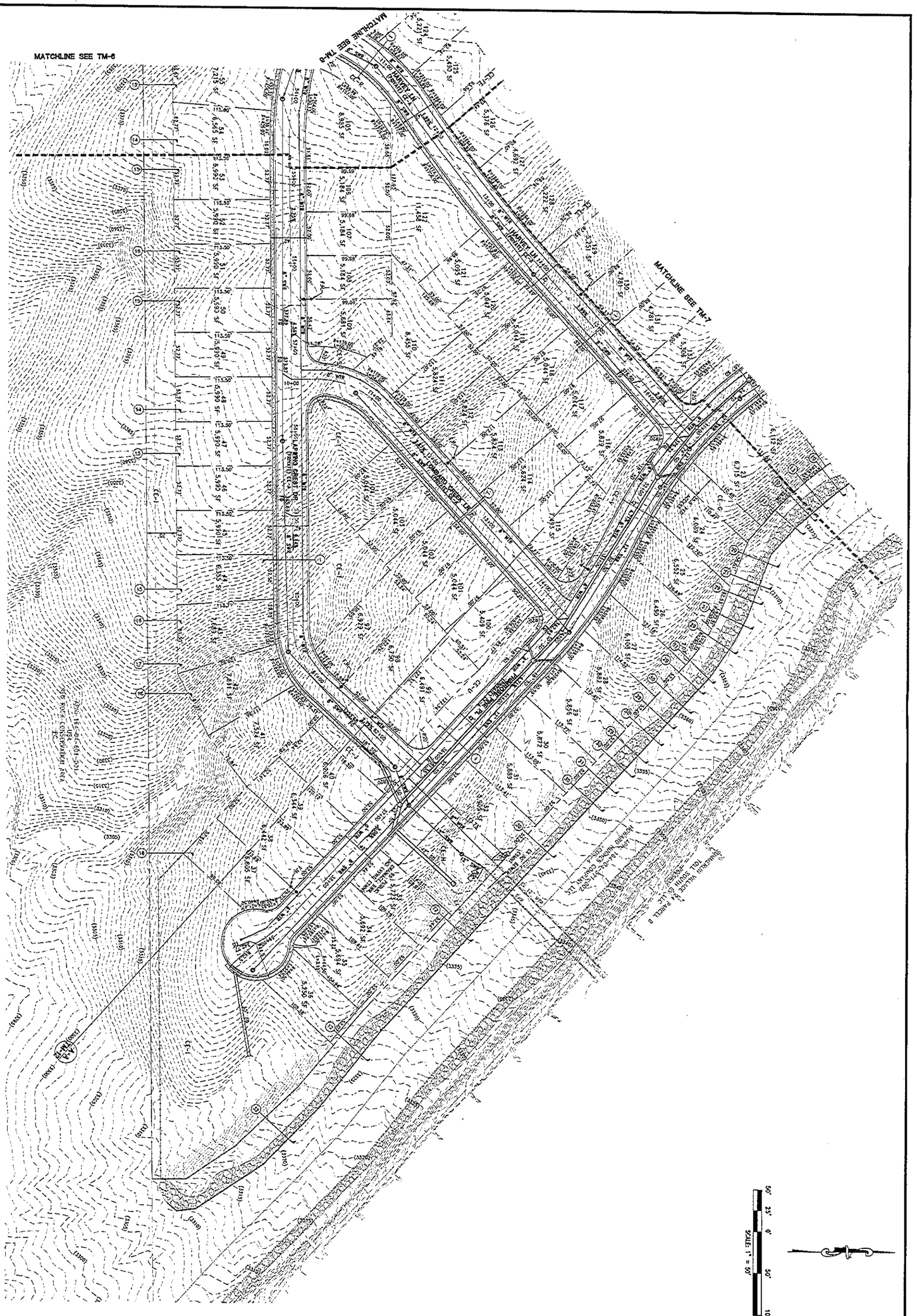


TENTATIVE MAP
SUMMERLIN VILLAGE 24 PARCEL FGH

TENTATIVE MAP (SHEET 7 OF 7)

CITY OF LAS VEGAS NEVADA

TM-8
SHT 8 OF 13

5-11-19


GREYSTONE NEVADA LLC
9275 W RUSSELL RD. LAS VEGAS, NV 89148
PHONE: (702) 736-2100 FAX:(702) 736-2200

RCI Engineering
500 S. Rancho Drive, Suite 17, Las Vegas, NV 89106
PH#702.453.0800 FAX#702.453.0801


DATE: May 09, 2019
HORIZ. SCALE: 1"=50'
VERT. SCALE: N/A
DRAWN BY: SR
DESIGNED BY: AM
CHECKED BY: CRT
APPROVED BY: CRT
PROJECT #: 3049.0057

| REV | DESCRIPTION | BY | APP'D | DATE |
|---|---|---|---|---|
| | | | | |

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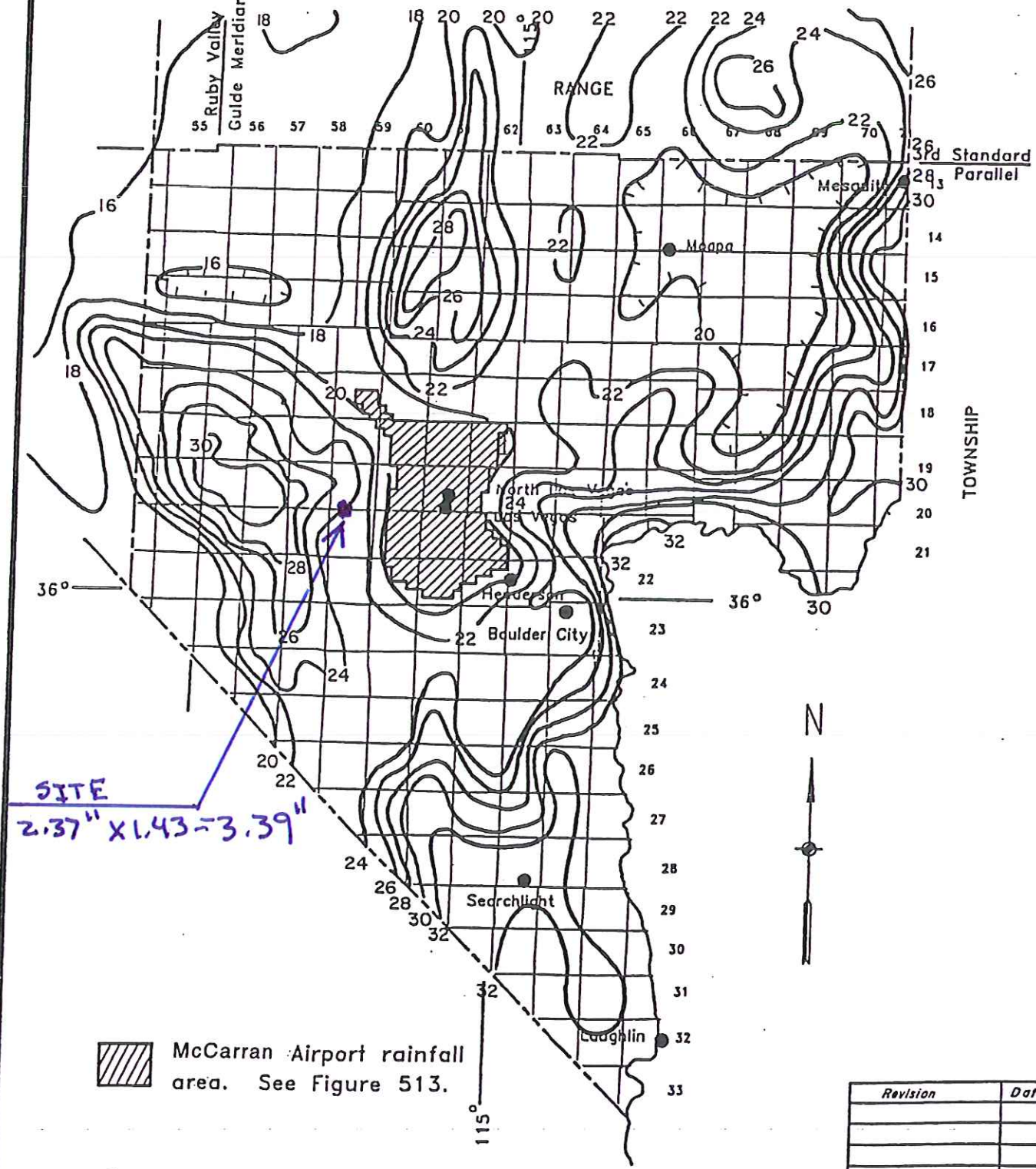
# RAINFALL DEPTH-DURATION-FREQUENCY
## 100-YEAR, 6-HOUR
### (DEPTHS IN TENTHS OF INCHES)

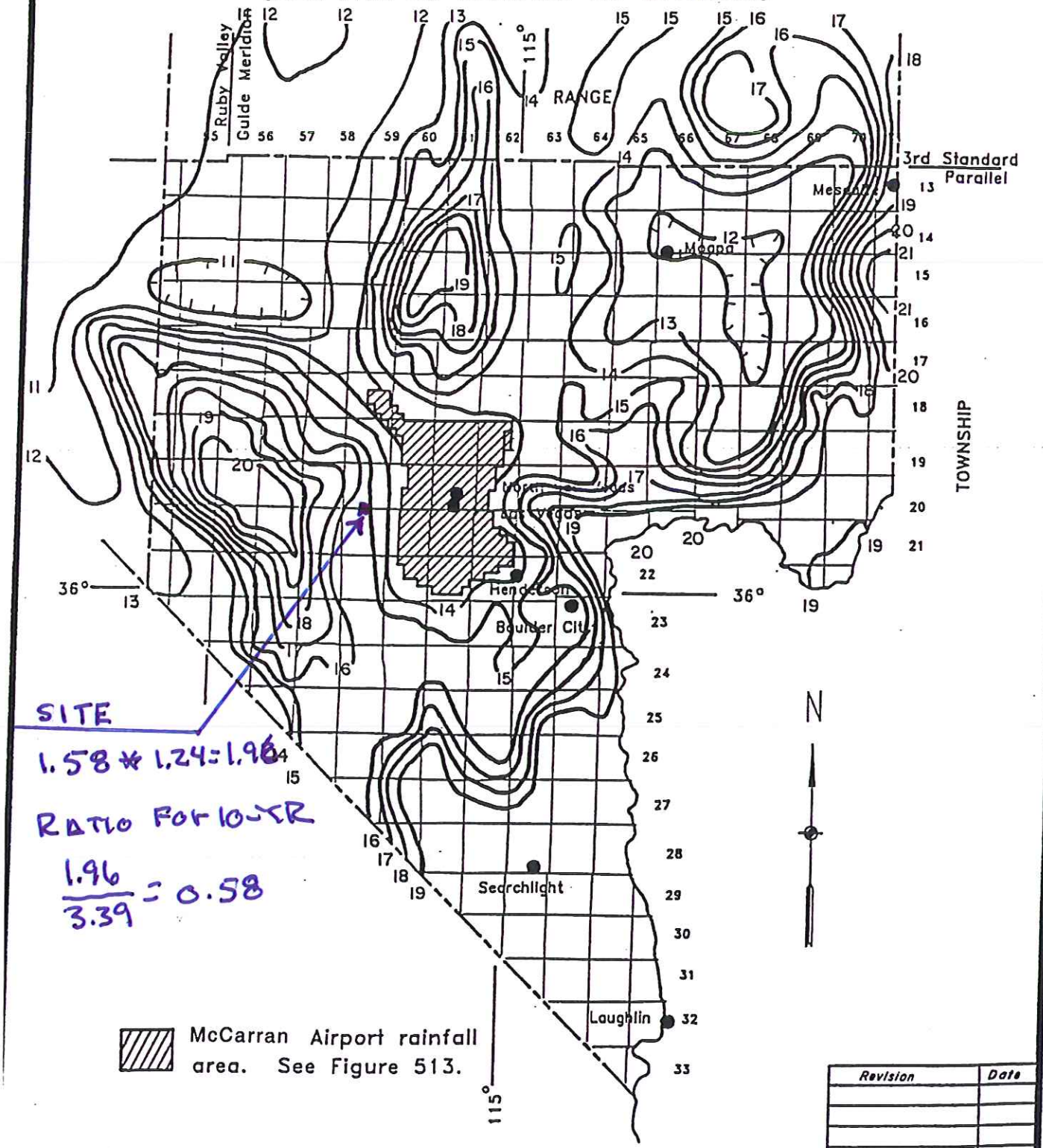



| Revision | Date |
|---|---|
| | |
| | |
| | |
| | |

| WRC ENGINEERING | REFERENCE: NOAA ATLAS 2, VOLUME VII NEVADA, 1973 | FIGURE 506 |
|---|---|---|

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## RAINFALL DEPTH-DURATION-FREQUENCY
## 10-YEAR, 6-HOUR
### (DEPTHS IN TENTHS OF INCHES)




| Revision | Date |
|---|---|
| | |
| | |
| | |
| | |

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 503

# PRECIPITATION ADJUSTMENT RATIOS

| Recurrence Interval | Ratio to NOAA Atlas 2 |
|---|---|
| 2-year | 1.00 |
| 5-year | 1.16 |
| 10-year | 1.24 |
| 25-year | 1.33 |
| 50-year | 1.39 |
| 100-year | 1.43 |

NOTE:
1. Multiply the values obtained from the NOAA Atlas 2 by the above ratios to obtain the adjusted precipitation values.
2. NOAA Atlas 2 values for use with TR-55 shall not be adjusted by the above ratios.
3. Tables 505 and 506 require no adjustments.

| Revision | Date |
|---|---|
| | |
| | |
| | |
| | |

Soil Map—Las Vegas Valley Area, Nevada, Part of Clark County
(Village 24 Parcels FGH)

Map Scale: 1:13,700 if printed on B landscape (17" x 11") sheet.

N

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

## MAP LEGEND

**Area of Interest (AOI)**
- Area of Interest (AOI)

**Soils**
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

**Special Point Features**
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

**Water Features**
- Streams and Canals

**Transportation**
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**
- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Las Vegas Valley Area, Nevada, Part of Clark County
Survey Area Data: Version 13, Sep 14, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 6, 2016—Sep 1, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

| Engineering Properties–Las Vegas Valley Area, Nevada, Part of Clark County | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Map unit symbol and soil name | Pct. of map unit | Hydrologic group | Depth | USDA texture | Classification | | Pct Fragments | | Percentage passing sieve number— | | | | Liquid limit | Plasticity index |
| | | | | | Unified | AASHTO | >10 inches | 3-10 inches | 4 | 10 | 40 | 200 | | |
| | | | *In* | | | | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* |
| 731—Purob-Irongold association | | | | | | | | | | | | | | |
| Purob | 60 | D | 0-3 | Extremely gravelly loam | GC-GM, GC | A-2 | 0- 2- 5 | 0- 6- 10 | 25-33-40 | 15-23-30 | 13-18-25 | 10-15-20 | 18-23-29 | 3-7 -10 |
| | | | 3-8 | Gravelly loam, very gravelly loam | GC-GM, GC, SC, SC-SM | A-4, A-6, A-2 | 0- 0- 5 | 0- 0- 5 | 45-55-80 | 35-45-70 | 30-45-60 | 25-38-50 | 22-30-34 | 7-13-14 |
| | | | 8-19 | Extremely gravelly loam, extremely gravelly clay loam, very gravelly loam | GC, GC-GM | A-2 | 0- 0- 5 | 0- 7- 15 | 25-40-55 | 15-30-45 | 15-25-35 | 10-20-30 | 22-31-31 | 7-12-14 |
| | | | 19-60 | Cemented material | — | — | — | — | — | — | — | — | — | — |
| Irongold | 25 | D | 0-1 | Extremely gravelly loam | GM | A-1 | 0- 2- 5 | 0- 8- 10 | 25-30-35 | 15-20-25 | 15-18-20 | 10-13-15 | 15-20-25 | NP-3 -5 |
| | | | 1-7 | Gravelly loam, loam | SM, ML, GM, CL-ML | A-4 | 0- 0- 5 | 0- 0- 5 | 70-83-95 | 60-75-90 | 50-65-80 | 45-58-70 | 15-20-25 | NP-3 -5 |
| | | | 7-11 | Gravelly sandy loam, very gravelly loam, very gravelly sandy loam, gravelly loam | GM, SM | A-1, A-2, A-4 | 0- 3- 5 | 0- 5- 10 | 35-48-65 | 30-43-60 | 20-35-50 | 15-28-40 | 15-20-25 | NP-3 -5 |
| | | | 11-34 | Cemented material | — | — | — | — | — | — | — | — | — | — |
| | | | 34-60 | Extremely gravelly loamy coarse sand | GP, GP-GM | A-1 | 0- 0- 5 | 0- 0- 5 | 30-38-45 | 10-18-25 | 5- 8- 10 | 0- 5- 10 | 0-17 -21 | NP-2 -4 |
| Typic torriorthents | 5 | A | 0-3 | Very gravelly sandy loam | GP, GP-GM | A-1 | 0- 0- 0 | 15-28-40 | 20-28-35 | 10-18-25 | 5-13- 20 | 0- 5- 10 | 15-20-25 | NP-3 -5 |

| Engineering Properties–Las Vegas Valley Area, Nevada, Part of Clark County | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Map unit symbol and soil name | Pct. of map unit | Hydrologic group | Depth | USDA texture | Classification | | Pct Fragments | | Percentage passing sieve number— | | | | Liquid limit | Plasticity index |
| | | | | | Unified | AASHTO | >10 inches | 3-10 inches | 4 | 10 | 40 | 200 | | |
| | | | *In* | | | | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* |
| | | | 3-9 | Extremely gravelly sandy loam, extremely gravelly fine sandy loam | GP, GP-GM | A-1 | 0- 0- 0 | 10-20-30 | 20-28-35 | 10-18-25 | 5-13- 20 | 0- 5- 10 | 15-20-25 | NP-3 -5 |
| | | | 9-31 | Extremely gravelly fine sandy loam, extremely gravelly sandy loam | GP, GW-GM | A-1 | 0- 3- 5 | 0- 5- 10 | 20-30-40 | 10-18-25 | 5-13- 20 | 0- 5- 10 | 15-20-25 | NP-3 -5 |
| | | | 31-60 | Stratified extremely gravelly loamy coarse sand to extremely gravelly fine sandy loam | GP, GW-GM | A-1 | 0- 3- 5 | 0- 5- 10 | 20-30-40 | 10-18-25 | 5-13- 20 | 0- 5- 10 | 15-20-25 | NP-3 -5 |
| Arizo | 3 | A | 0-5 | Extremely gravelly loamy coarse sand | GP-GM, GP | A-1 | 0- 2- 5 | 0- 5- 10 | 30-40-50 | 15-25-30 | 5-10- 15 | 0- 5- 10 | 10-12-15 | NP-2 -5 |
| | | | 5-60 | Stratified very gravelly coarse sand to extremely gravelly sand | GP-GM, SP-SM, SP, GP | A-1 | 0- 0- 5 | 0- 5- 25 | 25-40-55 | 10-25-45 | 5-15- 30 | 0- 3- 7 | 0-0 -18 | NP-0 -2 |
| Purob | 3 | D | 0-3 | Extremely gravelly loam | GC, GC-GM | A-2 | 0- 2- 5 | 0- 6- 10 | 25-33-40 | 15-23-30 | 13-18-25 | 10-15-20 | 18-23-29 | 3-7 -10 |
| | | | 3-8 | Gravelly loam, very gravelly loam | GC-GM, GC, SC, SC-SM | A-4, A-6, A-2 | 0- 0- 5 | 0- 0- 5 | 45-55-80 | 35-45-70 | 30-45-60 | 25-38-50 | 22-30-34 | 7-13-14 |
| | | | 8-19 | Extremely gravelly loam, very gravelly loam, extremely gravelly clay loam | GC, GC-GM | A-2 | 0- 0- 5 | 0- 7- 15 | 25-40-55 | 15-30-45 | 15-25-35 | 10-20-30 | 22-31-31 | 7-12-14 |

| Engineering Properties–Las Vegas Valley Area, Nevada, Part of Clark County | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Map unit symbol and soil name | Pct. of map unit | Hydrologic group | Depth | USDA texture | Classification | | Pct Fragments | | Percentage passing sieve number— | | | | Liquid limit | Plasticity index |
| | | | | | Unified | AASHTO | >10 inches | 3-10 inches | 4 | 10 | 40 | 200 | | |
| | | | *In* | | | | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* |
| | | | 19-60 | Cemented material | — | — | — | — | — | — | — | — | — | — |
| Typic haplocalcids | 2 | B | 0-5 | Very gravelly fine sandy loam | GM | A-1, A-2 | 0- 3- 5 | 0- 5- 10 | 35-45-55 | 25-38-50 | 20-30-40 | 10-20-30 | 25-28-30 | NP-3 -5 |
| | | | 5-14 | Extremely gravelly sandy loam | GP-GM | A-1 | 0- 3- 5 | 0- 5- 10 | 25-30-35 | 15-20-25 | 10-15-20 | 5- 8- 10 | 25-28-30 | NP-3 -5 |
| | | | 14-60 | Extremely gravelly fine sandy loam, extremely gravelly coarse sandy loam, extremely gravelly sandy loam | GP-GM | A-1 | 0- 3- 5 | 5-13- 20 | 25-30-35 | 15-20-25 | 10-15-20 | 5- 8- 10 | 25-28-30 | NP-3 -5 |
| Aridic calcixerolls | 1 | A | 0-3 | Very gravelly sandy loam | GM, SM | A-1-b | 0- 0- 0 | 0- 8- 15 | 30-47-65 | 25-38-50 | 20-30-40 | 10-18-25 | 15-20-25 | NP-3 -5 |
| | | | 3-10 | Gravelly fine sandy loam | GM, SM | A-4, A-1, A-2-4 | 0- 0- 0 | 0- 5- 10 | 55-70-85 | 50-63-75 | 35-50-65 | 20-33-45 | 15-20-25 | NP-3 -5 |
| | | | 10-46 | Extremely gravelly sandy loam, extremely gravelly fine sandy loam | GP, GM, GP-GM, GP-GM | A-1-a | 0- 0- 0 | 0- 8- 15 | 20-35-50 | 10-20-30 | 5-18- 30 | 0- 8- 15 | 15-20-25 | NP-3 -5 |

| Engineering Properties–Las Vegas Valley Area, Nevada, Part of Clark County | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Map unit symbol and soil name | Pct. of map unit | Hydrologic group | Depth | USDA texture | Classification | | Pct Fragments | | Percentage passing sieve number— | | | | Liquid limit | Plasticity index |
| | | | | | Unified | AASHTO | >10 inches | 3-10 inches | 4 | 10 | 40 | 200 | | |
| | | | *In* | | | | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* | *L-R-H* |
| | | | 46-60 | Very gravelly sandy loam, extremely gravelly sandy loam, very gravelly loamy coarse sand | GP-GM, GM, SP-SM, SM | A-1 | 0- 0- 0 | 0- 3- 5 | 30-47-65 | 20-35-50 | 10-23-35 | 5-13- 20 | 15-18 -20 | NP-3 -5 |
| Xeric haplocambids | 1 | A | 0-3 | Very gravelly sandy loam | GM, SM | A-1 | 0- 0- 0 | 0- 8- 15 | 30-47-65 | 25-38-50 | 20-30-40 | 10-18-25 | 15-20 -25 | NP-3 -5 |
| | | | 3-10 | Gravelly fine sandy loam | GM, SM | A-4, A-1, A-2 | 0- 0- 0 | 0- 5- 10 | 55-70-85 | 50-63-75 | 35-50-65 | 20-33-45 | 15-20 -25 | NP-3 -5 |
| | | | 10-46 | Extremely gravelly fine sandy loam, extremely gravelly sandy loam | GP, GM, GP-GM | A-1 | 0- 0- 0 | 0- 8- 15 | 20-35-50 | 10-20-30 | 5-18- 30 | 0- 8- 15 | 15-20 -25 | NP-3 -5 |
| | | | 46-60 | Very gravelly loamy coarse sand, extremely gravelly sandy loam | GP-GM, GM, SP-SM, SM | A-1 | 0- 0- 0 | 0- 3- 5 | 30-47-65 | 20-35-50 | 10-23-35 | 5-13- 20 | 15-18 -20 | NP-3 -5 |

88% "D"
10% "A"
2% "B"

## RUNOFF CURVE NUMBERS - RESIDENTIAL DISTRICTS

| Average Lot Size or Usage[1] | Percent Impervious[2] | Curve Number for Hydrologic Soil Groups | | | |
|---|---|---|---|---|---|
| | | A | B | C | D |
| Apartments/Condos | 72 | 81 | 88 | 91 | 93 |
| Townhouses/6,000 sq ft lots or less[3] | 69 | 80 | 87 | 90 | 92 |
| 7,000 sq ft lots | 63 | 76 | 84 | 89 | 91 |
| 8,000 sq ft lots 9000 SQ FT | 58 | 73 67 | 82 79 | 88 86 | 90 89 |
| 10,000 sq ft lots | 38 | 61 | 75 | 83 | 87 |
| 14,000 sq ft lots | 30 | 57 | 72 | 81 | 86 |
| 20,000 sq ft lots | 25 | 54 | 70 | 80 | 85 |
| 40,000 sq ft lots | 20 | 51 | 68 | 79 | 84 |
| 80,000 sq ft lots | 12 | 46 | 65 | 77 | 82 |

1 Lot size should represent the size of the average lot and not the gross acreage divided by the number of lots.
2 Actual percent impervious value should be compared to selected land use type.
3 In cases where average residential lots are smaller than 6,000 sq ft, commercial/business/industrial land use should be used.

| Revision | Date |
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| | |
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REFERENCE:

TABLE 602A

# RUNOFF CURVE NUMBERS
## (URBAN AREAS[1])

| Cover description | | Curve numbers for hydrologic soil group— | | | |
|---|---|---|---|---|---|
| Cover type and hydrologic condition | Average percent impervious area[2] | A | B | C | D |
| *Fully developed urban areas (vegetation established)* | | | | | |
| Open space (lawns, parks, golf courses, cemeteries, etc.)[3]: | | | | | |
| Poor condition (grass cover < 50%) | | 68 | 79 | 86 | 89 |
| Fair condition (grass cover 50% to 75%) | | 49 | 69 | 79 | 84 |
| Good condition (grass cover > 75%) | | 39 | 61 | 74 | 80 |
| Impervious areas: | | | | | |
| Paved parking lots, roofs, driveways, etc. (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Streets and roads: | | | | | |
| Paved; curbs and storm sewers (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Paved; open ditches (including right-of-way) | | 83 | 89 | 92 | 93 |
| Gravel (including right-of-way) | | 76 | 85 | 89 | 91 |
| Dirt (including right-of-way) | | 72 | 82 | 87 | 89 |
| Western desert urban areas: | | | | | |
| Natural desert landscaping (pervious areas only)[4] | | 63 | 77 | 85 | 88 |
| Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) | | 96 | 96 | 96 | 96 |
| Urban districts: | | | | | |
| Commercial and business | 85 | 89 | 92 | 94 | 95 |
| Industrial | 72 | 81 | 88 | 91 | 93 |
| Residential districts by average lot size: | | | | | |

**See Table 602A**

| | | | | | |
|---|---|---|---|---|---|
| *Developing urban areas* | | | | | |
| Newly graded areas (pervious areas only, no vegetation)[5] | | 77 | 86 | 91 | 94 |

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system. Impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using Figure 603.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using Figure 603 based on the impervious area percentage (CN #98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using Figure 603 based on the degree of development impervious area percentage) and the CN's for the newly graded pervious areas.

| Revision | Date |
|---|---|
| | |
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| | |

## CN CALCULATIONS - NEWLY GRADED CONDITIONS

| Basin | % SOIL TYPE | HYDRO | CN- NEWLY GRADED % | | WEIGHTED CN |
|---|---|---|---|---|---|
| RG-1 | 10 | A | 100 | 77 | 7.7 |
| | 2 | B | 100 | 86 | 1.7 |
| | | C | | 91 | 0.0 |
| | 88 | D | 100 | 94 | 82.7 |
| | | | | | **92** |

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## TIME OF CONCENTRATION

RCI ENGINEERING

SUMMERLIN VILLAGE 24 PARCELS FGH
ROUGH GRADING

BY: RTE
DATE: 7/26/19

| SUB-BASIN DATA | | | | | | INITIAL / OVERLAND TIME (Ti) | | | TRAVEL TIME (Tt) | | | | | Tc | Tc Check | Tlag | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIG: | DEV./EX. (D or E) | CN | K | AREA Ac | AREA Mi^2 | INITIAL LENGTH Feet | SLOPE % | Ti Min | TRAVEL LENGTH Feet | SLOPE % | V1 VELOCITY FPS | V2 VELOCITY FPS | Tt Min | Min | Min | Tlag= 0.6Tc/60 Hours | |
| (1) | | | (2) | (3) | | (4) | (5) | (6) | (7) | (8) | (9a) | (9b) | (10) | (13) | (14) | | |
| RG-1 | D | 92.0 | 0.8244 | 103.80 | 0.1622 | 309 | 2.6 | 6.3 | 4572 | 4.5 | 4.3 | 6.5 | 12.3 | 18.7 | 37 | 0.187 | |
| | | | | | | | | | | | | | | | | | |

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
Tc Check (Developed) = L/180+10

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
Existing V2 = 29.4*(S/100)^1/2
Minimum Tc (EX) = 10 Min per Section 602

Developed V1 = 20.2*(S/100)^1/2
Developed V2 = 30.6*(S/100)^1/2
Minimum Tc (DEV) = 5 Min per Section 602.1

REFERENCE :

STANDARD FORM 4

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN  1998                *
 *           VERSION 4.1                 *
 *                                       *
 *  RUN DATE   23JUL19  TIME  07:18:35   *
 *                                       *
 *****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*            (916) 756-1104             *
*                                       *
*****************************************
```

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

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

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



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

                        *DIAGRAM
            1           ID    SUMMERLIN VILLAGE 24 PARCEL FGH
            2           ID    NEWLY GRADED MODEL
            3           ID    DESIGN STORM = 100-YEAR 6-HOUR STORM
            4           ID    STORM DISTRIBUTION = SDN3
            5           ID
            6           IT      5       0       0     300
            7           IO      5       0       0
            8           IN      5       0       0
            9           JR    PREC    1.00    0.58
                        *

           10           KK    RG-1
           11           KM    SUBBASIN RG-1
           12           BA  0.1622
           13           PB    3.39
           14           PC  0.000   0.020   0.057   0.070   0.087   0.108   0.124   0.130   0.130   0.130
           15           PC  0.130   0.130   0.130   0.133   0.140   0.142   0.148   0.158   0.172   0.181
           16           PC  0.190   0.197   0.199   0.200   0.201   0.204   0.214   0.229   0.241   0.249
           17           PC  0.251   0.256   0.270   0.278   0.281   0.283   0.295   0.322   0.352   0.409
           18           PC  0.499   0.590   0.710   0.744   0.781   0.812   0.819   0.835   0.851   0.856
           19           PC  0.860   0.868   0.876   0.888   0.910   0.926   0.937   0.950   0.970   0.976
           20           PC  0.982   0.985   0.987   0.989   0.990   0.993   0.993   0.994   0.995   0.998
           21           PC  0.998   0.999   1.000
           22           LS      0      92
           23           UD  0.187
                        *
           24           ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

    10       RG-1

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```


```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN  1998                *
 *           VERSION 4.1                 *
 *                                       *
 *  RUN DATE   23JUL19  TIME  07:18:35   *
 *                                       *
 *****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*            (916) 756-1104             *
*                                       *
*****************************************
```


SUMMERLIN VILLAGE 24 PARCEL FGH
NEWLY GRADED MODEL
DESIGN STORM = 100-YEAR 6-HOUR STORM
STORM DISTRIBUTION = SDN3

```
   7 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
```

```
                    ITIME        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       .58
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  RATIO 2
                                                             1.00       .58

 HYDROGRAPH AT
+                  RG-1        .16      1   FLOW            303.      150.
                                             TIME            3.58      3.58


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

**CN CALCULATIONS - ULTIMATE CONDITIONS**

| | | | CN- COMMERCIAL (LESS 6,000 SF) | | CN-9,000 SF LOTS | | CN - DESERT LANDSCAPING | | |
|---|---|---|---|---|---|---|---|---|---|
| Basin | % SOIL TYPE | HYDRO | % | | % | | % | | WEIGHTED CN |
| ULT-1 | 10 | A | 50 | 89 | 50 | 67 | | 63 | 7.8 |
| | 2 | B | 50 | 92 | 50 | 79 | | 77 | 1.7 |
| | | C | | 94 | | 86 | | 85 | 0.0 |
| | 88 | D | 50 | 95 | 50 | 89 | | 88 | 81.0 |
| | | | | | | | | | **90** |
| Basin | % SOIL TYPE | HYDRO | | | | | | | WEIGHTED CN |
| ULT-2, ULT-3 | 10 | A | 100 | 89 | | 67 | | 63 | 8.9 |
| | 2 | B | 100 | 92 | | 79 | | 77 | 1.8 |
| | | C | | 94 | | 86 | | 85 | 0.0 |
| | 88 | D | 100 | 95 | | 89 | | 88 | 83.6 |
| | | | | | | | | | **94** |
| Basin | % SOIL TYPE | HYDRO | | | | | | | WEIGHTED CN |
| ULT-5, ULT6 | 10 | A | 100 | 89 | | 67 | | 63 | 8.9 |
| | 2 | B | 100 | 92 | | 79 | | 77 | 1.8 |
| | | C | | 94 | | 86 | | 85 | 0.0 |
| | 88 | D | 100 | 95 | | 89 | | 88 | 83.6 |
| | | | | | | | | | **94** |
| Basin | % SOIL TYPE | HYDRO | | | | | | | WEIGHTED CN |
| ULT-4 | 10 | A | | 89 | 100 | 67 | | 63 | 6.7 |
| | 2 | B | | 92 | 100 | 79 | | 77 | 1.6 |
| | | C | | 94 | | 86 | | 85 | 0.0 |
| | 88 | D | | 95 | 100 | 89 | | 88 | 78.3 |
| | | | | | | | | | **87** |
| Basin | % SOIL TYPE | HYDRO | | | | | | | WEIGHTED CN |
| ULT-RC1 | 10 | A | | 89 | | 67 | 100 | 63 | 6.3 |
| | 2 | B | | 92 | | 79 | 100 | 77 | 1.5 |
| | | C | | 94 | | 86 | | 85 | 0.0 |
| | 88 | D | | 95 | | 89 | 100 | 88 | 77.4 |
| | | | | | | | | | **85** |
| Basin | % SOIL TYPE | HYDRO | | | | | | | WEIGHTED CN |
| ULT-RC2 | 10 | A | 75 | 89 | 25 | 67 | | 63 | 8.4 |
| | 2 | B | 75 | 92 | 25 | 79 | | 77 | 1.8 |
| | | C | | 94 | | 86 | | 85 | 0.0 |
| | 88 | D | 75 | 95 | 25 | 89 | | 88 | 82.3 |
| | | | | | | | | | **92** |

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## TIME OF CONCENTRATION

RCI
ENGINEERING

**SUMMERLIN VILLAGE 24 PARCELS FGH**
**Ultimate Conditions**

BY: rjr
DATE: 7/24/19

| SUB-BASIN DATA | | | | | | INITIAL / OVERLAND TIME (Ti) | | | TRAVEL TIME (Tt) | | | | | Tc | Tc Check | Tlag | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIG: | DEV./EX. (D or E) | CN | K | AREA Ac | AREA Mi^2 | INITIAL LENGTH Feet | SLOPE % | Ti Min | TRAVEL LENGTH Feet | SLOPE % | V1 VELOCITY FPS | V2 VELOCITY FPS | Tt Min | Min | Min | Tlag= 0.6Tc/60 Hours | |
| (1) | | | (2) | (3) | | (4) | (5) | (6) | (7) | (8) | (9a) | (9b) | (10) | (13) | (14) | | |
| ULT-1 | D | 90.0 | 0.7980 | 20.88 | 0.0326 | 131 | 1.0 | 6.2 | 1940 | 4.2 | 4.2 | 6.3 | 5.8 | 12.0 | 21.5 | 0.120 | |
| ULT-2 | D | 94.0 | 0.8508 | 15.64 | 0.0244 | 300 | 2.2 | 6.0 | 1140 | 7.1 | 5.4 | 8.2 | 2.9 | 8.8 | 18.0 | 0.088 | |
| ULT-3 | D | 94.0 | 0.8508 | 11.43 | 0.0179 | 192 | 6.3 | 3.4 | 1770 | 1.5 | 2.5 | 3.8 | 9.0 | 12.3 | 20.9 | 0.123 | |
| ULT-4 | D | 87.0 | 0.7584 | 12.83 | 0.0200 | 244 | 2.2 | 7.4 | 1240 | 4.7 | 4.4 | 6.6 | 3.8 | 11.1 | 18.2 | 0.111 | |
| ULT-5 | D | 94.0 | 0.8508 | 18.76 | 0.0293 | 130 | 10.0 | 2.4 | 1645 | 4.0 | 4.0 | 6.1 | 5.2 | 7.5 | 19.9 | 0.075 | |
| ULT-6 | D | 94.0 | 0.8508 | 7.59 | 0.0119 | 180 | 1.7 | 5.1 | 1260 | 3.7 | 3.9 | 5.9 | 4.3 | 9.4 | 18.0 | 0.094 | |
| ULT-RC1 | D | 85.0 | 0.7320 | 3.99 | 0.0062 | 300 | 6.8 | 6.0 | 915 | 4.8 | 4.4 | 6.7 | 2.9 | 9.0 | 16.8 | 0.090 | |
| ULT-RC2 | D | 92.0 | 0.8244 | 8.55 | 0.0134 | 300 | 2.8 | 6.1 | 1065 | 4.2 | 4.1 | 6.2 | 3.5 | 9.6 | 17.6 | 0.096 | |

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
Tc Check (Developed) = L/180+10

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
Developed V1 = 20.2*(S/100)^1/2
Existing V2 = 29.4*(S/100)^1/2
Developed V2 = 30.6*(S/100)^1/2
Minimum Tc (EX) = 10 Min per Section 602
Minimum Tc (DEV) = 5 Min per Section 602.1

REFERENCE :

STANDARD FORM 4

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   19JUN19  TIME  08:56:40   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

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

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

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

1 HEC-1 INPUT PAGE 1

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

              *DIAGRAM
    1         ID     SUMMERLIN VILLAGE 24 PARCEL FGH
    2         ID     ULTIMATE CONDITION MODEL
    3         ID     DESIGN STORM = 100-YEAR 6-HOUR STORM
    4         ID     STORM DISTRIBUTION = SDN3
    5         ID
    6         IT       5       0       0     300
    7         IO       5       0       0
    8         IN       5       0       0
    9         JR    PREC    1.00    0.58
              *

   10         KK   ULT-1
   11         KM    SUBBASIN ULT-1
   12         BA   .0326
   13         PB    3.39
   14         PC   0.000   0.020   0.057   0.070   0.087   0.108   0.124   0.130   0.130   0.130
   15         PC   0.130   0.130   0.130   0.133   0.140   0.142   0.148   0.158   0.172   0.181
   16         PC   0.190   0.197   0.199   0.200   0.201   0.204   0.214   0.229   0.241   0.249
   17         PC   0.251   0.256   0.270   0.278   0.281   0.283   0.295   0.322   0.352   0.409
   18         PC   0.499   0.590   0.710   0.744   0.781   0.812   0.819   0.835   0.851   0.856
   19         PC   0.860   0.868   0.876   0.888   0.910   0.926   0.937   0.950   0.970   0.976
   20         PC   0.982   0.985   0.987   0.989   0.990   0.993   0.993   0.994   0.995   0.998
   21         PC   0.998   0.999   1.000
   22         LS       0      90
   23         UD   0.120
              *

   24         KK     SD
   25         KM    DIVERT FLOWS INTERCEPTED BY STORM DRAIN TO EX WASH
   26         DT    DIV
   27         DI       0      27      64
   28         DQ       0      27      44
              *

   29         KK  ULT-RC1
   30         KM    SUBBASIN ULT-RC1
   31         BA   .0062
   32         LS       0      85
   33         UD    .090
              *

   34         KK  ULT-RC2
   35         KM    SUBBASIN ULT-RC2
   36         BA   .0134
   37         LS       0      92
   38         UD    .096
              *

   39         KK    COM1
   40         KM    COMBINE ULT1, ULT-RC1 AND ULT-RC2
   41         KM    COMBINATION POINT
   42         HC       3
              *
```

1 HEC-1 INPUT PAGE 2

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

   43         KK   ULT-2
   44         KM    SUBBASIN ULT-2
   45         BA   .0244
   46         LS       0      94
   47         UD    .088
              *
```

```
48            KK   ULT-3
49            KM    SUBBASIN ULT-3
50            BA   .0179
51            LS       0       94
52            UD   0.123
              *

53            KK    COM2
54            KM    COMBINE ULT-2 AND ULT-3
55            KM    COMBINATION POINT
56            HC      2
              *

57            KK   COM10
58            KM     COMBINE COMB1 AND COMB2
59            KM     COMBINATION POINT
60            HC       2
              *

61            KK   ULT-4
62            KM    SUBBASIN ULT-4
63            BA   .0200
64            LS       0       87
65            UD   0.111
              *

66            KK   ULT-5
67            KM    SUBBASIN ULT-5
68            BA   .0293
69            LS       0       94
70            UD    .075
              *

71            KK   ULT-6
72            KM    SUBBASIN ULT-6
73            BA   .0119
74            LS       0       94
75            UD    .094
              *

76            KK    COM3
77            KM     COMBINE UTL-4, ULT-5, AND ULT-6
78            KM     COMBINATION POINT
79            HC       3
              *
80            ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING           (--->) DIVERSION OR PUMP FLOW

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

   10      ULT-1
               .
               .
   26          .-------->    DIV
   24        SD
             .
             .
   29        .      ULT-RC
             .          .
             .          .
   34        .          .      ULT-RC
             .          .          .
             .          .          .
   39       COM1.....................
             .
             .
   43        .       ULT-2
             .          .
             .          .
   48        .          .       ULT-3
             .          .          .
             .          .          .
   53        .        COM2.........
             .          .
             .          .
   57      COM10.........
             .
             .
   61        .       ULT-4
             .          .
             .          .
   66        .          .       ULT-5
             .          .          .
             .          .          .
   71        .          .          .       ULT-6
             .          .          .          .
             .          .          .          .
   76        .        COM3.....................
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*          VERSION 4.1                  *
*                                       *
*  RUN DATE   19JUN19  TIME  08:56:40   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

SUMMERLIN VILLAGE 24 PARCEL FGH
ULTIMATE CONDITION MODEL
DESIGN STORM = 100-YEAR 6-HOUR STORM
STORM DISTRIBUTION = SDN3

7 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 |
| ITIME | 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 .58

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

| OPERATION | STATION | AREA | PLAN | | RATIOS APPLIED TO PRECIPITATION RATIO 1 1.00 | RATIO 2 .58 |
|---|---|---|---|---|---|---|
| HYDROGRAPH AT | | | | | | |
| + | ULT-1 | .03 | 1 | FLOW | 64. | 31. |
| | | | | TIME | 3.58 | 3.58 |
| DIVERSION TO | | | | | | |
| + | DIV | .03 | 1 | FLOW | 44. | 29. |
| | | | | TIME | 3.58 | 3.58 |
| HYDROGRAPH AT | | | | | | |
| + | SD | .03 | 1 | FLOW | 20. | 2. |
| | | | | TIME | 3.58 | 3.58 |
| HYDROGRAPH AT | | | | | | |
| + | ULT-RC | .01 | 1 | FLOW | 11. | 5. |
| | | | | TIME | 3.50 | 3.50 |
| HYDROGRAPH AT | | | | | | |
| + | ULT-RC | .01 | 1 | FLOW | 30. | 15. |
| | | | | TIME | 3.50 | 3.50 |
| 3 COMBINED AT | | | | | | |
| + | COM1 | .05 | 1 | FLOW | 60. | 20. |
| | | | | TIME | 3.50 | 3.50 |
| HYDROGRAPH AT | | | | | | |
| + | ULT-2 | .02 | 1 | FLOW | 58. | 30. |
| | | | | TIME | 3.50 | 3.50 |
| HYDROGRAPH AT | | | | | | |
| + | ULT-3 | .02 | 1 | FLOW | 38. | 20. |
| | | | | TIME | 3.58 | 3.58 |
| 2 COMBINED AT | | | | | | |
| + | COM2 | .04 | 1 | FLOW | 96. | 50. |
| | | | | TIME | 3.50 | 3.50 |
| 2 COMBINED AT | | | | | | |
| + | COM10 | .09 | 1 | FLOW | 155. | 70. |
| | | | | TIME | 3.50 | 3.50 |
| HYDROGRAPH AT | | | | | | |
| + | ULT-4 | .02 | 1 | FLOW | 36. | 16. |
| | | | | TIME | 3.58 | 3.58 |
| HYDROGRAPH AT | | | | | | |
| + | ULT-5 | .03 | 1 | FLOW | 73. | 38. |
| | | | | TIME | 3.50 | 3.50 |
| HYDROGRAPH AT | | | | | | |
| + | ULT-6 | .01 | 1 | FLOW | 28. | 15. |
| | | | | TIME | 3.50 | 3.50 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 COMBINED AT | | | | | | |
| + | COM3 | .06 | 1 | FLOW | 136. | 68. |
| | | | | TIME | 3.50 | 3.50 |

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

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## TIME OF CONCENTRATION

RCI ENGINEERING

**SUMMERLIN VILLAGE 24 PARCELS FGH**
**Ultimate Conditions**

BY: rjr
DATE: 7/25/19

| SUB-BASIN DATA | | | | | | INITIAL / OVERLAND TIME (Ti) | | | TRAVEL TIME (Tt) | | | | | Tc | Tc Check | Tlag | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIG: | DEV./EX. (D or E) | CN | K | AREA Ac | AREA Mi^2 | INITIAL LENGTH Feet | SLOPE % | Ti Min | TRAVEL LENGTH Feet | SLOPE % | V1 VELOCITY FPS | V2 VELOCITY FPS | Tt Min | Min | Min | Tlag= 0.6Tc/60 Hours | |
| (1) | | | (2) | (3) | | (4) | (5) | (6) | (7) | (8) | (9a) | (9b) | (10) | (13) | (14) | | |
| ULT-1 | D | 90.0 | 0.7980 | 20.88 | 0.0326 | 131 | 1.0 | 6.2 | 1940 | 4.2 | 4.2 | 6.3 | 5.8 | 12.0 | 21.5 | 0.120 | |
| ULT-2 | D | 94.0 | 0.8508 | 15.64 | 0.0244 | 300 | 2.2 | 6.0 | 1140 | 7.1 | 5.4 | 8.2 | 2.9 | 8.8 | 18.0 | 0.088 | |
| ULT-3 | D | 94.0 | 0.8508 | 11.43 | 0.0179 | 192 | 6.3 | 3.4 | 1770 | 1.5 | 2.5 | 3.8 | 9.0 | 12.3 | 20.9 | 0.123 | |
| ULT-4 | D | 87.0 | 0.7584 | 12.83 | 0.0200 | 244 | 2.2 | 7.4 | 1240 | 4.7 | 4.4 | 6.6 | 3.8 | 11.1 | 18.2 | 0.111 | |
| ULT-5 | D | 94.0 | 0.8508 | 18.76 | 0.0293 | 130 | 10.0 | 2.4 | 1645 | 4.0 | 4.0 | 6.1 | 5.2 | 7.5 | 19.9 | 0.075 | |
| ULT-6 | D | 94.0 | 0.8508 | 7.59 | 0.0119 | 180 | 1.7 | 5.1 | 1260 | 3.7 | 3.9 | 5.9 | 4.3 | 9.4 | 18.0 | 0.094 | |
| ULT-RC1 | D | 85.0 | 0.7320 | 3.99 | 0.0062 | 300 | 6.8 | 6.0 | 915 | 4.8 | 4.4 | 6.7 | 2.9 | 9.0 | 16.8 | 0.090 | |
| ULT-RC2 | D | 92.0 | 0.8244 | 8.55 | 0.0134 | 300 | 2.8 | 6.1 | 1065 | 4.2 | 4.1 | 6.2 | 3.5 | 9.6 | 17.6 | 0.096 | |

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

Tc Check (Developed) = L/180+10

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
Developed V1 = 20.2*(S/100)^1/2

Existing V2 = 29.4*(S/100)^1/2
Developed V2 = 30.6*(S/100)^1/2

Minimum Tc (EX) = 10 Min per Section 602
Minimum Tc (DEV) = 5 Min per Section 602.1

**REFERENCE :**

**STANDARD FORM 4**

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## TIME OF CONCENTRATION

RCI ENGINEERING

SUMMERLIN VILLAGE 24 PARCELS FGH
REVISED AREA FOR SUBBASIN 4-3 FROM WEST PLANNING STUDY

BY: rjr
DATE: 7/26/19

| SUB-BASIN DATA | | | | | | INITIAL / OVERLAND TIME (Ti) | | | TRAVEL TIME (Tt) | | | | | Tc | Tc Check | Tlag | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIG: | DEV./EX. (D or E) | CN | K | AREA Ac | AREA MI^2 | INITIAL LENGTH Feet | SLOPE % | TI Min | TRAVEL LENGTH Feet | SLOPE % | V1 VELOCITY FPS | V2 VELOCITY FPS | Tt Min | Min | Min | Tlag= 0.6Tc/60 Hours | |
| (1) | | | (2) | (3) | | (4) | (5) | (6) | (7) | (8) | (9a) | (9b) | (10) | (13) | (14) | | |
| 4-3 | E | 85.1 | 0.7333 | 83.89 | 0.1311 | 100 | 6.0 | 3.6 | 4263 | 6.5 | 3.8 | 7.5 | 10.6 | 14.3 | N/A | 0.143 | |
| | | | | | | | | | | | | | | | | | |

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
Tc Check (Developed) = L/180+10

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
Existing V2 = 29.4*(S/100)^1/2
Minimum Tc (EX) = 10 Min per Section 602

Developed V1 = 20.2*(S/100)^1/2
Developed V2 = 30.6*(S/100)^1/2
Minimum Tc (DEV) = 5 Min per Section 602.1

REFERENCE :

STANDARD FORM 4

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   26JUL19  TIME  06:44:37   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

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

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

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



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

              *DIAGRAM
    1         ID     SUMMERLIN VILLAGE 24 PARCEL FGH
    2         ID     OFFSITE WASH MODEL
    3         ID     DESIGN STORM = 100-YEAR 6-HOUR STORM
    4         ID     STORM DISTRIBUTION = SDN3
    5         ID           AREA    DARF
    6         ID         0-0.5    0.99
    7         ID         0.5-1   0.975
    8         ID           1-2    0.95
    9         ID           2-3   0.925
   10         ID           3-4   0.915
   11         ID           4-5   0.908
   12         ID           5-6   0.903
   13         IT       5       0       0     300
   14         IO       5       0       0
   15         IN       5       0       0
   16         JR    PREC    0.99   0.975    0.95   0.925   0.915   0.908   0.903
              *

   17         KK    *4-1
   18         KM    SUBBASIN 4-1 REFERENCED FROM MASTER STUDY
   19         BA   4.601
   20         PB    3.77
   21         PC   0.000   0.020   0.057   0.070   0.087   0.108   0.124   0.130   0.130   0.130
   22         PC   0.130   0.130   0.130   0.133   0.140   0.142   0.148   0.158   0.172   0.181
   23         PC   0.190   0.197   0.199   0.200   0.201   0.204   0.214   0.229   0.241   0.249
   24         PC   0.251   0.256   0.270   0.278   0.281   0.283   0.295   0.322   0.352   0.409
   25         PC   0.499   0.590   0.710   0.744   0.781   0.812   0.819   0.835   0.851   0.856
   26         PC   0.860   0.868   0.876   0.888   0.910   0.926   0.937   0.950   0.970   0.976
   27         PC   0.982   0.985   0.987   0.989   0.990   0.993   0.993   0.994   0.995   0.998
   28         PC   0.998   0.999   1.000
   29         LS       0    87.6
   30         UD   0.725
              *

   31         KK    *R4-1
   32         KM     REFERENCED FROM SUMMERLIN WEST MASTER PLAN
   33         KM     ROUTE 4-1 TO CP4.1
   34         KM     FUTURE CONCRETE CHANNEL
   35         RD    5500     .071    .015       0    TRAP      12       2
              *

   36         KK    *4-2
   37         KM     REFERENCED FROM SUMMERLIN WEST STUDY
   38         BA  0.3656
   39         PB    3.48
   40         LS       0    85.4
   41         UD   0.163
              *
```



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

   42         KK  *CP4.1
   43         KM     COMBINATION POINT
   44         RC       2
              *

   45         KK  RCP4.1
   46         KM     REFERENCED FROM SUMMERLIN WEST MASTER PLAN
   47         KM     ROUTE CP4.1 TO CP4.2
   48         KM     NATURAL WASH
   49         RD    3140     .067    .030       0    TRAP     100       0
              *
```

```
            50          KK     4-3
            51          KM     MODIFIED FROM WEST PLANNING STUDY
            52          BA  0.1311
            53          PB    3.45
            54          LS       0    85.1
            55          UD   0.143
                        *

            56          KK   CP4.2
            57          KM     COMBINATION POINT
            58          HC       2
                        *

            59          KK   ULT-1
            60          KM    SUBBASIN ULT-1
            61          BA   .0326
            62          PB    3.39
            63          LS       0      90
            64          UD   0.120
                        *

            65          KK      SD
            66          KM     DIVERT FLOWS NOT INTERCEPTED BY STORM DRAIN
            67          DT     DIV
            68          DI       0      27      64
            69          DQ       0      20      20
                        *

            70          KK  CP4.2A
            71          KM     COMBINATION POINT
            72          HC       2
                        *
            73          ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING           (--->) DIVERSION OR PUMP FLOW

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

    17        *4-1
              V
              V
    31       *R4-1
              .
              .
    36        .         *4-2
              .           .
              .           .
    42      *CP4.1.............
              V
              V
    45      RCP4.1
              .
              .
    50        .           4-3
              .             .
              .             .
    56       CP4.2.............
              .
              .
    59        .         ULT-1
              .           .
              .           .
    67        .           .-------->     DIV
    65        .         SD
              .           .
              .           .
    70      CP4.2A.............

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   26JUL19  TIME  06:44:37   *
*                                       *
*****************************************

*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*         609 SECOND STREET         *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 756-1104          *
*                                   *
*************************************

                        SUMMERLIN VILLAGE 24 PARCEL FGH
                        OFFSITE WASH MODEL
                        DESIGN STORM = 100-YEAR 6-HOUR STORM
                        STORM DISTRIBUTION = SOH3
                              AREA    DARF
                             0-0.5    0.99
                             0.5-1   0.975
                               1-2    0.95
                               2-3   0.925
                               3-4   0.915
                               4-5   0.908
                               5-6   0.903

  14 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
                   ITIME         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
                  .99       .98       .95       .93       .92       .91       .90
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

| OPERATION | STATION | AREA | PLAN | | RATIOS APPLIED TO PRECIPITATION RATIO 1 .99 | RATIO 2 .98 | RATIO 3 .95 | RATIO 4 .93 | RATIO 5 .92 | RATIO 6 .91 | RATIO 7 .90 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HYDROGRAPH AT | | | | | | | | | | | |
| + | *4-1 | 4.60 | 1 | FLOW | 4301. | 4214. | 4069. | 3924. | 3866. | 3825. | 3796. |
| | | | | TIME | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |
| ROUTED TO | | | | | | | | | | | |
| + | *R4-1 | 4.60 | 1 | FLOW | 4281. | 4194. | 4047. | 3903. | 3846. | 3804. | 3777. |
| | | | | TIME | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |
| HYDROGRAPH AT | | | | | | | | | | | |
| + | *4-2 | .37 | 1 | FLOW | 600. | 587. | 565. | 543. | 535. | 529. | 524. |
| | | | | TIME | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 |
| 2 COMBINED AT | | | | | | | | | | | |
| + | *CP4.1 | 4.97 | 1 | FLOW | 4387. | 4298. | 4148. | 4001. | 3942. | 3899. | 3871. |
| | | | | TIME | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |
| ROUTED TO | | | | | | | | | | | |
| + | RCP4.1 | 4.97 | 1 | FLOW | 4361. | 4272. | 4124. | 3978. | 3918. | 3875. | 3846. |
| | | | | TIME | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |
| HYDROGRAPH AT | | | | | | | | | | | |
| + | 4-3 | .13 | 1 | FLOW | 218. | 213. | 206. | 198. | 194. | 192. | 191. |
| | | | | TIME | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 |
| 2 COMBINED AT | | | | | | | | | | | |
| + | CP4.2 | 5.10 | 1 | FLOW | 4394. | 4305. | 4155. | 4008. | 3948. | 3905. | 3876. |
| | | | | TIME | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |
| HYDROGRAPH AT | | | | | | | | | | | |
| + | ULT-1 | .03 | 1 | FLOW | 63. | 62. | 60. | 58. | 57. | 56. | 56. |
| | | | | TIME | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 |
| DIVERSION TO | | | | | | | | | | | |
| + | DIV | .03 | 1 | FLOW | 20. | 20. | 20. | 20. | 20. | 20. | 20. |
| | | | | TIME | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 |
| HYDROGRAPH AT | | | | | | | | | | | |
| + | SD | .03 | 1 | FLOW | 43. | 42. | 40. | 38. | 37. | 36. | 36. |
| | | | | TIME | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 |
| 2 COMBINED AT | | | | | | | | | | | |
| + | CP4.2A | 5.13 | 1 | FLOW | 4396. | 4307. | 4157. | 4010. | 3950. | 3906. | 3877. |
| | | | | TIME | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |

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 | | | | | | | | | |
| *R4-1 | MANE | 1.53 | 4298.80 | 251.63 | 2.45 | 5.00 | 4280.84 | 250.00 | 2.45 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6001E+03 EXCESS= .0000E+00 OUTFLOW= .6001E+03 BASIN STORAGE= .1663E-02 PERCENT ERROR= .0

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FOR PLAN = 1 RATIO= .00 | | | | | | | | | |
| *R4-1 | MANE | 1.54 | 4210.95 | 251.71 | 2.39 | 5.00 | 4193.82 | 250.00 | 2.39 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5874E+03 EXCESS= .0000E+00 OUTFLOW= .5874E+03 BASIN STORAGE= .1473E-02 PERCENT ERROR= .0

```
          FOR PLAN = 1  RATIO=  .00
            *R4-1  MANE          1.56   4066.82    251.38      2.31      5.00   4047.11    250.00        2.31

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5663E+03 EXCESS= .0000E+00 OUTFLOW= .5663E+03 BASIN STORAGE= .1905E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            *R4-1  MANE          1.58   3918.38    251.11      2.22      5.00   3903.20    250.00        2.22

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5453E+03 EXCESS= .0000E+00 OUTFLOW= .5453E+03 BASIN STORAGE= .1685E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            *R4-1  MANE          1.59   3859.34    252.29      2.19      5.00   3846.23    250.00        2.19

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5370E+03 EXCESS= .0000E+00 OUTFLOW= .5370E+03 BASIN STORAGE= .1886E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            *R4-1  MANE          1.59   3824.53    251.53      2.16      5.00   3804.00    250.00        2.16

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5311E+03 EXCESS= .0000E+00 OUTFLOW= .5311E+03 BASIN STORAGE= .1694E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            *R4-1  MANE          1.60   3790.76    252.14      2.15      5.00   3776.76    250.00        2.15

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5269E+03 EXCESS= .0000E+00 OUTFLOW= .5269E+03 BASIN STORAGE= .1835E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCP4.1 MANE          1.97   4381.68    252.47      2.41      5.00   4361.44    250.00        2.41

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6392E+03 EXCESS= .0000E+00 OUTFLOW= .6392E+03 BASIN STORAGE= .7354E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCP4.1 MANE          1.99   4292.42    252.57      2.36      5.00   4272.43    250.00        2.36

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6256E+03 EXCESS= .0000E+00 OUTFLOW= .6256E+03 BASIN STORAGE= .6733E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCP4.1 MANE          2.02   4144.43    252.15      2.28      5.00   4123.62    250.00        2.28

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6031E+03 EXCESS= .0000E+00 OUTFLOW= .6031E+03 BASIN STORAGE= .6236E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCP4.1 MANE          2.05   3991.73    251.73      2.19      5.00   3977.90    250.00        2.19

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5806E+03 EXCESS= .0000E+00 OUTFLOW= .5806E+03 BASIN STORAGE= .7613E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCP4.1 MANE          2.06   3935.75    253.21      2.16      5.00   3918.44    250.00        2.16

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5716E+03 EXCESS= .0000E+00 OUTFLOW= .5716E+03 BASIN STORAGE= .6424E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCP4.1 MANE          2.07   3895.07    252.26      2.13      5.00   3875.11    250.00        2.13

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5654E+03 EXCESS= .0000E+00 OUTFLOW= .5654E+03 BASIN STORAGE= .7687E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCP4.1 MANE          2.07   3865.49    252.99      2.12      5.00   3846.47    250.00        2.12

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5609E+03 EXCESS= .0000E+00 OUTFLOW= .5609E+03 BASIN STORAGE= .6346E-02 PERCENT ERROR=    .0


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

# APPENDIX B – HYDRAULIC CALCS

100-Year Existing Conditions HecRas Report

100-Year Proposed Conditions HecRas Report

Culvertmaster Calculation for 100-Year Storm Flows to 48-inch RCP

Standard Form 6 Models for Storm Drain

100-Year Scour Calculations for Redrock Wash

D-Load Calculations

HEC-RAS HEC-RAS 5.0.1 April 2016
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

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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     XXXXX    XXXX
X     X  X        X           X  X      X    X       X
X     X  X        X    X      X   X     X    X       X
X     X  XXXXXX    XXXX       X    X    X    X   XXXXX
```

PROJECT DATA
Project Title: exist-redrock
Project File : exist-redrock.prj
Run Date and Time: 7/24/2019 1:32:36 PM

Project in English units

Project Description:
EXISTING CONDITIONS MODEL

[redacted]

PLAN DATA

Plan Title: Plan 01
Plan File : o:\3040_LENR\0057_Summerlin_103_DRAIN\HECRAS\exist-redrock.p01

Geometry Title: exist
Geometry File : o:\3040_LENR\0057_Summerlin_103_DRAIN\HECRAS\exist-redrock.g01

Flow Title : exist
Flow File : o:\3040_LENR\0057_Summerlin_103_DRAIN\HECRAS\exist-redrock.f01

Plan Summary Information:
Number of: Cross Sections = 53 Multiple Openings = 0
Culverts = 0 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 = 0.3
Flow tolerance factor = 0.001

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

FLOW DATA

Flow Title: exist
Flow File : o:\3040_LENR\0057_Summerlin_103_DRAIN\HECRAS\exist-redrock.f01

Flow Data (cfs)

| River | Reach | RS | PF 1 |
|---|---|---|---|
| natural wash | redrock | 2693.56 | 3893 |

Boundary Conditions

| River | Reach | Profile | Upstream | Downstream |
|---|---|---|---|---|
| natural wash | redrock | PF 1 | Normal S = 0.0671 | Normal S = 0.0709 |

GEOMETRY DATA

Geometry Title: exist
Geometry File : o:\3040_LENR\0057_Summerlin_103_DRAIN\HECRAS\exist-redrock.g01

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 2693.56

INPUT
Description:
Station Elevation Data num= 74

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3568.041.039993 | 3567.872.509995 | 3567.55 3.87999 | 3566.063.949997 | 3566 | | | | |
| 4.389999 | 3565.865.069992 | 3565.715.099991 | 3565.685.119995 | 3565.645.279999 | 3565.58 | | | | |
| 10.98 | 3563.4112.10999 | 3563.1315.01999 | 3562.24 | 16.2 | 3561.74 | 17.67 | 3560.96 | | |
| 19.65999 | 3560.3820.82999 | 3560.2 | 21.67 | 3559.8922.90999 | 3559.2 | 24.59 | 3559.11 | | |
| 25.62999 | 3558.9728.84999 | 3558.6536.09999 | 3558.5251.29999 | 3558.4157.80999 | 3558.39 | | | | |

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59.00999 3558.8359.23999  3558.959.59999  3559.9   59.84 3558.9369.27999 3558.85
79.82999 3558.8581.41999 3559.2682.38999 3559.64   83.09 3559.6584.35999 3559.69
86.81999 3559.64   87.16 3559.6589.46999 3559.7395.68999 3559.8697.55999 3560.41
98.03999  3560.698.99999 3560.66   100.6 3560.68  101.83 3560.66  102.93 3560.67
  104.24 3560.63  106.17 3561.28  107.06 3561.35  111.17 3562.76   111.6 3562.99
  112.49 3563.23  114.78 3564.02  118.12 3562.87  118.34 3562.76  118.53 3562.79
  121.41 3562.94   121.6 3562.96  121.77 3562.98  123.64 3563.18  129.79 3563.84
     131 3563.96  131.65 3564.23  133.26 3564.86  134.38 3565.32  136.27 3566.29
  139.02 3567.67  141.18 3568.16  142.09 3568.08  149.56 3567.97  150.01 3567.93
  159.71 3567.78  167.53 3567.78  175.09 3567.55  180.43 3567.48

Manning's n Values         num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   180.43    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  180.43             48.03   48.03   48.03             .1       .3

CROSS SECTION


RIVER: natural wash
REACH: redrock             RS: 2645.53

INPUT
Description:
Station Elevation Data     num=       45
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3566.641.410004 3566.392.830002 3565.885.190002    35657.169998 3564.09
7.690002 3563.818.070007 3563.669.910004  3562.8   12.47 3561.79   18.44 3558.98
   21.02 3558.18   24.44 3556.81   25.41 3556.4326.90001 3555.89   27.72 3555.91
   31.03 3556.01   50.95 3555.38   60.77  3555.2   61.94 3555.17   67.62 3555.32
   68.52 3555.33   70.33 3555.26   77.71 3555.47   79.54 3555.58    82.2 3555.62
   83.98 3555.57   85.42 3555.58   87.77 3555.45   91.07 3555.29   91.63 3555.32
   95.02 3555.28  100.01 3555.25  102.24 3555.44  106.04 3555.94  113.75  3557.2
  114.51 3557.34  115.09 3557.44  128.96 3560.42  131.94 3561.28  145.51 3564.61
  147.87 3565.18  151.73 3565.11  160.32 3564.93  162.31 3564.92  183.83 3564.12

Manning's n Values         num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   183.83    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  183.83             49.64   49.64   49.64             .1       .3

CROSS SECTION


RIVER: natural wash
REACH: redrock             RS: 2595.89

INPUT
Description:
Station Elevation Data     num=       72
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3561.591.619995 3560.732.559998 3560.214.289993 3558.86     5.5 3559.04
6.110001 3558.89   10.38 3558.51   14.75 3557.6817.70999 3557.91   17.83 3557.89
18.20999 3557.86   19.44 3557.75    20.2  3557.9   22.02  3558.223.09999  3557.1
   25.33 3555.27   26.34  3554.3   28.41 3553.55   29.72 3552.9430.75999  3552.9
34.50999 3552.11   47.33 3552.05   52.65 3551.96   56.38 3551.87   58.63  3552.1
   59.63 3552.18    64.1 3552.16   71.16  3552.1      74 3551.88   75.57 3551.65
   78.04 3552.05   78.39 3552.09   79.99 3552.15   82.82 3552.24   83.63  3552.2
   84.92 3552.18   89.95 3551.78   90.81 3551.67   95.03 3551.39   96.92 3551.19
   97.87 3551.01    99.4  3551.5   99.56 3551.55  100.76 3551.72  100.98 3551.78
  101.66 3551.94  102.66 3552.34  102.78 3552.35  106.27 3552.14  107.81 3552.03
  108.48 3551.99  109.28 3551.98  109.91 3551.76  110.71 3551.88  111.11 3552.03
  111.69 3552.18  112.04 3552.34  112.87 3552.54   113.7  3552.9  115.95 3554.03
  122.28 3555.09  125.61 3555.61  127.06 3555.62   131.8 3556.79  136.39 3557.98
  139.35 3558.92  150.65 3561.64  161.55 3561.76  162.51 3561.75  173.96 3561.46
  177.09 3561.35  178.42 3561.31

Manning's n Values         num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   178.42    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  178.42             47.96   47.96   47.96             .1       .3

CROSS SECTION


RIVER: natural wash
REACH: redrock             RS: 2547.93

INPUT
Description:
Station Elevation Data     num=       49
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3555.47.1600037  3555.42.649994 3554.633.119995 3553.955.889999 3552.96
7.649994 3552.467.959991 3552.368.470001 3552.21   13.16  3550.3   13.27 3550.26
   13.34 3550.2513.42999 3550.25   15.31 3550.1816.89999 3549.86      17 3549.85
   17.52 3549.81   26.39 3549.09   32.47 3549.08   41.03  3548.9   43.62 3548.84
   43.96 3548.91   46.98 3549.42   58.84 3549.27   64.47 3549.26   76.02 3548.84
   77.66 3548.79   78.84 3548.97    79.6 3549.05    80.3 3548.99   82.48 3548.72
   84.61  3548.6   86.64 3548.54   87.47 3548.5787.75999 3548.57   88.49 3548.36
   91.58 3548.34   94.63 3548.22    98.1 3549.6298.25999 3549.68   98.95 3549.61
  112.25 3551.55  116.57 3552.23  123.12  3553.5  135.53 3555.63   139.2 3556.18
  145.85 3557.34  147.04 3557.32  153.46 3557.52  166.17 3558.38

Manning's n Values         num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   166.17    .032

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

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 166.17 | | 49.2 | 49.2 | 49.2 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 2498.73

INPUT
Description:
Station Elevation Data num= 41

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3552.47 | 2.490005 | 3551.583 | .840012 | 3551.06 | 4.51001 | 3550.845 | .139999 | 3550.62 |
| 10.29001 | 3548.971 | 4.57001 | 3547.721 | 6.29001 | 3547.19 | 17.72 | 3546.812 | 0.12001 | 3546.1 |
| 23.5 | 3545.672 | 5.71001 | 3545.512 | 9.48001 | 3545.78 | 31.63 | 3545.963 | 2.96001 | 3546.07 |
| 35.66 | 3546.274 | 9.81001 | 3545.915 | 3.31001 | 3545.815 | 4.42001 | 3545.8 | 54.87 | 3545.79 |
| 57.06001 | 3545.735 | 7.79001 | 3545.82 | 66.8 | 3546.506 | 7.56001 | 3546.587 | 2.25001 | 3546.44 |
| 97.44 | 3545.61 | 100.49 | 3545.57 | 102.5 | 3546.12 | 103.94 | 3546.42 | 106.2 | 3546.91 |
| 107.42 | 3547.24 | 113.63 | 3548.36 | 121.03 | 3549.62 | 125.51 | 3550.45 | 137.46 | 3552.53 |
| 145.01 | 3553.83 | 146.86 | 3554.14 | 156.34 | 3555.03 | 157.18 | 3555.12 | 158.71 | 3555.14 |
| 161.85 | 3555.21 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 161.85 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 161.85 | 53.47 | 53.47 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 2445.26

INPUT
Description:
Station Elevation Data num= 31

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3552.29 | 4.059998 | 3551.281 | 1.24001 | 3549.121 | 3.25999 | 3548.53 | 16.11 | 3547.78 |
| 21.43001 | 3546.26 | 27.98 | 3544.052 | 8.49001 | 3543.883 | 1.32001 | 3543.383 | 4.15001 | 3542.58 |
| 44.24001 | 3542.6 | 45.61 | 3542.56 | 56.1 | 3542.46 | 75.01 | 3542.46 | 83.96 | 3542.45 |
| 89.52 | 3542.28 | 99.96 | 3542.08 | 108.45 | 3541.96 | 110.18 | 3542.57 | 113.42 | 3543.81 |
| 123.97 | 3545.33 | 127.78 | 3545.89 | 128.85 | 3546.03 | 130.78 | 3546.31 | 132.58 | 3546.59 |
| 137.91 | 3547.35 | 145.91 | 3548.51 | 147.86 | 3548.86 | 156.94 | 3550.75 | 160.6 | 3551.59 |
| 170.58 | 3551.71 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 170.58 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 170.58 | 46.21 | 46.21 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 2399.05

INPUT
Description:
Station Elevation Data num= 34

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3550.18 | 1.479996 | 3549.91 | 4.789993 | 3549.28 | 7.769989 | 3548.78 | 6.860001 | 3548.44 |
| 12.34 | 3547.63 | 16.92 | 3546.56 | 20.34 | 3545.75 | 24.98 | 3544.92 | 6.92999 | 3544.53 |
| 30.53999 | 3544.04 | 34.45 | 3543.52 | 38.15999 | 3542.16 | 42.78 | 3540.47 | 44.37 | 3539.73 |
| 45.07999 | 3539.34 | 59.06999 | 3539.44 | 67.52 | 3539.5 | 71.7 | 3539.48 | 85.96 | 3539.29 |
| 93.14 | 3538.99 | 99.74 | 3538.57 | 102.09 | 3539.7 | 103.16 | 3540 | 110.8 | 3540.02 |
| 114.46 | 3540.07 | 123.18 | 3541.44 | 125.93 | 3541.86 | 130.25 | 3542.82 | 142.58 | 3544.55 |
| 150.44 | 3545.57 | 159.75 | 3547.14 | 162.81 | 3547.59 | 171.98 | 3548.01 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 171.98 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 171.98 | 53.24 | 53.24 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 2345.81

INPUT
Description:
Station Elevation Data num= 37

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3546.59 | 9.119995 | 3544.86 | 10.61 | 3544.52 | 11.33 | 3544.32 | 13.2 | 3543.81 |
| 22.35 | 3541.61 | 28.56 | 3539.42 | 28.8 | 3539.36 | 33.25 | 3538.84 | 34.39 | 3538.5 |
| 39.02 | 3538.01 | 39.49 | 3538 | 43.93 | 3537.61 | 44.78 | 3537.51 | 45.16 | 3537.04 |
| 45.49 | 3536.75 | 46.13 | 3536.06 | 55.31 | 3536.01 | 62.49 | 3536.01 | 68.63 | 3535.93 |
| 85.49 | 3535.89 | 93.73 | 3535.76 | 96.84 | 3535.65 | 97.91 | 3535.86 | 98.97 | 3536.04 |
| 104.68 | 3536.33 | 108.22 | 3536.51 | 112.19 | 3537.09 | 120.15 | 3538.04 | 121.51 | 3538.25 |
| 127.32 | 3539.01 | 134.1 | 3539.84 | 136.19 | 3540.07 | 138.35 | 3540.28 | 146.3 | 3541.27 |
| 148.06 | 3541.49 | 149.28 | 3541.63 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 149.28 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 149.28 | 50.17 | 50.17 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 2295.64

INPUT
Description:
Station Elevation Data num= 31

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3542.343.559998 | 3541.656.819992 | | 3540.828.319992 | | 3540.34 | 17.3 | 3537.47 | |
| 18.2 | 3537.1918.95999 | 353731.16999 | | 3534.25 | 39.2 | 3533.6740.77999 | | 3533.61 | |
| 40.92999 | 3533.642.50999 | 3532.7152.18999 | | 3532.761.21999 | | 3532.55 | 62.41 | 3532.81 | |
| 64.89 | 3533.3667.15999 | 3533.1667.76999 | | 3533.1 | 69.64 | 3532.8780.99999 | | 3532.63 | |
| 86.68999 | 3532.5189.42999 | 3532.4291.21999 | | 3533.0591.73999 | | 3533.18 | 92.31 | 3533.16 | |
| 97.56 | 3532.65 | 105.11 | 3534.3 | 108.09 | 3534.82 | 117.97 | 3536.41 | 119.28 | 3536.63 |
| 128.65 | 3536.91 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 128.65 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 128.65 | 42.32 | 52.3 | 62.2 | .1 .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 2253.32

INPUT
Description:
Station Elevation Data num= 36

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 35394.449997 | 3538.119.779999 | | 3536.9 | 11.86 | 3536.2419.68999 | | 3533.86 | |
| 22.16 | 3533.15 | 27.74 | 3531.08 | 28.88 | 3530.9 | 31.31 | 3530.49 | 34.53 | 3529.85 |
| 37.13 | 3529.13 | 37.57 | 3528.98 | 38.34 | 3529.01 | 49.77 | 3529.06 | 51.79 | 3529.61 |
| 52.04 | 3529.67 | 52.99 | 3529.69 | 61.03 | 3530.01 | 62.66 | 3529.27 | 62.7 | 3529.24 |
| 66.3 | 3529.24 | 87.42 | 3529.11 | 88.92 | 3530.41 | 90.12 | 3531.56 | 92.81 | 3532.98 |
| 94.39999 | 3533.85 | 96.33 | 3534.97 | 101.52 | 3536.66 | 103.08 | 3537.11 | 103.73 | 3537.31 |
| 105.14 | 3537.69 | 106.64 | 3537.76 | 112.35 | 3538.1 | 114.61 | 3538.23 | 118.62 | 3538.22 |
| 122.81 | 3538 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 122.81 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 122.81 | 32.31 | 53.4 | 60.8 | .1 .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 2221.01

INPUT
Description:
Station Elevation Data num= 35

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3536.092.110001 | 3535.815.890007 | | 3535.22 | 10.37 | 3533.58 | 15.33 | 3531.93 | |
| 19.62 | 3529.88 | 21.02 | 3529.14 | 23.95 | 3527.89 | 24.33 | 3527.6927.39001 | | 3526.1 |
| 28.09 | 3526.11 | 34.01 | 3526.22 | 36.27 | 3526.28 | 39.04 | 3526.62 | 40.93 | 3526.84 |
| 42.42001 | 3526.0342.96001 | | 3526.83 | 43.62 | 3526.84 | 48.75 | 3526.75 | 52.37 | 3526.87 |
| 57.34 | 3526.92 | 74.19 | 3526.52 | 80.55 | 3526.35 | 80.67 | 3526.67 | 81.7 | 3527.98 |
| 82.38 | 3529 | 84.38 | 3530.0686.60001 | | 3531.2388.07001 | | 3532.03 | 91.26 | 3533.09 |
| 95.78001 | 3534.75 | 107.78 | 3535.01 | 109.51 | 3535.02 | 111.32 | 3534.94 | 115.41 | 3534.73 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 115.41 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 115.41 | 16.52 | 26.8 | 36.2 | .1 .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 2204.49

INPUT
Description:
Station Elevation Data num= 31

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3533.58.7099991 | 3533.471.580002 | | 3533.146.989998 | | 3531.28 | 15.31 | 3527.26 | |
| 17.52 | 3526.16 | 17.95 | 3525.83 | 19.85 | 3524.34 | 24.71 | 3524.37 | 29.82 | 3524.32 |
| 31.98 | 3524.61 | 32.82 | 3524.79 | 35.75 | 3524.93 | 39.47 | 3525.06 | 41.45 | 3525.19 |
| 45.19 | 3525.35 | 48.96 | 3525.48 | 54.12 | 3525.31 | 59.54 | 3525.05 | 72.7 | 3524.4 |
| 72.96 | 3524.71 | 73.64 | 3525.24 | 75.24 | 3526.52 | 75.5 | 3526.7476.39999 | | 3527.22 |
| 80.65 | 3529.63 | 83.49 | 3530.53 | 88.28 | 3532.21 | 91 | 3532.34 | 103.53 | 3532.71 |
| 109.53 | 3532.3 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 109.53 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 109.53 | 24.6 | 24.6 | 24.6 | .1 .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 2179.89

INPUT
Description:
Station Elevation Data num= 41

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3532.8 | 66.76000 | 3532.69 | 14.58 | 3532.16 | 17.45 | 3531.91 | 19.63 | 3531.71 |
| 21.6 | 3531.5 | 28.2 | 3530.51 | 29.23 | 3530.42 | 29.89 | 3530.47 | 31.2 | 3530.51 |
| 31.48 | 3530.46 | 32.47 | 3529.92 | 32.9 | 3527.91 | 35.36 | 3527.22 | 36.83 | 3526.7 |
| 38.06001 | 3526.26 | 42.74001 | 3524.34 | 44.29 | 3523.71 | 45.37 | 3523.21 | 46.72 | 3522.59 |
| 47.28 | 3522.26 | 50.16 | 3522.24 | 61.35 | 3522.28 | 63.52 | 3522.85 | 64.71001 | 3523.09 |
| 66.02 | 3523.1 | 68.37 | 3523.05 | 73.57001 | 3522.97 | 74.85001 | 3522.79 | 78.3 | 3522.4 |
| 89.95 | 3522.25 | 105.31 | 3522.07 | 106.59 | 3522.78 | 106.6 | 3522.79 | 106.63 | 3522.83 |
| 108.3 | 3525.99 | 111.8 | 3527.31 | 114.25 | 3528.45 | 116.99 | 3529.2 | 120.59 | 3530.16 |
| 122.08 | 3530.2 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 122.08 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 122.08 | 34.86 | 34.9 | 42 | .1 .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 2145.03

INPUT
Description:
Station Elevation Data num= 42

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3528.8 | 12.47 | 3527.91 | 13.3 | 3527.84 | 18.47 | 3527.4 | 22.99 | 3527 |
| 26.22 | 3526.4 | 28.17 | 3525.91 | 29.84 | 3525.47 | 35.14 | 3523.91 | 38.5 | 3522.91 |
| 42.45 | 3521.2 | 43.56 | 3520.74 | 43.96 | 3520.55 | 47.15 | 3519.35 | 48.27 | 3519.38 |
| 58.68 | 3519.27 | 66.14999 | 3519.16 | 67.74 | 3519.78 | 68.14 | 3519.86 | 70.17999 | 3519.54 |
| 72.78999 | 3519.2 | 75.49 | 3519.19 | 76.7 | 3518.99 | 87.75999 | 3519.04 | 101.98 | 3519.21 |
| 102.87 | 3519.7 | 103.44 | 3519.81 | 103.97 | 3519.78 | 105.06 | 3522.82 | 105.89 | 3525.1 |
| 105.95 | 3525.11 | 106.07 | 3525.12 | 107.96 | 3525.4 | 108.57 | 3525.57 | 109.33 | 3525.68 |
| 114.84 | 3525.2 | 116.97 | 3525.23 | 124.36 | 3525.75 | 127.27 | 3525.91 | 127.84 | 3525.96 |
| 128.29 | 3526.04 | 129.67 | 3526.11 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 129.67 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 129.67 | 37.09 | 32.5 | 25.8 | .1 .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 2107.94

INPUT
Description:
Station Elevation Data num= 50

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3526.47 | 11.33 | 3524.61 | 15.97 | 3523.85 | 19.61 | 3523.12 | 26.86 | 3522.28 |
| 28.62999 | 3522.12 | 36.03999 | 3521.43 | 36.32999 | 3521.39 | 38.82999 | 3520.87 | 40.24 | 3520.72 |
| 43.37 | 3520.21 | 44.81 | 3520 | 45.41 | 3519.83 | 47.34 | 3519.47 | 49.59 | 3519.05 |
| 51.02 | 3518.75 | 3.85999 | 3518.12 | 58.28 | 3517.51 | 60.95 | 3516.83 | 61.07999 | 3516.79 |
| 61.12 | 3516.77 | 61.23 | 3516.78 | 66.63999 | 3517.06 | 73.92 | 3517.19 | 76.3 | 3517.22 |
| 76.95999 | 3517.26 | 79.10999 | 3517.11 | 81.25999 | 3516.96 | 82.13999 | 3516.97 | 86.03999 | 3517 |
| 105.68 | 3516.83 | 106.33 | 3517.07 | 107.38 | 3517.51 | 108.56 | 3517.72 | 109.35 | 3517.83 |
| 109.89 | 3518.08 | 111.67 | 3519.24 | 115.33 | 3520.23 | 115.84 | 3520.41 | 116.44 | 3520.44 |
| 122.15 | 3521.06 | 127.12 | 3520.89 | 131.4 | 3520.87 | 133.23 | 3521.2 | 137.65 | 3521.96 |
| 139.4 | 3522.51 | 142.91 | 3523.52 | 145.16 | 3523.68 | 152.94 | 3524.46 | 158.87 | 3524.61 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 158.87 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 158.87 | 42.91 | 42.91 | 42.91 | .1 .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 2065.03

INPUT
Description:
Station Elevation Data num= 43

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3523.57 | 17.91 | 3520.58 | 19.49001 | 3520.32 | 0.70001 | 3520.11 | 24.44 | 3519.63 |
| 27.87001 | 3519.19 | 31.88 | 3518.53 | 2.37001 | 3518.43 | 4.74001 | 3518.25 | 35.39001 | 3518.1 |
| 37.31001 | 3517.63 | 38.60001 | 3517.39 | 46.71001 | 3515.76 | 50.93001 | 3514.77 | 53.25001 | 3514.45 |
| 55.62 | 3513.91 | 57.79001 | 3513.56 | 0.42001 | 3513.77 | 63.44 | 3514.11 | 72.61001 | 3514.32 |
| 79.67001 | 3514.61 | 81.27 | 3514.74 | 95.94 | 3514.41 | 97.41 | 3514.39 | 97.82001 | 3514.36 |
| 100.83 | 3514.11 | 110.93 | 3513.66 | 115.01 | 3513.51 | 115.65 | 3513.72 | 115.95 | 3513.76 |
| 118.06 | 3514.46 | 124.58 | 3514.73 | 125.82 | 3514.76 | 127.08 | 3514.73 | 135 | 3514.77 |
| 138.1 | 3515.27 | 141.38 | 3515.69 | 146.74 | 3516.4 | 146.97 | 3516.43 | 148.14 | 3516.56 |
| 161.07 | 3517.98 | 162.37 | 3518.16 | 163.13 | 3518.26 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 163.13 | .032 |

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  163.13             50.66    44.3    38.8             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock            RS: 2014.37

INPUT
Description:
Station Elevation Data    num=      59
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3517.981.699997 3517.919.979996 3517.16 9.12999 3517.149.169998 3517.13
   16.41 3516.2824.62999 3514.8829.25999 3514.0829.39999 3514.06   29.62 3514.01
29.78999 3513.99   31.27 3513.63   41.98 3511.0545.53999 3509.84   45.59 3509.82
   45.64 3509.8350.84999  3510.3   54.56 3510.45   58.84  3510.962.00999 3511.04
66.50999 3511.1568.25999 3511.19   76.52 3511.0178.50999 3510.9679.43999 3510.96
92.75999 3511.16   94.57 3511.24   106.5 3511.54  107.12 3511.55  109.43 3511.56
  109.75 3511.57  109.93 3511.63  110.55 3511.56  114.03 3511.21  116.19 3511.03
  125.18 3510.86  126.82 3510.81  127.59 3510.78  127.75 3510.78  128.45 3510.91
  129.74 3511.36   129.8 3511.36  129.91 3511.37  132.54 3511.51  133.95 3511.52
  146.63 3511.22  147.58  3511.2  148.46 3511.15  149.47 3511.08  156.78 3510.63
  162.65 3510.26  163.65 3510.19  168.16 3510.57  171.24 3510.81  178.14 3511.72
   178.7 3511.79  180.23    3512   185.8 3512.92   188.2 3513.17

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032    188.2    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   188.2             59.61    61.1    45.9             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock            RS: 1954.76

INPUT
Description:
Station Elevation Data    num=      66
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3509.922.720001 3509.887.240005 3509.958.980011    351014.10001 3509.73
16.51001 3509.6119.45001 3509.4623.04001 3509.1128.60001 3508.2233.10001 3507.61
33.71001 3507.47   35.66 3507.0336.46001 3506.85    37.3 3506.43    44.5 3506.64
   47.69 3506.6752.85001 3506.89   58.47 3507.1474.76001  3507.386.21001 3507.35
88.81001 3507.43  100.66 3506.88  101.27 3506.88  101.81 3506.72  104.42 3506.11
   105.9 3506.41  108.59    3507  110.18  3507.1  114.68 3507.37  117.28 3507.09
  120.34  3506.9  121.42 3506.86  122.95 3507.27   123.8 3507.54  125.01 3507.55
  128.28 3507.52  128.34 3507.52  131.55 3507.24  135.31 3507.13  138.45 3506.95
  140.92 3507.37   142.4 3507.55   146.4 3507.63  148.05 3507.72  149.02 3507.55
  160.29 3506.96  161.45 3506.93  163.47 3506.86   164.1 3506.81  166.77 3506.65
  168.46  3507.1  168.99 3507.34  184.61  3507.3  188.73 3507.21  195.91 3506.35
  199.48 3505.94  203.73 3506.65  214.58 3508.14  218.72  3509.1  219.63 3509.31
   221.2  3509.6  228.29 3510.93  230.55 3511.27  231.93 3511.44  240.51 3512.56
   241.6 3512.68

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032    241.6    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   241.6             38.92   38.92   38.92             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock            RS: 1915.84

INPUT
Description:
Station Elevation Data    num=      89
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3506.541.869995 3506.64 7.01001 3506.9110.45999 3507.06   22.94 3506.57
      23 3506.57   23.03 3506.5630.42999 3505.0632.99001  3504.234.26001 3503.82
   38.28 3503.89   41.67 3504.27   43.36 3504.11   44.91 3504.04   50.63 3504.17
   57.66 3504.27   59.88 3504.26   61.77 3504.34   63.83 3504.69   65.23 3504.97
68.32001 3504.84   70.44 3504.78   71.63  3504.774.79001 3504.24   74.86 3504.23
   87.69 3504.2297.07001 3504.28  104.63 3504.06  110.77 3503.98  111.39 3503.85
  115.15 3503.14  117.27 3503.37  119.41 3503.46  121.17 3503.87   122.2 3504.05
  122.81 3504.07  127.23 3503.98  128.32 3503.46  128.97 3503.24  135.45 3503.16
  138.13 3503.11     139 3503.59  140.15 3504.33  140.78 3504.32  142.92 3504.26
  143.68 3504.23  144.02 3504.28   148.9 3504.94  151.71  3504.9   154.8 3504.95
   157.8 3505.08  159.76 3505.21  161.14 3505.44  164.32 3505.74  168.48 3506.06
  170.71 3506.02  174.84  3505.9  176.81 3505.81  178.37 3505.63  180.02 3505.51
  181.19 3505.34  181.91 3505.21  190.77 3503.95  191.12 3503.93  191.32 3503.92
  193.95 3503.69  198.28 3503.39  201.04  3503.2  201.91 3503.25  202.53 3503.38
  203.92  3503.2  204.97 3503.19  207.18 3503.42   211.7 3503.85   215.3 3503.73
  222.24 3503.76  223.66 3503.59  227.31  3503.1  231.51 3502.51  232.65 3502.39
  239.45 3502.95  248.13 3503.85  249.53 3504.12  255.45    3505  259.65 3505.54
  267.67 3506.49  272.74 3507.09  279.66 3507.85  288.19 3508.65

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032    288.19    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  288.19             48.33    62.9    48.5             .1      .3

CROSS SECTION
```

RIVER: natural wash
REACH: redrock RS: 1867.51

INPUT
Description:
Station Elevation Data num= 116

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3504.77 | .3000183 | 3504.79 | 1.01001 | 3504.85 | 10.71002 | 3504.5 | 15.72 | 3504.32 |
| 16.85001 | 3504 | 21.27002 | 3502.82 | 23.19 | 3502.45 | 23.61002 | 3502.4 | 24.06 | 3502.2 |
| 25.02002 | 3501.86 | 25.99002 | 3501.49 | 29.88 | 3501.75 | 31.31 | 3501.76 | 32.61002 | 3501.51 |
| 35.91 | 3501.54 | 38.09 | 3501.12 | 38.62 | 3500.92 | 39.74002 | 3500.93 | 42.33002 | 3500.98 |
| 44.58002 | 3500.99 | 46.86002 | 3501.03 | 48.99002 | 3501.02 | 51.67001 | 3500.53 | 52.39001 | 3500.39 |
| 58.21002 | 3500.49 | 65.14999 | 3500.49 | 67.72 | 3501.26 | 7.86002 | 3501.26 | 70.28001 | 3501.27 |
| 81.23001 | 3501.43 | 83.29001 | 3500.79 | 85.05 | 3500.25 | 93.14001 | 3500.26 | 96.52 | 3500.33 |
| 105.24 | 3500.03 | 108.92 | 3500.01 | 110.83 | 3499.88 | 115.55 | 3499.57 | 116.36 | 3499.24 |
| 117 | 3498.95 | 120.74 | 3498.98 | 129.37 | 3498.99 | 129.85 | 3499.24 | 129.99 | 3499.46 |
| 130.84 | 3500.13 | 132.64 | 3500.08 | 133.01 | 3500.09 | 134.43 | 3499.7 | 135.62 | 3499.38 |
| 137.82 | 3500.32 | 138.41 | 3500.49 | 142.97 | 3500.3 | 145.71 | 3500.14 | 146.23 | 3500.29 |
| 149.73 | 3501.3 | 151.32 | 3501.38 | 156.23 | 3501.74 | 158.6 | 3501.27 | 159.62 | 3501.12 |
| 161.47 | 3501.39 | 164.05 | 3501.73 | 169.27 | 3501.54 | 169.72 | 3501.52 | 175.26 | 3500.79 |
| 175.86 | 3500.71 | 176.76 | 3500.87 | 179.04 | 3501.45 | 179.29 | 3501.48 | 179.63 | 3501.48 |
| 188.65 | 3500.98 | 195.98 | 3501.31 | 200.51 | 3501.39 | 202.96 | 3501.45 | 208.42 | 3501.58 |
| 215 | 3501.74 | 217.78 | 3501.65 | 221.32 | 3501.49 | 224.87 | 3501.5 | 226.6 | 3501.46 |
| 230.79 | 3501.21 | 232.45 | 3501.14 | 240.06 | 3500.22 | 240.11 | 3500.21 | 240.17 | 3500.21 |
| 245.5 | 3499.8 | 246.3 | 3499.43 | 247.01 | 3499.02 | 248.2 | 3498.86 | 248.88 | 3498.84 |
| 250.33 | 3498.6 | 253.53 | 3499.16 | 255.12 | 3499.61 | 259.29 | 3498.87 | 261.84 | 3498.36 |
| 263.45 | 3498.21 | 267.53 | 3497.85 | 268.57 | 3497.95 | 271.17 | 3498.04 | 277.54 | 3498.06 |
| 282.82 | 3498.1 | 290.39 | 3498.07 | 290.7 | 3498.08 | 291.6 | 3498.17 | 293.43 | 3498.34 |
| 295.7 | 3498.64 | 299.41 | 3499.01 | 303.3 | 3499.71 | 306.54 | 3500.32 | 313.51 | 3502.16 |
| 313.57 | 3502.17 | 313.67 | 3502.21 | 313.79 | 3502.23 | 314.03 | 3502.28 | 322.43 | 3503.92 |
| 323.79 | 3504.14 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 323.79 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 323.79 | 60.97 | 45.5 | 23.7 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 1806.54

INPUT
Description:
Station Elevation Data num= 126

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3501.59 | 2.129974 | 3501.68 | 2.47998 | 3501.65 | 2.709991 | 3501.63 | 5.419983 | 3501.38 |
| 7.119995 | 3501.13 | 8.719971 | 3500.96 | 14.06 | 3499.74 | 16.14999 | 3499.97 | 16.18997 | 3499.98 |
| 16.50998 | 3499.97 | 21.07999 | 3499.57 | 22.82999 | 3498.93 | 24.07999 | 3498.55 | 28.84 | 3498.78 |
| 31.34 | 3498.74 | 43.06998 | 3497.84 | 43.65997 | 3497.78 | 43.92999 | 3497.74 | 47.32999 | 3497.17 |
| 50.96997 | 3497.25 | 1.35999 | 3497.2 | 51.62 | 3497.11 | 53.38998 | 3496.57 | 54.78998 | 3496.65 |
| 56.93997 | 3496.95 | 62.22998 | 3496.63 | 62.44998 | 3496.62 | 67.17999 | 3496.37 | 70.75 | 3496.89 |
| 70.81998 | 3496.97 | 1.50998 | 3496.86 | 77.65997 | 3496.57 | 8.10999 | 3496.51 | 79.45999 | 3496.75 |
| 80.26999 | 3496.86 | 80.94998 | 3496.91 | 86.62 | 3496.52 | 86.88998 | 3496.5 | 89.03 | 3496.97 |
| 89.91998 | 3497.19 | 4.55998 | 3496.95 | 113.49 | 3496.28 | 114.88 | 3496.24 | 115.22 | 3496.11 |
| 116.69 | 3495.58 | 121 | 3495.5 | 127.39 | 3495.37 | 129.53 | 3495.95 | 129.88 | 3496.08 |
| 130.14 | 3496.16 | 132.01 | 3496.04 | 132.51 | 3496.05 | 132.66 | 3496.05 | 132.93 | 3496.09 |
| 135.58 | 3496.61 | 140.11 | 3497.17 | 141.2 | 3497.3 | 141.39 | 3497.31 | 141.78 | 3497.31 |
| 149.66 | 3497.78 | 150.66 | 3497.88 | 151.81 | 3497.96 | 155.93 | 3498.21 | 157.26 | 3498.05 |
| 159.07 | 3497.68 | 160.04 | 3497.83 | 164.13 | 3498.47 | 168.1 | 3498.41 | 168.5 | 3498.41 |
| 168.89 | 3498.48 | 171.97 | 3499.07 | 186.32 | 3498.34 | 187.87 | 3498.23 | 188.38 | 3498.13 |
| 191.81 | 3497.28 | 194.11 | 3496.8 | 198.9 | 3497.51 | 199.17 | 3497.54 | 202.29 | 3497.48 |
| 209.46 | 3497.7 | 209.7 | 3497.71 | 209.95 | 3497.73 | 215.93 | 3498.1 | 222.85 | 3498.18 |
| 228 | 3498.25 | 233.75 | 3498.22 | 238.68 | 3498.19 | 243.6 | 3498.34 | 249.6 | 3498.56 |
| 253.77 | 3498.69 | 255.28 | 3498.67 | 261.45 | 3498.72 | 268.27 | 3498.15 | 268.72 | 3498.12 |
| 268.95 | 3498.08 | 276.33 | 3497.35 | 278.34 | 3496.27 | 278.35 | 3496.27 | 281.07 | 3495.69 |
| 281.71 | 3495.8 | 282.35 | 3496.05 | 284.2 | 3496.44 | 288.56 | 3496.23 | 292.28 | 3496.07 |
| 294.56 | 3495.63 | 297.12 | 3495.13 | 301.15 | 3495.62 | 301.39 | 3495.61 | 302.02 | 3495.31 |
| 303.52 | 3494.62 | 304.1 | 3494.8 | 305.52 | 3495.3 | 307.7 | 3495.2 | 311.91 | 3495.18 |
| 311.98 | 3495.2 | 316.13 | 3496.57 | 317.48 | 3496.92 | 323.44 | 3498.5 | 325.59 | 3499.03 |
| 335.2 | 3501.17 | 336.91 | 3501.38 | 338.99 | 3501.87 | 342.43 | 3502.56 | 346.44 | 3503.36 |
| 347.36 | 3503.5 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 347.36 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 347.36 | 67.03 | 60.1 | 44.1 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 1739.51

INPUT
Description:
Station Elevation Data num= 102

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3501.71 | .2799988 | 3501.67 | .5200195 | 3501.62 | 2.050018 | 3501.37 | 7.779999 | 3500.18 |
| 8.27002 | 3500.06 | 10.08002 | 3499.55 | 10.82001 | 3499.43 | 12.25 | 3499.01 | 13.83002 | 3498.45 |
| 15.05002 | 3498.01 | 16.23001 | 3497.45 | 18.96002 | 3496.68 | 20.28 | 3496.47 | 21.76001 | 3495.76 |
| 23.14001 | 3495.37 | 24.74002 | 3494.72 | 25.12003 | 3494.56 | 27.21002 | 3493.46 | 28.32001 | 3492.49 |
| 29.66 | 3492.43 | 1.36002 | 3492.24 | 32.14001 | 3492.05 | 33.37003 | 3491.82 | 36.72 | 3492.09 |
| 39.92001 | 3492.42 | 41.09003 | 3492.34 | 43.55002 | 3492.34 | 8.05002 | 3492.37 | 2.82001 | 3492.2 |
| 73.40002 | 3492.13 | 75.51001 | 3491.86 | 81.32001 | 3491.97 | 92.16002 | 3491.82 | 96.66002 | 3491.69 |
| 98.79001 | 3492.77 | 99.52002 | 3493.41 | 104.57 | 3493.17 | 105.07 | 3493.15 | 105.69 | 3493.14 |
| 106.32 | 3493.24 | 108.36 | 3493.56 | 114.16 | 3493.56 | 116.84 | 3493.58 | 123.22 | 3493.98 |
| 125.87 | 3494.17 | 129.28 | 3494.46 | 132.68 | 3494.7 | 143.63 | 3494.35 | 148.66 | 3494.21 |
| 151.85 | 3494.14 | 154.52 | 3494.04 | 162.36 | 3493.93 | 163 | 3493.79 | 168.41 | 3493.25 |

```
  168.44 3493.25  174.88 3493.42  179.57 3493.09  182.55  3492.9  185.05  3493.2
   186.4 3493.14  188.69 3493.23  190.09 3493.08  190.82 3492.97  191.76 3492.94
  192.39 3492.91  192.89 3492.93  214.49 3493.52  216.15 3493.61   230.4 3493.36
  232.62 3493.32  248.53 3493.56  253.51 3493.56  262.24 3493.34   263.7 3493.31
  273.07 3493.28  277.63 3493.25  278.57 3493.07  279.48 3492.93  283.33 3492.28
  284.61 3492.06  285.16 3491.97  286.11 3491.86  289.16 3491.42  289.89 3491.46
   292.8 3491.46  293.32 3491.44  297.97 3491.26  301.15 3491.29  302.93 3491.28
  303.45 3491.44  305.78 3492.42  308.47 3493.02  313.42 3494.28  315.33 3494.51
  320.03 3495.08  328.64 3495.89  329.27 3496.01  330.32 3496.19   340.6  3498.1
  342.92 3498.49  344.17 3498.71

Manning's n Values          num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   344.17    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  344.17             57.78    30.4    32.8             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock              RS: 1681.73

INPUT
Description:
Station Elevation Data     num=      112
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3501.061.060028 3500.557.150024  3497.8   11.88 3495.6612.42001  3495.4
14.10001 3494.67   16.25 3493.8117.74002 3492.7218.08002 3492.3321.40002 3490.97
   22.22 3490.6423.95001 3489.05   24.03    348924.09003 3488.9424.73001 3488.92
   34.19 3488.9539.45001 3488.9640.81003 3488.8358.32001 3488.67   59.69 3488.67
59.85001 3488.68   60.63 3488.74   61.97  3488.866.89001 3489.1567.40002 3489.11
70.07001 3488.9870.35001 3488.97   70.66 3488.9670.74002 3488.9373.57001 3488.04
76.95001 3487.9878.24002  3488.178.32001 3488.1180.06003 3488.1382.27002 3487.92
84.06001 3487.9284.59001 3487.9188.06001 3488.9791.67001  3489.893.33002  3489.8
96.58002 3490.0197.84001 3490.0299.84001 3490.06  101.62 3490.06  103.97 3490.34
  104.72 3490.36  106.55  3490.5  107.67 3490.55  110.61 3490.77  112.81 3490.95
  114.68 3490.95  116.31 3490.98  117.59 3490.99  118.72 3490.99  125.09 3490.93
  125.48  3490.9  126.62 3490.82  127.22 3489.79  128.33 3489.14   130.3 3490.08
  131.22 3491.02  133.43 3491.02   135.7 3491.17     138 3491.03  142.08 3491.26
  148.48  3490.6  151.06 3490.28  155.64 3490.66  156.18 3490.69  157.72 3490.67
  171.72 3490.35  171.92 3490.35  172.11 3490.37  172.44 3490.37  175.05 3490.44
  176.19  3490.5  183.85 3490.71  198.43 3491.18  205.79 3490.96  219.27  3490.7
  221.83 3490.75  227.91 3490.72  234.62  3490.6  241.59 3490.57  245.99 3490.49
  249.69 3490.42  255.67 3490.24  264.26 3490.03  266.75 3489.86  268.57 3489.37
   270.9 3488.81  271.67 3488.74  276.26 3488.24  277.01 3488.46  280.24 3488.69
  282.49 3488.85  284.29 3489.85  286.19 3488.79  288.94 3488.92  293.52 3490.06
  296.35 3490.71  297.62 3490.96  304.17 3492.13  309.83 3493.12  310.73 3493.27
   314.4 3493.84  317.95 3494.44  319.53 3494.72   324.4 3495.51   329.6 3496.33
  334.37 3497.08  338.92 3497.82

Manning's n Values          num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   338.92    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  338.92            114.22    26.5    27.9             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock              RS: 1567.51

INPUT
Description:
Station Elevation Data     num=      78
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3494.05.1398841 3494.036.269989 3491.976.789978  3491.910.60999 3490.73
   14.06 3489.16   14.22 3489.0915.09998 3488.83   16.25 3488.4917.88998 3487.39
   18.38 3487.2318.69998 3487.1218.84998  3486.9   19.84 3485.39   20.19 3485.22
21.48999  3484.821.72998 3484.6921.85999 3484.6323.50998 3483.57   26.28 3483.15
27.13998 3483.0427.42999 3482.8827.69998 3482.7729.53998 3481.83   57.48 3481.65
58.40999 3481.6558.60999 3481.66   61.09 3481.5890.98999 3480.8791.90999 3480.76
   92.23 3480.6493.06999 3480.9295.54999 3481.6197.52998 3481.55  103.48 3481.37
  105.94 3482.81   107.5 3483.63   109.5    3485  112.14 3486.95   114.7  3487.4
  118.31 3487.45  118.51 3487.47  124.15 3487.88  125.29  3487.9  129.02 3487.71
  139.23 3487.24  140.07 3487.34  141.42 3487.59  162.61 3488.46  169.67 3488.69
  175.31 3488.86  179.72 3488.86  185.78 3488.97  208.64 3487.93  213.51 3487.72
   216.1  3487.7  225.47  3487.6  226.25 3487.63   242.4 3487.59  251.16 3487.55
   252.2 3486.78  252.41 3486.62  254.53  3486.4  256.58 3486.15  258.24 3486.02
  259.73 3486.34  261.02 3486.55  267.87 3486.93  268.31 3486.95  269.05 3486.89
  273.97 3486.52   276.5 3487.27  278.65 3487.98  282.48 3489.15  283.53 3489.45
  300.09 3492.63   301.1 3492.82  305.24 3493.49

Manning's n Values          num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   305.24    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  305.24             31.51   31.51   31.51             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock              RS: 1536

INPUT
Description:
Station Elevation Data     num=      93
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3490.398.339996 3488.6911.13998 3488.13   15.38 3487.02   17.13 3486.56
```

```
18.10999 3486.2423.60001 3484.1923.72998 3484.1424.01999 3484.08   26.38 3483.54
28.28998 3483.2528.79999  3483.132.82999 3481.3733.44998 3481.1935.60001 3480.45
      37 3480.0237.66998 3479.7539.14999 3479.55   40.31 3479.4240.71999 3479.35
   48.12 3479.13   69.87 3479.5271.89999 3479.5272.98999 3479.54   76.12 3479.61
81.01999 3479.61   83.92 3479.4298.28999 3478.51  100.18 3479.31  100.67 3479.37
  102.07 3480.03  105.07 3481.56  105.98 3482.06  106.82 3482.39  108.73 3483.02
  109.88 3483.12   110.2  3483.1   111.1 3482.94  111.46 3482.94  112.91 3482.43
  114.15 3481.47  115.96 3480.93  118.29 3480.75  118.99 3481.11  119.16 3481.26
  120.49 3482.49  121.76 3483.58  123.16 3484.39  124.31 3484.97   128.5 3485.18
  133.64 3485.56  133.99 3485.56  140.45 3485.65  141.17 3485.68  141.41 3485.68
  142.07  3485.7   146.2 3485.73  178.06 3485.94  186.09 3485.84  190.27 3485.84
  193.68  3485.7  195.72 3485.66  212.23 3485.23  215.89 3484.42  216.34 3484.36
  220.16  3484.9  220.37 3484.93  220.84 3484.95  221.25 3484.95  229.65 3485.18
  234.14 3485.06  239.07 3484.91  239.19 3484.89   241.8 3484.68  245.39 3484.42
  246.83 3484.37  251.62 3484.01  253.47 3483.81  255.45  3483.6  260.79 3483.71
  260.88 3483.71  260.98 3483.75  263.43 3484.21  266.33 3485.69  266.39 3485.72
  266.49 3485.76  269.53 3486.93   270.8 3487.38  278.08 3488.83  280.81 3489.42
  286.51  3490.2  290.43 3490.87  295.71  3491.7

Manning's n Values         num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   295.71    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  295.71             42.51   42.51   42.51             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock             RS: 1493.49

INPUT
Description:
Station Elevation Data    num=      66
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0  3484.83.440002 3484.027.660004 3483.277.929993 3483.2210.32999 3482.72
11.01999 3482.62   16.62 3481.4323.28999 3480.4125.73999 3479.9526.92999 3479.76
28.88998 3479.3931.01999 3478.8832.81999 3478.5336.77998 3477.2736.81999 3477.26
37.00999 3477.2342.28999 3476.2943.76999 3476.0443.93999 3476.0144.07999 3475.96
   45.87 3476.0158.66998 3476.27   76.87 3476.2789.40999  3475.789.71999 3475.71
91.92999 3477.24   92.45 3477.4393.93999 3478.73   96.31  3480.899.24998  3481.1
  101.53 3481.65  104.19 3481.74  113.18 3481.67  117.33  3481.7  134.14 3481.75
  159.64 3481.82  162.93 3481.86  171.35 3481.82  175.93  3481.8  179.85 3481.89
  183.68 3482.06  186.03 3481.64  186.34 3481.55  186.68 3481.57   189.1  3481.7
  197.63 3481.57  202.95 3481.48  205.26 3481.18  208.98 3480.65  217.64 3480.49
  217.66 3480.49  222.16  3480.5  224.52 3480.43   229.3 3480.19  231.16  3480.1
  234.31 3480.23  234.92 3480.23  235.43 3480.34  236.08 3480.59  237.57 3480.76
  240.84  3481.1  242.47 3481.63  246.25 3482.89  250.51 3483.81  254.51 3484.65
  265.99 3486.98

Manning's n Values         num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   265.99    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  265.99             50.43   50.43   50.43             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock             RS: 1443.06

INPUT
Description:
Station Elevation Data    num=      75
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3481.54.1000061  3481.51.600006 3481.038.270004  3478.7   24.87 3476.45
   26.61  3476.2   26.78 3476.17   27.06 3476.13    27.7 3475.99   28.75  3475.8
31.10001 3475.3632.21001 3475.01   35.61 3474.08   37.06 3473.93   37.44 3473.81
   38.83 3473.3143.14999 3472.82   43.45 3472.82   82.88 3472.7389.35001 3472.82
   91.37 3472.5192.32001 3472.41   92.67 3472.93   94.77 3476.0796.39999 3476.34
  102.94 3477.39  109.76 3477.39  118.72 3477.32  123.96 3477.48  131.95 3477.71
  152.74 3477.43  153.26 3477.43  153.79 3477.42  153.94 3477.42  159.22 3477.08
  164.13  3477.3  164.43 3477.31  164.89 3477.35   167.4 3477.49  174.21 3477.86
  177.61 3477.61  181.48 3477.36  182.57 3476.98   183.9  3476.4  184.87 3476.77
  188.29 3476.84  188.79    3477  191.89 3477.72  192.64  3477.7  195.05 3477.62
  197.32 3477.68  199.73 3477.34  202.06 3476.69  203.98 3476.65  204.88 3476.67
  206.63 3476.48  207.93 3476.36  209.53 3476.04  212.81 3476.58  214.57 3476.77
  216.59 3476.89  218.14 3477.01  219.54 3476.88  220.73 3476.73  223.93  3477.4
  227.37 3478.28  229.36 3478.67  235.63 3479.97   240.7 3480.91  241.39 3481.05
  242.48 3481.22  248.34 3482.13  252.19 3482.59  258.59 3483.11   260.5 3483.25

Manning's n Values         num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   260.5    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   260.5             58.55   58.55   58.55             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock             RS: 1384.51

INPUT
Description:
Station Elevation Data    num=      85
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3477.642.110016 3476.694.110016 3475.669.570007 3475.04   11.62 3474.78
12.70001 3474.6513.68001  3474.6   23.38 3474.0728.40001 3472.6829.79001 3472.31
36.40001 3470.54   39.75 3469.7641.07001 3469.47   43.02 3469.42   45.75 3469.27
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   73.27 3469.2479.71001  3469.282.39001 3469.6382.43001 3469.6482.85001 3469.66
90.64001 3469.8696.09001 3469.6798.71001 3469.5799.85001 3469.47   99.91 3469.49
  100.21 3470.09  101.35 3471.86  102.13 3473.27  103.37 3473.19  110.52 3472.76
  110.83 3472.75  114.71 3472.81   117.7 3472.78  117.79 3472.79  118.57 3472.79
  133.55 3473.06  149.03  3472.6  149.82 3472.58  150.12 3472.48  152.59 3471.92
  154.31 3472.33  155.56 3472.65  159.13 3473.05  161.03 3473.24   164.4 3473.51
  175.29 3474.11  176.43 3474.04  176.62 3474.03  179.67 3473.34  180.68 3473.11
  182.79 3473.07  185.07 3472.78   189.3 3472.47   192.8 3472.17  193.15 3472.15
  193.39 3472.21     197 3473.01  201.47 3472.94  201.52 3472.95  201.58 3472.93
  205.08 3472.15  206.22 3472.39  208.12 3472.87  210.18 3473.01  211.23 3473.09
  212.45 3472.84  213.55 3472.66  221.19 3474.23  222.58 3474.52     224 3474.71
  230.05 3475.36  232.64 3475.41  239.64 3475.21  240.48 3475.16  247.48 3474.45
  248.92 3474.25  249.59 3474.26  253.56 3473.98  257.29 3473.97  257.37 3473.97
  257.57    3474  263.78    3475  264.45  3475.3  266.01 3475.77  268.32 3476.45

Manning's n Values         num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   268.32    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0  268.32             46.92   46.92   46.92             .1       .3

CROSS SECTION


RIVER: natural wash
REACH: redrock             RS: 1337.59

INPUT
Description:
Station Elevation Data     num=      77
     Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
       0 3477.452.630005 3476.4910.85001 3473.49   16.98 3471.28   18.75 3470.9
20.99001 3470.3222.21001 3469.9825.89999 3469.3530.04001 3468.6431.10001 3468.62
   34.34 3468.74   39.47 3468.0440.54001  3467.741.85001 3466.92   43.63 3466.37
   63.27 3466.25   78.44 3465.82   78.66 3465.8480.10001 3466.04   81.41 3466.22
81.79001 3466.2583.49001 3466.22   90.37 3466.53  100.64 3466.96  101.43 3467.01
  101.46 3467.09  101.52 3467.14  101.76 3467.53  103.61 3470.55  105.69 3470.53
  111.88 3470.38  115.55 3470.29  117.67 3470.23  127.13 3469.97  131.45 3469.82
  132.94 3469.66  135.31 3469.44  140.11 3469.15  140.57 3469.15  144.64 3469.07
  146.69 3468.58  148.62 3468.18  150.61 3468.61  151.46 3468.87  154.17 3468.91
  156.89 3468.95  161.52 3469.54   164.4 3469.95  170.78 3470.34  178.89 3470.77
   181.3 3470.61  186.44 3470.08  189.24 3469.87  193.67 3469.15  193.74 3469.14
  193.76 3469.14  196.82 3468.55  196.93 3468.54  197.08 3468.53  201.15 3468.18
  204.76 3468.82  205.06 3468.87  205.76 3468.86  211.82 3468.86  214.22 3468.97
   214.9 3468.73  216.75 3468.17  219.76 3468.93  220.67 3469.11  221.59 3469.23
  223.77 3469.66  229.57 3471.39  231.38 3471.72  235.47  3472.3  236.48 3472.44
  242.09 3473.25  242.22 3473.26

Manning's n Values         num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   242.22    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0  242.22             50.55   50.55   50.55             .1       .3

CROSS SECTION


RIVER: natural wash
REACH: redrock             RS: 1287.04

INPUT
Description:
Station Elevation Data     num=      67
     Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
       0 3473.546.800003  3471.8   11.55 3470.37   14.41 3469.4417.71001 3468.69
    22.5 3467.7436.56999 3464.95   37.03 3464.8438.75999 3464.5340.50999 3463.84
   42.27 3463.13   47.55  3463.1   72.67 3463.02   72.78 3463.0573.49001  3463.5
73.96001 3463.81   75.23 3463.6275.74001 3463.5475.92999 3463.3576.56999 3463.03
   92.58  3463.5   99.06 3463.72  100.46 3466.41  101.45 3467.79  102.91 3467.59
  103.73 3467.52  104.08  3467.5  105.93 3467.36  119.15 3467.37  119.31 3467.37
  129.91 3467.06     135 3466.78   140.1  3466.6  145.49 3466.19  155.26 3465.09
  155.31 3465.08  155.37 3465.07   159.7 3464.29  160.98 3464.64  162.85 3464.97
  163.54    3465  168.68 3465.49   169.4 3465.57  170.04  3465.6  173.52 3465.72
  176.15 3465.67  178.71 3465.36  184.18 3464.25  184.92 3464.11  185.52 3464.03
  185.85 3463.94  187.16 3464.13  190.92  3464.6  194.36 3464.77   197.1 3464.97
  197.81 3464.84  199.09 3464.61  203.49 3464.88   204.3 3464.98  206.07 3465.61
  209.26 3466.63  209.44 3466.69   209.6 3466.74  218.13  3469.7  218.55 3469.81
  225.44  3471.7  226.64 3471.87

Manning's n Values         num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   226.64    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0  226.64             49.68   49.68   49.68             .1       .3

CROSS SECTION


RIVER: natural wash
REACH: redrock             RS: 1237.36

INPUT
Description:
Station Elevation Data     num=      66
     Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
       0 3472.044.169998 3471.148.330002 3469.45   16.11  3466.1   18.33 3465.47
   19.56 3465.12   26.08 3462.99   28.44 3462.6340.43001 3460.56   40.91 3460.38
   42.39 3459.83   50.88 3459.58   58.31 3459.37   58.77 3459.59   59.81 3460.18
62.48001 3460.1164.87001  3460.1   65.75 3459.7366.60001 3459.4175.96001 3459.65
79.29001 3459.81   81.52 3459.97   85.19 3463.8285.82001 3464.64   87.33 3464.86
   88.16 3465.05   89.03  3465.1   90.25  3465.190.84001 3465.14   91.45 3465.14
```

92.21001 3465.16 93.63 3465.37 94.22 3465.38 96.76 3465.4899.71001 3465.74
101.6 3465.9 103.24 3465.93 113.44 3465 121.25 3463.91 122.66 3463.92
126.44 3463.98 136.79 3464.18 139.45 3464.16 149.9 3463.41 156.55 3462.92
160.72 3462.19 166.75 3461.16 167.99 3460.94 172.06 3460.3 177.95 3460.03
178.9 3460.94 186.83 3461.38 189.51 3461.56 189.69 3461.61 190.95 3462.04
193.35 3462.79 194.24 3463.1 196.71 3463.55 199.09 3463.97 200.45 3464.3
200.51 3464.32 200.58 3464.34 204.8 3465.94 208.77 3467.02 213.59 3468.73
224.52 3470.57

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 224.52 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 224.52 | 49.03 | 49.03 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 1188.33

INPUT
Description:
Station Elevation Data num= 47

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3468.882.860001 | 3468.396.470001 | 3467.8 | 11.23 | 3465.2212.14999 | 3464.68 | | | |
| 12.47 | 3464.56 | 15.37 | 3463.26 | 18.47 | 3461.8823.53999 | 3459.51 | 28.14 | 3458.14 | |
| 29.83 | 3457.29 | 31.03 | 3456.6633.35001 | 3456.6542.28999 | 3456.67 | 46.38 | 3456.64 | | |
| 46.83 | 3456.55 | 48.31 | 3456.2663.75999 | 3456.49 | 71.22 | 3456.6272.00999 | 3456.86 | | |
| 73.81999 | 3457.8881.96001 | 3460.5184.10001 | 3461.32 | 90.13 | 3461.9 | 96.79 | 3462.33 | | |
| 102.46 | 3462.68 | 116.5 | 3462.1 | 122.21 | 3461.9 | 127.5 | 3461.3 | 137.48 | 3460.08 |
| 143.88 | 3460.22 | 148.31 | 3460.41 | 151.06 | 3460.35 | 155.58 | 3460.02 | 157.18 | 3459.9 |
| 159.29 | 3459.59 | 160.7 | 3458.14 | 172.71 | 3457.74 | 175.29 | 3457.42 | 179.57 | 3458.32 |
| 179.59 | 3458.32 | 189.19 | 3458.85 | 193.04 | 3459.64 | 207.57 | 3465.35 | 209.44 | 3466 |
| 215.97 | 3467.03 | 219.39 | 3467.57 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 219.39 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 219.39 | 51.18 | 51.18 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 1137.15

INPUT
Description:
Station Elevation Data num= 50

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3462.079.889999 | 3461.08 | 10.22 | 3460.98 | 12.28 | 3460.47 | 16.77 | 3459.35 | |
| 17.24001 | 3459.01 | 19.42 | 3458.39 | 20.12 | 3458.11 | 20.36 | 3457.72 | 22.11 | 3455.44 |
| 23.77 | 3452.9623.85001 | 3452.84 | 26.39 | 3452.92 | 34.86 | 3453.1735.50999 | 3453.18 | | |
| 35.81 | 3453.19 | 36.69 | 3453.250.64999 | 3453.0759.75999 | 3453.02 | 76.53 | 3453 | | |
| 78.53999 | 3453.7379.82001 | 3454.14 | 83.59 | 3455.888.75999 | 3458.13 | 92.45 | 3458.22 | | |
| 92.57 | 3458.22 | 92.68 | 3458.23 | 109.14 | 3459.08 | 127.53 | 3458.31 | 131.1 | 3458.18 |
| 132.46 | 3458.03 | 147.06 | 3456.91 | 148.95 | 3456.75 | 149.96 | 3456.66 | 157.32 | 3455.99 |
| 163.64 | 3455.42 | 165.12 | 3455.31 | 174.04 | 3454.83 | 177.72 | 3454.46 | 179.76 | 3454.24 |
| 180.63 | 3454.3 | 184.38 | 3455.2 | 188.53 | 3457.69 | 188.94 | 3457.96 | 189.8 | 3458.32 |
| 191.67 | 3459.13 | 204.39 | 3464.67 | 205.54 | 3464.87 | 207.19 | 3464.97 | 216.86 | 3465.49 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 216.86 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 216.86 | 47.68 | 47.68 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 1089.47

INPUT
Description:
Station Elevation Data num= 59

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3455.313.159988 | 3454.924.659988 | 3454.63 | 8.87999 | 3454.729.259995 | 3454.73 | | | |
| 9.459991 | 3454.7218.59999 | 3454.6320.54999 | 3454.56 | 21.42 | 3454.2522.90999 | 3453.67 | | | |
| 27.43999 | 3452.03 | 30.45 | 3450.95 | 32.42 | 3450.26 | 34.2 | 3449.3334.29999 | 3449.29 | |
| 46.34999 | 3449.7 | 51.03 | 3449.84 | 56.62 | 3449.75 | 69.09 | 3449.3975.85999 | 3449.2 | |
| 77.12999 | 3450.03 | 78.64 | 3451.2284.09999 | 3453.1985.17999 | 3453.688.05999 | 3453.76 | | | |
| 95.46999 | 3454.24 | 111.06 | 3455.54 | 126.84 | 3454.48 | 133.1 | 3454.1 | 134.6 | 3453.96 |
| 143.83 | 3453.96 | 145.77 | 3453.41 | 146.1 | 3453.31 | 149.05 | 3452.75 | 151.69 | 3452.01 |
| 154.82 | 3451.24 | 158.88 | 3451.04 | 161.39 | 3451.02 | 165.34 | 3450.87 | 166.72 | 3450.82 |
| 166.99 | 3450.86 | 171.01 | 3451.64 | 181.71 | 3452.12 | 182.01 | 3452.13 | 188.76 | 3454.12 |
| 190.93 | 3454.69 | 193.01 | 3455.29 | 193.04 | 3455.3 | 193.11 | 3455.31 | 193.21 | 3455.33 |
| 194.36 | 3455.33 | 195.06 | 3455.42 | 196.41 | 3455.53 | 200.14 | 3455.88 | 200.81 | 3455.86 |
| 204.01 | 3455.54 | 206.33 | 3455.44 | 209.58 | 3455.42 | 210.43 | 3455.29 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 210.43 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 210.43 | 49.95 | 49.95 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 1039.52

INPUT
Description:
Station Elevation Data num= 58

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3450.97 | .6600037 | 3450.99 | 4.650006 | 3451.261 | 1.43001 | 3451.671 | 3.51001 | 3451.86 |
| 14.16 | 3451.72 | 19.14 | 3450.68 | 21.96001 | 3449.3 | 25.45 | 3447.722 | 7.15001 | 3446.51 |
| 27.63 | 3446.17 | 41.22 | 3446.37 | 45.73 | 3446.36 | 48.78 | 3446.27 | 57.09 | 3446.08 |
| 62.61 | 3445.9 | 62.95 | 3446.34 | 63.37001 | 3446.76 | 65.03 | 3448.327 | 8.10001 | 3448.34 |
| 78.57 | 3448.33 | 78.59 | 3448.34 | 78.86 | 3448.4 | 83.2 | 3449.31 | 83.65 | 3449.41 |
| 84.47 | 3449.54 | 89.09 | 3450.3 | 99.29 | 3451.15 | 103.53 | 3451.58 | 108.52 | 3451.72 |
| 130.75 | 3451.97 | 132.49 | 3451.99 | 140.8 | 3449.98 | 141.42 | 3449.86 | 142.39 | 3449.62 |
| 145.68 | 3449.12 | 147.71 | 3448.39 | 150.62 | 3447.07 | 153.09 | 3447.07 | 154.78 | 3447.18 |
| 155.75 | 3446.95 | 159.47 | 3446.65 | 160.15 | 3446.82 | 161.93 | 3447.29 | 162.83 | 3447.56 |
| 164.64 | 3447.68 | 167.33 | 3447.73 | 168.28 | 3447.58 | 169.81 | 3447.33 | 173.77 | 3448.11 |
| 173.88 | 3448.14 | 173.89 | 3448.13 | 174.1 | 3448.18 | 182.44 | 3450.29 | 191.9 | 3453.95 |
| 195.85 | 3455.53 | 197.14 | 3455.89 | 204.3 | 3457.5 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 204.3 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 204.3 | 53.37 | 53.37 | 53.37 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 986.15

INPUT
Description:
Station Elevation Data num= 51

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3448.3 | 3.87999 | 3448.94 | 8.159988 | 3446.89 | 11.62 | 3445.291 | 5.25999 | 3445.05 |
| 15.69 | 3445.02 | 17.89999 | 3444.77 | 18.83 | 3444.172 | 1.17999 | 3442.68 | 21.58 | 3442.6 |
| 33.17 | 3442.61 | 44.08 | 3442.69 | 50.15999 | 3442.53 | 59.42 | 3442.57 | 64.64 | 3442.53 |
| 65.62 | 3443.21 | 66.72 | 3443.74 | 67.5 | 3444.277 | 6.35999 | 3444.69 | 77.66 | 3444.75 |
| 78.93999 | 3444.9 | 83.59 | 3445.45 | 85.92999 | 3445.95 | 96.7 | 3448.03 | 103.95 | 3447.87 |
| 106.7 | 3447.78 | 109.07 | 3447.78 | 113.55 | 3447.5 | 115.21 | 3447.27 | 121.03 | 3447.4 |
| 122.63 | 3447.35 | 128 | 3446.85 | 131.55 | 3446.52 | 140.37 | 3445.01 | 140.96 | 3444.9 |
| 141.48 | 3444.72 | 146.42 | 3443.01 | 150.57 | 3443.13 | 154.02 | 3443.3 | 157.02 | 3442.95 |
| 157.34 | 3442.94 | 157.8 | 3443.06 | 160.66 | 3443.88 | 164.25 | 3444.33 | 167.58 | 3444.55 |
| 172.85 | 3445.82 | 177.77 | 3446.85 | 186.79 | 3450.05 | 194.85 | 3452.96 | 197.22 | 3453.63 |
| 197.48 | 3453.68 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 197.48 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 197.48 | 49.79 | 49.79 | 49.79 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 936.36

INPUT
Description:
Station Elevation Data num= 60

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3445.14 | .059998 | 3443.17 | 5.73999 | 3442.46 | 8.959991 | 3442.22 | 14.86 | 3441.78 |
| 16.59 | 3441.54 | 18.56 | 344018. | 75999 | 3439.83 | 18.89 | 3439.71 | 19.33 | 3439.72 |
| 21.53 | 3439.71 | 28.51999 | 3439.66 | 30.36 | 3439.27 | 30.94 | 3439.15 | 46.06 | 3439.26 |
| 49.04999 | 3439.26 | 54.06 | 3439.27 | 63.82999 | 3439.24 | 69.24 | 3439.27 | 70.24 | 3439.57 |
| 72.16 | 3439.99 | 72.91 | 3439.92 | 74.89999 | 3440.48 | 76.13 | 3440.08 | 79.75999 | 3441.44 |
| 80.91 | 3441.68 | 88.49 | 3442.09 | 97.87 | 3442.46 | 99.46999 | 3442.68 | 109.96 | 3443.44 |
| 110.47 | 3443.46 | 114.78 | 3441.93 | 118.81 | 3440.55 | 122.21 | 3439.97 | 127.24 | 3439.15 |
| 130.37 | 3438.8 | 131.88 | 3438.74 | 134.24 | 3438.95 | 134.96 | 3439.02 | 139.14 | 3439.29 |
| 141.67 | 3439.4 | 143.97 | 3439.44 | 144.43 | 3439.4 | 144.92 | 3439.43 | 148.22 | 3439.9 |
| 151.35 | 3440.05 | 151.78 | 3440.05 | 152.85 | 3439.99 | 155.88 | 3440.52 | 156.8 | 3440.73 |
| 157.4 | 3440.81 | 159.87 | 3441.08 | 163.31 | 3441.67 | 165.66 | 3442.3 | 175.67 | 3446.38 |
| 178.98 | 3447.69 | 180.91 | 3448.49 | 188.01 | 3451.02 | 190.08 | 3451.85 | 191.12 | 3452.12 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 191.12 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 191.12 | 50.1 | 50.1 | 50.1 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 886.26

INPUT
Description:
Station Elevation Data num= 58

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3442.83 | 2.599991 | 3442.87 | 7.959991 | 3442.93 | 9.039993 | 3442.96 | 10.89 | 3442.45 |
| 14.98999 | 3441.46 | 16.45999 | 3440.94 | 18.26999 | 3440.15 | 22.56999 | 3438.09 | 23.12999 | 3437.72 |
| 25.81 | 3436.52 | 29.31 | 3436.44 | 30.17999 | 3436.41 | 31.23999 | 3436.06 | 31.95999 | 3435.86 |
| 32.31999 | 3435.77 | 35.25 | 3435.76 | 43.00999 | 3435.74 | 47.87999 | 3435.91 | 51.53 | 3436.14 |
| 63.39999 | 3436.02 | 74.00999 | 3436.01 | 76.28 | 3436.87 | 6.43999 | 3436.87 | 77.02 | 3436.85 |
| 80.35999 | 3436.74 | 88.52 | 3436.5 | 94.06 | 3437.87 | 94.38 | 3437.95 | 98.35 | 3438.4 |
| 106.87 | 3439.27 | 109.98 | 3439.26 | 111.28 | 3439.21 | 119.14 | 3438.98 | 123.42 | 3438.71 |

```
  125.93 3438.58  130.57  3436.3  130.68 3436.23  137.85 3435.51  140.64  3435.4
  142.07 3435.72  143.43 3436.26  143.83 3436.37  145.13 3436.66   148.7 3438.35
  152.02  3439.5  156.93 3441.79  157.97 3442.32  161.61 3444.13  162.24 3444.54
   163.1 3444.87   163.9  3445.1  170.81 3446.89  173.84 3447.51  178.29 3448.49
  181.14 3449.07   182.2 3449.24  186.23  3449.5

Manning's n Values          num=      3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   186.23    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  186.23             50.07   50.07   50.07             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock              RS: 836.19

INPUT
Description:
Station Elevation Data      num=      50
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3440.033.539993 3440.0911.99001 3440.21   20.92 3436.79   21.38 3436.62
   21.64 3436.54   24.91 3434.82   29.72 3433.5629.78999 3433.54   29.83 3433.52
   29.87  3433.5   31.62 3432.87   33.86  3432.8   49.78 3432.51   57.77 3432.45
   66.56 3432.42   76.95 3432.52   80.37 3432.53   83.04 3433.39    83.4 3433.59
   84.74 3434.02   87.88 3434.88   90.44 3435.53   91.04 3435.67   92.72 3436.12
   97.82 3436.07  102.22 3436.18  103.18 3436.14  112.48 3435.53  116.26 3435.16
  118.55 3434.34   121.1 3433.25  122.56 3433.14  127.82 3432.66  129.28 3432.66
  130.67 3432.69  133.11 3433.62  139.56 3435.24  145.65 3438.04  148.99 3439.61
  151.94 3440.92  154.24 3441.99  158.15 3443.45  159.79 3443.83   161.6 3444.02
  167.12 3444.62  172.05 3445.22  175.54  3445.5  179.21 3445.68     180 3445.72

Manning's n Values          num=      3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032      180    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     180             49.48   49.48   49.48             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock              RS: 786.71

INPUT
Description:
Station Elevation Data      num=      47
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3437.348.369995 3437.25   15.92 3437.16   23.59 3437.1525.69999 3435.85
29.09999  3434.4   30.03 3433.4231.34999 3431.6636.60999 3430.99   40.09 3430.43
41.95999 3430.34      48 3429.5251.26999 3429.06   51.59 3429.0357.81999 3429.03
65.98999 3428.65   76.98 3428.5378.98999 3428.5580.26999 3428.4781.05999 3428.94
    82.8 3430.0486.99999  3431.3   88.23 3431.8693.03999  3432.299.50999 3432.64
  103.72 3432.03  107.98 3431.67  110.09 3430.76  111.96 3429.68   112.8 3429.71
  114.95 3429.93  115.69  3429.9  119.72 3429.48  122.12  3429.8  122.49 3429.85
  124.51 3430.17  130.88 3431.08  132.42  3431.9   140.3 3435.47  140.59 3435.59
  140.88 3435.69  147.69 3438.45  153.53 3440.38  157.61 3440.86  170.65 3441.29
  175.14  3441.6  182.43 3441.85

Manning's n Values          num=      3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   182.43    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  182.43             66.72   66.72   66.72             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock              RS: 719.99

INPUT
Description:
Station Elevation Data      num=      56
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 3433.24   13.19 3433.61     16 3433.61   20.31 3433.31   20.46  3433.3
   21.24 3432.14    22.8  3428.9   27.55 3427.54   29.62 3427.06   31.75  3426.9
   36.62 3426.38   39.09 3426.16   39.51  3426.1   40.14 3426.02   43.16 3425.77
   45.48 3425.63   47.55 3425.47   48.46 3425.37   49.37 3425.43   49.84 3425.33
   50.33 3425.38   51.78 3425.54   60.43 3425.09   65.57 3424.94   66.67 3425.49
   67.66 3425.91   69.42 3426.59   71.93 3427.53   73.83 3427.92   75.34  3428.2
   75.93 3428.15    78.5 3427.75   80.63 3427.06   81.75  3426.7   86.48 3426.53
   88.46 3426.59   92.53 3426.22   93.03 3426.12   93.48 3426.15    96.2 3426.21
   96.49 3426.36   97.38 3426.98  100.17 3427.13  103.35 3427.77  106.62 3430.26
  107.68 3430.82  111.31 3432.73  118.79 3436.22  120.32 3436.99  120.89 3437.19
  129.06 3437.59  132.11 3437.91  138.17 3438.12  142.42 3438.05     146 3437.93
  146.03 3437.93

Manning's n Values          num=      3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   146.03    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  146.03             36.9    36.9    36.9             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock              RS: 683.09
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```
INPUT
Description:
Station Elevation Data    num=      44
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3430.231.899996 3430.273.549995  3430.35.449997  3430.4   11.32 3430.55
    12.05  3430.5   13.37 3430.35   18.32 3429.7324.39999 3428.54   27.22 3427.87
    30.71 3427.13   35.98 3425.5136.82999  3425.2    37.2    3425      41 3422.77
    42.75 3422.6643.39999 3422.62    46.8  3422.4   47.47  3422.4   56.93 3422.24
       58  3422.2   60.42 3422.19   61.97  3422.2   71.55  3422.2   71.66 3422.26
    75.41 3423.37   78.48 3425.34   79.99 3426.2388.50999 3430.41   88.98 3430.66
    89.35 3430.84   96.06 3433.8997.00999 3434.03  101.65 3434.51  106.54  3435.1
   107.62 3435.26  108.07 3435.32   108.5 3435.36  111.05 3435.57  115.28 3435.84
    116.3 3435.92  120.72 3436.26  123.59 3436.41  131.31 3436.91

Manning's n Values        num=      3
      Sta   n Val      Sta   n Val      Sta   n Val
        0    .032        0    .032   131.31    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  131.31             54.23   54.23   54.23             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock            RS: 628.86

INPUT
Description:
Station Elevation Data    num=      38
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3426.84.4499969 3426.864.369995  3427.15.439987 3427.14   13.37 3427.35
     15.2 3427.38   17.02 3427.06   21.27 3426.2826.64999 3424.8526.07999  3424.8
35.89999 3423.3238.25999 3422.84   39.87 3422.4745.78999 3421.1749.59999 3418.91
49.63999 3418.8949.75999 3418.8961.05999 3418.9767.81999 3419.05   71.95 3418.94
76.09999 3418.8676.74999 3419.3977.82999 3419.9578.40999  3421.679.26999 3422.89
82.04999 3424.7884.24999 3426.3986.07999 3427.8387.35999 3428.4694.25999 3431.86
  101.51 3432.78  103.33 3432.96  104.53    3433   113.9  3433.4  118.75  3433.5
     121 3433.55  131.95 3433.77  134.04  3433.8

Manning's n Values        num=      3
      Sta   n Val      Sta   n Val      Sta   n Val
        0    .032        0    .032   134.04    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  134.04             40.38   43.9    45.2             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock            RS: 588.48

INPUT
Description:
Station Elevation Data    num=      37
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3424.282.660004 3424.56   10.23 3424.67   14.06 3424.63   20.21 3423.59
21.35999 3423.39    22.1 3423.23   30.92 3421.28   44.06 3419.59   47.02 3419.23
    47.77 3419.01   51.45 3417.85    54.2 3418.04   55.84 3418.09   57.77 3417.06
    58.41 3416.72   58.55 3416.63   59.92 3416.3681.17999 3415.99   81.84 3415.97
82.03999 3416.0285.09999 3416.93   85.45  3419.5   85.56 3419.8389.92999 3422.05
    92.84 3423.82   100.1 3428.17  101.59 3429.06  108.66 3429.31  109.45 3429.35
   109.87 3429.35  120.26 3429.36  122.29 3429.37   123.6 3429.39  132.74 3429.67
   145.57 3429.69  146.59 3429.73

Manning's n Values        num=      3
      Sta   n Val      Sta   n Val      Sta   n Val
        0    .032        0    .032   146.59    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  146.59             26.46   37.7    47.6             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock            RS: 562.02

INPUT
Description:
Station Elevation Data    num=      45
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3422.34      1.5 3422.583.809998 3422.646.259995 3422.66   11.73 3421.89
    14.12  3421.5   15.88    3421   24.85 3419.06   25.11 3419.04   36.62 3416.93
    40.18 3416.5442.68999 3415.96   44.88 3415.65   45.79 3415.58   50.43 3415.56
50.68999 3415.56   50.78 3415.51    53.7 3413.94   55.89 3414.37   57.12 3414.59
    57.66 3414.58   60.43 3414.51    61.7 3414.47   61.78 3414.44   62.92 3413.79
     62.7 3413.8687.28999 3413.9688.53999 3414.27   91.84 3415.04   92.23  3419.8
    92.61 3425.03  100.17 3425.18  105.27 3425.38  109.63 3425.28  113.92  3425.5
   113.98 3425.51  114.11 3425.52  116.99 3425.64  123.08 3425.89  123.52 3425.91
   123.85 3425.93  131.18 3426.51  134.82 3426.68  138.98 3426.87  147.56 3426.96

Manning's n Values        num=      3
      Sta   n Val      Sta   n Val      Sta   n Val
        0    .032        0    .032   147.56    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  147.56             17.59   31.7      49             .1      .3

CROSS SECTION
```

RIVER: natural wash
REACH: redrock RS: 544.43

INPUT
Description:
Station Elevation Data num= 39

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3419.845 | .919998 | 3421.17 | 6.25 | 3421.19 | 7.969994 | 3420.99 | 14.82999 | 3419.97 |
| 23.93 | 3417.36 | 25.46 | 3416.93 | 26.67 | 3416.58 | 31.95 | 3415.31 | 38.71 | 3414.02 |
| 40.1 | 3413.82 | 45.86 | 3413.15 | 47.25999 | 3412.26 | 48.49 | 3411.54 | 49.91 | 3411.67 |
| 52 | 3412.175 | 3.07999 | 3412.2 | 54.03 | 3412.06 | 55.23 | 3412.6 | 55.91 | 3412.8 |
| 57.62 | 3413.03 | 61.3 | 3413.38 | 62.13 | 3412.77 | 63.35 | 3411.63 | 78.03 | 3411.73 |
| 91.75 | 3411.78 | 93.88 | 3412.11 | 94.09 | 3412.14 | 94.37 | 3412.25 | 95.91 | 3412.81 |
| 97.71 | 3413.45 | 98.36 | 3418.34 | 99.03 | 3422.06 | 99.42999 | 3422.18 | 100.86 | 3422.49 |
| 125.88 | 3423.77 | 127.1 | 3423.8 | 127.84 | 3423.81 | 128.7 | 3423.81 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 128.7 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 128.7 | 49.55 | 59.4 | 68.5 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 494.88

INPUT
Description:
Station Elevation Data num= 32

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3407.42 | 4.830002 | 3407.185 | .290009 | 3407.247 | .270004 | 3407.711 | 0.24001 | 3409.29 |
| 11.95 | 3410.311 | 3.56001 | 3410.86 | 22.22 | 3414.66 | 23.51 | 3414.4 | 29.59 | 3413.26 |
| 36.31001 | 3411.55 | 40.15 | 3410.894 | 7.31001 | 3410.25 | 49.51 | 3410.085 | 1.89001 | 3409.98 |
| 52.14001 | 3409.575 | 4.32001 | 3407.198 | 6.28001 | 3407.258 | 6.96001 | 3407.258 | 9.49001 | 3411.32 |
| 89.56001 | 3411.468 | 9.79001 | 3411.58 | 90.55 | 3412.049 | 2.54001 | 341396 | .85001 | 3414.84 |
| 103.42 | 3417.86 | 110.35 | 3419.15 | 114.06 | 3419.96 | 121.45 | 3420.11 | 122.46 | 3420.13 |
| 125.1 | 3420.08 | 128.13 | 3420.05 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 128.13 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 128.13 | 50.38 | 43.7 | 39 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 444.5

INPUT
Description:
Station Elevation Data num= 55

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3406.07 | 7.6000021 | 3405.992 | .860001 | 3405.858 | .029999 | 3405.98 | 8.57 | 3406 |
| 8.990005 | 3406.019 | 9.099998 | 34069 | .270004 | 3405.98 | 10.18 | 3405.86 | 15.57 | 3405.15 |
| 16.46 | 3405.02 | 17.47 | 3404.58 | 18.44 | 3404.12 | 23.47 | 3404.04 | 26.18 | 3404 |
| 28.2 | 3404 | 28.88 | 3405.16 | 29.09 | 3405.5 | 31.35 | 3406.71 | 31.78 | 3406.9 |
| 33.59 | 3407.09 | 35.11 | 3407.16 | 35.8 | 3407.28 | 37.19 | 3407.57 | 41.17 | 3408.2 |
| 48.18 | 3408.61 | 48.73 | 3408.62 | 49.27 | 3408.51 | 49.77 | 3408.39 | 51.51 | 3407.75 |
| 52.43 | 3407.45 | 52.64 | 3406.97 | 53.71 | 3404.7 | 58.61 | 3404.44 | 59.64 | 3404.4 |
| 60.01 | 3404.38 | 61.61 | 3404.457 | 1.21001 | 3404.72 | 73.94 | 3404.718 | 0.24001 | 3404.72 |
| 82.31 | 3404.73 | 82.65 | 3404.81 | 85.27 | 3405.72 | 87.05 | 3406.36 | 90.94 | 3408.54 |
| 94.11 | 3410.36 | 94.13 | 3410.38 | 94.15 | 3410.39 | 101.24 | 3413.67 | 102.02 | 3413.95 |
| 109.38 | 3416.88 | 114.23 | 3417.29 | 122.09 | 3417.86 | 122.29 | 3417.84 | 123.58 | 3417.82 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 123.58 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 123.58 | 48.18 | 49.1 | 49.6 | .1 | .3 |

CROSS SECTION

RIVER: natural wash
REACH: redrock RS: 396.32

INPUT
Description:
Station Elevation Data num= 60

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3405.92 | 2.839996 | 3405.694 | .470001 | 3405.54 | 10.59 | 3405.03 | 10.83 | 3405.02 |
| 11.43 | 3404.96 | 15.37 | 3404.68 | 16.3 | 3404.55 | 19.4 | 3404.34 | 21.69 | 3404.14 |
| 23.73 | 3404.01 | 27.95 | 3403.53 | 28.11 | 3403.48 | 28.98 | 3403.26 | 32.28 | 3402.37 |
| 33.28 | 3402.21 | 34.06 | 3402.36 | 34.75 | 3402.02 | 35.48 | 3401.93 | 36.9 | 3401.68 |
| 38.87 | 3401.35 | 40.27 | 3401.36 | 43.29 | 3401.36 | 45.01 | 3401.34 | 45.84 | 3401.35 |
| 49.98 | 3401.33 | 55.18 | 3401.17 | 55.26 | 3401.18 | 56.44 | 3401.19 | 58.06 | 3401.57 |
| 58.23 | 3401.6 | 58.84 | 3401.24 | 60.33 | 3401.35 | 65.81 | 3401.46 | 66.43 | 3401.69 |
| 68.83 | 3401.86 | 70.07 | 3402 | 71.54 | 3401.98 | 77.51 | 3401.89 | 79.62 | 3401.63 |
| 81.26 | 3401.47 | 81.72 | 3401.44 | 90.72 | 3401.38 | 90.82 | 3401.369 | 1.10001 | 3401.44 |
| 92.98 | 3401.8 | 93.72 | 3402 | 94.55 | 3402.42 | 101.97 | 3405.93 | 106.61 | 3407.26 |
| 106.94 | 3407.36 | 107.24 | 3407.44 | 107.85 | 3407.61 | 115.6 | 3410.11 | 119.14 | 3411.26 |
| 121.46 | 3412.2 | 129.9 | 3413.78 | 130 | 3413.8 | 130.25 | 3413.82 | 134.11 | 3414.15 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 134.11 | .032 |

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  134.11             48.86    49.9    50.2             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock            RS: 347.46

INPUT
Description:
Station Elevation Data    num=      47
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 3401.91.349998 3401.572.529999 3401.795.339996 3402.258.439995 3402.73
   14.04 3403.2114.75999 3403.16       17 3403.18   23.22   3403.1   25.12 3402.92
   26.84 3402.75   30.61 3402.47   32.59  3402.2   35.54 3401.71   39.97 3400.81
   42.61  3400.7   46.72 3400.65    48.9 3400.55   49.96 3400.28   51.71 3399.87
   52.86 3398.85   53.17 3398.58   57.07 3398.66   60.29 3398.71   61.94 3398.75
   62.26 3398.83   64.78 3399.11   71.02 3398.93   72.49 3398.82   77.27  3398.9
   77.61  3398.9   77.73 3398.89   79.61 3398.73   81.49 3398.57   81.57 3398.56
   84.05 3398.54   88.22 3398.46   98.13 3398.35   98.42 3398.57   98.81 3398.86
   98.97 3398.96   99.19 3399.18   99.81 3399.59  105.68 3403.17  108.68 3404.11
  111.73 3404.64  119.17 3406.13

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   119.17    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  119.17             75.71    55.4    45.5             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock            RS: 271.75

INPUT
Description:
Station Elevation Data    num=      51
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 3397.99.1900024 3397.972.059998  3397.8   10.62 3398.04   12.72 3398.12
    24.2 3398.48   27.36 3398.51   28.73 3398.41   36.74 3397.63   39.38 3397.27
43.75999 3396.84    46.3 3396.59   46.55 3396.57      47 3396.53   47.79 3395.64
   48.23    3395   56.39  3394.456.57999 3394.39   56.77 3394.38   57.27 3394.36
   57.31  3394.4   58.78 3395.3864.07999 3395.72   64.13 3395.72   64.31 3395.73
64.75999 3395.66    65.6 3395.55   68.69 3395.18   69.36 3395.26   72.33 3395.76
   74.28 3395.32   78.27 3394.96    79.7 3394.7680.64999 3394.76   82.59 3394.72
   84.85 3394.79   89.56  3394.8   91.06 3394.78   92.94 3394.7898.03999 3394.72
   99.64  3394.7   99.71 3394.79  101.05 3396.08  102.34 3397.36   103.4 3398.18
  106.59 3399.46  107.87 3399.92  108.61 3400.06  114.96 3401.27  129.23 3402.09
  129.56 3402.14

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   129.56    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  129.56             61.28   61.28   61.28             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock            RS: 210.47

INPUT
Description:
Station Elevation Data    num=      59
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 3395.218.599998  3394.7   10.19 3394.29   13.89 3393.56   15.55 3393.61
   21.92 3393.88      23 3394.04   26.84 3394.51   28.18 3394.55   28.75 3394.53
   30.38 3394.61   35.09  3394.8   38.37 3394.38   39.78 3394.26   40.02 3394.32
   40.12 3394.29   40.26 3394.04   41.25 3392.47   41.54 3391.98   42.01 3391.82
    42.6 3391.62    44.6  3390.9   51.81  3391.2   57.67 3391.38   58.35 3391.63
   59.37 3391.96   61.63 3391.82   63.13 3391.64   64.66 3391.66   66.82 3391.78
   69.75 3391.99   71.73 3391.9373.50999 3391.86   74.45 3391.06   74.48 3391.03
   74.56 3391.03   80.41  3391.3   90.61 3391.24   92.29 3391.13   96.58 3391.05
   98.97    3391    99.5 3391.54  100.14 3392.06  101.04 3393.69  101.87 3394.79
  102.73 3395.18  106.28 3395.99  108.65 3396.52  110.01 3396.39  113.23 3396.23
  116.02 3395.29  116.71 3395.21  120.21 3395.88  120.63 3395.96  120.75 3395.98
  120.88 3396.01  120.98 3396.05  122.75  3396.8  123.39 3397.07

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   123.39    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  123.39             49.35   49.35   49.35             .1      .3

CROSS SECTION


RIVER: natural wash
REACH: redrock            RS: 161.12

INPUT
Description:
Station Elevation Data    num=      48
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  3391.58.800003 3391.338.980003 3391.329.060005 3391.319.270004  3391.3
   16.14 3390.5619.42001 3390.22   21.19 3390.91   22.32 3391.26   26.54 3391.34
26.92001 3391.36   27.07 3391.37   27.25 3391.41   27.88 3391.49   31.13 3391.91
   31.75 3390.21   32.22 3388.7341.49001 3388.35   48.83 3387.9650.49001  3388.4
```

```
  50.97 3388.4751.31001 3388.49   52.36 3388.56   53.11 3388.61   53.26 3388.58
   54.1 3388.33   54.72 3388.05   65.14 3387.89   65.29 3387.88   66.31 3388.11
  66.75 3388.2367.43001 3388.0567.93001 3387.81   69.8 3387.77   80.77 3387.81
   87.8 3387.83   96.37 3387.84   97.29 3388.92   97.41 3389.08   97.45 3389.11
  99.87 3390.77  100.38 3391.22   101.4 3391.75  102.83 3392.52  105.61 3393.47
 106.17 3393.63  109.46 3393.79  117.94 3394.22

Manning's n Values         num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   117.94    .032

Bank Sta: Left   Right    Coeff Contr.   Expan.
             0  117.94              .1       .3
```

SUMMARY OF MANNING'S N VALUES

River:natural wash

| Reach | River Sta. | n1 | n2 | n3 |
|---|---|---|---|---|
| redrock | 2693.56 | .032 | .032 | .032 |
| redrock | 2645.53 | .032 | .032 | .032 |
| redrock | 2595.89 | .032 | .032 | .032 |
| redrock | 2547.93 | .032 | .032 | .032 |
| redrock | 2498.73 | .032 | .032 | .032 |
| redrock | 2445.26 | .032 | .032 | .032 |
| redrock | 2399.05 | .032 | .032 | .032 |
| redrock | 2345.81 | .032 | .032 | .032 |
| redrock | 2295.64 | .032 | .032 | .032 |
| redrock | 2253.32 | .032 | .032 | .032 |
| redrock | 2221.01 | .032 | .032 | .032 |
| redrock | 2204.49 | .032 | .032 | .032 |
| redrock | 2179.89 | .032 | .032 | .032 |
| redrock | 2145.03 | .032 | .032 | .032 |
| redrock | 2107.94 | .032 | .032 | .032 |
| redrock | 2065.03 | .032 | .032 | .032 |
| redrock | 2014.37 | .032 | .032 | .032 |
| redrock | 1954.76 | .032 | .032 | .032 |
| redrock | 1915.84 | .032 | .032 | .032 |
| redrock | 1867.51 | .032 | .032 | .032 |
| redrock | 1806.54 | .032 | .032 | .032 |
| redrock | 1739.51 | .032 | .032 | .032 |
| redrock | 1681.73 | .032 | .032 | .032 |
| redrock | 1567.51 | .032 | .032 | .032 |
| redrock | 1536 | .032 | .032 | .032 |
| redrock | 1493.49 | .032 | .032 | .032 |
| redrock | 1443.06 | .032 | .032 | .032 |
| redrock | 1384.51 | .032 | .032 | .032 |
| redrock | 1337.59 | .032 | .032 | .032 |
| redrock | 1287.04 | .032 | .032 | .032 |
| redrock | 1237.36 | .032 | .032 | .032 |
| redrock | 1188.33 | .032 | .032 | .032 |
| redrock | 1137.15 | .032 | .032 | .032 |
| redrock | 1089.47 | .032 | .032 | .032 |
| redrock | 1039.52 | .032 | .032 | .032 |
| redrock | 986.15 | .032 | .032 | .032 |
| redrock | 936.36 | .032 | .032 | .032 |
| redrock | 886.26 | .032 | .032 | .032 |
| redrock | 836.19 | .032 | .032 | .032 |
| redrock | 786.71 | .032 | .032 | .032 |
| redrock | 719.99 | .032 | .032 | .032 |
| redrock | 683.09 | .032 | .032 | .032 |
| redrock | 628.86 | .032 | .032 | .032 |
| redrock | 588.48 | .032 | .032 | .032 |
| redrock | 562.02 | .032 | .032 | .032 |
| redrock | 544.43 | .032 | .032 | .032 |
| redrock | 494.88 | .032 | .032 | .032 |
| redrock | 444.5 | .032 | .032 | .032 |
| redrock | 396.32 | .032 | .032 | .032 |
| redrock | 347.46 | .032 | .032 | .032 |
| redrock | 271.75 | .032 | .032 | .032 |
| redrock | 210.47 | .032 | .032 | .032 |
| redrock | 161.12 | .032 | .032 | .032 |

SUMMARY OF REACH LENGTHS

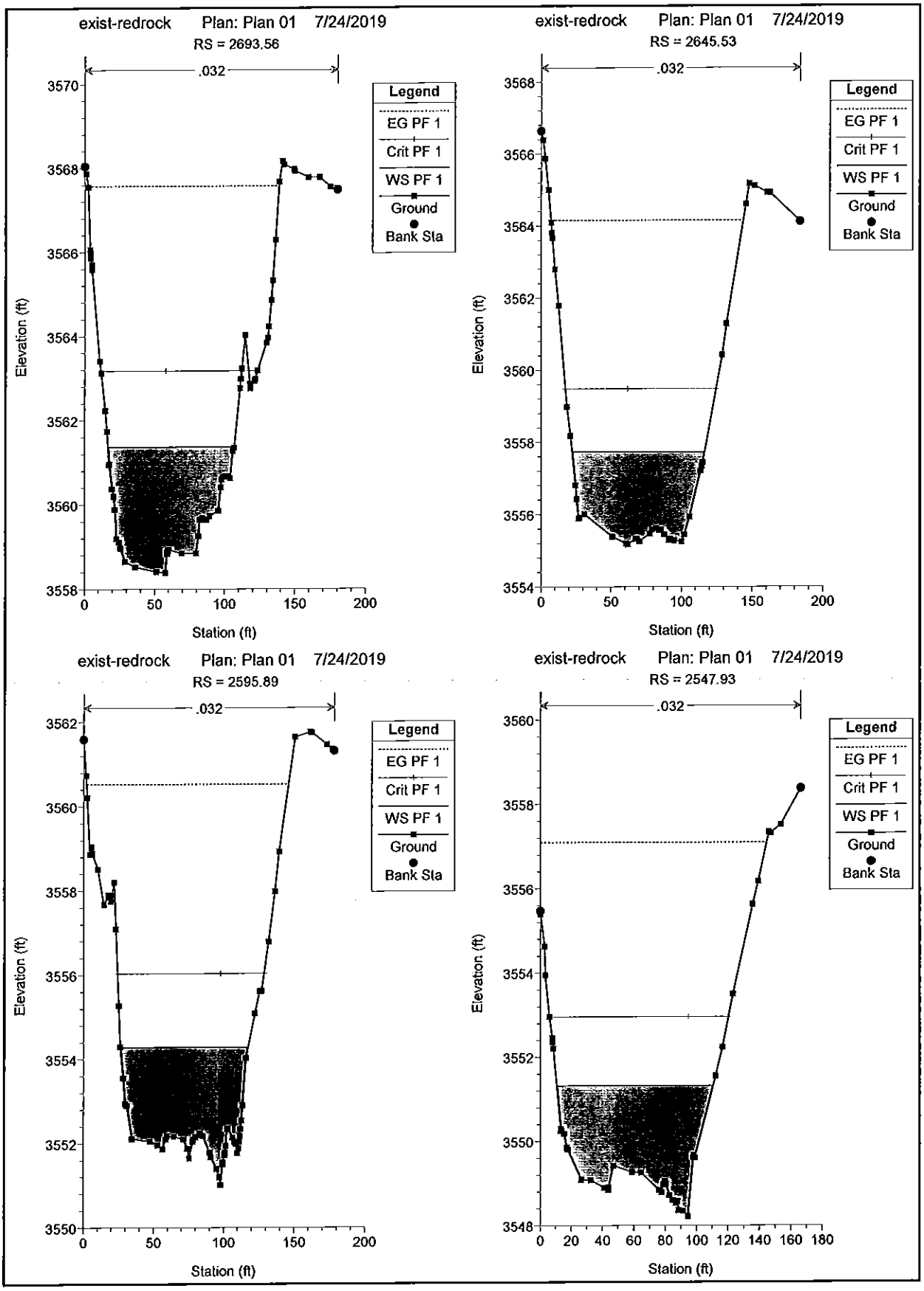
River: natural wash

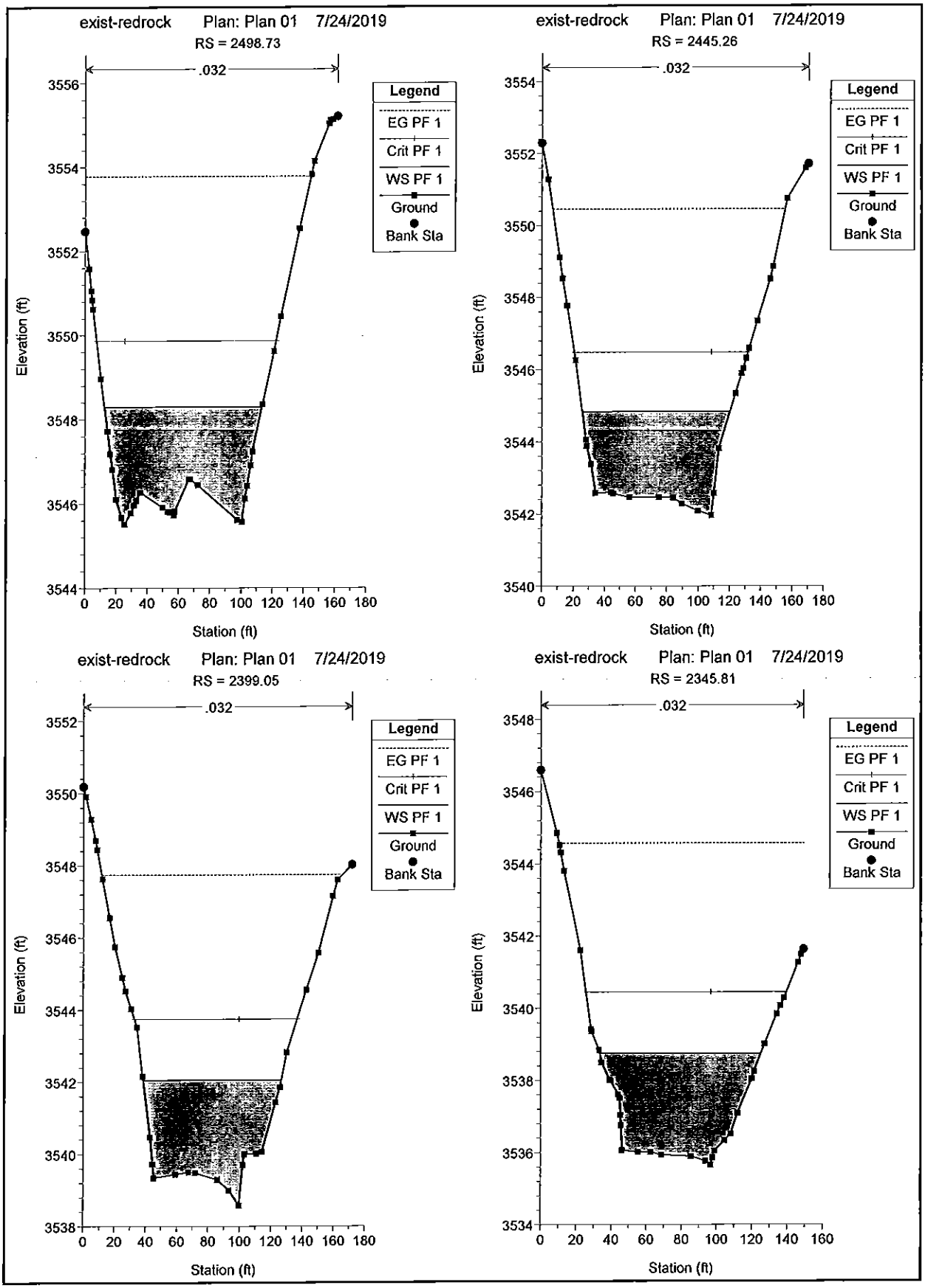
| Reach | River Sta. | Left | Channel | Right |
|---|---|---|---|---|
| redrock | 2693.56 | 48.03 | 48.03 | 48.03 |
| redrock | 2645.53 | 49.64 | 49.64 | 49.64 |
| redrock | 2595.89 | 47.96 | 47.96 | 47.96 |
| redrock | 2547.93 | 49.2 | 49.2 | 49.2 |
| redrock | 2498.73 | 53.47 | 53.47 | 53.47 |
| redrock | 2445.26 | 46.21 | 46.21 | 46.21 |
| redrock | 2399.05 | 53.24 | 53.24 | 53.24 |
| redrock | 2345.81 | 50.17 | 50.17 | 50.17 |
| redrock | 2295.64 | 42.32 | 52.3 | 62.2 |
| redrock | 2253.32 | 32.31 | 53.4 | 60.8 |
| redrock | 2221.01 | 16.52 | 26.8 | 36.2 |
| redrock | 2204.49 | 24.6 | 24.6 | 24.6 |
| redrock | 2179.89 | 34.86 | 34.9 | 42 |
| redrock | 2145.03 | 37.09 | 32.5 | 25.8 |
| redrock | 2107.94 | 42.91 | 42.91 | 42.91 |
| redrock | 2065.03 | 50.66 | 44.3 | 38.8 |
| redrock | 2014.37 | 59.61 | 61.1 | 45.9 |
| redrock | 1954.76 | 38.92 | 38.92 | 38.92 |
| redrock | 1915.84 | 48.33 | 62.9 | 48.5 |

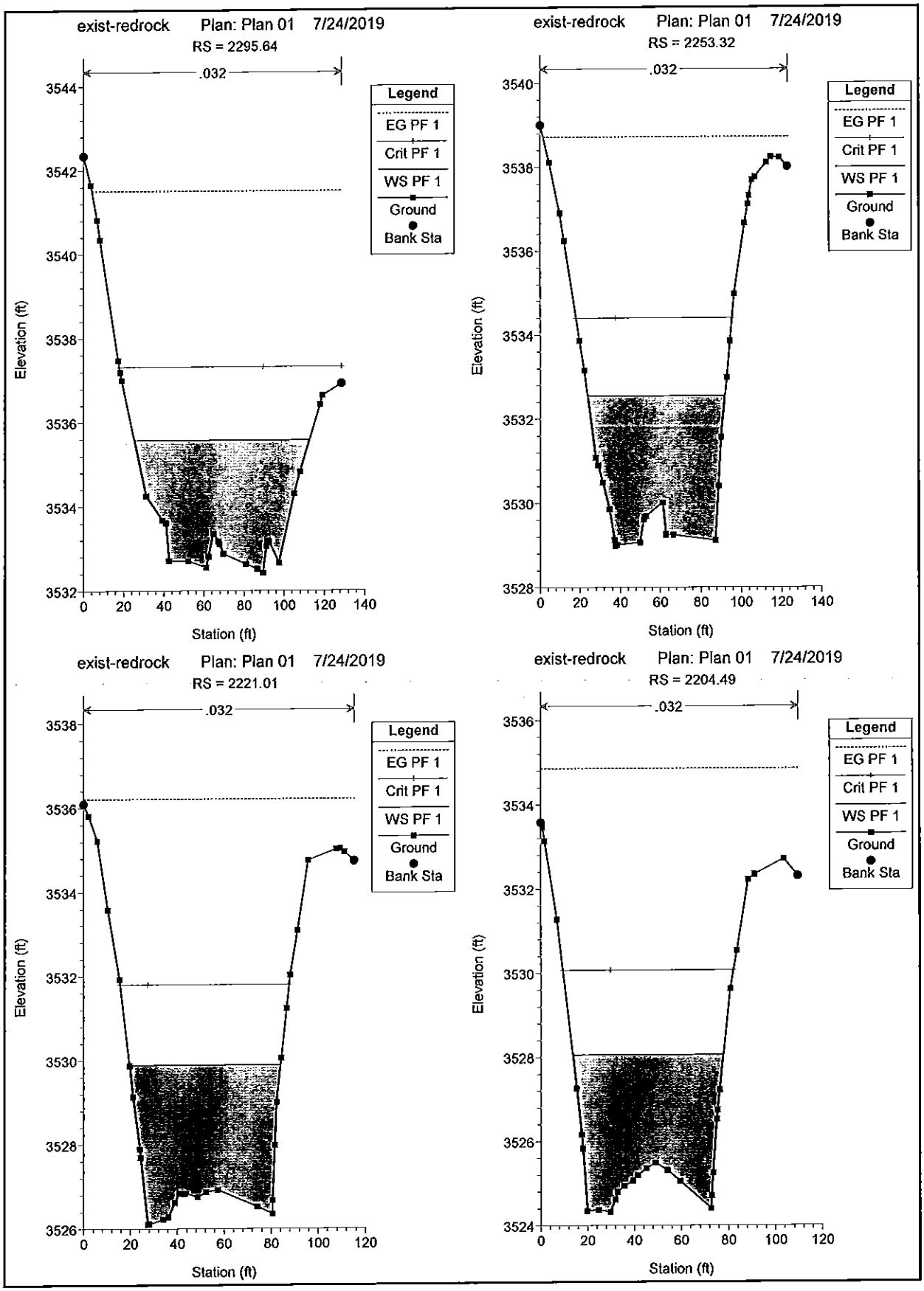
| | | | | |
|---|---|---|---|---|
| redrock | 1867.51 | 60.97 | 45.5 | 23.7 |
| redrock | 1806.54 | 67.03 | 60.1 | 44.1 |
| redrock | 1739.51 | 57.78 | 30.4 | 32.8 |
| redrock | 1681.73 | 114.22 | 26.5 | 27.9 |
| redrock | 1567.51 | 31.51 | 31.51 | 31.51 |
| redrock | 1536 | 42.51 | 42.51 | 42.51 |
| redrock | 1493.49 | 50.43 | 50.43 | 50.43 |
| redrock | 1443.06 | 58.55 | 58.55 | 58.55 |
| redrock | 1384.51 | 46.92 | 46.92 | 46.92 |
| redrock | 1337.59 | 50.55 | 50.55 | 50.55 |
| redrock | 1287.04 | 49.68 | 49.68 | 49.68 |
| redrock | 1237.36 | 49.03 | 49.03 | 49.03 |
| redrock | 1188.33 | 51.18 | 51.18 | 51.18 |
| redrock | 1137.15 | 47.68 | 47.68 | 47.68 |
| redrock | 1089.47 | 49.95 | 49.95 | 49.95 |
| redrock | 1039.52 | 53.37 | 53.37 | 53.37 |
| redrock | 986.15 | 49.79 | 49.79 | 49.79 |
| redrock | 936.36 | 50.1 | 50.1 | 50.1 |
| redrock | 886.26 | 50.07 | 50.07 | 50.07 |
| redrock | 836.19 | 49.48 | 49.48 | 49.48 |
| redrock | 786.71 | 66.72 | 66.72 | 66.72 |
| redrock | 719.99 | 36.9 | 36.9 | 36.9 |
| redrock | 683.09 | 54.23 | 54.23 | 54.23 |
| redrock | 628.86 | 40.38 | 43.9 | 45.2 |
| redrock | 588.48 | 26.46 | 37.7 | 47.6 |
| redrock | 562.02 | 17.59 | 31.7 | 49 |
| redrock | 544.43 | 49.55 | 59.4 | 68.5 |
| redrock | 494.88 | 50.38 | 43.7 | 39 |
| redrock | 444.5 | 48.18 | 49.1 | 49.6 |
| redrock | 396.32 | 48.86 | 49.9 | 50.2 |
| redrock | 347.46 | 75.71 | 55.4 | 45.5 |
| redrock | 271.75 | 61.28 | 61.28 | 61.28 |
| redrock | 210.47 | 49.35 | 49.35 | 49.35 |
| redrock | 161.12 | | | |

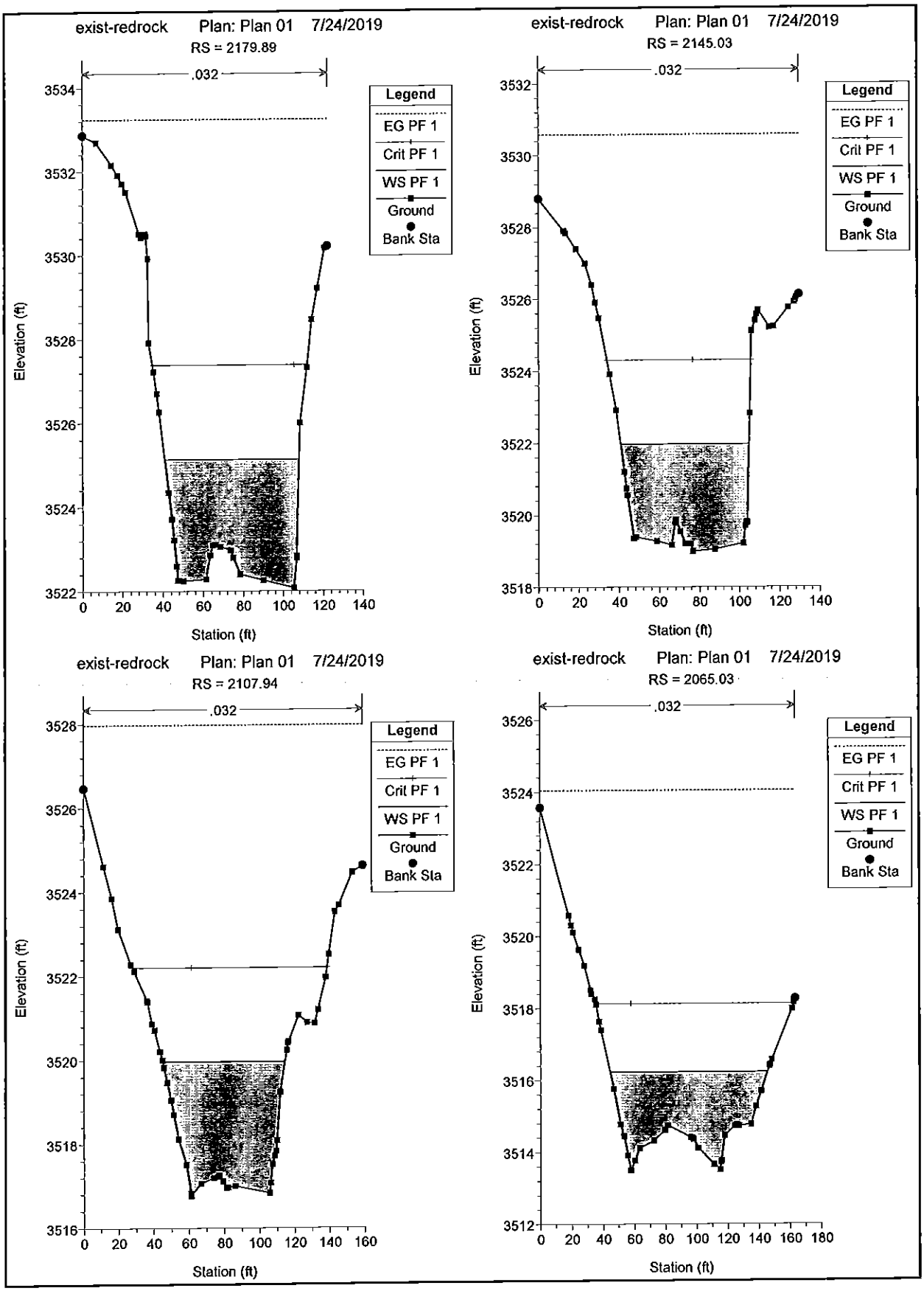
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: natural wash

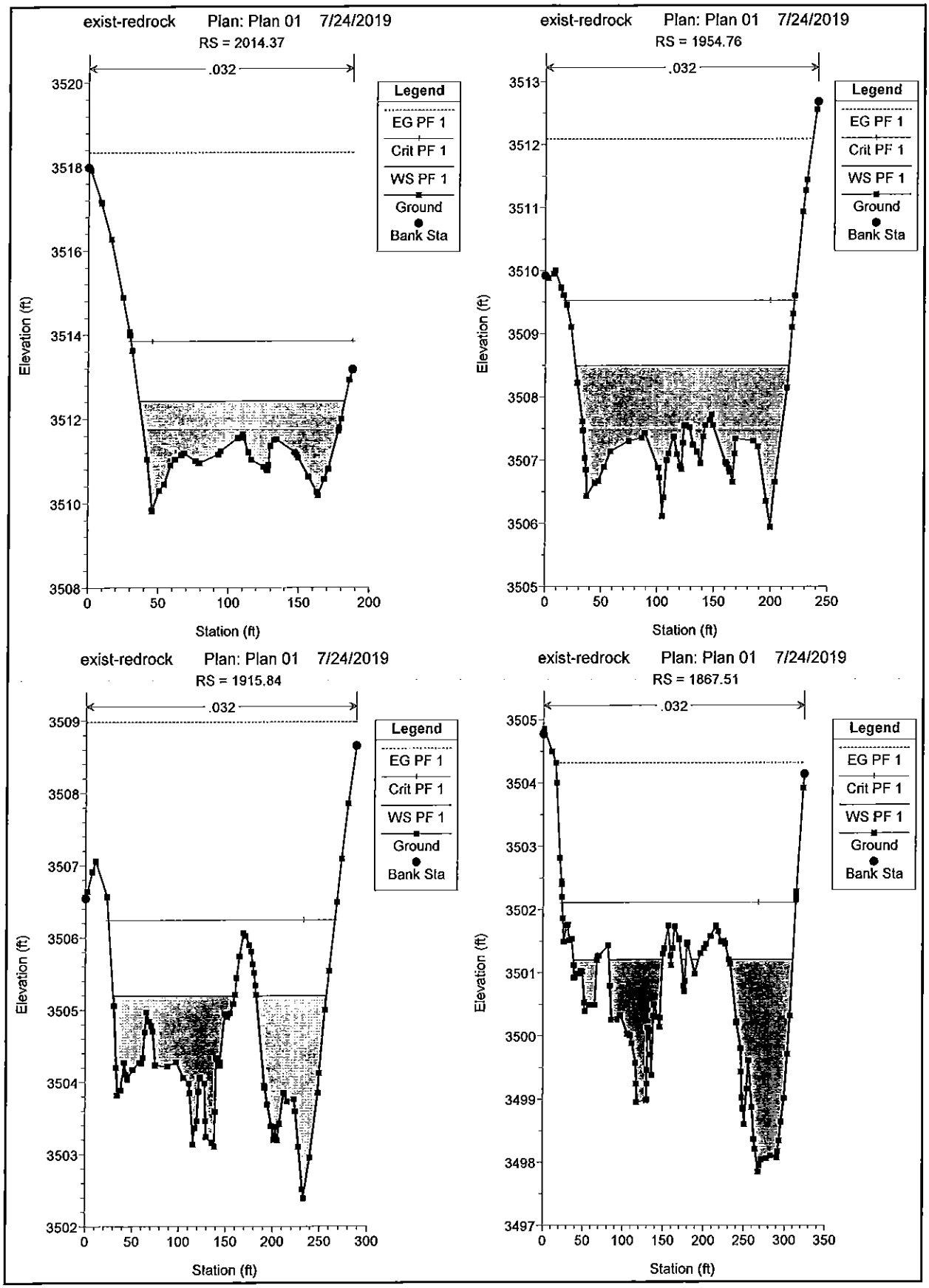
| Reach | River Sta. | Contr. | Expan. |
|---|---|---|---|
| redrock | 2693.56 | .1 | .3 |
| redrock | 2645.53 | .1 | .3 |
| redrock | 2595.89 | .1 | .3 |
| redrock | 2547.93 | .1 | .3 |
| redrock | 2498.73 | .1 | .3 |
| redrock | 2445.26 | .1 | .3 |
| redrock | 2399.05 | .1 | .3 |
| redrock | 2345.81 | .1 | .3 |
| redrock | 2295.64 | .1 | .3 |
| redrock | 2253.32 | .1 | .3 |
| redrock | 2221.01 | .1 | .3 |
| redrock | 2204.49 | .1 | .3 |
| redrock | 2179.89 | .1 | .3 |
| redrock | 2145.03 | .1 | .3 |
| redrock | 2107.94 | .1 | .3 |
| redrock | 2065.03 | .1 | .3 |
| redrock | 2014.37 | .1 | .3 |
| redrock | 1954.76 | .1 | .3 |
| redrock | 1915.84 | .1 | .3 |
| redrock | 1867.51 | .1 | .3 |
| redrock | 1806.54 | .1 | .3 |
| redrock | 1739.51 | .1 | .3 |
| redrock | 1681.73 | .1 | .3 |
| redrock | 1567.51 | .1 | .3 |
| redrock | 1536 | .1 | .3 |
| redrock | 1493.49 | .1 | .3 |
| redrock | 1443.06 | .1 | .3 |
| redrock | 1384.51 | .1 | .3 |
| redrock | 1337.59 | .1 | .3 |
| redrock | 1287.04 | .1 | .3 |
| redrock | 1237.36 | .1 | .3 |
| redrock | 1188.33 | .1 | .3 |
| redrock | 1137.15 | .1 | .3 |
| redrock | 1089.47 | .1 | .3 |
| redrock | 1039.52 | .1 | .3 |
| redrock | 986.15 | .1 | .3 |
| redrock | 936.36 | .1 | .3 |
| redrock | 886.26 | .1 | .3 |
| redrock | 836.19 | .1 | .3 |
| redrock | 786.71 | .1 | .3 |
| redrock | 719.99 | .1 | .3 |
| redrock | 683.09 | .1 | .3 |
| redrock | 628.86 | .1 | .3 |
| redrock | 588.48 | .1 | .3 |
| redrock | 562.02 | .1 | .3 |
| redrock | 544.43 | .1 | .3 |
| redrock | 494.88 | .1 | .3 |
| redrock | 444.5 | .1 | .3 |
| redrock | 396.32 | .1 | .3 |
| redrock | 347.46 | .1 | .3 |
| redrock | 271.75 | .1 | .3 |
| redrock | 210.47 | .1 | .3 |
| redrock | 161.12 | .1 | .3 |

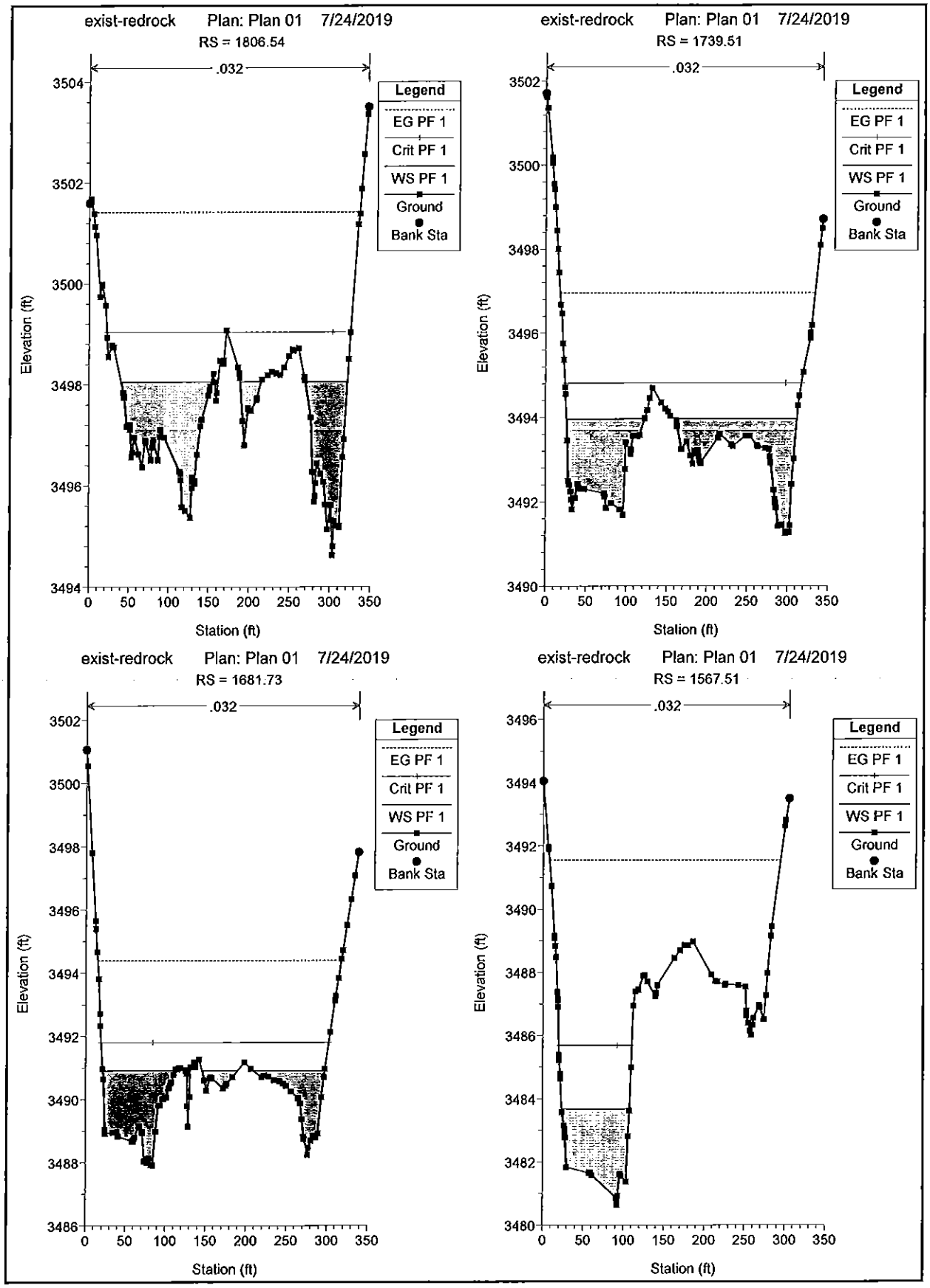

exist-redrock Plan: Plan 01 7/24/2019
RS = 2693.56
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 2645.53
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 2595.89
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 2547.93
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

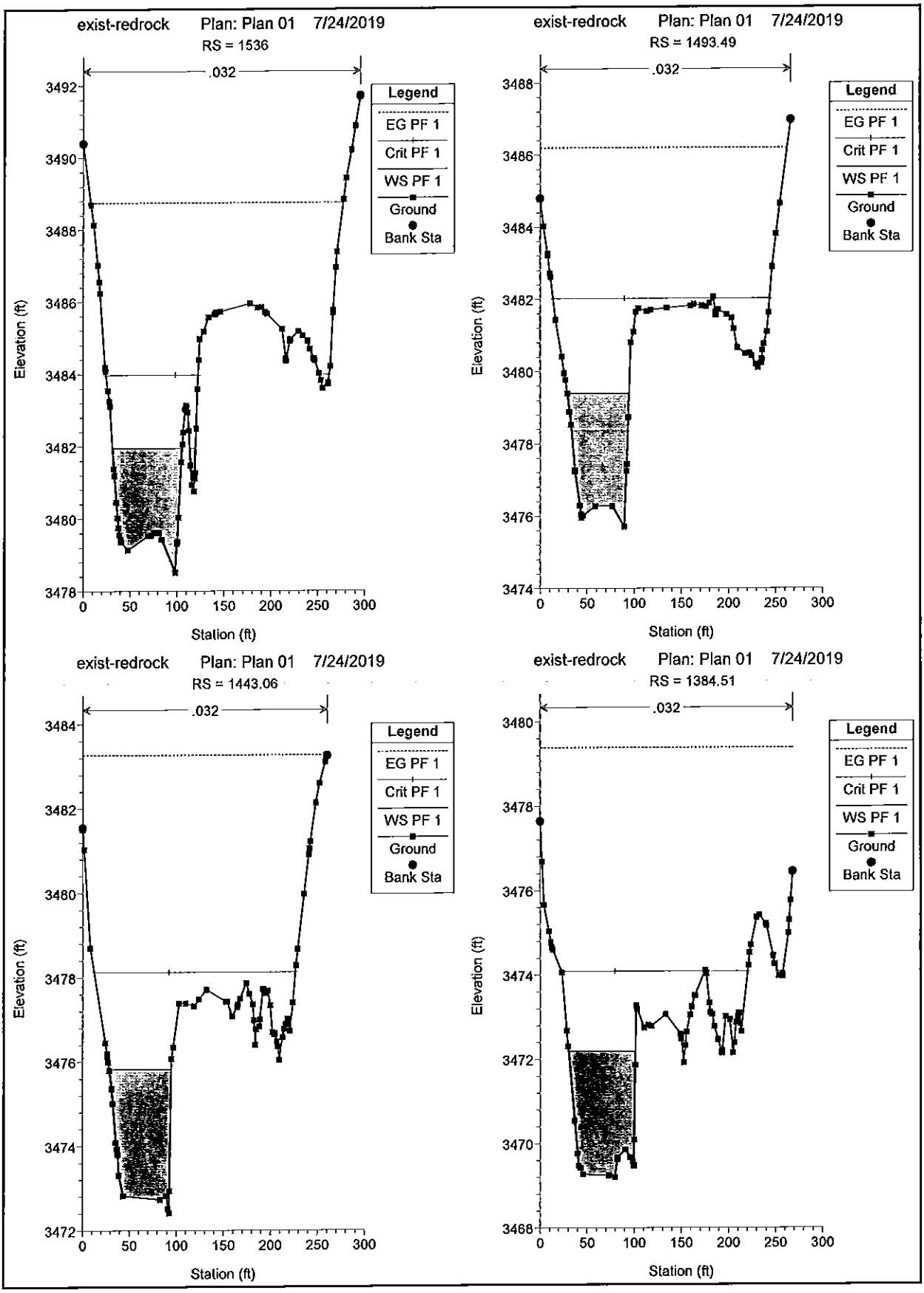

exist-redrock Plan: Plan 01 7/24/2019
RS = 2498.73
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 2445.26
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 2399.05
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 2345.81
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

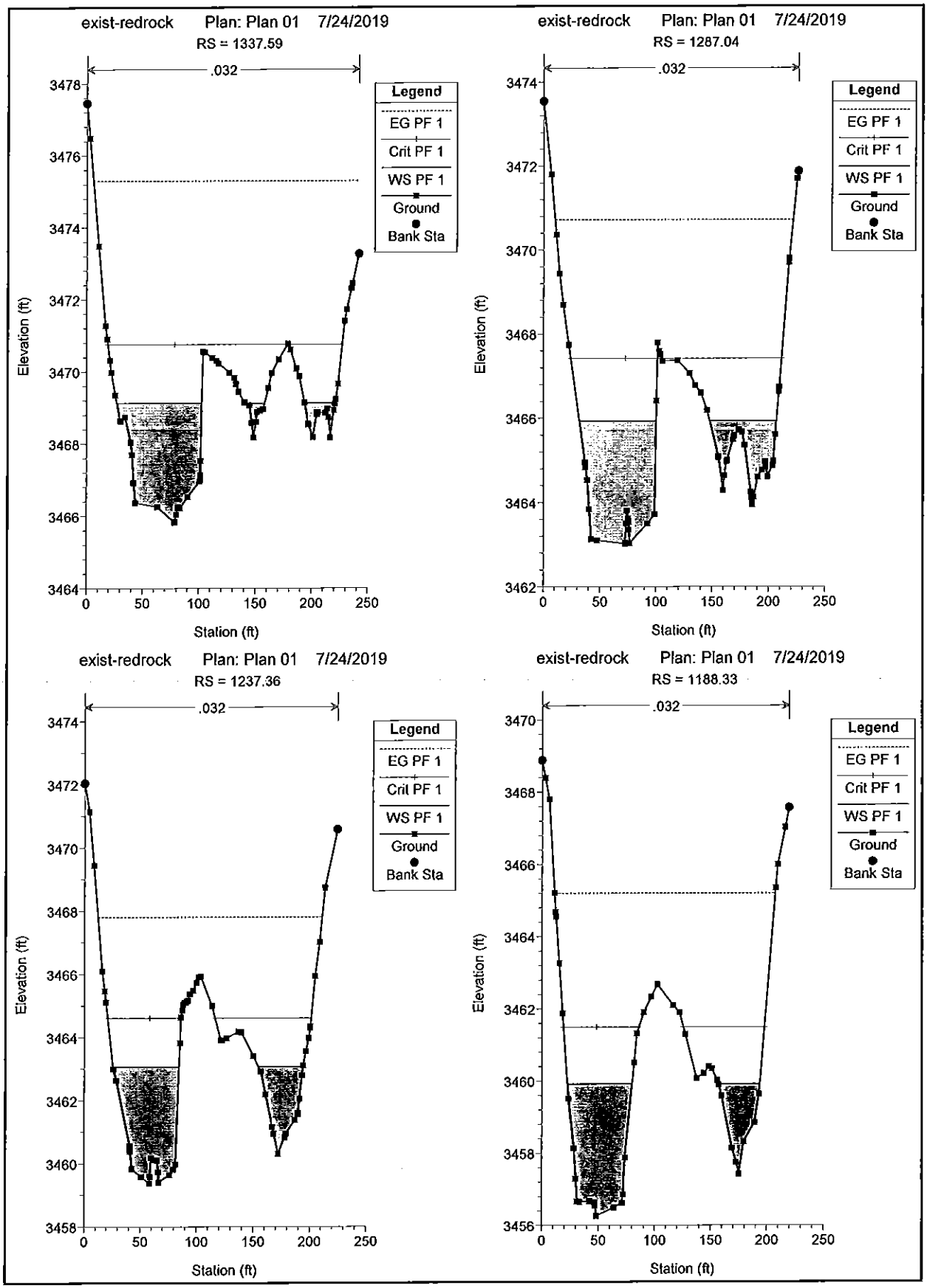

exist-redrock Plan: Plan 01 7/24/2019
RS = 2295.64
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 2253.32
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 2221.01
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 2204.49
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

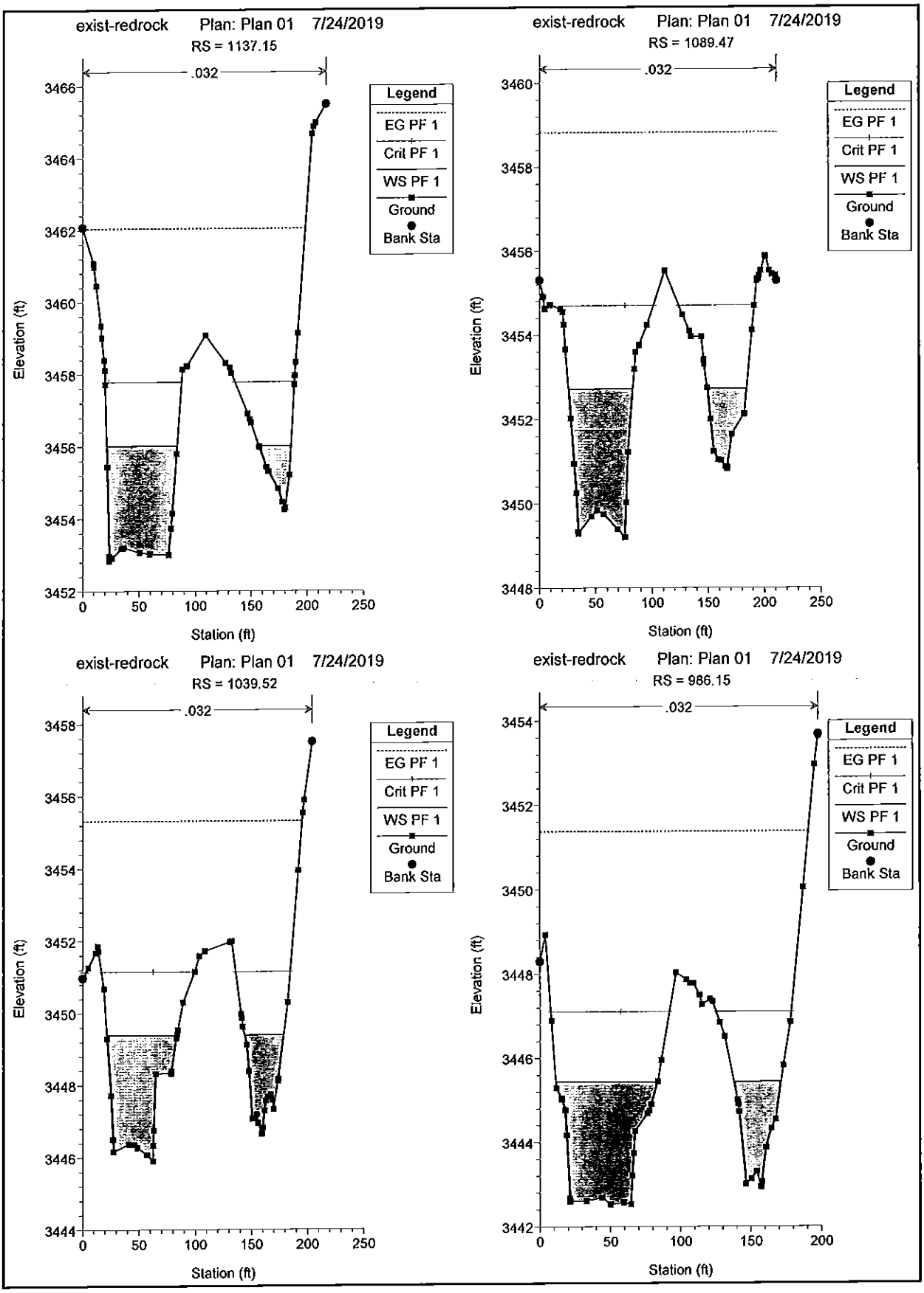

exist-redrock Plan: Plan 01 7/24/2019
RS = 2179.89
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 2145.03
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 2107.94
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 2065.03
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

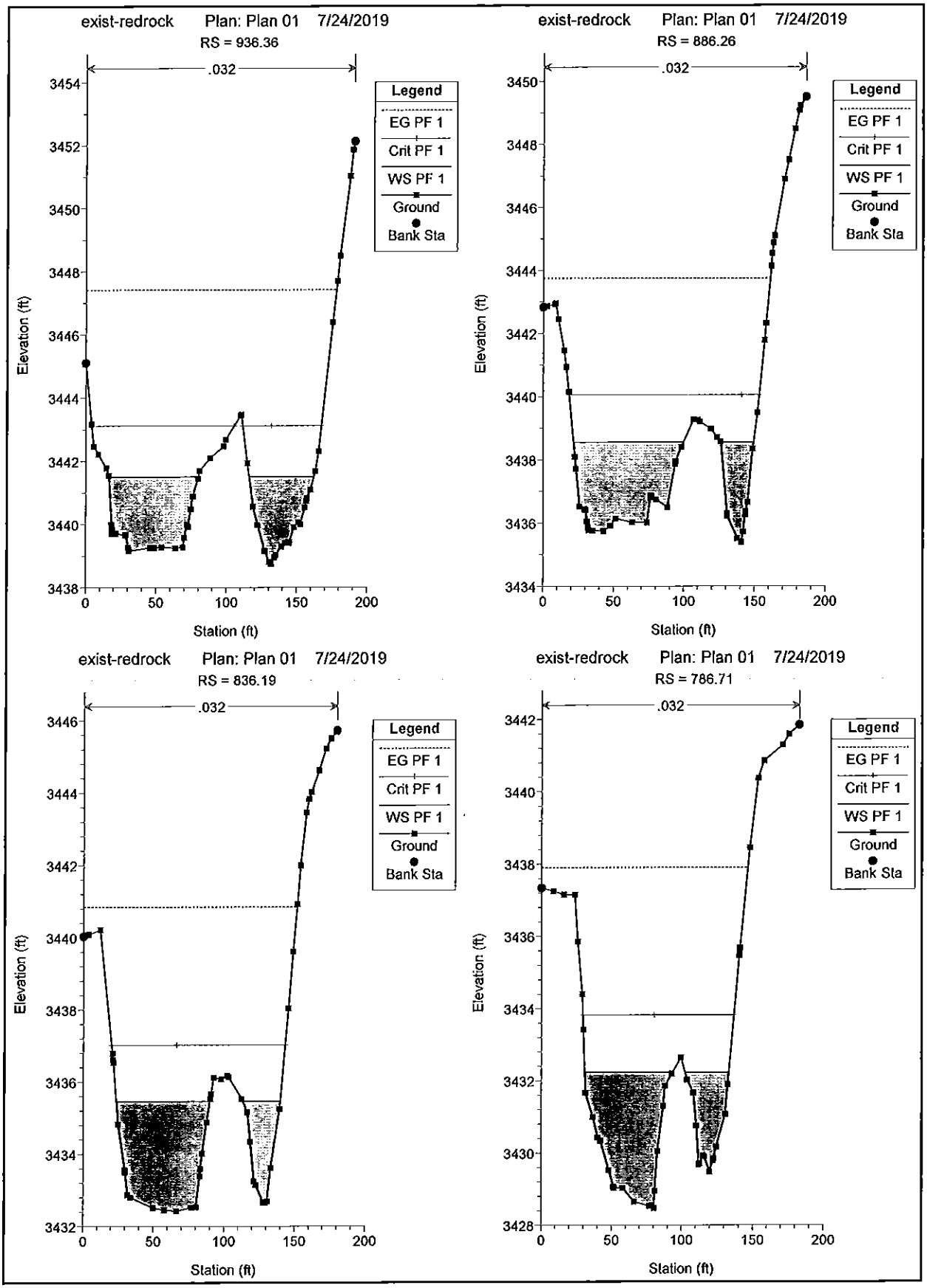

exist-redrock Plan: Plan 01 7/24/2019
RS = 2014.37
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1954.76
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1915.84
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1867.51
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

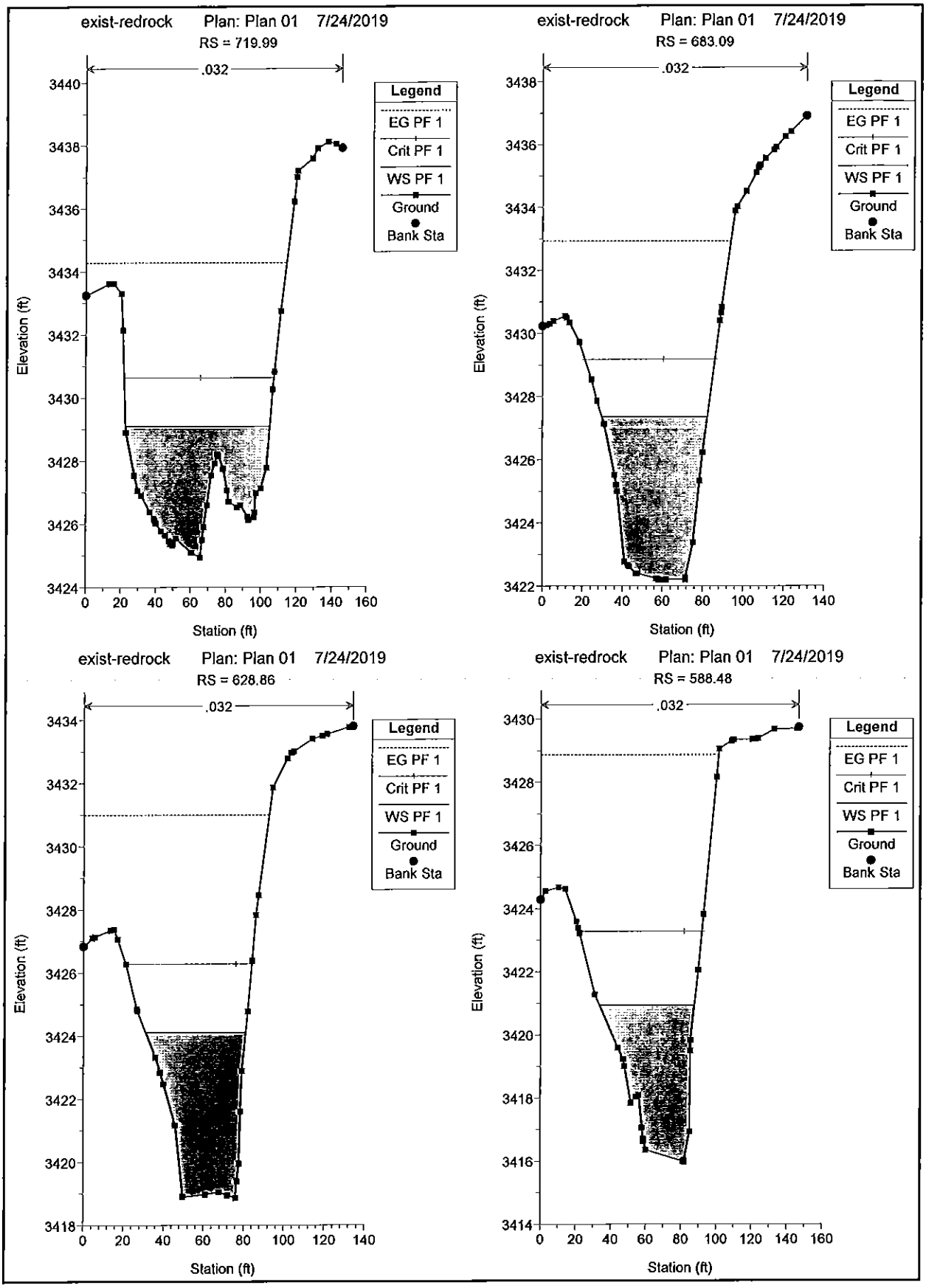

exist-redrock Plan: Plan 01 7/24/2019
RS = 1806.54
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1739.51
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1681.73
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1567.51
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

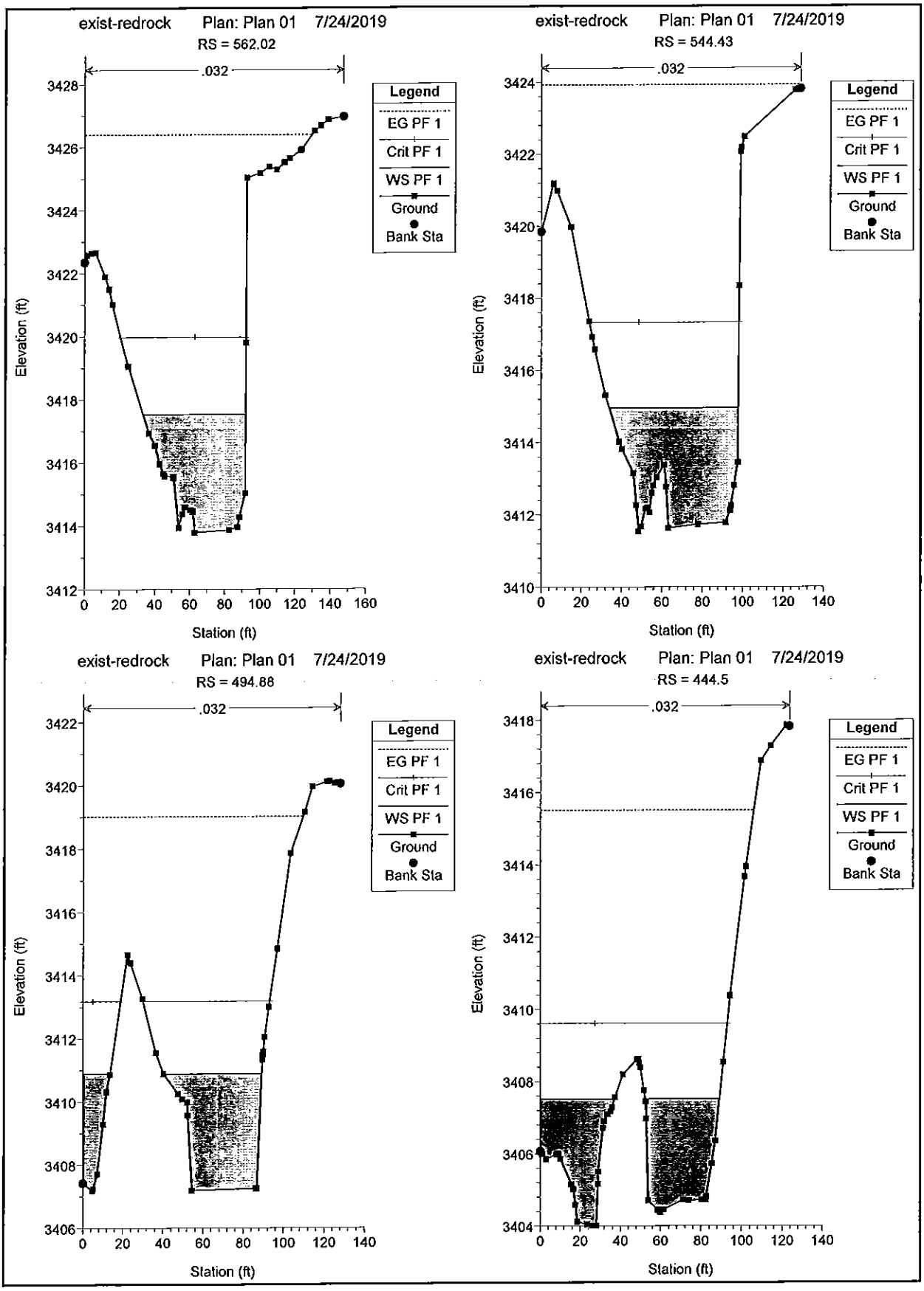

exist-redrock Plan: Plan 01 7/24/2019
RS = 1536
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1493.49
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1443.06
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1384.51
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

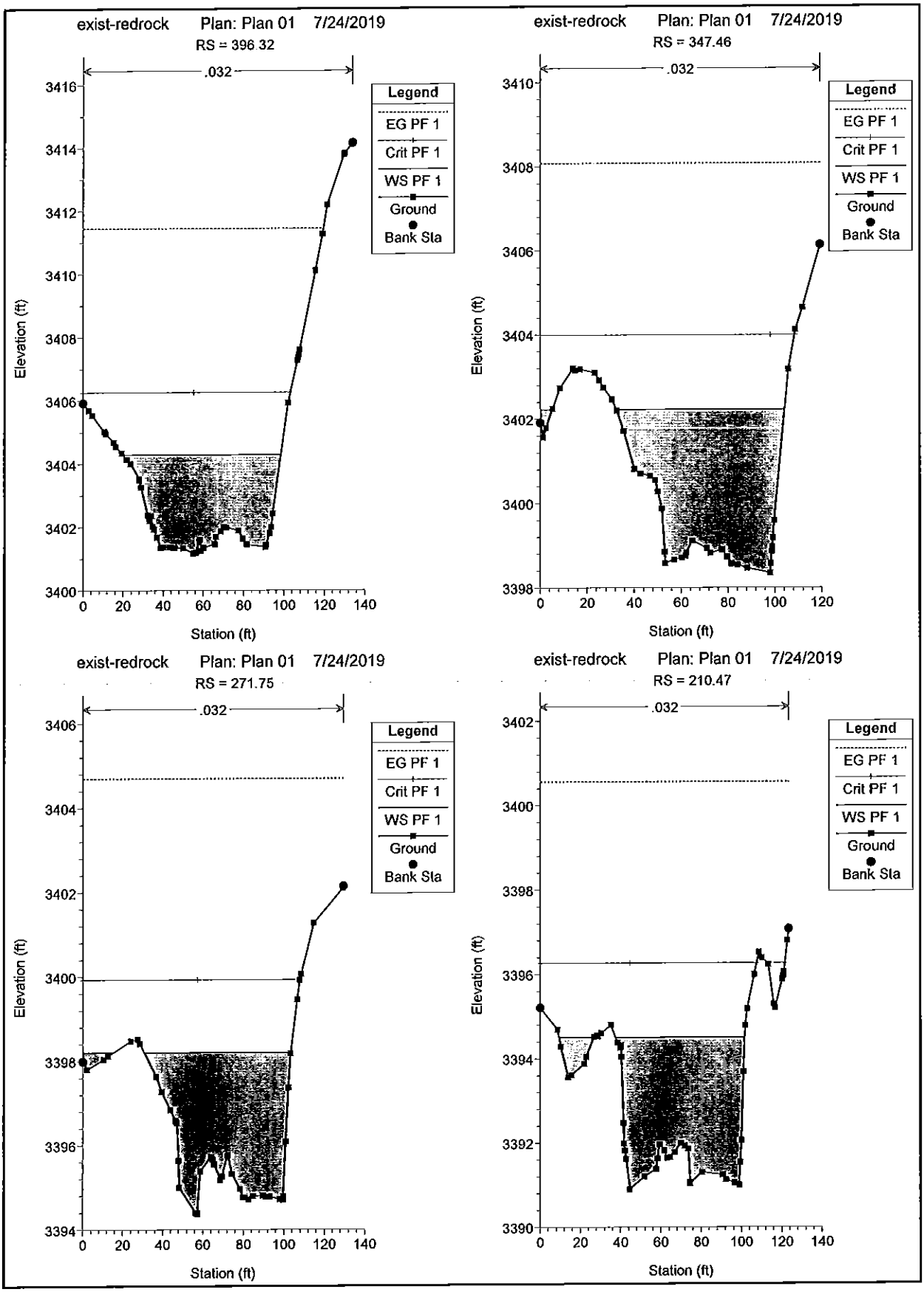

exist-redrock Plan: Plan 01 7/24/2019
RS = 1337.59
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1287.04
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1237.36
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1188.33
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


exist-redrock Plan: Plan 01 7/24/2019
RS = 1137.15
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1089.47
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 1039.52
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 986.15
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


exist-redrock Plan: Plan 01 7/24/2019
RS = 936.36
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 886.26
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 836.19
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 786.71
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


exist-redrock Plan: Plan 01 7/24/2019
RS = 719.99
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 683.09
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 628.86
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 588.48
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


exist-redrock Plan: Plan 01 7/24/2019
RS = 562.02
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 544.43
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 494.88
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 444.5
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


exist-redrock Plan: Plan 01 7/24/2019
RS = 396.32
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Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 347.46
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 271.75
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
exist-redrock Plan: Plan 01 7/24/2019
RS = 210.47
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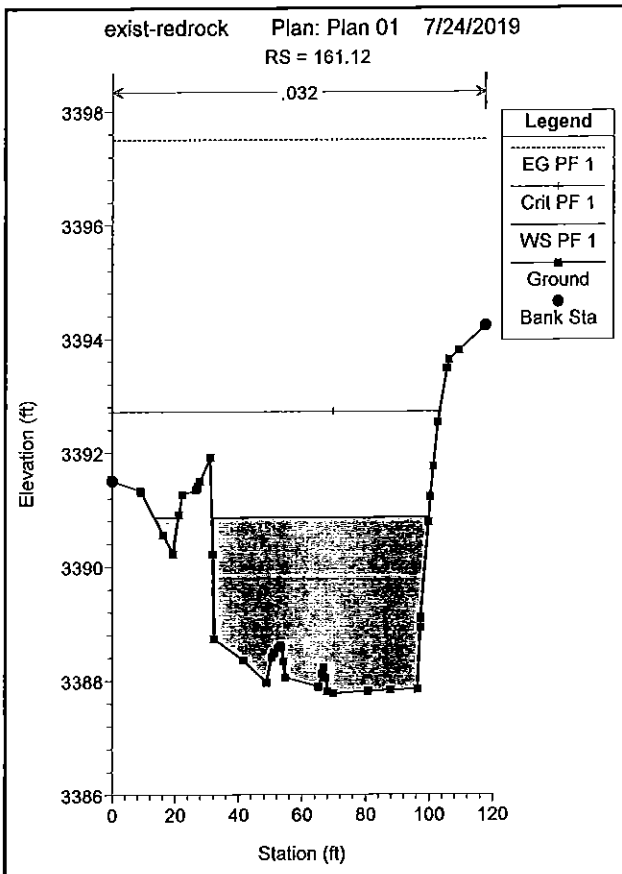
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


exist-redrock Plan: Plan 01 7/24/2019
RS = 161.12
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
3398
3396
3394
3392
3390
3388
3386
0
20
40
60
80
100
120
Station (ft)

HEC-RAS Plan: Plan 01 River: natural wash Reach: redrock 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) | |
| redrock | 2693.56 | PF 1 | 3893.00 | 3558.39 | 3561.37 | 3563.17 | 3567.57 | 0.067172 | 19.98 | 194.88 | 90.22 | 2.40 |
| redrock | 2645.53 | PF 1 | 3893.00 | 3555.17 | 3557.73 | 3559.48 | 3564.15 | 0.075068 | 20.33 | 191.54 | 94.28 | 2.51 |
| redrock | 2595.89 | PF 1 | 3893.00 | 3551.01 | 3554.28 | 3556.04 | 3560.52 | 0.069032 | 20.04 | 194.26 | 91.06 | 2.42 |
| redrock | 2547.93 | PF 1 | 3893.00 | 3548.22 | 3551.32 | 3552.96 | 3557.09 | 0.068210 | 19.27 | 202.00 | 100.02 | 2.39 |
| redrock | 2498.73 | PF 1 | 3893.00 | 3545.51 | 3548.29 | 3549.87 | 3553.78 | 0.063114 | 18.79 | 207.21 | 100.65 | 2.31 |
| redrock | 2445.26 | PF 1 | 3893.00 | 3541.96 | 3544.83 | 3546.47 | 3550.45 | 0.060777 | 19.02 | 204.66 | 94.83 | 2.28 |
| redrock | 2399.05 | PF 1 | 3893.00 | 3538.57 | 3542.06 | 3543.74 | 3547.74 | 0.056587 | 19.12 | 203.59 | 88.37 | 2.22 |
| redrock | 2345.81 | PF 1 | 3893.00 | 3535.65 | 3538.74 | 3540.44 | 3544.57 | 0.061922 | 19.37 | 200.98 | 91.69 | 2.31 |
| redrock | 2295.64 | PF 1 | 3893.00 | 3532.42 | 3535.57 | 3537.31 | 3541.50 | 0.059952 | 19.54 | 199.19 | 87.42 | 2.28 |
| redrock | 2253.32 | PF 1 | 3893.00 | 3528.98 | 3532.54 | 3534.40 | 3538.71 | 0.047003 | 19.93 | 195.32 | 68.17 | 2.08 |
| redrock | 2221.01 | PF 1 | 3893.00 | 3526.10 | 3529.89 | 3531.80 | 3536.21 | 0.045993 | 20.17 | 193.06 | 64.45 | 2.05 |
| redrock | 2204.49 | PF 1 | 3893.00 | 3524.32 | 3528.05 | 3530.07 | 3534.86 | 0.051540 | 20.92 | 186.07 | 64.20 | 2.17 |
| redrock | 2179.89 | PF 1 | 3893.00 | 3522.07 | 3525.13 | 3527.38 | 3533.23 | 0.072984 | 22.84 | 170.42 | 67.02 | 2.53 |
| redrock | 2145.03 | PF 1 | 3893.00 | 3518.99 | 3521.97 | 3524.30 | 3530.58 | 0.076258 | 23.55 | 165.34 | 64.07 | 2.58 |
| redrock | 2107.94 | PF 1 | 3893.00 | 3516.77 | 3519.96 | 3522.20 | 3527.97 | 0.072870 | 22.70 | 171.53 | 69.40 | 2.55 |
| redrock | 2065.03 | PF 1 | 3893.00 | 3513.50 | 3516.22 | 3518.12 | 3524.05 | 0.114367 | 22.44 | 173.51 | 100.98 | 3.02 |
| redrock | 2014.37 | PF 1 | 3893.00 | 3509.82 | 3512.42 | 3513.85 | 3518.33 | 0.117611 | 19.51 | 199.59 | 146.50 | 2.95 |
| redrock | 1954.76 | PF 1 | 3893.00 | 3505.94 | 3508.49 | 3509.52 | 3512.09 | 0.072302 | 15.21 | 255.89 | 189.18 | 2.31 |
| redrock | 1915.84 | PF 1 | 3893.00 | 3502.39 | 3505.19 | 3506.24 | 3508.98 | 0.087708 | 15.61 | 249.36 | 204.66 | 2.49 |
| redrock | 1867.51 | PF 1 | 3893.00 | 3497.85 | 3501.20 | 3502.11 | 3504.32 | 0.058623 | 14.15 | 275.07 | 192.44 | 2.09 |
| redrock | 1806.54 | PF 1 | 3893.00 | 3494.62 | 3498.05 | 3499.04 | 3501.41 | 0.068387 | 14.71 | 264.69 | 196.23 | 2.23 |
| redrock | 1739.51 | PF 1 | 3893.00 | 3491.26 | 3493.96 | 3494.82 | 3496.95 | 0.076732 | 13.87 | 280.73 | 248.94 | 2.30 |
| redrock | 1681.73 | PF 1 | 3893.00 | 3487.91 | 3490.90 | 3491.80 | 3494.39 | 0.089508 | 14.98 | 259.90 | 229.11 | 2.48 |
| redrock | 1567.51 | PF 1 | 3893.00 | 3480.64 | 3483.68 | 3485.68 | 3491.55 | 0.091646 | 22.51 | 172.96 | 84.22 | 2.77 |
| redrock | 1536 | PF 1 | 3893.00 | 3478.51 | 3481.94 | 3483.97 | 3488.74 | 0.068613 | 20.92 | 186.09 | 80.61 | 2.43 |
| redrock | 1493.49 | PF 1 | 3893.00 | 3475.70 | 3479.39 | 3482.02 | 3486.20 | 0.052578 | 20.93 | 186.00 | 65.81 | 2.19 |
| redrock | 1443.06 | PF 1 | 3893.00 | 3472.41 | 3475.82 | 3478.13 | 3483.26 | 0.061882 | 21.89 | 177.81 | 65.93 | 2.35 |
| redrock | 1384.51 | PF 1 | 3893.00 | 3469.20 | 3472.18 | 3474.09 | 3479.38 | 0.068098 | 21.52 | 180.87 | 74.42 | 2.43 |
| redrock | 1337.59 | PF 1 | 3893.00 | 3465.82 | 3469.12 | 3470.75 | 3475.29 | 0.097050 | 19.91 | 195.50 | 118.80 | 2.74 |
| redrock | 1287.04 | PF 1 | 3893.00 | 3463.02 | 3465.93 | 3467.42 | 3470.72 | 0.070540 | 17.55 | 221.78 | 127.81 | 2.35 |
| redrock | 1237.36 | PF 1 | 3893.00 | 3459.37 | 3463.06 | 3464.61 | 3467.81 | 0.049060 | 17.47 | 222.81 | 98.09 | 2.04 |
| redrock | 1188.33 | PF 1 | 3893.00 | 3456.26 | 3459.92 | 3461.49 | 3465.20 | 0.055142 | 18.44 | 211.12 | 94.27 | 2.17 |
| redrock | 1137.15 | PF 1 | 3893.00 | 3452.84 | 3456.01 | 3457.78 | 3462.04 | 0.066480 | 19.69 | 197.70 | 91.05 | 2.36 |
| redrock | 1089.47 | PF 1 | 3893.00 | 3449.20 | 3452.72 | 3454.70 | 3458.82 | 0.068179 | 19.81 | 196.52 | 92.13 | 2.39 |
| redrock | 1039.52 | PF 1 | 3893.00 | 3445.90 | 3449.39 | 3451.15 | 3455.32 | 0.070122 | 19.53 | 199.35 | 96.74 | 2.40 |
| redrock | 986.15 | PF 1 | 3893.00 | 3442.53 | 3445.44 | 3447.10 | 3451.38 | 0.077871 | 19.55 | 199.12 | 105.56 | 2.51 |
| redrock | 936.36 | PF 1 | 3893.00 | 3438.74 | 3441.50 | 3443.11 | 3447.41 | 0.080859 | 19.51 | 199.53 | 109.65 | 2.55 |
| redrock | 886.26 | PF 1 | 3893.00 | 3435.40 | 3438.55 | 3440.05 | 3443.75 | 0.059359 | 18.28 | 212.92 | 101.51 | 2.23 |
| redrock | 836.19 | PF 1 | 3893.00 | 3432.42 | 3435.46 | 3437.02 | 3440.84 | 0.056070 | 18.62 | 209.12 | 93.22 | 2.19 |
| redrock | 786.71 | PF 1 | 3893.00 | 3428.47 | 3432.23 | 3433.82 | 3437.90 | 0.061624 | 19.10 | 203.80 | 93.36 | 2.28 |
| redrock | 719.99 | PF 1 | 3893.00 | 3424.94 | 3429.09 | 3430.63 | 3434.27 | 0.044955 | 18.26 | 213.20 | 82.38 | 2.00 |
| redrock | 683.09 | PF 1 | 3893.00 | 3422.19 | 3427.35 | 3429.18 | 3432.93 | 0.028597 | 18.94 | 205.52 | 52.61 | 1.69 |
| redrock | 628.86 | PF 1 | 3893.00 | 3418.86 | 3424.11 | 3426.29 | 3430.99 | 0.039228 | 21.04 | 185.02 | 49.98 | 1.93 |
| redrock | 588.48 | PF 1 | 3893.00 | 3415.97 | 3420.94 | 3423.28 | 3428.86 | 0.055037 | 22.58 | 172.42 | 54.17 | 2.23 |
| redrock | 562.02 | PF 1 | 3893.00 | 3413.79 | 3417.52 | 3419.97 | 3426.39 | 0.072781 | 23.89 | 162.96 | 58.65 | 2.53 |
| redrock | 544.43 | PF 1 | 3893.00 | 3411.54 | 3414.95 | 3417.32 | 3423.92 | 0.082725 | 24.03 | 162.02 | 64.07 | 2.66 |
| redrock | 494.88 | PF 1 | 3893.00 | 3407.18 | 3410.88 | 3413.18 | 3419.01 | 0.074497 | 22.87 | 170.19 | 62.56 | 2.45 |
| redrock | 444.5 | PF 1 | 3893.00 | 3404.00 | 3407.51 | 3409.61 | 3415.50 | 0.084851 | 22.68 | 171.66 | 73.76 | 2.62 |
| redrock | 396.32 | PF 1 | 3893.00 | 3401.17 | 3404.28 | 3406.26 | 3411.44 | 0.071273 | 21.47 | 181.31 | 78.36 | 2.49 |
| redrock | 347.46 | PF 1 | 3893.00 | 3398.35 | 3402.22 | 3403.99 | 3408.08 | 0.050620 | 19.42 | 200.51 | 76.82 | 2.12 |
| redrock | 271.75 | PF 1 | 3893.00 | 3394.36 | 3398.20 | 3399.93 | 3404.69 | 0.072066 | 20.44 | 190.50 | 87.82 | 2.45 |
| redrock | 210.47 | PF 1 | 3893.00 | 3390.90 | 3394.50 | 3396.26 | 3400.56 | 0.059324 | 19.75 | 197.15 | 81.58 | 2.24 |
| redrock | 161.12 | PF 1 | 3893.00 | 3387.77 | 3390.86 | 3392.71 | 3397.50 | 0.062496 | 20.67 | 188.31 | 76.10 | 2.32 |

EXISTING HECRAS TABLE

HEC-RAS HEC-RAS 5.0.1 April 2016
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
X     X  X        X    X      X   X     X    X        X
X     X  XXXXXX    XXXX       X    X    X    X   XXXXX
```

PROJECT DATA
Project Title: FG-REDROCK
Project File : FG-REDROCK.prj
Run Date and Time: 7/26/2019 6:51:39 AM

Project in English units

FINISHED GRADE MODEL

PLAN DATA

Plan Title: Plan 01
Plan File : o:\3040_LENR\0057_Summerlin_103_DRAIN\HECRAS\ORIGINAL\finish grade\FG-REDROCK.p01

Geometry Title: redrock
Geometry File : o:\3040_LENR\0057_Summerlin_103_DRAIN\HECRAS\ORIGINAL\finish grade\FG-REDROCK.g01

Flow Title : FG-REDROCK
Flow File : o:\3040_LENR\0057_Summerlin_103_DRAIN\HECRAS\ORIGINAL\finish grade\FG-REDROCK.f01

Plan Summary Information:
Number of: Cross Sections = 53 Multiple Openings = 0
Culverts = 0 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 = 0.3
Flow tolerance factor = 0.001

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

FLOW DATA

Flow Title: FG-REDROCK
Flow File : o:\3040_LENR\0057_Summerlin_103_DRAIN\HECRAS\ORIGINAL\finish grade\FG-REDROCK.f01

Flow Data (cfs)

| River | Reach | RS | PF 1 |
|---|---|---|---|
| redrock | redrock | 2693.56 | 3877 |

Boundary Conditions

| River | Reach | Profile | Upstream | Downstream |
|---|---|---|---|---|
| redrock | redrock | PF 1 | Normal S = 0.0671 | Normal S = 0.0709 |

GEOMETRY DATA

Geometry Title: redrock
Geometry File : o:\3040_LENR\0057_Summerlin_103_DRAIN\HECRAS\ORIGINAL\finish grade\FG-REDROCK.g01

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 2693.56

INPUT
Description:
Station Elevation Data num= 74

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3568.041.039993 | 3567.872.509995 | 3567.55 | 3.87999 | 3566.063.949997 | | | | 3566 |
| 4.389999 | 3565.865.069992 | 3565.715.099991 | 3565.685.119995 | | 3565.645.279999 | | | | 3565.58 |
| 10.98 | 3563.4112.10999 | 3563.1315.01999 | 3562.24 | 16.2 | 3561.74 | 17.67 | | | 3560.96 |
| 19.65999 | 3560.3820.82999 | 3560.2 | 21.67 | 3559.8922.90999 | | 3559.2 | 24.59 | | 3559.11 |
| 25.62999 | 3558.9728.84999 | 3558.6536.09999 | 3558.5251.29999 | | 3558.4157.80999 | | | | 3558.39 |
| 59.00999 | 3558.8359.23999 | 3558.959.59999 | 3558.9 | 59.84 | 3558.9369.27999 | | | | 3558.85 |
| 79.82999 | 3558.8581.41999 | 3559.2682.38999 | 3559.64 | 83.09 | 3559.6584.35999 | | | | 3559.69 |
| 86.81999 | 3559.64 | 87.16 | 3559.6589.46999 | 3559.7395.68999 | | 3559.8697.55999 | | | 3560.41 |
| 98.03999 | 3560.698.99999 | 3560.66 | 100.6 | 3560.68 | 101.83 | 3560.66 | 102.93 | | 3560.67 |

```
  104.24 3560.63  106.17 3561.28  107.06 3561.35  111.17 3562.76   111.6 3562.99
  112.49 3563.23  114.78 3564.02  118.12 3562.87  118.34 3562.76  118.53 3562.79
  121.41 3562.94   121.6 3562.96  121.77 3562.98  123.64 3563.18  129.79 3563.84
     131 3563.96  131.65 3564.23  133.26 3564.86  134.38 3565.32  136.27 3566.29
  139.02 3567.67  141.18 3568.16  142.09 3568.08  149.56 3567.97  150.01 3567.93
  159.71 3567.78  167.53 3567.78  175.09 3567.55  180.43 3567.48

 Manning's n Values         num=       3
      Sta   n Val      Sta   n Val      Sta   n Val
        0    .032        0    .032   180.43    .032

 Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
              0  180.43              48.03   48.03   48.03              .1       .3

 CROSS SECTION


 RIVER: redrock
 REACH: redrock             RS: 2645.53

 INPUT
 Description:
 Station Elevation Data     num=      45
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3566.641.410004 3566.392.830002 3565.885.190002    35657.169998 3564.09
7.690002 3563.818.070007 3563.669.910004  3562.8    12.47 3561.79   18.44 3558.98
   21.02 3558.18   24.44 3556.81   25.41 3556.4326.90001 3555.89   27.72 3555.91
   31.03 3556.01   50.95 3555.38   60.77  3555.2   61.94 3555.17   67.62 3555.32
   68.52 3555.33   70.33 3555.26   77.71 3555.47   79.54 3555.58    82.2 3555.62
   83.98 3555.57   85.42 3555.58   87.77 3555.45   91.07 3555.29   91.63 3555.32
   95.02 3555.28  100.01 3555.25  102.24 3555.44  106.04 3555.94  113.75  3557.2
  114.51 3557.34  115.09 3557.44  128.96 3560.42  131.94 3561.28  145.51 3564.61
  147.87 3565.18  151.73 3565.11  160.32 3564.93  162.31 3564.92  183.83 3564.12

 Manning's n Values         num=       3
      Sta   n Val      Sta   n Val      Sta   n Val
        0    .032        0    .032   183.83    .032

 Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
              0  183.83              49.64   49.64   49.64              .1       .3

 CROSS SECTION


 RIVER: redrock
 REACH: redrock             RS: 2595.89

 INPUT
 Description:
 Station Elevation Data     num=      72
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3561.591.619995 3560.732.559998 3560.214.289993 3558.86     5.5 3559.04
6.110001 3558.89   10.38 3558.51   14.75 3557.6817.70999 3557.91   17.83 3557.89
18.20999 3557.86   19.44 3557.75    20.2  3557.9   22.02  3558.223.09999  3557.1
   25.33 3555.27   26.34  3554.3   28.41 3553.55   29.72 3552.9430.75999  3552.9
34.50999 3552.11   47.33 3552.05   52.65 3551.96   56.38 3551.87   58.63  3552.1
   59.63 3552.18    64.1 3552.16   71.16  3552.1      74 3551.98   75.57 3551.65
   78.04 3552.05   78.39 3552.09   79.99 3552.15   82.82 3552.24   83.63  3552.2
   84.92 3552.18   89.95 3551.78   90.81 3551.67   95.03 3551.39   96.92 3551.19
   97.87 3551.01    99.4  3551.5   99.56 3551.55  100.76 3551.72  100.98 3551.78
  101.66 3551.94  102.66 3552.34  102.78 3552.35  106.27 3552.14  107.81 3552.03
  108.48 3551.99  109.28 3551.98  109.91 3551.76  110.71 3551.88  111.11 3552.03
  111.69 3552.18  112.04 3552.34  112.87 3552.54   113.7  3552.9  115.95 3554.03
  122.28 3555.09  125.61 3555.61  127.06 3555.62   131.8 3556.79  136.39 3557.98
  139.35 3558.92  150.65 3561.64  161.55 3561.76  162.51 3561.75  173.36 3561.46
  177.09 3561.35  178.42 3561.31

 Manning's n Values         num=       3
      Sta   n Val      Sta   n Val      Sta   n Val
        0    .032        0    .032   178.42    .032

 Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
              0  178.42              47.96   47.96   47.96              .1       .3

 CROSS SECTION


 RIVER: redrock
 REACH: redrock             RS: 2547.93

 INPUT
 Description:
 Station Elevation Data     num=      49
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3555.47.1600037  3555.42.649994 3554.633.119995 3553.955.889999 3552.96
7.649994 3552.467.959991 3552.368.470001 3552.21   13.16  3550.3   13.27 3550.26
   13.34 3550.2513.42999 3550.25   15.31 3550.1816.89999 3549.86      17 3549.85
   17.52 3549.81   26.39 3549.09   32.47 3549.08   41.03  3548.9   43.62 3548.84
   43.96 3548.91   46.98 3549.42   58.84 3549.27   64.47 3549.26   76.02 3548.84
   77.66 3548.79   78.84 3548.97    79.6 3549.05    80.3 3548.99   82.48 3548.72
   84.61  3548.6   86.64 3548.54   87.47 3548.5707.75999 3548.57   88.49 3548.36
   91.58 3548.34   94.63 3548.22    98.1 3549.6298.25999 3549.68   98.95 3549.61
  112.25 3551.55  116.57 3552.23  123.12  3553.5  135.53 3555.63   139.2 3556.18
  145.85 3557.34  147.04 3557.32  153.46 3557.52  166.17 3558.38

 Manning's n Values         num=       3
      Sta   n Val      Sta   n Val      Sta   n Val
        0    .032        0    .032   166.17    .032

 Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
              0  166.17              49.2    49.2    49.2              .1       .3

 CROSS SECTION
```

RIVER: redrock
REACH: redrock RS: 2498.73

INPUT
Description:
Station Elevation Data num= 41

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3552.47 | 2.490005 | 3551.58 | 3.840012 | 3551.06 | 4.51001 | 3550.84 | 5.139999 | 3550.62 |
| 10.29001 | 3548.97 | 14.57001 | 3547.72 | 16.29001 | 3547.19 | 17.72 | 3546.81 | 20.12001 | 3546.1 |
| 23.5 | 3545.67 | 25.71001 | 3545.51 | 29.48001 | 3545.78 | 31.63 | 3545.96 | 32.96001 | 3546.07 |
| 35.66 | 3546.27 | 49.81001 | 3545.91 | 53.31001 | 3545.81 | 54.42001 | 3545.8 | 54.87 | 3545.79 |
| 57.06001 | 3545.73 | 57.79001 | 3545.82 | 66.8 | 3546.58 | 67.56001 | 3546.58 | 72.25001 | 3546.44 |
| 97.44 | 3545.61 | 100.49 | 3545.57 | 102.5 | 3546.12 | 103.94 | 3546.42 | 106.2 | 3546.91 |
| 107.42 | 3547.24 | 113.63 | 3548.36 | 121.03 | 3549.62 | 125.51 | 3550.45 | 137.46 | 3552.53 |
| 145.01 | 3553.83 | 146.86 | 3554.14 | 156.34 | 3555.03 | 157.18 | 3555.12 | 158.71 | 3555.14 |
| 161.85 | 3555.21 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 161.85 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 161.85 | 53.47 | 53.47 | .1 | .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 2445.26

INPUT
Description:
Station Elevation Data num= 31

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3552.29 | 4.059998 | 3551.28 | 11.24001 | 3549.121 | 3.25999 | 3548.53 | 16.11 | 3547.78 |
| 21.43001 | 3546.26 | 27.98 | 3544.05 | 28.49001 | 3543.883 | 1.32001 | 3543.38 | 34.15001 | 3542.58 |
| 44.24001 | 3542.6 | 45.61 | 3542.56 | 56.1 | 3542.46 | 75.01 | 3542.46 | 83.96 | 3542.45 |
| 89.52 | 3542.28 | 99.96 | 3542.08 | 108.45 | 3541.96 | 110.18 | 3542.57 | 113.42 | 3543.81 |
| 123.97 | 3545.33 | 127.78 | 3545.89 | 128.85 | 3546.03 | 130.78 | 3546.31 | 132.58 | 3546.59 |
| 137.91 | 3547.35 | 145.91 | 3548.51 | 147.86 | 3548.86 | 156.94 | 3550.75 | 160.6 | 3551.59 |
| 170.58 | 3551.71 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 170.58 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 170.58 | 46.21 | 46.21 | .1 | .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 2399.05

INPUT
Description:
Station Elevation Data num= 34

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3550.18 | 1.479996 | 3549.91 | 4.789993 | 3549.28 | 7.769989 | 3548.78 | 8.860001 | 3548.44 |
| 12.34 | 3547.63 | 16.92 | 3546.56 | 20.34 | 3545.75 | 24.98 | 3544.92 | 6.92999 | 3544.53 |
| 30.53999 | 3544.04 | 34.45 | 3543.52 | 38.15999 | 3542.16 | 42.78 | 3540.47 | 44.37 | 3539.73 |
| 45.07999 | 3539.34 | 59.06999 | 3539.44 | 67.52 | 3539.5 | 71.7 | 3539.48 | 85.96 | 3539.29 |
| 93.14 | 3538.99 | 99.74 | 3538.57 | 102.09 | 3539.7 | 103.16 | 3540 | 110.8 | 3540.02 |
| 114.46 | 3540.07 | 123.18 | 3541.44 | 125.93 | 3541.86 | 130.25 | 3542.82 | 142.58 | 3544.55 |
| 150.44 | 3545.57 | 159.75 | 3547.14 | 162.81 | 3547.59 | 171.98 | 3548.01 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 171.98 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 171.98 | 53.24 | 53.24 | .1 | .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 2345.81

INPUT
Description:
Station Elevation Data num= 37

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3546.59 | 9.119995 | 3544.86 | 10.61 | 3544.52 | 11.33 | 3544.32 | 13.2 | 3543.81 |
| 22.35 | 3541.61 | 28.56 | 3539.42 | 28.8 | 3539.36 | 33.25 | 3538.84 | 34.39 | 3538.5 |
| 39.02 | 3538.01 | 39.49 | 3538 | 43.93 | 3537.61 | 44.78 | 3537.51 | 45.16 | 3537.04 |
| 45.49 | 3536.75 | 46.13 | 3536.06 | 55.31 | 3536.01 | 62.49 | 3536.01 | 68.63 | 3535.93 |
| 85.49 | 3535.89 | 93.73 | 3535.76 | 96.84 | 3535.65 | 97.91 | 3535.86 | 98.97 | 3536.04 |
| 104.68 | 3536.33 | 108.22 | 3536.51 | 112.19 | 3537.09 | 120.15 | 3538.04 | 121.51 | 3538.25 |
| 127.32 | 3539.01 | 134.1 | 3539.84 | 136.19 | 3540.07 | 138.35 | 3540.28 | 146.3 | 3541.27 |
| 148.06 | 3541.49 | 149.28 | 3541.63 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 149.28 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 149.28 | 50.17 | 50.17 | .1 | .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 2295.64

INPUT
Description:
Station Elevation Data num= 34

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3542.23.5899963 | 3542.231.979996 | | 3541.962.579994 | | 3541.843.559998 | | 3541.65 | |
| 6.819992 | 3540.828.319992 | 3540.34 | | 17.3 | 3537.47 | 18.2 | 3537.1918.95999 | | 3537 |
| 31.16999 | 3534.25 | 39.2 | 3533.6740.77999 | | 3533.6140.92999 | | 3533.642.50999 | | 3532.71 |
| 52.18999 | 3532.761.21999 | 3532.55 | | 62.41 | 3532.81 | 64.89 | 3533.3667.15999 | | 3533.16 |
| 67.76999 | 3533.1 | 69.64 | 3532.8780.99999 | | 3532.6386.68999 | | 3532.5189.42999 | | 3532.42 |
| 91.21999 | 3533.0591.73999 | 3533.18 | | 92.31 | 3533.16 | 97.56 | 3532.65 | 105.11 | 3534.3 |
| 108.09 | 3534.82 | 117.97 | 3536.41 | 119.28 | 3536.63 | 128.65 | 3536.91 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 128.65 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 128.65 | 42.32 | 52.3 | 62.2 | .1 .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 2253.32

INPUT
Description:
Station Elevation Data num= 37

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3538.95.3099976 | 3538.944.449997 | | 3538.119.779999 | | 3536.9 | 11.86 | 3536.24 | |
| 19.68999 | 3533.86 | 22.16 | 3533.15 | 27.74 | 3531.08 | 28.88 | 3530.9 | 31.31 | 3530.49 |
| 34.53 | 3529.85 | 37.13 | 3529.13 | 37.57 | 3528.98 | 38.34 | 3529.01 | 49.77 | 3529.06 |
| 51.79 | 3529.61 | 52.04 | 3529.67 | 52.99 | 3529.69 | 61.03 | 3530.01 | 62.66 | 3529.27 |
| 62.7 | 3529.24 | 66.3 | 3529.24 | 87.42 | 3529.11 | 88.92 | 3530.41 | 90.12 | 3531.56 |
| 92.81 | 3532.9894.39999 | 3533.85 | | 96.33 | 3534.97 | 101.52 | 3536.66 | 103.08 | 3537.11 |
| 103.73 | 3537.31 | 105.14 | 3537.69 | 106.64 | 3537.76 | 112.35 | 3538.1 | 114.61 | 3538.23 |
| 118.62 | 3538.22 | 122.81 | 3538 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 122.81 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 122.81 | 32.31 | 53.4 | 60.8 | .1 .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 2221.01

INPUT
Description:
Station Elevation Data num= 35

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3536.092.110001 | 3535.815.890007 | | 3535.22 | 10.37 | 3533.58 | 15.33 | 3531.93 | |
| 19.62 | 3529.88 | 21.02 | 3529.14 | 23.95 | 3527.89 | 24.33 | 3527.6927.39001 | | 3526.1 |
| 28.09 | 3526.11 | 34.01 | 3526.22 | 36.27 | 3526.28 | 39.04 | 3526.62 | 40.93 | 3526.84 |
| 42.42001 | 3526.8342.96001 | 3526.83 | | 43.62 | 3526.84 | 48.75 | 3526.75 | 52.37 | 3526.87 |
| 57.34 | 3526.92 | 74.19 | 3526.52 | 80.55 | 3526.35 | 80.67 | 3526.67 | 81.7 | 3527.98 |
| 82.38 | 3529 | 84.38 | 3530.0686.60001 | | 3531.2388.07001 | | 3532.03 | 91.26 | 3533.09 |
| 95.78001 | 3534.75 | 107.78 | 3535.01 | 109.51 | 3535.02 | 111.32 | 3534.94 | 115.41 | 3534.73 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 115.41 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 115.41 | 16.52 | 26.8 | 36.2 | .1 .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 2204.49

INPUT
Description:
Station Elevation Data num= 31

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3533.58.7099991 | 3533.471.580002 | | 3533.146.989998 | | 3531.28 | 15.31 | 3527.26 | |
| 17.52 | 3526.16 | 17.95 | 3525.83 | 19.85 | 3524.34 | 24.71 | 3524.37 | 29.82 | 3524.32 |
| 31.98 | 3524.61 | 32.82 | 3524.79 | 35.75 | 3524.93 | 39.47 | 3525.06 | 41.45 | 3525.19 |
| 45.19 | 3525.35 | 48.96 | 3525.48 | 54.12 | 3525.31 | 59.54 | 3525.05 | 72.7 | 3524.4 |
| 72.96 | 3524.71 | 73.64 | 3525.24 | 75.24 | 3526.52 | 75.5 | 3526.7476.39999 | | 3527.22 |
| 80.65 | 3529.63 | 83.49 | 3530.53 | 88.28 | 3532.21 | 91 | 3532.34 | 103.53 | 3532.71 |
| 109.53 | 3532.3 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 109.53 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 109.53 | 24.6 | 24.6 | 24.6 | .1 .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 2179.89

```
INPUT
Description:
Station Elevation Data    num=      41
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3530.925.260002 3531.08   20.19 3531.52   21.02 3531.54    21.2 3531.54
     21.6  3531.5    28.2 3530.51   29.23 3530.42   29.89 3530.47    31.2 3530.51
    31.48 3530.46   32.47 3529.92    32.9 3527.91   35.36 3527.22   36.83  3526.7
38.06001 3526.2642.74001 3524.34   44.29 3523.71   45.37 3523.21   46.72 3522.59
    47.28 3522.26   50.16 3522.24   61.35 3522.28   63.52 3522.8564.71001 3523.09
    66.02  3523.1   68.37 3523.0573.57001 3522.9776.85001 3522.79    78.3  3522.4
    89.95 3522.25  105.31 3522.07  106.59 3522.78   106.6 3522.79  106.63 3522.83
    108.3 3525.99   111.8 3527.31  114.25 3528.45  116.99  3529.2  120.59 3530.16
   122.08  3530.2

Manning's n Values        num=       2
      Sta   n Val      Sta   n Val
        0    .044     21.6    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  122.08             34.86   34.9      42             .1       .3

CROSS SECTION


RIVER: redrock
REACH: redrock            RS: 2145.03

INPUT
Description:
Station Elevation Data    num=      47
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3527.58   12.89 3527.59    15.5 3527.59   16.15  3527.6   16.23 3527.59
    17.36 3527.49   18.22 3527.42   18.33 3527.41   18.47  3527.4   22.99     3527
    26.22  3526.4   28.17 3525.91   29.84 3525.47   35.14 3523.91    38.5 3522.91
    42.45  3521.2   43.56 3520.74   43.96 3520.55   47.15 3519.35   48.27 3519.38
    58.68 3519.2766.14999 3519.16   67.74 3519.78   68.14 3519.8670.17999 3519.54
72.78999  3519.2   75.49 3519.19    76.7 3518.9987.75999 3519.04  101.98 3519.21
   102.87  3519.7  103.44 3519.81  103.97 3519.78  105.06 3522.82  105.89  3525.1
   105.95 3525.11  106.07 3525.12  107.96  3525.4  108.57 3525.57  109.33 3525.68
   114.84  3525.2  116.97 3525.23  124.36 3525.75  127.27 3525.91  127.84 3525.96
   128.29 3526.04  129.67 3526.11

Manning's n Values        num=       2
      Sta   n Val      Sta   n Val
        0    .044    16.23    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  129.67             37.09    32.5    25.8             .1       .3

CROSS SECTION


RIVER: redrock
REACH: redrock            RS: 2107.94

INPUT
Description:
Station Elevation Data    num=      53
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3524.0111.51999 3523.97   12.23 3523.97   12.34 3523.9524.45999 3522.42
    24.97 3522.43   25.48 3522.44   26.86 3522.2828.62999 3522.1236.03999 3521.43
36.32999 3521.3938.82999 3520.87   40.24 3520.72   43.37 3520.21   44.81     3520
    45.41 3519.83   47.34 3519.47   49.59 3519.05   51.02  3518.753.85999 3518.12
    58.28 3517.51   60.95 3516.8361.07999 3516.79   61.12 3516.77   61.23 3516.78
66.63999 3517.06   73.92 3517.19    76.3 3517.2276.95999 3517.2679.10999 3517.11
81.25999 3516.9682.13999 3516.9786.03999     3517  105.68 3516.83  106.33 3517.07
   107.38 3517.51  108.56 3517.72  109.35 3517.83  109.89 3518.08  111.67 3519.24
   115.33 3520.23  115.84 3520.41  116.44 3520.44  122.15 3521.06  127.12 3520.89
    131.4 3520.87  133.23  3521.2  137.65 3521.96   139.4 3522.51  142.91 3523.52
   145.16 3523.68  152.94 3524.46  158.87 3524.61

Manning's n Values        num=       2
      Sta   n Val      Sta   n Val
        0    .044    25.48    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  158.87             42.91   42.91   42.91             .1       .3

CROSS SECTION


RIVER: redrock
REACH: redrock            RS: 2065.03

INPUT
Description:
Station Elevation Data    num=      46
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3521.082.820007 3521.0412.20001 3520.9321.10001 3519.8824.40001 3519.49
    24.53 3519.49   25.42  3519.5   26.17 3519.4127.87001 3519.19   31.88  3518.5
32.37001  3518.434.74001 3518.2535.39001  3518.137.31001 3517.6338.60001 3517.39
46.71001 3515.7650.93001 3514.7753.25001 3514.45   55.62 3513.9157.79001  3513.5
60.42001 3513.77   63.44 3514.1172.61001 3514.3279.67001 3514.61   81.27 3514.74
    95.94 3514.41   97.41 3514.3997.82001 3514.36  100.83 3514.11  110.93 3513.66
   115.01 3513.51  115.65 3513.72  115.95 3513.76  118.06 3514.46  124.58 3514.73
   125.82 3514.76  127.08 3514.73     135 3514.77   138.1 3515.27  141.38 3515.69
   146.74  3516.4  146.97 3516.43  148.14 3516.56  161.07 3517.98  162.37 3518.16
   163.13 3518.26

Manning's n Values        num=       2
      Sta   n Val      Sta   n Val
        0    .044    25.42    .032

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

```
            0  163.13            50.66    44.3    38.8            .1       .3

 CROSS SECTION


 RIVER: redrock
 REACH: redrock            RS: 2014.37

 INPUT
 Description:
 Station Elevation Data    num=      67
      Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
        0 3517.495.110001 3517.42   12.42 3517.33   13.91    351715.39999 3516.68
 20.09999 3515.65   24.22 3514.77   24.44 3514.7224.62999 3514.68   24.84 3514.64
    24.86 3514.6425.87999 3514.6629.20999 3514.0929.25999 3514.0829.39999 3514.06
    29.42 3514.0529.45999 3514.05   29.62 3514.0129.78999 3513.99   31.27 3513.63
    41.98 3511.0545.53999 3509.84   45.59 3509.82   45.64 3509.8350.84999  3510.3
    54.56 3510.45   58.84  3510.962.00999 3511.0466.50999 3511.1568.25999 3511.19
    76.52 3511.0178.50999 3510.9679.43999 3510.9692.75999 3511.16   94.57 3511.24
    106.5 3511.54  107.12 3511.55  109.43 3511.56  109.75 3511.57  109.93 3511.63
   110.55 3511.56  114.03 3511.21  116.19 3511.03  125.18 3510.86  126.82 3510.81
   127.59 3510.78  127.75 3510.78  128.45 3510.91  129.74 3511.36   129.8 3511.36
   129.91 3511.37  132.54 3511.51  133.95 3511.52  146.63 3511.22  147.58  3511.2
   148.46 3511.15  149.47 3511.08  156.78 3510.63  162.65 3510.26  163.65 3510.19
   168.16 3510.57  171.24 3510.81  178.14 3511.72   178.7 3511.79  180.23     3512
    185.8 3512.92   188.2 3513.17

 Manning's n Values        num=       2
      Sta   n Val     Sta   n Val
        0    .04425.87999    .032

 Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   188.2             59.61    61.1    45.9             .1       .3

 CROSS SECTION


 RIVER: redrock
 REACH: redrock            RS: 1954.76

 INPUT
 Description:
 Station Elevation Data    num=      67
      Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
        0 3514.191.830002 3514.1411.93001 3513.87   21.83 3509.7224.09001 3508.76
    25.02 3508.7825.10001 3508.7825.71001 3508.6828.60001 3508.22   28.97 3508.17
 33.10001 3507.6133.71001 3507.47   35.66 3507.0336.46001 3506.85    37.3 3506.43
     44.5 3506.64   47.69 3506.6752.85001 3506.89   58.47 3507.1474.76001  3507.3
 86.21001 3507.3588.81001 3507.43  100.66 3506.88  101.27 3506.88  101.81 3506.72
   104.42 3506.11   105.9 3506.41  108.59    3507  110.18  3507.1  114.68 3507.37
   117.28 3507.09  120.34  3506.9  121.42 3506.86  122.95 3507.27   123.8 3507.54
   125.01 3507.55  128.28 3507.52  128.34 3507.52  131.55 3507.24  135.31 3507.13
   138.45 3506.95  140.92 3507.37   142.4 3507.55   146.4 3507.63  148.05 3507.72
   149.02 3507.55  160.29 3506.96  161.45 3506.93  163.47 3506.86   164.1 3506.81
   166.77 3506.65  168.46  3507.1  168.99 3507.34  184.61  3507.3  188.73 3507.21
   195.91 3506.35  199.48 3505.94  203.73 3506.65  214.58 3508.14  218.72  3509.1
   219.63 3509.31   221.2  3509.6  228.29 3510.93  230.55 3511.27  231.93 3511.44
   240.51 3512.56   241.6 3512.68

 Manning's n Values        num=       2
      Sta   n Val     Sta   n Val
        0    .044   25.02    .032

 Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   241.6             30.92   38.92   38.92             .1       .3

 CROSS SECTION


 RIVER: redrock
 REACH: redrock            RS: 1915.84

 INPUT
 Description:
 Station Elevation Data    num=      93
      Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
        0 3510.611.899994 3511.562.179993 3511.57 2.51001 3511.5810.85001  3511.3
    14.62 3511.1722.45001 3507.5526.73001  3505.627.26001  3505.627.73999 3505.61
 27.92001 3505.5930.42999 3505.0632.99001  3504.234.26001 3503.82   38.28 3503.89
    41.67 3504.27   43.36 3504.11   44.91 3504.04   50.63 3504.17   57.66 3504.27
    59.88 3504.26   61.77 3504.34   63.83 3504.69   65.23 3504.9768.32001 3504.84
    70.44 3504.78   71.63  3504.774.79001 3504.24   74.86 3504.23   87.69 3504.22
 97.07001 3504.28  104.63 3504.06  110.77 3503.98  111.39 3503.85  115.15 3503.14
   117.27 3503.37  119.41 3503.46  121.17 3503.87   122.2 3504.05  122.81 3504.07
   127.23 3503.98  128.32 3503.46  128.97 3503.24  135.45 3503.16  138.13 3503.11
      139 3503.59  140.15 3504.33  140.78 3504.32  142.92 3504.26  143.68 3504.23
   144.02 3504.28   148.9 3504.94  151.71  3504.9   154.8 3504.95   157.8 3505.08
   159.76 3505.21  161.14 3505.44  164.32 3505.74  168.48 3506.06  170.71 3506.02
   174.84  3505.9  176.81 3505.81  178.37 3505.63  180.02 3505.51  181.19 3505.34
   181.91 3505.21  190.77 3503.95  191.12 3503.93  191.32 3503.92  193.95 3503.69
   198.28 3503.39  201.04  3503.2  201.91 3503.25  202.53 3503.38  203.92  3503.2
   204.97 3503.19  207.18 3503.42   211.7 3503.85   215.3 3503.73  222.24 3503.76
   223.66 3503.59  227.31  3503.1  231.51 3502.51  232.65 3502.39  239.45 3502.95
   248.13 3503.85  249.53 3504.12  255.45    3505  259.65 3505.54  267.67 3506.49
   272.74 3507.09  279.66 3507.85  288.19 3508.65

 Manning's n Values        num=       2
      Sta   n Val     Sta   n Val
        0    .04427.82001    .032

 Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  288.19             48.33    62.9    48.5             .1       .3

 CROSS SECTION
```

RIVER: redrock
REACH: redrock RS: 1867.51

INPUT
Description:
Station Elevation Data num= 117

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3508.26 | 3000183 | 3508.25 | 11.47 | 3507.77 | 12.06 | 3507.74 | 12.41 | 3507.57 |
| 12.67001 | 3507.44 | 17.59 | 3505.02 | 24.12 | 3501.82 | 25.13 | 3501.82 | 25.38 | 3501.73 |
| 25.5 | 3501.68 | 25.53 | 3501.6725 | 99002 | 3501.49 | 29.88 | 3501.75 | 31.31 | 3501.76 |
| 32.61002 | 3501.51 | 35.91 | 3501.54 | 38.09 | 3501.12 | 38.62 | 3500.9239 | 74002 | 3500.93 |
| 42.33002 | 3500.9844 | 58002 | 3500.9946 | 86002 | 3501.0348 | 99002 | 3501.0251 | 67001 | 3500.53 |
| 52.39001 | 3500.3958 | 21002 | 3500.4965 | 14999 | 3500.49 | 67.72 | 3501.267 | 86002 | 3501.26 |
| 70.28001 | 3501.2781 | 23001 | 3501.4383 | 29001 | 3500.79 | 85.05 | 3500.2593 | 14001 | 3500.26 |
| 96.52 | 3500.33 | 105.24 | 3500.03 | 108.92 | 3500.01 | 110.83 | 3499.88 | 115.55 | 3499.57 |
| 116.36 | 3499.24 | 117 | 3498.95 | 128.74 | 3498.98 | 129.37 | 3498.99 | 129.85 | 3499.24 |
| 129.99 | 3499.46 | 130.84 | 3500.13 | 132.64 | 3500.08 | 133.01 | 3500.09 | 134.43 | 3499.7 |
| 135.62 | 3499.38 | 137.82 | 3500.32 | 138.41 | 3500.49 | 142.97 | 3500.3 | 145.71 | 3500.14 |
| 146.23 | 3500.29 | 149.73 | 3501.3 | 151.32 | 3501.38 | 156.23 | 3501.74 | 158.6 | 3501.27 |
| 159.62 | 3501.12 | 161.47 | 3501.39 | 164.05 | 3501.73 | 169.27 | 3501.54 | 169.72 | 3501.52 |
| 175.26 | 3500.79 | 175.86 | 3500.71 | 176.76 | 3500.87 | 179.04 | 3501.45 | 179.29 | 3501.48 |
| 179.63 | 3501.48 | 188.65 | 3500.98 | 195.98 | 3501.31 | 200.51 | 3501.39 | 202.96 | 3501.45 |
| 208.42 | 3501.58 | 215 | 3501.74 | 217.78 | 3501.65 | 221.32 | 3501.49 | 224.87 | 3501.5 |
| 226.6 | 3501.46 | 230.79 | 3501.21 | 232.45 | 3501.14 | 240.06 | 3500.22 | 240.11 | 3500.21 |
| 240.17 | 3500.21 | 245.5 | 3499.8 | 246.3 | 3499.43 | 247.01 | 3499.02 | 248.2 | 3498.86 |
| 248.88 | 3498.84 | 250.33 | 3498.6 | 253.53 | 3499.16 | 255.12 | 3499.61 | 259.29 | 3498.87 |
| 261.84 | 3498.36 | 263.45 | 3498.21 | 267.53 | 3497.85 | 268.57 | 3497.95 | 271.17 | 3498.04 |
| 277.54 | 3498.06 | 282.82 | 3498.1 | 290.39 | 3498.07 | 290.7 | 3498.08 | 291.6 | 3498.17 |
| 293.43 | 3498.34 | 295.7 | 3498.64 | 299.41 | 3499.01 | 303.3 | 3499.71 | 306.54 | 3500.32 |
| 313.51 | 3502.16 | 313.57 | 3502.17 | 313.67 | 3502.21 | 313.79 | 3502.23 | 314.03 | 3502.28 |
| 322.43 | 3503.92 | 323.79 | 3504.14 | | | | | | |

Manning's n Values num= 2

| Sta | n Val | Sta | n Val |
|---|---|---|---|
| 0 | .044 | 25.5 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 323.79 | 60.97 | 45.5 | 23.7 | .1 | .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 1806.54

INPUT
Description:
Station Elevation Data num= 141

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3503.32 | 539978 | 3503.192 | 629974 | 3503.183 | 139984 | 3503.163 | 669983 | 3503.14 |
| 5.48999 | 3503.056 | 379974 | 3503.017 | 779999 | 3502.958 | 519989 | 3502.919 | 209991 | 3502.88 |
| 11.63998 | 3502.76 | 12.62 | 3502.71 | 12.81 | 3502.7112 | 85999 | 3502.716 | 32999 | 3502.53 |
| 20.22998 | 3501.53 | 21.56 | 3501.2624 | 38998 | 3500.5725 | 69998 | 3500.2626 | 66998 | 3500.02 |
| 27.28998 | 3499.8027 | 59998 | 3499.828 | 65997 | 3499.56 | 29 | 3499.4732 | 66998 | 3498.61 |
| 33.09 | 3498.59 | 34.03 | 3498.5338 | 92999 | 3498.1642 | 82999 | 3497.8643 | 06998 | 3497.84 |
| 43.28 | 3497.8243 | 35999 | 3497.8143 | 65997 | 3497.7843 | 92999 | 3497.7447 | 32999 | 3497.17 |
| 50.96997 | 3497.251 | 35999 | 3497.2 | 51.62 | 3497.1153 | 38998 | 3496.5754 | 78998 | 3496.65 |
| 56.93997 | 3496.9562 | 22998 | 3496.6362 | 44998 | 3496.6267 | 17999 | 3496.37 | 70.75 | 3496.89 |
| 70.81998 | 3496.971 | 50998 | 3496.8677 | 65997 | 3496.578 | 10999 | 3496.5179 | 45999 | 3496.75 |
| 80.26999 | 3496.8680 | 94998 | 3496.91 | 86.62 | 3496.5286 | 88998 | 3496.5 | 89.03 | 3496.97 |
| 89.91998 | 3497.194 | 55998 | 3496.95 | 113.49 | 3496.28 | 114.88 | 3496.24 | 115.22 | 3496.11 |
| 116.69 | 3495.58 | 121 | 3495.5 | 127.39 | 3495.37 | 129.53 | 3495.95 | 129.88 | 3496.08 |
| 130.14 | 3496.16 | 132.01 | 3496.04 | 132.51 | 3496.05 | 132.66 | 3496.05 | 132.93 | 3496.09 |
| 135.58 | 3496.61 | 140.11 | 3497.17 | 141.2 | 3497.3 | 141.39 | 3497.31 | 141.78 | 3497.31 |
| 149.66 | 3497.78 | 150.66 | 3497.88 | 151.81 | 3497.96 | 155.93 | 3498.21 | 157.26 | 3498.05 |
| 159.07 | 3497.68 | 160.04 | 3497.83 | 164.13 | 3498.47 | 168.1 | 3498.41 | 168.5 | 3498.41 |
| 168.89 | 3498.48 | 171.97 | 3499.07 | 186.32 | 3498.34 | 187.87 | 3498.23 | 188.38 | 3498.13 |
| 191.81 | 3497.28 | 194.11 | 3496.8 | 198.9 | 3497.51 | 199.17 | 3497.54 | 202.29 | 3497.48 |
| 209.46 | 3497.7 | 209.7 | 3497.71 | 209.95 | 3497.73 | 215.93 | 3498.1 | 222.85 | 3498.18 |
| 228 | 3498.25 | 233.75 | 3498.22 | 238.68 | 3498.19 | 243.6 | 3498.34 | 249.6 | 3498.56 |
| 253.77 | 3498.69 | 255.28 | 3498.67 | 261.45 | 3498.72 | 268.27 | 3498.15 | 268.72 | 3498.12 |
| 268.95 | 3498.08 | 276.33 | 3497.35 | 278.34 | 3496.27 | 278.35 | 3496.27 | 281.07 | 3495.69 |
| 281.71 | 3495.8 | 282.35 | 3496.05 | 284.2 | 3496.44 | 288.56 | 3496.23 | 292.28 | 3496.07 |
| 294.56 | 3495.63 | 297.12 | 3495.13 | 301.15 | 3495.62 | 301.39 | 3495.61 | 302.02 | 3495.31 |
| 303.52 | 3494.62 | 304.1 | 3494.8 | 305.52 | 3495.3 | 307.7 | 3495.2 | 311.91 | 3495.18 |
| 311.98 | 3495.2 | 316.13 | 3496.57 | 317.48 | 3496.92 | 323.44 | 3498.5 | 325.59 | 3499.03 |
| 335.2 | 3501.17 | 336.91 | 3501.38 | 338.99 | 3501.87 | 342.43 | 3502.56 | 346.44 | 3503.36 |
| 347.36 | 3503.5 | | | | | | | | |

Manning's n Values num= 2

| Sta | n Val | Sta | n Val |
|---|---|---|---|
| 0 | .044 | 34.03 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 347.36 | 67.03 | 60.1 | 44.1 | .1 | .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 1739.51

INPUT
Description:
Station Elevation Data num= 113

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3497.29 | 5200195 | 3497.25 | 8200073 | 3497.24 | 9300232 | 3497.232 | 850006 | 3497.11 |
| 2.990021 | 3497.13 | 650024 | 3497.06 | 4.77002 | 3496.98 | 7.52002 | 3496.81 | 9.5 | 3496.68 |
| 10.95001 | 3496.581 | 1.02002 | 3496.581 | 2.15002 | 3496.512 | 55002 | 3496.481 | 6.14001 | 3496.23 |
| 16.21002 | 3496.23 | 16.47 | 3496.211 | 8.26001 | 3495.74 | 18.41 | 3495.719 | 57001 | 3495.4 |
| 21.02002 | 3494.992 | 4.80002 | 3493.972 | 5.20001 | 3493.852 | 5.56003 | 3493.762 | 7.58002 | 3493.18 |
| 28.55002 | 3492.91 | 29.25 | 3492.722 | 9.45001 | 3492.673 | 2.84003 | 3491.933 | 2.86002 | 3491.92 |

```
   32.94 3491.9132.95001 3491.9134.31003 3491.8934.48001 3491.9134.55002 3491.91
   36.72 3492.0939.92001 3492.4241.09003 3492.3443.55002  3492.348.05002  3492.3
72.82001  3492.273.40002 3492.1375.51001 3491.8681.32001 3491.9792.16002 3491.82
96.66002 3491.6998.79001 3492.7799.52002 3493.41  104.57 3493.17  105.07 3493.15
  105.69 3493.14  106.32 3493.24  108.36 3493.56  114.16 3493.56  116.84 3493.58
  123.22 3493.98  125.87 3494.17  129.28 3494.46  132.68  3494.7  143.63 3494.35
  148.66 3494.21  151.85 3494.14  154.52 3494.04  162.36 3493.93     163 3493.79
  168.41 3493.25  168.44 3493.25  174.88 3493.42  179.57 3493.09  182.55  3492.9
  185.05  3493.2   186.4 3493.14  188.69 3493.23  190.09 3493.08  190.82 3492.97
  191.76 3492.94  192.39 3492.91  192.89 3492.93  214.49 3493.52  216.15 3493.61
   230.4 3493.36  232.62 3493.32  248.53 3493.56  253.51 3493.56  262.24 3493.34
   263.7 3493.31  273.07 3493.28  277.63 3493.25  278.57 3493.07  279.48 3492.93
  283.33 3492.28  284.61 3492.06  285.16 3491.97  286.11 3491.86  289.16 3491.42
  289.89 3491.46   292.8 3491.46  293.32 3491.44  297.97 3491.26  301.15 3491.29
  302.93 3491.28  303.45 3491.44  305.78 3492.42  308.47 3493.02  313.42 3494.28
  315.33 3494.51  320.03 3495.08  328.64 3495.89  329.27 3496.01  330.32 3496.19
   340.6  3498.1  342.92 3498.49  344.17 3498.71

Manning's n Values         num=       2
     Sta   n Val     Sta   n Val
       0    .04432.86002    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0  344.17             57.78    30.4   32.8             .1       .3

CROSS SECTION


RIVER: redrock
REACH: redrock             RS: 1681.73

INPUT
Description:
Station Elevation Data     num=      114
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 3492.182.360016 3492.114.340027 3492.064.620026 3492.068.920013 3491.94
   12.75 3491.8515.67001 3491.31   18.97 3490.5219.08002 3490.49   19.19 3490.47
20.49002 3490.1922.51001 3489.7223.67001 3489.4625.49002 3488.97   25.94 3488.95
26.55002 3488.9327.82001 3488.93   34.19 3488.9539.45001 3488.9640.81003 3488.83
58.32001 3488.67   59.69 3488.6759.85001 3488.68   60.63 3488.74   61.97  3488.8
66.89001 3489.1567.40002 3489.1170.07001 3488.9870.35001 3488.97   70.66 3488.96
70.74002 3488.9373.57001 3488.0476.95001 3487.9878.24002  3488.178.32001 3488.11
80.06003 3488.1382.27002 3487.9284.06001 3487.9284.59001 3487.9188.06001 3488.97
91.67001  3489.893.33002  3489.896.58002 3490.0197.84001 3490.0299.84001 3490.06
  101.62 3490.06  103.97 3490.34  104.72 3490.36  106.55  3490.5  107.67 3490.55
  110.61 3490.77  112.81 3490.95  114.68 3490.95  116.31 3490.98  117.59 3490.99
  118.72 3490.99  125.09 3490.93  125.48  3490.9  126.62 3490.82  127.22 3489.79
  128.33 3489.14   130.3 3490.08  131.22 3491.02  133.43 3491.02   135.7 3491.17
     138 3491.03  142.08 3491.26  148.48  3490.6  151.06 3490.28  155.64 3490.66
  156.18 3490.69  157.72 3490.67  171.72 3490.35  171.92 3490.35  172.11 3490.37
  172.44 3490.37  175.05 3490.44  176.19  3490.5  183.85 3490.71  198.43 3491.18
  205.79 3490.96  219.27  3490.7  221.83 3490.75  227.91 3490.72  234.62  3490.6
  241.59 3490.57  245.99 3490.49  249.69 3490.42  255.67 3490.24  264.26 3490.03
  266.75 3489.86  268.57 3489.37   270.9 3488.81  271.67 3488.74  276.26 3488.24
  277.01 3488.46  280.24 3488.69  282.48 3488.85  284.29 3488.85  286.19 3488.79
  288.94 3488.92  293.52 3490.06  296.35 3490.71  297.62 3490.96  304.17 3492.13
  309.83 3493.12  310.73 3493.27   314.4 3493.84  317.95 3494.44  319.53 3494.72
   324.4 3495.51   329.6 3496.33  334.37 3497.08  338.92 3497.82

Manning's n Values         num=       2
     Sta   n Val     Sta   n Val
       0    .04427.82001    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0  338.92            114.22    26.5   27.9             .1       .3

CROSS SECTION


RIVER: redrock
REACH: redrock             RS: 1567.51

INPUT
Description:
Station Elevation Data     num=       74
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
       0 3487.922.179993 3487.843.160004 3487.817.109985 3487.6712.16998 3487.49
12.42999  3487.4   12.63 3487.3212.72998 3487.2912.73999 3487.2920.04999 3484.69
21.72998 3484.14   24.34 3483.2925.35999 3483.2926.23999 3483.1626.31998 3483.14
26.50998 3483.1227.13998 3483.0427.42999 3482.8827.69998 3482.7729.53998 3481.83
   57.48 3481.6558.40999 3481.6558.60999 3481.66   61.09 3481.5890.98999 3480.87
91.90999 3480.76   92.23 3480.6493.06999 3480.9295.54999 3481.6197.52998 3481.55
  103.48 3481.37  105.94 3482.81   107.5 3483.63   109.5    3485  112.14 3486.95
   114.7  3487.4  118.31 3487.45  118.51 3487.47  124.15 3487.88  125.29  3487.9
  129.02 3487.71  139.23 3487.24  140.07 3487.34  141.42 3487.59  162.61 3488.46
  169.67 3488.69  175.31 3488.86  179.72 3488.86  185.78 3488.97  208.64 3487.93
  213.51 3487.72   216.1  3487.7  225.47  3487.6  226.25 3487.63   242.4 3487.59
  251.16 3487.55   252.2 3486.78  252.41 3486.62  254.53  3486.4  256.58 3486.15
  258.24 3486.02  259.73 3486.34  261.02 3486.55  267.87 3486.93  268.31 3486.95
  269.05 3486.89  273.97 3486.52   276.5 3487.27  278.65 3487.98  282.48 3489.15
  283.53 3489.45  300.09 3492.63   301.1 3492.82  305.24 3493.49

Manning's n Values         num=       2
     Sta   n Val     Sta   n Val
       0    .044   24.34    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0  305.24             31.51   31.51   31.51             .1       .3

CROSS SECTION


RIVER: redrock
REACH: redrock             RS: 1536
```

INPUT
Description:
Station Elevation Data num= 106

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3485.311.589996 | 3485.271.629987 | 3485.26 | 3.23999 | 3485.22 | 4.47998 | 3485.18 | | |
| 6.649994 | 3485.126.650006 | 3485.117.089996 | 3485.18.399994 | 3485.079.009979 | 3485.05 | | | | |
| 10.06 | 3485.0210.28998 | 3485.0112.32999 | 3484.95 | 15.38 | 3484.6517.19998 | 3484.46 | | | |
| 18.72 | 3484.31 | 20.34 | 3484.1322.01999 | 3483.9524.66998 | 3483.7125.07999 | 3483.7 | | | |
| 25.69998 | 3483.7 | 25.97 | 3483.63 | 26.38 | 3483.5420.28998 | 3483.2528.79999 | 3483.1 | | |
| 32.82999 | 3481.3733.44998 | 3481.1935.60001 | 3480.45 | 37 | 3480.0237.66998 | 3479.75 | | | |
| 39.14999 | 3479.55 | 40.31 | 3479.4240.71999 | 3479.35 | 48.12 | 3479.13 | 69.87 | 3479.52 | |
| 71.89999 | 3479.5272.98999 | 3479.54 | 76.12 | 3479.6181.01999 | 3479.61 | 83.92 | 3479.42 | | |
| 98.28999 | 3478.51 | 100.18 | 3479.31 | 100.67 | 3479.37 | 102.07 | 3480.03 | 105.07 | 3481.56 |
| 105.98 | 3482.06 | 106.82 | 3482.39 | 108.73 | 3483.02 | 109.88 | 3483.12 | 110.2 | 3483.1 |
| 111.1 | 3482.94 | 111.46 | 3482.94 | 112.91 | 3482.43 | 114.15 | 3481.47 | 115.96 | 3480.93 |
| 118.29 | 3480.75 | 118.99 | 3481.11 | 119.16 | 3481.26 | 120.49 | 3482.49 | 121.76 | 3483.58 |
| 123.16 | 3484.39 | 124.31 | 3484.97 | 128.5 | 3485.18 | 133.64 | 3485.56 | 133.99 | 3485.56 |
| 140.45 | 3485.65 | 141.17 | 3485.68 | 141.41 | 3485.68 | 142.07 | 3485.7 | 146.2 | 3485.73 |
| 178.06 | 3485.94 | 186.08 | 3485.84 | 190.27 | 3485.84 | 193.68 | 3485.7 | 195.72 | 3485.66 |
| 212.23 | 3485.23 | 215.89 | 3484.42 | 216.34 | 3484.36 | 220.16 | 3484.9 | 220.37 | 3484.93 |
| 220.84 | 3484.95 | 221.25 | 3484.95 | 229.65 | 3485.18 | 234.14 | 3485.06 | 239.07 | 3484.91 |
| 239.19 | 3484.89 | 241.8 | 3484.68 | 245.39 | 3484.42 | 246.83 | 3484.37 | 251.62 | 3484.01 |
| 253.47 | 3483.81 | 255.45 | 3483.6 | 260.79 | 3483.71 | 260.88 | 3483.71 | 260.98 | 3483.75 |
| 263.43 | 3484.21 | 266.33 | 3485.69 | 266.39 | 3485.72 | 266.49 | 3485.76 | 269.53 | 3486.93 |
| 270.8 | 3487.38 | 278.08 | 3488.83 | 280.81 | 3489.42 | 286.51 | 3490.2 | 290.43 | 3490.87 |
| 295.71 | 3491.7 | | | | | | | | |

Manning's n Values num= 2

| Sta | n Val | Sta | n Val |
|---|---|---|---|
| 0 | .04425.69998 | .032 | |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 295.71 | 42.51 | 42.51 | 42.51 | .1 .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 1493.49

INPUT
Description:
Station Elevation Data num= 66

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3481.777.660004 | 3481.5612.04999 | 3481.4412.42999 | 3481.4222.14999 | 3480.3 | | | | |
| 24.85999 | 3479.9525.49998 | 3479.9325.82999 | 3479.9225.88998 | 3479.9226.92999 | 3479.76 | | | | |
| 28.88998 | 3479.3931.01999 | 3478.8832.81999 | 3478.5336.77998 | 3477.2736.81999 | 3477.26 | | | | |
| 37.00999 | 3477.2342.28999 | 3476.2943.76999 | 3476.0443.93999 | 3476.0144.07999 | 3475.96 | | | | |
| 45.87 | 3476.0158.66998 | 3476.27 | 76.87 | 3476.2789.40999 | 3475.789.71999 | 3475.71 | | | |
| 91.92999 | 3477.24 | 92.45 | 3477.4393.93999 | 3478.73 | 96.31 | 3480.899.24998 | 3481.1 | | |
| 101.53 | 3481.65 | 104.19 | 3481.74 | 113.18 | 3481.67 | 117.33 | 3481.7 | 134.14 | 3481.75 |
| 159.64 | 3481.82 | 162.93 | 3481.86 | 171.35 | 3481.82 | 175.93 | 3481.8 | 179.85 | 3481.89 |
| 183.68 | 3482.06 | 186.03 | 3481.64 | 186.34 | 3481.55 | 186.68 | 3481.57 | 189.1 | 3481.7 |
| 197.63 | 3481.57 | 202.95 | 3481.48 | 205.26 | 3481.18 | 208.98 | 3480.65 | 217.64 | 3480.49 |
| 217.66 | 3480.49 | 222.16 | 3480.5 | 224.52 | 3480.43 | 229.3 | 3480.19 | 231.16 | 3480.1 |
| 234.31 | 3480.23 | 234.92 | 3480.23 | 235.43 | 3480.34 | 236.08 | 3480.59 | 237.57 | 3480.76 |
| 240.84 | 3481.1 | 242.47 | 3481.63 | 246.25 | 3482.89 | 250.51 | 3483.81 | 254.51 | 3484.65 |
| 265.99 | 3486.98 | | | | | | | | |

Manning's n Values num= 2

| Sta | n Val | Sta | n Val |
|---|---|---|---|
| 0 | .04424.85999 | .032 | |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 265.99 | 50.43 | 50.43 | 50.43 | .1 .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 1443.06

INPUT
Description:
Station Elevation Data num= 79

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3478.99.1000061 | 3478.941.890015 | 3478.04 | 10.78 | 3477.82 | 13.91 | 3477.75 | | |
| 24.72 | 3476.3225.92999 | 3476.1526.92999 | 3476.15 | 27.05 | 3476.14 | 27.06 | 3476.13 | | |
| 27.39999 | 3476.05 | 27.7 | 3475.99 | 28.63 | 3475.82 | 28.75 | 3475.831.10001 | 3475.36 | |
| 32.21001 | 3475.01 | 35.61 | 3474.08 | 37.06 | 3473.93 | 37.44 | 3473.81 | 38.83 | 3473.31 |
| 43.14999 | 3472.82 | 43.45 | 3472.82 | 82.88 | 3472.7389.35001 | 3472.82 | 91.37 | 3472.51 | |
| 92.32001 | 3472.41 | 92.67 | 3472.93 | 94.77 | 3476.0796.39999 | 3476.34 | 102.94 | 3477.39 | |
| 109.76 | 3477.39 | 118.72 | 3477.32 | 123.96 | 3477.48 | 131.95 | 3477.71 | 152.74 | 3477.43 |
| 153.26 | 3477.43 | 153.79 | 3477.42 | 153.94 | 3477.42 | 159.22 | 3477.08 | 164.13 | 3477.3 |
| 164.43 | 3477.31 | 164.89 | 3477.35 | 167.4 | 3477.49 | 174.21 | 3477.86 | 177.61 | 3477.61 |
| 181.48 | 3477.36 | 182.57 | 3476.98 | 183.9 | 3476.4 | 184.87 | 3476.77 | 188.29 | 3476.84 |
| 188.79 | 3477 | 191.89 | 3477.72 | 192.64 | 3477.7 | 195.05 | 3477.62 | 197.32 | 3477.60 |
| 199.73 | 3477.34 | 202.06 | 3476.69 | 203.98 | 3476.65 | 204.88 | 3476.67 | 206.63 | 3476.48 |
| 207.93 | 3476.36 | 209.53 | 3476.04 | 212.81 | 3476.58 | 214.57 | 3476.77 | 216.59 | 3476.89 |
| 218.14 | 3477.01 | 219.54 | 3476.88 | 220.73 | 3476.73 | 223.93 | 3477.4 | 227.37 | 3478.28 |
| 229.36 | 3478.67 | 235.63 | 3479.97 | 240.7 | 3480.91 | 241.39 | 3481.05 | 242.48 | 3481.22 |
| 248.34 | 3482.13 | 252.19 | 3482.59 | 258.59 | 3483.11 | 260.5 | 3483.25 | | |

Manning's n Values num= 2

| Sta | n Val | Sta | n Val |
|---|---|---|---|
| 0 | .04425.92999 | .032 | |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 260.5 | 58.55 | 58.55 | 58.55 | .1 .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 1384.51

INPUT
Description:
Station Elevation Data num= 85

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3474.37 | .8399963 | 3474.351 | 0.14999 | 3474.14 | 11.62 | 3474.11 | 12 | 3474.1 |
| 12.19 | 3474.09 | 24.01001 | 3473.622 | 5.01001 | 3473.622 | 8.40001 | 3472.682 | 9.79001 | 3472.31 |
| 36.40001 | 3470.54 | 39.75 | 3469.764 | 1.07001 | 3469.47 | 43.02 | 3469.42 | 45.75 | 3469.27 |
| 73.27 | 3469.24 | 79.71001 | 3469.28 | 2.39001 | 3469.638 | 2.43001 | 3469.648 | 2.85001 | 3469.66 |
| 90.64001 | 3469.86 | 96.09001 | 3469.679 | 8.71001 | 3469.579 | 9.85001 | 3469.47 | 99.91 | 3469.49 |
| 100.21 | 3470.09 | 101.35 | 3471.86 | 102.13 | 3473.27 | 103.37 | 3473.19 | 110.52 | 3472.76 |
| 110.83 | 3472.75 | 114.71 | 3472.81 | 117.7 | 3472.78 | 117.79 | 3472.79 | 118.57 | 3472.79 |
| 133.55 | 3473.06 | 149.03 | 3472.6 | 149.82 | 3472.58 | 150.12 | 3472.48 | 152.59 | 3471.92 |
| 154.31 | 3472.33 | 155.56 | 3472.65 | 159.13 | 3473.05 | 161.03 | 3473.24 | 164.4 | 3473.51 |
| 175.29 | 3474.11 | 176.43 | 3474.04 | 176.62 | 3474.03 | 179.67 | 3473.34 | 180.68 | 3473.11 |
| 182.79 | 3473.07 | 185.07 | 3472.78 | 189.3 | 3472.47 | 192.8 | 3472.17 | 193.15 | 3472.15 |
| 193.39 | 3472.21 | 197 | 3473.01 | 201.47 | 3472.94 | 201.52 | 3472.95 | 201.58 | 3472.93 |
| 205.08 | 3472.15 | 206.22 | 3472.39 | 208.12 | 3472.87 | 210.18 | 3473.01 | 211.23 | 3473.09 |
| 212.45 | 3472.84 | 213.55 | 3472.66 | 221.19 | 3474.23 | 222.58 | 3474.52 | 224 | 3474.71 |
| 230.05 | 3475.36 | 232.64 | 3475.41 | 239.64 | 3475.21 | 240.48 | 3475.16 | 247.48 | 3474.45 |
| 248.92 | 3474.25 | 249.59 | 3474.26 | 253.56 | 3473.98 | 257.29 | 3473.97 | 257.37 | 3473.97 |
| 257.57 | 3474 | 263.78 | 3475 | 264.45 | 3475.3 | 266.01 | 3475.77 | 268.32 | 3476.45 |

Manning's n Values num= 2

| Sta | n Val | Sta | n Val |
|---|---|---|---|
| 0 | .04424 | .01001 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 268.32 | 46.92 | 46.92 | .1 | .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 1337.59

INPUT
Description:
Station Elevation Data num= 81

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3471.54 | 4.020004 | 3471.45 | 12.03 | 3471.25 | 14.47 | 3470.82 | 24.05 | 3469.49 |
| 24.98 | 3469.5 | 25.05 | 3469.52 | 5.89999 | 3469.35 | 29.91 | 3468.663 | 0.04001 | 3468.64 |
| 30.99001 | 3468.62 | 31.10001 | 3468.62 | 31.18001 | 3468.63 | 34.34 | 3468.74 | 34.5 | 3468.72 |
| 39.47 | 3468.04 | 40.54001 | 3467.74 | 1.85001 | 3466.92 | 43.63 | 3466.37 | 63.27 | 3466.25 |
| 78.44 | 3465.82 | 78.66 | 3465.84 | 80.10001 | 3466.04 | 81.41 | 3466.22 | 81.79001 | 3466.25 |
| 83.49001 | 3466.22 | 90.37 | 3466.53 | 100.64 | 3466.96 | 101.43 | 3467.01 | 101.46 | 3467.09 |
| 101.52 | 3467.14 | 101.76 | 3467.53 | 103.61 | 3470.55 | 105.69 | 3470.53 | 111.88 | 3470.38 |
| 115.55 | 3470.29 | 117.67 | 3470.23 | 127.13 | 3469.97 | 131.45 | 3469.82 | 132.94 | 3469.66 |
| 135.31 | 3469.44 | 140.11 | 3469.15 | 140.57 | 3469.15 | 144.64 | 3469.07 | 146.69 | 3468.58 |
| 148.62 | 3468.18 | 150.61 | 3468.61 | 151.46 | 3468.87 | 154.17 | 3468.91 | 156.89 | 3468.95 |
| 161.52 | 3469.54 | 164.4 | 3469.95 | 170.78 | 3470.34 | 178.89 | 3470.77 | 181.3 | 3470.61 |
| 186.44 | 3470.08 | 189.24 | 3469.87 | 193.67 | 3469.15 | 193.74 | 3469.14 | 193.76 | 3469.14 |
| 196.82 | 3468.55 | 196.93 | 3468.54 | 197.08 | 3468.53 | 201.15 | 3468.18 | 204.76 | 3468.82 |
| 205.06 | 3468.87 | 205.76 | 3468.86 | 211.82 | 3468.86 | 214.22 | 3468.97 | 214.9 | 3468.73 |
| 216.75 | 3468.17 | 219.76 | 3468.93 | 220.67 | 3469.11 | 221.59 | 3469.23 | 223.77 | 3469.66 |
| 229.57 | 3471.39 | 231.38 | 3471.72 | 235.47 | 3472.3 | 236.48 | 3472.44 | 242.09 | 3473.25 |
| 242.22 | 3473.26 | | | | | | | | |

Manning's n Values num= 2

| Sta | n Val | Sta | n Val |
|---|---|---|---|
| 0 | .044 | 24.05 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 242.22 | 50.55 | 50.55 | .1 | .3 |

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 1287.04

INPUT
Description:
Station Elevation Data num= 73

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3468.25 | 2.880005 | 3468.18 | 12.02 | 3467.96 | 13.27 | 3467.92 | 1.24001 | 3467.41 |
| 22.5 | 3467.33 | 23.59 | 3467.272 | 4.03999 | 3467.24 | 24.09 | 3467.242 | 5.03999 | 3467.23 |
| 36.56999 | 3464.95 | 37.03 | 3464.84 | 37.09 | 3464.833 | 7.50999 | 3464.763 | 8.75999 | 3464.53 |
| 40.50999 | 3463.84 | 42.27 | 3463.13 | 47.55 | 3463.1 | 72.67 | 3463.02 | 72.78 | 3463.05 |
| 73.49001 | 3463.57 | 3.96001 | 3463.81 | 75.23 | 3463.627 | 5.74001 | 3463.547 | 5.92999 | 3463.35 |
| 76.56999 | 3463.03 | 92.58 | 3463.5 | 99.06 | 3463.72 | 100.46 | 3466.41 | 101.45 | 3467.79 |
| 102.91 | 3467.59 | 103.73 | 3467.52 | 104.08 | 3467.5 | 105.93 | 3467.36 | 119.15 | 3467.37 |
| 119.31 | 3467.37 | 129.91 | 3467.06 | 135 | 3466.78 | 140.1 | 3466.6 | 145.49 | 3466.19 |
| 155.26 | 3465.09 | 155.31 | 3465.08 | 155.37 | 3465.07 | 159.7 | 3464.29 | 160.98 | 3464.64 |
| 162.85 | 3464.97 | 163.54 | 3465 | 168.68 | 3465.49 | 169.4 | 3465.57 | 170.04 | 3465.6 |
| 173.52 | 3465.72 | 176.15 | 3465.67 | 178.71 | 3465.36 | 184.18 | 3464.25 | 184.92 | 3464.11 |
| 185.52 | 3464.03 | 185.85 | 3463.94 | 187.16 | 3464.13 | 190.92 | 3464.6 | 194.36 | 3464.77 |
| 197.1 | 3464.97 | 197.81 | 3464.84 | 199.09 | 3464.61 | 203.49 | 3464.88 | 204.3 | 3464.98 |
| 206.07 | 3465.61 | 209.26 | 3466.63 | 209.44 | 3466.69 | 209.6 | 3466.74 | 218.13 | 3469.7 |
| 218.55 | 3469.81 | 225.44 | 3471.7 | 226.64 | 3471.87 | | | | |

Manning's n Values num= 2

| Sta | n Val | Sta | n Val |
|---|---|---|---|
| 0 | .04424 | .03999 | .032 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 0 | 226.64 | 49.68 | 49.68 | .1 | .3 |

CROSS SECTION

RIVER: redrock

```
REACH: redrock              RS: 1237.36

INPUT
Description:
Station Elevation Data     num=      68
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3465.023.180008 3464.94    12.02 3464.7313.71001 3464.52    18.33 3463.99
24.04001 3463.33    25.05 3463.3325.18001 3463.28    26.08 3462.99    28.44 3462.63
40.43001 3460.56    40.91 3460.38    42.39 3459.83    50.88 3459.58    58.31 3459.37
   58.77 3459.59    59.81 3460.1862.48001 3460.1164.87001  3460.1    65.75 3459.73
66.60001 3459.4175.96001 3459.6579.29001 3459.81    81.52 3459.97    85.19 3463.82
85.82001 3464.64    87.33 3464.86    88.16 3465.05    89.03  3465.1    90.25  3465.1
90.84001 3465.14    91.45 3465.1492.21001 3465.16    93.63 3465.37    94.22 3465.38
   96.76 3465.4899.71001 3465.74    101.6  3465.9   103.24 3465.93   113.44     3465
  121.25 3463.91   122.66 3463.92   126.44 3463.98   136.79 3464.18   139.45 3464.16
   149.9 3463.41   156.55 3462.92   160.72 3462.19   166.75 3461.16   167.99 3460.94
  172.06  3460.3   177.95 3460.83    178.9 3460.94   186.83 3461.38   189.51 3461.56
  189.69 3461.61   190.95 3462.04   193.35 3462.79   194.24  3463.1   196.71 3463.55
  199.09 3463.97   200.45  3464.3   200.51 3464.32   200.58 3464.34    204.8 3465.94
  208.77 3467.02   213.59 3468.73   224.52 3470.57

Manning's n Values         num=       2
      Sta   n Val      Sta   n Val
        0    .04424.04001    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  224.52             49.03   49.03   49.03             .1      .3

CROSS SECTION


RIVER: redrock
REACH: redrock              RS: 1188.33

INPUT
Description:
Station Elevation Data     num=      48
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3461.837.179993 3461.66    12.03 3461.54    15.37 3460.9415.56999 3460.91
    24.05 3459.07    24.88 3459.06    25.06 3459.06    25.81 3458.83    27.09 3458.45
    28.14 3458.14    29.83 3457.29    31.03 3456.6633.35001 3456.6542.28999 3456.67
    46.38 3456.64    46.83 3456.55    48.31 3456.2663.75999 3456.49    71.22 3456.62
72.00999 3456.8673.81999 3457.8881.96001 3460.5184.10001 3461.32    90.13  3461.9
    96.79 3462.33   102.46 3462.68   116.5  3462.1   122.21  3461.9   127.5  3461.3
  137.48 3460.08   143.88 3460.22   148.31 3460.41   151.06 3460.35  155.58 3460.02
  157.18  3459.9   159.29 3459.59   168.7  3458.14   172.71 3457.74  175.29 3457.42
  179.57 3458.32   179.59 3458.32   189.19 3458.85   193.04 3459.64  207.57 3465.35
  209.44     3466  215.97 3467.03   219.39 3467.57

Manning's n Values         num=       2
      Sta   n Val      Sta   n Val
        0    .044    24.05    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  219.39             51.18   51.18   51.18             .1      .3

CROSS SECTION


RIVER: redrock
REACH: redrock              RS: 1137.15

INPUT
Description:
Station Elevation Data     num=      47
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3458.49    10.87 3458.23    12.02  3458.2    12.28 3458.09    19.03  3455.1
24.03999 3452.88    25.05 3452.88    26.39 3452.9234.39999 3453.16    34.86 3453.17
   35.14 3453.1835.50999 3453.18    35.81 3453.19    36.69  3453.250.64999 3453.07
59.75999 3453.02    76.53     345378.53999 3453.7379.82001 3454.14    83.59  3455.8
88.75999 3458.13    92.45 3458.22    92.57 3458.22    92.68 3458.23   109.14 3459.08
  127.53 3458.31   131.1 3458.18   132.46 3458.03   147.06 3456.91   148.95 3456.75
  149.96 3456.66   157.32 3455.99   163.64 3455.42   165.12 3455.31   174.04 3454.83
  177.72 3454.46   179.76 3454.24   180.63  3454.3   184.38  3455.2   188.53 3457.69
  188.94 3457.96    189.8 3458.32   191.67 3459.13   204.39 3464.67   205.54 3464.87
  207.19 3464.97   216.86 3465.49

Manning's n Values         num=       2
      Sta   n Val      Sta   n Val
        0    .04424.03999    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  216.86             47.68   47.68   47.68             .1      .3

CROSS SECTION


RIVER: redrock
REACH: redrock              RS: 1089.47

INPUT
Description:
Station Elevation Data     num=      59
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3455.437.269989 3455.229.459991 3455.1612.09999 3455.09    17.28 3454.13
24.18999 3452.8524.71999 3452.85    25.2 3452.8425.89999 3452.5926.51999 3452.37
27.43999 3452.03    30.45 3450.95    32.42 3450.26     34.2 3449.3334.29999 3449.29
46.34999  3449.7    51.03 3449.84    56.62 3449.75    69.09 3449.3975.85999  3449.2
77.12999 3450.03    78.64 3451.2284.09999 3453.1985.17999  3453.688.05999 3453.76
95.46999 3454.24   111.06 3455.54   126.84 3454.48    133.1  3454.1   134.6 3453.96
  143.83 3453.96   145.77 3453.41    146.1 3453.31   149.05 3452.75   151.89 3452.01
  154.82 3451.24   158.88 3451.04   161.39 3451.02   165.34 3450.87   166.72 3450.82
  166.99 3450.86   171.01 3451.64   181.71 3452.12   182.01 3452.13   188.76 3454.12
  190.93 3454.69   193.01 3455.29   193.04  3455.3   193.11 3455.31   193.21 3455.33
```

```
  194.36 3455.33  195.06 3455.42  196.41 3455.53  200.14 3455.88  200.81 3455.86
  204.01 3455.54  206.33 3455.44  209.58 3455.42  210.43 3455.29

 Manning's n Values         num=       2
      Sta   n Val     Sta   n Val
        0    .04424.18999    .032

 Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  210.43             49.95   49.95   49.95             .1       .3

 CROSS SECTION


 RIVER: redrock
 REACH: redrock             RS: 1039.52

 INPUT
 Description:
 Station Elevation Data     num=       62
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3452.162.180008  3452.14.850006 3452.024.940002 3452.029.690002 3451.88
    12.09 3451.82   17.73 3450.11   24.19 3447.8625.04001 3447.84    25.2 3447.84
    25.34 3447.78   25.45 3447.7225.62001  3447.627.15001 3446.51   27.63 3446.17
    41.22 3446.37   45.73 3446.36   48.78 3446.27   57.09 3446.08   62.61  3445.9
    62.95 3446.3463.37001 3446.76   65.03 3448.3278.10001 3448.34   78.57 3448.33
    78.59 3448.34   78.86  3448.4    83.2 3449.31   83.65 3449.41   84.47 3449.54
    89.09  3450.3   99.29 3451.15  103.53 3451.58  108.52 3451.72  130.75 3451.97
   132.49 3451.99   140.8 3449.98  141.42 3449.86  142.39 3449.62  145.68 3449.12
   147.71 3448.39  150.62 3447.07  153.09 3447.07  154.78 3447.18  155.75 3446.95
   159.47 3446.65  160.15 3446.82  161.93 3447.29  162.83 3447.56  164.64 3447.68
   167.33 3447.73  168.28 3447.58  169.81 3447.33  173.77 3448.11  173.88 3448.14
   173.89 3448.13   174.1 3448.18  182.44 3450.29   191.9 3453.95  195.85 3455.53
   197.14 3455.89   204.3  3457.5

 Manning's n Values         num=       2
      Sta   n Val     Sta   n Val
        0    .044   24.19    .032

 Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   204.3             53.37   53.37   53.37             .1       .3

 CROSS SECTION


 RIVER: redrock
 REACH: redrock             RS: 986.15

 INPUT
 Description:
 Station Elevation Data     num=       50
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3448.845.389999 3448.6912.09999  3448.515.25999 3446.96   21.12 3444.11
    23.48 3442.96   24.19 3442.6224.26999 3442.61   33.17 3442.61   34.25 3442.62
    44.08 3442.6950.15999 3442.53   59.42 3442.57   64.64 3442.53   65.62 3443.21
    66.72 3443.74    67.5 3444.2776.35999 3444.69   77.66 3444.7578.93999  3444.9
    83.59 3445.4585.92999 3445.95    96.7 3448.03  103.95 3447.87   106.7 3447.78
   109.07 3447.78  113.55  3447.5  115.21 3447.27  121.03  3447.4  122.63 3447.35
      128 3446.85  131.55 3446.52  140.37 3445.01  140.96  3444.9  141.48 3444.72
   146.42 3443.01  150.57 3443.13  154.02  3443.3  157.02 3442.95  157.34 3442.94
    157.8 3443.06  160.66 3443.88  164.25 3444.33  167.58 3444.55  172.85 3445.82
   177.77 3446.85  186.79 3450.05  194.85 3452.96  197.22 3453.63  197.48 3453.68

 Manning's n Values         num=       2
      Sta   n Val     Sta   n Val
        0    .044   24.19    .032

 Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  197.48             49.79   49.79   49.79             .1       .3

 CROSS SECTION


 RIVER: redrock
 REACH: redrock             RS: 936.36

 INPUT
 Description:
 Station Elevation Data     num=       58
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
        0 3445.583.039993 3445.498.959991 3445.3312.09999 3445.24   19.14    3442
 24.20999 3439.69   24.81 3439.6925.20999 3439.68   25.53 3439.6828.51999 3439.66
    30.36 3439.27   30.94 3439.15   46.06 3439.2649.04999 3439.26   54.06 3439.27
 63.82999 3439.24   69.24 3439.27   70.24 3439.57   72.16 3439.99   72.91 3439.92
 74.89999 3440.48   76.13 3440.9879.75999 3441.44   80.91 3441.68   88.49 3442.09
    97.87 3442.4699.46999 3442.68  109.96 3443.44  110.47 3443.46  114.78 3441.93
   118.81 3440.55  122.21 3439.97  127.24 3439.15  130.37  3438.8  131.88 3438.74
   134.24 3438.95  134.96 3439.02  139.14 3439.29  141.67  3439.4  143.97 3439.44
   144.43  3439.4  144.92 3439.43  148.22  3439.9  151.35 3440.05  151.78 3440.05
   152.85 3439.99  155.88 3440.52   156.8 3440.73   157.4 3440.81  159.87 3441.08
   163.31 3441.67  165.66  3442.3  175.67 3446.38  178.98 3447.69  180.91 3448.49
   188.01 3451.02  190.08 3451.85  191.12 3452.12

 Manning's n Values         num=       2
      Sta   n Val     Sta   n Val
        0    .04424.20999    .032

 Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  191.12             50.1    50.1    50.1              .1       .3

 CROSS SECTION


 RIVER: redrock
 REACH: redrock             RS: 886.26
```

```
INPUT
Description:
Station Elevation Data    num=      58
      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
        0 3442.32.599991 3442.225.069992 3442.1512.09999 3441.95   13.17 3441.47
15.34999 3440.55   22.11 3437.63    24.2 3436.7925.20999 3436.79   25.22 3436.78
   25.81 3436.52   29.31 3436.4430.17999 3436.4131.23999 3436.0631.95999 3435.86
32.31999 3435.77   35.25 3435.7643.00999 3435.7447.87999 3435.91   51.53 3436.14
63.39999 3436.0274.00999 3436.01   76.28  3436.876.43999 3436.87   77.02 3436.85
80.35999 3436.74   88.52  3436.5   94.06 3437.87   94.38 3437.95   98.35  3438.4
  106.87 3439.27  109.98 3439.26  111.28 3439.21  119.14 3438.98  123.42 3438.71
  125.93 3438.58  130.57  3436.3  130.68 3436.23  137.85 3435.51  140.64  3435.4
  142.07 3435.72  143.43 3436.26  143.83 3436.37  145.13 3436.66   148.7 3438.35
  152.02  3439.5  156.93 3441.79  157.97 3442.32  161.61 3444.13  162.24 3444.54
   163.1 3444.87   163.9  3445.1  170.81 3446.89  173.84 3447.51  178.29 3448.49
  181.14 3449.07   182.2 3449.24  186.23  3449.5

Manning's n Values        num=       2
      Sta   n Val     Sta   n Val
        0    .044    24.2    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  186.23             50.07   50.07   50.07             .1      .3

CROSS SECTION


RIVER: redrock
REACH: redrock            RS: 836.19

INPUT
Description:
Station Elevation Data    num=      53
      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
        0 3439.44.8399963 3439.014.809998  3438.912.67999 3438.68   12.94 3438.68
   13.11 3438.6225.03999 3434.54   25.45 3434.53   26.05 3434.52   29.56  3433.6
   29.72 3433.5629.78999 3433.54   29.83 3433.52   29.87  3433.5   31.62 3432.87
   33.86  3432.8   49.78 3432.51   57.77 3432.45   66.56 3432.42   76.95 3432.52
   80.37 3432.53   83.04 3433.39    83.4 3433.59   84.74 3434.02   87.88 3434.88
   90.44 3435.53   91.04 3435.67   92.72 3436.12   97.82 3436.07  102.22 3436.18
  103.18 3436.14  112.48 3435.53  116.26 3435.16  118.55 3434.34   121.1 3433.25
  122.56 3433.14  127.82 3432.66  129.28 3432.66  130.67 3432.69  133.11 3433.62
  139.56 3435.24  145.65 3430.04  148.99 3439.61  151.94 3440.92  154.24 3441.99
  158.15 3443.45  159.79 3443.83   161.6 3444.02  167.12 3444.62  172.05 3445.22
  175.54  3445.5  179.21 3445.68     180 3445.72

Manning's n Values        num=       2
      Sta   n Val     Sta   n Val
        0   .04425.03999    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     180             49.48   49.48   49.48             .1      .3

CROSS SECTION


RIVER: redrock
REACH: redrock            RS: 786.71

INPUT
Description:
Station Elevation Data    num=      55
      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
        0 3437.342.799988 3437.313.189987  3437.34.809998 3437.295.689987 3437.28
7.139999 3437.267.619995 3437.028.159988 3436.7518.23999  3436.520.25999 3436.45
21.06999 3436.1129.35999 3432.6632.34999 3431.41    32.7 3431.4133.35999  3431.4
   36.25 3431.0336.60999 3430.99   40.09 3430.4341.95999 3430.34      48 3429.52
51.26999 3429.06   51.59 3429.0357.81999 3429.0365.98999 3428.65   76.98 3428.53
78.98999 3428.5580.26999 3428.4781.05999 3428.94    82.8 3430.0486.99999  3431.3
   88.23 3431.8693.03999  3432.299.50999 3432.64  103.72 3432.03  107.98 3431.67
  110.09 3430.76  111.96 3429.68   112.8 3429.71  114.95 3429.93  115.69  3429.9
  119.72 3429.48  122.12  3429.8  122.49 3429.85  124.51 3430.17  130.88 3431.08
  132.42  3431.9   140.3 3435.47  140.59 3435.59  140.88 3435.69  147.69 3438.45
  153.53 3440.38  157.61 3440.86  170.65 3441.29  175.14  3441.6  182.43 3441.85

Manning's n Values        num=       2
      Sta   n Val     Sta   n Val
        0   .04433.35999    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  182.43             66.72   66.72   66.72             .1      .3

CROSS SECTION


RIVER: redrock
REACH: redrock            RS: 719.99

INPUT
Description:
Station Elevation Data    num=      56
      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
        0 3434.616.410004 3434.46   10.34 3434.36   15.92 3431.68   22.42 3428.72
   23.43 3428.72   27.42 3427.58   27.55 3427.54   29.62 3427.06   31.75  3426.9
   36.62 3426.38   39.09 3426.16   39.51  3426.1   40.14 3426.02   43.16 3425.77
   45.48 3425.63   47.55 3425.47   48.46 3425.37   49.37 3425.43   49.84 3425.33
   50.33 3425.38   51.78 3425.54   60.43 3425.09   65.57 3424.94   66.67 3425.49
   67.66 3425.91   69.42 3426.59   71.93 3427.53   73.83 3427.92   75.34  3428.2
   75.93 3428.15    78.5 3427.75   80.63 3427.06   81.75  3426.7   86.48 3426.53
   88.46 3426.59   92.53 3426.22   93.03 3426.12   93.48 3426.15    96.2 3426.21
   96.49 3426.36   97.38 3426.98  100.17 3427.13  103.35 3427.77  106.62 3430.26
  107.68 3430.82  111.31 3432.73  118.79 3436.22  120.32 3436.99  120.89 3437.19
  129.06 3437.59  132.11 3437.91  138.17 3438.12  142.42 3438.05     146 3437.93
```

146.03 3437.93

Manning's n Values num= 2
Sta n Val Sta n Val
0 .044 23.43 .032

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
0 146.03 36.9 36.9 36.9 .1 .3

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 683.09

INPUT
Description:
Station Elevation Data num= 48
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
0 3431.766.220001 3431.65 11.78 3431.56 13.34 3431.17 15.56 3430.59
21.29 3429.14 23.86 3428.44 24.53 3428.43 24.87 3428.43 25.28 3428.33
25.34 3428.31 27.22 3427.87 28.71 3427.5528.75999 3427.54 30.71 3427.13
35.98 3425.5136.82999 3425.2 37.2 3425 41 3422.77 42.75 3422.66
43.39999 3422.62 46.8 3422.4 47.47 3422.4 56.93 3422.24 58 3422.2
60.42 3422.19 61.97 3422.2 71.55 3422.2 71.66 3422.26 75.41 3423.37
78.48 3425.34 79.99 3426.2388.50999 3430.41 88.98 3430.66 89.35 3430.84
96.06 3433.8997.00999 3434.03 101.65 3434.51 106.54 3435.1 107.62 3435.26
108.07 3435.32 108.5 3435.36 111.05 3435.57 115.28 3435.84 116.3 3435.92
120.72 3436.26 123.59 3436.41 131.31 3436.91

Manning's n Values num= 2
Sta n Val Sta n Val
0 .044 23.86 .032

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
0 131.31 54.23 54.23 54.23 .1 .3

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 628.86

INPUT
Description:
Station Elevation Data num= 38
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
0 3426.84.4499969 3426.864.369995 3427.15.439987 3427.14 13.37 3427.35
15.2 3427.38 17.02 3427.06 21.27 3426.2826.64999 3424.8526.87999 3424.8
35.89999 3423.3238.25999 3422.84 39.87 3422.4745.78999 3421.1749.59999 3418.91
49.63999 3418.8949.75999 3418.8961.05999 3418.9767.81999 3419.05 71.95 3418.94
76.09999 3418.8676.74999 3419.3977.82999 3419.9578.40999 3421.679.26999 3422.89
82.04999 3424.7884.24999 3426.3986.07999 3427.8387.35999 3428.4694.25999 3431.86
101.51 3432.78 103.33 3432.96 104.53 3433 113.9 3433.4 118.75 3433.5
121 3433.55 131.95 3433.77 134.04 3433.8

Manning's n Values num= 2
Sta n Val Sta n Val
0 .04435.89999 .032

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
0 134.04 40.38 43.9 45.2 .1 .3

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 598.48

INPUT
Description:
Station Elevation Data num= 37
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
0 3424.282.660004 3424.56 10.23 3424.67 14.06 3424.63 20.21 3423.59
21.35999 3423.39 22.1 3423.23 30.92 3421.28 44.06 3419.59 47.02 3419.23
47.77 3419.01 51.45 3417.85 54.2 3418.04 55.84 3418.09 57.77 3417.06
58.41 3416.72 58.55 3416.63 59.92 3416.3681.17999 3415.99 81.84 3415.97
82.03999 3416.0285.09999 3416.93 85.45 3419.5 85.56 3419.8389.92999 3422.05
92.84 3423.82 100.1 3428.17 101.59 3429.06 108.66 3429.31 109.45 3429.35
109.87 3429.35 120.26 3429.36 122.29 3429.37 123.6 3429.39 132.74 3429.67
145.57 3429.69 146.59 3429.73

Manning's n Values num= 3
Sta n Val Sta n Val Sta n Val
0 .032 0 .032 146.59 .032

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
0 146.59 26.46 37.7 47.6 .1 .3

CROSS SECTION

RIVER: redrock
REACH: redrock RS: 562.02

INPUT
Description:
Station Elevation Data num= 45
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
0 3422.34 1.5 3422.583.809998 3422.646.259995 3422.66 11.73 3421.89
14.12 3421.5 15.88 3421 24.85 3419.06 25.11 3419.04 36.62 3416.93
40.18 3416.5442.68999 3415.96 44.88 3415.65 45.79 3415.58 50.43 3415.56
50.68999 3415.56 50.78 3415.51 53.7 3413.94 55.89 3414.37 57.12 3414.59
57.66 3414.58 60.43 3414.51 61.7 3414.47 61.78 3414.44 62.92 3413.79

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    82.7 3413.8687.28999 3413.9688.53999 3414.27   91.84 3415.04   92.23  3419.8
   92.61 3425.03  100.17 3425.18  105.27 3425.38  109.63 3425.28  113.92  3425.5
  113.98 3425.51  114.11 3425.52  116.99 3425.64  123.08 3425.89  123.52 3425.91
  123.85 3425.93  131.18 3426.51  134.82 3426.68  138.98 3426.87  147.56 3426.96

Manning's n Values        num=      3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .032       0    .032  147.56    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0  147.56             17.59    31.7      49             .1      .3

CROSS SECTION


RIVER: redrock
REACH: redrock            RS: 544.43

INPUT
Description:
Station Elevation Data    num=      39
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 3419.845.919998 3421.17    6.25 3421.197.969994 3420.9914.82999 3419.97
   23.93 3417.36   25.46 3416.93   26.67 3416.58   31.95 3415.31   38.71 3414.02
    40.1 3413.82   45.86 3413.1547.25999 3412.26   48.49 3411.54   49.91 3411.67
      52 3412.1753.07999  3412.2   54.03 3412.06   55.23  3412.6   55.91  3412.8
   57.62 3413.03    61.3 3413.38   62.13 3412.77   63.35 3411.63   78.03 3411.73
   91.75 3411.78   93.88 3412.11   94.09 3412.14   94.37 3412.25   95.91 3412.81
   97.71 3413.45   98.36 3418.34   99.03 3422.0699.42999 3422.18  100.86 3422.49
  125.88 3423.77   127.1  3423.8  127.84 3423.81   128.7 3423.81

Manning's n Values        num=      3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .032       0    .032   128.7    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0   128.7             49.55    59.4    68.5             .1      .3

CROSS SECTION


RIVER: redrock
REACH: redrock            RS: 494.88

INPUT
Description:
Station Elevation Data    num=      32
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 3407.424.830002 3407.185.290009 3407.247.270004 3407.7110.24001 3409.29
   11.95 3410.3113.56001 3410.86   22.22 3414.66   23.51  3414.4   29.59 3413.26
36.31001 3411.55   40.15 3410.8947.31001 3410.25   49.51 3410.0851.89001 3409.98
52.14001 3409.5754.32001 3407.1986.28001 3407.2586.96001 3407.2589.49001 3411.32
89.56001 3411.4689.79001 3411.58   90.55 3412.0492.54001    341396.85001 3414.84
  103.42 3417.86  110.35 3419.15  114.06 3419.96  121.45 3420.11  122.46 3420.13
   125.1 3420.08  128.13 3420.05

Manning's n Values        num=      3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .032       0    .032  128.13    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0  128.13             50.38    43.7      39             .1      .3

CROSS SECTION


RIVER: redrock
REACH: redrock            RS: 444.5

INPUT
Description:
Station Elevation Data    num=      55
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 3406.07.7600021 3405.992.860001 3405.858.029999 3405.98    8.57    3406
8.990005 3406.019.099998    34069.270004 3405.98   10.18 3405.86   15.57 3405.15
   16.46 3405.02   17.47 3404.58   18.44 3404.12   23.47 3404.04   26.18    3404
    28.2    3404   28.88 3405.16   29.09  3405.5   31.35 3406.71   31.78  3406.9
   33.59 3407.09   35.11 3407.16    35.8 3407.28   37.19 3407.57   41.17  3408.2
   48.18 3408.61   48.73 3408.62   49.27 3408.51   49.77 3408.39   51.51 3407.75
   52.43 3407.45   52.64 3406.97   53.71  3404.7   58.61 3404.44   59.64  3404.4
   60.01 3404.38   61.61 3404.4571.21001 3404.72   73.94 3404.7180.24001 3404.72
   82.31 3404.73   82.65 3404.81   85.27 3405.72   87.05 3406.36   90.94 3408.54
   94.11 3410.36   94.13 3410.38   94.15 3410.39  101.24 3413.67  102.02 3413.95
  109.38 3416.88  114.23 3417.29  122.09 3417.86  122.29 3417.84  123.58 3417.82

Manning's n Values        num=      3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .032       0    .032  123.58    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0  123.58             48.18    49.1   49.6             .1      .3

CROSS SECTION


RIVER: redrock
REACH: redrock            RS: 396.32

INPUT
Description:
Station Elevation Data    num=      60
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 3405.922.839996 3405.694.470001 3405.54   10.59 3405.03   10.83 3405.02
   11.43 3404.96   15.37 3404.68    16.3 3404.55    19.4 3404.34   21.69 3404.14
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   23.73 3404.01   27.95 3403.53   28.11 3403.48   28.98 3403.26   32.28 3402.37
   33.28 3402.21   34.06 3402.36   34.75 3402.02   35.48 3401.93    36.9 3401.68
   38.87 3401.35   40.27 3401.36   43.29 3401.36   45.01 3401.34   45.84 3401.35
   49.98 3401.33   55.18 3401.17   55.26 3401.18   56.44 3401.19   58.06 3401.57
   58.23  3401.6   58.84 3401.24   60.33 3401.35   65.81 3401.46   66.43 3401.69
   68.83 3401.86   70.07    3402   71.54 3401.98   77.51 3401.89   79.62 3401.63
   81.26 3401.47   81.72 3401.44   90.72 3401.38   90.82 3401.3691.10001 3401.44
   92.98  3401.8   93.72    3402   94.55 3402.42  101.97 3405.93  106.61 3407.26
  106.94 3407.36  107.24 3407.44  107.85 3407.61   115.6 3410.11  119.14 3411.26
  121.46  3412.2   129.9 3413.78     130  3413.8  130.25 3413.82  134.11 3414.15

Manning's n Values          num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   134.11    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.    Expan.
             0  134.11             48.86    49.9    50.2              .1       .3

CROSS SECTION


RIVER: redrock
REACH: redrock            RS: 347.46

INPUT
Description:
Station Elevation Data    num=      47
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 3401.911.349998 3401.572.529999 3401.795.339996 3402.258.439995 3402.73
   14.04 3403.2114.75999 3403.16       17 3403.18   23.22  3403.1   25.12 3402.92
   26.84 3402.75   30.61 3402.47   32.59  3402.2   35.54 3401.71   39.97 3400.81
   42.61  3400.7   46.72 3400.65    48.9 3400.55   49.96 3400.28   51.71 3399.87
   52.86 3398.85   53.17 3398.58   57.07 3398.66   60.29 3398.71   61.94 3398.75
   62.26 3398.83   64.78 3399.11   71.02 3398.93   72.49 3398.82   77.27  3398.9
   77.61  3398.9   77.73 3398.89   79.61 3398.73   81.49 3398.57   81.57 3398.56
   84.05 3398.54   88.22 3398.46   98.13 3398.35   98.42 3398.57   98.81 3398.86
   98.97 3398.96   99.19 3399.18   99.81 3399.59  105.68 3403.17  108.68 3404.11
  111.73 3404.64  119.17 3406.13

Manning's n Values          num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   119.17    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.    Expan.
             0  119.17             75.71    55.4    45.5              .1       .3

CROSS SECTION


RIVER: redrock
REACH: redrock            RS: 271.75

INPUT
Description:
Station Elevation Data    num=      51
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 3397.99.1900024 3397.972.059998  3397.8   10.62 3398.04   12.72 3398.12
    24.2 3398.48   27.36 3398.51   28.73 3398.41   36.74 3397.63   39.38 3397.27
43.75999 3396.84    46.3 3396.59   46.55 3396.57      47 3396.53   47.79 3395.64
   48.23    3395   56.39  3394.456.57999 3394.39   56.77 3394.38   57.27 3394.36
   57.31  3394.4   58.78 3395.3864.07999 3395.72   64.13 3395.72   64.31 3395.73
64.75999 3395.66    65.6 3395.55   68.69 3395.18   69.36 3395.26   72.33 3395.76
   74.28 3395.32   78.27 3394.96    79.7 3394.7680.64999 3394.76   82.59 3394.72
   84.85 3394.79   89.56  3394.8   91.06 3394.78   92.94 3394.7898.03999 3394.72
   99.64  3394.7   99.71 3394.79  101.05 3396.08  102.34 3397.36   103.4 3398.18
  106.59 3399.46  107.87 3399.92  108.61 3400.06  114.96 3401.27  129.23 3402.09
  129.56 3402.14

Manning's n Values          num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   129.56    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.    Expan.
             0  129.56             61.28   61.28   61.28              .1       .3

CROSS SECTION


RIVER: redrock
REACH: redrock            RS: 210.47

INPUT
Description:
Station Elevation Data    num=      59
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 3395.218.599998  3394.7   10.19 3394.29   13.89 3393.56   15.55 3393.61
   21.92 3393.88      23 3394.04   26.84 3394.51   28.18 3394.55   28.75 3394.53
   30.38 3394.61   35.09  3394.8   38.37 3394.38   39.78 3394.26   40.02 3394.32
   40.12 3394.29   40.26 3394.04   41.25 3392.47   41.54 3391.98   42.01 3391.82
    42.6 3391.62    44.6  3390.9   51.81  3391.2   57.67 3391.38   58.35 3391.63
   59.37 3391.96   61.63 3391.82   63.13 3391.64   64.66 3391.66   66.82 3391.78
   69.75 3391.99   71.73 3391.9373.50999 3391.86   74.45 3391.06   74.48 3391.03
   74.56 3391.03   80.41  3391.3   90.61 3391.24   92.29 3391.13   96.58 3391.05
   98.97    3391    99.5 3391.54  100.14 3392.06  101.04 3393.69  101.87 3394.79
  102.73 3395.18  106.28 3395.99  108.65 3396.52  110.01 3396.39  113.23 3396.23
  116.02 3395.29  116.71 3395.21  120.21 3395.88  120.63 3395.96  120.75 3395.98
  120.88 3396.01  120.98 3396.05  122.75  3396.8  123.39 3397.07

Manning's n Values          num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .032        0    .032   123.39    .032

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.    Expan.
             0  123.39             49.35   49.35   49.35              .1       .3
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CROSS SECTION

RIVER: redrock
REACH: redrock RS: 161.12

INPUT
Description:
Station Elevation Data num= 48

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3391.58 | .800003 | 3391.33 | 8.980003 | 3391.32 | 9.060005 | 3391.31 | 9.270004 | 3391.3 |
| 16.14 | 3390.56 | 19.42001 | 3390.22 | 21.19 | 3390.91 | 22.32 | 3391.26 | 26.54 | 3391.34 |
| 26.92001 | 3391.36 | 27.07 | 3391.37 | 27.25 | 3391.41 | 27.88 | 3391.49 | 31.13 | 3391.91 |
| 31.75 | 3390.21 | 32.22 | 3388.73 | 41.49001 | 3388.35 | 48.83 | 3387.96 | 50.49001 | 3388.4 |
| 50.97 | 3388.47 | 51.31001 | 3388.49 | 52.36 | 3388.56 | 53.11 | 3388.61 | 53.26 | 3388.58 |
| 54.1 | 3388.33 | 54.72 | 3388.05 | 65.14 | 3387.89 | 65.29 | 3387.88 | 66.31 | 3388.11 |
| 66.75 | 3388.23 | 67.43001 | 3388.05 | 67.93001 | 3387.81 | 69.8 | 3387.77 | 80.77 | 3387.81 |
| 87.8 | 3387.83 | 96.37 | 3387.84 | 97.29 | 3388.92 | 97.41 | 3389.08 | 97.45 | 3389.11 |
| 99.87 | 3390.77 | 100.38 | 3391.22 | 101.4 | 3391.75 | 102.83 | 3392.52 | 105.61 | 3393.47 |
| 106.17 | 3393.63 | 109.46 | 3393.79 | 117.94 | 3394.22 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .032 | 0 | .032 | 117.94 | .032 |

| Bank Sta: Left | Right | Coeff Contr. | Expan. |
|---|---|---|---|
| 0 | 117.94 | .1 | .3 |

SUMMARY OF MANNING'S N VALUES

River:redrock

| Reach | River Sta. | n1 | n2 | n3 |
|---|---|---|---|---|
| redrock | 2693.56 | .032 | .032 | .032 |
| redrock | 2645.53 | .032 | .032 | .032 |
| redrock | 2595.89 | .032 | .032 | .032 |
| redrock | 2547.93 | .032 | .032 | .032 |
| redrock | 2498.73 | .032 | .032 | .032 |
| redrock | 2445.26 | .032 | .032 | .032 |
| redrock | 2399.05 | .032 | .032 | .032 |
| redrock | 2345.81 | .032 | .032 | .032 |
| redrock | 2295.64 | .032 | .032 | .032 |
| redrock | 2253.32 | .032 | .032 | .032 |
| redrock | 2221.01 | .032 | .032 | .032 |
| redrock | 2204.49 | .032 | .032 | .032 |
| redrock | 2179.89 | .044 | .032 | |
| redrock | 2145.03 | .044 | .032 | |
| redrock | 2107.94 | .044 | .032 | |
| redrock | 2065.03 | .044 | .032 | |
| redrock | 2014.37 | .044 | .032 | |
| redrock | 1954.76 | .044 | .032 | |
| redrock | 1915.84 | .044 | .032 | |
| redrock | 1867.51 | .044 | .032 | |
| redrock | 1806.54 | .044 | .032 | |
| redrock | 1739.51 | .044 | .032 | |
| redrock | 1681.73 | .044 | .032 | |
| redrock | 1567.51 | .044 | .032 | |
| redrock | 1536 | .044 | .032 | |
| redrock | 1493.49 | .044 | .032 | |
| redrock | 1443.06 | .044 | .032 | |
| redrock | 1384.51 | .044 | .032 | |
| redrock | 1337.59 | .044 | .032 | |
| redrock | 1287.04 | .044 | .032 | |
| redrock | 1237.36 | .044 | .032 | |
| redrock | 1188.33 | .044 | .032 | |
| redrock | 1137.15 | .044 | .032 | |
| redrock | 1089.47 | .044 | .032 | |
| redrock | 1039.52 | .044 | .032 | |
| redrock | 986.15 | .044 | .032 | |
| redrock | 936.36 | .044 | .032 | |
| redrock | 886.26 | .044 | .032 | |
| redrock | 836.19 | .044 | .032 | |
| redrock | 786.71 | .044 | .032 | |
| redrock | 719.99 | .044 | .032 | |
| redrock | 683.09 | .044 | .032 | |
| redrock | 628.86 | .044 | .032 | |
| redrock | 588.48 | .032 | .032 | .032 |
| redrock | 562.02 | .032 | .032 | .032 |
| redrock | 544.43 | .032 | .032 | .032 |
| redrock | 494.88 | .032 | .032 | .032 |
| redrock | 444.5 | .032 | .032 | .032 |
| redrock | 396.32 | .032 | .032 | .032 |
| redrock | 347.46 | .032 | .032 | .032 |
| redrock | 271.75 | .032 | .032 | .032 |
| redrock | 210.47 | .032 | .032 | .032 |
| redrock | 161.12 | .032 | .032 | .032 |

SUMMARY OF REACH LENGTHS

River: redrock

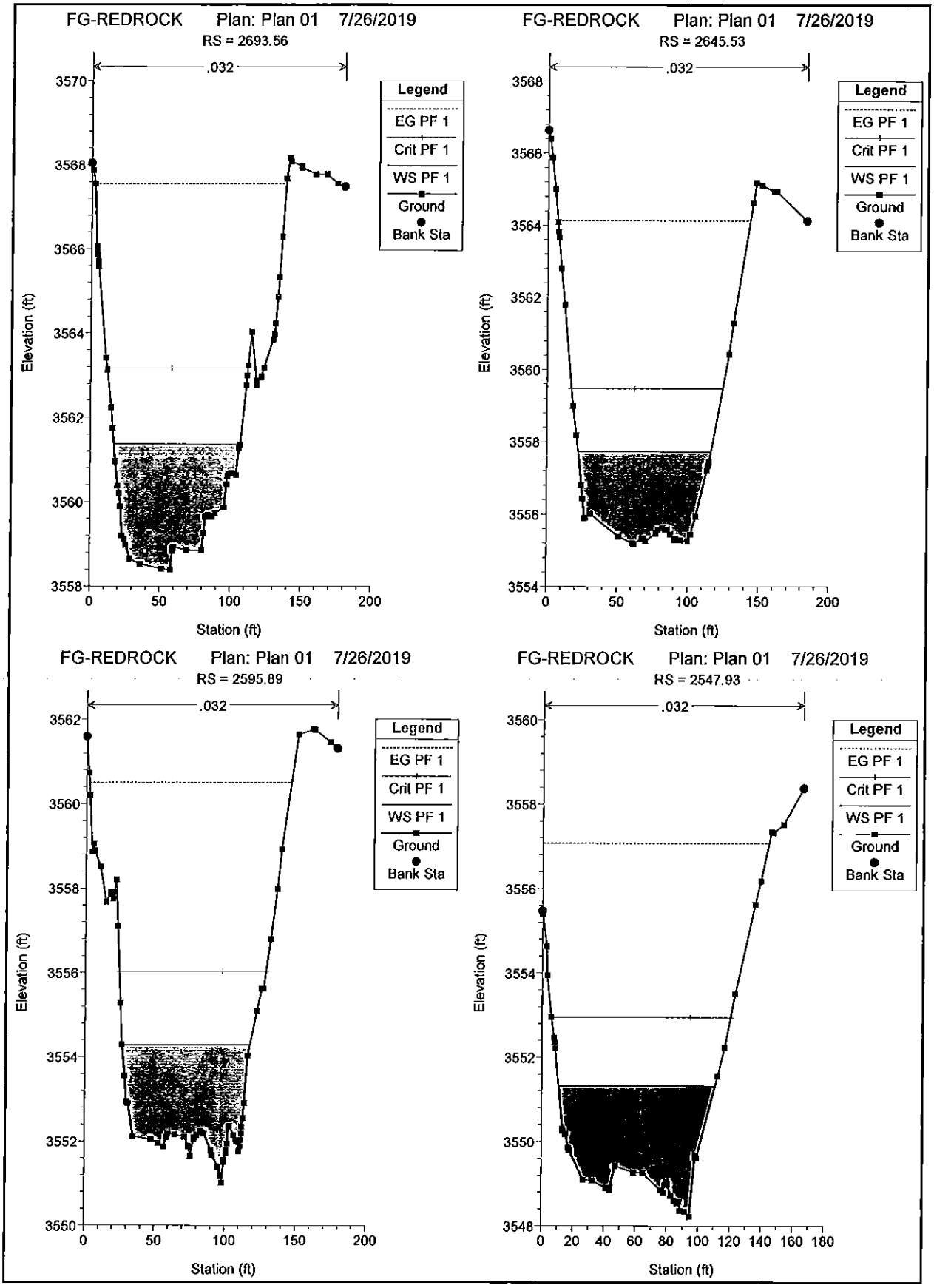
| Reach | River Sta. | Left | Channel | Right |
|---|---|---|---|---|
| redrock | 2693.56 | 48.03 | 48.03 | 48.03 |
| redrock | 2645.53 | 49.64 | 49.64 | 49.64 |
| redrock | 2595.89 | 47.96 | 47.96 | 47.96 |
| redrock | 2547.93 | 49.2 | 49.2 | 49.2 |

| | | | | |
|---|---|---|---|---|
| redrock | 2498.73 | 53.47 | 53.47 | 53.47 |
| redrock | 2445.26 | 46.21 | 46.21 | 46.21 |
| redrock | 2399.05 | 53.24 | 53.24 | 53.24 |
| redrock | 2345.81 | 50.17 | 50.17 | 50.17 |
| redrock | 2295.64 | 42.32 | 52.3 | 62.2 |
| redrock | 2253.32 | 32.31 | 53.4 | 60.8 |
| redrock | 2221.01 | 16.52 | 26.8 | 36.2 |
| redrock | 2204.49 | 24.6 | 24.6 | 24.6 |
| redrock | 2179.89 | 34.86 | 34.9 | 42 |
| redrock | 2145.03 | 37.09 | 32.5 | 25.8 |
| redrock | 2107.94 | 42.91 | 42.91 | 42.91 |
| redrock | 2065.03 | 50.66 | 44.3 | 38.8 |
| redrock | 2014.37 | 59.61 | 61.1 | 45.9 |
| redrock | 1954.76 | 38.92 | 38.92 | 38.92 |
| redrock | 1915.84 | 48.33 | 62.9 | 48.5 |
| redrock | 1867.51 | 60.97 | 45.5 | 23.7 |
| redrock | 1806.54 | 67.03 | 60.1 | 44.1 |
| redrock | 1739.51 | 57.78 | 30.4 | 32.8 |
| redrock | 1681.73 | 114.22 | 26.5 | 27.9 |
| redrock | 1567.51 | 31.51 | 31.51 | 31.51 |
| redrock | 1536 | 42.51 | 42.51 | 42.51 |
| redrock | 1493.49 | 50.43 | 50.43 | 50.43 |
| redrock | 1443.06 | 58.55 | 58.55 | 58.55 |
| redrock | 1384.51 | 46.92 | 46.92 | 46.92 |
| redrock | 1337.59 | 50.55 | 50.55 | 50.55 |
| redrock | 1287.04 | 49.68 | 49.68 | 49.68 |
| redrock | 1237.36 | 49.03 | 49.03 | 49.03 |
| redrock | 1188.33 | 51.18 | 51.18 | 51.18 |
| redrock | 1137.15 | 47.68 | 47.68 | 47.68 |
| redrock | 1089.47 | 49.95 | 49.95 | 49.95 |
| redrock | 1039.52 | 53.37 | 53.37 | 53.37 |
| redrock | 986.15 | 49.79 | 49.79 | 49.79 |
| redrock | 936.36 | 50.1 | 50.1 | 50.1 |
| redrock | 886.26 | 50.07 | 50.07 | 50.07 |
| redrock | 836.19 | 49.48 | 49.48 | 49.48 |
| redrock | 786.71 | 66.72 | 66.72 | 66.72 |
| redrock | 719.99 | 36.9 | 36.9 | 36.9 |
| redrock | 683.09 | 54.23 | 54.23 | 54.23 |
| redrock | 628.86 | 40.38 | 43.9 | 45.2 |
| redrock | 588.48 | 26.46 | 37.7 | 47.6 |
| redrock | 562.02 | 17.59 | 31.7 | 49 |
| redrock | 544.43 | 49.55 | 59.4 | 68.5 |
| redrock | 494.88 | 50.38 | 43.7 | 39 |
| redrock | 444.5 | 48.18 | 49.1 | 49.6 |
| redrock | 396.32 | 48.86 | 49.9 | 50.2 |
| redrock | 347.46 | 75.71 | 55.4 | 45.5 |
| redrock | 271.75 | 61.28 | 61.28 | 61.28 |
| redrock | 210.47 | 49.35 | 49.35 | 49.35 |
| redrock | 161.12 | | | |

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: redrock

| Reach | River Sta. | Contr. | Expan. |
|---|---|---|---|
| redrock | 2693.56 | .1 | .3 |
| redrock | 2645.53 | .1 | .3 |
| redrock | 2595.89 | .1 | .3 |
| redrock | 2547.93 | .1 | .3 |
| redrock | 2498.73 | .1 | .3 |
| redrock | 2445.26 | .1 | .3 |
| redrock | 2399.05 | .1 | .3 |
| redrock | 2345.81 | .1 | .3 |
| redrock | 2295.64 | .1 | .3 |
| redrock | 2253.32 | .1 | .3 |
| redrock | 2221.01 | .1 | .3 |
| redrock | 2204.49 | .1 | .3 |
| redrock | 2179.89 | .1 | .3 |
| redrock | 2145.03 | .1 | .3 |
| redrock | 2107.94 | .1 | .3 |
| redrock | 2065.03 | .1 | .3 |
| redrock | 2014.37 | .1 | .3 |
| redrock | 1954.76 | .1 | .3 |
| redrock | 1915.84 | .1 | .3 |
| redrock | 1867.51 | .1 | .3 |
| redrock | 1806.54 | .1 | .3 |
| redrock | 1739.51 | .1 | .3 |
| redrock | 1681.73 | .1 | .3 |
| redrock | 1567.51 | .1 | .3 |
| redrock | 1536 | .1 | .3 |
| redrock | 1493.49 | .1 | .3 |
| redrock | 1443.06 | .1 | .3 |
| redrock | 1384.51 | .1 | .3 |
| redrock | 1337.59 | .1 | .3 |
| redrock | 1287.04 | .1 | .3 |
| redrock | 1237.36 | .1 | .3 |
| redrock | 1188.33 | .1 | .3 |
| redrock | 1137.15 | .1 | .3 |
| redrock | 1089.47 | .1 | .3 |
| redrock | 1039.52 | .1 | .3 |
| redrock | 986.15 | .1 | .3 |
| redrock | 936.36 | .1 | .3 |
| redrock | 886.26 | .1 | .3 |
| redrock | 836.19 | .1 | .3 |
| redrock | 786.71 | .1 | .3 |
| redrock | 719.99 | .1 | .3 |
| redrock | 683.09 | .1 | .3 |
| redrock | 628.86 | .1 | .3 |
| redrock | 588.48 | .1 | .3 |
| redrock | 562.02 | .1 | .3 |

| | | | |
|---|---|---|---|
| redrock | 544.43 | .1 | .3 |
| redrock | 494.88 | .1 | .3 |
| redrock | 444.5 | .1 | .3 |
| redrock | 396.32 | .1 | .3 |
| redrock | 347.46 | .1 | .3 |
| redrock | 271.75 | .1 | .3 |
| redrock | 210.47 | .1 | .3 |
| redrock | 161.12 | .1 | .3 |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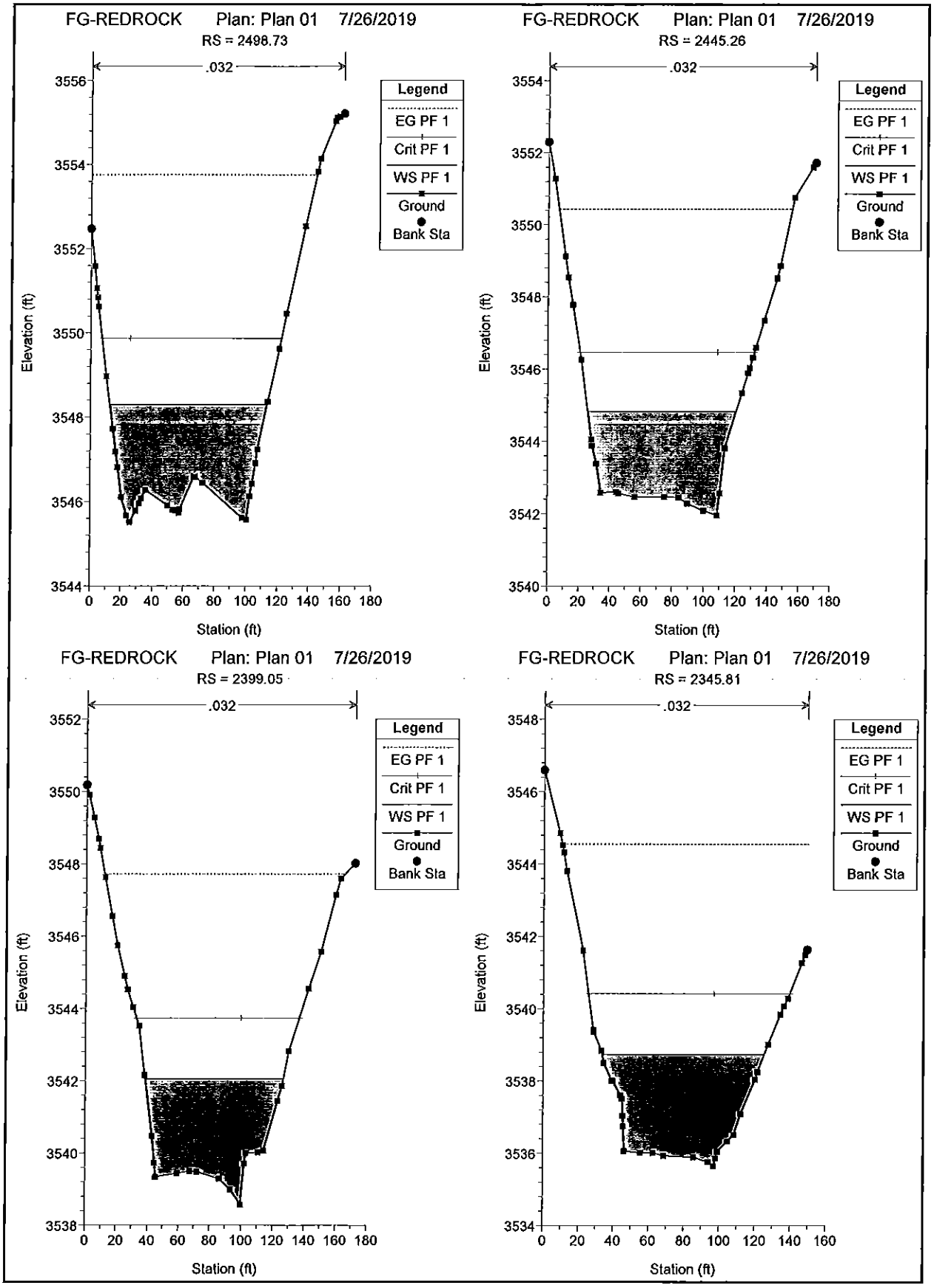
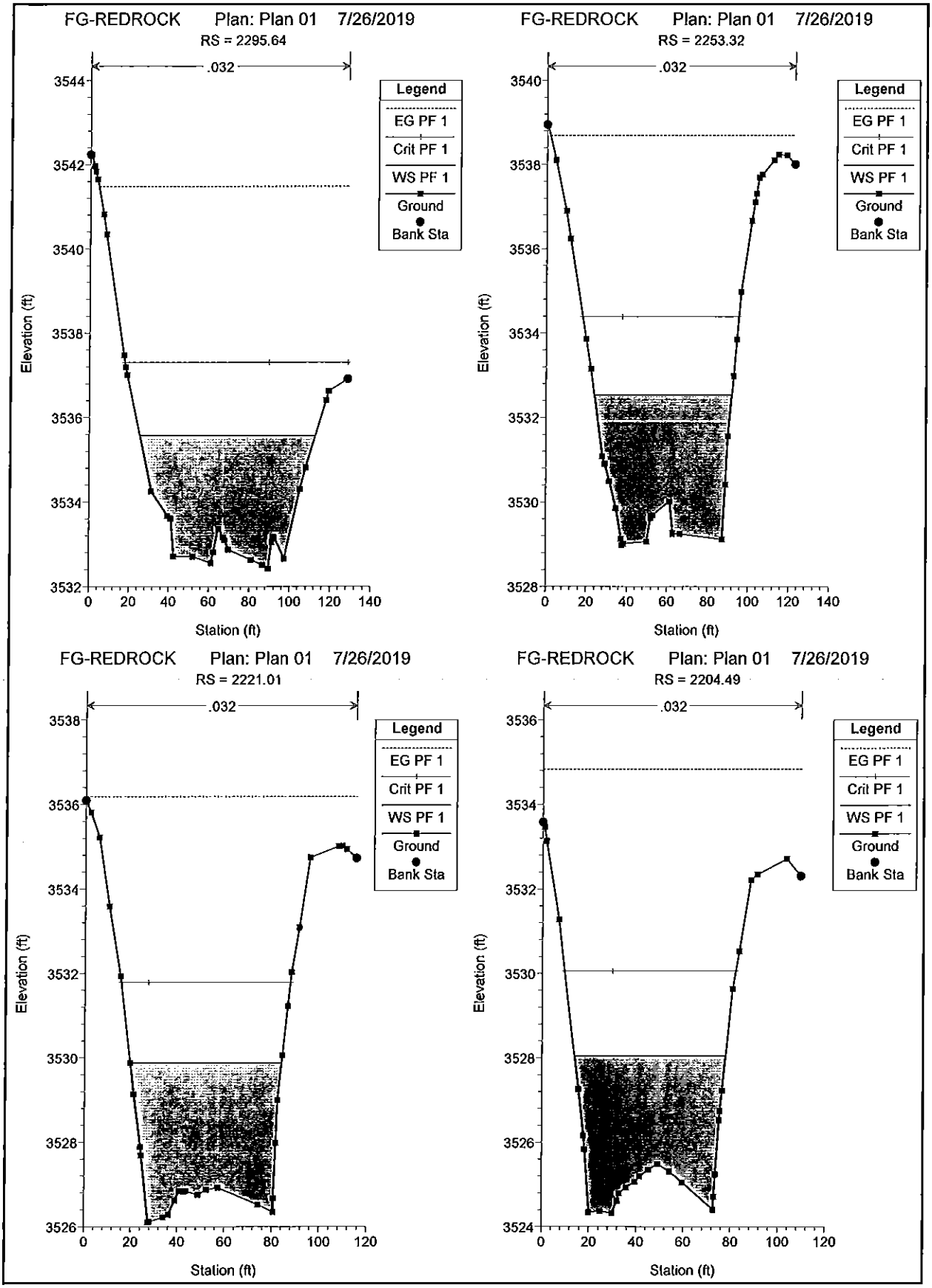
RS = 2693.56
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2645.53
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2595.89
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2547.93
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2498.73
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2445.26
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2399.05
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2345.81
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2295.64
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2253.32
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2221.01
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2204.49
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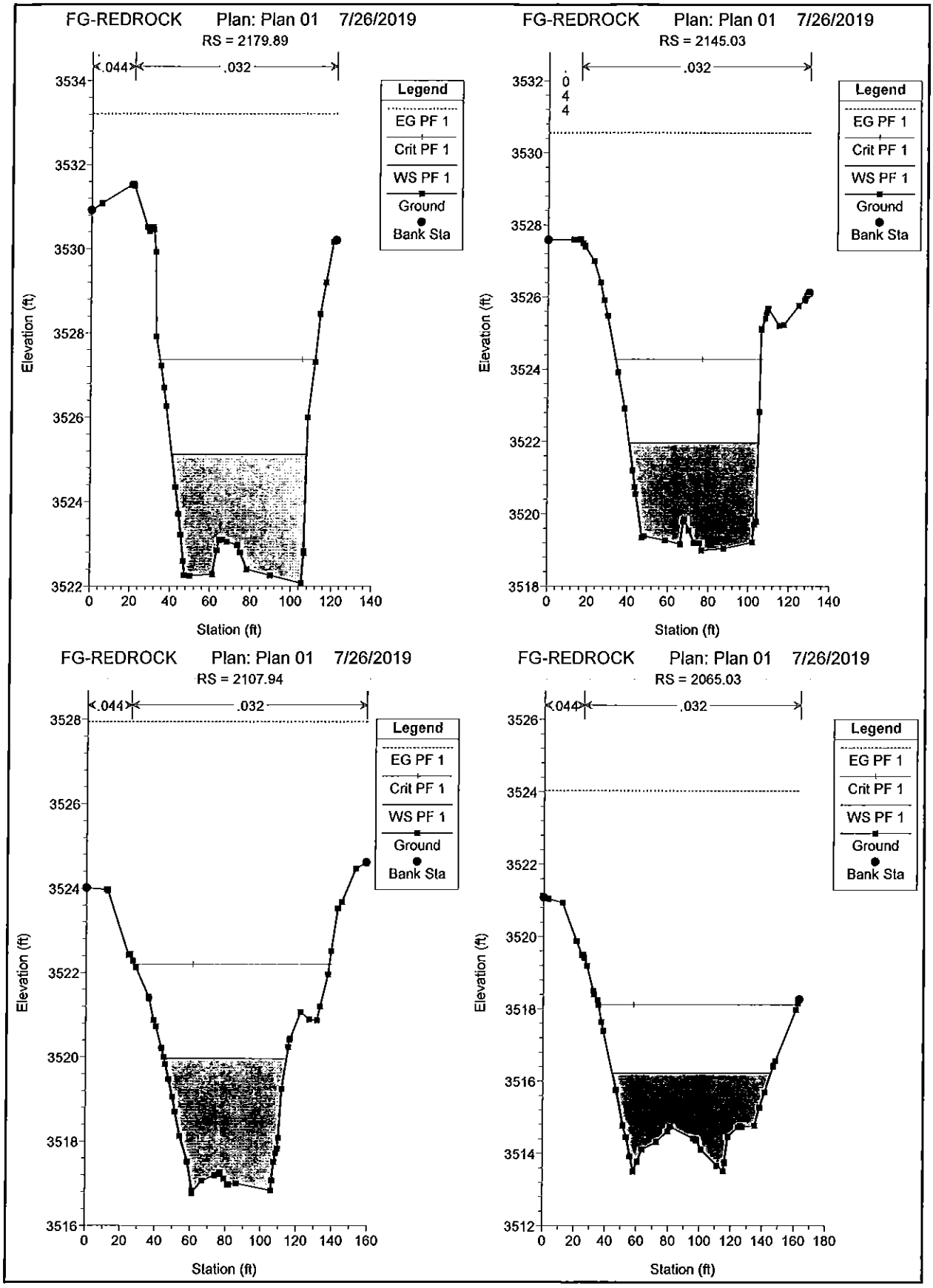
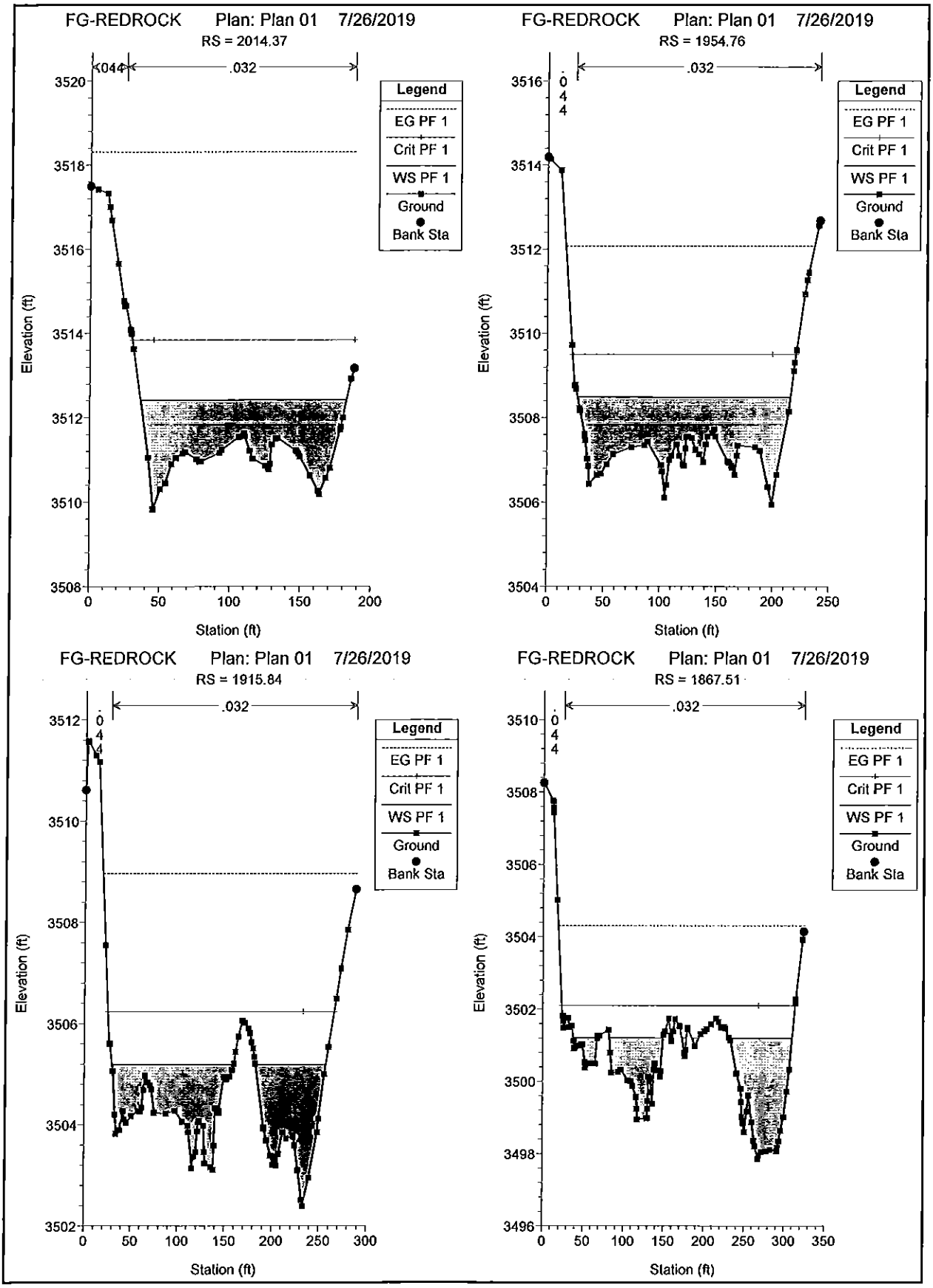
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2179.89
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2145.03
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2107.94
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2065.03
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FG-REDROCK Plan: Plan 01 7/26/2019
RS = 2014.37
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1954.76
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1915.84
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1867.51
.044
.032
Legend
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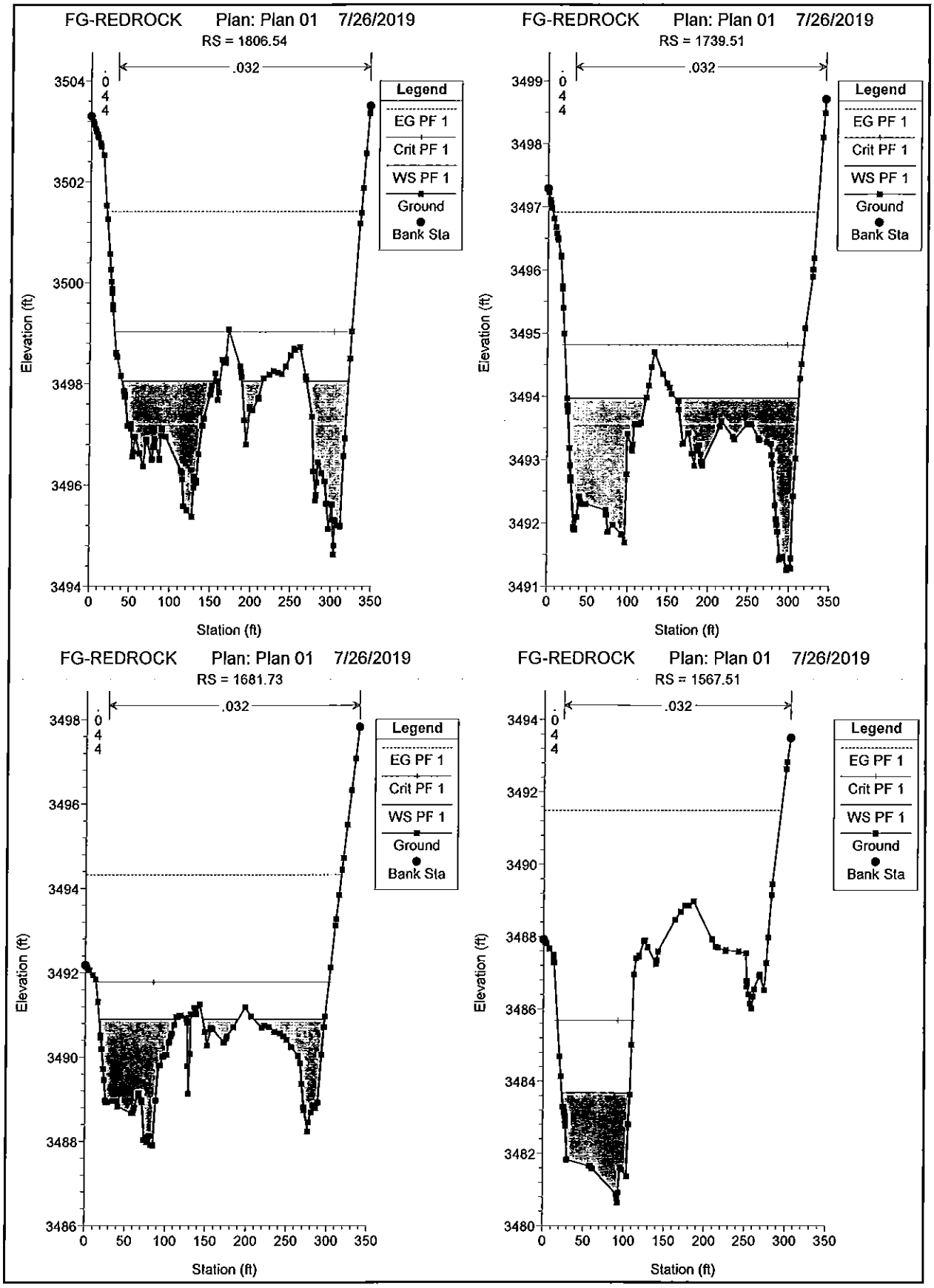
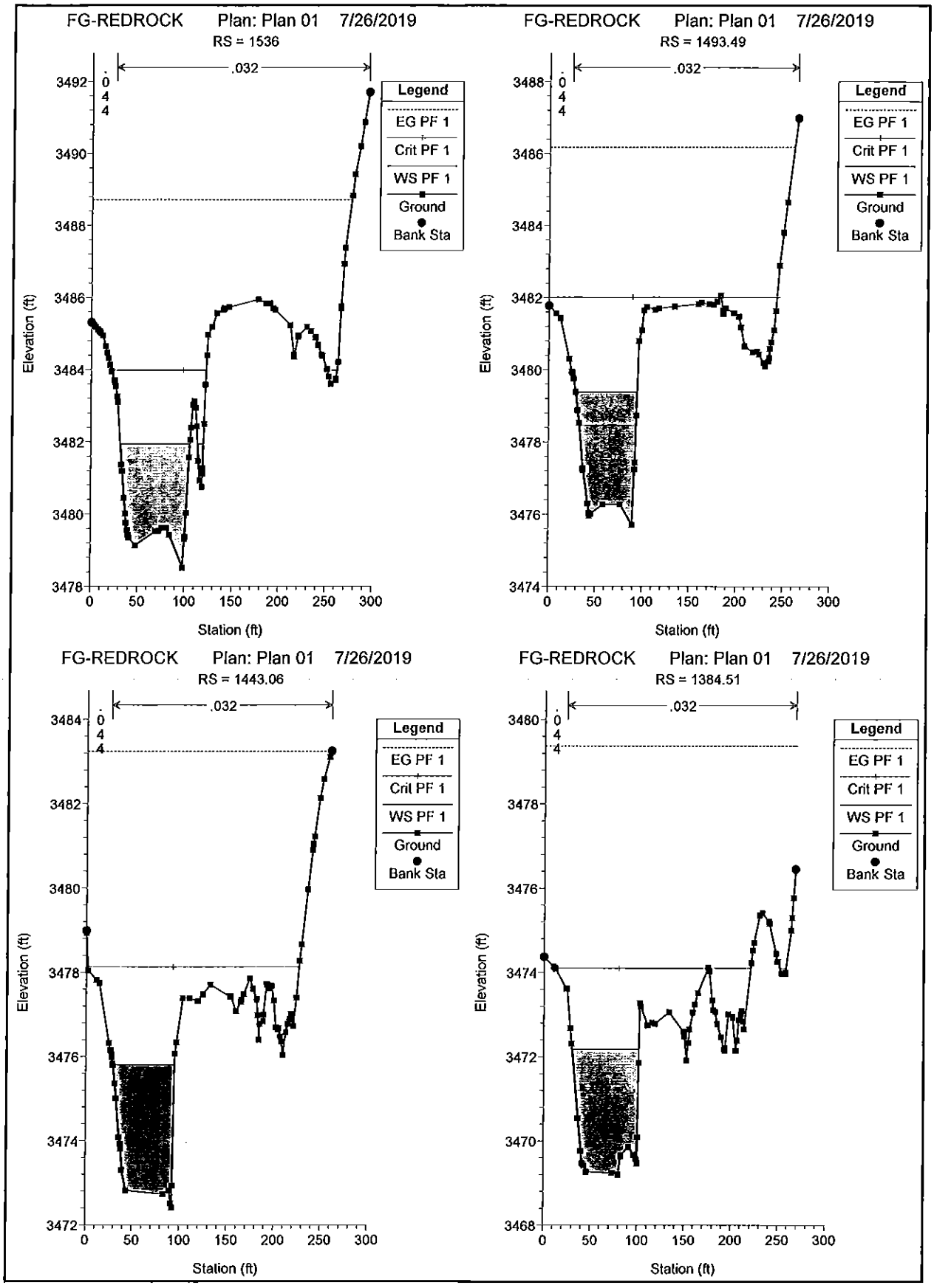
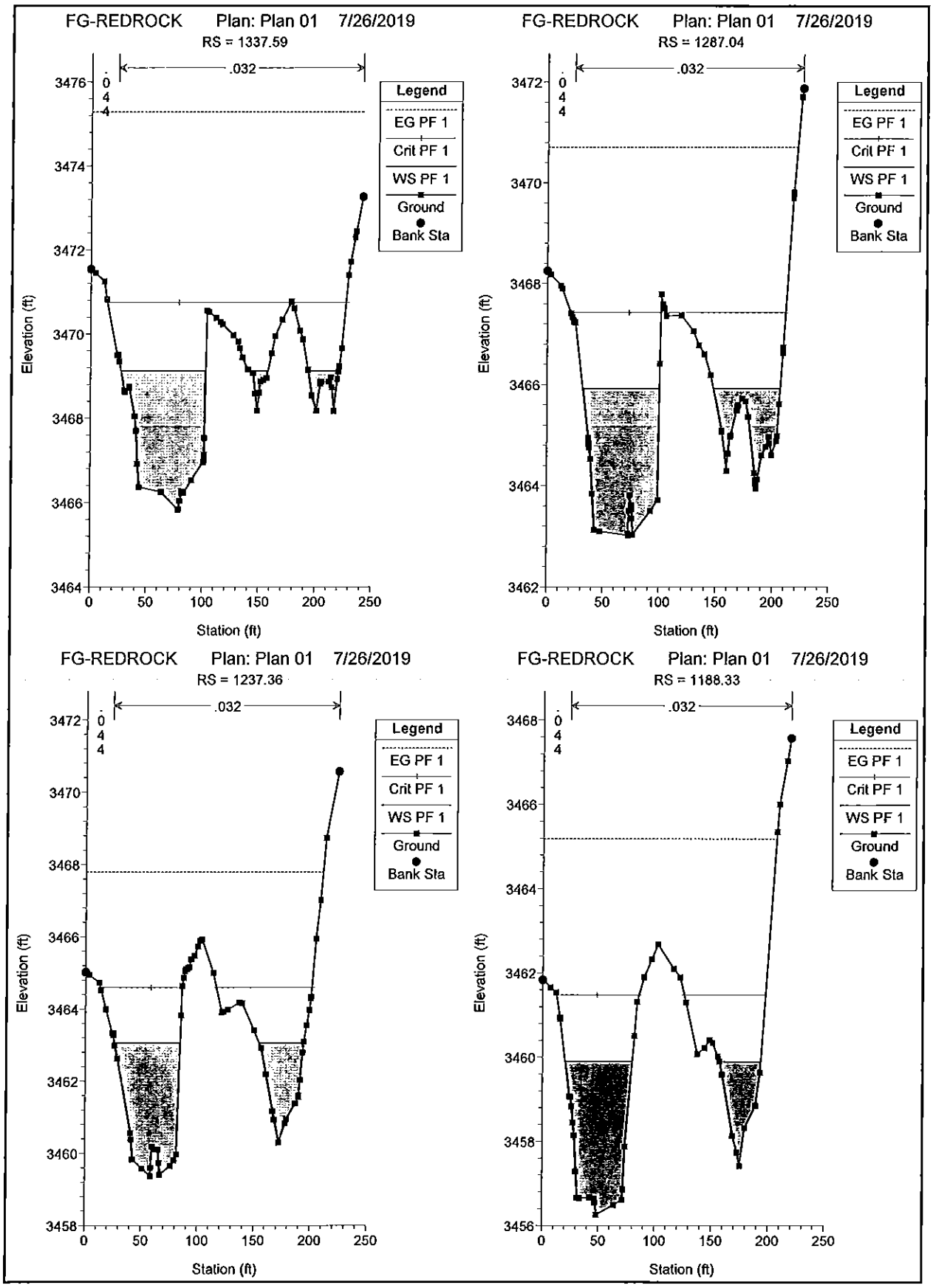
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1806.54
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1739.51
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1681.73
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1567.51
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1536
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1493.49
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1443.06
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1384.51
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1337.59
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1287.04
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1237.36
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1188.33
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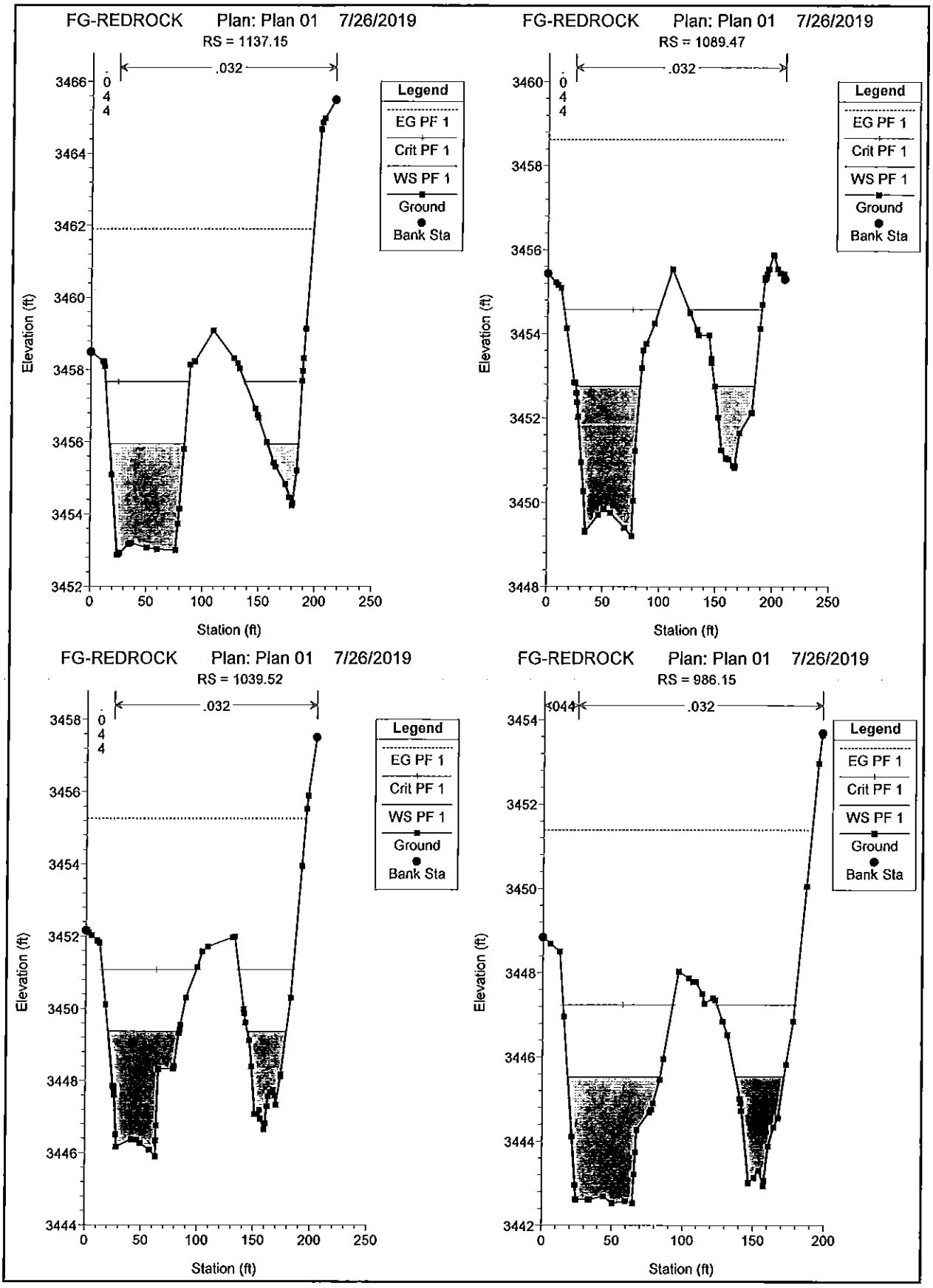
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1137.15
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1089.47
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 1039.52
.032
.044
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 986.15
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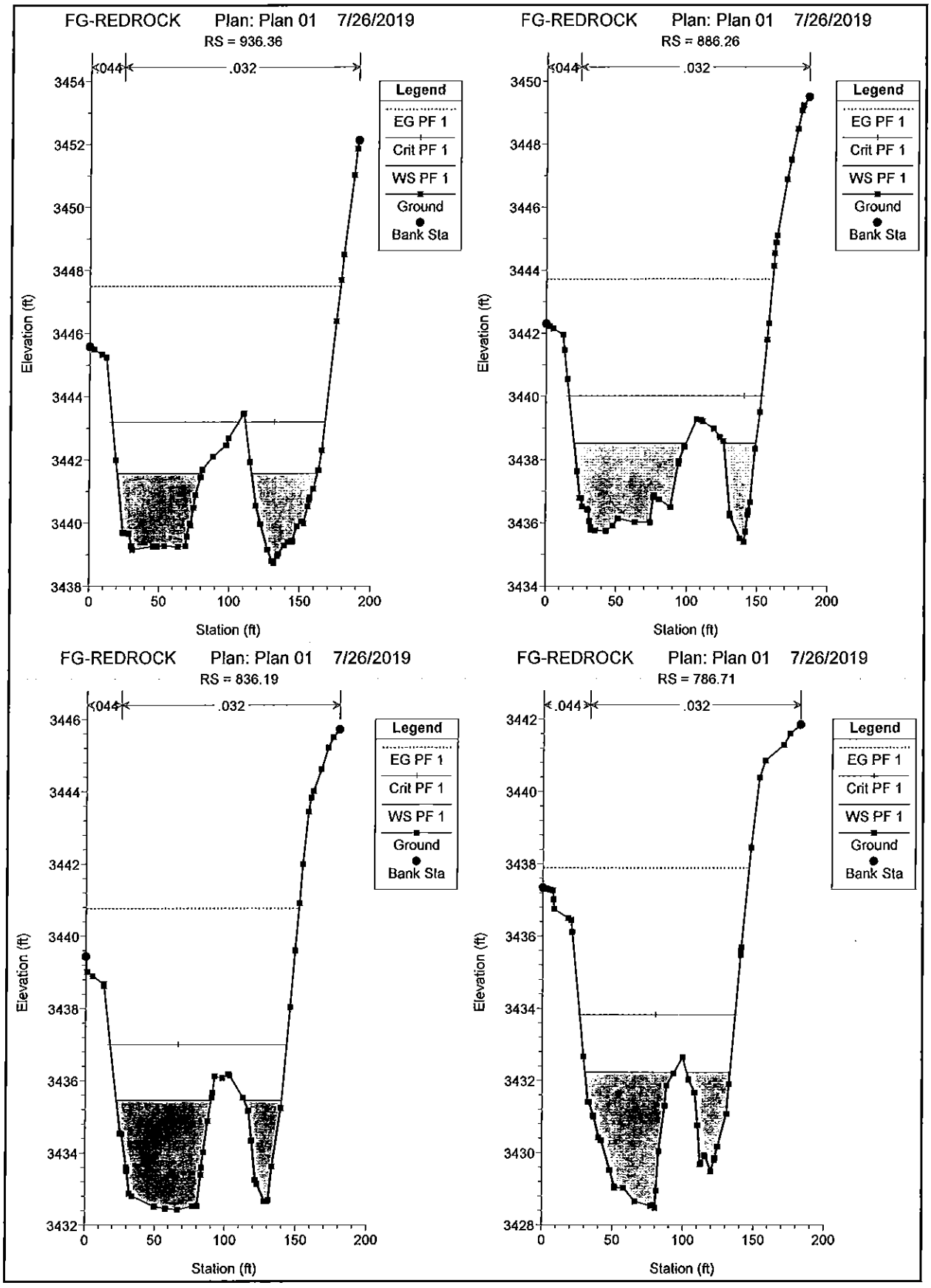
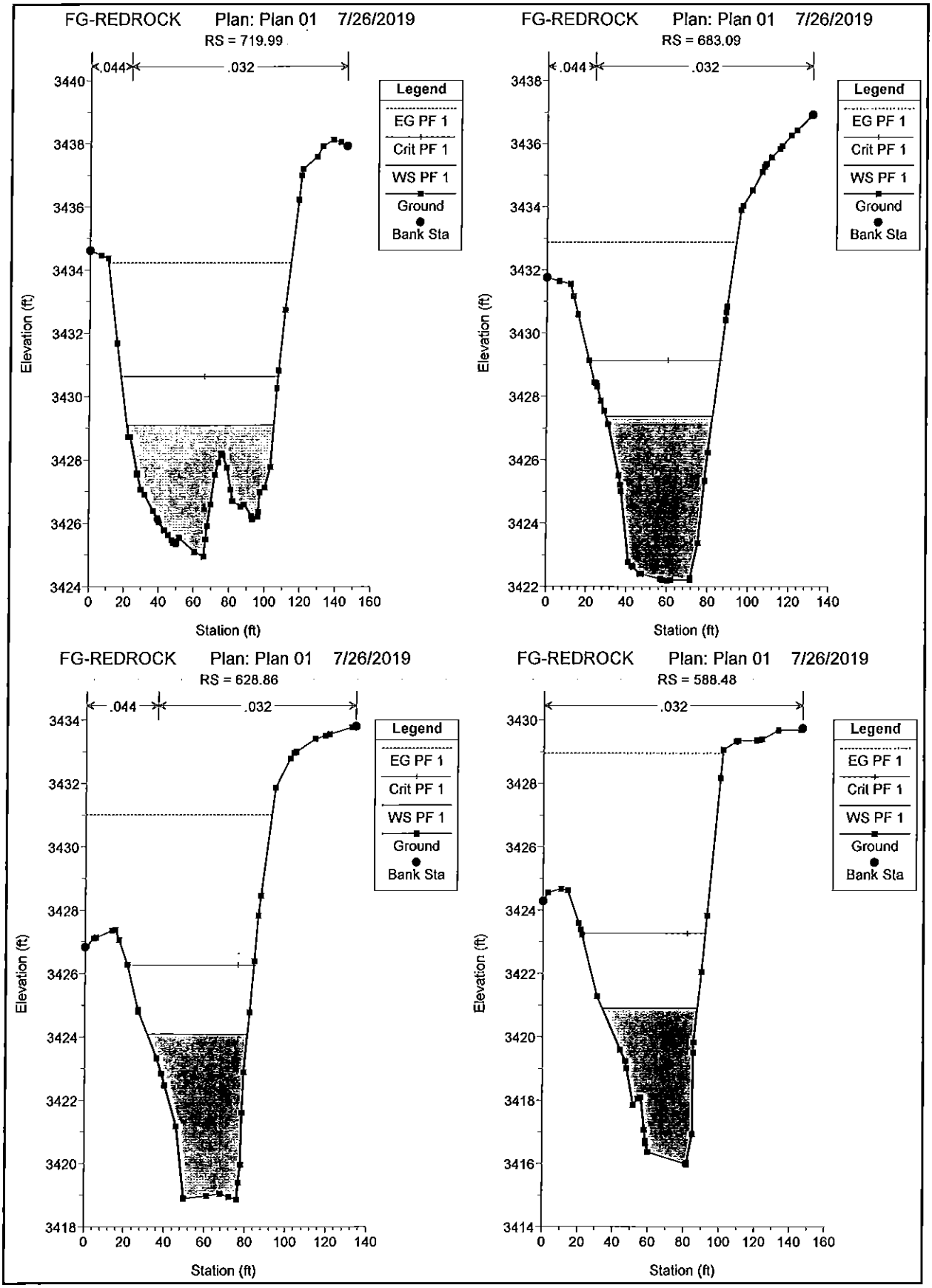
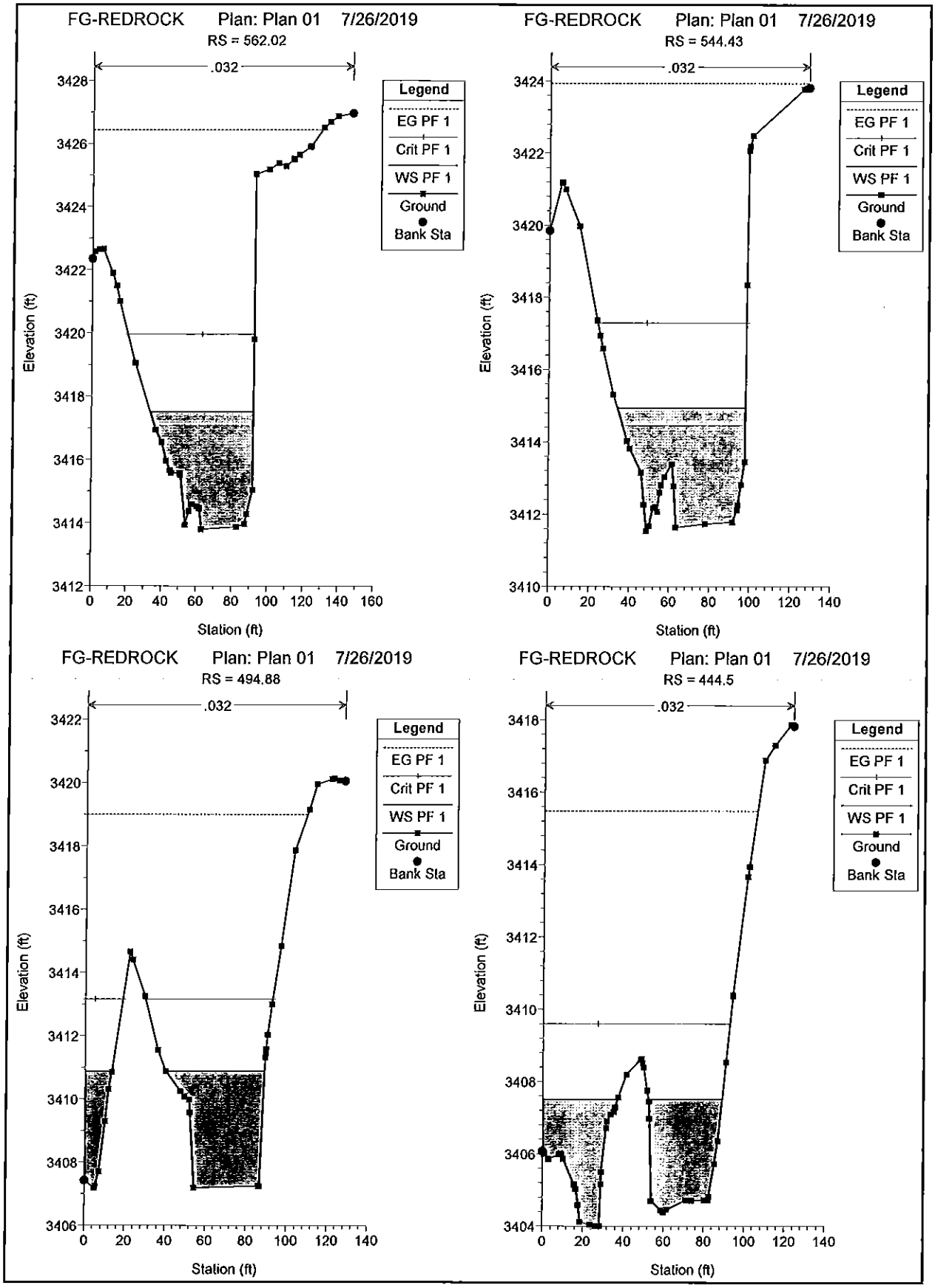
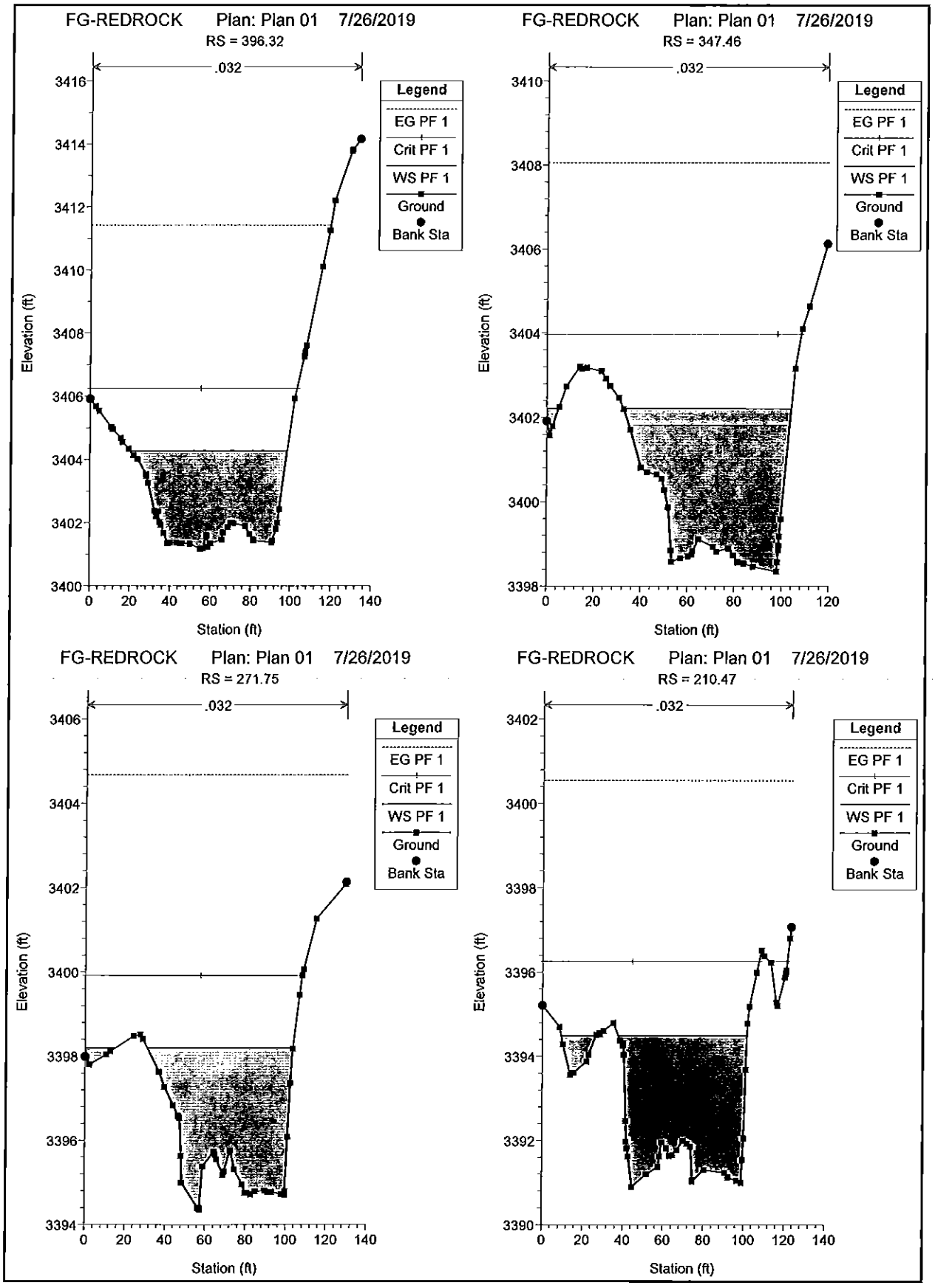
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FG-REDROCK Plan: Plan 01 7/26/2019
RS = 936.36
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 886.26
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 836.19
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 786.71
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FG-REDROCK Plan: Plan 01 7/26/2019
RS = 719.99
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 683.09
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 628.86
.044
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 588.48
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FG-REDROCK Plan: Plan 01 7/26/2019
RS = 562.02
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 544.43
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 494.88
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 444.5
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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RS = 396.32
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Legend
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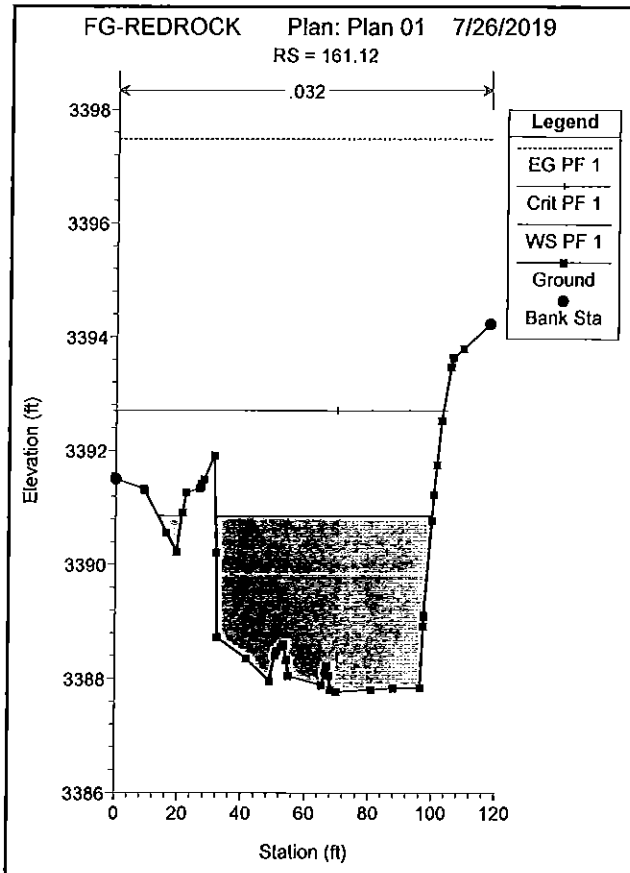
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 347.46
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 271.75
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FG-REDROCK Plan: Plan 01 7/26/2019
RS = 210.47
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FG-REDROCK Plan: Plan 01 7/26/2019
RS = 161.12
.032
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
3398
3396
3394
3392
3390
3388
3386
0
20
40
60
80
100
120

HEC-RAS Plan: Plan 01 River: redrock Reach: redrock 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) | |
| redrock | 2693.56 | PF 1 | 3877.00 | 3558.39 | 3561.36 | 3563.17 | 3567.55 | 0.067172 | 19.95 | 194.37 | 90.19 | 2.40 |
| redrock | 2645.53 | PF 1 | 3877.00 | 3555.17 | 3557.72 | 3559.47 | 3564.12 | 0.075070 | 20.30 | 191.03 | 94.25 | 2.51 |
| redrock | 2595.89 | PF 1 | 3877.00 | 3551.01 | 3554.28 | 3556.03 | 3560.50 | 0.069019 | 20.01 | 193.75 | 91.02 | 2.42 |
| redrock | 2547.93 | PF 1 | 3877.00 | 3548.22 | 3551.31 | 3552.95 | 3557.07 | 0.068207 | 19.24 | 201.46 | 99.97 | 2.39 |
| redrock | 2498.73 | PF 1 | 3877.00 | 3545.51 | 3548.29 | 3549.87 | 3553.76 | 0.063103 | 18.76 | 206.67 | 100.60 | 2.31 |
| redrock | 2445.26 | PF 1 | 3877.00 | 3541.96 | 3544.82 | 3546.46 | 3550.43 | 0.060777 | 18.99 | 204.11 | 94.77 | 2.28 |
| redrock | 2399.05 | PF 1 | 3877.00 | 3538.57 | 3542.05 | 3543.73 | 3547.72 | 0.056601 | 19.10 | 203.03 | 88.32 | 2.22 |
| redrock | 2345.81 | PF 1 | 3877.00 | 3535.65 | 3538.74 | 3540.42 | 3544.55 | 0.061905 | 19.34 | 200.45 | 91.62 | 2.31 |
| redrock | 2295.64 | PF 1 | 3877.00 | 3532.42 | 3535.56 | 3537.30 | 3541.48 | 0.059953 | 19.52 | 198.63 | 87.35 | 2.28 |
| redrock | 2253.32 | PF 1 | 3877.00 | 3528.98 | 3532.53 | 3534.39 | 3538.69 | 0.047033 | 19.91 | 194.76 | 68.14 | 2.08 |
| redrock | 2221.01 | PF 1 | 3877.00 | 3526.10 | 3529.88 | 3531.79 | 3536.18 | 0.046018 | 20.14 | 192.50 | 64.42 | 2.05 |
| redrock | 2204.49 | PF 1 | 3877.00 | 3524.32 | 3528.05 | 3530.05 | 3534.83 | 0.051571 | 20.90 | 185.53 | 64.17 | 2.17 |
| redrock | 2179.89 | PF 1 | 3877.00 | 3522.07 | 3525.12 | 3527.36 | 3533.21 | 0.073045 | 22.81 | 169.93 | 67.00 | 2.53 |
| redrock | 2145.03 | PF 1 | 3877.00 | 3518.99 | 3521.96 | 3524.28 | 3530.55 | 0.076312 | 23.52 | 164.87 | 64.05 | 2.58 |
| redrock | 2107.94 | PF 1 | 3877.00 | 3516.77 | 3519.96 | 3522.19 | 3527.94 | 0.072850 | 22.66 | 171.07 | 69.36 | 2.54 |
| redrock | 2065.03 | PF 1 | 3877.00 | 3513.50 | 3516.22 | 3518.11 | 3524.03 | 0.114566 | 22.42 | 172.94 | 100.91 | 3.02 |
| redrock | 2014.37 | PF 1 | 3877.00 | 3509.82 | 3512.42 | 3513.84 | 3518.31 | 0.117521 | 19.47 | 199.12 | 146.46 | 2.94 |
| redrock | 1954.76 | PF 1 | 3877.00 | 3505.94 | 3508.49 | 3509.50 | 3512.07 | 0.072217 | 15.18 | 255.34 | 189.16 | 2.30 |
| redrock | 1915.84 | PF 1 | 3877.00 | 3502.39 | 3505.19 | 3506.24 | 3508.97 | 0.087685 | 15.59 | 248.71 | 204.55 | 2.49 |
| redrock | 1867.51 | PF 1 | 3877.00 | 3497.85 | 3501.20 | 3502.10 | 3504.31 | 0.058572 | 14.14 | 274.18 | 191.94 | 2.09 |
| redrock | 1806.54 | PF 1 | 3877.00 | 3494.62 | 3498.05 | 3499.03 | 3501.41 | 0.068437 | 14.70 | 263.78 | 195.85 | 2.23 |
| redrock | 1739.51 | PF 1 | 3877.00 | 3491.26 | 3493.97 | 3494.81 | 3496.92 | 0.077260 | 13.77 | 281.53 | 250.81 | 2.29 |
| redrock | 1681.73 | PF 1 | 3877.00 | 3487.91 | 3490.90 | 3491.78 | 3494.32 | 0.091179 | 14.85 | 261.15 | 232.51 | 2.47 |
| redrock | 1567.51 | PF 1 | 3877.00 | 3480.64 | 3483.67 | 3485.67 | 3491.48 | 0.089813 | 22.42 | 172.93 | 84.40 | 2.76 |
| redrock | 1536 | PF 1 | 3877.00 | 3478.51 | 3481.94 | 3483.98 | 3488.71 | 0.068556 | 20.88 | 185.64 | 80.58 | 2.43 |
| redrock | 1493.49 | PF 1 | 3877.00 | 3475.70 | 3479.38 | 3482.01 | 3486.17 | 0.052554 | 20.90 | 185.52 | 65.77 | 2.19 |
| redrock | 1443.06 | PF 1 | 3877.00 | 3472.41 | 3475.81 | 3478.13 | 3483.24 | 0.061893 | 21.87 | 177.31 | 65.89 | 2.35 |
| redrock | 1384.51 | PF 1 | 3877.00 | 3469.20 | 3472.17 | 3474.10 | 3479.37 | 0.068016 | 21.53 | 180.11 | 74.03 | 2.43 |
| redrock | 1337.59 | PF 1 | 3877.00 | 3465.82 | 3469.12 | 3470.75 | 3475.28 | 0.097038 | 19.91 | 194.68 | 118.27 | 2.74 |
| redrock | 1287.04 | PF 1 | 3877.00 | 3463.02 | 3465.92 | 3467.43 | 3470.70 | 0.070685 | 17.54 | 221.04 | 127.72 | 2.35 |
| redrock | 1237.36 | PF 1 | 3877.00 | 3459.37 | 3463.05 | 3464.60 | 3467.79 | 0.049055 | 17.45 | 222.14 | 97.95 | 2.04 |
| redrock | 1188.33 | PF 1 | 3877.00 | 3456.26 | 3459.89 | 3461.48 | 3465.18 | 0.055156 | 18.44 | 210.19 | 96.27 | 2.20 |
| redrock | 1137.15 | PF 1 | 3877.00 | 3452.88 | 3455.94 | 3457.66 | 3461.90 | 0.072222 | 19.58 | 198.03 | 94.54 | 2.38 |
| redrock | 1089.47 | PF 1 | 3877.00 | 3449.20 | 3452.76 | 3454.57 | 3458.62 | 0.064615 | 19.42 | 199.60 | 92.56 | 2.33 |
| redrock | 1039.52 | PF 1 | 3877.00 | 3445.90 | 3449.36 | 3451.08 | 3455.26 | 0.069895 | 19.48 | 199.06 | 98.26 | 2.41 |
| redrock | 986.15 | PF 1 | 3877.00 | 3442.53 | 3445.53 | 3447.24 | 3451.38 | 0.075097 | 19.41 | 199.73 | 100.03 | 2.42 |
| redrock | 936.36 | PF 1 | 3877.00 | 3438.74 | 3441.56 | 3443.20 | 3447.49 | 0.081526 | 19.53 | 198.55 | 107.07 | 2.53 |
| redrock | 886.26 | PF 1 | 3877.00 | 3435.40 | 3438.52 | 3440.02 | 3443.71 | 0.062506 | 18.27 | 212.16 | 102.64 | 2.24 |
| redrock | 836.19 | PF 1 | 3877.00 | 3432.42 | 3435.45 | 3437.00 | 3440.77 | 0.054818 | 18.49 | 209.64 | 94.48 | 2.19 |
| redrock | 786.71 | PF 1 | 3877.00 | 3428.47 | 3432.22 | 3433.82 | 3437.88 | 0.060559 | 19.08 | 203.17 | 93.68 | 2.28 |
| redrock | 719.99 | PF 1 | 3877.00 | 3424.94 | 3429.09 | 3430.63 | 3434.22 | 0.046098 | 18.18 | 213.25 | 83.47 | 2.01 |
| redrock | 683.09 | PF 1 | 3877.00 | 3422.19 | 3427.36 | 3429.14 | 3432.87 | 0.028288 | 18.84 | 205.74 | 52.64 | 1.68 |
| redrock | 628.86 | PF 1 | 3877.00 | 3418.86 | 3424.08 | 3426.27 | 3431.01 | 0.036060 | 21.10 | 183.71 | 49.78 | 1.94 |
| redrock | 588.48 | PF 1 | 3877.00 | 3415.97 | 3420.90 | 3423.26 | 3428.94 | 0.056255 | 22.75 | 170.43 | 53.81 | 2.25 |
| redrock | 562.02 | PF 1 | 3877.00 | 3413.79 | 3417.50 | 3419.96 | 3426.43 | 0.073792 | 23.97 | 161.75 | 58.54 | 2.54 |
| redrock | 544.43 | PF 1 | 3877.00 | 3411.54 | 3414.94 | 3417.29 | 3423.93 | 0.083422 | 24.06 | 161.13 | 64.00 | 2.67 |
| redrock | 494.88 | PF 1 | 3877.00 | 3407.18 | 3410.87 | 3413.16 | 3418.99 | 0.074522 | 22.86 | 169.61 | 62.43 | 2.44 |
| redrock | 444.5 | PF 1 | 3877.00 | 3404.00 | 3407.50 | 3409.60 | 3415.48 | 0.084900 | 22.65 | 171.14 | 73.69 | 2.62 |
| redrock | 396.32 | PF 1 | 3877.00 | 3401.17 | 3404.27 | 3406.25 | 3411.42 | 0.071255 | 21.44 | 180.79 | 78.27 | 2.49 |
| redrock | 347.46 | PF 1 | 3877.00 | 3398.35 | 3402.21 | 3403.98 | 3408.06 | 0.050586 | 19.39 | 199.92 | 76.71 | 2.12 |
| redrock | 271.75 | PF 1 | 3877.00 | 3394.36 | 3398.19 | 3399.92 | 3404.67 | 0.071912 | 20.42 | 189.88 | 87.50 | 2.44 |
| redrock | 210.47 | PF 1 | 3877.00 | 3390.90 | 3394.49 | 3396.25 | 3400.55 | 0.059412 | 19.74 | 196.39 | 81.39 | 2.24 |
| redrock | 161.12 | PF 1 | 3877.00 | 3387.77 | 3390.85 | 3392.70 | 3397.48 | 0.062570 | 20.66 | 187.66 | 75.99 | 2.32 |

DEVELOPED
HEC RAS

# Culvert Calculator Report
## 48-inch RCP

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 44.51 | ft | Headwater Depth/Height | 1.28 | |
| Computed Headwater Elev | 43.63 | ft | Discharge | 106.00 | cfs |
| Inlet Control HW Elev. | 43.51 | ft | Tailwater Elevation | 42.00 | ft |
| Outlet Control HW Elev. | 43.63 | ft | Control Type | Outlet Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 38.51 | ft | Downstream Invert | 38.21 | ft |
| Length | 51.94 | ft | Constructed Slope | 0.005776 | ft/ft |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | M1 | | Depth, Downstream | 3.79 | ft |
| Slope Type | Mild | | Normal Depth | 3.18 | ft |
| Flow Regime | Subcritical | | Critical Depth | 3.12 | ft |
| Velocity Downstream | 8.61 | ft/s | Critical Slope | 0.006017 | ft/ft |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 4.00 | ft |
| Section Size | 48 inch | | Rise | 4.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 43.63 | ft | Upstream Velocity Head | 1.18 | ft |
| Ke | 0.20 | | Entrance Loss | 0.24 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 43.51 | ft | Flow Control | Submerged | |
| Inlet Type | Groove end projecting | | Area Full | 12.6 | ft² |
| K | 0.00450 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 3 | |
| C | 0.03170 | | Equation Form | 1 | |
| Y | 0.69000 | | | | |

# Storm Drain Hydraulics Calculations

SUMMERLIN VILLAGE 24 PARCELS FGH INLETS 3-9 DATE: 07/25/19

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 | | | | | | | | | $S_f$ | $H_f$ | $H_f$ | Θ | $K_{mh}$ | $H_{mh}$ | Θ | $K_j$ | $H_j$ | Inlet/ | $K_i$ | $H_c$ | Θ | $K_e$ | $H_o$ | $R_{bend}$ | 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) | (%) | ($ft^2$) | | (cfs) | (ft/s) | (ft) | (ft/ft) | (ft/ft) | (ft) | (ft) | (deg) | | (ft) | (deg) | | (ft) | Cont | | (ft) | (deg) | | (ft) | (ft) | (deg) | | (ft) | (ft) | (ft) | EGL | HGL | EGL | HGL | FLOW | |
| | 100.00 | | 30 | | | | | | 3459.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Outlet $K_e$= | 1.0 | | | | | | | | | | | | |
| 100.00 | 135.95 | R | 30 | | | | | 1 | 3459.00 | 36.0 | 1.30% | 4.91 | 0.0049 | 28.0 | 5.70 | 0.51 | 0.0046 | 0.0046 | 0.17 | | | | | | | | | | | | | | | | | | 0.00 | 3462.47 | 3461.97 | | | FULL | D/S |
| 135.95 | 140.98 | T | 30 | | | | | 1 | 3459.47 | 5.0 | 2.03% | 4.91 | 0.0049 | 28.0 | 5.70 | 0.51 | 0.0046 | 0.0046 | | 0.02 | 23 | 0.11 | 0.06 | | | | | | | | | | | | | | 0.08 | | | 3462.58 | 3462.07 | FULL | D/S |
| 140.98 | 300.26 | R | 30 | | | | | 1 | 3459.57 | 159.3 | 3.79% | 4.91 | 0.0049 | 28.0 | 5.70 | 0.51 | 0.0046 | 0.0046 | 0.74 | | | | | | | | | | | | | | | | | | 0.00 | 3468.61 | 3468.10 | | | PART | D/S |
| 300.26 | 305.26 | T | 30 | | | | | 1 | 3465.60 | 5.0 | 3.00% | 4.91 | 0.0049 | 28.0 | 5.70 | 0.51 | 0.0046 | 0.0046 | | 0.02 | 87 | 1.33 | 0.67 | | | | | | | | | | | | | | 0.70 | | | 3469.30 | 3468.80 | FULL | U/S |
| 305.26 | 430.42 | R | 30 | | | | | 1 | 3465.75 | 125.2 | 0.60% | 4.91 | 0.0049 | 28.0 | 5.70 | 0.51 | 0.0046 | 0.0046 | 0.58 | | | | | | | | | | | | | | | | | | 0.00 | 3469.88 | 3469.38 | | | FULL | U/S |

## *Summary of Results*

| | | | | | (Optional) | | | HGL with respect | Pressure Gasket |
|---|---|---|---|---|---|---|---|---|---|
| STATION | INVERT | SOFFIT | EGL | HGL | GRADE | LOCATION | DESCRIPTION | to FG | Required? |
| 100.00 | 3459.00 | 3461.50 | 3462.01 | 3461.50 | 3461.50 | OUTLET | TOP OF PIPE | HGL<1ft below FG | NO |
| 135.95 | 3459.47 | 3461.97 | 3462.47 | 3461.97 | 3465.20 | | | OK | NO |
| 140.98 | 3459.57 | 3462.07 | 3462.58 | 3462.07 | 3465.20 | SDMH5 | TMH | OK | NO |
| 300.26 | 3465.60 | 3468.10 | 3468.61 | 3468.10 | 3474.40 | | | OK | NO |
| 305.26 | 3465.75 | 3468.25 | 3469.30 | 3468.80 | 3474.40 | SDMH 4 | TMH | OK | NO |
| 430.42 | 3466.50 | 3469.00 | 3469.88 | 3469.38 | 3472.40 | INLET | ROUGH GRADE | OK | NO |
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# Storm Drain Hydraulics Calculations

SUMMERLIN VILLAGE 24 PARCELS FGH DROP INLETS 1 AND 2 DATE: 07/23/19

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 | | | | | | | | | $S_f$ | $H_f$ | $H_t$ | 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) | (ft/ft) | (ft) | (ft) | (deg) | | (ft) | (deg) | | (ft) | Cont | | (ft) | (deg) | | (ft) | (ft) | (deg) | | (ft) | (ft) | (ft) | (ft) | EGL | HGL | EGL | HGL | FLOW | |
| | 100.00 | | 24 | | | | | | | 17.67 | | | | | | | | | | | | | | | | | | | | Outlet $K_o$= | 1.0 | | | | | | | | | 20.27 | 19.67 | | |
| 100.00 | 173.06 | R | 24 | | | | | 1 | 17.87 | 18.31 | 73.1 | 0.60% | 3.14 | 0.0049 | 16.0 | 5.09 | 0.40 | 0.0050 | 0.0050 | 0.36 | | | | | | | | | | | | | | | | | | 0.00 | 20.71 | 20.31 | | | FULL | D/S |
| 173.06 | 178.06 | T | 24 | | | | | 1 | 18.31 | 18.33 | 5.0 | 0.40% | 3.14 | 0.0049 | 16.0 | 5.09 | 0.40 | 0.0050 | 0.0050 | | 0.02 | 77 | 1.06 | 0.43 | | | | | | | | | | | | | | 0.45 | | | 21.16 | 20.76 | FULL | U/S |
| 178.06 | 338.65 | R | 24 | | | | | 1 | 18.33 | 19.30 | 160.6 | 0.60% | 3.14 | 0.0049 | 16.0 | 5.09 | 0.40 | 0.0050 | 0.0050 | 0.80 | | | | | | | | | | | | | | | | | | 0.00 | 21.97 | 21.56 | | | FULL | U/S |

## *Summary of Results*

| | | | | | (Optional) | | | HGL with respect | Pressure Gasket |
|---|---|---|---|---|---|---|---|---|---|
| STATION | INVERT | SOFFIT | EGL | HGL | GRADE | LOCATION | DESCRIPTION | to FG | Required? |
| 100.00 | 17.87 | 19.87 | 20.27 | 19.87 | 19.87 | OUTLET | TOP OF PIPE | HGL<1ft below FG | NO |
| 173.06 | 18.31 | 20.31 | 20.71 | 20.31 | 28.60 | | | OK | NO |
| 178.06 | 18.33 | 20.33 | 21.16 | 20.76 | 28.60 | SDMH #1 | TMH | OK | NO |
| 338.65 | 19.30 | 21.30 | 21.97 | 21.56 | 22.00 | INLET | INLET | HGL<1ft below FG | NO |
| | | | | | | | | | |
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DEVELOPED CONDITIONS HEC RAS STATION 21+45.03 to 26+93.56

## Anti-Dune Trough Depth Za

| Station (ft) | Vavg (ft/s) | Za[1/] (ft) | Y (ft) | 1/2*Y (ft) | Za[1/] check |
|---|---|---|---|---|---|
| 22+04.43 | 20.93 | 6.0 | 3.7 | 1.9 | 1.9 |

Note:

Za can not exceed 1/2 the depth of flow

1/ Eqn. 708, Section 704.2.1.3, Clark County Hydrologic Drainage Design Manual, August 12, 1999.

2/ Hydraulic input data from Hecras results.

## Long-term Aggradation/degradation Analysis

| | | | Hydraulic ( 100-year flow = 3877 cfs) | | | | | | | | Sediment Transport Rate | | Headcut |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Developed | | Station (ft) | Manning's n | Aavg ($ft^2$) | Tavg (ft) | Yavg (ft) | Vavg (ft/s) | Yh (ft) | $S_{actual}$ (ft/ft) | $S_{equilibrium}$ [3/] (ft/ft) | qs[2/] (cfs/ft) | Qs (cfs) | $Z_{LT}$ * (ft) |
| | HecRas | 22+04.49 | 0.032 | 185.53 | 64.17 | 3.73 | 20.9 | 2.89 | 0.0606 | 0.0495 | 2.870 | 184.18 | -5.43 |

Notes:

*(+)=aggradation, (-)=degradation

1/ Hydraulic input data from Hecras results.

2/ Eqn. 704, Section 704.2.1.2, Clark County Hydrologic Drainage Design Manual, August 12, 1999.

From Table 704:

C1 = 0.0000214 d50=0.4748

C2 = 0.837

C3 = 3.59

3/ Eqn. 707, Section 704.2.1.2, Clark County Hydrologic Drainage Design Manual, August 12, 1999.

5.4
1.9
7.3

CALCS

SCOUR

DEVELOPED CONDITIONS HEC RAS STATION 6+28.86 to 7+19.99

## Anti-Dune Trough Depth Za

| Station (ft) | Vavg (ft/s) | Za[1/] (ft) | Y (ft) | 1/2*Y (ft) | Za[1/] check |
|---|---|---|---|---|---|
| 6+28.86 | 21.12 | 6.1 | 5.2 | 2.6 | 2.6 |

Note:

Za can not exceed 1/2 the depth of flow

1/ Eqn. 708, Section 704.2.1.3, Clark County Hydrologic Drainage Design Manual, August 12, 1999.

2/ Hydraulic input data from Hecras results.

## Long-term Aggradation/degradation Analysis

| Developed | | Station (ft) | Hydraulic (100-year flow = 3877 cfs) Manning's n | Aavg ($ft^2$) | Tavg (ft) | Yavg (ft) | Vavg (ft/s) | Yh (ft) | $S_{actual}$ (ft/ft) | $S_{equilibrium}$[3/] (ft/ft) | Sediment Transport Rate qs[2/] (cfs/ft) | Qs (cfs) | Headcut $Z_{LT}$ * (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HecRas | 6+28.86 | 0.032 | 183.71 | 50 | 5.2 | 21.1 | 3.67 | 0.0641 | 0.0364 | 3.611 | 180.55 | -11.36 |

Notes:

1/ Hydraulic input data from Hecras results.

2/ Eqn. 704, Section 704.2.1.2, Clark County Hydrologic Drainage Design Manual, August 12, 1999.

From Table 704:

C1 = 0.0000214 D50=0.1779

C2 = 0.837

C3 = 3.59

3/ Eqn. 707, Section 704.2.1.2, Clark County Hydrologic Drainage Design Manual, August 12, 1999.

*(+)=aggradation,
(-)=degradation

2.6
+11.4
14'

CALCS

SCOUR

DEVELOPED CONDITIONS HEC RAS STATION 7+19.99 to 15+67.51

**Anti-Dune Trough Depth Za**

| Station (ft) | Vavg (ft/s) | Za[1/] (ft) | Y (ft) | 1/2*Y (ft) | Za[1/] check |
|---|---|---|---|---|---|
| 11+88.33 | 18.44 | 4.7 | 3.6 | 1.8 | 1.8 |

Note:

Za can not exceed 1/2 the depth of flow

1/ Eqn. 708, Section 704.2.1.3, Clark County Hydrologic Drainage Design Manual, August 12, 1999.

2/ Hydraulic input data from Hecras results.

**Long-term Aggradation/degradation Analysis**

| Developed | | Station (ft) | Hydraulic ( 100-year flow = 3877 cfs) Manning's n | Aavg ($ft^2$) | Tavg (ft) | Yavg (ft) | Vavg (ft/s) | Yh (ft) | $S_{actual}$ (ft/ft) | $S_{equilibrium}$[3/] (ft/ft) | Sediment Transport Rate $qs^{2/}$ (cfs/ft) | Qs (cfs) | Headcut $Z_{LT}$ * (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HecRas | 11+88.33 | 0.032 | 210.19 | 96.27 | 3.63 | 18.5 | 2.18 | 0.0565 | 0.0559 | 1.446 | 139.16 | -0.42 |

Notes:

1/ Hydraulic input data from Hecras results.

2/ Eqn. 704, Section 704.2.1.2, Clark County Hydrologic Drainage Design Manual, August 12, 1999.

From Table 704:

C1 = 0.0000214 D50=0.1779

C2 = 0.837

C3 = 3.59

3/ Eqn. 707, Section 704.2.1.2, Clark County Hydrologic Drainage Design Manual, August 12, 1999.

*(+)=aggradation, (-)=degradation

1.8
+6.4

2.2

CALCS

SCOUR

DEVELOPED CONDITIONS HEC RAS STATION 15+67.51 to 21+45.03

## Bend Scour Zbs

| Station (ft) | Manning's n | rc (ft) | T (ft) | rc/T (ft/ft) | Vavg (ft/s) | Ymax (ft) | A ($ft^2$) | Yh (ft) | Se (ft/ft) | α (deg) | Zbs 1/,2/ (ft) | X 3/ (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19+54.76 | 0.032 | 350 | 189.16 | 1.85 | 15.18 | 2.6 | 255 | 1.3 | 0.0683 | 26 | 0.6 | 56 |

Notes:
If rc/T is greater than 10 or Alpha is less than 17.8 degrees Zbs = 0
1/ Eqn. 709, Section 704.2.1.4, Clark County Hydrologic Drainage Design Manual, August 12, 1999.
2/ Eqn. 5.25, Arizona Department of Water Resources Design Manual for Engineering Analysis of Fluvial Systems, 1985.
3/ Eqn. 711, Section 704.2.1.4, Clark County Hydrologic Drainage Design Manual, August 12, 1999.
4/ Hydraulic input data from Hecras results.

## Anti-Dune Trough Depth Za

| Station (ft) | Vavg (ft/s) | Za 1/ (ft) | Y (ft) | 1/2*Y (ft) | Za 1/ check |
|---|---|---|---|---|---|
| 19+54.76 | 15.18 | 3.2 | 2.6 | 1.3 | 1.3 |

Note:
Za can not exceed 1/2 the depth of flow
1/ Eqn. 708, Section 704.2.1.3, Clark County Hydrologic Drainage Design Manual, August 12, 1999.
2/ Hydraulic input data from Hecras results.

## Long-term Aggradation/degradation Analysis

| Developed | | Station (ft) | Hydraulic Manning's n | ( 100-year flow = 3877 cfs) Aavg ($ft^2$) | Tavg (ft) | Yavg (ft) | Vavg (ft/s) | Yh (ft) | $S_{actual}$ (ft/ft) | $S_{equilibrium}$ 3/ (ft/ft) | Sediment Transport Rate qs 2/ (cfs/ft) | Qs (cfs) | Headcut $Z_{LT}$ * (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HecRas | 19+54.76 | 0.032 | 255.34 | 189.16 | 2.55 | 15.2 | 1.35 | 0.0758 | 0.0724 | 0.483 | 91.45 | -1.58 |

*(+)=aggradation,
(-)=degradation

Notes:
1/ Hydraulic input data from Hecras results.
2/ Eqn. 704, Section 704.2.1.2, Clark County Hydrologic Drainage Design Manual, August 12, 1999.
From Table 704:
C1 = 0.0000214 D50=0.1779
C2 = 0.837
C3 = 3.59
3/ Eqn. 707, Section 704.2.1.2, Clark County Hydrologic Drainage Design Manual, August 12, 1999.

1.6
6.6
+1.3
3.5

SCOUR CALCS

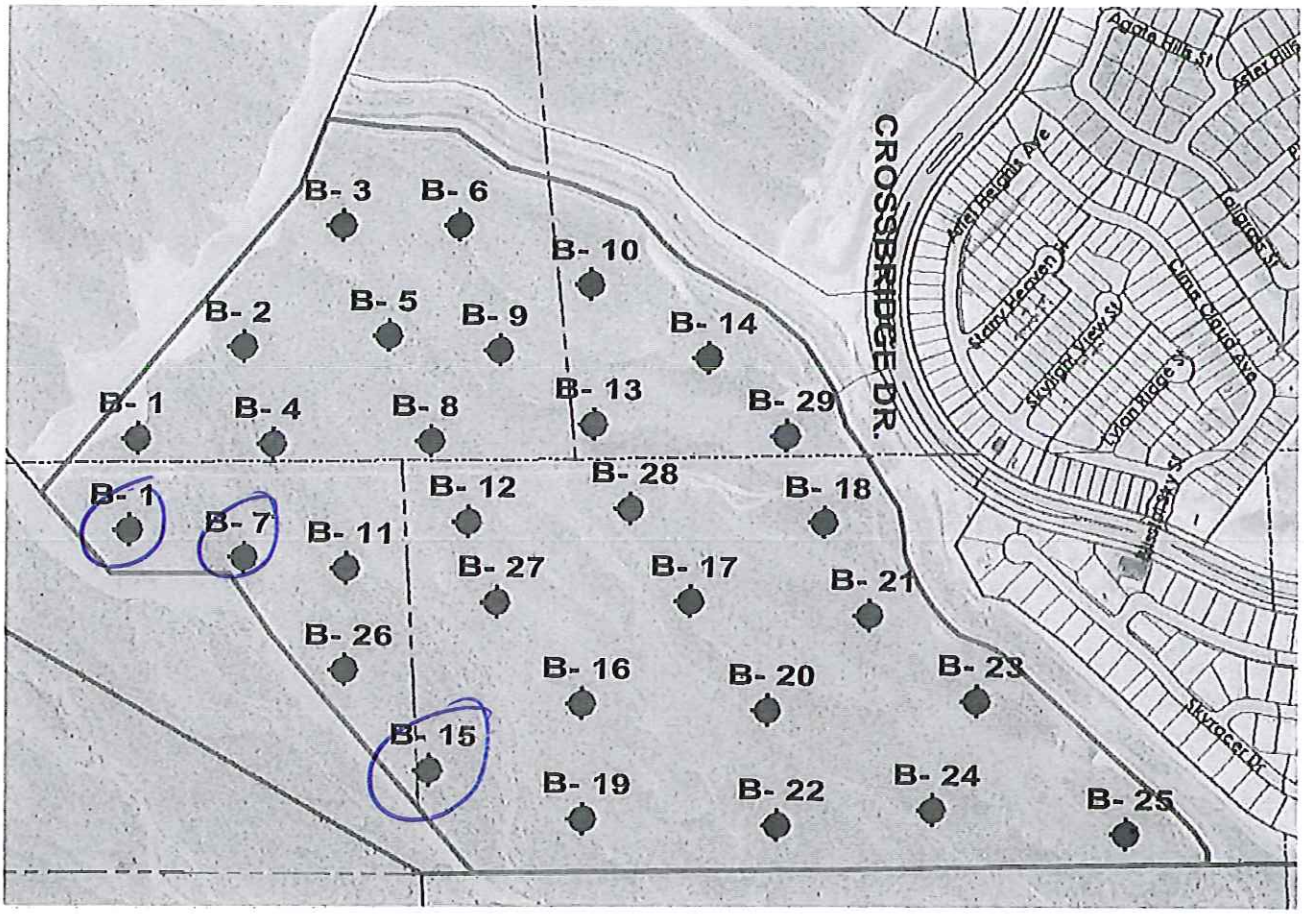
ACCESS CONSULTING
ENGINEERS
3255 Pepper Lane, Suite 107, Las Vegas, NV 89120
Phone: 702-987-5153 Fax: 702-207-5034
www.AccessConsultingEngineers.com

# GEOTECHNICAL EXPLORATION REPORT
# SUMMERLIN VILLAGE 24 – PARCEL "FGH"
# A PROPOSED 103 (±) ACRES
# SINGLE FAMILY RESIDENTIAL SUBDIVISION
# ONE VACANT PARCEL (APN 164-04-511-001)
# NORTHWEST OF CHARLESTON BLVD. & SKY VISTA DR.
# WEST OF CROSSBRIDGE DR. AT SUMMERLIN
# STONEBRIDGE VILLAGE
# LAS VEGAS, NEVADA

**Prepared for:**

**Mr. Robert Flaxa**
**Lennar Corporation**
**9275 West Russell Road, Suite 400**
**Las Vegas, Nevada 89148**

**Project No.: 19-148**
**April 20, 2019**




USE B-15
SINCE IT IS IN A WASH

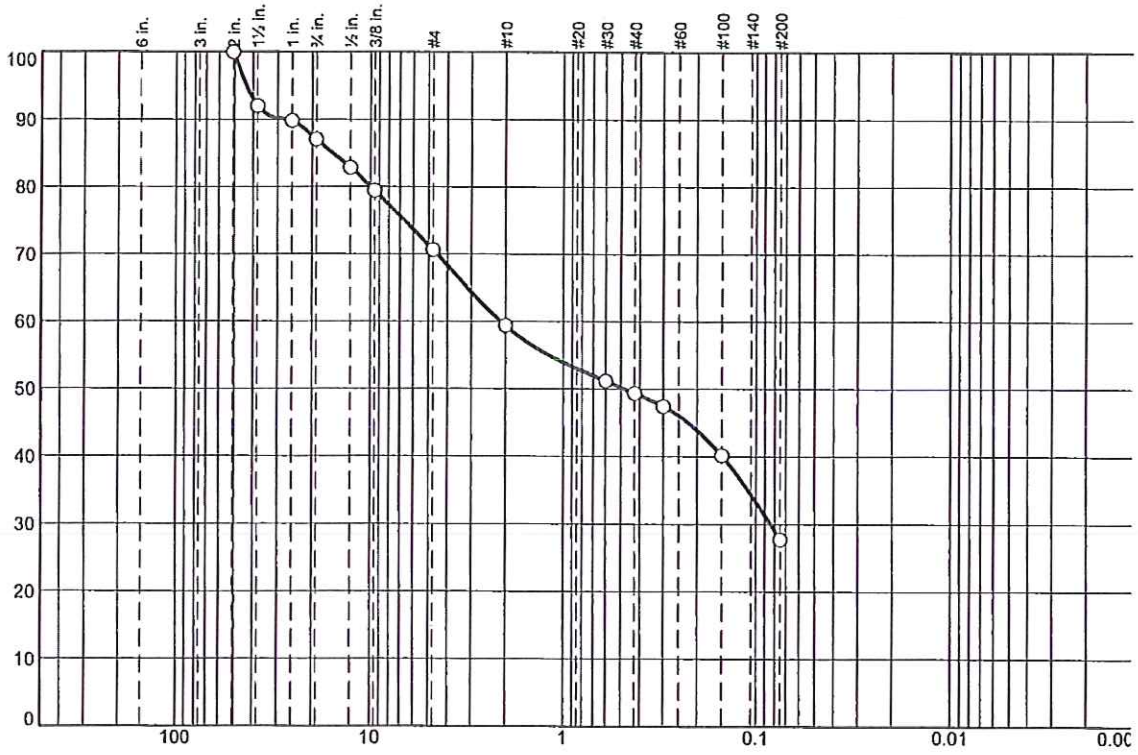
**NOT TO SCALE**

North

B- # - APPROX. BORING LOCATION & BORING NO.

| | | |
|---|---|---|
| ACCESS CONSULTING ENGINEERS | SUMMERLIN VILLAGE 24 - PARCEL "FGH"<br>NW CHARLESTON BLVD. & SKY VISTA DR.<br>LAS VEGAS, NEVADA | FIGURE - 2 |
| 3255 Pepper Lane, Suite 107<br>Las Vegas, Nevada 89120<br>Ph: 702-987-5153 \| Fax: 702-207-5034 | BORING LOCATION MAP | DATE: 04/22/19<br>PROJECT NO.: 19-148 |

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 13.0 | 16.4 | 11.2 | 10.0 | 21.7 | 27.7 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 2 | 100.0 | | |
| 1 1/2 | 92.0 | | |
| 1 | 89.8 | | |
| 3/4 | 87.0 | | |
| 1/2 | 82.9 | | |
| 3/8 | 79.4 | | |
| #4 | 70.6 | | |
| #10 | 59.4 | | |
| #30 | 51.2 | | |
| #40 | 49.4 | | |
| #50 | 47.5 | | |
| #100 | 40.2 | | |
| #200 | 27.7 | | |

* (no specification provided)

**Soil Description**

silty sand with gravel

**Atterberg Limits**

PL= NP LL= NV PI= NP

**Coefficients**

$D_{90}$= 26.8598 $D_{85}$= 15.6408 $D_{60}$= 2.1159
$D_{50}$= 0.4748 $D_{30}$= 0.0842 $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= SM AASHTO= A-2-4(0)

**Remarks**

25.4mm = 1"
.4748 = .0187"

**Location:** B-1 @ 0'
**Sample Number:** S-1040

**Date:** 04/04/19

**Access Consulting Engineers**

**Las Vegas, Nevada**

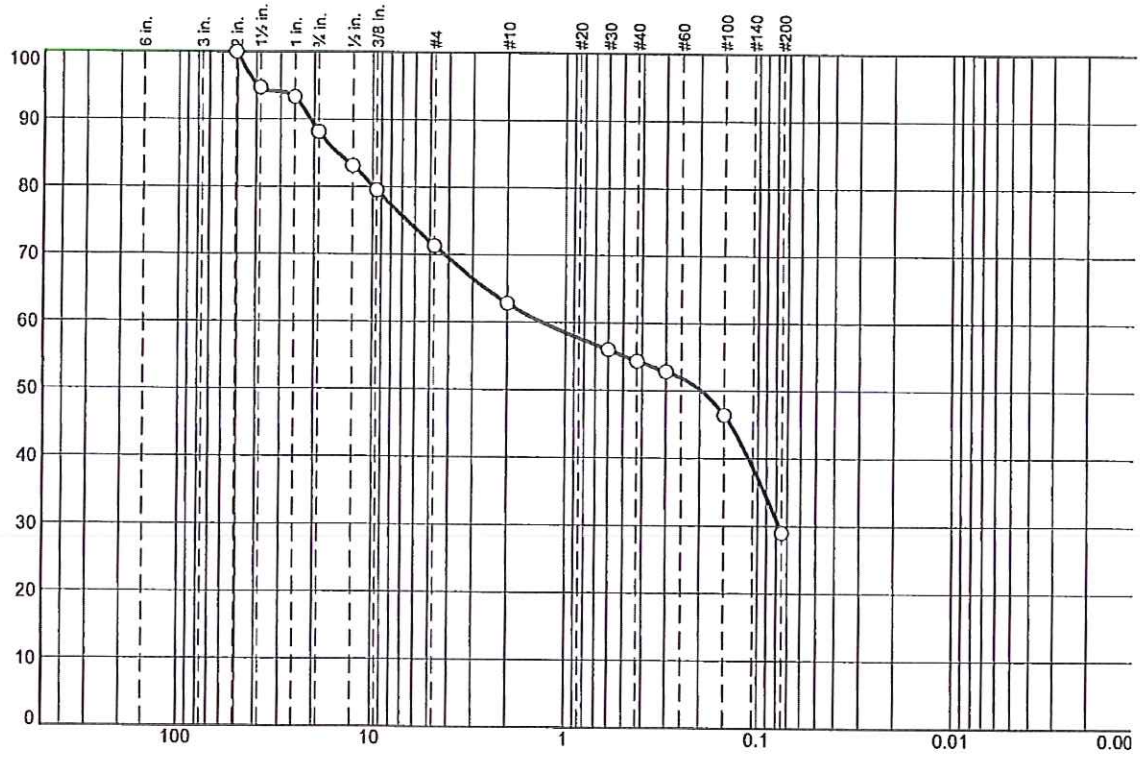
**Client:** LENNAR
**Project:** SUMMERLIN VILLAGE 24 PARCEL "FGH"

**Project No:** 19-148 **Figure**

**Tested By:** ASB **Checked By:** ASB

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identic

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 11.9 | 16.8 | 8.5 | 8.4 | 25.4 | 29.0 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 2 | 100.0 | | |
| 1 1/2 | 94.7 | | |
| 1 | 93.3 | | |
| 3/4 | 88.1 | | |
| 1/2 | 83.1 | | |
| 3/8 | 79.5 | | |
| #4 | 71.3 | | |
| #10 | 62.8 | | |
| #30 | 56.1 | | |
| #40 | 54.4 | | |
| #50 | 52.9 | | |
| #100 | 46.4 | | |
| #200 | 29.0 | | |

* (no specification provided)

**Soil Description**

silty sand with gravel

**Atterberg Limits**

PL= NP LL= NV PI= NP

**Coefficients**

$D_{90}$= 20.9529 $D_{85}$= 15.1427 $D_{60}$= 1.3196
$D_{50}$= 0.1955 $D_{30}$= 0.0777 $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= SM AASHTO= A-2-4(0)

**Remarks**

.1955mm = .0077"

**Location:** B-15 @ 0'
**Sample Number:** S-1110

**Date:** 03/28/19

**Access Consulting Engineers**

Las Vegas, Nevada

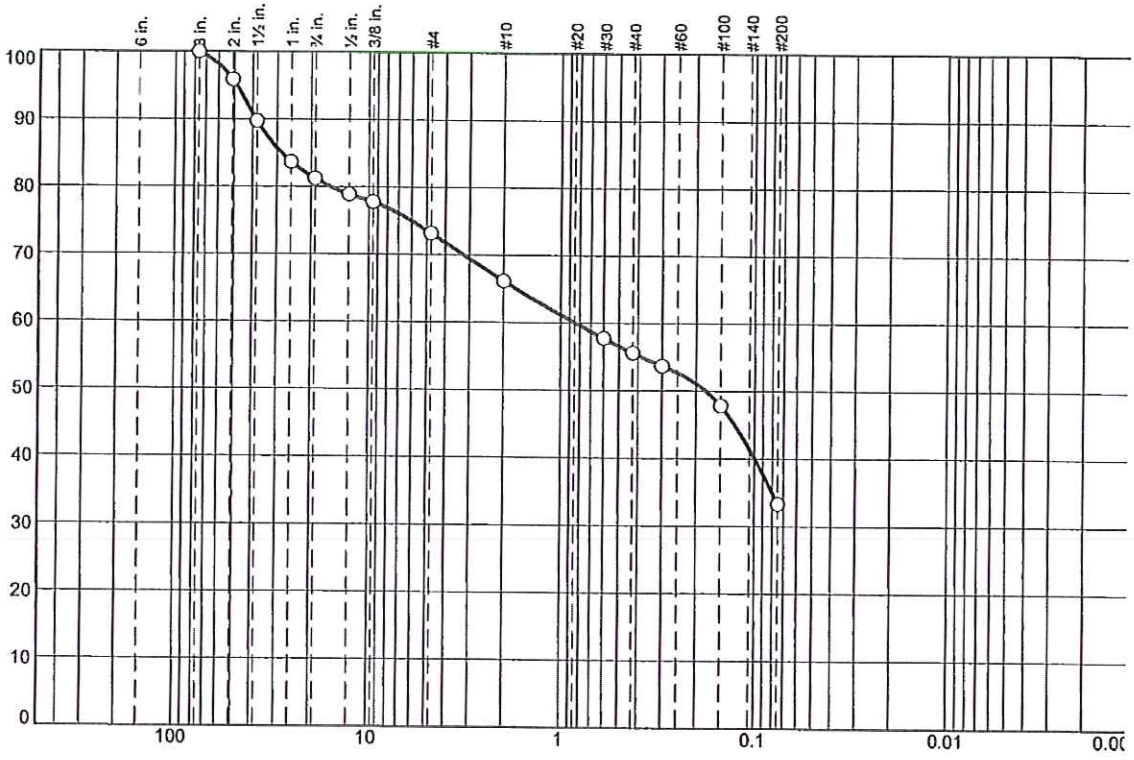
**Client:** LENNAR
**Project:** SUMMERLIN VILLAGE 24 PARCEL "FGH"

**Project No:** 19-148 **Figure**

**Tested By:** ASB **Checked By:** ASB

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identic

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 18.8 | 8.0 | 7.0 | 10.6 | 22.3 | 33.3 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 3 | 100.0 | | |
| 2 | 95.9 | | |
| 1 1/2 | 89.8 | | |
| 1 | 83.7 | | |
| 3/4 | 81.2 | | |
| 1/2 | 78.9 | | |
| 3/8 | 77.8 | | |
| #4 | 73.2 | | |
| #10 | 66.2 | | |
| #30 | 57.8 | | |
| #40 | 55.6 | | |
| #50 | 53.7 | | |
| #100 | 47.9 | | |
| #200 | 33.3 | | |

* (no specification provided)

**Soil Description**

silty sand with gravel

**Atterberg Limits**

PL= NP LL= NV PI= NP

**Coefficients**

$D_{90}$= 38.5232 $D_{85}$= 28.5096 $D_{60}$= 0.8405
$D_{50}$= 0.1779 $D_{30}$= $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= SM AASHTO= A-2-4(0)

**Remarks**

.1779mm = .007"

**Location:** B-7 @ 0'
**Sample Number:** S-1165

**Date:** 04/04/19

**Access Consulting Engineers**

**Las Vegas, Nevada**

**Client:** LENNAR
**Project:** SUMMERLIN VILLAGE 24 PARCEL "FGH"
**Project No:** 19-148 **Figure**

**Tested By:** ASB **Checked By:** ASB

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identic

# CONSTANTS FOR SEDIMENT TRANSPORT EQUATION

| Class | Size (in) | Geometric Mean (in) | $C_1$ | $C_2$ | $C_3$ |
|---|---|---|---|---|---|
| Very fine sand | .00244 - .00492 | .00346 | $58.50 \times 10^{-6}$ | 1.040 | 3.20 |
| Fine sand | .00492 - .00984 | .00697 | $21.40 \times 10^{-6}$ | 0.837 | 3.59 |
| Medium sand | .00984 - .01969 | .01394 | $6.47 \times 10^{-6}$ | 0.535 | 4.05 |
| Coarse sand | .01969 - .03937 | .02783 | $2.90 \times 10^{-6}$ | 0.239 | 4.36 |
| Very coarse sand | .03937 - .07874 | .05551 | $2.37 \times 10^{-6}$ | -0.044 | 4.44 |

Limitations:
(1) Sediment sizes from .00244 to .07874 inches
(2) Channel bed slope from 0.002 to 0.010
(3) Flow velocities less than 25 fps.

| Revision | Date |
|---|---|
| | |
| | |
| | |
| | |

WRC ENGINEERING

**REFERENCE:** Design Guidelines and Criteria for Channels and Hydraulic Structures on Sandy Soil Simons, Li, and Associates, 1981

**TABLE 704**

# MANNING'S ROUGHNESS COEFFICIENTS FOR CHANNEL LINING TYPES

| Channel Material | Roughness Coefficient (n) | |
|---|---|---|
| | Normal | Maximum |
| Corrugated Metal | 0.025 | 0.030 |
| Concrete** | | |
| 1) Trowel finish | 0.013 | 0.015 |
| 2) Float finish | 0.015 | 0.016 |
| 3) Unfinished | 0.017 | 0.020 |
| 4) Shotcrete, Good section | 0.019 | 0.023 |
| 5) Shotcrete, wavy section | 0.122 | 0.025 |
| Asphalt (use maximum value when cars are present) | 0.016 | 0.020 |
| Soil-Cement | 0.020 | 0.025 |
| Constructed channels with earth or sand bottom, sides of | | |
| 1) Clean earth; straight | 0.022 | 0.025 |
| 2) Earth with grass and weeds | 0.025 | 0.030 |
| 3) Earth with trees and shrubs | 0.032 | 0.040 |
| 4) Shotcrete | 0.022 | 0.025 |
| 5) Soil-cement | 0.025 | 0.028 |
| 6) Concrete | 0.020 | 0.024 |
| 7) Dry rubble or riprap | 0.033 | 0.036 |
| Natural channels with sand bottom, sides of | | |
| 1) Trees and shrubs | 0.035 USE 0.032 | 0.045 0.040 |
| X 2) Rock X | | |
| Natural channel with rock bottom | 0.060 | 0.090 |
| Overbank floodplains | | |
| 1) Desert brush, normal density | 0.060 | 0.080 |
| 2) Dense vegetation | 0.100 | 0.160 |

• Adapted from Chow (1959) and Aldridge and Garrett (1973).
** Manning's Coefficients for Clear Water Only
__ City of Tucson Standards Manual for Drainage Design

| Revision | Date |
|---|---|
| | |
| | |
| | |
| | |

REFERENCE:

TABLE 702

# RANGE OF PARAMETERS FOR PARAMETERS FOR THE SIMONS-Li-FULLERTON METHOD

| Parameters | Value Range |
|---|---|
| Froude Number | 1 - 4 |
| Velocity | 6.5 - 26 ft/s |
| Manning Coefficient *n* | 0.015 - 0.025 |
| Bed Slope | 0.005 - 0.040 |
| Unit Discharge | 10 - 200 cfs/ft |
| Particle Size | $d_{50}$ |

DOES NOT MEET THIS CRITERIA USE TABLE 704

n: .032
S > .04

| Revision | Date |
|---|---|
| | |
| | |
| | |
| | |

REFERENCE:

TABLE 703B

# CONSTANTS FOR SEDIMENT TRANSPORT EQUATION

| Class | Size (in) | Geometric Mean (in) | $C_1$ | $C_2$ | $C_3$ |
|---|---|---|---|---|---|
| Very fine sand | .00244 - .00492 | .00346 | $58.50 \times 10^{-6}$ | 1.040 | 3.20 |
| Fine sand | .00492 - .00984 | .00697 | $21.40 \times 10^{-6}$ | 0.837 | 3.59 |
| Medium sand | .00984 - .01969 | .01394 | $6.47 \times 10^{-6}$ | 0.535 | 4.05 |
| Coarse sand | .01969 - .03937 | .02783 | $2.90 \times 10^{-6}$ | 0.239 | 4.36 |
| Very coarse sand | .03937 - .07874 | .05551 | $2.37 \times 10^{-6}$ | -0.044 | 4.44 |

Limitations:
(1) Sediment sizes from .00244 to .07874 inches
(2) Channel bed slope from 0.002 to 0.010
(3) Flow velocities less than 25 fps.

| Revision | Date |
|---|---|
| | |
| | |
| | |
| | |

WRC ENGINEERING

**REFERENCE:** Design Guidelines and Criteria for Channels and Hydraulic Structures on Sandy Soil Simons, Li, and Associates, 1981

**TABLE 704**

DATE

CLIENT [illegible] JOB NO. CALC. BY

DESCRIPTION [illegible] CHECKED BY

DLOADS

USE

Bedding Factor Other 1.9

Wall thickness B

Soil Density 140

Live Load HS series 20

Soil Type 0.165 Sand & Gravel.

SHEET OF

8320 old courthouse road • vienna, virginia 22180
© april 1979 (revised)

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 $\mu'$ 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 |

24" RCP

DATE: 7/31/19

DESIGNER: RJR

PROGRAM SAMM
D-LOAD REQUIREMENTS FOR A 24 IN. DIAMETER CIRCULAR PIPE

**********

P I P E D A T A

| | |
|---|---|
| DIAMETER (in.) | 24.00 |
| WALL B, THICKNESS (in.) | 3.000 |

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.) | 1.00 |
| 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.) | 6.50 |
| SOIL LATERAL PRESSURE/FRICTION TERM (KMU') | 0.0165 |
| 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 |

R 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) |
|---|---|---|---|---|---|---|---|---|---|
| 1.0 | 1.08 | Y | 378. | 3008. | 0. | 3386. | 1.90 | 891. | 1337. |
| 1.5 | 1.12 | Y | 591. | 2400. | 0. | 2991. | 1.90 | 787. | 1181. |
| 2.0 | 1.17 | Y | 820. | 1781. | 0. | 2600. | 1.90 | 684. | 1026. |
| 2.5 | 1.22 | Y | 1067. | 1269. | 0. | 2336. | 1.90 | 615. | 922. |
| 3.0 | 1.27 | Y | 1334. | 927. | 0. | 2261. | 1.90 | 595. | 893. |
| 3.5 | 1.33 | Y | 1623. | 763. | 0. | 2386. | 1.90 | 628. | 942. |
| 4.0 | 1.38 | Y | 1935. | 641. | 0. | 2575. | 1.90 | 678. | 1017. |
| 4.5 | 1.44 | Y | 2272. | 546. | 0. | 2818. | 1.90 | 742. | 1112. |
| 5.0 | 1.46 | Y | 2562. | 472. | 0. | 3034. | 1.90 | 798. | 1197. |
| 5.5 | 1.47 | Y | 2827. | 412. | 0. | 3239. | 1.90 | 852. | 1278. |
| 6.0 | 1.47 | Y | 3091. | 363. | 0. | 3454. | 1.90 | 909. | 1363. |
| 6.5 | 1.47 | Y | 3356. | 322. | 0. | 3678. | 1.90 | 968. | 1452. |
| 7.0 | 1.48 | Y | 3625. | 288. | 0. | 3913. | 1.90 | 1030. | 1545. |
| 7.5 | 1.48 | Y | 3889. | 260. | 0. | 4149. | 1.90 | 1092. | 1638. |
| 8.0 | 1.48 | Y | 4153. | 235. | 0. | 4388. | 1.90 | 1155. | 1732. |
| 8.5 | 1.48 | Y | 4417. | 214. | 0. | 4631. | 1.90 | 1219. | 1828. |
| 9.0 | 1.49 | Y | 4682. | 195. | 0. | 4877. | 1.90 | 1283. | 1925. |
| 9.5 | 1.49 | Y | 4946. | 179. | 0. | 5125. | 1.90 | 1349. | 2023. |
| 10.0 | 1.49 | Y | 5210. | 165. | 0. | 5375. | 1.90 | 1414. | 2122. |
| 10.5 | 1.49 | Y | 5474. | 152. | 0. | 5627. | 1.90 | 1481. | 2221. |
| 11.0 | 1.49 | Y | 5738. | 141. | 0. | 5880. | 1.90 | 1547. | 2321. |
| 11.5 | 1.49 | Y | 6003. | 131. | 0. | 6134. | 1.90 | 1614. | 2421. |
| 12.0 | 1.49 | Y | 6267. | 122. | 0. | 6389. | 1.90 | 1681. | 2522. |
| 12.5 | 1.49 | Y | 6531. | 114. | 0. | 6645. | 1.90 | 1749. | 2623. |
| 13.0 | 1.49 | Y | 6795. | 107. | 0. | 6902. | 1.90 | 1816. | 2725. |
| 13.5 | 1.49 | Y | 7060. | 100. | 0. | 7160. | 1.90 | 1884. | 2826. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 14.0 | 1.49 | Y | 9011. | 114. | 0. | 9125. | 1.90 | 1921. | 2882. |
| 14.5 | 1.49 | Y | 9337. | 107. | 0. | 9444. | 1.90 | 1988. | 2982. |
| 15.0 | 1.49 | Y | 9663. | 101. | 0. | 9764. | 1.90 | 2056. | 3055. |
| 15.5 | 1.49 | Y | 9989. | 96. | 0. | 10085. | 1.90 | 2123. | 3119. |
| 16.0 | 1.49 | Y | 10315. | 91. | 0. | 10405. | 1.90 | 2191. | 3182. |
| 16.5 | 1.49 | Y | 10641. | 86. | 0. | 10727. | 1.90 | 2258. | 3242. |
| 17.0 | 1.49 | Y | 10967. | 82. | 0. | 11048. | 1.90 | 2326. | 3299. |
| 17.5 | 1.49 | Y | 11293. | 78. | 0. | 11370. | 1.90 | 2394. | 3355. |
| 18.0 | 1.50 | Y | 11619. | 74. | 0. | 11693. | 1.90 | 2462. | 3408. |
| 18.5 | 1.50 | Y | 11945. | 71. | 0. | 12015. | 1.90 | 2530. | 3459. |
| 19.0 | 1.50 | Y | 12271. | 67. | 0. | 12338. | 1.90 | 2598. | 3508. |
| 19.5 | 1.50 | Y | 12597. | 64. | 0. | 12661. | 1.90 | 2666. | 3555. |
| 20.0 | 1.49 | Y | 12904. | 62. | 0. | 12965. | 1.90 | 2730. | 3596. |

30" RCP

DATE: 7/31/19

DESIGNER: R/R

PROGRAM SAMM
D-LOAD REQUIREMENTS FOR A 30 IN. DIAMETER CIRCULAR PIPE

**********

P I P E D A T A

| | |
|---|---|
| DIAMETER (in.) | 30.00 |
| WALL B, THICKNESS (in.) | 3.500 |

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.) | 1.00 |
| 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.) | 7.10 |
| 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 |

R 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) | REQUIRED D-LOAD ULT. (lb/ft/ft) |
|---|---|---|---|---|---|---|---|---|---|
| 1.0 | 1.07 | Y | 460. | 2830. | 0. | 3290. | 1.90 | 693. | 1039. |
| 1.5 | 1.10 | Y | 712. | 2777. | 0. | 3489. | 1.90 | 734. | 1102. |
| 2.0 | 1.14 | Y | 981. | 2069. | 0. | 3050. | 1.90 | 642. | 963. |
| 2.5 | 1.17 | Y | 1266. | 1480. | 0. | 2746. | 1.90 | 578. | 867. |
| 3.0 | 1.21 | Y | 1571. | 1084. | 0. | 2655. | 1.90 | 559. | 838. |
| 3.5 | 1.25 | Y | 1895. | 896. | 0. | 2790. | 1.90 | 587. | 881. |
| 4.0 | 1.30 | Y | 2239. | 754. | 0. | 2993. | 1.90 | 630. | 945. |
| 4.5 | 1.34 | Y | 2606. | 644. | 0. | 3250. | 1.90 | 684. | 1026. |
| 5.0 | 1.39 | Y | 2997. | 558. | 0. | 3554. | 1.90 | 748. | 1122. |
| 5.5 | 1.44 | Y | 3412. | 488. | 0. | 3900. | 1.90 | 821. | 1232. |
| 6.0 | 1.46 | Y | 3783. | 431. | 0. | 4214. | 1.90 | 887. | 1331. |
| 6.5 | 1.47 | Y | 4115. | 383. | 0. | 4498. | 1.90 | 947. | 1420. |
| 7.0 | 1.47 | Y | 4441. | 343. | 0. | 4784. | 1.90 | 1007. | 1511. |
| 7.5 | 1.47 | Y | 4767. | 310. | 0. | 5077. | 1.90 | 1069. | 1603. |
| 8.0 | 1.47 | Y | 5093. | 281. | 0. | 5374. | 1.90 | 1131. | 1697. |
| 8.5 | 1.48 | Y | 5427. | 255. | 0. | 5682. | 1.90 | 1196. | 1794. |
| 9.0 | 1.48 | Y | 5753. | 234. | 0. | 5986. | 1.90 | 1260. | 1890. |
| 9.5 | 1.48 | Y | 6079. | 215. | 0. | 6293. | 1.90 | 1325. | 1987. |
| 10.0 | 1.48 | Y | 6404. | 198. | 0. | 6602. | 1.90 | 1390. | 2085. |
| 10.5 | 1.48 | Y | 6730. | 183. | 0. | 6913. | 1.90 | 1455. | 2183. |
| 11.0 | 1.49 | Y | 7056. | 170. | 0. | 7226. | 1.90 | 1521. | 2282. |
| 11.5 | 1.49 | Y | 7382. | 158. | 0. | 7540. | 1.90 | 1587. | 2381. |
| 12.0 | 1.49 | Y | 7708. | 147. | 0. | 7855. | 1.90 | 1654. | 2480. |
| 12.5 | 1.49 | Y | 8034. | 138. | 0. | 8171. | 1.90 | 1720. | 2580. |
| 13.0 | 1.49 | Y | 8359. | 129. | 0. | 8488. | 1.90 | 1787. | 2681. |
| 13.5 | 1.49 | Y | 8685. | 121. | 0. | 8806. | 1.90 | 1854. | 2781. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 14.0 | 1.49 | Y | 7324. | 94. | 0. | 7418. | 1.90 | 1952. | 2928. |
| 14.5 | 1.50 | Y | 7588. | 89. | 0. | 7677. | 1.90 | 2020. | 3020. |
| 15.0 | 1.50 | Y | 7853. | 84. | 0. | 7937. | 1.90 | 2089. | 3087. |
| 15.5 | 1.50 | Y | 8117. | 79. | 0. | 8196. | 1.90 | 2157. | 3151. |
| 16.0 | 1.49 | Y | 8369. | 75. | 0. | 8444. | 1.90 | 2222. | 3210. |
| 16.5 | 1.49 | Y | 8633. | 71. | 0. | 8704. | 1.90 | 2291. | 3269. |
| 17.0 | 1.50 | Y | 8897. | 68. | 0. | 8964. | 1.90 | 2359. | 3327. |
| 17.5 | 1.50 | Y | 9160. | 64. | 0. | 9225. | 1.90 | 2428. | 3382. |
| 18.0 | 1.50 | Y | 9424. | 61. | 0. | 9485. | 1.90 | 2496. | 3435. |
| 18.5 | 1.50 | Y | 9688. | 58. | 0. | 9746. | 1.90 | 2565. | 3485. |
| 19.0 | 1.50 | Y | 9952. | 56. | 0. | 10008. | 1.90 | 2634. | 3533. |
| 19.5 | 1.50 | Y | 10216. | 53. | 0. | 10269. | 1.90 | 2702. | 3579. |
| 20.0 | 1.50 | Y | 10480. | 51. | 0. | 10530. | 1.90 | 2771. | 3622. |

# APPENDIX C – REFERENCE MATERIALS

Conceptual Drainage Study for Summerlin Village 24, GC Wallace, Inc., June 2004.

Update to the Conceptual Study for Summerlin Village 24, GCW Engineering, June 2014.

Summerlin West Planning Area Flood Control Master Plan Update, VTN, Nevada

Village 24-Parcel FGH Entry Road improvement plans, GCW Engineering,

Technical Drainage Study For Summerlin Village 24 Parcel COS-4 Wash, GCW Engineering, October 2017.

Technical Drainage Study for Summerlin West Village 24 Western Boundary Grading and Drainage, VTN Nevada, July 2018.

# CONCEPTUAL DRAINAGE STUDY
# FOR
# SUMMERLIN VILLAGE 24

**62A.24.001**

**February 2004**

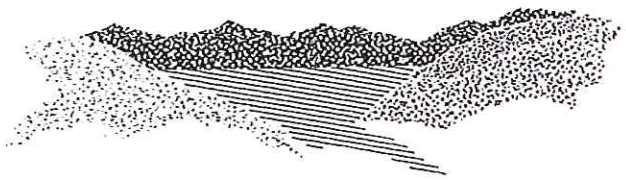
* FOR EXISTING CONDITIONS

**Prepared for:**


**The Howard Hughes Corporation**
**a Delaware Corporation**
**10000 West Charleston Blvd., Ste. 200**
**Las Vegas, Nevada 89134**
**Phone: (702) 791- 4300**
**Fax: (702) 791- 4453**

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

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT



ale Wm. Fraser, II, P.E.
General Manager/Chief Engineer

IOARD OF DIRECTORS

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Chairman
City of Las Vegas

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Bruce L. Woodbury
Clark County

May 14, 2004

Mr. Randy Fultz, P.E.
City of Las Vegas Public Works
731 S. Fourth St
Las Vegas, NV 89101

**DISTRICT CONCURRENCE: SUMMERLIN VILLAGE 24 (DS3505)**
**(RFCD NO. 04-5683)**

Dear Mr. Fultz:

Clark County Regional Flood Control District (District) reviewed Technical Drainage Study dated March 19, 2004, for the above-mentioned project as submitted by G. C. Wallace, Inc. In addition, District is in receipt of the Conditional Letter of Acceptance from City of Las Vegas Public Works dated April 8, 2004.

District concurs with acceptance of this Technical Drainage Study by City of Las Vegas Public Works.

District's review of this project was limited to issues of Regional Flood Control Significance as defined in *Uniform Regulations for the Control of Drainage.*

Please be aware that as additional information becomes available and/or restudies of Flood Insurance Studies are performed, information submitted by G. C. Wallace, Inc. may be superseded. Compliance with regulatory elements and design standards specified in *Uniform Regulations for the Control of Drainage* does not imply a guarantee that properties will be free from flooding or flood damage. The District, its officials, or employees assume no liability for information, data, or conclusions presented by consulting engineers. We, therefore, make no warranties, either expressed or implied, in conducting this review.

GALE WM. FRASER, II, P.E.
General Manager/Chief Engineer

BY: _____
Andrew R. Trelease, P.E.
Senior Civil Engineer

ART:css

c: Randall K. Gremlich, P.E., G. C. Wallace, Inc.

File: 20-59-22.GCW

600 S. Grand Central Parkway, Suite 300 • Las Vegas, Nevada 89106-4511
(702) 455-3139 • FAX: (702) 455-3870
Website: *http://www.ccrfcd.org*

| CITY OF LAS VEGAS<br>INTER-OFFICE MEMORANDUM | | | DATE:<br>June 10, 2004 |
|---|---|---|---|
| TO:<br>Land Development Services<br>Department of Public Works | | | FROM:<br>Albert Sung, P.E.<br>Flood Control Project Engineer<br>Department of Public Works |
| SUBJECT: | Drainage Study for:<br>Summerlin Village 24 - Conceptual | | COPIES TO:<br>G.C. Wallace |
| Cross Streets: | NWC of Charleston Boulevard at Red Rock Detention Basin | | Howard Hughes Corp. |
| File Number: | F:\Depot\DSMEMOS\DS3505D.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 G.R. 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 |
| | | | TOTAL FEES (LDDRS): | $800.00 | — |

**REMARKS:**

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 |

1. *The final approval of this conceptual study is based off two offsite flows from the Summerlin West Master Plan Study (1900 cfs at concentration point 23 and 615 cfs at concentration point 9). The two points of impact are at the west boundary of Village 24. Any future land use change which leads to a higher density and higher curve numbers will constitute a revision of the Summerlin West Master Plan. The subject Village 24 and all drainage infrastructures must be updated per the revised 100-year offsite flows.*

2. *Per previous comment #4 and response, a technical drainage study will be submitted to address the impact of discharge from the proposed storm drain to natural washes adjacent to the Charleston Bridge.*

3. *The "Future Berm" proposed in Figure 5 must be designed in a technical study and constructed prior to any development of Village 24.*

4. *Hydraulic calculations for the proposed storm drain system must be submitted in a technical drainage study for Village 24 upon site development.*

| Post-it® Fax Note 7671 | Date | # of pages ▶ |
|---|---|---|
| To Randall Gremlich | From Albert Sung | |
| Co./Dept. GCW | Co. CLV | |
| Phone # | Phone # | |
| Fax # | | |

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.

Note: All land surface area disturbances over 1 acre require a stormwater discharge permit issued by the Nevada Division of Environmental Protection (NDEP). 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. A stormwater discharge permit application and associated information may be downloaded from the web site:

http://www.state.nv.us/ndep/bwpc/storm01.htm

Projects that disturb more than one acre of land must submit to NDEP a "Notice of Intent" for inclusion under Stormwater Permit No. NVR100000 along with the appropriate filing fee.

**END OF REMARKS** T/R/S: T20S/R59E/22
B&H/ays AREA K-22

| CITY OF LAS VEGAS<br>INTER-OFFICE MEMORANDUM | | | DATE:<br>August 9, 2017 |
|---|---|---|---|
| TO:<br>**Land Development Services**<br>Department of Public Works | | | FROM:<br>Albert Sung, P.E.<br>Flood Control Project Engineer<br>Department of Public Works |
| **SUBJECT:** | Drainage Study for:<br>**Summerlin Village 24 – Conceptual – Update #3** | | **COPIES TO:**<br>G.C. Wallace |
| **Cross Streets:** | NWC of Charleston Blvd. & Sky Vista Drive | | Howard Hughes Corp. |
| **File Number:** | F:\Depot\DSMEMOS\DS3505J.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 | Approved | $100.00 | 371844: $100 |
| 5th Submittal | 5/18/2017 | 6/10/2017 | Approved | $100.00 | 485761: $100 |
| 6th Submittal | 6/21/2017 | 7/17/2017 | Not Approved | $100.00 | 488287: $100 |
| 7th Submittal (Supplement) | 7/25/2017 | 8/9/2017 | See Comments Below | N/C | N/C |
| | | | **TOTAL FEES (LDDRS):** | **$1,200.00** | ---- |

**REMARKS:**

**7th (Supplement) & 6th Submittals: Update #4 & Supplement to address increase in lot density for some Parcels**

5th Submittal: Update #3 to adjust peak flow rate of Parcel C

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 |

1. The previously approved "***COS-4 Wash***" study must be updated after the subject ***Conceptual Update*** study is approved. The impact to erosion control to the downstream areas of ***COS-4 Wash*** due to increased outflow must be addressed in that update.

**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

# TRAVEL TIME CALCULATIONS

**DEVELOPMENT:** Summerlin
**W.O. #** 7809 **CALCULATED BY:** SVB

$$Velocity = CS^{1/2}$$

C1 applies to the first 500 feet of travel distance
C2 applies to the remaining travel distance

| Existing: | | Developed | |
|---|---|---|---|
| C1=14.8 | C2=29.4 | C1=20.2 | C2=30.6 |

| | | | | | First 500 feet | | Remaining Travel Distance | |
|---|---|---|---|---|---|---|---|---|
| Basin | Length (ft) | High Elev (ft) | Low Elev (ft) | Slope (ft/ft) | C1 | V1 (fps) | C2 | V2 (fps) |
| EXISTING CONDITION | | | | | | | | |
| 1-1 | 11284 | | | | | | | |
| 1-3 | 6213 | 4880 | 4060 | 0.132 | 14.8 | 5.4 | 29.4 | 10.7 |
| 1-4 | 5402 | 5200 | 3900 | 0.241 | 14.8 | 7.3 | 29.4 | 14.4 |
| 1-5 | 4955 | 3955 | 3800 | 0.031 | 14.8 | 2.6 | 29.4 | 5.2 |
| 1-6 | 1780 | 4245 | 3850 | 0.222 | 14.8 | 7.0 | 29.4 | 13.8 |
| 1-7 | 9501 | 5100 | 3290 | 0.191 | 14.8 | 6.5 | 29.4 | 12.8 |
| 3-1 | 14144 | | | | | | | |
| 3-2 | 5695 | 5640 | 4315 | 0.233 | 14.8 | 7.1 | 29.4 | 14.2 |
| 3-3 | 3019 | 4680 | 4160 | 0.172 | 14.8 | 6.1 | 29.4 | 12.2 |
| 3-4 | 5808 | 5680 | 4360 | 0.227 | 14.8 | 7.1 | 29.4 | 14.0 |
| 3-5 | 5108 | 5680 | 4320 | 0.266 | 14.8 | 7.6 | 29.4 | 15.2 |
| 3-6 | 2956 | 5000 | 4300 | 0.237 | 14.8 | 7.2 | 29.4 | 14.3 |
| 3-7 | 2770 | 5160 | 4315 | 0.305 | 14.8 | 8.2 | 29.4 | 16.2 |
| 3-8 | 10844 | 6000 | 4315 | 0.155 | 14.8 | 5.8 | 29.4 | 11.6 |
| 4-1 | 23488 | | | | | | | |
| 4-2 | 5288 | 4190 | 3755 | 0.082 | 14.8 | 4.2 | 29.4 | 8.4 |
| 4-3 | 4263 | 3795 | 3520 | 0.065 | 14.8 | 3.8 | 29.4 | 7.5 |

SUMMARY OF HEC-1 MODEL

| BASIN/ CONCENTRATION POINT | AREA (ac) | Q100 (cfs) |
|---|---|---|
| RG6* | 220.2 | 477 |
| OFF5 | 187.8 | 615 |
| ON7 | 45.3 | 111 |
| CP6 | – | 688 |
| CP7 | – | 1096 |
| OFF6 | 3.5 | 13 |
| ON8 | 89.0 | 207 |
| CP8 | – | 1245 |
| OFF7 | 76.1 | 203 |
| OFF8 | 13.8 | 40 |
| CP9 | – | 242 |
| ON9 | 35.8 | 91 |
| CP10 | – | 309 |
| OFF9 | 4.4 | 15 |
| OFF10 | 7.4 | 24 |
| CP11 | – | 39 |
| ON10 | 47.9 | 125 |
| CP12 | – | 152 |
| OFF11 | 30.6 | 85 |
| OFF12 | 2.01 | 7 |
| OFF13 | 1.21 | 4 |
| OFF14 | 5.1 | 16 |
| CP13 | – | 107 |
| ON12 | 65.5 | 178 |
| CP14 | – | 265 |
| OFF15 | 44.3 | 123 |
| ON17 | 14.0 | 39 |
| CP15 | – | 163 |
| OFF16 | 7.1 | 23 |
| OFF17 | 1.1 | 4 |
| CP16 | – | 27 |
| ON18 | 7.9 | 26 |
| CP17 | – | 53 |
| CP18 | – | 201 |
| ON16 | 2.4 | 9 |
| CP19 | – | 206 |
| ON14 | 22.8 | 64 |
| CP20 | – | 270 |
| ON15 | 2.7 | 9 |
| CP21 | – | 277 |
| ON13 | 13.2 | 37 |
| CP22 | – | 313 |
| CP23 | – | 564 |
| ON11 | 18.6 | 52 |
| CP24 | – | 615 |
| CP25 | – | 762 |
| CP26 | – | 1021 |
| CP27 | – | 2152 |
| ON20 | 1.2 | 4 |
| CP28 | – | 2153 |
| ON19 | 7.3 | 26 |
| CP29 | – | 2163 |

LEGEND

- (EX-1) SUBBASIN DESIGNATION
- CP1 COMBINATION POINT
- FLOW DIRECTION
- SUBBASIN BOUNDARY
- 5' CONTOUR LINES

•Referenced from Village 23A Rough Grade Study

••Future berm sites to be addressed in separate technical drainage study not included in this study.

FUTURE BERM SITE**

FUTURE BERM SITE**

EXISTING DETENTION BASIN DB5

ALTA DRIVE

EXISTING SKY VISTA CHANNEL

EXISTING VILLAGE 23A

DESERT MOON

CHARLESTON BLVD.

EXISTING BRIDGE CROSSING

EXISTING RED ROCK DETENTION BASIN

PROJECT SITE

NORTH

GRAPHIC SCALE

500 0 250 500

( IN FEET )

1 inch = 500 ft.

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

DESIGN:
DRAWN:
CHECK:
ISSUE DATE:
ISSUE EDITOR:
PLOT DATE: 04-02-04
PLOT TIME: 11:58:17

G.C. WALLACE, INC.
Engineers/Planners/Surveyors
1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89146
TELEPHONE: (702) 804-2000 • FAX: (702) 804-2299

G:\GCA-24-01\0 drawings (dwg)\fig 5.dwg

THE HOWARD HUGHES CORPORATION
SUMMERLIN VILLAGE 24
FIGURE 5
EXISTING CONDITIONS DRAINAGE MAP

SHEET
FIG 5
OF SHTS

gca2436.dwg 020912.rtn

# UPDATE TO THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24

* FOR COMPARABLE DENSITIES AND RAINFALL

**62024-320**

**June 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**

CWA
FILE V24 ENG. SUPT.

| CITY OF LAS VEGAS<br>INTER-OFFICE MEMORANDUM | | | DATE:<br>June 24, 2014 |
|---|---|---|---|
| TO:<br>Land Development Services<br>Department of Public Works | | | FROM:<br>Albert Sung, P.E.<br>Flood Control Project Engineer<br>Department of Public Works |
| SUBJECT: | Drainage Study for:<br>Summerlin Village 24 – Conceptual - Update | | COPIES TO:<br>G.C. Wallace |
| Cross Streets: | NWC of Charleston Boulevard at Red Rock Detention Basin | | Howard Hughes Corp. |
| File Number: | F:\Depot\DSMEMOS\DS3505E.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 | See Comments Below | $100.00 | 359768: $100 |
| | | | **TOTAL FEES (LDDRS):** | **$900.00** | ---- |

**REMARKS:**

**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.

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**END OF REMARKS**
B&H/ays

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

**NOTES**

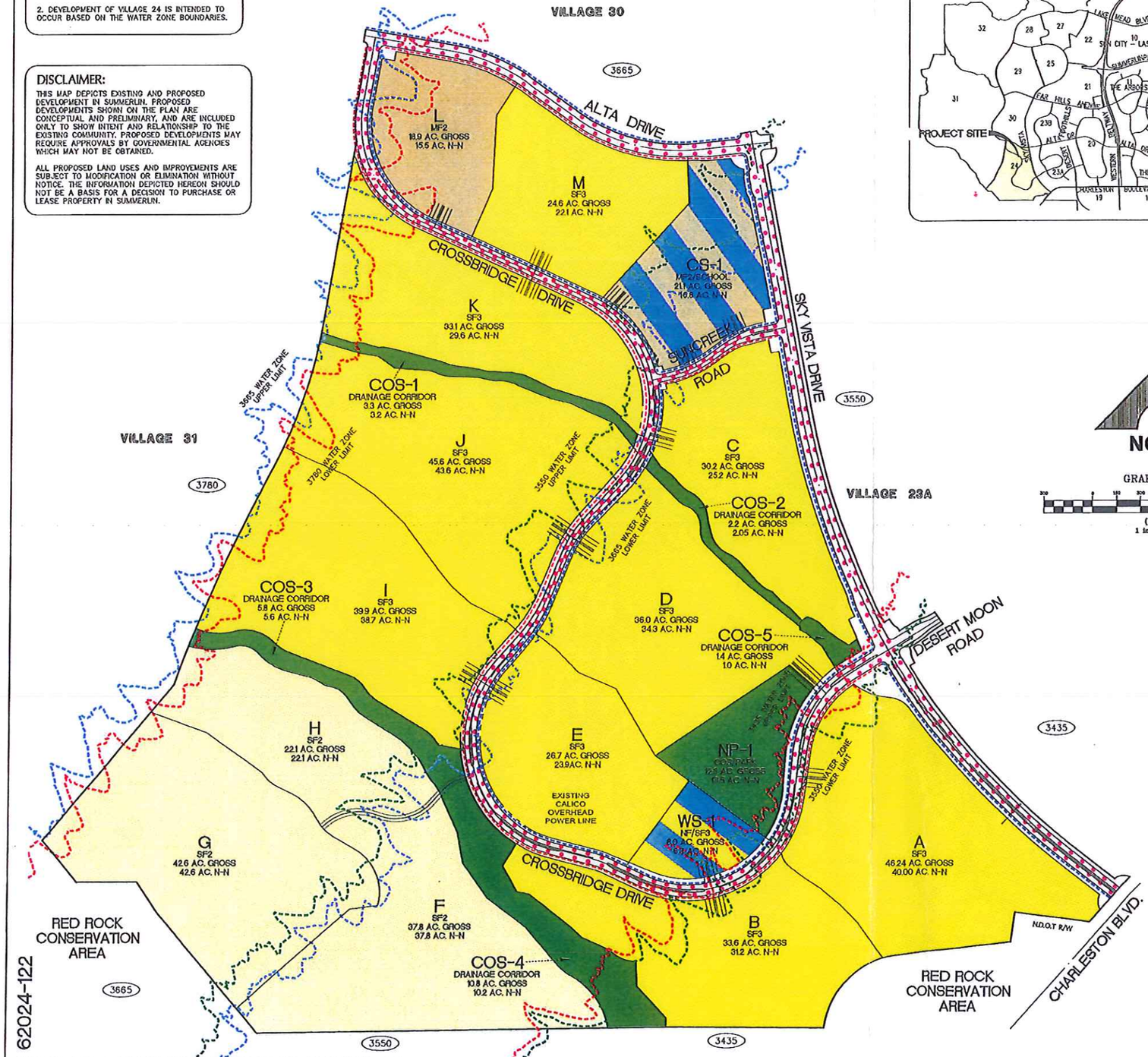
1. MAXIMUM RESIDENTIAL UNITS BASED ON GROSS ACREAGE MULTIPLIED BY MAXIMUM DENSITY.

2. DEVELOPMENT OF VILLAGE 24 IS INTENDED TO OCCUR BASED ON THE WATER ZONE BOUNDARIES.

**DISCLAIMER:**

THIS MAP DEPICTS EXISTING AND PROPOSED DEVELOPMENT IN SUMMERLIN. PROPOSED DEVELOPMENTS SHOWN ON THE PLAN ARE CONCEPTUAL AND PRELIMINARY, AND ARE INCLUDED ONLY TO SHOW INTENT AND RELATIONSHIP TO THE EXISTING COMMUNITY. PROPOSED DEVELOPMENTS MAY REQUIRE APPROVALS BY GOVERNMENTAL AGENCIES WHICH MAY NOT BE OBTAINED.

ALL PROPOSED LAND USES AND IMPROVEMENTS ARE SUBJECT TO MODIFICATION OR ELIMINATION WITHOUT NOTICE. THE INFORMATION DEPICTED HEREON SHOULD NOT BE A BASIS FOR A DECISION TO PURCHASE OR LEASE PROPERTY IN SUMMERLIN.




62024-122

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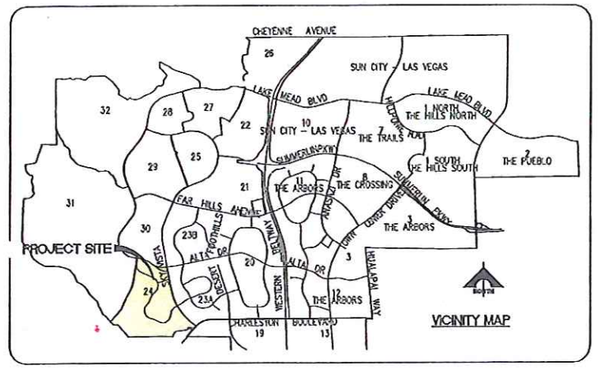



**VILLAGE 24 - LAND USE TABULATION**

| PARCEL DESIGNATION | LAND USE | MAXIMUM DENSITY UNITS/ACRES | ACRES (GROSS) | ALLOWABLE RESIDENTIAL UNITS |
|---|---|---|---|---|
| A | SF3 | 10 | 46.24 | 462 |
| B | SF3 | 10 | 33.58 | 335 |
| C | SF3 | 10 | 30.5 | 305 |
| D | SF3 | 10 | 36.0 | 360 |
| E | SF3 | 10 | 26.7 | 267 |
| F | SF2 | 6 | 37.8 | 227 |
| G | SF2 | 6 | 42.6 | 256 |
| H | SF2 | 6 | 22.1 | 133 |
| I | SF3 | 10 | 39.9 | 399 |
| J | SF3 | 10 | 45.6 | 456 |
| K | SF3 | 10 | 33.1 | 331 |
| L | MF2 | 21 | 18.9 | 397 |
| M | SF3 | 10 | 24.6 | 246 |
| CS-1 | MF2/SCHOOL | 21 | 21.1 | 443 |
| COS-1 | COS (PASEO) | -- | 3.3 | -- |
| COS-2 | COS (PASEO) | -- | 3.2 | -- |
| COS-3 | COS (PASEO) | -- | 5.8 | -- |
| COS-4 | COS (PASEO) | -- | 10.8 | -- |
| NP-1 | COS/PARK | -- | 12.3 | -- |
| WS-1 | NF/SF3 | 10 | 8.0 | 80 |
| PROJECT TOTALS - | | | 502.12 | 4732 |

616

**LEGEND**

- SF2 - SINGLE FAMILY DETACHED
- SF3 - SINGLE FAMILY DETACHED
- MF2 - MULTI FAMILY MEDIUM DENSITY
- NF - NEIGHBORHOOD FOCUS
- COS - COMMUNITY OPEN SPACE
- NN - NET-NET ACREAGE
- A - PARCEL DESIGNATION
- COS 3.5 - LAND USE/ACREAGE
- WATER ZONE BOUNDARIES
- BIKE LANES
- 8' WIDE SIDEWALK
- 5' WIDE SIDEWALK

NORTH

GRAPHIC SCALE

300 0 150 300 600 1200

( IN FEET )
1 inch = 300 ft

**DEVELOPER**

Howard Hughes.
THE HOWARD HUGHES CORPORATION

THE HOWARD HUGHES COMPANY, LLC
A DELAWARE LIMITED LIABILITY CORPORATION
10801 W. CHARLESTON BLVD., 3rd FLOOR
LAS VEGAS, NEVADA 89135
OFFICE PHONE NO. (702) 791-4000
OFFICE FAX NO. (702) 791-4450

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BOULEVARD · LAS VEGAS, NV 89146
T: 702.804.3000 · F: 702.804.2559 · GCWALLACE.COM

SUMMERLIN

# VILLAGE 24
## DEVELOPMENT PLAN

MAY 22, 2014

# HYDROLOGIC CRITERIA AND DESIGN MANUAL

## TIME OF CONCENTRATION

**G. C. WALLACE COMPANIES**
Engineers/Planners/Surveyors

**SUMMERLIN VILLAGE 24**
**CONCEPTUAL DRAINAGE STUDY UPDATE**
**ULTIMATE CONDITIONS**

Project No: 62024-320
Date: 8-May-14
Calculated by: dbc

| SUB-BASIN DATA | | | | | | INITIAL / OVERLAND TIME (Ti) | | | TRAVEL TIME (Tt) | | | | | Tc CHECK URBANIZED BASINS | | Tc | Tlag | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIG: | DEV./EX. (D or E) | CN | K | AREA Ac | AREA Sq Mi | INITIAL LENGTH Feet | SLOPE % | Ti Min | TRAVEL LENGTH Feet | SLOPE % | V1 VELOCITY fps | V2 VELOCITY fps | Tt Min | TOTAL LENGTH Feet | Tc = (L/180)+10 Min | Min | Tlag = 0.6Tc/60 Hours | Remarks: 100 yr Precip |
| (1) | | (16) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9a) | (9b) | (10) | (11) | (12) | (13) | (14) | (15) | |
| A1 | D | 87.6 | 0.7663 | 4.6 | 0.00714 | 100 | 1.0 | 6.0 | 840 | 4.7 | 4.4 | 6.6 | 2.8 | 940 | 15.2 | 8.8 | 0.088 | 3.33 |
| A2 | D | 90.2 | 0.8006 | 34.0 | 0.05306 | 100 | 1.0 | 5.4 | 2270 | 2.3 | 3.1 | 4.6 | 9.1 | 2370 | 23.2 | 14.5 | 0.145 | 3.34 |
| B | D | 90.7 | 0.8072 | 30.0 | 0.04683 | 120 | 1.0 | 5.8 | 2175 | 4.6 | 4.3 | 6.6 | 6.2 | 2295 | 22.8 | 11.9 | 0.119 | 3.35 |
| C | D | 85.7 | 0.7412 | 25.2 | 0.03938 | 150 | 1.0 | 7.9 | 2580 | 3.2 | 3.6 | 5.5 | 8.6 | 2730 | 25.2 | 16.5 | 0.165 | 3.37 |
| D | D | 86.4 | 0.7505 | 34.3 | 0.05366 | 150 | 1.0 | 7.7 | 2595 | 3.3 | 3.7 | 5.6 | 8.6 | 2745 | 25.3 | 16.3 | 0.163 | 3.36 |
| E | D | 86.4 | 0.7505 | 23.9 | 0.03739 | 150 | 1.0 | 7.7 | 2275 | 3.8 | 3.9 | 6.0 | 7.1 | 2425 | 23.5 | 14.8 | 0.148 | 3.37 |
| F | D | 84.2 | 0.7214 | 37.8 | 0.05913 | 200 | 1.0 | 9.6 | 2218 | 6.3 | 5.1 | 7.7 | 5.4 | 2418 | 23.4 | 15.0 | 0.150 | 3.37 |
| G | D | 84.2 | 0.7214 | 42.6 | 0.06655 | 200 | 1.0 | 9.6 | 2491 | 4.4 | 4.2 | 6.4 | 7.1 | 2691 | 25.0 | 16.8 | 0.168 | 3.39 |
| H | D | 85.3 | 0.7360 | 22.1 | 0.03449 | 160 | 1.0 | 8.3 | 1759 | 7.1 | 5.4 | 8.2 | 4.1 | 1919 | 20.7 | 12.4 | 0.124 | 3.39 |
| I | D | 86.4 | 0.7505 | 38.7 | 0.06047 | 150 | 1.0 | 7.7 | 2458 | 4.5 | 4.3 | 6.5 | 7.0 | 2608 | 24.5 | 14.7 | 0.147 | 3.39 |
| J | D | 86.4 | 0.7505 | 43.6 | 0.06819 | 150 | 1.0 | 7.7 | 2935 | 3.6 | 3.8 | 5.8 | 9.2 | 3085 | 27.1 | 16.9 | 0.169 | 3.39 |
| K | D | 86.4 | 0.7505 | 29.6 | 0.04618 | 150 | 1.0 | 7.7 | 1771 | 4.8 | 4.4 | 6.7 | 5.0 | 1921 | 20.7 | 12.7 | 0.127 | 3.39 |
| L | D | 92.2 | 0.8270 | 15.5 | 0.02427 | 100 | 1.0 | 4.9 | 1275 | 2.6 | 3.3 | 4.9 | 5.2 | 1375 | 17.6 | 10.1 | 0.101 | 3.41 |
| M | D | 92.2 | 0.8270 | 22.0 | 0.03445 | 100 | 1.0 | 4.9 | 1765 | 3.6 | 3.8 | 5.8 | 5.8 | 1865 | 20.4 | 10.7 | 0.107 | 3.40 |
| CS-1 | D | 92.2 | 0.8270 | 16.8 | 0.02631 | 100 | 1.0 | 4.9 | 1475 | 2.6 | 3.3 | 4.9 | 5.9 | 1575 | 18.8 | 10.8 | 0.108 | 3.38 |
| NP-1 | D | 81.5 | 0.6858 | 10.5 | 0.01648 | 200 | 1.0 | 10.5 | 1055 | 1.6 | 2.6 | 3.9 | 5.7 | 1255 | 17.0 | 16.2 | 0.162 | 3.35 |
| WS-1 | D | 92.2 | 0.8270 | 6.3 | 0.00988 | 100 | 1.0 | 4.9 | 1320 | 1.6 | 2.6 | 3.9 | 6.8 | 1420 | 17.9 | 11.7 | 0.117 | 3.36 |
| ALTA | D | 94.0 | 0.8508 | 9.8 | 0.01533 | 30 | 2.0 | 2.0 | 3090 | 5.4 | 4.7 | 7.1 | 7.8 | 3120 | 27.3 | 9.8 | 0.098 | 3.41 |
| CD1 | D | 94.0 | 0.8508 | 3.7 | 0.00570 | 25 | 2.0 | 1.8 | 870 | 0.6 | 1.6 | 2.4 | 7.9 | 895 | 15.0 | 9.7 | 0.097 | 3.38 |
| CD2 | D | 94.0 | 0.8508 | 3.6 | 0.00569 | 25 | 2.0 | 1.8 | 1100 | 0.6 | 1.6 | 2.4 | 9.5 | 1125 | 16.3 | 11.3 | 0.113 | 3.37 |
| CD3 | D | 94.0 | 0.8508 | 1.3 | 0.00209 | 35 | 2.0 | 2.1 | 490 | 6.3 | 5.1 | 7.7 | 1.6 | 525 | 12.9 | 3.7 | 0.050 | 3.36 |
| SB1 | D | 94.0 | 0.8508 | 3.6 | 0.00566 | 60 | 2.0 | 2.8 | 1310 | 5.9 | 4.9 | 7.4 | 3.5 | 1370 | 17.6 | 6.3 | 0.063 | 3.36 |
| SB2 | D | 94.0 | 0.8508 | 1.3 | 0.00200 | 60 | 2.0 | 2.8 | 414 | 2.1 | 2.9 | 4.4 | 2.4 | 474 | 12.6 | 5.1 | 0.051 | 3.35 |
| SB3 | D | 94.0 | 0.8508 | 3.5 | 0.00550 | 60 | 2.0 | 2.8 | 1098 | 1.4 | 2.4 | 3.6 | 6.2 | 1158 | 16.4 | 9.0 | 0.090 | 3.35 |
| SB4 | D | 94.0 | 0.8508 | 0.5 | 0.00082 | 60 | 2.0 | 2.8 | 365 | 2.7 | 3.3 | 5.0 | 1.8 | 425 | 12.4 | 4.6 | 0.050 | 3.35 |
| ST1 | D | 94.0 | 0.8508 | 1.1 | 0.00178 | 30 | 2.0 | 2.0 | 420 | 0.5 | 1.4 | 2.2 | 4.9 | 450 | 12.5 | 6.9 | 0.069 | 3.43 |
| ST2 | D | 94.0 | 0.8508 | 9.6 | 0.01501 | 30 | 2.0 | 2.0 | 2980 | 4.0 | 4.0 | 6.1 | 8.8 | 3010 | 26.7 | 10.8 | 0.108 | 3.37 |
| ST4 | D | 94.0 | 0.8508 | 6.0 | 0.00932 | 30 | 2.0 | 2.0 | 2525 | 4.8 | 4.4 | 6.7 | 6.9 | 2555 | 24.2 | 8.9 | 0.089 | 3.40 |
| ST6 | D | 94.0 | 0.8508 | 1.8 | 0.00286 | 30 | 2.0 | 2.0 | 800 | 5.0 | 4.5 | 6.8 | 2.6 | 830 | 14.6 | 4.5 | 0.050 | 3.38 |
| SV1 | D | 94.0 | 0.8508 | 3.6 | 0.00558 | 62 | 2.0 | 2.8 | 975 | 4.3 | 4.2 | 6.3 | 3.2 | 1037 | 15.8 | 6.0 | 0.060 | 3.35 |
| SV2 | D | 94.0 | 0.8508 | 2.1 | 0.00321 | 62 | 2.0 | 2.8 | 705 | 5.8 | 4.9 | 7.4 | 2.2 | 767 | 14.3 | 5.0 | 0.050 | 3.34 |
| SV3 | D | 94.0 | 0.8508 | 2.7 | 0.00428 | 62 | 2.0 | 2.8 | 800 | 5.8 | 4.9 | 7.4 | 2.4 | 862 | 14.8 | 5.2 | 0.052 | 3.32 |
| COS-1 | D | 81.5 | 0.6858 | 3.2 | 0.00497 | 50 | 2.0 | 4.2 | 1925 | 6.2 | 5.0 | 7.6 | 4.8 | 1975 | 21.0 | 9.0 | 0.090 | 3.39 |
| COS-2 | D | 81.5 | 0.6858 | 2.7 | 0.00422 | 50 | 2.0 | 4.2 | 1730 | 4.9 | 4.5 | 6.8 | 4.9 | 1780 | 19.9 | 9.1 | 0.091 | 3.36 |
| COS-3 | D | 81.5 | 0.6858 | 5.6 | 0.00875 | 50 | 2.0 | 4.2 | 1516 | 5.3 | 4.7 | 7.0 | 4.2 | 1566 | 18.7 | 8.4 | 0.084 | 3.39 |
| COS-4 | D | 81.5 | 0.6858 | 9.6 | 0.01498 | 50 | 2.0 | 4.2 | 1880 | 5.4 | 4.7 | 7.1 | 5.0 | 1930 | 20.7 | 9.2 | 0.092 | 3.36 |
| COS-5 | D | 81.5 | 0.6858 | 3.2 | 0.00502 | 50 | 1.0 | 5.3 | 1878 | 6.7 | 5.2 | 7.9 | 4.5 | 1928 | 20.7 | 9.8 | 0.098 | 3.34 |
| Referenced from the *Technical Drainage Study* for 2004 *Summerlin West MPU* | | | | | | | | | | | | | | | | | | |
| 7-2A | D | 88.2 | 0.7742 | 288.8 | 0.4513 | 200 | 2.0 | 6.6 | 9426 | 8.5 | 5.9 | 8.9 | 18.1 | 9626 | 63.5 | 24.7 | 0.247 | 3.50 |
| 7-2B | E | 88.0 | 0.7716 | 60.4 | 0.0944 | 500 | 8.0 | 6.6 | 3630 | 8.0 | 4.2 | 8.3 | 8.3 | 4130 | N/A | 14.9 | 0.149 | 3.58 |
| 7-4A | E | 88.0 | 0.7716 | 214.1 | 0.3345 | 500 | 8.0 | 6.6 | 10732 | 7.0 | 3.9 | 7.8 | 24.1 | 11232 | N/A | 30.7 | 0.307 | 3.46 |
| 7-5A | D | 87.0 | 0.7584 | 190.0 | 0.297 | 200 | 2.0 | 6.9 | 4110 | 7.8 | 5.6 | 8.5 | 8.5 | 4310 | 33.9 | 15.4 | 0.154 | 3.43 |
| 7-7A | D | 88.7 | 0.7808 | 51.8 | 0.081 | 200 | 2.0 | 6.4 | 3641 | 7.4 | 5.5 | 8.3 | 7.8 | 3841 | 31.3 | 14.3 | 0.143 | 3.44 |

$Tc = Ti + Tt$ $Tlag = 0.6\ Tc$

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

$K = 0.0132\ (CN) - 0.39$

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**

* USE 3.39 TO MATCH CONCEPTUAL STUDY

# Addendum #1 to the FLOOD CONTROL MASTER PLAN UPDATE

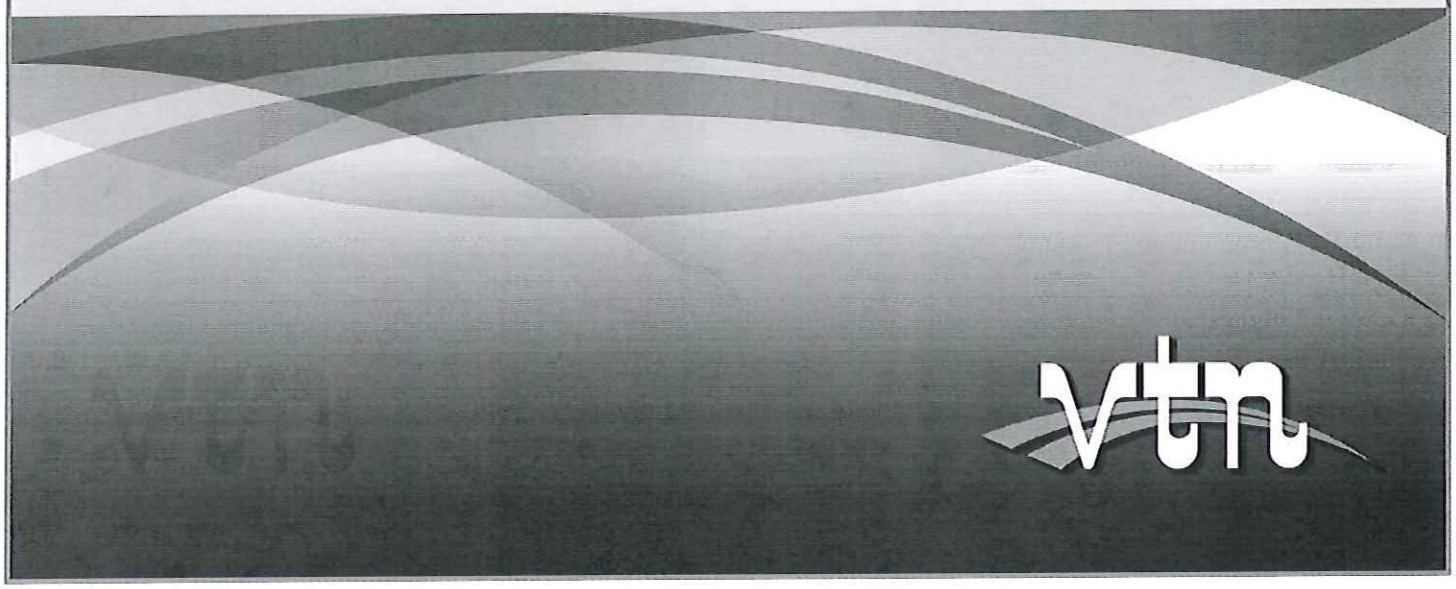
## SUMMERLIN WEST PLANNING AREA

*Las Vegas, Nevada*

W.O. # 7809

*Prepared for:*
Howard Hughes Corp.

*Submitted to:*
Public Works Department
City of Las Vegas



| CITY OF LAS VEGAS<br>INTER-OFFICE MEMORANDUM | | | | DATE:<br>January 11, 2018 |
|---|---|---|---|---|
| TO:<br>**Land Development Services**<br>Department of Building & Safety | | | | FROM:<br>Albert Sung, P.E.<br>Flood Control Project Engineer<br>Department of Public Works |
| **SUBJECT:** | Drainage Study for:<br>**Summerlin West Planning Area Master Plan Update** | | | **COPIES TO:**<br>VTN Nevada |
| **Cross Streets:** | West of I-215 between Lake Mead Boulevard and Charleston Boulevard | | | The Howard Hughes Corporation |
| **File Number:** | F:\Depot\DSMemos\DS4926B.doc | | | Bart Anderson, P.E., DevCo |
| **Parcel Number:** | 137-22-000-017 | | | CCRFCD |
| **Zoning Action:** | | | | CCPW |
| **FEMA Flood Zone** | YES | X | NO | |
| **Proposed Storm Drain** | YES | X | NO | |

| HISTORY | DATE RECEIVED | DATE REVIEWED | COMMENTS | REVIEW FEES | FEES PAID Payment Trn # |
|---|---|---|---|---|---|
| 1st Submittal | 10/9/2017 & 10/25/2017 | 11/8/2017 | Not Approved | $400.00 | 490518: $400 |
| 2nd Submittal | 12/6/2017 | 12/20/2017 & 1/10/2018 | See Comments Below | $400.00 | 492005: $400 |
| | | | **TOTAL FEES (LDDRS):** | **$800.00** | ---- |

**REMARKS:** NOT APPROVED, BUT NO COMMENTS ON RED ROCK WASH AREA

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 site is adjacent to or crosses an existing or proposed *Clark County Regional Flood Control District (CCRFCD)* master planned facility. Therefore, CCRFCD concurrence is required prior to final approval of the drainage study.
2. The site is adjacent to Clark County. Clark County Public Works concurrence is required prior to final approval of the drainage study.
3. Atkins is working on the 2018 MPU. Coordinate and verify the proposed regional flood control facilities as shown in Sheet A.6.5 with Atkins for inclusion of the Summerlin West Master Plan facilities into the ongoing 2018 MPU.
4. On Exhibit A.6.3, provide flow arrows, a scale and a north arrow as was done on A.6.2 and A.6.4.
5. The sum of percentages for curve number calculations for Basin 3-2 add up to only 98%. Revise and reflect changes accordingly.
6. In Appendix B.5 Ultimate Condition HEC-1 Model Output, the provided $Q_{100}$ value for Basin 2-C is 906 cfs, however on the A.6.2 Beltway Channel North / V26 Basin Tributary Exhibit the table shows 786 cfs. Verify and revise accordingly.

7. Per the HEC-1 for the Alta Tributary it is shown that a portion of Basin 3-N will go to CPDB3 and CP3.7. These combination points are not shown on the Alta Tributary Exhibit A.6.3, but seem to drain to CPDB5. Verify and reflect changes accordingly.
8. Exhibits A.6.6 and A.6.7 do not provide contours or flow direction arrows. Provide as such in the next submittal.
9. The Flow Master calculation reports for all proposed RCPs have diameters that do not reflect the designed pipe sizes. Review and revise accordingly.
10. The velocity calculated for SD-F5 in the Flow Master report is 27.74 ft/s, but it is shown to be 25.74 ft/s on Exhibit A.6.5. Review and revise accordingly.
11. All proposed RCPs and RCBs Flow Master reports are included in Appendix C except fo SD-J. Provide as such in the next submittal.

**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**
WSP/AYS

T/R/S: T21S/R69E/22
AREA K-22

VTN Study

# B.5.7 100-YEAR RED ROCK DETENTION BASIN TRIBUTARY

```
1*****************************************
*****************************************
 *                                       *                                       *
 *                                       *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                       *    U.S. ARMY CORPS OF ENGINEERS
 *                                       *                                       *
 *               JUN   1998              *                                       *    HYDROLOGIC ENGINEERING CENTER
 *                                       *                                       *
 *            VERSION 4.1                *                                       *         609 SECOND STREET
 *                                       *                                       *
 *                                       *                                       *       DAVIS, CALIFORNIA 95616
 *                                       *                                       *
 *  RUN DATE   22NOV17  TIME  09:43:28   *                                       *           (916) 756-1104
 *                                       *                                       *
 *                                       *                                       *
 *****************************************
*****************************************

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

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

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



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

                        *DIAGRAM
*** FREE ***
               1        ID    INPUT FILE DATE = NOVEMBER 30, 2016
               2        ID    DESIGN STORM = 100-YEAR 6-HR STORM
               3        ID    STORM DISTRIBUTION = SDN #3
               4        ID    MODELED BY VTN (SVB/WJM)
               5        ID    RESPONSE TO COMMENTS
               6        ID
               7        ID    ************************************************************
               8        ID    * REFERENCED HYDROLOGIC MODELS:                            *
               9        ID    * FLAMINGO / TROPICANA WASHES WATERSHED 2008 MPU FLAM3A *
              10        ID    * ALL PB CARDS WERE REFERENCED FROM THIS STUDY             *
              11        ID    ************************************************************
              12        ID
              13        ID
              14        ID
              15        ID
              16        ID                          AREA    DARF
              17        ID                          SQ. MI.
              18        ID                          0-0.5   0.99
              19        ID                          0.5-1   0.975
              20        ID                          1-2     0.95
              21        ID                          2-3     0.925
              22        ID                          3-4     0.915
              23        ID                          4-5     0.908
              24        ID                          5-6     0.903
              25        ID                          6-7     0.895
              26        ID                          7-8     0.885
              27        ID
              28        ID  JR CARD RATIOS REPRESENT DEPTH-AREA REDUCTION FACTORS (DARF'S)
              29        ID
              30        ID  100-YEAR,  6-HOUR STORM,  SDN3
              31        ID
              32        IT       5       0       0     300
              33        IO       5       0       0
              34        IN       5       0       0
              35        JR    PREC    0.99   0.975    0.95   0.925   0.915   0.908   0.903   0.895   0.885
                        *
              36        KK     4-1
              37        KM   COMPARE TO MPU BASIN RR14A
              38        BA   4.601
              39        PB    3.77
              40        PC       0    0.02   0.057    0.07   0.087   0.108   0.124    0.13    0.13   0.130
              41        PC    0.13    0.13    0.13   0.133    0.14   0.142   0.148   0.158   0.172   0.181
              42        PC    0.19   0.197   0.199     0.2   0.201   0.204   0.214   0.229   0.241   0.249
              43        PC   0.251   0.256    0.27   0.278   0.281   0.283   0.295   0.322   0.352   0.409
              44        PC   0.499    0.59    0.71   0.744   0.781   0.812   0.819   0.835   0.851   0.856
```

```
          45          PC    0.86   0.868   0.876   0.888    0.91   0.926   0.937    0.95    0.97   0.976
          46          PC   0.982   0.985   0.987   0.989    0.99   0.993   0.993   0.994   0.995   0.998
          47          PC   0.998   0.999       1
          48          LS       0    87.6
          49          UD   0.725
                      *
1                                                 HEC-1 INPUT                                                 PAGE  2

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


          50          KK    R4-1
          51          KM   REFERENCED FROM 2008 MPU SEE R-RR14A
          52          KM   ROUTE R4-1 THROUGH 4-2
          53          KM   FUTURE CONCRETE CHANNEL
          54          RD    5500   0.071   0.015       0    TRAP      12       2
                      *

          55          KK     4-2
          56          KM   PORTION OF 2008 MPU BASIN RD4
          57          BA  0.3656
          58          PB    3.48
          59          LS       0    85.4
          60          UD   0.163
                      *

          61          KK   CP4.1
          62          KM   COMBINE 4-2 AND R4-1
          63          KM   CHECK TO SEE IF 4-A CAN DRAIN INTO CHANNEL
          64          HC       2
                      *

          65          KK  RCP4.1
          66          KM   ROUTE CP4-2 THROUGH 4-3
          67          KM   EXISTING NATURAL BRAIDED CHANNELS
          68          RD    3140   0.067   0.030       0    TRAP     100       0
                      *

          69          KK     4-3
          70          KM   PORTION OF 2008 MPU BASIN RD5
          71          BA  0.2102
          72          PB    3.45
          73          LS       0    85.1
          74          UD   0.143
                      *

          75          KK   CP4.2
          76          KM   COMBINE 4-3 AND RCP4.1
          77          HC       2
                      *

          78          KK     4-A
          79          KM   PORTION OF 2008 MPU BASIN RD1
          80          BA  0.3599
          81          PB    3.52
          82          LS       0    84.6
          83          UD   0.202
                      *

          84          KK  RCP4-A
          85          KM   ROUTE 4-A THROUGH 4-B
          86          KM   EXISTING NATURAL BRAIDED CHANNELS
          87          RD    3940   0.041   0.030       0    TRAP     100       0
                      *
1                                                 HEC-1 INPUT                                                 PAGE  3

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

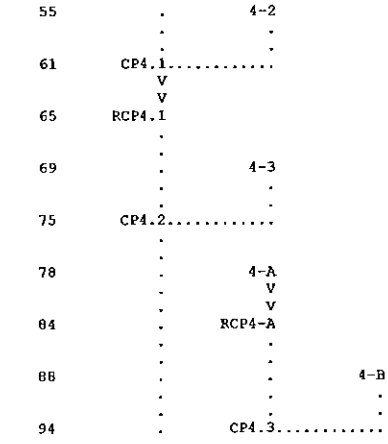

          88          KK     4-B
          89          KM   PORTION OF 2008 MPU BASIN RD53.42 AND RD2=3.42
          90          BA  0.5403
          91          PB    3.43
          92          LS       0    86.3
          93          UD   0.331
                      *

          94          KK   CP4.3
          95          KM   COMBINE 4-A AND 4-B
          96          HC       2
                      *
          97          ZZ
1
              SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING           (--->) DIVERSION OR PUMP FLOW

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

    36          4-1
                  V
                  V
    50          R4-1
                  .
                  .
```




(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

1**********

FLOOD HYDROGRAPH PACKAGE (HEC-1)

JUN 1998

VERSION 4.1

RUN DATE 22NOV17 TIME 09:43:28

U.S. ARMY CORPS OF ENGINEERS

HYDROLOGIC ENGINEERING CENTER

609 SECOND STREET

DAVIS, CALIFORNIA 95616

(916) 756-1104

INPUT FILE DATE = NOVEMBER 30, 2016
DESIGN STORM = 100-YEAR 6-HR STORM
STORM DISTRIBUTION = SDN #3
MODELED BY VTN (SVB/WJM)
RESPONSE TO COMMENTS

**********
* REFERENCED HYDROLOGIC MODELS: *
* FLAMINGO / TROPICANA WASHES WATERSHED 2008 MPU FLAM3A *
* ALL PB CARDS WERE REFERENCED FROM THIS STUDY *
**********

| AREA SQ. MI. | DARF |
|---|---|
| 0-0.5 | 0.99 |
| 0.5-1 | 0.975 |
| 1-2 | 0.95 |
| 2-3 | 0.925 |
| 3-4 | 0.915 |
| 4-5 | 0.908 |
| 5-6 | 0.903 |
| 6-7 | 0.895 |
| 7-8 | 0.885 |

JR CARD RATIOS REPRESENT DEPTH-AREA REDUCTION FACTORS (DARF'S)

100-YEAR, 6-HOUR STORM, SDN3

33 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 |
| ITIME | | 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
.99 .98 .95 .93 .92 .91 .90 .89 .88

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

| OPERATION | STATION | AREA | PLAN | | RATIOS APPLIED TO PRECIPITATION RATIO 1 | RATIO 2 | RATIO 3 | RATIO 4 | RATIO 5 | RATIO 6 | RATIO 7 | RATIO 8 | RATIO 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | .99 | .98 | .95 | .93 | .92 | .91 | .90 | .89 | .88 |
| HYDROGRAPH AT | 4-1 | 4.60 | 1 | FLOW | 4301. | 4214. | 4069. | 3924. | 3866. | 3825. | 3796. | 3750. | 3692. |
| | | | | TIME | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |
| ROUTED TO | R4-1 | 4.60 | 1 | FLOW | 4281. | 4194. | 4047. | 3903. | 3846. | 3804. | 3777. | 3729. | 3672. |
| | | | | TIME | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |
| HYDROGRAPH AT | 4-2 | .37 | 1 | FLOW | 600. | 587. | 565. | 543. | 535. | 529. | 524. | 517. | 509. |
| | | | | TIME | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 |
| 2 COMBINED AT | CP4.1 | 4.97 | 1 | FLOW | 4387. | 4298. | 4148. | 4001. | 3942. | 3899. | 3871. | 3822. | 3764. |
| | | | | TIME | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |
| ROUTED TO | RCP4.1 | 4.97 | 1 | FLOW | 4361. | 4272. | 4124. | 3978. | 3918. | 3875. | 3846. | 3799. | 3742. |
| | | | | TIME | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |
| HYDROGRAPH AT | 4-3 | .21 | 1 | FLOW | 350. | 342. | 330. | 317. | 312. | 308. | 306. | 302. | 297. |
| | | | | TIME | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 |
| 2 COMBINED AT | CP4.2 | 5.18 | 1 | FLOW | 4414. | 4324. | 4174. | 4026. | 3966. | 3922. | 3893. | 3845. | 3788. |
| | | | | TIME | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |
| HYDROGRAPH AT | 4-A | .36 | 1 | FLOW | 525. | 513. | 493. | 474. | 466. | 461. | 457. | 450. | 443. |
| | | | | TIME | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.67 |
| ROUTED TO | RCP4-A | .36 | 1 | FLOW | 533. | 522. | 503. | 484. | 477. | 472. | 468. | 462. | 454. |
| | | | | TIME | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 |
| HYDROGRAPH AT | 4-B | .54 | 1 | FLOW | 667. | 653. | 629. | 605. | 596. | 589. | 584. | 577. | 567. |
| | | | | TIME | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 |
| 2 COMBINED AT | CP4.3 | .90 | 1 | FLOW | 1200. | 1175. | 1132. | 1089. | 1072. | 1061. | 1052. | 1038. | 1021. |

TIME 3.75 3.75 3.75 3.75 3.75 3.75 3.75 3.75
3.75
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 | | | | | | | | | |
| | R4-1 MANE | 1.53 | 4298.80 | 251.63 | 2.45 | 5.00 | 4280.84 | 250.00 | 2.45 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6001E+03 EXCESS= .0000E+00 OUTFLOW= .6001E+03 BASIN STORAGE= .1663E-02 PERCENT ERROR= .0

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FOR PLAN = 1 RATIO= .00 | | | | | | | | | |
| | R4-1 MANE | 1.54 | 4210.95 | 251.71 | 2.39 | 5.00 | 4193.82 | 250.00 | 2.39 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5874E+03 EXCESS= .0000E+00 OUTFLOW= .5874E+03 BASIN STORAGE= .1473E-02 PERCENT ERROR= .0

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FOR PLAN = 1 RATIO= .00 | | | | | | | | | |
| | R4-1 MANE | 1.56 | 4066.82 | 251.38 | 2.31 | 5.00 | 4047.11 | 250.00 | 2.31 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5663E+03 EXCESS= .0000E+00 OUTFLOW= .5663E+03 BASIN STORAGE= .1905E-02 PERCENT ERROR= .0

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FOR PLAN = 1 RATIO= .00 | | | | | | | | | |
| | R4-1 MANE | 1.58 | 3918.38 | 251.11 | 2.22 | 5.00 | 3903.20 | 250.00 | 2.22 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5453E+03 EXCESS= .0000E+00 OUTFLOW= .5453E+03 BASIN STORAGE= .1685E-02 PERCENT ERROR= .0

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FOR PLAN = 1 RATIO= .00 | | | | | | | | | |
| | R4-1 MANE | 1.59 | 3858.34 | 252.29 | 2.19 | 5.00 | 3846.23 | 250.00 | 2.19 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5370E+03 EXCESS= .0000E+00 OUTFLOW= .5370E+03 BASIN STORAGE= .1886E-02 PERCENT ERROR= .0

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FOR PLAN = 1 RATIO= .00 | | | | | | | | | |
| | R4-1 MANE | 1.59 | 3824.53 | 251.53 | 2.16 | 5.00 | 3804.00 | 250.00 | 2.16 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5311E+03 EXCESS= .0000E+00 OUTFLOW= .5311E+03 BASIN STORAGE= .1694E-02 PERCENT ERROR= .0

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FOR PLAN = 1 RATIO= .00 | | | | | | | | | |
| | R4-1 MANE | 1.60 | 3790.76 | 252.14 | 2.15 | 5.00 | 3776.76 | 250.00 | 2.15 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5269E+03 EXCESS= .0000E+00 OUTFLOW= .5269E+03 BASIN STORAGE= .1835E-02 PERCENT ERROR= .0

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FOR PLAN = 1 RATIO= .00 | | | | | | | | | |
| | R4-1 MANE | 1.60 | 3749.19 | 251.51 | 2.12 | 5.00 | 3728.60 | 250.00 | 2.12 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5203E+03 EXCESS= .0000E+00 OUTFLOW= .5203E+03 BASIN STORAGE= .1560E-02 PERCENT ERROR= .0

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FOR PLAN = 1 RATIO= .00 | | | | | | | | | |
| | R4-1 MANE | 1.61 | 3686.57 | 251.13 | 2.09 | 5.00 | 3672.05 | 250.00 | 2.09 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5119E+03 EXCESS= .0000E+00 OUTFLOW= .5119E+03 BASIN STORAGE= .1647E-02 PERCENT ERROR= .0

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FOR PLAN = 1 RATIO= .00 | | | | | | | | | |
| | RCP4.1 MANE | 1.97 | 4381.68 | 252.47 | 2.41 | 5.00 | 4361.44 | 250.00 | 2.41 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6392E+03 EXCESS= .0000E+00 OUTFLOW= .6392E+03 BASIN STORAGE= .7354E-02 PERCENT ERROR= .0

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FOR PLAN = 1 RATIO= .00 | | | | | | | | | |
| | RCP4.1 MANE | 1.99 | 4292.42 | 252.57 | 2.36 | 5.00 | 4272.43 | 250.00 | 2.36 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6256E+03 EXCESS= .0000E+00 OUTFLOW= .6256E+03 BASIN STORAGE= .6733E-02 PERCENT ERROR=
.0

FOR PLAN = 1 RATIO= .00

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RCP4.1 | MANE | 2.02 | 4144.43 | 252.15 | 2.28 | 5.00 | 4123.62 | 250.00 | 2.28 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6031E+03 EXCESS= .0000E+00 OUTFLOW= .6031E+03 BASIN STORAGE= .6236E-02 PERCENT ERROR=
.0

FOR PLAN = 1 RATIO= .00

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RCP4.1 | MANE | 2.05 | 3991.73 | 251.73 | 2.19 | 5.00 | 3977.90 | 250.00 | 2.19 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5806E+03 EXCESS= .0000E+00 OUTFLOW= .5806E+03 BASIN STORAGE= .7613E-02 PERCENT ERROR=
.0

FOR PLAN = 1 RATIO= .00

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RCP4.1 | MANE | 2.06 | 3935.75 | 253.21 | 2.16 | 5.00 | 3918.44 | 250.00 | 2.16 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5716E+03 EXCESS= .0000E+00 OUTFLOW= .5716E+03 BASIN STORAGE= .6424E-02 PERCENT ERROR=
.0

FOR PLAN = 1 RATIO= .00

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RCP4.1 | MANE | 2.07 | 3895.07 | 252.26 | 2.13 | 5.00 | 3875.11 | 250.00 | 2.13 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5654E+03 EXCESS= .0000E+00 OUTFLOW= .5654E+03 BASIN STORAGE= .7687E-02 PERCENT ERROR=
.0

FOR PLAN = 1 RATIO= .00

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RCP4.1 | MANE | 2.07 | 3865.49 | 252.99 | 2.12 | 5.00 | 3846.47 | 250.00 | 2.12 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5609E+03 EXCESS= .0000E+00 OUTFLOW= .5609E+03 BASIN STORAGE= .6346E-02 PERCENT ERROR=
.0

FOR PLAN = 1 RATIO= .00

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RCP4.1 | MANE | 2.08 | 3817.80 | 252.20 | 2.09 | 5.00 | 3798.81 | 250.00 | 2.09 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5538E+03 EXCESS= .0000E+00 OUTFLOW= .5538E+03 BASIN STORAGE= .7274E-02 PERCENT ERROR=
.0

FOR PLAN = 1 RATIO= .00

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RCP4.1 | MANE | 2.10 | 3754.01 | 253.75 | 2.06 | 5.00 | 3742.10 | 250.00 | 2.06 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5448E+03 EXCESS= .0000E+00 OUTFLOW= .5448E+03 BASIN STORAGE= .7723E-02 PERCENT ERROR=
.0

FOR PLAN = 1 RATIO= .00

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RCP4-A | MANE | 5.00 | 533.13 | 225.00 | 1.97 | 5.00 | 533.13 | 225.00 | 1.97 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3783E+02 EXCESS= .0000E+00 OUTFLOW= .3790E+02 BASIN STORAGE= .9693E-02 PERCENT ERROR= -
.2

FOR PLAN = 1 RATIO= .00

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RCP4-A | MANE | 5.00 | 521.87 | 225.00 | 1.93 | 5.00 | 521.87 | 225.00 | 1.93 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3696E+02 EXCESS= .0000E+00 OUTFLOW= .3702E+02 BASIN STORAGE= .9614E-02 PERCENT ERROR= -
.2

FOR PLAN = 1 RATIO= .00

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RCP4-A | MANE | 5.00 | 503.09 | 225.00 | 1.85 | 5.00 | 503.09 | 225.00 | 1.85 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3551E+02 EXCESS= .0000E+00 OUTFLOW= .3557E+02 BASIN STORAGE= .9480E-02 PERCENT ERROR= -
.2

FOR PLAN = 1 RATIO= .00

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RCP4-A | MANE | 5.00 | 484.31 | 225.00 | 1.78 | 5.00 | 484.31 | 225.00 | 1.78 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3407E+02 EXCESS= .0000E+00 OUTFLOW= .3413E+02 BASIN STORAGE= .9343E-02 PERCENT ERROR= -
.2

FOR PLAN = 1 RATIO= .00

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RCP4-A | MANE | 5.00 | 476.79 | 225.00 | 1.75 | 5.00 | 476.79 | 225.00 | 1.75 |

```
 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3349E+02 EXCESS= .0000E+00 OUTFLOW= .3355E+02 BASIN STORAGE= .9288E-02 PERCENT ERROR= -
.2

          FOR PLAN = 1  RATIO=  .00
            RCP4-A  MANE        5.00    471.53    225.00      1.73      5.00    471.53    225.00      1.73

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3309E+02 EXCESS= .0000E+00 OUTFLOW= .3315E+02 BASIN STORAGE= .9248E-02 PERCENT ERROR= -
.2

          FOR PLAN = 1  RATIO=  .00
            RCP4-A  MANE        5.00    467.77    225.00      1.71      5.00    467.77    225.00      1.71

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3281E+02 EXCESS= .0000E+00 OUTFLOW= .3287E+02 BASIN STORAGE= .9221E-02 PERCENT ERROR= -
.2

          FOR PLAN = 1  RATIO=  .00
            RCP4-A  MANE        5.00    461.76    225.00      1.69      5.00    461.76    225.00      1.69

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3235E+02 EXCESS= .0000E+00 OUTFLOW= .3241E+02 BASIN STORAGE= .9176E-02 PERCENT ERROR= -
.2

          FOR PLAN = 1  RATIO=  .00
            RCP4-A  MANE        5.00    454.25    225.00      1.66      5.00    454.25    225.00      1.66

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3178E+02 EXCESS= .0000E+00 OUTFLOW= .3184E+02 BASIN STORAGE= .9119E-02 PERCENT ERROR= -
.2



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

# STANDARD FORM 4

**DEVELOPMENT:** Summerlin

**W.O. #** 7809 **CALCULATED BY:** SVB

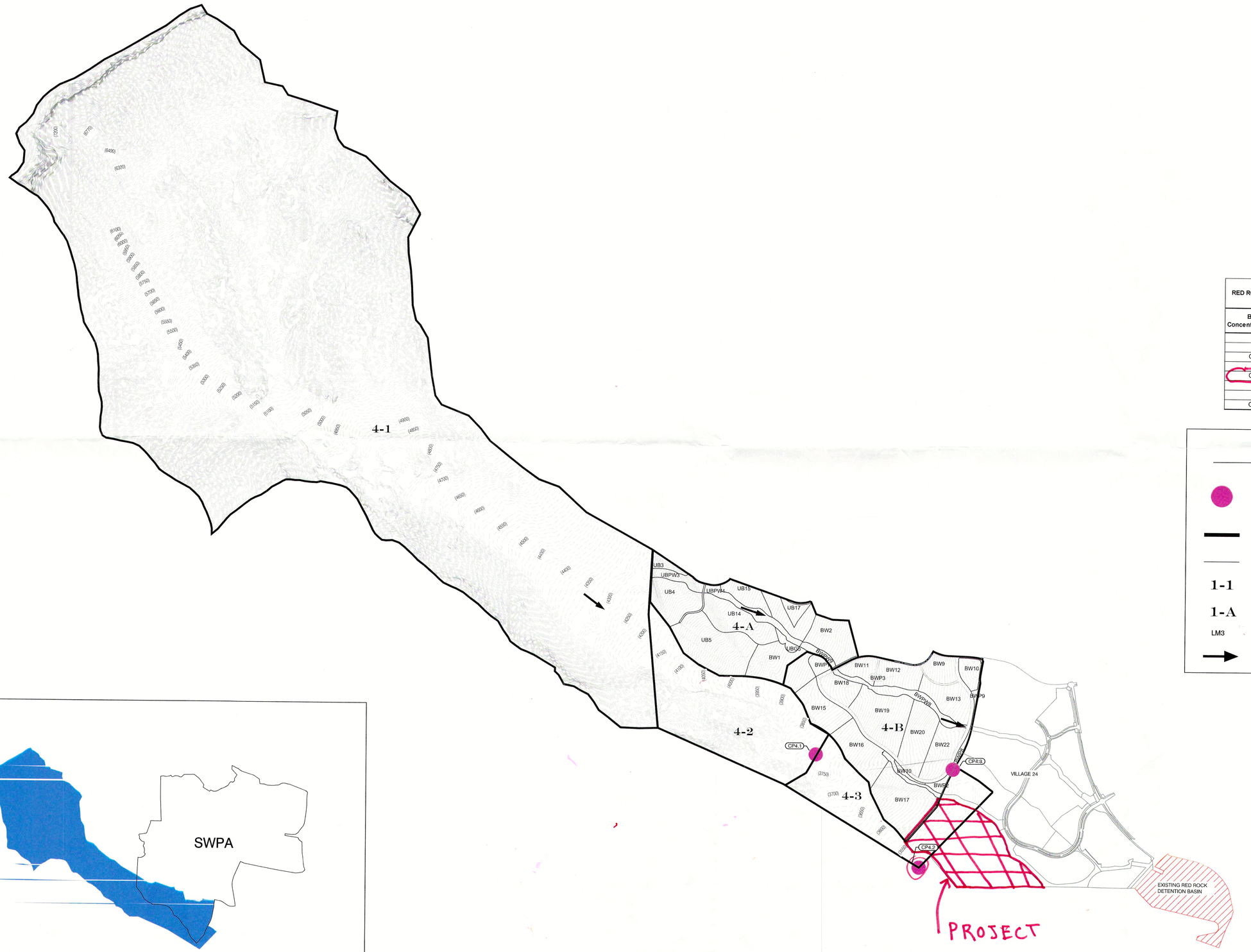
| V1 applies to the first 500 feet of travel distance<br>V2 applies to the remaining travel distance | | | |
|---|---|---|---|
| **Existing:** | | **Developed** | |
| $V1=148*S^{1/2}$ | $V2=294*S^{1/2}$ | $V1=202*S^{1/2}$ | $V2=306*S^{1/2}$ |

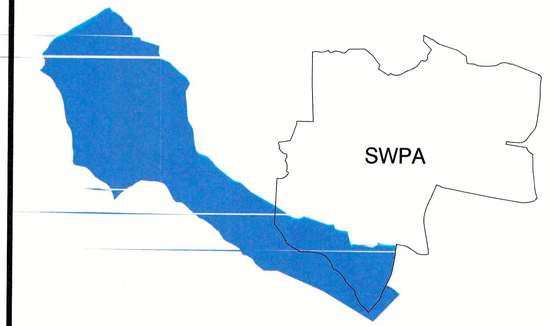
$$T_i = \frac{1.8(1.1-k)L^{1/2}}{S^{1/3}} \qquad T_t = \frac{L}{60V}$$

$$k = 0.0132C_n - 0.39 \qquad T_c = T_i + T_t$$

| SUB-BASIN DATA | | | | | INITIAL/OVERLAND TIME (Ti) | | | TRAVEL TIME (Tt) | | | | | Tc CHECK (URBANIZED BASINS) | | FINAL Tc | LAG TIME | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIG. (1) | Cn | K (2) | AREA Ac. (3) | AREA Mi^2 | LENGTH Ft (4) | SLOPE % (5) | Ti Min. (6) | LENGTH Ft. (7) | SLOPE % (8) | V1 fps (9a) | V2 fps (9b) | Tt Min. (10) | TOTAL LENGTH (11) | Tc Min. (12) | Min. | TLAG Hr. | |
| EXISTING CONDITION | | | | | | | | | | | | | | | | | |
| 1-1 | 87.0 | 0.758 | 1273.30 | 1.990 | | | | | | | | | | | | | OVER 1 MI$^2$ |
| 1-3 | 84.3 | 0.722 | 211.25 | 0.330 | 500 | 48.0 | 4.19 | 6213 | 13.2 | 5.4 | 10.7 | 10.46 | 6713 | 47.29 | 14.65 | 0.146 | |
| 1-4 | 88.0 | 0.772 | 347.58 | 0.543 | 500 | 44.0 | 3.74 | 5402 | 24.1 | 7.3 | 14.4 | 6.81 | 5902 | 42.79 | 10.56 | 0.106 | |
| 1-5 | 78.3 | 0.643 | 153.59 | 0.240 | 500 | 64.0 | 4.60 | 4955 | 3.1 | 2.6 | 5.2 | 17.46 | 5455 | 40.31 | 22.06 | 0.221 | |
| 1-6 | 88.0 | 0.772 | 48.17 | 0.075 | 100 | 32.0 | 1.86 | 1780 | 22.2 | 7.0 | 13.8 | 2.74 | 1880 | 20.44 | 10.00 | 0.100 | ORIGINAL TC WAS 4.6 MIN |
| 1-7 | 86.6 | 0.753 | 354.66 | 0.554 | 100 | 50.0 | 1.70 | 9501 | 19.1 | 6.5 | 12.8 | 12.98 | 9601 | 63.34 | 14.68 | 0.147 | |
| 3-1 | 87.0 | 0.758 | 1422.67 | 2.223 | | | | | | | | | | | | | OVER 1 MI$^2$ |
| 3-2 | 83.9 | 0.717 | 144.58 | 0.226 | 440 | 59.0 | 3.71 | 5695 | 23.3 | 7.1 | 14.2 | 7.27 | 6135 | 44.08 | 10.99 | 0.110 | THIS IS EXACT SAME BASIN AS DB54-5 |
| 3-3 | 88.0 | 0.771 | 111.16 | 0.174 | 500 | 64.0 | 3.31 | 3019 | 17.2 | 6.1 | 12.2 | 4.80 | 3519 | 29.55 | 8.10 | 0.081 | |
| 3-4 | 88.0 | 0.771 | 221.26 | 0.346 | 170 | 85.0 | 1.75 | 5808 | 22.7 | 7.1 | 14.0 | 7.49 | 5978 | 43.21 | 9.25 | 0.092 | |
| 3-5 | 87.7 | 0.768 | 187.91 | 0.294 | 500 | 72.0 | 3.22 | 5108 | 26.6 | 7.6 | 15.2 | 6.15 | 5608 | 41.16 | 9.37 | 0.094 | |
| 3-6 | 88.0 | 0.771 | 56.74 | 0.089 | 460 | 52.0 | 3.40 | 2956 | 23.7 | 7.2 | 14.3 | 4.02 | 3416 | 28.98 | 7.42 | 0.074 | |
| 3-7 | 87.2 | 0.761 | 109.69 | 0.171 | 100 | 77.0 | 1.43 | 2770 | 30.5 | 8.2 | 16.2 | 3.35 | 2870 | 25.94 | 4.78 | 0.048 | |
| 3-8 | 87.8 | 0.769 | 408.73 | 0.639 | 500 | 64.0 | 3.33 | 10844 | 15.5 | 5.8 | 11.6 | 16.30 | 11344 | 73.02 | 19.64 | 0.196 | |
| 4-1 | 87.6 | 0.766 | 2946.48 | 4.604 | | | | | | | | | | | | | OVER 1 MI$^2$ |
| 4-2 | 85.4 | 0.737 | 233.47 | 0.365 | 225 | 8.0 | 4.90 | 5288 | 8.2 | 4.2 | 8.4 | 11.43 | 5513 | 40.63 | 16.32 | 0.163 | |
| 4-3 | 85.1 | 0.733 | 134.55 | 0.210 | 100 | 6.0 | 3.63 | 4263 | 6.5 | 3.8 | 7.5 | 10.62 | 4363 | 34.24 | 14.25 | 0.143 | |

ONLY CHANGE IS AREA.




HEC-1 SUMMARY TABLE
RED ROCK DETENTION BASIN TRIBUTARY
PROPOSED CONDITION

| Basin / Concentration Point | Area (acre) | $Q_{100}$ (cfs) |
|---|---|---|
| 4-1 | 2946.46 | 3825 |
| 4-2 | 233.47 | 600 |
| CP4.1 | - | 3899 |
| 4-3 | 134.55 | 350 |
| CP4.2 | - | 3893 |
| 4-A | 230.33 | 525 |
| 4-B | 345.76 | 653 |
| CP4.3 | - | 1175 |

## LEGEND

- CONCENTRATION POINT
- BASIN BOUNDARY
- LOT BOUNDARY
- 1-1 OFF SITE BASIN ID
- 1-A ON SITE BASIN ID
- LM3 LOT ID
- FLOW ARROW

REVISION | BY | DATE | REV

THE HOWARD HUGHES CORPORATION
10801 WEST CHARLESTON BLVD. 3RD FLOOR
LAS VEGAS, NV

2727 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NEVADA 89146-5148
PH. (702) 873-7550 FAX (702) 362-2697 WEB WWW.VTNNV.COM
CONSULTING ENGINEERS ● PLANNERS ● LAND SURVEYORS

2017 SUMMERLIN WEST
PLANNING AREA

A.6.4
RED ROCK DETENTION BASIN
TRIBUTARY

DRAWN BY: SVB 9/2017
DESIGNED BY: SVB 9/2017
CHECKED BY:
PROJECT NO: 7809
SCALE: HORIZ. VERT.

SHEET
OF SHEETS
DRAWING NO.

H:\7809\Drainage\2_ADD\A Figures & Exhibits\A.6.4_Red Rock Tributary\Basin Map_Red Rock DB Tributary.dwg

# UPDATE #7 TO THE
# TECHNICAL DRAINAGE STUDY
# FOR
# SUMMERLIN VILLAGE 24 UNIT 2 IMPROVEMENTS - CROSSBRIDGE DRIVE
# (CROSSBRIDGE UNIT 1 TO SUNCREEK ROAD)

## 62024-221/62024-2226

## May 2017

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<br>INTER-OFFICE MEMORANDUM | | | | DATE:<br>May 17, 2017 |
|---|---|---|---|---|
| TO:<br>Land Development Services<br>Department of Public Works | | | | FROM:<br>Albert Sung, P.E.<br>Flood Control Project Engineer<br>Department of Public Works |
| SUBJECT: | Drainage Study for: | | | COPIES TO: |
| Summerlin Village 24 Unit 2 Improvements – Update #7<br>Crossbridge Drive Improvements<br>(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\DS4136M.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 | Approved | $100.00 | 435704: $100 |
| 12th Submittal | 5/1/2017 | 5/17/2017 | See Comments Below | $100.00 | 483385: $100 |
| | | | TOTAL FEES (LDDRS): | $3,000.00 | ---- |

**REMARKS:**

**12th Submittal: Update #7 to add a service pedestal**

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 Conc |

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 the update must be approved by the *City of Las Vegas Flood Control Section* prior to final approval of technical drainage study.

2. Provide a standard detail for cut-off wall at riprap pad. Provide a layer of geotextile filter membrane under the riprap with a base underneath. The cut-off wall must be at a minimum of 1' below the riprap. Revise all pertinent detail sections accordingly.

3. The project proposes to build temporary drainage facilities along the west boundary of **Village 24**. 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 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. Structural plans for the storm drain improvements (6# 5'x5' RCB culverts) and the *USBR Type IV Stilling Basin* 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.

5. 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.

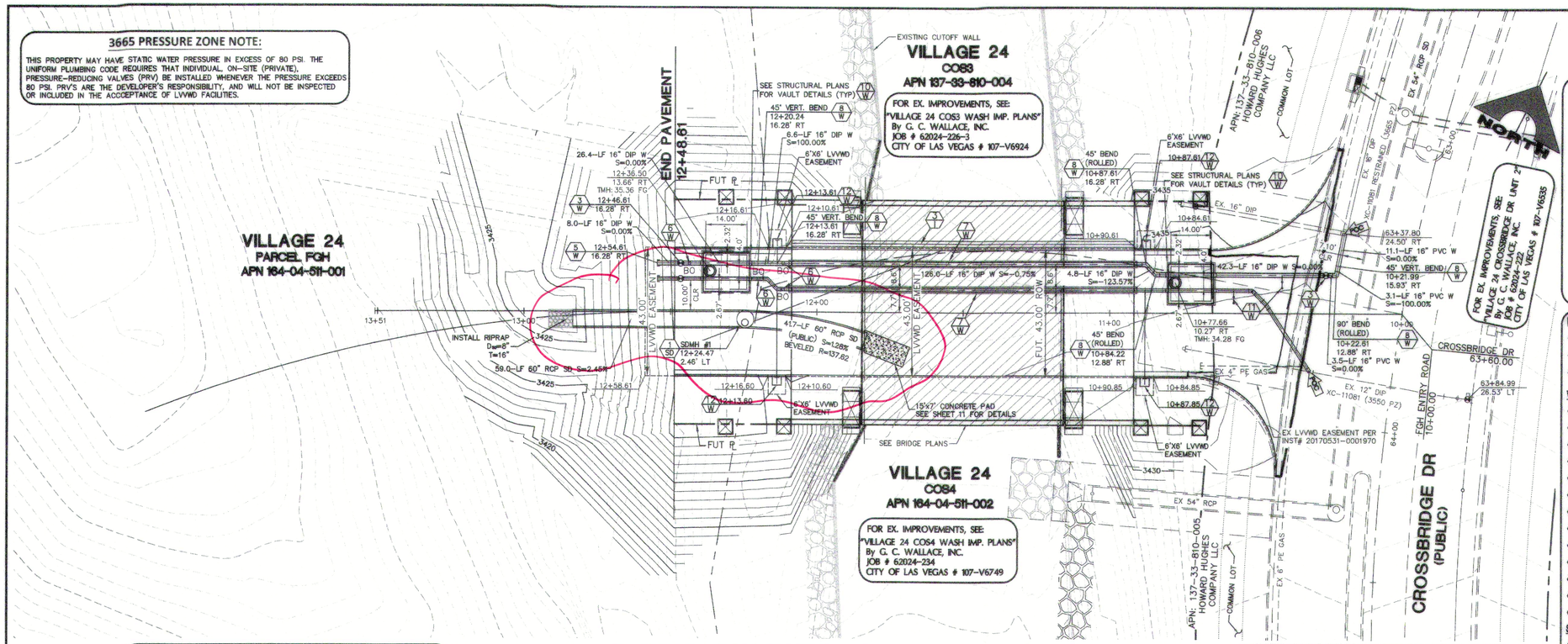
**NOTE:** Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the Nevada Division of Environmental Protection a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained 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.

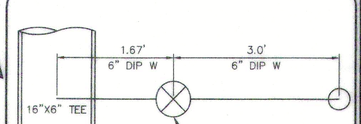
**END OF REMARKS**
Osk/ays

T/R/S: T20S/R59E/33 and 34
AREA K-22

### 3665 PRESSURE ZONE NOTE:

THIS PROPERTY MAY HAVE STATIC WATER PRESSURE IN EXCESS OF 80 PSI. THE UNIFORM PLUMBING CODE REQUIRES THAT INDIVIDUAL, ON-SITE (PRIVATE), PRESSURE-REDUCING VALVES (PRV) BE INSTALLED WHENEVER THE PRESSURE EXCEEDS 80 PSI. PRV'S ARE THE DEVELOPER'S RESPONSIBILITY, AND WILL NOT BE INSPECTED OR INCLUDED IN THE ACCEPTANCE OF LVVWD FACILITIES.




**6" MANUAL BLOW-OFF DETAIL** (A)
SCALE: N.T.S. PER UDACS PLATE NO. 37

**IMPROVEMENT NOTES:**
- PROTECT IN PLACE AND ADJUST TO GRADE AS REQUIRED
- RELOCATE WATER APPURTENANCES (VALVES TO REMAIN ACCESSIBLE AT ALL TIMES)
- INSTALL (3) 6" IRRIGATION SLEEVES

**WATER CONSTRUCTION NOTES:**
- INSTALL TEE/CROSS (RESTRAINED)
- INSTALL BEND (RESTRAINED. SEE PLAN FOR ∠)
- INSTALL GATE VALVE PER UDACS PLT. NO. 39
- INSTALL REDUCER PER UDACS PLT. NO. 30
- INSTALL CAP W/ 2" BLOW-OFF ASSEMBLY PER UDACS PLT. NO. 36
- INSTALL 2" MANUAL BLOW OFF ASSY PER UDACS PLT. NO. 36
- INSTALL STEEL CASING PER UDACS PLATE 22 & 23 CASING TO BE EMPTY – NO FILLING
- INSTALL VERT. 45° BEND (RESTRAINED)
- REMOVE CAP & BLOWOFF PER UDACS PLT. NO. 36 AND CONNECT TO EXISTING WATER LINE
- INSTALL REHABILITATION VAULT PER DWG. NO. S1 & S2 AND DETAIL 4 DWG. NO. 12.
- INSTALL 6" MANUAL BLOW OFF ASSY PER UDACS PLT. NO. 37 AND DETAIL A/DWG. NO. 9 (16" DIP) OR DETAIL A/DWG. NO. 9A (12" DIP)
- INSTALL TYPE "I" TEST STATION PER DETAIL 3 DWG. NO. 12 AND DETAILS 1, 2, 4, 5 & 6 ON DWG. NO. 13.
- INSTALL FL X FL 45 DEGREE VERTICAL BEND W/ INSULATING FLANGE PER UDACS PLATE NO. 73.

**STORM DRAIN CONSTRUCTION NOTES:**
- INSTALL TYPE II-SD MANHOLE PER USD DWG. 405.2
- INSTALL TEMPORARY PLUG AND CAP STORM DRAIN LINE

* CONTRACTOR TO VERIFY SIZE AND LOCATION OF EXISTING UTILITIES PRIOR TO CONSTRUCTION

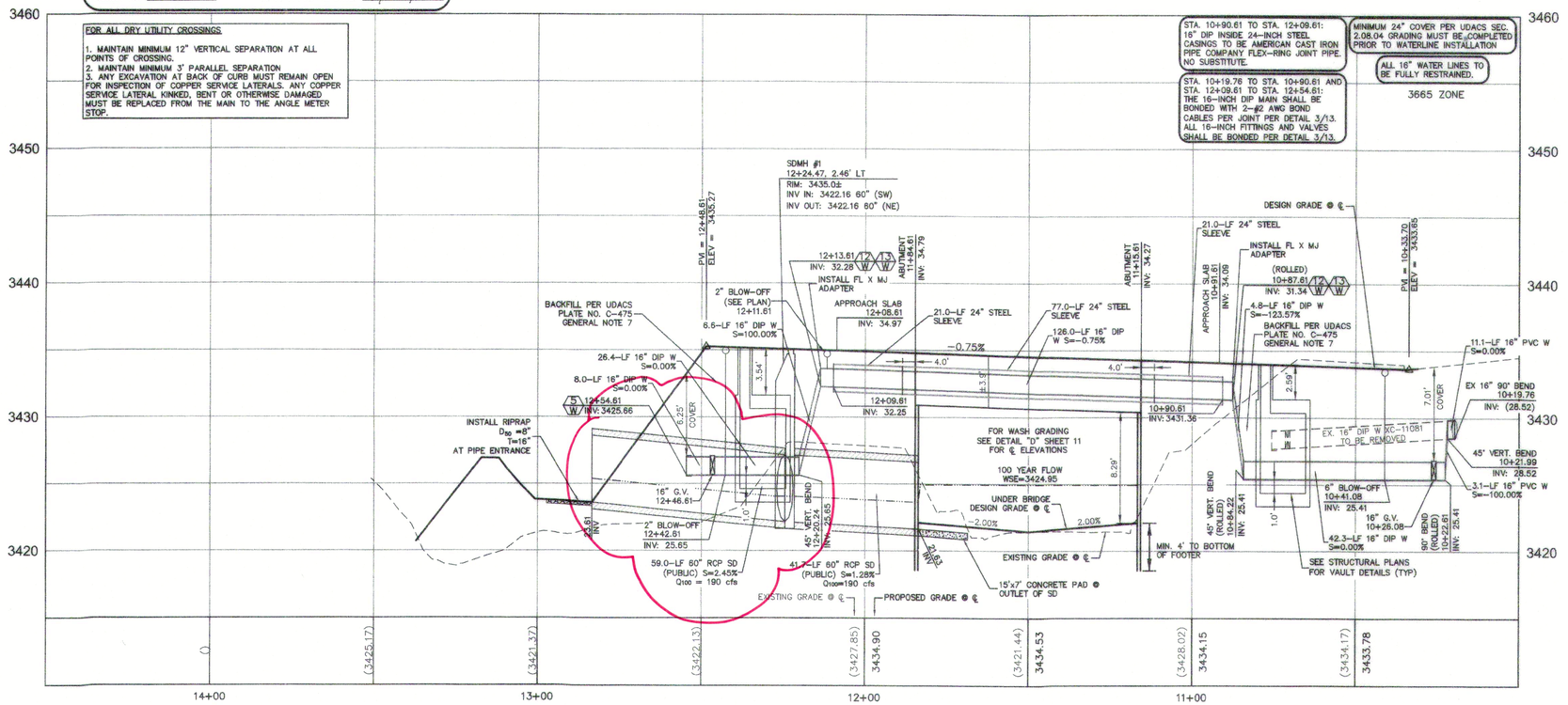
## PARCEL FGH ENTRY ROAD

SCALE: HORIZ 1" = 20'
VERT. 1" = 5'

**APPROVED FOR CONSTRUCTION**
LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES
PROJECT NO. 126311 FIRST APPROVAL DATE: 1/28/19

**SOUTHWEST GAS APPROVAL**
N/A — SOUTHWEST GAS CORPORATION — N/A DATE

**FOR ALL DRY UTILITY CROSSINGS**
1. MAINTAIN MINIMUM 12" VERTICAL SEPARATION AT ALL POINTS OF CROSSING.
2. MAINTAIN MINIMUM 3' PARALLEL SEPARATION
3. ANY EXCAVATION AT BACK OF CURB MUST REMAIN OPEN FOR INSPECTION OF COPPER SERVICE LATERALS. ANY COPPER SERVICE LATERAL KINKED, BENT OR OTHERWISE DAMAGED MUST BE REPLACED FROM THE MAIN TO THE ANGLE METER STOP.



**NOTE**
LVVWD CANNOT GUARANTEE A WATERTIGHT SHUTDOWN WHERE CONNECTIONS OR REPAIRS TO EXISTING FACILITIES ARE REQUIRED. THE CONTRACTOR SHALL ENSURE ALL LABOR AND EQUIPMENT IS AVAILABLE TO REMOVE REMAINING WATER. COORDINATION WITH INSPECTION DIVISION MUST TAKE PLACE PRIOR TO ANY TRIAL SHUTDOWN.
CONTRACTOR TO INSTALL TEMPORARY SERVICE TO ENSURE PROPER SHUTDOWN IN THE EVENT NO OTHER APPURTENANCES ARE AVAILABLE.

**TO ENSURE LVVWD ACCESS WITHIN EASEMENT**
ALL ABOVE GROUND OBSTRUCTIONS INCLUDING BUT NOT LIMITED TO, LANDSCAPE BOULDERS, FENCES/WALLS, AND SIGNS ARE STRICTLY PROHIBITED WITHIN EASEMENT.

**NOTE**
1. INSTALL PIPELINE MARKER BALLS, PER UDACS PLATE NO. 15.
2. THIS PROJECT PROVIDES FOR THE INSTALLATION OF OFF-SITE WATER MAINS ONLY, AND DOES NOT PROVIDE OR IMPLY ANY WATER COMMITMENT.
3. ALL SEWER/STORM DRAIN CROSSING WATER LINES MUST COMPLY WITH UDACS SECTION 2.22.

**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 CLARK COUNTY RURAL OPERATIONS 1-702-455-6000
AVOID HITTING OVERHEAD POWER LINES. IT'S COSTLY. CALL BEFORE YOU DO OVERHEAD 811 1-702-227-2929
FAST — Call before you UnderGround 1-702-432-5300 FREEWAY AND ARTERIAL SYSTEM OF TRANSPORTATION

CLV # L18-02027 107V7659


GCW
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
ENGINEERS \ SURVEYORS gcwengineering.com
F:\Projects\600\62024-235\DWG\Production\V24-235_UT.dwg
Alexander Santiago


ENGINEER - STATE OF NEVADA — VICKI D. MARJERRISON — No. 13079 — PROFESSIONAL ENGINEER — DATE: 01/16/19

| REV | DATE | DESCRIPTION | DATE | AGEN. APP | DATE | CCW APP | DATE |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

PROJECT NO. 62024-235
DESIGN:
DRAWN:
CHECK:
PLOT DATE: 01-16-19
PLOT TIME: 18:16:33

HOWARD HUGHES COMPANY, LLC
VILLAGE 24 - PARCEL FGH ENTRY ROAD
UTILITY PLAN - 3665 ZONE

DRAWING 9
9 OF 37 SHTS

PROJ#:126311A QS:137-33-SE

# UPDATE #2 TO THE TECHNICAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24 PARCEL COS-4

62024-234

September 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

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

TRANSMISSION OK

| | |
|---|---|
| JOB NO. | 0597 |
| DESTINATION ADDRESS | 7028042299 |
| PSWD/SUBADDRESS | |
| DESTINATION ID | |
| ST. TIME | 10/18 16:47 |
| USAGE T | 00'41 |
| PGS. | 2 |
| RESULT | OK |

# CITY OF LAS VEGAS
# INTER-OFFICE MEMORANDUM

**DATE:** October 17, 2017

**TO:**
**Land Development Services**
Department of Building & Safety

**FROM:**
Albert Sung, P.E.
Flood Control Project Engineer
Department of Public Works

**COPIES TO:**
GCW Engineers / Surveyors
Howard Hughes Company, LLC
Bart Anderson, P.E., DevCo

| | | | |
|---|---|---|---|
| **SUBJECT:** | Drainage Study for: **Summerlin Village 24 – Parcel COS-4 – Update #2** | | |
| **Cross Streets:** | West of Sky Vista Drive & Charleston Blvd. | | |
| **File Number:** | F:\Depot\DSMemos\DS4775D.doc | | |
| **Parcel Number:** | 137-33-801-002 | | |
| **Zoning Action:** | FMP-62680 | | |
| **FEMA Flood Zone** | YES | NO X | |
| **Proposed Storm Drain** | YES | NO X | |

COS-4 WASH

| HISTORY | DATE RECEIVED | DATE REVIEWED | COMMENTS | REVIEW FEES | FEES PAID Payment Trn # |
|---|---|---|---|---|---|
| 1st Submittal | 12/31/2015 | 1/25/2016 | Not Approved | $400.00 | 428201: $400 |
| 2nd Submittal | 3/10/2016 | 4/7/2016 | Approved | $400.00 | 436539: $400 |
| 3rd Submittal | 8/24/2016 | 9/12/2016 | Approved | $100.00 | 456091: $100 |
| 4th Submittal | 9/25/2017 | 10/18/2017 | See Comments Below | $100.00 | 490241: $100 |
| | | | **TOTAL FEES (LDDRS):** | **$1,000.00** | ---- |

**REMARKS:**

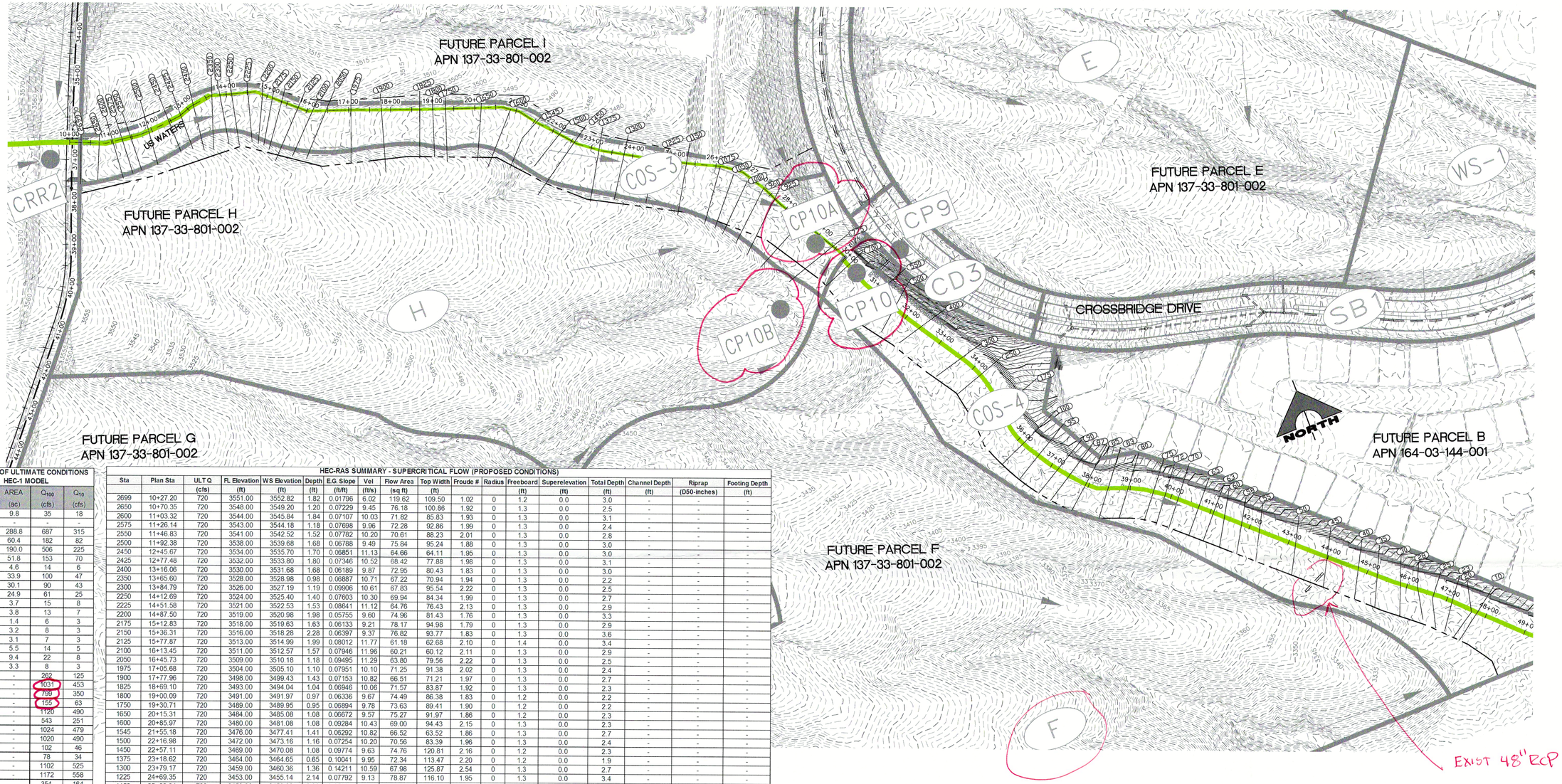
**4th Submittal: Update #2 for minor flow revision per Update #4 to Conceptual Drainage Study for Summerlin Village 24**

3rd Submittal: Update #1 to revise channel side slopes from 2:1 to 3:1 or 4:1

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-4" wash 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.




SCALE: 120 0 120 240 FEET

## LEGEND

- COS-3 — DRAINAGE SUBBASIN
- CP1 — CONCENTRATION POINT
- SUBBASIN BOUNDARY
- 850 — HEC-RAS CROSS SECTION
- EX. US WATERS DELINEATION

**SUMMARY OF ULTIMATE CONDITIONS HEC-1 MODEL**

| SC OR CP | AREA (ac) | $Q_{100}$ (cfs) | $Q_{10}$ (cfs) |
|---|---|---|---|
| ALTA | 9.8 | 35 | 18 |
| - | - | - | - |
| 7-2A | 288.8 | 687 | 315 |
| 7-2B | 60.4 | 182 | 82 |
| 7-5A | 190.0 | 506 | 225 |
| 7-7A | 51.8 | 153 | 70 |
| A1 | 4.6 | 14 | 6 |
| A2 | 33.9 | 100 | 47 |
| B | 30.1 | 90 | 43 |
| C | 24.9 | 61 | 25 |
| CD1 | 3.7 | 15 | 8 |
| CD2 | 3.8 | 13 | 7 |
| CD3 | 1.4 | 6 | 3 |
| COS-1 | 3.2 | 8 | 3 |
| COS-2 | 3.1 | 7 | 3 |
| COS-3 | 5.5 | 14 | 5 |
| COS-4 | 9.4 | 22 | 8 |
| COS-6 | 3.3 | 8 | 3 |
| CP1 | - | 262 | 125 |
| CP10 | - | 1031 | 453 |
| CP10A | - | 799 | 350 |
| CP10B | - | 155 | 63 |
| CP11 | - | 1120 | 490 |
| CP12 | - | 543 | 251 |
| CP15 | - | 1024 | 479 |
| CP16 | - | 1020 | 490 |
| CP17 | - | 102 | 46 |
| CP17A | - | 78 | 34 |
| CP18 | - | 1102 | 525 |
| CP19 | - | 1172 | 558 |
| CP2 | - | 354 | 164 |
| CP3 | - | 356 | 165 |
| CP5 | - | 408 | 192 |
| CP6 | - | 435 | 204 |
| CP7 | - | 595 | 274 |
| CP8 | - | 949 | 446 |
| CP9 | - | 123 | 52 |
| CPA2 | - | 114 | 54 |
| CPAD | - | 40 | 21 |
| CPSV2 | - | 23 | 12 |
| CPSV3 | - | 25 | 12 |
| CRR1 | - | 841 | 386 |
| CRR2 | - | 720 | 313 |
| CS-1 | 16.8 | 55 | 27 |
| D | 34.8 | 88 | 37 |
| DIV1 | - | 287 | 132 |
| E | 24.1 | 64 | 27 |
| F | 37.8 | 92 | 36 |
| FS1 | - | 554 | 255 |
| G | 42.6 | 100 | 39 |
| H | 22.1 | 58 | 24 |
| I | 38.6 | 102 | 43 |
| J | 43.6 | 110 | 46 |
| K | 29.6 | 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 | 1.3 | 5 | 3 |
| SB3 | 3.5 | 13 | 7 |
| SB4 | 0.5 | 2 | 1 |
| ST1 | 1.1 | 5 | 2 |
| ST2 | 9.6 | 33 | 17 |
| ST4 | 6.0 | 22 | 12 |
| ST6 | 1.8 | 8 | 4 |
| SV1 | 3.6 | 14 | 8 |
| SV2 | 2.1 | 9 | 4 |
| SV3 | 2.7 | 11 | 6 |
| WS-1 | 5.9 | 19 | 9 |

**HEC-RAS SUMMARY - SUPERCRITICAL FLOW (PROPOSED CONDITIONS)**

| Sta | Plan Sta | ULTQ (cfs) | FL Elevation (ft) | WS Elevation (ft) | Depth (ft) | E.G. Slope (ft/ft) | Vel (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # | Radius | Freeboard (ft) | Superelevation (ft) | Total Depth (ft) | Channel Depth (ft) | Riprap (D50-inches) | Footing Depth (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2699 | 10+27.20 | 720 | 3551.00 | 3552.82 | 1.82 | 0.01796 | 6.02 | 119.62 | 109.50 | 1.02 | 0 | 1.2 | 0.0 | 3.0 | - | - | - |
| 2650 | 10+70.35 | 720 | 3548.00 | 3549.20 | 1.20 | 0.07229 | 9.45 | 76.18 | 100.86 | 1.92 | 0 | 1.3 | 0.0 | 2.5 | - | - | - |
| 2600 | 11+03.32 | 720 | 3544.00 | 3545.84 | 1.84 | 0.07107 | 10.03 | 71.82 | 85.83 | 1.93 | 0 | 1.3 | 0.0 | 3.1 | - | - | - |
| 2575 | 11+26.14 | 720 | 3543.00 | 3544.18 | 1.18 | 0.07698 | 9.96 | 72.28 | 92.86 | 1.99 | 0 | 1.3 | 0.0 | 2.4 | - | - | - |
| 2550 | 11+46.83 | 720 | 3541.00 | 3542.52 | 1.52 | 0.07782 | 10.20 | 70.61 | 88.23 | 2.01 | 0 | 1.3 | 0.0 | 2.8 | - | - | - |
| 2500 | 11+92.38 | 720 | 3538.00 | 3539.68 | 1.68 | 0.06788 | 9.49 | 75.84 | 95.24 | 1.88 | 0 | 1.3 | 0.0 | 3.0 | - | - | - |
| 2450 | 12+45.67 | 720 | 3534.00 | 3535.70 | 1.70 | 0.06851 | 11.13 | 64.66 | 64.11 | 1.95 | 0 | 1.3 | 0.0 | 3.0 | - | - | - |
| 2425 | 12+77.48 | 720 | 3532.00 | 3533.80 | 1.80 | 0.07346 | 10.52 | 68.42 | 77.88 | 1.98 | 0 | 1.3 | 0.0 | 3.1 | - | - | - |
| 2400 | 13+16.06 | 720 | 3530.00 | 3531.68 | 1.68 | 0.06189 | 9.87 | 72.95 | 80.43 | 1.83 | 0 | 1.3 | 0.0 | 3.0 | - | - | - |
| 2350 | 13+65.60 | 720 | 3528.00 | 3528.98 | 0.98 | 0.06887 | 10.71 | 67.22 | 70.94 | 1.94 | 0 | 1.3 | 0.0 | 2.2 | - | - | - |
| 2300 | 13+84.79 | 720 | 3526.00 | 3527.19 | 1.19 | 0.09906 | 10.61 | 67.83 | 95.54 | 2.22 | 0 | 1.3 | 0.0 | 2.5 | - | - | - |
| 2250 | 14+12.69 | 720 | 3524.00 | 3525.40 | 1.40 | 0.07603 | 10.30 | 69.94 | 84.34 | 1.99 | 0 | 1.3 | 0.0 | 2.7 | - | - | - |
| 2225 | 14+51.58 | 720 | 3521.00 | 3522.53 | 1.53 | 0.08641 | 11.12 | 64.76 | 76.43 | 2.13 | 0 | 1.3 | 0.0 | 2.9 | - | - | - |
| 2200 | 14+87.50 | 720 | 3519.00 | 3520.98 | 1.98 | 0.05755 | 9.60 | 74.96 | 81.43 | 1.76 | 0 | 1.3 | 0.0 | 3.3 | - | - | - |
| 2175 | 15+12.83 | 720 | 3518.00 | 3519.63 | 1.63 | 0.06133 | 9.21 | 78.17 | 94.98 | 1.79 | 0 | 1.3 | 0.0 | 2.9 | - | - | - |
| 2150 | 15+36.31 | 720 | 3516.00 | 3518.28 | 2.28 | 0.06397 | 9.37 | 76.82 | 93.77 | 1.83 | 0 | 1.3 | 0.0 | 3.6 | - | - | - |
| 2125 | 15+77.87 | 720 | 3513.00 | 3514.99 | 1.99 | 0.08012 | 11.77 | 61.18 | 62.68 | 2.10 | 0 | 1.4 | 0.0 | 3.4 | - | - | - |
| 2100 | 16+13.45 | 720 | 3511.00 | 3512.57 | 1.57 | 0.07946 | 11.96 | 60.21 | 60.12 | 2.11 | 0 | 1.3 | 0.0 | 2.9 | - | - | - |
| 2050 | 16+45.73 | 720 | 3509.00 | 3510.18 | 1.18 | 0.09495 | 11.29 | 63.80 | 79.56 | 2.22 | 0 | 1.3 | 0.0 | 2.5 | - | - | - |
| 1975 | 17+05.68 | 720 | 3504.00 | 3505.10 | 1.10 | 0.07951 | 10.10 | 71.25 | 91.38 | 2.02 | 0 | 1.3 | 0.0 | 2.4 | - | - | - |
| 1900 | 17+77.96 | 720 | 3498.00 | 3499.43 | 1.43 | 0.07153 | 10.82 | 66.51 | 71.21 | 1.97 | 0 | 1.3 | 0.0 | 2.7 | - | - | - |
| 1825 | 18+69.10 | 720 | 3493.00 | 3494.04 | 1.04 | 0.06946 | 10.06 | 71.57 | 83.87 | 1.92 | 0 | 1.3 | 0.0 | 2.3 | - | - | - |
| 1800 | 19+00.09 | 720 | 3491.00 | 3491.97 | 0.97 | 0.06336 | 9.67 | 74.49 | 86.38 | 1.83 | 0 | 1.2 | 0.0 | 2.2 | - | - | - |
| 1750 | 19+30.71 | 720 | 3489.00 | 3489.95 | 0.95 | 0.06894 | 9.78 | 73.63 | 89.41 | 1.90 | 0 | 1.2 | 0.0 | 2.2 | - | - | - |
| 1650 | 20+15.31 | 720 | 3484.00 | 3485.08 | 1.08 | 0.06672 | 9.57 | 75.27 | 91.97 | 1.86 | 0 | 1.2 | 0.0 | 2.3 | - | - | - |
| 1600 | 20+85.97 | 720 | 3480.00 | 3481.08 | 1.08 | 0.09284 | 10.43 | 69.00 | 94.43 | 2.15 | 0 | 1.3 | 0.0 | 2.3 | - | - | - |
| 1545 | 21+55.18 | 720 | 3476.00 | 3477.41 | 1.41 | 0.06292 | 10.82 | 66.52 | 63.52 | 1.86 | 0 | 1.3 | 0.0 | 2.7 | - | - | - |
| 1500 | 22+16.98 | 720 | 3472.00 | 3473.16 | 1.16 | 0.07254 | 10.20 | 70.56 | 83.39 | 1.96 | 0 | 1.3 | 0.0 | 2.4 | - | - | - |
| 1450 | 22+57.11 | 720 | 3469.00 | 3470.08 | 1.08 | 0.09774 | 9.63 | 74.76 | 120.81 | 2.16 | 0 | 1.2 | 0.0 | 2.3 | - | - | - |
| 1375 | 23+18.62 | 720 | 3464.00 | 3464.65 | 0.65 | 0.10041 | 9.95 | 72.34 | 113.47 | 2.20 | 0 | 1.2 | 0.0 | 1.9 | - | - | - |
| 1300 | 23+79.17 | 720 | 3459.00 | 3460.36 | 1.36 | 0.14211 | 10.59 | 67.98 | 125.87 | 2.54 | 0 | 1.3 | 0.0 | 2.7 | - | - | - |
| 1225 | 24+69.35 | 720 | 3453.00 | 3455.14 | 2.14 | 0.07792 | 9.13 | 78.87 | 116.10 | 1.95 | 0 | 1.3 | 0.0 | 3.4 | - | - | - |
| 1150 | 25+29.34 | 720 | 3450.00 | 3450.83 | 0.83 | 0.05262 | 8.35 | 86.19 | 108.32 | 1.65 | 0 | 1.2 | 0.0 | 2.0 | - | - | - |
| 1075 | 26+10.01 | 720 | 3444.00 | 3445.70 | 1.70 | 0.09472 | 10.60 | 67.95 | 92.07 | 2.17 | 0 | 1.3 | 0.0 | 3.0 | - | - | - |
| 1050 | 26+45.61 | 720 | 3442.00 | 3443.67 | 1.67 | 0.08035 | 9.46 | 76.11 | 108.83 | 1.99 | 0 | 1.3 | 0.0 | 3.0 | - | - | - |
| 1000 | 26+86.80 | 720 | 3441.00 | 3442.09 | 1.09 | 0.05644 | 8.82 | 81.67 | 99.79 | 1.72 | 0 | 1.2 | 0.0 | 2.3 | - | - | - |
| 960 | 27+27.71 | 720 | 3438.00 | 3439.74 | 1.74 | 0.05949 | 8.76 | 82.15 | 104.98 | 1.75 | 0 | 1.3 | 0.0 | 3.0 | - | - | - |
| 925 | 27+63.01 | 720 | 3436.00 | 3437.31 | 1.31 | 0.06483 | 9.33 | 77.15 | 95.87 | 1.83 | 0 | 1.3 | 0.0 | 2.6 | - | - | - |
| 850 | 28+47.94 | 799 | 3431.00 | 3432.83 | 1.83 | 0.04558 | 9.30 | 85.93 | 81.97 | 1.60 | 0 | 1.3 | 0.0 | 3.1 | - | - | - |
| 775 | 29+42.50 | 799 | 3424.00 | 3426.14 | 2.14 | 0.07972 | 11.29 | 70.76 | 77.14 | 2.08 | 0 | 1.4 | 0.0 | 3.5 | - | - | - |
| 700 | 30+14.92 | 799 | 3421.00 | 3422.63 | 1.63 | 0.01787 | 11.72 | 68.19 | 61.95 | 1.97 | 0 | 1.3 | 0.0 | 3.0 | 8.0 | 12 (LOB, ROB) | 5.0 |
| 550 | 31+10.26 | 1078 | 3415.41 | 3416.61 | 1.20 | 0.16515 | 15.20 | 70.93 | 85.67 | 2.94 | 0 | 1.4 | 0.0 | 2.6 | 7.9 | 12 (LOB, ROB) | 5.0 |
| 500 | 31+64.49 | 1078 | 3412.00 | 3413.66 | 1.66 | 0.04912 | 10.70 | 100.73 | 81.95 | 1.70 | 0 | 1.3 | 0.0 | 3.0 | 6.3 | 12 (LOB, ROB) | 5.0 |
| 400 | 32+40.88 | 1078 | 3406.78 | 3408.51 | 1.73 | 0.06721 | 13.16 | 81.89 | 60.69 | 2.00 | 0 | 1.4 | 0.0 | 3.1 | 6.7 | 12 (LOB, ROB) | 5.0 |
| 300 | 33+62.68 | 1078 | 3399.62 | 3401.79 | 2.17 | 0.05600 | 11.52 | 93.58 | 73.58 | 1.80 | 0 | 1.4 | 0.0 | 3.5 | 7.4 | 12 (LOB, ROB) | 5.0 |
| 250 | 34+23.30 | 1078 | 3396.22 | 3397.89 | 1.67 | 0.06954 | 11.77 | 91.59 | 83.63 | 1.98 | 0 | 1.3 | 0.0 | 3.0 | 6.6 | 12 (LOB, ROB) | 5.0 |
| 175 | 35+17.24 | 1078 | 3390.96 | 3392.53 | 1.57 | 0.05313 | 10.97 | 98.26 | 81.59 | 1.76 | 0 | 1.3 | 0.0 | 2.9 | 5.4 | 12 (LOB, ROB) | 5.0 |
| 100 | 36+14.97 | 1078 | 3384.96 | 3386.86 | 1.90 | 0.06358 | 11.17 | 96.50 | 88.37 | 1.88 | 0 | 1.3 | 0.0 | 3.2 | 5.4 | 12 (LOB, ROB) | 5.0 |
| 95 | 36+61.08 | 1078 | 3381.93 | 3383.79 | 1.86 | 0.06331 | 11.27 | 95.63 | 85.92 | 1.88 | 0 | 1.3 | 0.0 | 3.2 | 5.9 | 12 (LOB, ROB) | 5.0 |
| 90 | 37+17.65 | 1078 | 3378.92 | 3380.56 | 1.64 | 0.05589 | 10.88 | 99.05 | 85.80 | 1.79 | 0 | 1.3 | 0.0 | 3.0 | 5.9 | 12 (LOB, ROB) | 5.0 |
| 87 | 37+48.34 | 1078 | 3376.89 | 3378.76 | 1.87 | 0.06039 | 11.05 | 97.57 | 87.15 | 1.84 | 0 | 1.3 | 0.0 | 3.2 | 6.8 | 12 (LOB, ROB) | 5.0 |
| 85 | 37+92.84 | 1078 | 3373.00 | 3375.55 | 2.55 | 0.07220 | 11.78 | 91.53 | 85.21 | 2.00 | 0 | 1.4 | 0.0 | 4.0 | 7.8 | 12 (LOB, ROB) | 5.0 |
| 83 | 38+47.42 | 1078 | 3370.00 | 3372.62 | 2.62 | 0.05198 | 10.43 | 103.32 | 89.70 | 1.71 | 0 | 1.4 | 0.0 | 4.0 | 8.6 | 12 (LOB, ROB) | 5.0 |
| 80 | 38+95.33 | 1078 | 3368.00 | 3370.85 | 2.85 | 0.03511 | 9.61 | 112.18 | 81.26 | 1.44 | 0 | 1.3 | 0.0 | 4.2 | 8.2 | 12 (LOB, ROB) | 5.0 |
| 75 | 39+56.20 | 1078 | 3365.45 | 3367.44 | 1.99 | 0.06528 | 11.29 | 95.52 | 87.31 | 1.90 | 0 | 1.4 | 0.0 | 3.3 | 6.2 | 12 (LOB, ROB) | 5.0 |
| 72 | 39+85.09 | 1078 | 3363.00 | 3365.30 | 2.30 | 0.07200 | 11.68 | 92.27 | 86.39 | 1.99 | 0 | 1.4 | 0.0 | 3.7 | 6.8 | 12 (LOB, ROB) | 5.0 |
| 70 | 40+17.18 | 1078 | 3360.73 | 3362.92 | 2.19 | 0.07403 | 11.79 | 91.45 | 86.36 | 2.02 | 0 | 1.4 | 0.0 | 3.6 | 6.2 | 12 (LOB, ROB) | 5.0 |
| 65 | 40+70.16 | 1078 | 3357.57 | 3359.62 | 2.05 | 0.05992 | 11.11 | 97.01 | 85.65 | 1.84 | 0 | 1.4 | 0.0 | 3.4 | 6.3 | 12 (LOB, ROB) | 5.0 |
| 63 | 41+07.62 | 1078 | 3354.00 | 3356.48 | 2.48 | 0.08874 | 12.25 | 88.02 | 89.85 | 2.18 | 0 | 1.4 | 0.0 | 3.9 | 6.8 | 12 (LOB, ROB) | 5.0 |
| 60 | 41+35.51 | 1078 | 3353.00 | 3354.61 | 1.61 | 0.06638 | 11.43 | 94.32 | 86.52 | 1.93 | 0 | 1.3 | 0.0 | 2.9 | 5.6 | 12 (LOB, ROB) | 5.0 |
| 58 | 41+79.54 | 1078 | 3350.05 | 3351.76 | 1.71 | 0.06439 | 11.34 | 95.03 | 86.25 | 1.91 | 0 | 1.3 | 0.0 | 3.0 | 6.0 | 12 (LOB, ROB) | 5.0 |
| 55 | 42+25.29 | 1078 | 3347.25 | 3348.92 | 1.67 | 0.06433 | 11.02 | 97.79 | 92.38 | 1.89 | 0 | 1.3 | 0.0 | 3.0 | 5.6 | 12 (LOB, ROB) | 5.0 |
| 50 | 43+17.42 | 1078 | 3341.92 | 3343.88 | 1.96 | 0.05016 | 10.45 | 103.16 | 87.59 | 1.70 | 0 | 1.3 | 0.0 | 3.3 | 6.1 | 12 (LOB, ROB) | 5.0 |
| 45 | 43+97.91 | 1225 | 3337.00 | 3339.14 | 2.14 | 0.05834 | 11.50 | 106.56 | 87.63 | 1.84 | 0 | 1.4 | 0.0 | 3.5 | 5.8 | 12 (LOB, ROB) | 5.0 |
| 40 | 44+77.01 | 1225 | 3332.62 | 3334.17 | 1.55 | 0.06429 | 11.84 | 103.50 | 87.77 | 1.92 | 0 | 1.3 | 0.0 | 2.9 | 4.8 | 12 (LOB, ROB) | 5.0 |
| 35 | 45+24.82 | 1225 | 3329.00 | 3330.96 | 1.96 | 0.06721 | 12.00 | 102.08 | 88.18 | 1.97 | 0 | 1.4 | 0.0 | 3.3 | 4.1 | 12 (LOB, ROB) | 5.0 |
| 30 | 45+83.77 | 1225 | 3325.94 | 3327.28 | 1.34 | 0.06073 | 11.74 | 104.39 | 86.56 | 1.88 | 0 | 1.3 | 0.0 | 2.7 | 4.9 | 12 (LOB, ROB) | 5.0 |
| 28 | 46+27.38 | 1225 | 3323.00 | 3325.10 | 2.10 | 0.04802 | 10.95 | 111.85 | 86.16 | 1.69 | 0 | 1.4 | 0.0 | 3.5 | 6.5 | 12 (LOB, ROB) | 5.0 |
| 25 | 46+66.69 | 1225 | 3320.66 | 3322.64 | 1.98 | 0.06429 | 11.96 | 102.45 | 85.47 | 1.93 | 0 | 1.4 | 0.0 | 3.4 | 6.5 | 12 (LOB, ROB) | 5.0 |
| 23 | 47+13.40 | 1225 | 3319.00 | 3321.75 | 2.75 | 0.02628 | 9.11 | 134.40 | 87.52 | 1.30 | 0 | 1.3 | 0.0 | 4.1 | 7.1 | 12 (LOB, ROB) | 5.0 |
| 20 | 47+62.46 | 1225 | 3317.00 | 3318.80 | 1.80 | 0.04493 | 8.58 | 143.71 | 156.75 | 1.57 | 0 | 1.3 | 0.0 | 3.1 | 7.0 | 12 (LOB, ROB) | 5.0 |
| 10 | 47+78.43 | 1225 | 3315.37 | 3318.93 | 3.56 | 0.015609 | 7.72 | 161.84 | 93.04 | 1.03 | 0 | 1.3 | 0.0 | 4.9 | 6.9 | 12 (LOB, ROB) | 5.0 |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gcwengineering.com


F:\Projects\620\62024-23A\Division\Civil\Figures\Fig-7RU Proposed HEC-RAS1.dwg

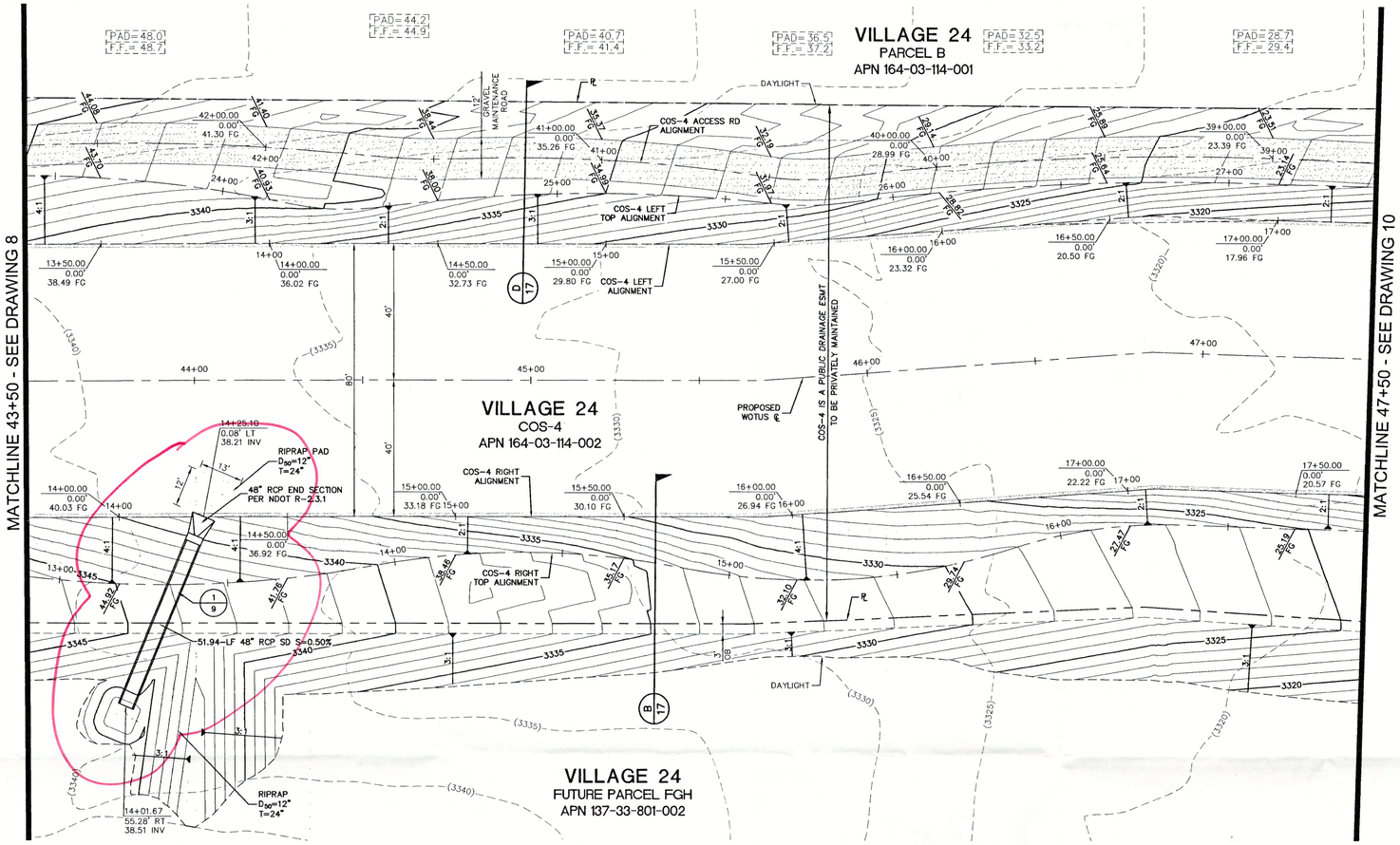
DESIGN:
DRAWN:
CHECK:
ISSUE DATE:
ISSUE EDITOR:
PLOT DATE: 09-06-17
PLOT TIME: 09:33:26

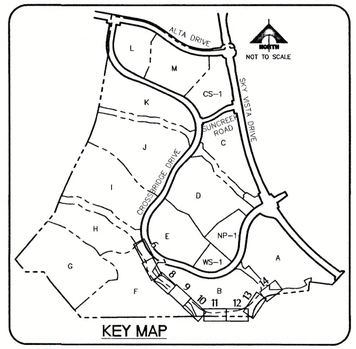
| REV. | DATE | DESCRIPTION | DATE | AGEN. APP | DATE | DWN. APP | DATE: |
|---|---|---|---|---|---|---|---|

THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24 - US WATERS
COS-4 WASH
PROPOSED CONDITIONS HEC-RAS EXHIBIT

DRAWING
FIG-7RU
OF SHTS

20242B dwg 09/01/17 pm

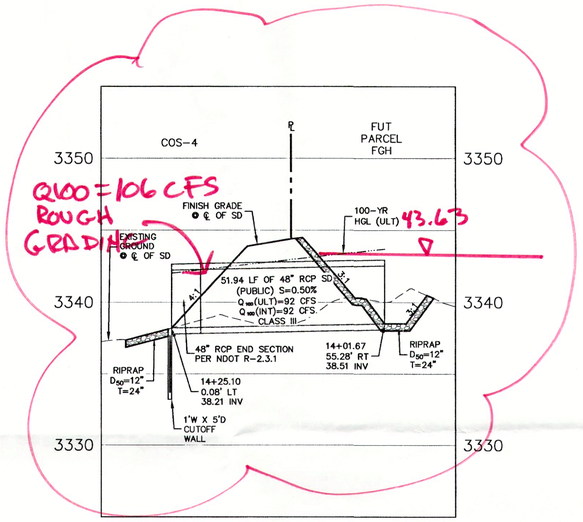



KEY MAP

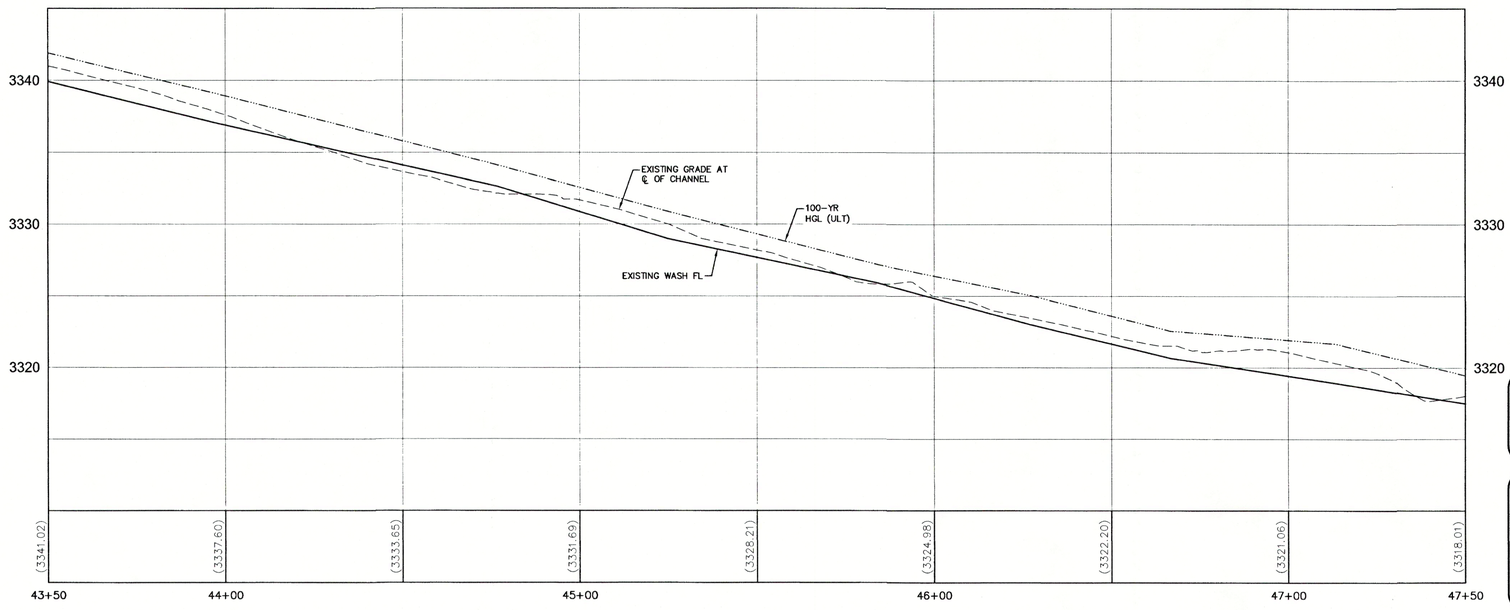
**GRAVEL MAINTENANCE ROAD**

2" CRUSHED ROCK/GRAVEL @ 95%




## COS-4 (WATERS OF THE US)

SCALE: HORIZ 1" = 20'
VERT. 1" = 5'

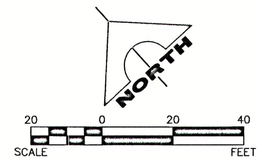



## COS-4 STORM DRAIN PROFILE @ 14+25.10

(RIGHT BERM ALIGNMENT)

SCALE: HORIZ. 1"=20', VERT. 1"=5'

1 / —




**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) |

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 1 SHEET 17.

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.

Call before you Dig — Avoid cutting underground utility lines, it's costly. Call 811 or 1-800-227-2600 or CLARK COUNTY WASTE 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

107V6749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F: 702.804.2299
gcwengineering.com


F:\Projects\600\62024-226-4\DWG\Production\V24-226-4_GD.dwg
Matthew Burge

PROJECT NO. 62024-234
DESIGN: LG/BV
DRAWN: BV
CHECK: JLJ
PLOT DATE: 09-27-16
PLOT TIME: 14:18:39

| REV | DATE | DESCRIPTION | DATE | AGEN APP | DATE | GCW APP | DATE |
|---|---|---|---|---|---|---|---|
| | | | | | | | 09/27/16 |

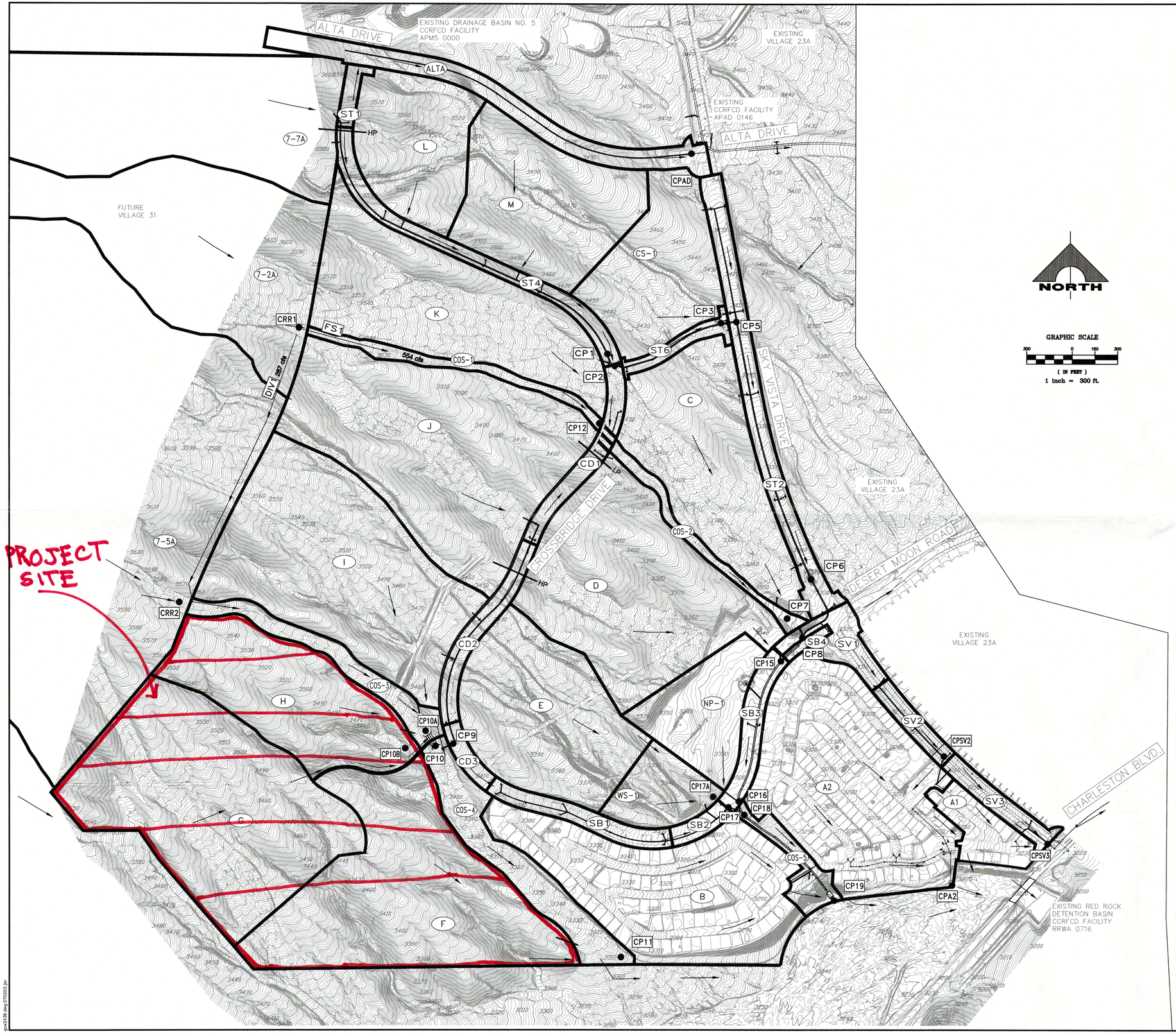
THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS - 4 WASH

GRADING PLAN 4

DRAWING 9
12 OF 21 SHTS

H#66858




NORTH

GRAPHIC SCALE

300 0 150 300

( IN FEET )

1 inch = 300 ft.

**SUMMARY OF ULTIMATE CONDITIONS HEC-1 MODEL**

| SC OR CP | AREA (ac) | $Q_{100}$ (cfs) | $Q_{10}$ (cfs) |
|---|---|---|---|
| ALTA | 9.8 | 35 | 18 |
| - | - | - | - |
| 7-2A | 288.8 | 687 | 315 |
| 7-2B | 60.4 | 182 | 82 |
| 7-5A | 190.0 | 506 | 225 |
| 7-7A | 51.8 | 153 | 70 |
| A1 | 4.6 | 14 | 6 |
| A2 | 34 | 100 | 47 |
| B | 30.5 | 90 | 43 |
| C | 25.2 | 62 | 25 |
| CD1 | 4.2 | 15 | 8 |
| CD2 | 3.1 | 10 | 5 |
| CD3 | 1.3 | 6 | 3 |
| COS-1 | 3.2 | 8 | 3 |
| COS-2 | 2.7 | 6 | 2 |
| COS-3 | 5.6 | 14 | 5 |
| COS-4 | 10.2 | 23 | 8 |
| COS-5 | 2.2 | 7 | 3 |
| CP1 | - | 262 | 125 |
| CP10 | - | 1030 | 452 |
| CP10A | - | 800 | 350 |
| CP10B | - | 155 | 63 |
| CP11 | - | 1119 | 490 |
| CP12 | - | 543 | 251 |
| CP15 | - | 1023 | 479 |
| CP16 | - | 1019 | 490 |
| CP17 | - | 97 | 43 |
| CP17A | - | 81 | 35 |
| CP18 | - | 1100 | 527 |
| CP19 | - | 1168 | 559 |
| CP2 | - | 354 | 164 |
| CP3 | - | 356 | 165 |
| CP5 | - | 408 | 192 |
| CP6 | - | 435 | 204 |
| CP7 | - | 595 | 274 |
| CP8 | - | 949 | 446 |
| CP9 | - | 120 | 51 |
| CPA2 | - | 114 | 54 |
| CPAD | - | 40 | 21 |
| CPSV2 | - | 23 | 12 |
| CPSV3 | - | 25 | 12 |
| CRR1 | - | 841 | 386 |
| CRR2 | - | 720 | 313 |
| CS-1 | 16.8 | 55 | 27 |
| D | 34.3 | 87 | 36 |
| DIV1 | - | 287 | 132 |
| E | 23.9 | 63 | 26 |
| F | 37.8 | 92 | 36 |
| FS1 | - | 554 | 255 |
| G | 42.6 | 100 | 39 |
| H | 22.1 | 58 | 24 |
| I | 38.7 | 102 | 43 |
| J | 43.6 | 110 | 46 |
| K | 29.6 | 80 | 34 |
| L | 15.5 | 53 | 26 |
| M | 22.0 | 73 | 36 |
| NP-1 | 10.5 | 22 | 8 |
| RETD1 | - | 287 | 132 |
| SB1 | 3.6 | 14 | 8 |
| SB2 | 1.3 | 5 | 3 |
| SB3 | 3.5 | 13 | 7 |
| SB4 | 0.5 | 2 | 1 |
| ST1 | 1.1 | 5 | 2 |
| ST2 | 9.6 | 33 | 17 |
| ST4 | 6.0 | 22 | 12 |
| ST6 | 1.8 | 8 | 4 |
| SV1 | 3.6 | 14 | 8 |
| SV2 | 2.1 | 9 | 4 |
| SV3 | 2.7 | 11 | 6 |
| WS-1 | 6.3 | 20 | 10 |

LEGEND

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

% COMPLETE

| REV | DATE | DESCRIPTION | DATE | AGEN APP | DATE | GOW APP | DATE |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

PROJECT NO. 62024-320

DESIGN: RRD, DBC

DRAWN:

CHECK:

PLOT DATE: 06-10-14

PLOT TIME: 15:23:20

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD - LAS VEGAS, NV 89146
T: 702.804.8000 F: 702.804.8299 GCWALLACE.COM

LAS VEGAS

F:\Projects\60\62024-320\division\Civil\Figures\FIG6U.dwg

David Clark

THE HOWARD HUGHS COMPANY, LLC

SUMERLRIN VILLAGE 24

FIGURE 6U
ULTIMATE CONDITIONS DRAINAGE MAP

DRAWING
FIG 6U
OF XX SHTS

LID#:

HTE: 00-00000

g:\e2438.dwg 070203.jpr

# Addendum #1 to the Technical Drainage Study for

## Summerlin West Village 24
## Western Boundary Grading & Drainage

*Las Vegas, Nevada*

*Prepared for:*
Howard Hughes Company, LLC

*Submitted to:*
City of Las Vegas
Land Development Services

| CITY OF LAS VEGAS<br>INTER-OFFICE MEMORANDUM | | | DATE:<br>July 24, 2018 |
|---|---|---|---|
| TO:<br>**Land Development Services**<br>Department of Building & Safety | | | FROM:<br>Albert Sung, P.E.<br>Flood Control Project Engineer<br>Department of Public Works |
| **SUBJECT:** | Drainage Study for:<br>**Summerlin West Village 24 -<br>Western Boundary Grading & Drainage** | | **COPIES TO:**<br>VTN Nevada |
| **Cross Streets:** | SWC of Crossbridge Drive & Alta Drive | | Howard Hughes Company, LLC |
| **File Number:** | F:\Depot\DSMemos\DS4992B.doc | | Bart Anderson, P.E., DevCo |
| **Parcel Number:** | 137-22-000-017 | | |
| **Zoning Action:** | PMP-72289 | | |
| **FEMA Flood Zone** | YES | NO **X** | |
| **Proposed Storm Drain** | YES **X** | NO | |

| HISTORY | DATE RECEIVED | DATE REVIEWED | COMMENTS | REVIEW FEES | FEES PAID Payment Trn # |
|---|---|---|---|---|---|
| 1st Submittal | 5/16/2018 | 5/31/2018 & 6/6/2018 | Not Approved | $400.00 | 495843: $400 |
| 2nd Submittal & Supplement | 6/27/2018 | 7/12/2018 & 7/23/2018 | See Comments Below | $400.00 | 496934: $400 |
| | | | **TOTAL FEES (LDDRS):** | **$800.00** | ---- |

**REMARKS:**

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 proposed *Western Boundary Grading & Drainage Facilities* are interim facilities to be owned and maintained by the *Howard Hughes Company*. The *City of Las Vegas* will not take over ownership and maintenance liability until a permanent improved roadway dedicated and accepted as a public right-of-way is completed.

   Prior to final plan approval the developer must complete a maintenance and liability agreement for the interim drainage improvements (off-site berms, channels & storm drains) and post a minimum maintenance bond of $50,000 or 50-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.

   In order for the maintenance bond to be released in the future, a drainage update / letter will be required to justify that the offsite berms / channels are no longer necessary and can be removed.

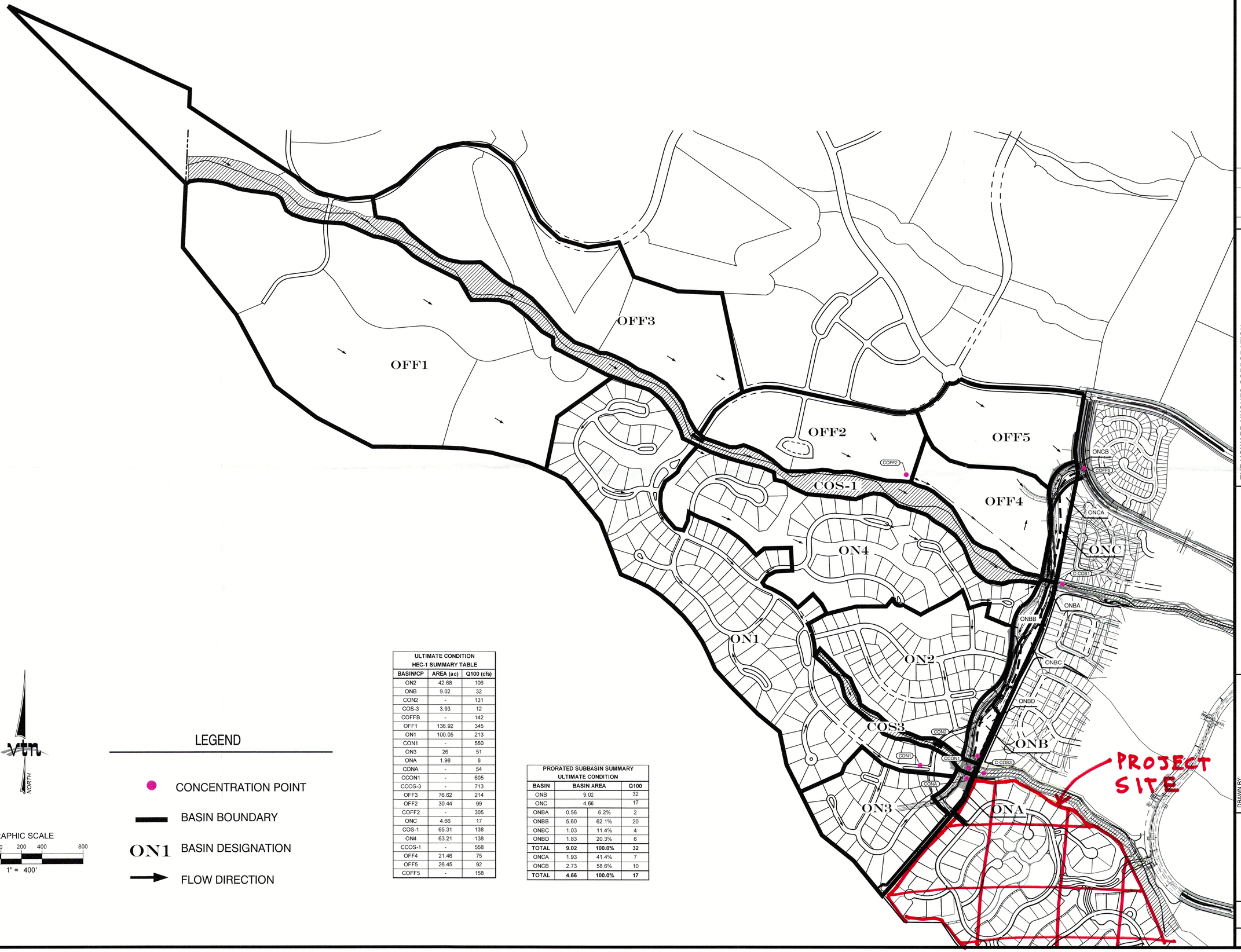
2. Previous Comment #3 regarding *Facilities 21 to 25* shall have a minimum of 3'-wide concrete valley gutter at the flow line to reduce maintenance burden for the future homeowners association. Revise typical *Cross Section C/DT1* and all pertinent plans and construction note accordingly.

   *Facilities 21 to 25* must be within a public drainage easement to be privately maintained by the Homeowners Association. Dedicate as such either by map or by separate document. The dedication must be recorded prior to the final approval of the improvement plans.

**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**
WSP/AYS

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




NORTH

GRAPHIC SCALE

400 0 200 400 800

1" = 400'

## LEGEND

- CONCENTRATION POINT
- BASIN BOUNDARY
- ON1 BASIN DESIGNATION
- FLOW DIRECTION

**ULTIMATE CONDITION HEC-1 SUMMARY TABLE**

| BASIN/CP | AREA (ac) | Q100 (cfs) |
|---|---|---|
| ON2 | 42.68 | 106 |
| ONB | 9.02 | 32 |
| CON2 | - | 131 |
| COS-3 | 3.93 | 12 |
| COFFB | - | 142 |
| OFF1 | 136.92 | 345 |
| ON1 | 100.05 | 213 |
| CON1 | - | 550 |
| ON3 | 26 | 51 |
| ONA | 1.98 | 8 |
| CONA | - | 54 |
| CCON1 | - | 605 |
| CCOS-3 | - | 713 |
| OFF3 | 76.62 | 214 |
| OFF2 | 30.44 | 99 |
| COFF2 | - | 305 |
| ONC | 4.66 | 17 |
| COS-1 | 65.31 | 138 |
| ON4 | 63.21 | 138 |
| CCOS-1 | - | 558 |
| OFF4 | 21.46 | 75 |
| OFF5 | 26.45 | 92 |
| COFF5 | - | 158 |

**PRORATED SUBBASIN SUMMARY ULTIMATE CONDITION**

| BASIN | BASIN AREA | | Q100 |
|---|---|---|---|
| ONB | 9.02 | | 32 |
| ONC | 4.66 | | 17 |
| ONBA | 0.56 | 6.2% | 2 |
| ONBB | 5.60 | 62.1% | 20 |
| ONBC | 1.03 | 11.4% | 4 |
| ONBD | 1.83 | 20.3% | 6 |
| **TOTAL** | **9.02** | **100.0%** | **32** |
| ONCA | 1.93 | 41.4% | 7 |
| ONCB | 2.73 | 58.6% | 10 |
| **TOTAL** | **4.66** | **100.0%** | **17** |

**THE HOWARD HUGHES CORPORATION**
10001 PARK RUN DRIVE, 3RD FLOOR
LAS VEGAS, NV 89135

CLV

2727 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NEVADA 89146-5148
PH. (702) 873-7550 FAX (702) 362-2597 WEB WWW.VTNNV.COM
CONSULTING ENGINEERS ● PLANNERS ● LAND SURVEYORS

| REV | DATE | BY | REVISION |
|---|---|---|---|
| | | | |

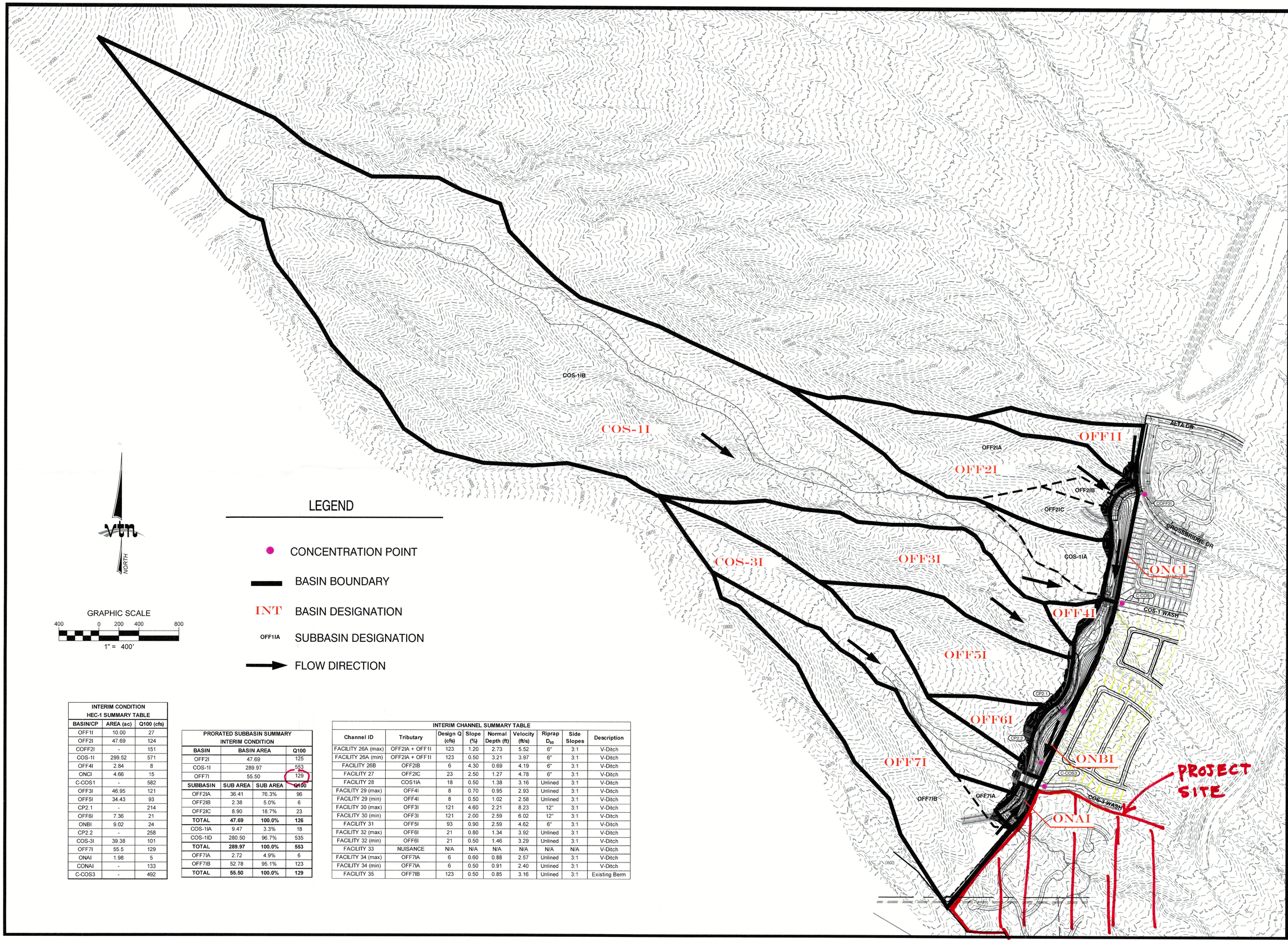
**FIGURE 10:**
**ULTIMATE CONDITION BASIN MAP**

**SUMMERLIN WEST VILLAGE 24**
**WESTERN BOUNDARY**
**GRADING & DRAINAGE**

DRAWN BY: JYA 02/2018
DESIGNED BY: JYA 02/2018
CHECKED BY: WJM 02/2018
PROJECT NO: #### SCALE: 1" = 400' HORIZ. N/A VERT.

SHEET
**FIG 10**
1 OF 1 SHEETS
DRAWING NO.

H:\7851\Village 24 Collector-WATER\Drainage\2_ADD #1\A Figures\Fig 10 - Ultimate Basin Map.dwg




**INTERIM CONDITION HEC-1 SUMMARY TABLE**

| BASIN/CP | AREA (ac) | Q100 (cfs) |
|---|---|---|
| OFF1I | 10.00 | 27 |
| OFF2I | 47.69 | 124 |
| COFF2I | - | 151 |
| COS-1I | 299.52 | 571 |
| OFF4I | 2.84 | 8 |
| ONCI | 4.66 | 15 |
| C-COS1 | - | 582 |
| OFF3I | 46.95 | 121 |
| OFF5I | 34.43 | 93 |
| CP2.1 | - | 214 |
| OFF6I | 7.36 | 21 |
| ONBI | 9.02 | 24 |
| CP2.2 | - | 258 |
| COS-3I | 39.38 | 101 |
| OFF7I | 55.5 | 129 |
| ONAI | 1.98 | 5 |
| CONAI | - | 133 |
| C-COS3 | - | 492 |

**PRORATED SUBBASIN SUMMARY INTERIM CONDITION**

| BASIN | BASIN AREA | | Q100 |
|---|---|---|---|
| OFF2I | 47.69 | | 125 |
| COS-1I | 289.97 | | 553 |
| OFF7I | 55.50 | | 129 |
| **SUBBASIN** | **SUB AREA** | **SUB AREA** | **Q100** |
| OFF2IA | 36.41 | 76.3% | 96 |
| OFF2IB | 2.38 | 5.0% | 6 |
| OFF2IC | 8.90 | 18.7% | 23 |
| **TOTAL** | **47.69** | **100.0%** | **126** |
| COS-1IA | 9.47 | 3.3% | 18 |
| COS-1ID | 280.50 | 96.7% | 535 |
| **TOTAL** | **289.97** | **100.0%** | **553** |
| OFF7IA | 2.72 | 4.9% | 6 |
| OFF7IB | 52.78 | 95.1% | 123 |
| **TOTAL** | **55.50** | **100.0%** | **129** |

**INTERIM CHANNEL SUMMARY TABLE**

| Channel ID | Tributary | Design Q (cfs) | Slope (%) | Normal Depth (ft) | Velocity (ft/s) | Riprap $D_{50}$ | Side Slopes | Description |
|---|---|---|---|---|---|---|---|---|
| FACILITY 26A (max) | OFF2IA + OFF1I | 123 | 1.20 | 2.73 | 5.52 | 6" | 3:1 | V-Ditch |
| FACILITY 26A (min) | OFF2IA + OFF1I | 123 | 0.50 | 3.21 | 3.97 | 6" | 3:1 | V-Ditch |
| FACILITY 26B | OFF2IB | 6 | 4.30 | 0.69 | 4.19 | 6" | 3:1 | V-Ditch |
| FACILITY 27 | OFF2IC | 23 | 2.50 | 1.27 | 4.78 | 6" | 3:1 | V-Ditch |
| FACILITY 28 | COS1IA | 18 | 0.50 | 1.38 | 3.16 | Unlined | 3:1 | V-Ditch |
| FACILITY 29 (max) | OFF4I | 8 | 0.70 | 0.95 | 2.93 | Unlined | 3:1 | V-Ditch |
| FACILITY 29 (min) | OFF4I | 8 | 0.50 | 1.02 | 2.58 | Unlined | 3:1 | V-Ditch |
| FACILITY 30 (max) | OFF3I | 121 | 4.60 | 2.21 | 8.23 | 12" | 3:1 | V-Ditch |
| FACILITY 30 (min) | OFF3I | 121 | 2.00 | 2.59 | 6.02 | 12" | 3:1 | V-Ditch |
| FACILITY 31 | OFF5I | 93 | 0.90 | 2.59 | 4.62 | 6" | 3:1 | V-Ditch |
| FACILITY 32 (max) | OFF6I | 21 | 0.80 | 1.34 | 3.92 | Unlined | 3:1 | V-Ditch |
| FACILITY 32 (min) | OFF6I | 21 | 0.50 | 1.46 | 3.29 | Unlined | 3:1 | V-Ditch |
| FACILITY 33 | NUISANCE | N/A | N/A | N/A | N/A | N/A | N/A | V-Ditch |
| FACILITY 34 (max) | OFF7IA | 6 | 0.60 | 0.88 | 2.57 | Unlined | 3:1 | V-Ditch |
| FACILITY 34 (min) | OFF7IA | 6 | 0.50 | 0.91 | 2.40 | Unlined | 3:1 | V-Ditch |
| FACILITY 35 | OFF7IB | 123 | 0.50 | 0.85 | 3.16 | Unlined | 3:1 | Existing Berm |

| REV | DATE | BY | REVISION |
|---|---|---|---|

CLV

THE HOWARD HUGHES CORPORATION
10801 W. CHARLESTON BLVD. 3RD FLOOR
LAS VEGAS, NV 89135

2727 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NEVADA 89146-5148
PH. (702) 873-7550 FAX (702) 362-2597 WEB WWW.VTNNV.COM
CONSULTING ENGINEERS ● PLANNERS ● LAND SURVEYORS

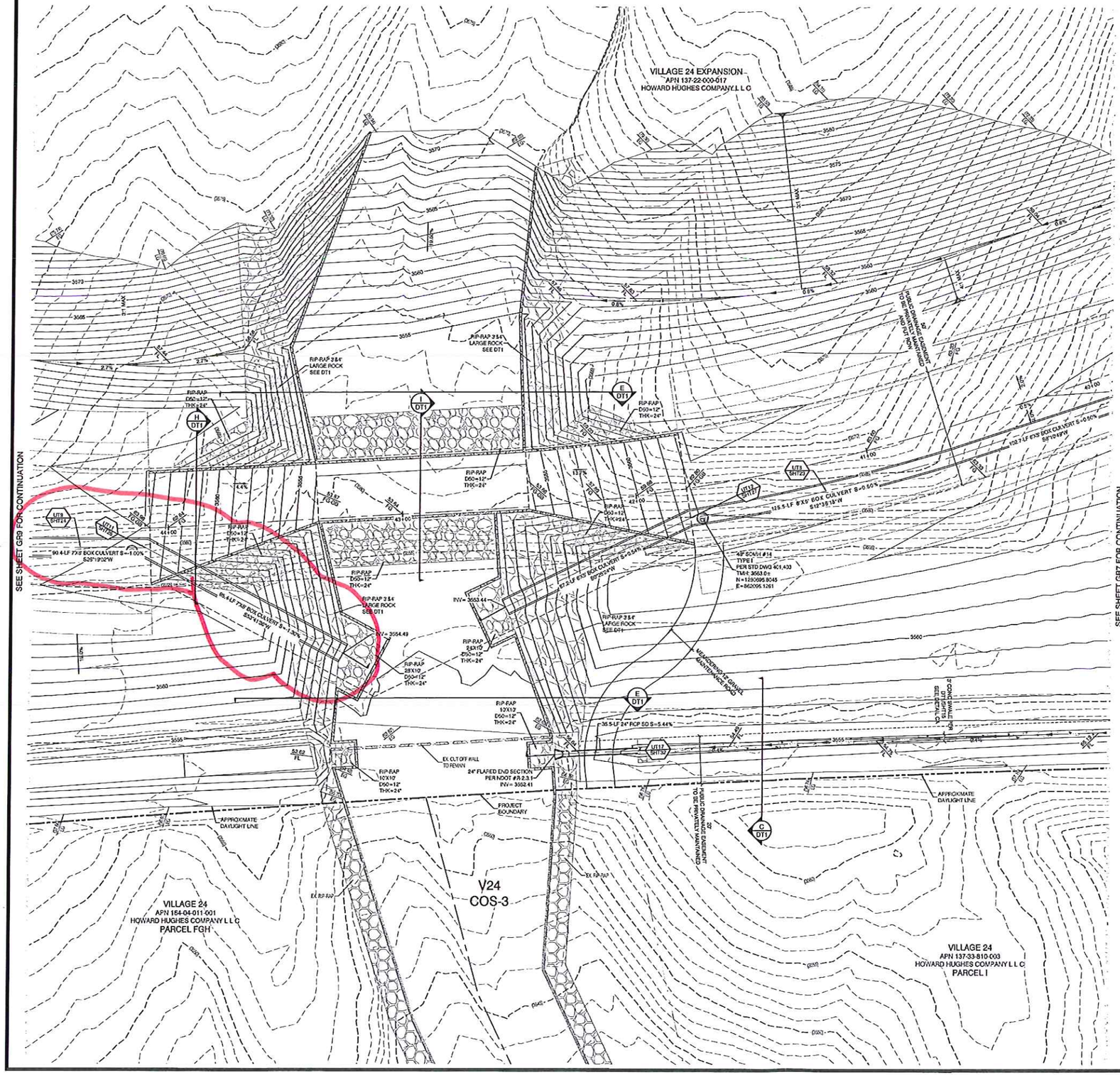
**FIGURE 9: INTERIM CONDITION BASIN MAP**

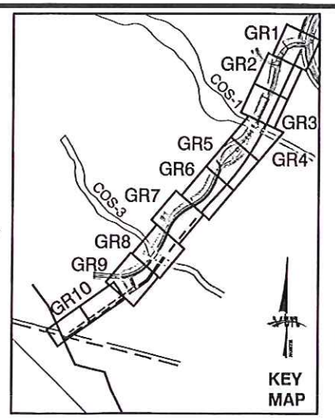
**SUMMERLIN WEST VILLAGE 24 WESTERN BOUNDARY GRADING & DRAINAGE**

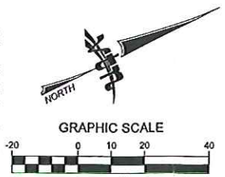
DRAWN BY: JYA 02/2018
DESIGNED BY: JYA 02/2018
CHECKED BY: VAA 02/2018
PROJECT NO: 7851
SCALE: 1" = 400' HORIZ. N/A VERT.

SHEET
FIG 9
1 OF 1 SHEETS
DRAWING NO.

H:\7851\Village 24 Collector\HATER\Drainage\ADD #1\A Figures\Fig 9 - Interim Basin Map.dwg




**GRADING PERMIT NOTE**

THIS GRADING PERMIT DOES NOT INCLUDE THE CONSTRUCTION OF RETAINING WALLS AND OTHERS STRUCTURES. SEPARATE PERMITS AND APPLICATIONS ARE REQUIRED FOR THESE.

**GEOTECHNICAL NOTE:**

REFER TO SOILS REPORT, NOVA GEOTECHNICAL PROJECT #3-17-158, DATED JANUARY 18, 2018

**SIGHT VISIBILITY ZONES:**

NO STRUCTURE, WALLS, VEGETATION, OR OBJECT OF ANY KIND IS PERMITTED OVER TWENTY-FOUR (24) INCHES IN HEIGHT (MEASURED FROM THE TOP OF ADJACENT CURB IF CURB EXISTS) WITHIN THE SIGHT VISIBILITY ZONES.

**CONSTRUCTION NOTES**

- FUTURE ROW AND EDGE OF PROPOSED TYPE II
- FUTURE 24" TYPE "L" CURB & GUTTER PER STD. DWG. 216.
- FUTURE TYPE "A" CURB PER STD. DWG. 219.
- INSTALL 4" TYPE II COMPACTED TO 95% IN PREPARATION FOR FUTURE PAVEMENT
- FUTURE SIDEWALK PER STD. DWG. 234.
- CONSTRUCT DRAINAGE SWALE FLOW LINE
- FIELD VERIFY AND MATCH EXISTING

**CONSTRUCTION NOTES**

UT# SHT# — UTILITY PROFILE REFERENCE LABEL
UT # = SHEET INDEX
SHT# = SHEET NUMBER

Call before you Underground 1-702-455-501
811 OR 1-800-227-2600 AND 1-702-455-6000 CLARK COUNTY TRAFFIC OPERATIONS

AVOID HITTING OVERHEAD POWER LINES IT'S COSTLY
CALL BEFORE YOU DIG OVERHEAD
1-702-227-2929

Call before you Dig
A cold cutting underground utility lines, it's costly.
CALL 811 OR 1-800-227-2600 AND 1-702-455-6000 CLARK COUNTY TRAFFIC OPERATIONS

**BASIS OF BEARING**

GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM (NCRS), LAS VEGAS HIGH ELEVATION ZONE, NORTH AMERICAN DATUM OF 1983, BAD MERIDIAN EAST) COINCIDENT WITH 114°58' WEST OF THE GREENWICH MERIDIAN.

LINEAR UNIT: US SURVEY FOOT (FTUS)

DATUM (REFERENCE FRAME): NAD 83 (2011) EPOCH 2010.00

SYSTEM: NEVADA COORDINATE REFERENCE SYSTEM (NCRS)

ZONE: LAS VEGAS HIGH ELEVATION ZONE

PROJECTION: TRANSVERSE MERCATOR
STANDARD PARALLEL (AND LATITUDE OF GRID ORIGIN) 36°15'00"N
LONGITUDE OF CENTRAL MERIDIAN 114°58'00"W
NORTHING AT GRID ORIGIN: 430,000.00 M (1,312,333.3333 FTUS)
EASTING AT CENTRAL MERIDIAN: 300,000.00 M (984,250.0000 FTUS)
SCALE FACTOR ON CENTRAL MERIDIAN: 1.000135 (EXACT)

NOTES:
1. ALL DISTANCES AND BEARINGS SHOWN HEREON ARE PROJECTED (GRID) VALUES BASED ON THE PRECEDING PROJECTION DEFINITION. THE PROJECTION WAS DEFINED SUCH THAT PROJECTED (GRID) DISTANCES ARE EQUIVALENT TO "GROUND" DISTANCES IN THE PROJECT AREA.
2. GRID BEARINGS SHOWN HEREON (OR IMPLIED BY GRID COORDINATES) DO NOT EQUAL GEODETIC BEARINGS DUE TO MERIDIAN CONVERGENCE.

**BENCHMARK**

PROJECT DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

CITY OF LAS VEGAS BENCHMARK: D008 (REVISED 2008) NAVD88 ELEVATION: 969.574 METERS (3 240.53 FEET)

FND USC&GS DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD. & WEST OF DETENTION BASIN. T21S R58E S33

**ENGINEER DISCLAIMER NOTE:**

UTILITY LOCATIONS SHOWN HERE ON ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE EXACT HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UNDERGROUND AND OVERHEAD UTILITIES AND NOTIFY THE DESIGN ENGINEER IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO COMMENCING CONSTRUCTION. NO REPRESENTATION IS MADE THAT ALL EXISTING UTILITIES ARE SHOWN HERE ON. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR UTILITIES NOT SHOWN OR UTILITIES NOT SHOWN IN THEIR PROPER LOCATION.

I CERTIFY THAT THIS GRADING PLAN CONFORMS TO THE APPROVED DRAINAGE STUDY FOR THIS SITE ON FILE WITH CITY OF LAS VEGAS, # 4092B

DAVID L. EDWARDS, P.E. No. 17860 — DATE 9/5/18

107V7419

HOWARD HUGHES COMPANY, LLC
A DELAWARE LIMITED LIABILITY COMPANY
10801 W CHARLESTON BLVD SUITE 500
LAS VEGAS, NEVADA 89135
702-791-4080

CITY OF LAS VEGAS

2727 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NEVADA 89146-5148
PH: (702) 873-7500 FAX: (702) 362-2697 WEB WWW.VTNNV.COM
CONSULTING ENGINEERS ● PLANNERS ● LAND SURVEYORS

| REV | DATE | BY | REVISION |
|---|---|---|---|

**GRADING PLAN 8**

**SUMMERLIN WEST VILLAGE 24**
**WESTERN BOUNDARY**
**GRADING & DRAINAGE**

| | | |
|---|---|---|
| DRAWN BY: DEH | 10/25/2017 | |
| DESIGNED BY: DEH | 10/25/2017 | |
| CHECKED BY: WJM | 09/05/2018 | |
| PROJECT NO: 2081 | SCALE: 1"=20' N/A | HORIZ. VERT. |

PROFESSIONAL ENGINEER — STATE OF NEVADA — No. 17860 — DAVID L. EDWARDS — EXP. 12/31/19 — 9/5/18

SHEET
GR8
12 OF 33 SHEETS

DRAWING NO
L18-01496

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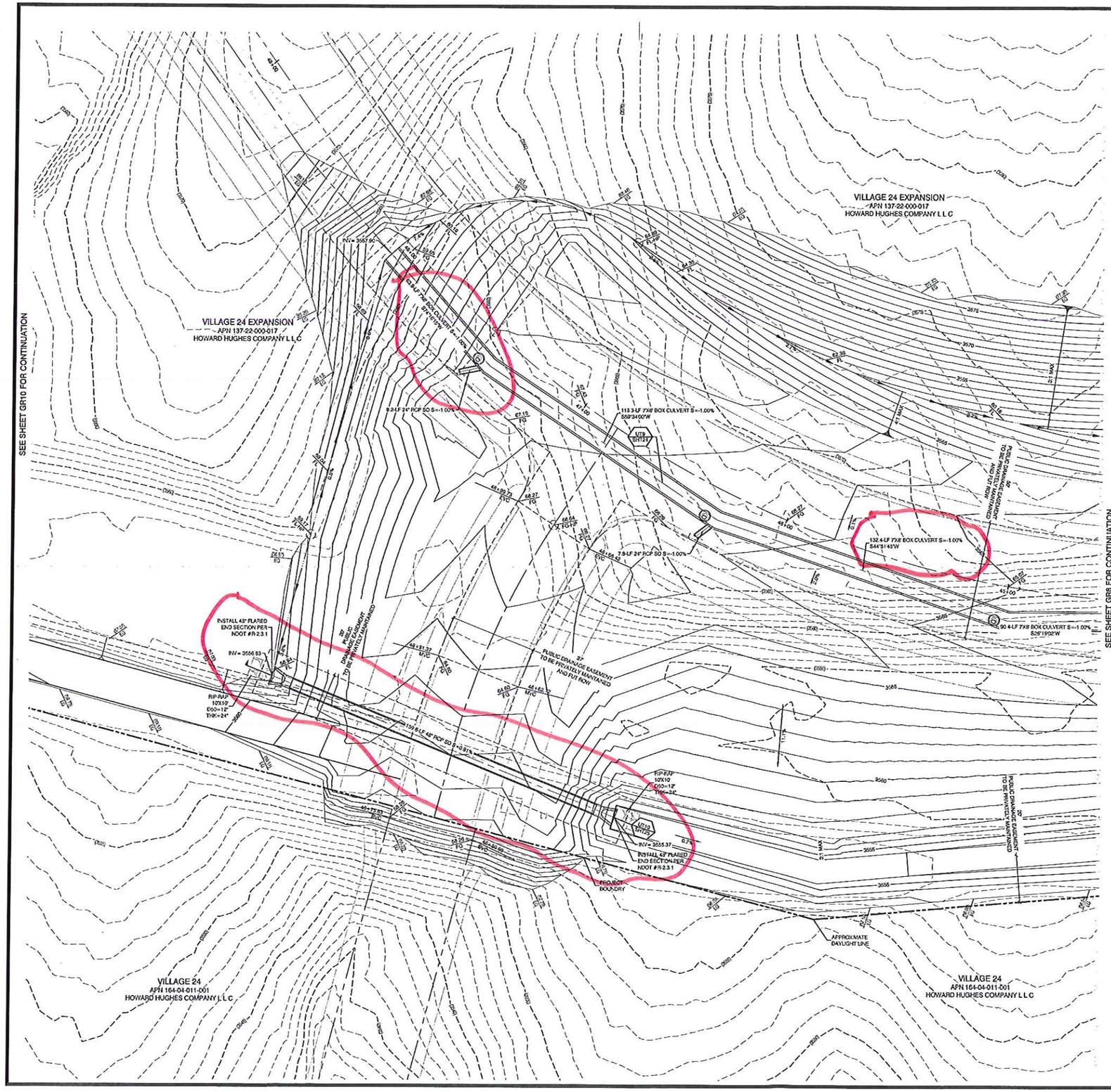
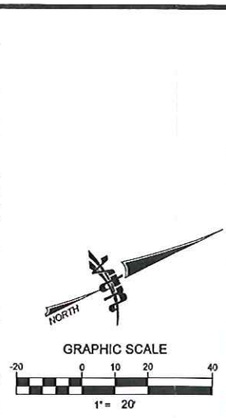
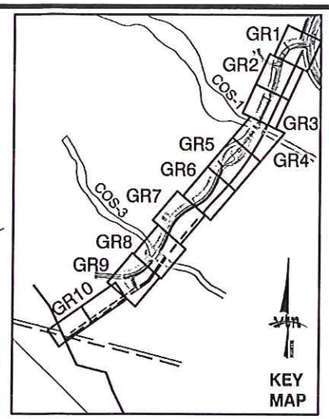



**GRADING PERMIT NOTE**

THIS GRADING PERMIT DOES NOT INCLUDE THE CONSTRUCTION OF RETAINING WALLS AND OTHERS STRUCTURES. SEPARATE PERMITS AND APPLICATIONS ARE REQUIRED FOR THESE.

**GEOTECHNICAL NOTE:**

REFER TO SOILS REPORT: NOVA GEOTECHNICAL PROJECT #3-17-158, DATED JANUARY 18, 2018

**SIGHT VISIBILITY ZONES:**

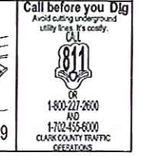
NO STRUCTURE, WALLS, VEGETATION, OR OBJECT OF ANY KIND IS PERMITTED OVER TWENTY-FOUR (24) INCHES IN HEIGHT (MEASURED FROM THE TOP OF ADJACENT CURB IF CURB EXISTS) WITHIN THE SIGHT VISIBILITY ZONES.

**CONSTRUCTION NOTES**

- FUTURE ROW AND EDGE OF PROPOSED TYPE II
- FUTURE 24" TYPE "L" CURB & GUTTER PER STD. DWG. 215.
- FUTURE TYPE "A" CURB PER STD. DWG. 219
- INSTALL 4" TYPE II COMPACTED TO 95% IN PREPARATION FOR FUTURE PAVEMENT
- FUTURE SIDEWALK PER STD. DWG. 234.
- CONSTRUCT DRAINAGE SWALE FLOW LINE
- FIELD VERIFY AND MATCH EXISTING

**CONSTRUCTION NOTES**

UT # = SHEET INDEX
SHT # = SHEET NUMBER




**BASIS OF BEARING**

GRID NORTH AS DEFINED BY THE CENTRAL MEADIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM (NCRS), LAS VEGAS HIGH ELEVATION ZONE, NORTH AMERICAN DATUM OF 1983, SAID MERIDIAN BEING CONGIDENT WITH 115°58' WEST OF THE GREENWICH MERIDIAN.

LINEAR UNIT: US SURVEY FOOT (FTUS)

DATUM (REFERENCE FRAME): NAD 83 (2011) EPOCH 2010.00

SYSTEM: NEVADA COORDINATE REFERENCE SYSTEM (NCRS)

ZONE: LAS VEGAS HIGH ELEVATION ZONE

PROJECTION: TRANSVERSE MERCATOR
STANDARD PARALLEL (AXIS) LATITUDE OF GRID ORIGIN(-36°15'00"N
LONGITUDE OF CENTRAL MERIDIAN 115°58'00"W
NORTHING AT GRID ORIGIN: 400,000.00 M (1,312,333.3333 FTUS)
EASTING AT CENTRAL MERIDIAN: 300,000 M (664,250.0000 FTUS)
SCALE FACTOR ON CENTRAL MERIDIAN: 1.000135 (EXACT)

NOTES:
1. ALL DISTANCES AND BEARINGS SHOWN HEREON ARE PROJECTED (GRID) VALUES BASED ON THE PRECEDING PROJECTION DEFINITION. THE PROJECTION WAS DEFINED SUCH THAT PROJECTED (GRID) DISTANCES ARE EQUIVALENT TO "GROUND" DISTANCES IN THE PROJECT AREA.

2. GRID BEARINGS SHOWN HEREON (OR IMPLIED BY GRID COORDINATES) DO NOT EQUAL GEODETIC BEARINGS DUE TO MERIDIAN CONVERGENCE.

**BENCHMARK**

PROJECT DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

CITY OF LAS VEGAS BENCHMARK: D008 (REVISED 2008)
NAVD88 ELEVATION: 669.574 METERS (2,196.63 FEET)

FND USC&GS DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD. & WEST OF DETENTION BASIN.
T21S,R59E,S33

**ENGINEER DISCLAIMER NOTE:**

UTILITY LOCATIONS SHOWN HERE ON ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE EXACT HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UNDERGROUND AND OVERHEAD UTILITIES AND NOTIFY THE DESIGN ENGINEER IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO COMMENCING CONSTRUCTION. NO REPRESENTATION IS MADE THAT ALL EXISTING UTILITIES ARE SHOWN HERE ON. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR UTILITIES NOT SHOWN OR UTILITIES NOT SHOWN IN THEIR PROPER LOCATION.

I CERTIFY THAT THIS GRADING PLAN CONFORMS TO THE APPROVED DRAINAGE STUDY FOR THIS SITE ON FILE WITH CITY OF LAS VEGAS, # 4992B

9/5/18
DAVID L EDWARDS, P.E. No. 17860 DATE

| REVISION | DATE | BY |
|---|---|---|
| | | |

HOWARD HUGHES COMPANY, LLC
A DELAWARE LIMITED LIABILITY COMPANY
1980 FESTIVAL PLAZA DRIVE, SUITE 300
LAS VEGAS, NEVADA 89135
702-791-4500

CITY OF LAS VEGAS

2702 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NEVADA 89146-5148
PH. (702) 873-7500 FAX (702) 240-2297 WEB WWW.VTNV.COM
CONSULTING ENGINEERS ● PLANNERS ● LAND SURVEYORS

GRADING PLAN 9

SUMMERLIN WEST VILLAGE 24
WESTERN BOUNDARY
GRADING & DRAINAGE

| | |
|---|---|
| DRAWN BY: | BDC 04/19/2018 |
| DESIGNED BY: | DSCC 04/19/2018 |
| CHECKED BY: | WAM 08/06/2018 |
| PROJECT NO: | 7851 |
| SCALE: | 1"=20' HORIZ. NA VERT. |

PROFESSIONAL ENGINEER - STATE OF NEVADA
DAVID L EDWARDS
EXP. 12-31-19
No. 17860
9/5/18

SHEET
GR9
13 OF 33 SHEETS

DRAWING NO.
L18-01496

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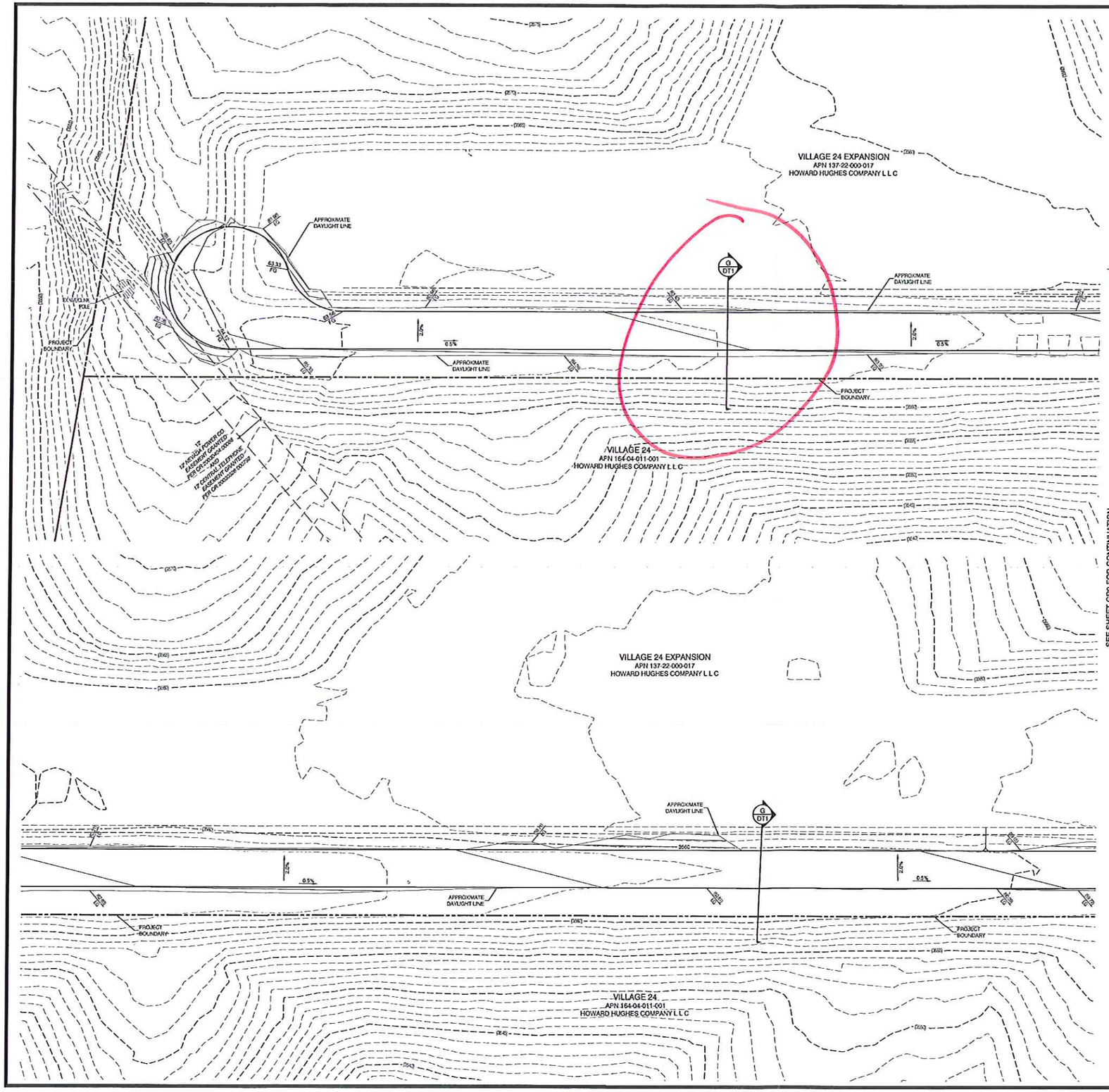
10/17/19



GRAPHIC SCALE

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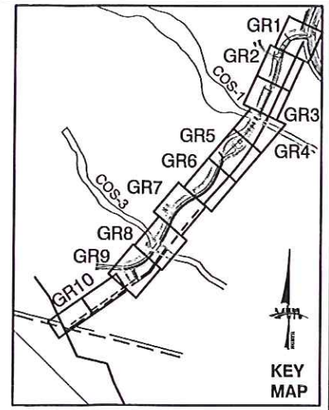
1" = 20'




**GRADING PERMIT NOTE**

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**GEOTECHNICAL NOTE:**

REFER TO SOILS REPORT: NOVA GEOTECHNICAL PROJECT #3-17-188, DATED JANUARY 18, 2018

**SIGHT VISIBILITY ZONES:**

NO STRUCTURE, WALLS, VEGETATION, OR OBJECT OF ANY KIND IS PERMITTED OVER TWENTY-FOUR (24) INCHES IN HEIGHT (MEASURED FROM THE TOP OF ADJACENT CURB IF CURB EXISTS) WITHIN THE SIGHT VISIBILITY ZONES.

**CONSTRUCTION NOTES**

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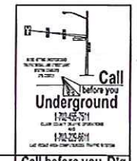
- FUTURE TYPE "A" CURB PER STD. DWG. 219.
- INSTALL 4" TYPE II COMPACTED TO 95% IN PREPARATION FOR FUTURE PAVEMENT
- FUTURE SIDEWALK PER STD. DWG. 234.
- CONSTRUCT DRAINAGE SWALE FLOW LINE
- FIELD VERIFY AND MATCH EXISTING

**CONSTRUCTION NOTES**

UT.# / SHT.# — UTILITY PROFILE REFERENCE LABEL
UT.# = SHEET INDEX
SHT.# = SHEET NUMBER




**BASIS OF BEARING**

GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM (NCRS), LAS VEGAS HIGH ELEVATION ZONE, NORTH AMERICAN DATUM OF 1983, SAID MERIDIAN BEING CONCIDENT WITH 115°58' WEST OF THE GREENWICH MERIDIAN.

LINEAR UNIT: US SURVEY FOOT (FTUS)

DATUM (REFERENCE FRAME): NAD 83 (2011) EPOCH 2010.00

SYSTEM: NEVADA COORDINATE REFERENCE SYSTEM (NCRS)

ZONE: LAS VEGAS HIGH ELEVATION ZONE

PROJECTION: TRANSVERSE MERCATOR
STANDARD PARALLEL (AND LATITUDE OF GRID ORIGIN) 36°15'00"N
LONGITUDE OF CENTRAL MERIDIAN 115°58'00"W
NORTHING AT GRID ORIGIN: 400,000.00 M (1,312,333.3333 FTUS)
EASTING AT CENTRAL MERIDIAN: 200,000 M (656,250.0000 FTUS)
SCALE FACTOR ON CENTRAL MERIDIAN: 1.000135 (EXACT)

NOTES:
1. ALL DISTANCES AND BEARINGS SHOWN HEREON ARE PROJECTED (GRID) VALUES BASED ON THE PRECEDING PROJECTION DEFINITION. THE PROJECTION WAS DEFINED SUCH THAT PROJECTED (GRID) DISTANCES ARE EQUIVALENT TO "GROUND" DISTANCES IN THE PROJECT AREA.

2. GRID BEARINGS SHOWN HEREON (OR IMPLIED BY GRID COORDINATES) DO NOT EQUAL GEODETIC BEARINGS DUE TO MERIDIAN CONVERGENCE.

**BENCHMARK**

PROJECT DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

CITY OF LAS VEGAS BENCHMARK: D368 (REVISED 2009)
NAVD88 ELEVATION: 969.574 METERS (3,246.63 FEET)

FND USC&GS DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD. & WEST OF DETENTION BASIN.
T21S R56 S33

**ENGINEER DISCLAIMER NOTE:**

UTILITY LOCATIONS SHOWN HERE ON ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO DETERMINE THE EXACT HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UNDERGROUND AND OVERHEAD UTILITIES AND NOTIFY THE DESIGN ENGINEER IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO COMMENCING CONSTRUCTION. NO REPRESENTATION IS MADE THAT ALL EXISTING UTILITIES ARE SHOWN HERE ON. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR UTILITIES NOT SHOWN OR UTILITIES NOT SHOWN IN THEIR PROPER LOCATION.

I CERTIFY THAT THIS GRADING PLAN CONFORMS TO THE APPROVED DRAINAGE STUDY FOR THIS SITE ON FILE WITH CITY OF LAS VEGAS, # 40928

9/5/18
DAVID L EDWARDS, P.E. No. 17880 DATE

407V7419

HOWARD HUGHES COMPANY, LLC
A DELAWARE LIMITED LIABILITY COMPANY
10001 W CHARLESTON BLVD SUITE 300
LAS VEGAS, NEVADA 89135
702-791-4000

CITY OF LAS VEGAS

2727 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NEVADA 89146-5143
PH. (702) 873-7500 FAX (702) 362-2697 WEB WWW.VTNNV.COM
CONSULTING ENGINEERS ● PLANNERS ● LAND SURVEYORS

| REV | DATE | BY | REVISION |
|---|---|---|---|
| | | | |

GRADING PLAN 10

SUMMERLIN WEST VILLAGE 24
WESTERN BOUNDARY
GRADING & DRAINAGE

| | |
|---|---|
| DRAWN BY: DDH | 10/25/2017 |
| DESIGNED BY: DDH | 10/25/2017 |
| CHECKED BY: WJM | 08/05/2018 |
| PROJECT NO: 7951 | SCALE: 1"=20' HORIZ, N/A VERT. |

SHEET
GR10
14 OF 33 SHEETS
DRAWING NO.
L18-01496

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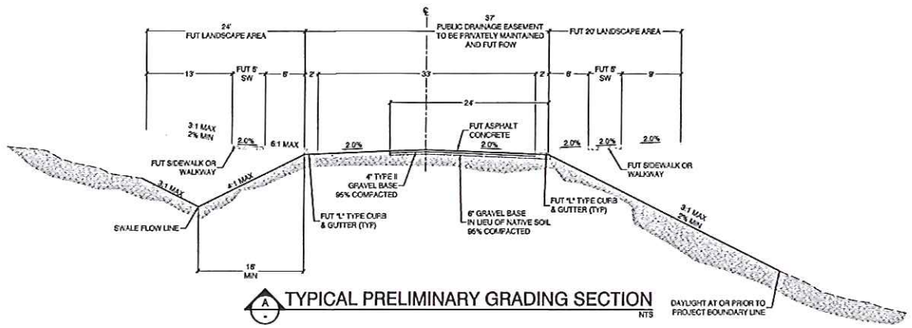
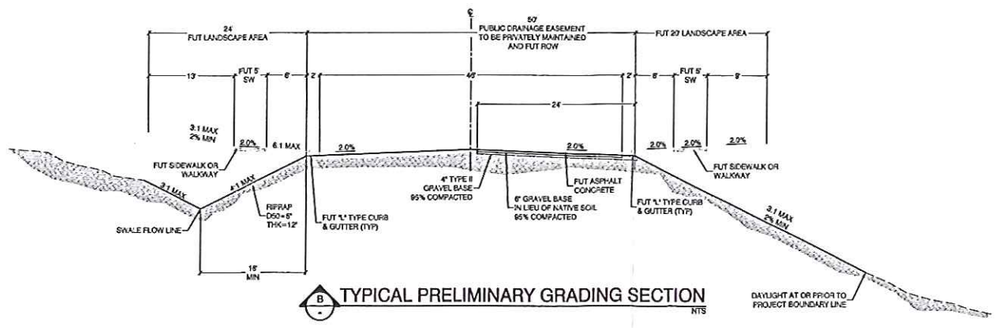



A TYPICAL PRELIMINARY GRADING SECTION
NTS




B TYPICAL PRELIMINARY GRADING SECTION
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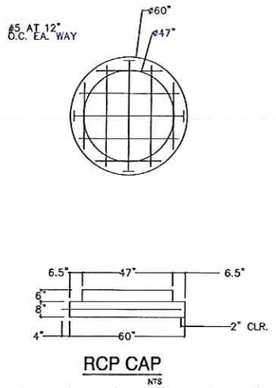
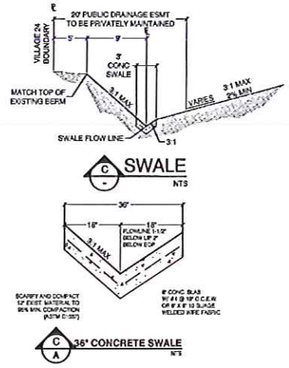


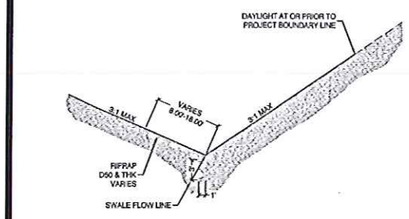

RCP CAP
NTS



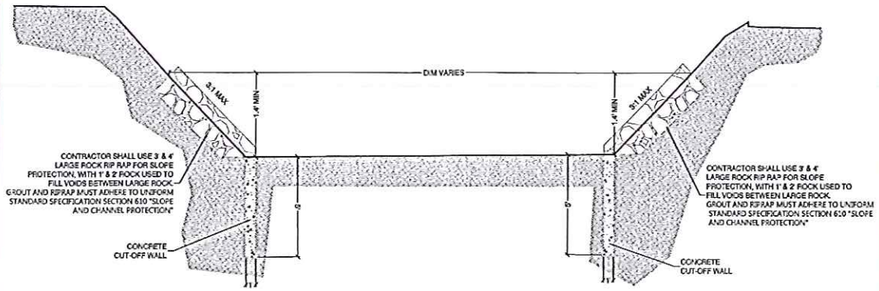

C SWALE
NTS



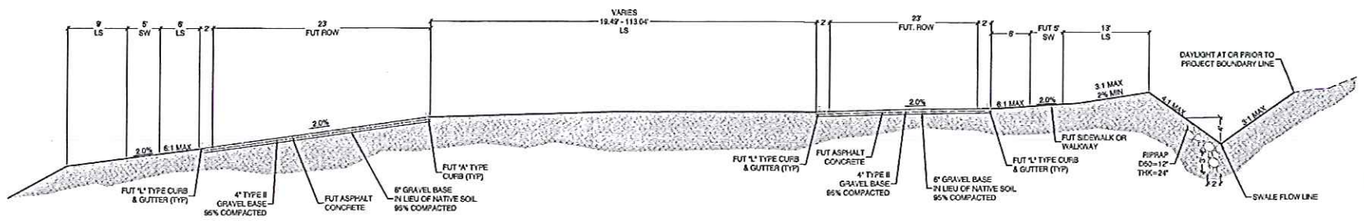

C/A 36" CONCRETE SWALE
NTS




D TYPICAL PRELIMINARY GRADING SECTION
NTS




E TYPICAL CHANNEL
NTS

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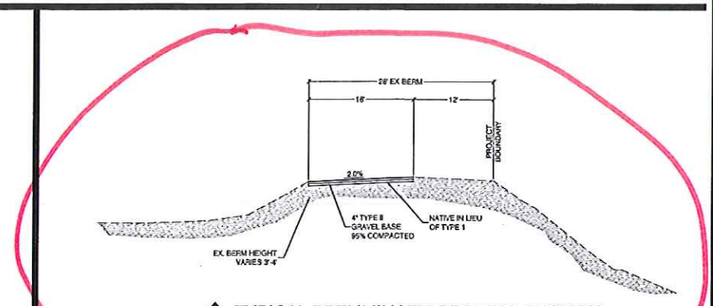
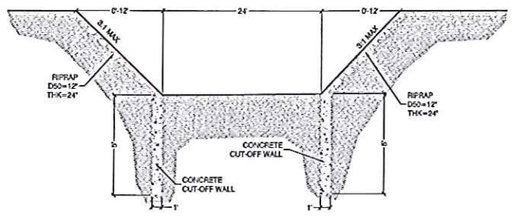
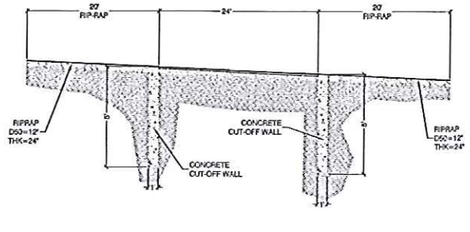


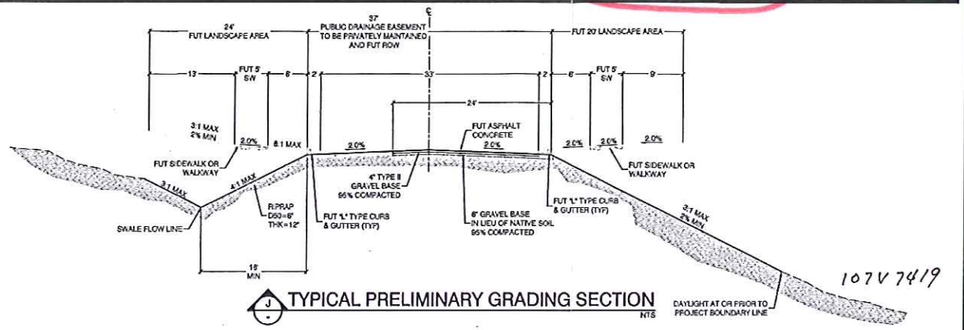

G TYPICAL PRELIMINARY GRADING SECTION
NTS




H TYPICAL PRELIMINARY GRADING SECTION
NTS




I TYPICAL PRELIMINARY GRADING SECTION
NTS




J TYPICAL PRELIMINARY GRADING SECTION
NTS

107V7419

| REV | DATE | BY | REVISION |
|---|---|---|---|
| | | | |

HOWARD HUGHES COMPANY, LLC
A DELAWARE LIMITED LIABILITY COMPANY
CITY OF LAS VEGAS
1980 FESTIVAL PLAZA DRIVE, SUITE 300
LAS VEGAS, NEVADA 89135
702-791-4000
2727 SOUTH RAINBOW BOULEVARD
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PH. (702) 873-7500 FAX (702) 362-2697 WEB WWW.VTNNV.COM
CONSULTING ENGINEERS ● PLANNERS ● LAND SURVEYORS

DETAIL SHEET 1

SUMMERLIN WEST VILLAGE 24
WESTERN BOUNDARY
GRADING & DRAINAGE

| DRAWN BY: | DESIGNED BY: | CHECKED BY: | SCALE: | HORZ. |
|---|---|---|---|---|
| DEH | DEH | MJM | N/A | VERT. |
| 10/25/2017 | 10/25/2017 | 06/06/2018 | N/A | |

PROJECT NO: 7001

PROFESSIONAL ENGINEER - STATE OF NEVADA
DAVID EDWARDS
No. 17860
9/5/18

SHEET
DT1
15 OF 33 SHEETS

DRAWING NO.
L18-01496

H:\7001\Village 24 Collector-WATER\Sheet Set\UNT 11761-DT.dwg