

DS #: 5402

APN: 137-22-301-006 & 137-15-801-002

PROJECT: Summerlin Village 25 - High School Staging Stockpile

SUBMITTAL: 1st

SCANNED BY/DATE:

CHECKED BY/DATE:



|                                                                            |                                                      |                                                                                                   |
|----------------------------------------------------------------------------|------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <b>CITY OF LAS VEGAS</b>                                                   |                                                      | <b>DATE:</b>                                                                                      |
| <b>INTER-OFFICE MEMORANDUM</b>                                             |                                                      | January 19, 2021                                                                                  |
| <b>TO:</b><br>Land Development Services<br>Department of Building & Safety |                                                      | <b>FROM:</b><br>Albert Sung, P.E.<br>Flood Control Project Engineer<br>Department of Public Works |
| <b>SUBJECT:</b>                                                            | Drainage Study for:                                  | <b>COPIES TO:</b>                                                                                 |
|                                                                            | Summerlin Village 25 – High School Staging Stockpile | GCW, Inc.                                                                                         |
| <b>Cross Streets:</b>                                                      | East of Lake Mead Blvd. & Sunset Run Dr.             | Howard Hughes Company, LLC                                                                        |
| <b>File Number:</b>                                                        | F:\Depot\DSMemos\DS5402A.doc                         | Bart Anderson, P.E., DevCo                                                                        |
| <b>Parcel Number:</b>                                                      | 137-22-301-006 & 137-15-801-002                      | CCRFC                                                                                             |
| <b>Zoning Action:</b>                                                      | N/A                                                  |                                                                                                   |
| <b>FEMA Flood Zone</b>                                                     | YES                                                  | NO <b>X</b>                                                                                       |
| <b>Proposed Storm Drain</b>                                                | YES                                                  | NO <b>X</b>                                                                                       |

| HISTORY                   | DATE RECEIVED | DATE REVIEWED | COMMENTS                   | REVIEW FEES     | FEES PAID<br>Payment Trn # |
|---------------------------|---------------|---------------|----------------------------|-----------------|----------------------------|
| 1 <sup>st</sup> Submittal | 1/5/2021      | 1/19/2021     | See Comments Below         | \$400.00        | 4121984: \$400             |
|                           |               |               | <b>TOTAL FEES (LDDRS):</b> | <b>\$400.00</b> | ----                       |

#### REMARKS:

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

|          |                                                                                                |
|----------|------------------------------------------------------------------------------------------------|
|          | is approved subject to conformance to all City standards and the following conditions:         |
| <b>X</b> | 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. Provide a copy of the approved *Clark County Dust Mitigation Plan* with the BMPs prior to the final approval of the subject drainage study.
2. Provide a note on the grading plans that states "Stockpile to comply with the approved Dust Mitigation Plan #\_\_\_\_\_".
3. Provide a note on the plans indicating the time limit of the proposed stockpile as outlined in the approved *Dust Mitigation Plan*.
4. **Standard Form 1:** Correct the "Township" numbering from 22 to **20** 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**  
AYS

T/R/S: T20S/R59E/20  
AREA K-22



# Summerlin West Village 25

## High School Staging Stockpile

December 2020

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL  
**DRAINAGE STUDY INFORMATION FORM**

Name of Development: Summerlin West Village 25 High School Staging Stockpile Date: December 2020  
Location of Development: a) Descriptive (Cross Streets) North/South: Scurry Bend Drive  
East/West: Sunset Run Drive  
b) Section: 20 Township: 22 Range: 59  
c) APN : 137-22-301-006, 137-15-801-002

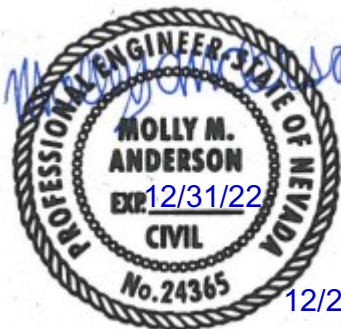
Name of Owner: Howard Hughes Company, LLC  
Telephone No.: (702) 791-4000 Fax No.: (702) 791-4450 E-Mail Address: april.chapman@howardhughes.com  
Address: 10845 Griffith Peak Drive, Suite 160, Las Vegas, NV 89135

Contact Person-Name: Molly Anderson, PE Telephone No.: (702) 551-0330  
\* E-Mail Address: molly.anderson@atkinsglobal.com Fax No.: (702) 263-7200  
Firm: Atkins  
Address: 2270 Corporate Circle, Ste 200, Henderson, NV 89074

Type of Land Development/Land Disturbance Process:

|                          |                  |                          |                          |                                     |                              |
|--------------------------|------------------|--------------------------|--------------------------|-------------------------------------|------------------------------|
| <input type="checkbox"/> | Rezoning         | <input type="checkbox"/> | Subdivision Map          | <input type="checkbox"/>            | Clearing and Grading Only    |
| <input type="checkbox"/> | Parcel Map       | <input type="checkbox"/> | Planned Unit Development | <input type="checkbox"/>            | Other (Please specify below) |
| <input type="checkbox"/> | Large Parcel Map | <input type="checkbox"/> | Building Permit          | <input checked="" type="checkbox"/> | Stockpile                    |

1. Total Owned Land Area: At Site: +/- 340 acres Being Developed/Disturbed: 39.44 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.): Stockpile Area
5. Approximate upstream land area which drains to the subject site: \_\_\_\_\_
6. Has the site drainage been evaluated in the past? ☒ YES ☐ NO If yes, please identify documentation: Update #1 to the Master Conceptual Drainage Study for Summerlin West Village 25
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: Existing CC-215 Western Beltway Channel
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

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE SUBMITTAL CHECKLIST

|                                                                  |                  |                                     |
|------------------------------------------------------------------|------------------|-------------------------------------|
| Project Name: Summerlin West Village 25 High School Staging Area |                  | Map ID: 137-22-301-006              |
| Firm Name: <b>Atkins</b>                                         |                  | Engineer: <b>Molly Anderson, PE</b> |
| Address: 2270 Corporate Circle, Ste 200                          |                  |                                     |
| City: <b>Henderson</b>                                           | State: <b>NV</b> | Zip: <b>89074</b>                   |
| Phone Number: <b>(702) 551-0330</b>                              |                  | Fax Number: <b>(702) 263-7200</b>   |
| Property Owner: <b>Howard Hughes Company, LLC</b>                |                  |                                     |
| Address: 10845 Griffith Peak Drive, Suite 160                    |                  |                                     |
| City: <b>Las Vegas</b>                                           | State: <b>NV</b> | Zip: <b>89135</b>                   |
| 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             |                                                                                                |
| <u>  x  </u>  | <u>      </u>  | Design Manual <b>Standard Form 1</b> with the engineer's seal and signature.                   |
| <u>  X  </u>  | <u>      </u>  | Design Manual <b>Standard Form 4</b> .                                                         |
| <u>  X  </u>  | <u>      </u>  | 2 copies of the 24" x 36" Drainage Plan.                                                       |
| <u>      </u> | <u>  N/A  </u> | A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge. |

### II. MAPS AND EXHIBITS

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

|                   |                        |
|-------------------|------------------------|
| <b>REFERENCE:</b> | <b>STANDARD FORM 2</b> |
|-------------------|------------------------|



# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE SUBMITTAL CHECKLIST

### II. MAPS AND EXHIBITS (Continued)

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

### III. DRAINAGE PLAN

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

**REFERENCE:**

**STANDARD FORM 2**

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE SUBMITTAL CHECKLIST

### III. DRAINAGE PLAN (Continued)

| Yes           | No            |                                                                                                                                                                                                                                                                             |
|---------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>      </u> | <u>N/A</u>    | Streets with off-set crowns.                                                                                                                                                                                                                                                |
| <u>X</u>      | <u>      </u> | Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.                                                                                                                                                                 |
| <u>X</u>      | <u>      </u> | Property lines.                                                                                                                                                                                                                                                             |
| <u>X</u>      | <u>      </u> | Right-of-way lines and widths, existing and proposed.                                                                                                                                                                                                                       |
| <u>X</u>      | <u>      </u> | Existing improvements and their elevations.                                                                                                                                                                                                                                 |
| <u>X</u>      | <u>      </u> | Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points.                                                                                                                                    |
| <u>X</u>      | <u>      </u> | Concentration points and drainage flow direction with $Q_{100}$ and $V_{100}$ and $D_{100}$ in streets.                                                                                                                                                                     |
| <u>X</u>      | <u>      </u> | Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.                                                                                                                                               |
| <u>      </u> | <u>N/A</u>    | Location and cross-section of street capacity calculations.                                                                                                                                                                                                                 |
| <u>X</u>      | <u>      </u> | Cross-sectional detail for channels, including cutoff wall locations.                                                                                                                                                                                                       |
| <u>X</u>      | <u>      </u> | 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. |
| <u>X</u>      | <u>      </u> | Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.                                                                                                |
| <u>      </u> | <u>N/A</u>    | Location and detail of existing, proposed, and future block wall openings. Minimum size is 16" x 48". Wrought iron gate is required for flows > 10 cfs.                                                                                                                     |
| <u>      </u> | <u>N/A</u>    | Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.                                                                                                                                                                               |
| <u>      </u> | <u>N/A</u>    | 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.                                                                              |
| <u>X</u>      | <u>      </u> | Building and/or lot numbers.                                                                                                                                                                                                                                                |
| <u>X</u>      | <u>      </u> | Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.                                                                                                                                                                                    |
| <u>X</u>      | <u>      </u> | Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.                                                                                                                      |

**REFERENCE:**

**STANDARD FORM 2**

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE SUBMITTAL CHECKLIST

### III. DRAINAGE PLAN (Continued)

| Yes                                   | No                                      |                                                                                                                                                                                                                |
|---------------------------------------|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/>              | <input checked="" type="checkbox"/> 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. |
| <input type="checkbox"/>              | <input checked="" type="checkbox"/> 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.                                          |
| <input checked="" type="checkbox"/> X | <input type="checkbox"/>                | Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.                                                                                                                            |
| <input type="checkbox"/>              | <input checked="" type="checkbox"/> N/A | Location and detail of best management practice (BMP) for parking lots and low impact development (LID) (if required).                                                                                         |

### IV. HYDROLOGIC ANALYSIS

| Yes                                   | No                                      |                                                                                                                                                                              |
|---------------------------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> X | <input type="checkbox"/>                | Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.                                                        |
| <input checked="" type="checkbox"/> X | <input type="checkbox"/>                | 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.                     |
| <input checked="" type="checkbox"/> X | <input type="checkbox"/>                | 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.                       |
| <input checked="" type="checkbox"/> X | <input type="checkbox"/>                | Use of correct precipitation values in and around the McCarran Airport rainfall area.                                                                                        |
| <input checked="" type="checkbox"/> X | <input type="checkbox"/>                | A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations.                                    |
| <input checked="" type="checkbox"/> X | <input type="checkbox"/>                | A summary table of stormwater flows showing basin area, $Q_{10}$ and $Q_{100}$ for both individual basins and combined basin flows, where applicable.                        |
| <input checked="" type="checkbox"/> X | <input type="checkbox"/>                | Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.                                              |
| <input checked="" type="checkbox"/> X | <input type="checkbox"/>                | On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law. |
| <input type="checkbox"/>              | <input checked="" type="checkbox"/> N/A | Calculation for impervious area for parking lots and LIDs (if required).                                                                                                     |

REFERENCE:

STANDARD FORM 2

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE SUBMITTAL CHECKLIST

### V. HYDRAULIC ANALYSIS

| Yes                      | No                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> | <u>N/A</u>               | Flow split calculations and supporting documentation or reference for the method of flow split calculations used.                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <input type="checkbox"/> | <u>N/A</u>               | 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. $Q_{100} d \times v \leq 8$ . $Q_{10} d \times v \leq 6$ and 12 foot dry lane for rights-of-way $\geq 80$ feet. Calculations must be labeled by street name as indicated on the Grading Plan.                                                                                          |
| <input type="checkbox"/> | <u>N/A</u>               | 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.                                                                                                                                                                                                                                                                                             |
| <input type="checkbox"/> | <u>N/A</u>               | Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.)                                                                                                                                                                                                                                                                                                                                                                     |
| <input type="checkbox"/> | <u>N/A</u>               | 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.                                                                                                                                                                                                                                                                                       |
| <input type="checkbox"/> | <u>N/A</u>               | 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, whichever is greater.                                                                                            |
| <input type="checkbox"/> | <u>N/A</u>               | A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. <ul style="list-style-type: none"> <li>• Field survey data.</li> <li>• Input and output information.</li> <li>• Plotted cross-sections based on survey with proper encroachments.</li> <li>• A map showing the location of the cross-sections.</li> <li>• Analysis of both sub and super-critical flow segments.</li> <li>• A summary table and a discussion of the results in the text of the report.</li> </ul> |
| <input type="checkbox"/> | <u>N/A</u>               | Provide a 50 percent clogging factor in the capacity calculation for drop inlets.                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <u>X</u>                 | <input type="checkbox"/> | 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.                                                                                                                                                                                                                                                                                                                                                    |
| <u>X</u>                 | <input type="checkbox"/> | The mitigation of nuisance water, both during construction and in the fully developed condition, must be addressed.                                                                                                                                                                                                                                                                                                                                                                                                               |
| <input type="checkbox"/> | <u>N/A</u>               | Provide BMP type, size and supporting calculations for parking lots and LIDs (if required).                                                                                                                                                                                                                                                                                                                                                                                                                                       |

REFERENCE:

STANDARD FORM 2





# CITY OF LAS VEGAS

## MINIMUM DRAINAGE STUDY CRITERIA STANDARD FORM 2 CHECKLIST SUPPLEMENT

(Revised 5/18/11)

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

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

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

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

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

## CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

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

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

### CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

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

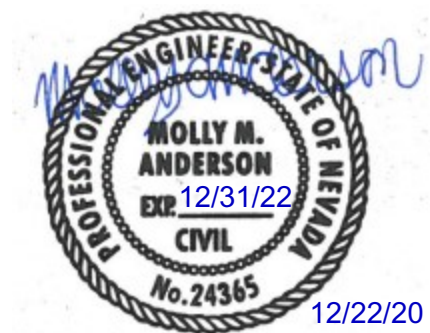
- Contact the Flood Control Section regarding the drainage study review fee. These fees are payable at the time of submittal.
- The Drainage Study must be conditionally approved prior to submitting improvement plans to the Civil and Planning Development of the Department of Building and Safety for review.

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

# Engineer's Certification

Atkins certifies that the information contained herein has been prepared in accordance with generally accepted engineering principles and practices, and to the best of our knowledge, is true and correct.

This letter certifies that all items in the **Summerlin West Village 25 Technical Drainage Study for High School Staging Stockpile** electronic submittal match the paper version bound into the study.



Molly M. Anderson, PE (NV #24365)  
Senior Engineer

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# Executive Summary

This Technical Drainage Study (TDS), prepared on behalf of Howard Hughes Company, LLC represents the hydrologic and hydraulic analysis for the High School Staging Stockpile of the Summerlin West Village 25 development. Summerlin West Village 25 is located in the northwest Las Vegas Valley, west of the CC-215 beltway and is located between Lake Mead Boulevard and Far Hills Avenue. A vicinity map is provided in Figure 1. The High School Staging Stockpile is located to the north of the future Sunset Run Drive alignment between Lake Mead Boulevard and Scurry Bend Drive and is shown on the location map in Figure 2.

A Master Conceptual Drainage Study (MCDS) for Summerlin West Village 25 (W.O. 7919-A) was approved June 18, 2019. Update #1 of the MCDS was approved April 14, 2020. Portions of the TDS, such as the parcel name, and facility locations are directly referenced from the Village 25 MCDS and other relevant studies, which are referenced at the end of this report.



# 1. Introduction

## 1.1. Study Overview and Purpose

The Howard Hughes Company, LLC is proposing to construct a temporary staging stockpile within Summerlin West Village 25 Parcel HS-1. This Technical Drainage Study for Summerlin West Village 25 High School Staging Stockpile serves to accompany the grading plans and to provide a detailed hydrologic and hydraulic analysis for the proposed site. The methodology presented in this study is in accordance with the criteria set forth in the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (HCDDM).

## 1.2. Location

The site is located within a portion of Sections 15 and 22, Township 20, Range 59, M.D.M., Clark County, Nevada. The project lies within Village 25 of the Summerlin West Planning Area (SWPA), Lot 1, per Parcel Map 125, Page 15, Figure 1 (Vicinity Map).

## 1.3. Description

The existing site slopes from the west to the east at approximately 7%. The site and its surroundings are currently undeveloped land, bounded on the east by the existing Bruce Woodbury Beltway (CC-215) and the Western Beltway Channel. In the ultimate condition, Lake Mead Boulevard to the northwest, Scurry Bend Drive to the east, and Sunset Run Drive to the southwest will be constructed.

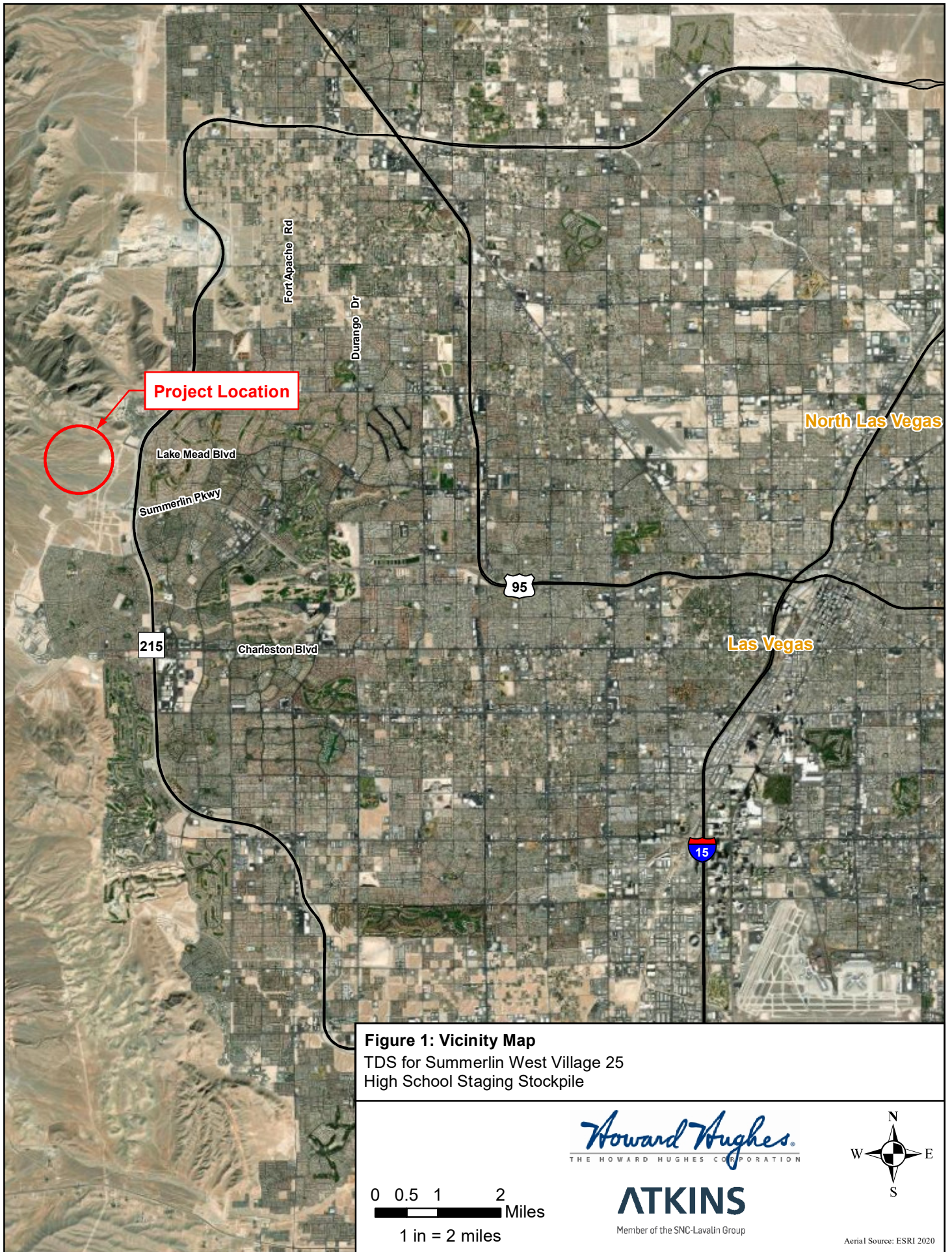
## 1.4. Floodplain Information

The site is within Village 25, depicted on the referenced Flood Insurance Rate Map (FIRM), Community Panel Number 32003C2150E, dated September 27, 2002 (Figure 3 of the Village 25 MCDS, Appendix A). The site is located within an Un-shaded Zone X. Un-shaded Zone X is defined as an area determined to be outside the 0.2% annual chance floodplain.

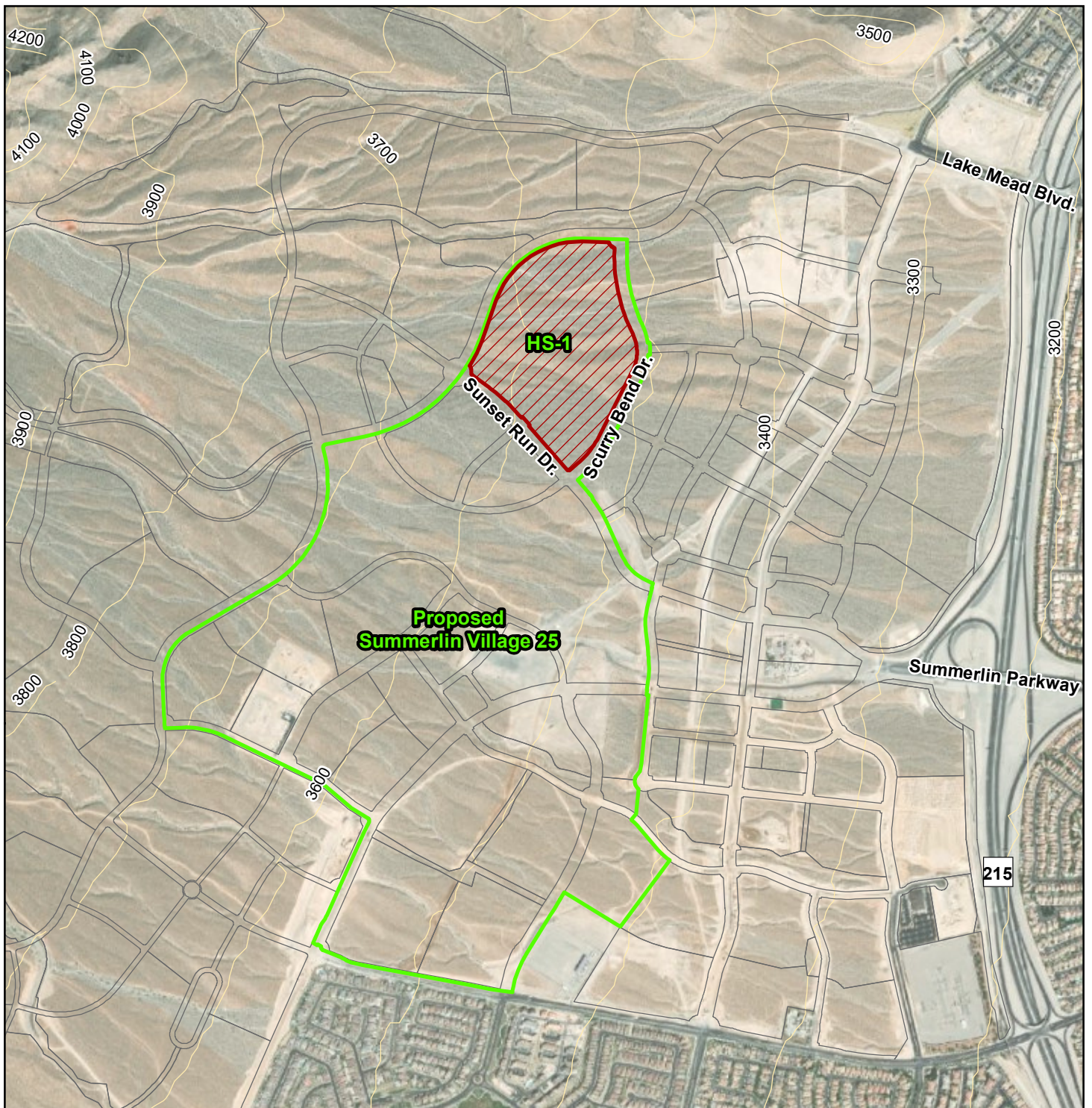
## 1.5. Master Planning Information

The site is within Village 25, depicted on the referenced Figure 4A: MPU Facilities (Village 25 MCDS, Appendix A), also, Figure F-24 from the CCRFCD Master Plan Update. According to the 2018 CCRFCD MPU, two proposed category B facilities (GOB2 0096/0033) cross the project area.









**Figure 2: Site Map**

TDS for Summerlin West Village 25  
High School Staging Stockpile

**Legend**

-  Project Area
-  V25 Boundary
-  Ultimate Parcels
-  100 ft Contours

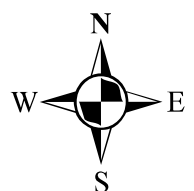
1,500 750 0 1,500 Feet



1 inch = 1,500 feet

*Howard Hughes*  
THE HOWARD HUGHES CORPORATION

**ATKINS**  
Member of the SNC-Lavalin Group



Aerial Source: ESRI 2020

## 2. Hydrologic Analysis

### 2.1. Existing Condition

The existing site condition is undeveloped desert land. The Western Beltway Channel to the east of the project is fully developed and includes a 20-foot wide concrete channel that conveys flows north to the Village 26 Detention Basin.

According to the Village 25 MCDS, in the existing condition, runoff generated by the project and the undeveloped areas west of the project drains east as sheet flow to the Western Beltway Channel. In addition, the allowable discharge flow rates for the project have been established in the 2017 Summerlin West Planning Area (SWPA) MPU study. Therefore, an additional existing condition hydrologic model was not required as part of this study.

Table 1, below, provides a summary of spatially relevant existing flows presented in Volume 1 of the Flood Control Master Plan Update (W.O. # 7809). The current study has made updates for hydrologic subbasin relevance.

**Table 1 – Existing Condition HEC-1 Model Results**

| <b>HEC-1 Node</b> | <b>Tributary Area<br/>(ac)</b> | <b>100-year Flow<br/>(cfs)</b> |
|-------------------|--------------------------------|--------------------------------|
| 3-A*              | 217.07                         | 422                            |
| 3-O*              | 71.96                          | 237                            |
| 3-P1*             | 92.53                          | 507                            |
| 3-P2*             | 156.22                         | 260                            |

\*Referenced from the Summerlin West Planning Area Flood Control Master Plan Update (W.O. # 7809)

### 2.2. Interim Condition

The developer is proposing to grade a temporary staging stockpile area between the future Lake Mead Boulevard, Sunset Run Drive, and Scurry Bend Drive alignments. The yard will be graded into three (3) stockpiles at roughly 8%, with 3:1 slopes to tie back into the existing and/or proposed ground. As established in the Village 25 MCDS, there will be two downstream stubs that will collect runoff from the proposed yard. The flows will be directed into the storm drain systems in both Fleet Wing Avenue and Flight Range Avenue. A dust mitigation plan will be in place before the Grading Permit is issued.

Atkins has reviewed the construction staging yard location and its influence on the drainage patterns depicted in the MCDS. This report presents an interim condition scenario. The existing and ultimate conditions remain unchanged.

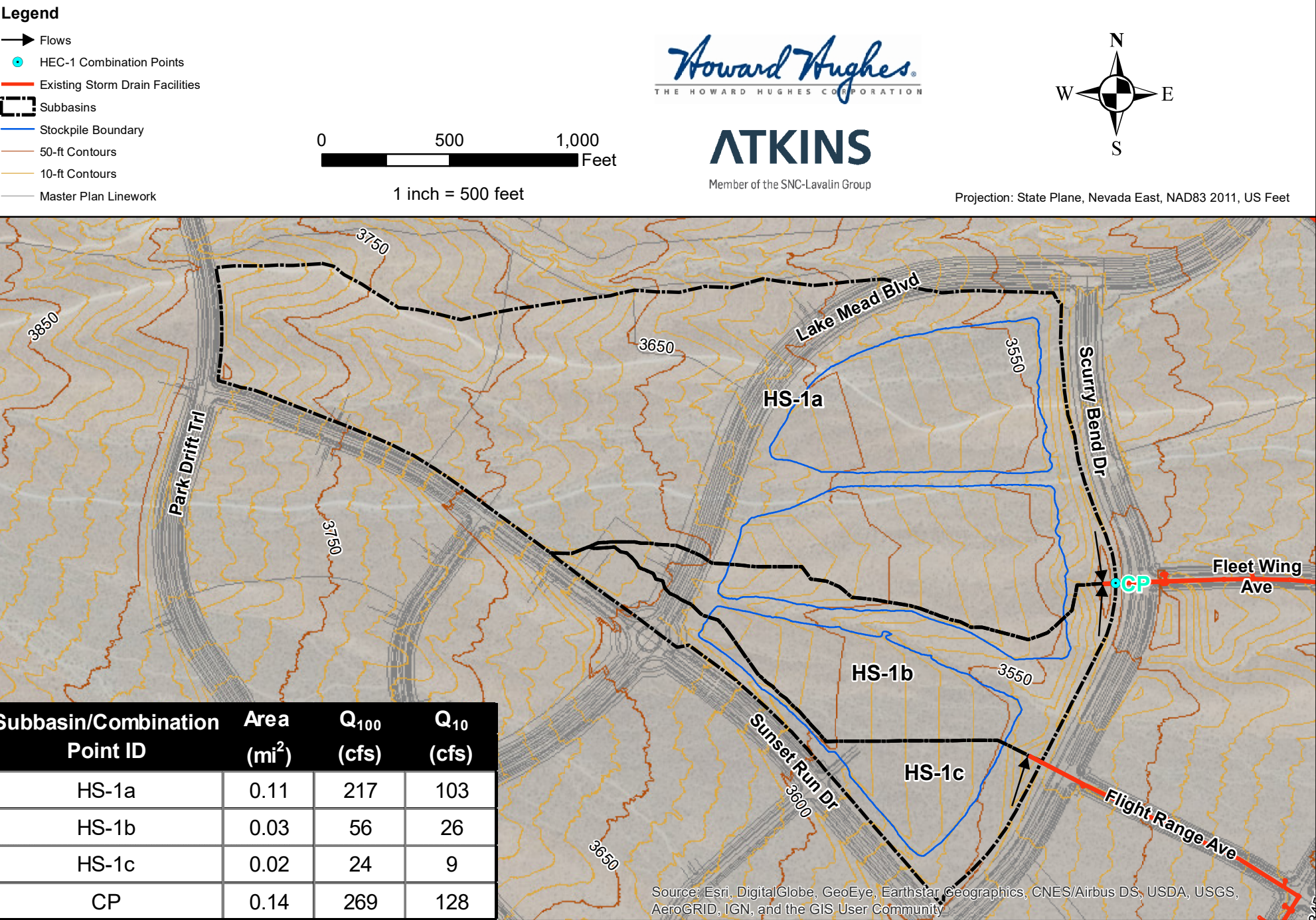
In the interim condition, the rough grading of Scurry Bend Drive is complete; Sunset Run Drive is graded up to Park Drift Trail, and Park Drift Trail is rough-graded to intercept offsite flows from the west. Lake Mead Boulevard along the extents of the subject parcel will be assumed to be ungraded to analyze the worst case, maximum flow scenario, where offsite flows from west of the future Lake Mead Boulevard, but east of Park Drift Trail will enter the stockpile site unimpeded. The proposed stockpiles will be in use during this phase.

Figure 3 (Hydrology) shows the location of the staging area in relation to the hydrologic subbasins and existing/proposed major grading presented in this study, for the interim condition. The Grading Plan is included in this submittal.



Figure 3: Hydrology

TDS for Summerlin West Village 25  
High School Staging Stockpile



| Subbasin/Combination Point ID | Area (mi <sup>2</sup> ) | Q <sub>100</sub> (cfs) | Q <sub>10</sub> (cfs) |
|-------------------------------|-------------------------|------------------------|-----------------------|
| HS-1a                         | 0.11                    | 217                    | 103                   |
| HS-1b                         | 0.03                    | 56                     | 26                    |
| HS-1c                         | 0.02                    | 24                     | 9                     |
| CP                            | 0.14                    | 269                    | 128                   |

The street improvements referred to in this study and on the plans have different names than in the Master Conceptual Drainage Study. The MCDS referred to the roadways by letters. Now that the roadways have been named, the plans and report refer to the roadways by name. Table 5 in Section 4.1 compares the roadway names to their letter names in the MCDS.

CN calculations have been performed according to the SCS Curve Number Method, utilizing soils data from the 2018 Las Vegas Valley Flood Control Master Plan Update and modified according to the HCDDM, for newly graded areas. The CN calculations, Soils Map (Figure B-1) and Land Use Map (Figure B-2) are included in Appendix B. Lag time calculations have been made using Form 4 from the HCDDM for the interim condition scenario and are also included in Appendix B. Finally, ArcMap10.7 and zonal statistics were used to calculate the mean rainfall for each drainage subbasin, using HCDDM rainfall raster data for the 100-yr, 6-hr storm. Ten-year rainfall totals were determined by applying a reduction factor to those 100-year rainfalls in the HEC-1 model. Figure B-3 shows the 100-year rainfall values.

The interim stockpile grading has been designed to ensure that the existing drainage patterns are maintained in the interim condition and that none of the existing downstream facilities are adversely affected by the proposed improvements. In the proposed interim condition, the location of the staging area does not significantly alter any drainage patterns from the existing topography. The staging area is temporary and will be removed in the ultimate condition. The ultimate condition will be addressed in a future TDS unrelated to the High School Staging Stockpile.

The interim subbasin flows were modeled using HEC-1. The results are summarized in Table 2.

**Table 2 – Interim Condition HEC-1 Model Results**

| <b>HEC-1 Node</b> | <b>Tributary Area<br/>(sq mi)</b> | <b>Tributary Area<br/>(ac)</b> | <b>100-year Flow<br/>(cfs)</b> | <b>10-year Flow<br/>(cfs)</b> |
|-------------------|-----------------------------------|--------------------------------|--------------------------------|-------------------------------|
| HS-1a             | 0.1148                            | 73.44                          | 217                            | 103                           |
| HS-1b             | 0.0278                            | 17.82                          | 56                             | 26                            |
| HS-1c             | 0.0170                            | 10.88                          | 24                             | 9                             |
| CP                | 0.1426                            | 91.26                          | 269                            | 128                           |

## 2.3. Ultimate Condition

In the ultimate condition the stockpiles will be removed for the construction of the school property. The ultimate condition flows can be found in the approved Village 25 MCDS Update #1 (W.O. # 7919).

## 3. Hydraulic Analysis

### 3.1. Normal Depth Calculations

The computer program Bentley FlowMaster V8i was utilized to perform normal depth calculations for the swales around the proposed staging stockpiles. These normal depth calculations were utilized to ensure that existing and proposed swales are adequately designed around the adjacent yards and streets.

Four cross-sections were analyzed for engineered swales A-a, A-b, B and C, respectively, as delineated in Figure 4 (Hydraulics). The drainage swales were designed along Scurry Bend Drive to direct flows into the two RCP stubs indicated in the Village 25 MCDS and the current grading plans and connect to the downstream storm drain facilities. The swale cross sections and slopes were referenced from the Scurry Bend Drive Rough Grade Plans, Street J Improvement Plans and the High School Staging Stockpile Grading Exhibit. Table 3 summarizes the normal depth calculations for the 100-year storm event. Printouts of all normal depth calculations for the interim condition are provided in Appendix C. The locations of the swales and calculation summaries have been included in Figure 4. A prorated 100-year flow from subbasin HS-1a was used to model Swale A-a, as indicated in Figure 4, to account for the partial subbasin flow which will reach that swale. All other swale flows were used directly from the HEC-1 subbasin outputs.

In addition, eleven cross-sections were analyzed for natural swales A-1, A-2, B-1 and B-2, respectively, as delineated in Figure 4 (Hydraulics). These natural swales direct flows from on and off site into the engineered swales downstream. The natural swales were cut into different zones for riprap analysis and design, in an effort to minimize the locations where riprap is specified and minimize the size of that riprap. The swale cross sections and average slopes were approximated from existing and proposed grading plans. Table 3 summarizes the normal depth calculations for the 100-year storm event. Printouts of all normal depth calculations for the interim condition are provided in Appendix C. The locations of the swales and calculation summaries have been included in Figure 4. Prorated 100-year flows were approximated from the HEC-1 results and the contributing area for each swale zone.



**Table 3 – Normal Depth Calculations**

| Swale Type        | ID        | Total Flow (cfs) | Slope Range (%)   | Max Flow Depth (ft) | Max Velocity (ft/s) |
|-------------------|-----------|------------------|-------------------|---------------------|---------------------|
| Engineered Swales | Swale A-a | 196              | 4.3 – 2.0         | 2.3                 | 7.5                 |
|                   | Swale A-b | 217              | 5.2               | 2.0                 | 9.8                 |
|                   | Swale B   | 56               | 6.3 – 3.2         | 1.1                 | 7.7                 |
|                   | Swale C   | 24               | 9.2 – 2.3         | 0.8                 | 4.2                 |
| Swale Type        | ID*       | Total Flow (cfs) | Average Slope (%) | Flow Depth (ft)     | Velocity (ft/s)     |
| Natural Swales    | A-1-1     | 120              | 6.4               | 0.5                 | 6.2**               |
|                   | A-1-2     | 118              | 6.7               | 0.8                 | 6.8                 |
|                   | A-1-3     | 109              | 6.6               | 0.9                 | 6.5**               |
|                   | A-1-4     | 78               | 6.6               | 0.4                 | 5.9**               |
|                   | A-2-1     | 48               | 7.2               | 0.6                 | 4.4                 |
|                   | A-2-2     | 42               | 7.5               | 0.4                 | 4.4                 |
|                   | A-2-3     | 36               | 7.7               | 0.4                 | 4.1                 |
|                   | B-1-1     | 41               | 5.7               | 0.7                 | 5.6**               |
|                   | B-1-2     | 33               | 5.6               | 0.8                 | 6.7**               |
|                   | B-1-3     | 18               | 8.5               | 0.4                 | 5.6                 |
|                   | C-1-1     | 13               | 6.5               | 0.3                 | 3.2                 |

\*For natural swales, the third part of the ID refers to the zone. For example, A-1-1 indicates swale A-1 in zone 1.

\*\*Calculations demonstrated that 6-inch riprap was adequate for velocity criteria, but 8-inch riprap was specified based on Summerlin construction standards.

## 3.2. Riprap Calculations

The riprap analyses were performed utilizing shear stress calculations based on HCDDM Section 705, using HEC-11 methodology. The data are included in Appendix C.

For the engineered swales, the interim flows calculated in this study and the swale sections provided in the Scurry Bend Drive Rough Grade Plans and Street J Improvement Plans were used in the calculations to determine if the current riprap requirements are suitable for the interim flow characteristics. Table 4 summarizes the results. For the natural swales, interim flow and proposed grading information were used to determine the need and sizing of riprap. Those results are also summarized in Table 4.

**Table 4 – Riprap Calculations**

| Swale Type        | ID        | Total Flow (cfs) | Channel Cross Section (ft) |           |       |                    | Riprap, D50 (in) |          |
|-------------------|-----------|------------------|----------------------------|-----------|-------|--------------------|------------------|----------|
|                   |           |                  | Bottom Width               | Top Width | Depth | Side Slope         | Current          | Proposed |
| Engineered Swales | Swale A-a | 196              | 5                          | 41        | 6.0   | 3:1                | 8                | 8        |
|                   | Swale A-b | 217              | 5                          | 26        | 3.5   | 3:1                | 12               | 12       |
|                   | Swale B   | 56               | 5                          | 26        | 3.5   | 3:1                | 8                | 8        |
|                   | Swale C   | 24               | 5                          | 26        | 3.5   | 3:1                | 8                | 8        |
| Swale Type        | ID*       | Total Flow (cfs) | Approx. Bottom Width       | Top Width | Depth | Approx. Side Slope | Current          | Proposed |
| Natural Swales    | A-1-1     | 120              | 40                         | -         | -     | 4:1                | -                | 8**      |
|                   | A-1-2     | 118              | 12                         | -         | -     | 13:1               | -                | 8        |
|                   | A-1-3     | 109              | 2                          | -         | -     | 20:1               | -                | 8**      |
|                   | A-1-4     | 78               | 26                         | -         | -     | 9:1                | -                | 8**      |
|                   | A-2-1     | 48               | 37                         | -         | -     | 24:1               | -                | -        |
|                   | A-2-2     | 42               | 26                         | -         | -     | 26:1               | -                | -        |
|                   | A-2-3     | 36               | 7/9                        | -         | -     | 20:1/26:1          | -                | -        |
|                   | B-1-1     | 41               | 4                          | -         | -     | 10:1               | -                | 8**      |
|                   | B-1-2     | 33               | 4                          | -         | -     | 3:1                | -                | 8**      |
|                   | B-1-3     | 18               | 6                          | -         | -     | 6:1                | -                | 8**      |
|                   | C-1-1     | 13               | 5                          | -         | -     | 40:1               | -                | -        |

\*For Natural swales, the third part of the ID refers to the zone. For example, A-1-1 indicates swale A-1 in zone 1.  
 \*\*Calculations demonstrated that 6-inch riprap was adequate for velocity criteria, but 8-inch riprap was specified based on Summerlin construction standards.

As illustrated in Table 4, for the engineered swales, it is concluded that all of the engineered swales are expected to perform suitably, with the cross sections and riprap sizing as previously designed.

For the natural swales, the analysis results show that riprap should be added to swales A-1 and B-1, and sized according to Table 4.

### 3.3. Effects to Downstream Storm Drain Collection

The collection stub in subbasin HS-1c leading to the Flight Range Avenue storm drain (shown in Figure 4) was found in this study to collect a maximum flowrate of 24 cfs. The Village 22 Flight Range Ave drainage study, which covered that storm drain section, considered flows of up to 48 cfs at that stub. Therefore, the lower flows in the current study will not have any adverse effects on the downstream collection system.



The current analysis resulted in a maximum flow of 269 cfs at the Fleet Wing Avenue stub (CP) leading to the downstream Fleet Wing Avenue storm drain (Figure 4). The Village 22 Fleet Wing Avenue TDS shows a downstream flowrate of 282 cfs, so once again no adverse downstream effects should result from the proposed interim condition stockpile scenario.

| Natural Swales |                         |                        |       |              |                                           |                |                                       |                    |                 |            |                       |                   |           |                 |                      |                                                        |                       |
|----------------|-------------------------|------------------------|-------|--------------|-------------------------------------------|----------------|---------------------------------------|--------------------|-----------------|------------|-----------------------|-------------------|-----------|-----------------|----------------------|--------------------------------------------------------|-----------------------|
| Basin          | Area (mi <sup>2</sup> ) | Q <sub>100</sub> (cfs) | Swale | Section/Zone | Contributing Sub-Basin (mi <sup>2</sup> ) | Sub-Flow (cfs) | Proposed Riprap, D <sub>50</sub> (in) | Avg. Slope (ft/ft) | Base Width (ft) | Side Slope | Riprap Thickness (in) | Riprap Width (ft) | Roughness | Flow Depth (ft) | Flow Velocity (ft/s) | Swale Stationing (from Centerline of Engineered Swale) | Notes                 |
| HS-1a          | 0.1148                  | 217                    | A-1   | 1            | 0.0633                                    | 120            | 8*                                    | 0.064              | 40              | 4:1        | 16                    | 47                | 0.035     | 0.5             | 6.2                  | 0+00 - 3+50                                            |                       |
|                |                         |                        |       | 2            | 0.0622                                    | 118            | 8                                     | 0.067              | 12              | 13:1       | 16                    | 28                | 0.037     | 0.8             | 6.8                  | 3+50 - 6+50                                            |                       |
|                |                         |                        |       | 3            | 0.0574                                    | 109            | 8*                                    | 0.066              | 2               | 20:1       | 16                    | 34                | 0.035     | 0.9             | 6.5                  | 6+50 - 10+00                                           |                       |
|                |                         |                        |       | 4            | 0.0411                                    | 78             | 8*                                    | 0.066              | 26              | 9:1        | 16                    | 34                | 0.035     | 0.4             | 5.9                  | 10+00 - 12+00                                          |                       |
|                |                         |                        | A-2   | 1            | 0.0252                                    | 48             | NA                                    | 0.072              | 37              | 24:1       | NA                    | NA                | 0.035     | 0.6             | 4.4                  | 0+00 - 3+50                                            |                       |
|                |                         |                        |       | 2            | 0.0221                                    | 42             | NA                                    | 0.075              | 26              | 26:1       | NA                    | NA                | 0.035     | 0.4             | 4.4                  | 3+50 - 6+50                                            |                       |
|                |                         |                        |       | 3            | 0.0187                                    | 36             | NA                                    | 0.077              | 7/9             | 20:1/26:1  | NA                    | NA                | 0.035     | 0.4             | 4.1                  | 6+50 - 14+00                                           | Side-by-side channels |
| HS-1b          | 0.0278                  | 56                     | B-1   | 1            | 0.0203                                    | 41             | 8*                                    | 0.057              | 4               | 10:1       | 16                    | 18                | 0.035     | 0.7             | 5.6                  | 0+00 - 4+00                                            |                       |
|                |                         |                        |       | 2            | 0.0161                                    | 33             | 8*                                    | 0.056              | 4               | 3:1        | 16                    | 11                | 0.035     | 0.8             | 6.7                  | 4+00 - 8+00                                            |                       |
|                |                         |                        |       | 3            | 0.0090                                    | 18             | 8*                                    | 0.085              | 6               | 6:1        | 16                    | 13                | 0.035     | 0.4             | 5.6                  | 8+00 - 15+50                                           |                       |
| HS-1c          | 0.0170                  | 24                     | C-1   | 1            | 0.0090                                    | 13             | NA                                    | 0.065              | 5               | 40:1       | NA                    | NA                | 0.035     | 0.3             | 3.2                  | 0+00 - 14+50                                           |                       |

\*Calculation results included here demonstrated that 6-inch riprap was adequate, but 8 inch riprap was specified based on minimum Summerlin construction standards.

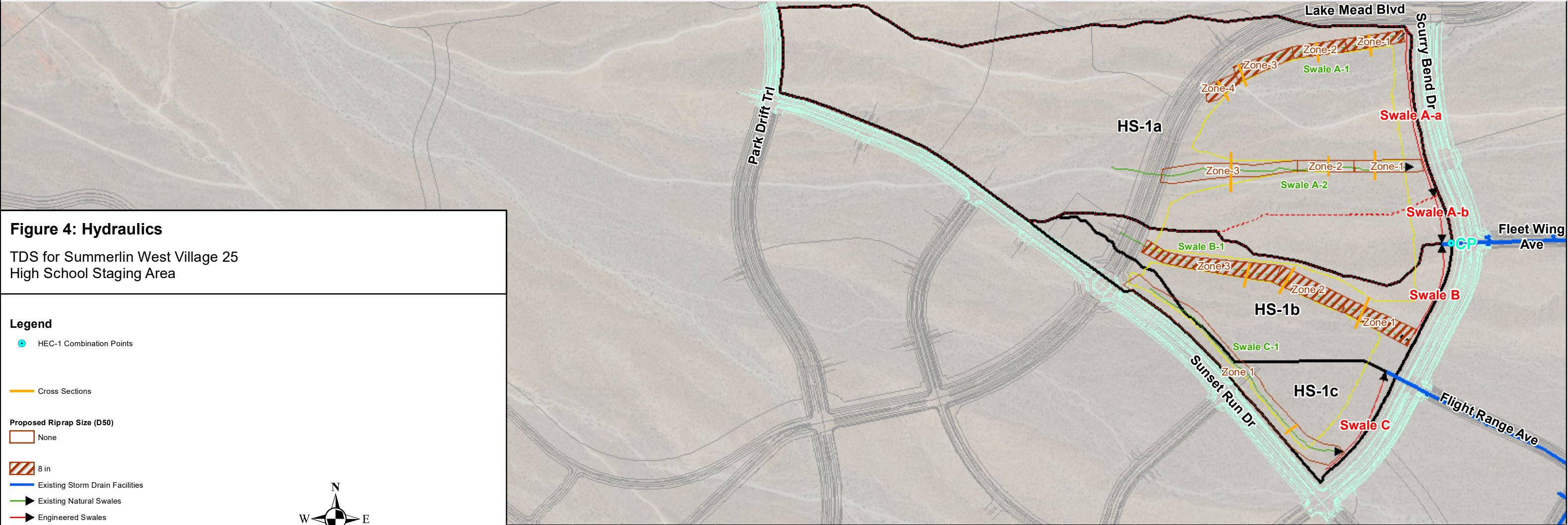


Figure 4: Hydraulics

TDS for Summerlin West Village 25 High School Staging Area

- Legend
- HEC-1 Combination Points

Cross Sections

Proposed Riprap Size (D50)

None

8 in

Existing Storm Drain Facilities

Existing Natural Swales

Engineered Swales

Stockpile Outline

Prorated Sub-Area (Engineered Swales)

Basins

Rough Graded Roadways

Proposed Master Plan Linework
- 
- 
- ATKINS  
Member of the SNC-Lavalin Group
- 0 500 1,000 Feet  
1 inch = 500 feet
- Projection: State Plane, Nevada East, NAD83 2011, US Feet

| Engineered Swales |               |       |                           |                                         |                            |           |       |            |                              |           |                |            |                |
|-------------------|---------------|-------|---------------------------|-----------------------------------------|----------------------------|-----------|-------|------------|------------------------------|-----------|----------------|------------|----------------|
| Swale             | Slope (ft/ft) |       | Q <sub>100</sub><br>(cfs) | Contributing Area<br>(mi <sup>2</sup> ) | Channel Cross Section (ft) |           |       |            | Riprap, D <sub>50</sub> (in) | Roughness | Velocity (fps) | Depth (ft) | Freeboard (ft) |
|                   | max           | min   |                           |                                         | bottom width               | top width | depth | side slope | proposed                     | n         | max            | max        | min            |
| Swale A-a         | 0.023         | 0.020 | 196                       | Prorated HS-1a flow<br>(0.1037/0.1148)  | 5                          | 41        | 6.0   | 3:1        | 8                            | 0.037     | 7.5            | 2.3        | 3.7            |
| Swale A-b         | 0.052         | 0.052 | 217                       | HS-1a (0.1148)                          | 5                          | 26        | 3.5   | 3:1        | 12                           | 0.040     | 9.8            | 2.0        | 1.5            |
| Swale B           | 0.063         | 0.032 | 56                        | HS-1b (0.0278)                          | 5                          | 26        | 3.5   | 3:1        | 8                            | 0.037     | 7.7            | 1.1        | 2.4            |
| Swale C           | 0.092         | 0.023 | 24                        | HS-1c (0.0170)                          | 5                          | 26        | 3.5   | 3:1        | 8                            | 0.037     | 6.8            | 0.8        | 2.7            |

## 4. Differences Between Village 25 MCDS and Proposed TDS

### 4.1. Road Names

Roadways in the original Village 25 MCDS are represented by a letter or have been re-named. On the proposed improvement plans, and in the report, the roadways are referenced by their proposed name. Table 5 compares the proposed name in the TDS to the MCDS letter names.

**Table 5 – Village 25 MCDS and TDS Roadway Names**

| <b>MCDS Street Name</b>          | <b>TDS Street Name</b> |
|----------------------------------|------------------------|
| Street E                         | Flight Range Avenue    |
| Street G                         | Fleet Wing Avenue      |
| Street N                         | Scurry Bend Drive      |
| Summerlin Parkway<br>WB/Street Q | Sunset Run Drive       |
| Street J                         | Kettle Ridge Drive     |
| Street K                         | Park Drift Trail       |

## 5. References

1. Master Conceptual Drainage Study for Summerlin West Village 25 (W.O. # 7919-A; CLV # DS5104), VTN, 2019 and Update #1 to the MCDS for Summerlin West Village 25 (W.O. # 7919; CLV # DS5104), VTN, 2019.
2. Flood Control Master Plan Update, Summerlin West Planning Area (W.O. # 7809; CLV # DS4926), Volume 1, VTN, 2017.
3. Village 25, High School Staging Stockpile, Village 25, Preliminary Exhibit, Atkins, 2020.
4. Summerlin West Village 22, Flight range Avenue (Street E): Scurry Bend Drive (Street N) to Kettle Ridge Drive (Street J), Atkins, 2020.
5. Summerlin Village 22 Improvement Plans for: Scurry Bend Drive (Street N) Rough Grade, Sunset Run Drive to Fleet Wing Avenue (Street G), CLV # 107V8560, L20-01966, Atkins, 2020.
6. Summerlin West Village 22: Street J, Street G to Lake Mead Boulevard, Street N Rough Grade, Street G to Lake Mead Boulevard, Update #1 (CLV # DS5156), Atkins, 2019.
7. Summerlin West Village 22, Fleet Wing Avenue (Street G): Kettle Ridge Drive (Street J) to Scurry Bend Drive (CLV # DS5367), Atkins, 2020.

# Appendices





## Appendix A. References

## A.1 Flood Insurance Rate Map and Flood Control Facility Figures from MCDS

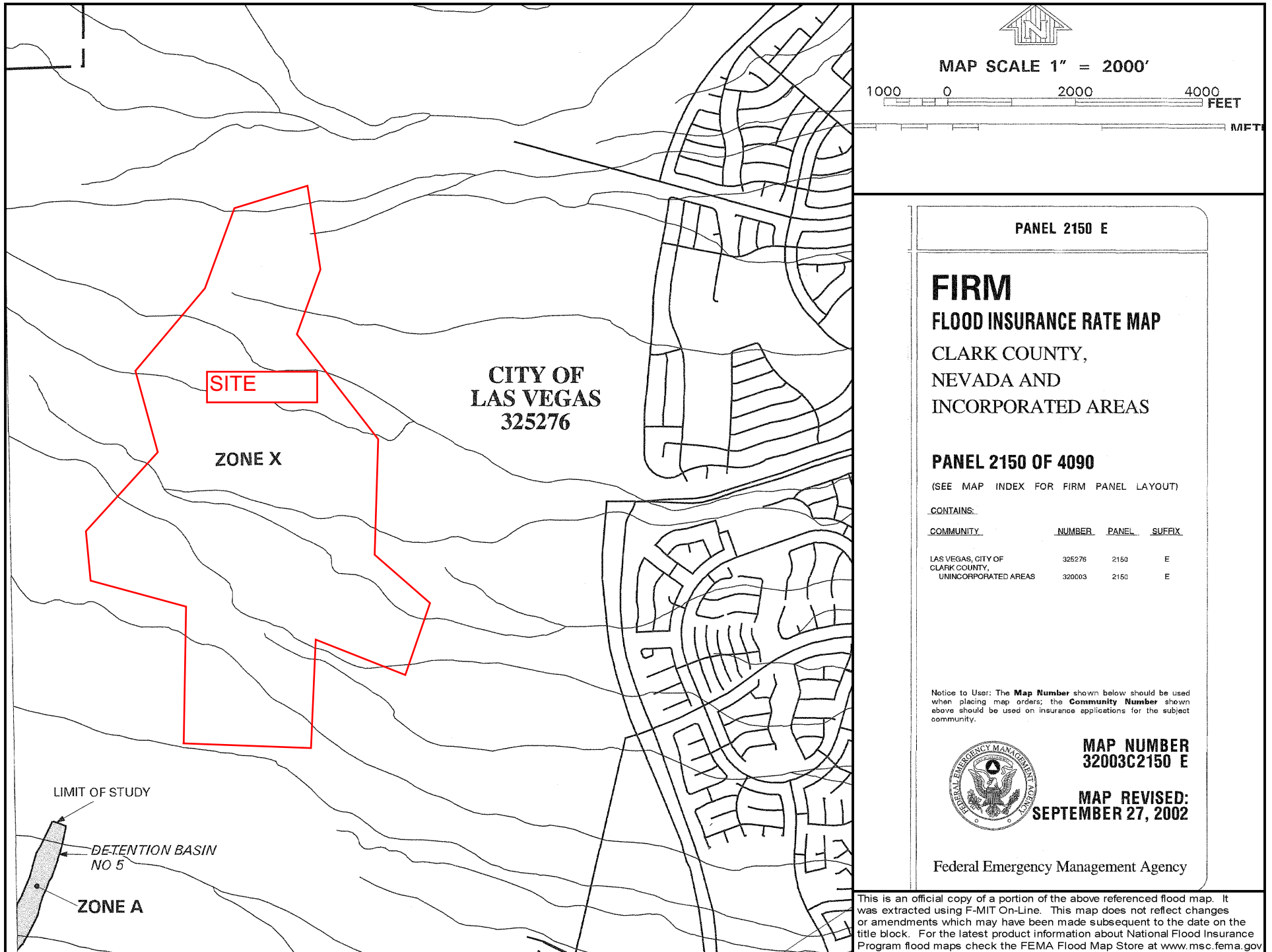
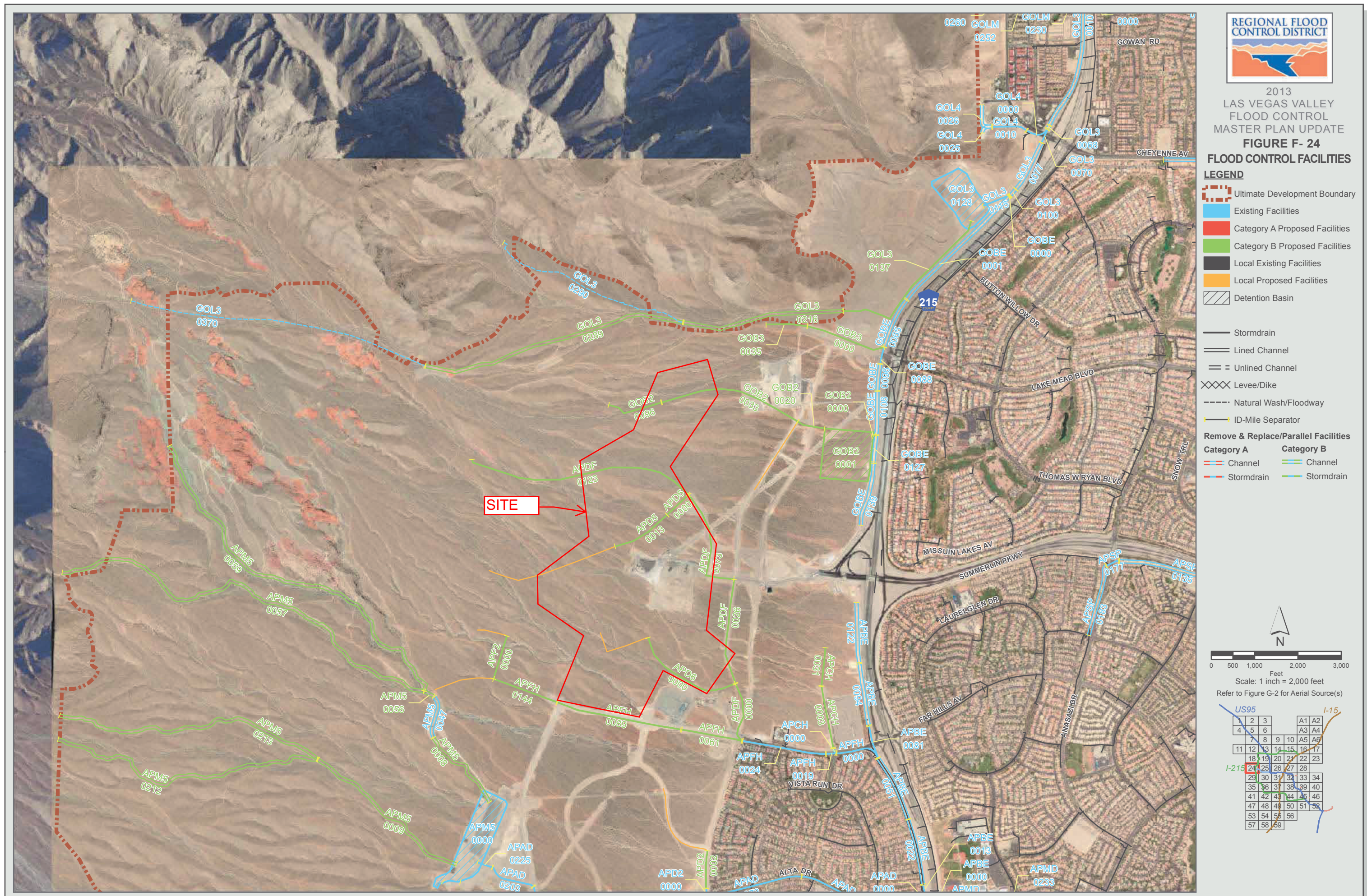


FIGURE 3







| ID / River Mile | Status | Facility Description                       | Length (ft.) | Flow (cfs) | HEC-1 Node | HEC-1 Model | Tributary Area (sq.mi.) | Channel Slope (%) ** |
|-----------------|--------|--------------------------------------------|--------------|------------|------------|-------------|-------------------------|----------------------|
| APAD            |        | ANGEL PARK - ALTA DRIVE BRANCH             |              |            |            |             |                         |                      |
| 0044            | E      | 11' X 8' RCAP                              | 1565         | 3140       | CSWAA-3    | ALLGOW4     | 8.26                    | 4.24                 |
| 0073            | E      | 11' X 8' RCAP                              | 2220         | 2917       | CSWAA-2    | ALLGOW3     | 7.68                    | 3.50                 |
| 0146            | E      | 10' X 8' RCB                               | 3010         | 2220       | CSWAA-1    | ALLGOW3     | 6.98                    | 4.40                 |
| 0203            | E      | 2: 7' X 5.5' RCB                           | 1136         | 2220       | CSWAA-1    | ALLGOW3     | 6.98                    | 5.28                 |
| 0225            | E      | 2: 7' X 5.5' RCB Outlet                    | 360          | 2149       | SUM5DB     | ALLGOW3     | 6.74                    | 3.40                 |
| APBE            |        | ANGEL PARK - BELTWAY BRANCH                |              |            |            |             |                         |                      |
| 0013            | E      | 3: 12' X 8' RCB                            | 489          | 4060       | CSWFH-9    | ALLGOW3     | 2.65                    | 6.50                 |
| 0022            | E      | Conc Chnl 20'W 7'D 2:1 SS                  | 1556         | 4060       | CSWFH-9    | ALLGOW3     | 2.65                    | 1.81                 |
| 0051            | E      | Conc Chnl 20'W 7'D 2:1 SS                  | 1583         | 4060       | CSWFH-9    | ALLGOW3     | 2.65                    | 2.77                 |
| 0081            | E      | 8' X 8' RCBC @ Far Hills                   | 777          | 423        | SWFH-9     | ALLGOW3     | 0.17                    | 2.32                 |
| 0094            | E      | Conc Chnl 10'W 5'D 2:1 SS                  | 1465         | 423        | SWFH-9     | ALLGOW3     | 0.17                    | 1.88                 |
| 0122            | E      | Conc Chnl 10'W 4'D 2:1 SS                  | 1409         | 423        | SWFH-9     | ALLGOW3     | 0.17                    | 0.80                 |
| APCH            |        | ANGEL PARK - CARRIAGE HILL BRANCH          |              |            |            |             |                         |                      |
| 0000            | E      | 8' X 6' RCB                                | 152          | 585        | SWFH-8     | ALLGOW3     | 0.29                    | 0.87                 |
| 0003            | P0     | 8' X 7' RCB                                | 1461         | 585        | SWFH-8     | ALLGOW3     | 0.29                    | 2.39                 |
| 0031            | P0     | 8' X 5' RCB                                | 896          | 585        | SWFH-8     | ALLGOW3     | 0.29                    | 0.60                 |
| APD2            |        | ANGEL PARK - DESERT FOOTHILLS 2 BRANCH     |              |            |            |             |                         |                      |
| 0002            | P0     | 7' X 7' RCB                                | 964          | 948        | SWAA-2     | ALLGOW3     | 0.70                    | 2.00                 |
| APD5            |        | ANGEL PARK - DESERT FOOTHILLS 5 BRANCH     |              |            |            |             |                         |                      |
| 0000            | P0     | 8' X 6' RCB                                | 685          | 1701       | CSWFH-2    | ALLGOW3     | 1.09                    | 1.89                 |
| 0013            | P0     | 72" RCP                                    | 1436         | 1701       | CSWFH-2    | ALLGOW3     | 1.09                    | 4.18                 |
| APD6            |        | ANGEL PARK - DESERT FOOTHILLS 6 BRANCH     |              |            |            |             |                         |                      |
| 0000            | P0     | 6' X 6' RCB                                | 2604         | 1076       | CSWFH-6    | ALLGOW3     | 0.56                    | 6.15                 |
| APDF            |        | ANGEL PARK - DESERT FOOTHILLS BRANCH       |              |            |            |             |                         |                      |
| 0000            | P0     | 12' X 10' RCB                              | 1356         | 2897       | CSWFH-7    | ALLGOW3     | 1.81                    | 2.20                 |
| 0026            | P0     | 12' X 10' RCB                              | 2463         | 1962       | CSWFH-3    | ALLGOW3     | 1.25                    | 1.62                 |
| 0073            | P0     | 10' X 8' RCB                               | 2679         | 1962       | CSWFH-3    | ALLGOW3     | 1.25                    | 4.10                 |
| 0123            | P0     | 6' X 5' RCB                                | 5355         | 1701       | CSWFH-2    | ALLGOW3     | 1.09                    | 6.53                 |
| APF2            |        | ANGEL PARK - FAR HILLS 2 BRANCH            |              |            |            |             |                         |                      |
| 0000            | P0     | 8' X 6' RCB                                | 1046         | 669        | CSWFH-5    | ALLGOW3     | 0.38                    | 1.00                 |
| APFH            |        | ANGEL PARK - FAR HILLS BRANCH              |              |            |            |             |                         |                      |
| 0000            | E      | 2: 8' X 8' RCB                             | 995          | 3862       | CSWFH-8    | ALLGOW3     | 2.48                    | 3.50                 |
| 0019            | E      | 2: 8' X 8' RCB                             | 250          | 3392       | CCSWFH-7   | ALLGOW3     | 2.18                    | 4.19                 |
| 0024            | E      | 16' X 8' RCAP                              | 1943         | 3392       | CCSWFH-7   | ALLGOW3     | 2.18                    | 5.10                 |
| 0061            | P0     | 8' X 6' RCB                                | 1492         | 669        | CSWFH-5    | ALLGOW3     | 0.38                    | 2.00                 |
| 0089            | P0     | 8' X 6' RCB                                | 2902         | 669        | CSWFH-5    | ALLGOW3     | 0.38                    | 2.00                 |
| 0144            | P0     | 7' X 6' RCB                                | 1556         | 669        | CSWFH-5    | ALLGOW3     | 0.38                    | 5.50                 |
| APM5            |        | ANGEL PARK - MIDDLE 5 BRANCH               |              |            |            |             |                         |                      |
| 0000            | E      | 384 ac-ft Detention Basin #5               |              | 7001       | SUM5IN     | ALLGOW3     | 6.74                    |                      |
| 0001            | E      | 12,153 cfs PMF Spillway                    |              | 12153      | SUM5IN     | ALLGOW3     | 6.74                    |                      |
| 0008            | P0     | Conc Chnl 50'W 4.5'D 2:1 SS                | 2102         | 3725       | CDB54-6R   | ALLGOW3     | 4.30                    | 5.20                 |
| 0009            | P0     | Conc Chnl 50'W 4.5'D 2:1 SS                | 4180         | 3624       | CDB55-8    | ALLGOW3     | 2.45                    | 5.80                 |
| 0047            | E      | Diversion Berm with Gabion Bank Protection | 1000         | 3725       | CDB54-6R   | ALLGOW3     | 4.30                    | 1.30                 |
| 0056            | P0     | Conc Chnl 80'W 4'D 2:1 SS                  | 264          | 3725       | CDB54-6R   | ALLGOW3     | 4.30                    | 1.30                 |
| 0057            | P0     | Conc Chnl 50'W 3'D 2:1 SS                  | 9922         | 1821       | CDB54-4    | ALLGOW3     | 1.01                    | 6.80                 |
| 0059            | P0     | Conc Chnl 100'W 3'D 2:1 SS                 | 8923         | 2358       | CDB54-5    | ALLGOW3     | 2.45                    | 7.00                 |
| 0212            | P0     | Conc Chnl 30'W 3.5'D 2:1 SS                | 6695         | 1238       | CDB55-2    | ALLGOW3     | 0.74                    | 7.50                 |
| 0213            | P0     | Conc Chnl 50'W 2.5'D 2:1 SS                | 6522         | 1125       | CDB55-5    | ALLGOW3     | 0.62                    | 7.30                 |
| APSP            |        | ANGEL PARK - SUMMERLIN PARKWAY             |              |            |            |             |                         |                      |
| 0135            | E      | Conc Chnl 10'W 6'D 2:1 SS                  | 2030         | 1173       | C8B-1      | ALLGOW3     | 1.14                    | 2.40                 |
| 0177            | E      | 9' X 8' RCBC @ Anasazi                     | 330          | 867        | C11B-1     | ALLGOW3     | 0.84                    | 1.70                 |
| 0183            | E      | Conc Chnl 10'W 6'D 2:1 SS                  | 1680         | 867        | C11B-1     | ALLGOW3     | 0.84                    | 1.70                 |
| GO02            |        | GOWAN SOUTH FACILITIES (CHEYENNE CHANNEL)  |              |            |            |             |                         |                      |
| 0257            | E      | Conc Chnl 10'W 6.75'D 1.5:1 SS             | 4293         | 2577       | CCJ-C      | ALLGOW3     | 2.97                    | 4.10                 |
| GOB2            |        | GOWAN LONE MOUNTAIN SYST. 2 BELTWAY        |              |            |            |             |                         |                      |
| 0000            | P0     | 36" RCP Outlet                             | 118          | 75         | DET22      | ALLGOW3     | 0.76                    | 6.76                 |
| 0001            | P0     | 123 ac-ft Village 22 Detention Basin       |              | 1344       | CSV22-DB   | ALLGOW3     | 0.76                    |                      |
| 0020            | P0     | 8' X 7' RCB                                | 657          | 1247       | SV22-2     | ALLGOW3     | 0.70                    | 8.30                 |
| 0033            | P0     | 8' X 6' RCB                                | 3359         | 1247       | SV22-2     | ALLGOW3     | 0.70                    | 6.90                 |
| 0096            | P0     | 6' X 5' RCB                                | 1332         | 1247       | SV22-2     | ALLGOW3     | 0.70                    | 6.00                 |

| ID / River Mile | Status | Facility Description                 | Length (ft.) | Flow (cfs) | HEC-1 Node | HEC-1 Model | Tributary Area (sq.mi.) | Channel Slope (%) ** |
|-----------------|--------|--------------------------------------|--------------|------------|------------|-------------|-------------------------|----------------------|
| GOB3            |        | GOWAN LONE MOUNTAIN SYST. 3 BELTWAY  |              |            |            |             |                         |                      |
| 0000            | P0     | 66" RCP                              | 1877         | 530        | SV22-3     | ALLGOW3     | 0.28                    | 6.60                 |
| 0035            | P0     | 54" RCP                              | 965          | 530        | SV22-3     | ALLGOW3     | 0.28                    | 6.40                 |
| GOBE            |        | GOWAN LONE MOUNTAIN SYST. BELTWAY    |              |            |            |             |                         |                      |
| 0000            | E      | 20' X 10' RCBC @ Access Rd           | 30           | 958        | CSV22-3    | GW3SC       | 0.28                    | 5.67                 |
| 0001            | E      | Conc Chnl 20'W 5'D 2:1 SS            | 3355         | 958        | CSV22-3    | GW3SC       | 0.28                    | 6.50                 |
| 0065            | E      | Conc Chnl 20'W 6'D 2:1 SS            | 1220         | 958        | CSV22-3    | GW3SC       | 0.28                    | 1.90                 |
| 0088            | E      | 2: 10'X9' RCBC @ Lake Mead           | 400          | 471        | CDET22     | ALLGOW3     | 0.96                    | 0.50                 |
| 0096            | E      | Conc Chnl 20'W 9'D 2:1 SS            | 627          | 471        | CDET22     | ALLGOW3     | 0.96                    | 0.50                 |
| 0108            | E      | Conc Chnl 20'W 6'D 2:1 SS            | 1021         | 471        | CDET22     | ALLGOW3     | 0.96                    | 0.50                 |
| 0127            | E      | Conc Chnl 20'W 6'D 2:1 SS            | 638          | 442        | SV22-1     | ALLGOW3     | 0.20                    | 0.50                 |
| 0139            | E      | Conc Chnl 10'W 5.5'D 2:1 SS          | 1500         | 442        | SV22-1     | ALLGOW3     | 0.20                    | 1.02                 |
| GOL3            |        | GOWAN LONE MOUNTAIN SYSTEM-BRANCH 3  |              |            |            |             |                         |                      |
| 0010            | E      | Conc Chnl 20'W 10'D 0:1 SS           | 3037         | 2946       | CRCLMT1R   | GW3SC       | 2.61                    | 2.78                 |
| 0068            | E      | Transition Structure                 | 100          | 2946       | CRCLMT1R   | GW3SC       | 2.61                    | 3.50                 |
| 0070            | E      | 20' X 6' RCBC @ Cliff Shadows        | 350          | 1162       | CRCSV223   | ALLGOW3     | 5.68                    | 2.44                 |
| 0077            | E      | Conc Chnl 20'W 6'D 0:1 SS            | 1229         | 1162       | CRCSV223   | ALLGOW3     | 5.68                    | 6.11                 |
| 0100            | E      | Conc Chnl 20'W 10'D 0:1 SS           | 200          | 1162       | CRCSV223   | ALLGOW3     | 5.68                    | 5.67                 |
| 0115            | E      | 66" RCP Outlet                       | 670          | 679        | DET26      | ALLGOW3     | 4.43                    |                      |
| 0128            | E      | 333 ac-ft Village 26 Detention Basin |              | 3767       | VIL26IN    | ALLGOW3     | 4.43                    |                      |
| 0137            | P0     | 14' X 14' RCB                        | 4335         | 3767       | VIL26IN    | ALLGOW3     | 4.43                    | 0.50                 |
| 0216            | P0     | Conc Chnl 50'W 4.5'D 2:1 SS          | 3761         | 3693       | CSV26-1    | ALLGOW3     | 4.15                    | 6.08                 |
| 0289            | P0     | Conc Chnl 50'W 3.5'D 2:1 SS          | 6215         | 2396       | 30         | ALLGOW3     | 2.51                    | 7.95                 |
| 0290            | E      | Natural Wash 363"W                   | 4850         | 1465       | SV26-1     | ALLGOW3     | 1.64                    | 22.50                |
| 0370            | E      | Natural Wash 450"W                   | 7000         | 2396       | 30         | ALLGOW3     | 2.51                    | 8.50                 |
| GOL4            |        | GOWAN LONE MOUNTAIN SYSTEM-BRANCH 4  |              |            |            |             |                         |                      |
| 0000            | E      | 14' X 8' RCB                         | 554          | 2257       | CLMT1R     | ALLGOW3     | 2.33                    | 2.50                 |
| 0010            | E      | 2: 9' X 8' RCB                       | 820          | 2257       | CLMT1R     | ALLGOW3     | 2.33                    | 4.74                 |
| 0025            | E      | Soil Cement Chnl 60"W 8'D 3-4:1 SS   | 320          | 2257       | CLMT1R     | ALLGOW3     | 2.33                    | 2.00                 |
| 0026            | E      | Soil Cement Chnl 42"W 6'D 3-4:1 SS   | 700          | 2257       | CLMT1R     | ALLGOW3     | 2.33                    | 1.00                 |

\* The HEC-1 node shown identifies the controlling concentration point for the associated facility and is located upstream of this facility due to decreasing peak flow with increasing tributary area caused by storm distribution transitions, depth area reduction factors, or attenuation of flow from routing.

\*\* As-built or design slopes were used when available. All other slopes are based on existing topography. The user should verify the facility slope listed prior to performing any facility specific analysis.

^ For parallel facilities, the existing facility flow equals its normal depth capacity, and the proposed parallel facility flow equals the remaining flow (i.e., HEC-1 Node flow = existing facility normal depth capacity + proposed parallel facility flow).



2013 LAS VEGAS VALLEY  
FLOOD CONTROL  
MASTER PLAN UPDATE

FACILITY INVENTORY  
FIGURE F - 24

L  
E  
G  
E  
N  
D

ID (Facility Identifier)  
Parent Stream Name  
Stream Name  
River Mile  
Distance Above Confluence  
with Parent Stream (Miles)  
Miles in Hundredths

AAB

0000

Existing Facility.....E  
Proposed or Modified Facility.....P  
Contingency Level  
Category B.....P0  
Master Plan.....P1  
Preliminary Design.....P2  
Design.....P3

Bottom Width.....W

Depth.....D

Side Slope, H:V.....SS

Construction Features

Cast in Place Concrete Pipe..... CIPCP  
Corrugated Metal Arch Pipe Culvert..... CMAP  
Corrugated Metal Pipe Culvert..... CMPC  
High Density Polyethylene..... HDPE  
Horizontal Elliptical Reinforced Concrete Pipe..... HERCP  
Reinforced Concrete Arch Pipe..... RCAP  
Reinforced Concrete Arch Culvert.....RCAC  
Reinforced Concrete Box.....RCB  
Reinforced Concrete Box Culvert.....RCBC  
Reinforced Concrete Pipe.....RCP  
Reinforced Concrete Pipe Culvert.....RCP  
Storm Sewer Pipe.....SSP

## Appendix B. Hydrology Appendix

## B.1 Parameters

## RUNOFF CURVE NUMBERS (URBAN AREAS<sup>1</sup>)

| Cover description                                                                                                                    |                                              | Curve numbers for hydrologic soil group— |    |    |    |
|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------|----|----|----|
| Cover type and hydrologic condition                                                                                                  | Average percent impervious area <sup>2</sup> | A                                        | B  | C  | D  |
| <i>Fully developed urban areas (vegetation established)</i>                                                                          |                                              |                                          |    |    |    |
| Open space (lawns, parks, golf courses, cemeteries, etc.): <sup>3</sup>                                                              |                                              |                                          |    |    |    |
| 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) <sup>4</sup> ...                                                                    |                                              | 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)<sup>5</sup> .....

77

86

91

94

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

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 |
|----------|------|
|          |      |
|          |      |
|          |      |
|          |      |



# CN CALCULATIONS FOR SUMMERLIN WEST VILLAGE 25

## TDS FOR H.S. STAGING AREA

Condition: Interim (Rough Grading With Stockpile)

| BASIN ID | LAND USE INDEX NUMBER | LAND USE DESCRIPTION                | SOIL MAP UNIT # | SUBREGION CN | SUBREGION AREA (SQ FT) | SUBBASIN AREA (SQ FT) | PERCENT OF SUBBASIN | CUMULATIVE PERCENT | AREAL WEIGHTED CN | CUMULATIVE CN | COMPOSITE CN |
|----------|-----------------------|-------------------------------------|-----------------|--------------|------------------------|-----------------------|---------------------|--------------------|-------------------|---------------|--------------|
| HS-1a    | 0                     | Newly Graded Area (HCDDM)           | 1155            | 94           | 1159242                | 3199248               | 36.2%               | 36.2%              | 34.06             | 34.06         |              |
| HS-1a    | 0                     | Newly Graded Area (HCDDM)           | 1502            | 77           | 39004                  | 3199248               | 1.2%                | 37.5%              | 0.94              | 35.00         |              |
| HS-1a    | 1                     | Undeveloped Land, Open Desert (MPU) | 1155            | 88           | 1706538                | 3199248               | 53.3%               | 90.8%              | 46.94             | 81.94         |              |
| HS-1a    | 1                     | Undeveloped Land, Open Desert (MPU) | 1502            | 73           | 295103                 | 3199248               | 9.2%                | 100.0%             | 6.73              | 88.67         | <b>88.7</b>  |
| HS-1c    | 0                     | Newly Graded Area (HCDDM)           | 1155            | 94           | 34001                  | 473976                | 7.2%                | 7.2%               | 6.74              | 6.74          |              |
| HS-1c    | 0                     | Newly Graded Area (HCDDM)           | 1502            | 77           | 241150                 | 473976                | 50.9%               | 58.1%              | 39.18             | 45.92         |              |
| HS-1c    | 1                     | Undeveloped Land, Open Desert (MPU) | 1155            | 88           | 85579                  | 473976                | 18.1%               | 76.1%              | 15.89             | 61.81         |              |
| HS-1c    | 1                     | Undeveloped Land, Open Desert (MPU) | 1502            | 73           | 113190                 | 473976                | 23.9%               | 100.0%             | 17.43             | 79.24         | <b>79.2</b>  |
| HS-1b    | 0                     | Newly Graded Area (HCDDM)           | 1155            | 94           | 386632                 | 776196                | 49.8%               | 49.8%              | 46.82             | 46.82         |              |
| HS-1b    | 0                     | Newly Graded Area (HCDDM)           | 1502            | 77           | 149603                 | 776196                | 19.3%               | 69.1%              | 14.84             | 61.66         |              |
| HS-1b    | 1                     | Undeveloped Land, Open Desert (MPU) | 1155            | 88           | 226162                 | 776196                | 29.1%               | 98.2%              | 25.64             | 87.30         |              |
| HS-1b    | 1                     | Undeveloped Land, Open Desert (MPU) | 1502            | 73           | 13799                  | 776196                | 1.8%                | 100.0%             | 1.30              | 88.60         | <b>88.6</b>  |

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## TIME OF CONCENTRATION

|                                     |                                                   |      |       |       |        |                                                      |       |     |                  |                       |                |                |      |                       |          |        |          |
|-------------------------------------|---------------------------------------------------|------|-------|-------|--------|------------------------------------------------------|-------|-----|------------------|-----------------------|----------------|----------------|------|-----------------------|----------|--------|----------|
| <br>Member of the SNC-Lavalin Group | TDS for Summerlin West Village 25                 |      |       |       |        |                                                      |       |     |                  |                       |                |                |      |                       |          |        |          |
|                                     | High School Staging Stockpile                     |      |       |       |        |                                                      |       |     |                  |                       |                |                |      | BY:                   | MEE      |        |          |
|                                     | CONDITION: INTERIM (ROUGH GRADING WITH STOCKPILE) |      |       |       |        |                                                      |       |     |                  |                       |                |                |      | DATE:                 | 11/11/20 |        |          |
|                                     |                                                   |      |       |       |        |                                                      |       |     |                  |                       |                |                |      |                       |          |        |          |
| SUB-BASIN                           |                                                   |      |       |       |        | INITIAL / OVERLAND                                   |       |     | TRAVEL TIME      |                       |                |                |      | Tc                    | Tc       | Tlag   |          |
| DATA                                |                                                   |      |       |       |        | TIME (Ti)                                            |       |     | (Tt)             |                       |                |                |      |                       | Check    |        |          |
| DESIG:                              | DEV./EX.                                          | CN   | K     | AREA  | AREA   | INITIAL<br>LENGTH                                    | SLOPE | Ti  | TRAVEL<br>LENGTH | SLOPE                 | V1<br>VELOCITY | V2<br>VELOCITY | Tt   |                       |          | Tlag=  | RAINFALL |
|                                     | (D or E)                                          |      |       | Ac    | Mi^2   | Feet                                                 | %     | Min | Feet             | %                     | FPS            | FPS            | Min  | Min                   | Min      | Hours  | Inches   |
| (1)                                 |                                                   |      | (2)   | (3)   |        | (4)                                                  | (5)   | (6) | (7)              | (8)                   | (9a)           | (9b)           | (10) | (13)                  | (14)     |        |          |
| HS-1a                               | E                                                 | 88.7 | 0.781 | 73.44 | 0.1148 | 235                                                  | 17.0  | 3.4 | 4490             | 6.0                   | 3.6            | 7.2            | 11.5 | 15.0                  | N/A      | 0.150  | 3.47     |
| HS-1b                               | E                                                 | 88.6 | 0.780 | 17.82 | 0.0278 | 115                                                  | 7.9   | 3.1 | 2415             | 7.4                   | 4.0            | 8.0            | 6.1  | 9.2                   | N/A      | 0.10** | 3.45     |
| HS-1c                               | E                                                 | 79.2 | 0.655 | 10.88 | 0.0170 | 45                                                   | 34.0  | 1.7 | 2665             | 6.0                   | 3.6            | 7.2            | 7.3  | 9.0                   | N/A      | 0.10** | 3.46     |
| Tc = Ti + Tt      Tlag = 0.6 Tc     |                                                   |      |       |       |        | For the travel time (Tt) calculations,               |       |     |                  | V1 = 14.8*(S/100)^1/2 |                | Developed      |      | V1 = 20.2*(S/100)^1/2 |          |        |          |
| Ti = 1.8 (1.1 - K) L^1/2 / S^1/3    |                                                   |      |       |       |        | V1 applies to the first 500 feet of travel distance; |       |     |                  |                       |                |                |      |                       |          |        |          |
| K = 0.0132 (CN) - 0.39              |                                                   |      |       |       |        | V2 applies to the remaining travel distance.         |       |     |                  | V2 = 29.4*(S/100)^1/2 |                | Developed      |      | V2 = 30.6*(S/100)^1/2 |          |        |          |
| Tc Check = L/180+10                 |                                                   |      |       |       |        |                                                      |       |     |                  |                       |                |                |      |                       |          |        |          |
| REFERENCE :                         |                                                   |      |       |       |        | STANDARD FORM 4                                      |       |     |                  |                       |                |                |      |                       |          |        |          |

\*Minimum recommended Tc for developed subbasins is 5 mins. A value of 0.05 was use for the Tlag where the calculated Tc was less than 5 mins.

\*\*Minimum recommended Tc for undeveloped subbasins is 10 mins. A value of 0.10 was use for the Tlag where the calculated Tc was less than 10 mins.

## B.2 HEC-1 Model

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 12NOV20 TIME 07:47:44
*
*****

```

```

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

```

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X X XXXXXXX XXXX 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 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

\*\*\* FREE \*\*\*

```

1 ID TECHNICAL DRAINAGE STUDY
2 ID SUMMERLIN VILLAGE 25
3 ID HIGH SCHOOL STAGING STOCKPILE
4 ID INTERIM CONDITION (ROUGH GRADING WITH STOCKPILE)
5 ID 100-YEAR 6-HR STORM
6 ID SDN #3 STORM DISTRIBUTION
7 ID ATKINS NOVEMBER 2020
8 ID HS_Int.DAT
9 ID JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES
10 ID
11 ID AREA (SQUARE MILES) DARF
12 ID
13 ID 0 - 0.5 1.00
14 ID Estimated 10-year 0.59
15 ID
16 IT 5 0 0 300
17 IO 5 0 0
18 IN 5 0 0
19 JR PREC 1.00 0.59
*
20 KK HS-1a
21 KM PART OF BASIN HS-1 FROM VTN VILLAGE 25 MCDS AND CONTRIBUTORY OFFSITE
22 BA 0.1148
23 PB 3.47
24 PC 0.000 0.020 0.057 0.070 0.087 0.108 0.124 0.130 0.130 0.130
25 PC 0.130 0.130 0.130 0.133 0.140 0.142 0.148 0.158 0.172 0.181
26 PC 0.190 0.197 0.199 0.200 0.201 0.204 0.214 0.229 0.241 0.249
27 PC 0.251 0.256 0.270 0.278 0.281 0.283 0.295 0.322 0.352 0.409
28 PC 0.499 0.590 0.710 0.744 0.781 0.812 0.819 0.835 0.851 0.856
29 PC 0.860 0.868 0.876 0.888 0.910 0.926 0.937 0.950 0.970 0.976
30 PC 0.982 0.985 0.987 0.989 0.990 0.993 0.993 0.994 0.995 0.998
31 PC 0.998 0.999 1.000
32 LS 0 88.7
33 UD 0.150
*
34 KK HS-1b
35 KM PART OF BASIN HS-1 FROM VTN VILLAGE 25 MCDS AND CONTRIBUTORY OFFSITE
36 BA 0.0278
37 PB 3.45
38 LS 0 88.6
39 UD 0.100
*
40 KK CP
41 KM COMBINE SUBBASINS HS-1a AND HS-1b
42 HC 2
*

```

1 HEC-1 INPUT PAGE 2



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

43 KK HS-1c  
44 KM PART OF BASIN HS-1 FROM VTN VILLAGE 25 MCDS AND CONTRIBUTORY OFFSITE  
45 BA 0.0170  
46 PB 3.46  
47 LS 0 79.2  
48 UD 0.100  
\*  
49 ZZ

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT  
LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW  
NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW  
20 HS-1a  
.  
.  
34 . HS-1b  
.  
.  
40 CP.....  
.  
.  
43 . HS-1c

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

1\*\*\*\*\*  
\*  
\* FLOOD HYDROGRAPH PACKAGE (HEC-1) \*  
\* JUN 1998 \*  
\* VERSION 4.1 \*  
\* RUN DATE 12NOV20 TIME 07:47:44 \*  
\*  
\*\*\*\*\*

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

TECHNICAL DRAINAGE STUDY  
SUMMERLIN VILLAGE 25 HIGH SCHOOL STAGING STOCKPILE  
INTERIM CONDITION (ROUGH GRADING WITH STOCKPILE)  
100-YEAR 6-HR STORM  
SDN #3 STORM DISTRIBUTION  
ATKINS NOVEMBER 2020  
HS\_Int.DAT  
JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES

| AREA (SQUARE MILES) | DARF |
|---------------------|------|
| 0 - 0.5             | 1.00 |
| Estimated 10-year   | 0.59 |

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

IT HYDROGRAPH TIME DATA  
NMIN 5 MINUTES IN COMPUTATION INTERVAL  
IDATE 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        .59

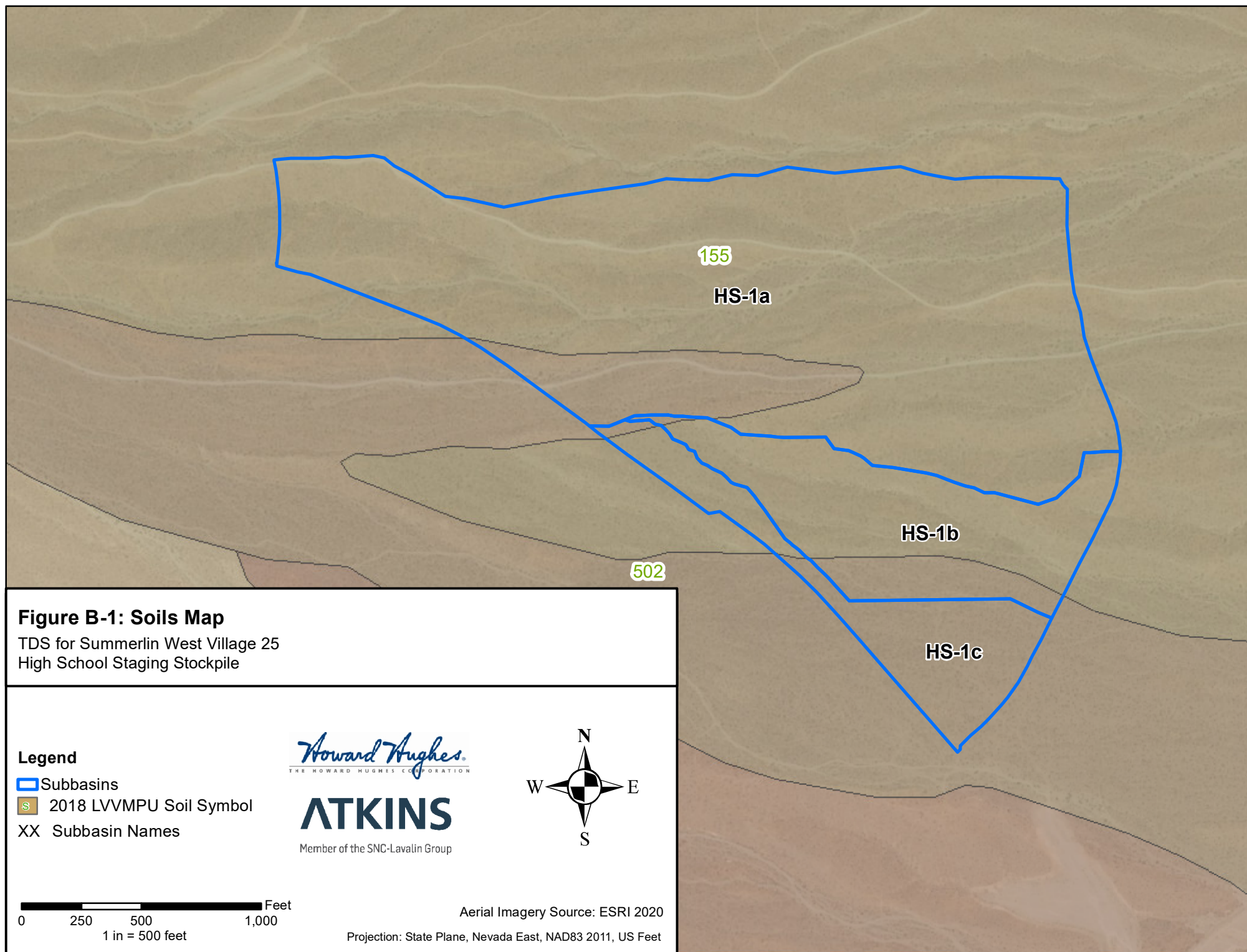
1

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

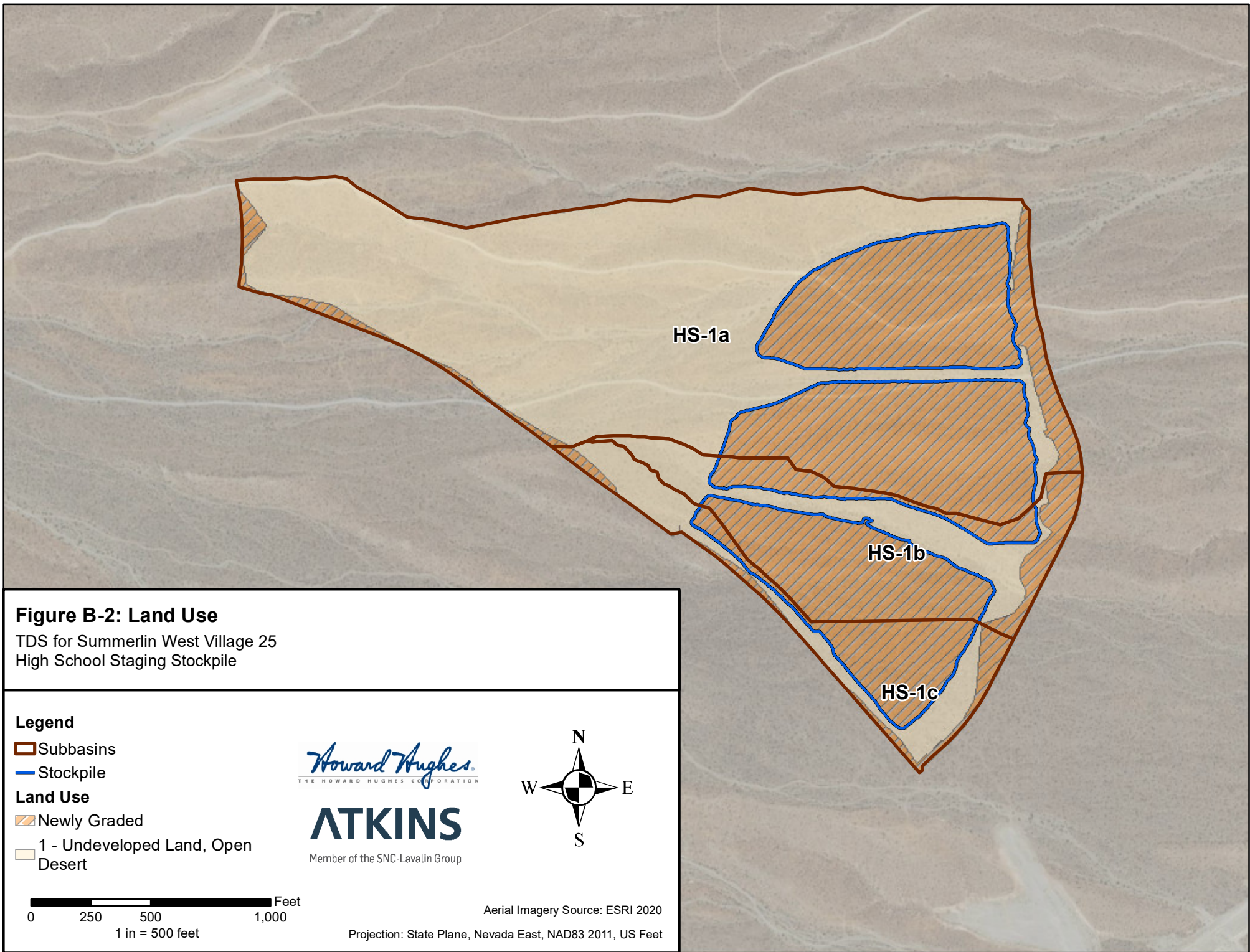
| OPERATION     | STATION | AREA | PLAN | RATIOS APPLIED TO PRECIPITATION |         |
|---------------|---------|------|------|---------------------------------|---------|
|               |         |      |      | RATIO 1                         | RATIO 2 |
|               |         |      |      | 1.00                            | .59     |
| HYDROGRAPH AT |         |      |      |                                 |         |
| +             | HS-1a   | .11  | 1    | FLOW                            | 217.    |
|               |         |      |      | TIME                            | 103.    |
|               |         |      |      |                                 | 3.58    |
| HYDROGRAPH AT |         |      |      |                                 |         |
| +             | HS-1b   | .03  | 1    | FLOW                            | 56.     |
|               |         |      |      | TIME                            | 26.     |
|               |         |      |      |                                 | 3.50    |
| 2 COMBINED AT |         |      |      |                                 |         |
| +             | CP      | .14  | 1    | FLOW                            | 269.    |
|               |         |      |      | TIME                            | 128.    |
|               |         |      |      |                                 | 3.58    |
| HYDROGRAPH AT |         |      |      |                                 |         |
| +             | HS-1c   | .02  | 1    | FLOW                            | 24.     |
|               |         |      |      | TIME                            | 9.      |
|               |         |      |      |                                 | 3.50    |

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

## B.3 Figures (Soils Map, Land Use and Precipitation Coverage)











**Figure B-3: Precipitation Coverage Map**

TDS for Summerlin West Village 25  
High School Staging Stockpile

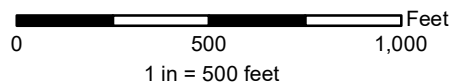
**Legend**

 Subbasins

**100-yr 6 hr Rainfall (in)**



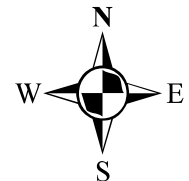
XX (XX) Subbasin Name (Rainfall)



*Howard Hughes*  
THE HOWARD HUGHES CORPORATION

**ATKINS**

Member of the SNC-Lavalin Group



Aerial Imagery Source: ESRI 2020

Projection: State Plane, Nevada East, NAD83 2011, US Feet

## Appendix C. Hydraulics Appendix

## C.1 Normal Depth Calculations

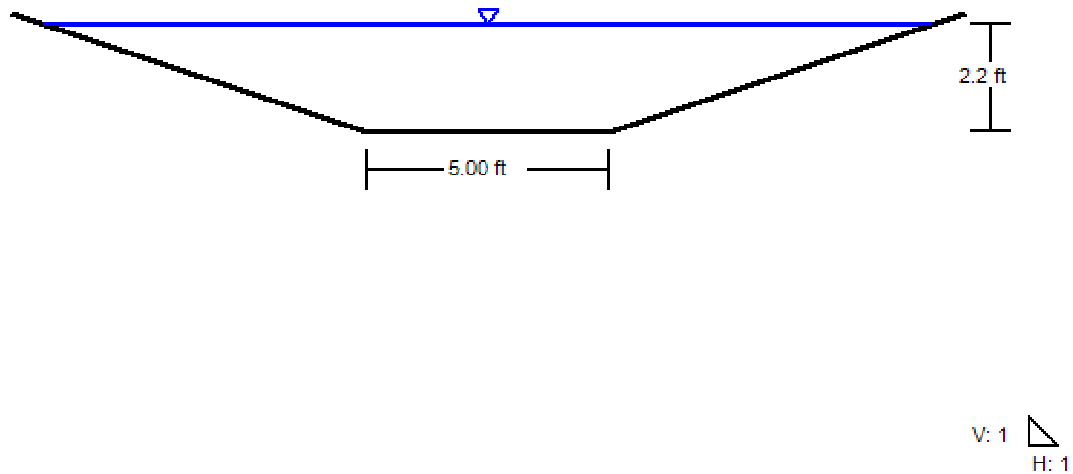
## Worksheet for Trapezoidal Channel - Swale A-a (max slope)

|                       |                      |
|-----------------------|----------------------|
| Project Description   |                      |
| Friction Method       | Manning<br>Formula   |
| Solve For             | Normal Depth         |
| Input Data            |                      |
| Roughness Coefficient | 0.037                |
| Channel Slope         | 0.023 ft/ft          |
| Left Side Slope       | 3.000 H:V            |
| Right Side Slope      | 3.000 H:V            |
| Bottom Width          | 5.00 ft              |
| Discharge             | 196.00 cfs           |
| Results               |                      |
| Normal Depth          | 2.2 ft               |
| Flow Area             | 26.1 ft <sup>2</sup> |
| Wetted Perimeter      | 19.1 ft              |
| Hydraulic Radius      | 1.4 ft               |
| Top Width             | 18.40 ft             |
| Critical Depth        | 2.4 ft               |
| Critical Slope        | 0.018 ft/ft          |
| Velocity              | 7.50 ft/s            |
| Velocity Head         | 0.87 ft              |
| Specific Energy       | 3.11 ft              |
| Froude Number         | 1.109                |
| Flow Type             | Supercritical        |
| GVF Input Data        |                      |
| Downstream Depth      | 0.0 ft               |
| Length                | 0.0 ft               |
| Number Of Steps       | 0                    |
| GVF Output Data       |                      |
| Upstream Depth        | 0.0 ft               |
| Profile Description   | N/A                  |
| Profile Headloss      | 0.00 ft              |
| Downstream Velocity   | Infinity ft/s        |
| Upstream Velocity     | Infinity ft/s        |
| Normal Depth          | 2.2 ft               |
| Critical Depth        | 2.4 ft               |
| Channel Slope         | 0.023 ft/ft          |
| Critical Slope        | 0.018 ft/ft          |



## Cross Section for Trapezoidal Channel - Swale A-a (max slope)

| Project Description   |                 |
|-----------------------|-----------------|
| Friction Method       | Manning Formula |
| Solve For             | Normal Depth    |
| Input Data            |                 |
| Roughness Coefficient | 0.037           |
| Channel Slope         | 0.023 ft/ft     |
| Normal Depth          | 2.2 ft          |
| Left Side Slope       | 3.000 H:V       |
| Right Side Slope      | 3.000 H:V       |
| Bottom Width          | 5.00 ft         |
| Discharge             | 196.00 cfs      |

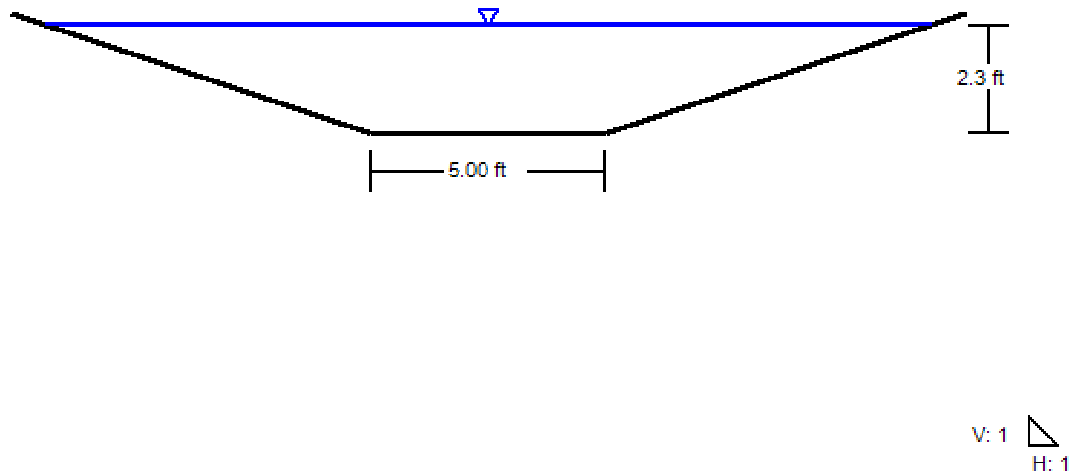


## Worksheet for Trapezoidal Channel - Swale A-a (min slope)

|                       |                      |
|-----------------------|----------------------|
| Project Description   |                      |
| Friction Method       | Manning<br>Formula   |
| Solve For             | Normal Depth         |
| Input Data            |                      |
| Roughness Coefficient | 0.037                |
| Channel Slope         | 0.020 ft/ft          |
| Left Side Slope       | 3.000 H:V            |
| Right Side Slope      | 3.000 H:V            |
| Bottom Width          | 5.00 ft              |
| Discharge             | 196.00 cfs           |
| Results               |                      |
| Normal Depth          | 2.3 ft               |
| Flow Area             | 27.5 ft <sup>2</sup> |
| Wetted Perimeter      | 19.6 ft              |
| Hydraulic Radius      | 1.4 ft               |
| Top Width             | 18.85 ft             |
| Critical Depth        | 2.4 ft               |
| Critical Slope        | 0.018 ft/ft          |
| Velocity              | 7.12 ft/s            |
| Velocity Head         | 0.79 ft              |
| Specific Energy       | 3.10 ft              |
| Froude Number         | 1.039                |
| Flow Type             | Supercritical        |
| GVF Input Data        |                      |
| Downstream Depth      | 0.0 ft               |
| Length                | 0.0 ft               |
| Number Of Steps       | 0                    |
| GVF Output Data       |                      |
| Upstream Depth        | 0.0 ft               |
| Profile Description   | N/A                  |
| Profile Headloss      | 0.00 ft              |
| Downstream Velocity   | Infinity ft/s        |
| Upstream Velocity     | Infinity ft/s        |
| Normal Depth          | 2.3 ft               |
| Critical Depth        | 2.4 ft               |
| Channel Slope         | 0.020 ft/ft          |
| Critical Slope        | 0.018 ft/ft          |

## Cross Section for Trapezoidal Channel - Swale A-a (min slope)

| Project Description   |              |
|-----------------------|--------------|
| Friction Method       | Manning      |
|                       | Formula      |
| Solve For             | Normal Depth |
| Input Data            |              |
| Roughness Coefficient | 0.037        |
| Channel Slope         | 0.020 ft/ft  |
| Normal Depth          | 2.3 ft       |
| Left Side Slope       | 3.000 H:V    |
| Right Side Slope      | 3.000 H:V    |
| Bottom Width          | 5.00 ft      |
| Discharge             | 196.00 cfs   |



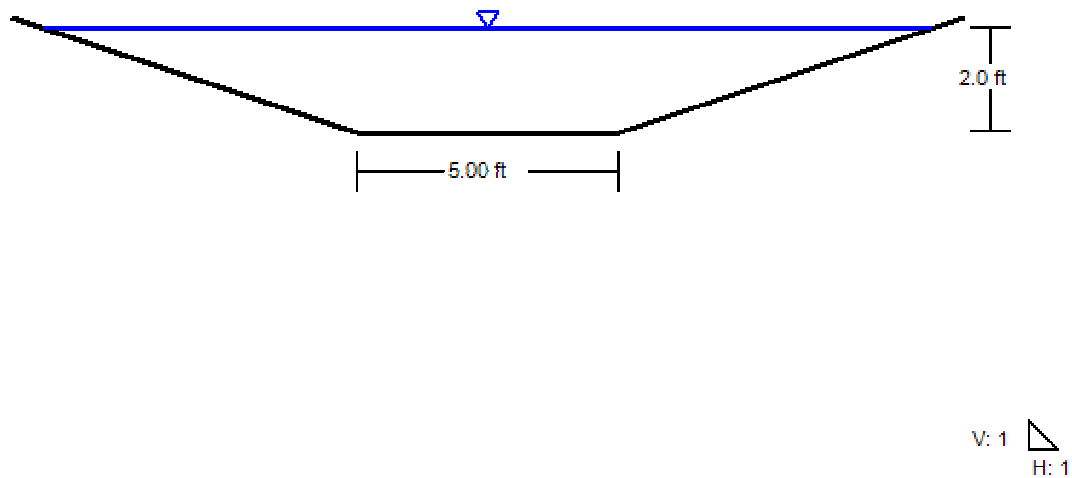
## Trapezoidal Channel - Swale A-b (max/min slope)

|                       |                      |
|-----------------------|----------------------|
| Project Description   |                      |
| Friction Method       | Manning Formula      |
| Solve For             | Normal Depth         |
| Input Data            |                      |
| Roughness Coefficient | 0.040                |
| Channel Slope         | 0.052 ft/ft          |
| Left Side Slope       | 3.000 H:V            |
| Right Side Slope      | 3.000 H:V            |
| Bottom Width          | 5.00 ft              |
| Discharge             | 217.00 cfs           |
| Results               |                      |
| Normal Depth          | 2.0 ft               |
| Flow Area             | 22.1 ft <sup>2</sup> |
| Wetted Perimeter      | 17.7 ft              |
| Hydraulic Radius      | 1.2 ft               |
| Top Width             | 17.03 ft             |
| Critical Depth        | 2.5 ft               |
| Critical Slope        | 0.021 ft/ft          |
| Velocity              | 9.83 ft/s            |
| Velocity Head         | 1.50 ft              |
| Specific Energy       | 3.51 ft              |
| Froude Number         | 1.521                |
| Flow Type             | Supercritical        |
| GVF Input Data        |                      |
| Downstream Depth      | 0.0 ft               |
| Length                | 0.0 ft               |
| Number Of Steps       | 0                    |
| GVF Output Data       |                      |
| Upstream Depth        | 0.0 ft               |
| Profile Description   | N/A                  |
| Profile Headloss      | 0.00 ft              |
| Downstream Velocity   | Infinity ft/s        |
| Upstream Velocity     | Infinity ft/s        |
| Normal Depth          | 2.0 ft               |
| Critical Depth        | 2.5 ft               |
| Channel Slope         | 0.052 ft/ft          |
| Critical Slope        | 0.021 ft/ft          |



## Cross Section for Trapezoidal Channel - Swale A-b (max/min slope)

| Project Description   |              |
|-----------------------|--------------|
| Friction Method       | Manning      |
|                       | Formula      |
| Solve For             | Normal Depth |
| Input Data            |              |
| Roughness Coefficient | 0.040        |
| Channel Slope         | 0.052 ft/ft  |
| Normal Depth          | 2.0 ft       |
| Left Side Slope       | 3.000 H:V    |
| Right Side Slope      | 3.000 H:V    |
| Bottom Width          | 5.00 ft      |
| Discharge             | 217.00 cfs   |

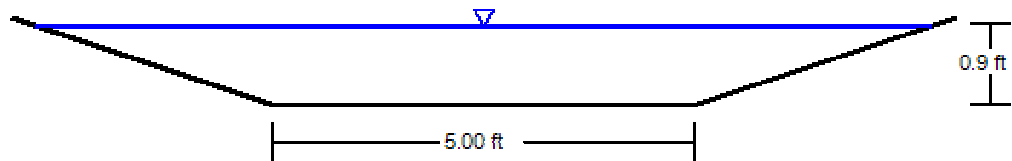


## Trapezoidal Channel - Swale B (max slope)

|                       |                     |
|-----------------------|---------------------|
| Project Description   |                     |
| Friction Method       | Manning Formula     |
| Solve For             | Normal Depth        |
| Input Data            |                     |
| Roughness Coefficient | 0.037               |
| Channel Slope         | 0.063 ft/ft         |
| Left Side Slope       | 3.000 H:V           |
| Right Side Slope      | 3.000 H:V           |
| Bottom Width          | 5.00 ft             |
| Discharge             | 56.00 cfs           |
| Results               |                     |
| Normal Depth          | 0.9 ft              |
| Flow Area             | 7.3 ft <sup>2</sup> |
| Wetted Perimeter      | 10.9 ft             |
| Hydraulic Radius      | 0.7 ft              |
| Top Width             | 10.60 ft            |
| Critical Depth        | 1.2 ft              |
| Critical Slope        | 0.022 ft/ft         |
| Velocity              | 7.70 ft/s           |
| Velocity Head         | 0.92 ft             |
| Specific Energy       | 1.85 ft             |
| Froude Number         | 1.637               |
| Flow Type             | Supercritical       |
| GVF Input Data        |                     |
| Downstream Depth      | 0.0 ft              |
| Length                | 0.0 ft              |
| Number Of Steps       | 0                   |
| GVF Output Data       |                     |
| Upstream Depth        | 0.0 ft              |
| Profile Description   | N/A                 |
| Profile Headloss      | 0.00 ft             |
| Downstream Velocity   | Infinity ft/s       |
| Upstream Velocity     | Infinity ft/s       |
| Normal Depth          | 0.9 ft              |
| Critical Depth        | 1.2 ft              |
| Channel Slope         | 0.063 ft/ft         |
| Critical Slope        | 0.022 ft/ft         |

## Cross Section for Trapezoidal Channel - Swale B (max slope)

| Project Description   |              |
|-----------------------|--------------|
| Friction Method       | Manning      |
|                       | Formula      |
| Solve For             | Normal Depth |
| Input Data            |              |
| Roughness Coefficient | 0.037        |
| Channel Slope         | 0.063 ft/ft  |
| Normal Depth          | 0.9 ft       |
| Left Side Slope       | 3.000 H:V    |
| Right Side Slope      | 3.000 H:V    |
| Bottom Width          | 5.00 ft      |
| Discharge             | 56.00 cfs    |



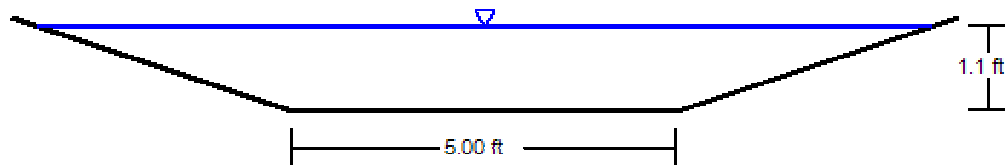
V: 1  
H: 1

## Trapezoidal Channel - Swale B (min slope)

|                       |                     |
|-----------------------|---------------------|
| Project Description   |                     |
| Friction Method       | Manning             |
|                       | Formula             |
| Solve For             | Normal Depth        |
| Input Data            |                     |
| Roughness Coefficient | 0.037               |
| Channel Slope         | 0.032 ft/ft         |
| Left Side Slope       | 3.000 H:V           |
| Right Side Slope      | 3.000 H:V           |
| Bottom Width          | 5.00 ft             |
| Discharge             | 56.00 cfs           |
| Results               |                     |
| Normal Depth          | 1.1 ft              |
| Flow Area             | 9.3 ft <sup>2</sup> |
| Wetted Perimeter      | 12.0 ft             |
| Hydraulic Radius      | 0.8 ft              |
| Top Width             | 11.67 ft            |
| Critical Depth        | 1.2 ft              |
| Critical Slope        | 0.022 ft/ft         |
| Velocity              | 6.04 ft/s           |
| Velocity Head         | 0.57 ft             |
| Specific Energy       | 1.68 ft             |
| Froude Number         | 1.194               |
| Flow Type             | Supercritical       |
| GVF Input Data        |                     |
| Downstream Depth      | 0.0 ft              |
| Length                | 0.0 ft              |
| Number Of Steps       | 0                   |
| GVF Output Data       |                     |
| Upstream Depth        | 0.0 ft              |
| Profile Description   | N/A                 |
| Profile Headloss      | 0.00 ft             |
| Downstream Velocity   | Infinity ft/s       |
| Upstream Velocity     | Infinity ft/s       |
| Normal Depth          | 1.1 ft              |
| Critical Depth        | 1.2 ft              |
| Channel Slope         | 0.032 ft/ft         |
| Critical Slope        | 0.022 ft/ft         |

## Cross Section for Trapezoidal Channel - Swale B (min slope)

| Project Description   |              |
|-----------------------|--------------|
| Friction Method       | Manning      |
|                       | Formula      |
| Solve For             | Normal Depth |
| Input Data            |              |
| Roughness Coefficient | 0.037        |
| Channel Slope         | 0.032 ft/ft  |
| Normal Depth          | 1.1 ft       |
| Left Side Slope       | 3.000 H:V    |
| Right Side Slope      | 3.000 H:V    |
| Bottom Width          | 5.00 ft      |
| Discharge             | 56.00 cfs    |



V: 1  
H: 1

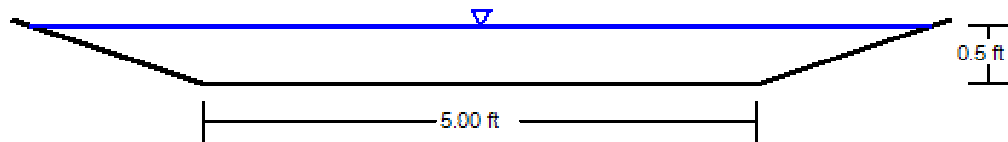


## Trapezoidal Channel - Swale C (max slope)

|                       |                     |
|-----------------------|---------------------|
| Project Description   |                     |
| Friction Method       | Manning Formula     |
| Solve For             | Normal Depth        |
| Input Data            |                     |
| Roughness Coefficient | 0.037               |
| Channel Slope         | 0.092 ft/ft         |
| Left Side Slope       | 3.000 H:V           |
| Right Side Slope      | 3.000 H:V           |
| Bottom Width          | 5.00 ft             |
| Discharge             | 24.00 cfs           |
| Results               |                     |
| Normal Depth          | 0.5 ft              |
| Flow Area             | 3.5 ft <sup>2</sup> |
| Wetted Perimeter      | 8.4 ft              |
| Hydraulic Radius      | 0.4 ft              |
| Top Width             | 8.20 ft             |
| Critical Depth        | 0.8 ft              |
| Critical Slope        | 0.025 ft/ft         |
| Velocity              | 6.83 ft/s           |
| Velocity Head         | 0.72 ft             |
| Specific Energy       | 1.26 ft             |
| Froude Number         | 1.839               |
| Flow Type             | Supercritical       |
| GVF Input Data        |                     |
| Downstream Depth      | 0.0 ft              |
| Length                | 0.0 ft              |
| Number Of Steps       | 0                   |
| GVF Output Data       |                     |
| Upstream Depth        | 0.0 ft              |
| Profile Description   | N/A                 |
| Profile Headloss      | 0.00 ft             |
| Downstream Velocity   | Infinity ft/s       |
| Upstream Velocity     | Infinity ft/s       |
| Normal Depth          | 0.5 ft              |
| Critical Depth        | 0.8 ft              |
| Channel Slope         | 0.092 ft/ft         |
| Critical Slope        | 0.025 ft/ft         |

## Cross Section for Trapezoidal Channel - Swale C (max slope)

| Project Description   |              |
|-----------------------|--------------|
| Friction Method       | Manning      |
|                       | Formula      |
| Solve For             | Normal Depth |
| Input Data            |              |
| Roughness Coefficient | 0.037        |
| Channel Slope         | 0.092 ft/ft  |
| Normal Depth          | 0.5 ft       |
| Left Side Slope       | 3.000 H:V    |
| Right Side Slope      | 3.000 H:V    |
| Bottom Width          | 5.00 ft      |
| Discharge             | 24.00 cfs    |



V: 1  
H: 1

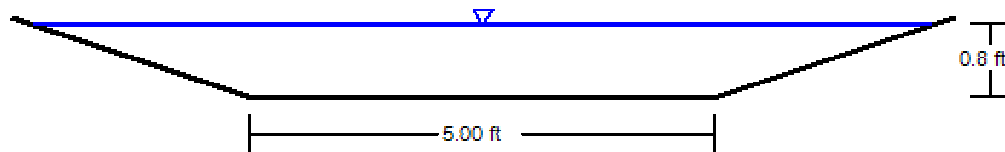


## Trapezoidal Channel - Swale C (min slope)

|                       |                     |
|-----------------------|---------------------|
| Project Description   |                     |
| Friction Method       | Manning Formula     |
| Solve For             | Normal Depth        |
| Input Data            |                     |
| Roughness Coefficient | 0.037               |
| Channel Slope         | 0.023 ft/ft         |
| Left Side Slope       | 3.000 H:V           |
| Right Side Slope      | 3.000 H:V           |
| Bottom Width          | 5.00 ft             |
| Discharge             | 24.00 cfs           |
| Results               |                     |
| Normal Depth          | 0.8 ft              |
| Flow Area             | 5.7 ft <sup>2</sup> |
| Wetted Perimeter      | 9.9 ft              |
| Hydraulic Radius      | 0.6 ft              |
| Top Width             | 9.67 ft             |
| Critical Depth        | 0.8 ft              |
| Critical Slope        | 0.025 ft/ft         |
| Velocity              | 4.21 ft/s           |
| Velocity Head         | 0.28 ft             |
| Specific Energy       | 1.05 ft             |
| Froude Number         | 0.966               |
| Flow Type             | Subcritical         |
| GVF Input Data        |                     |
| Downstream Depth      | 0.0 ft              |
| Length                | 0.0 ft              |
| Number Of Steps       | 0                   |
| GVF Output Data       |                     |
| Upstream Depth        | 0.0 ft              |
| Profile Description   | N/A                 |
| Profile Headloss      | 0.00 ft             |
| Downstream Velocity   | Infinity ft/s       |
| Upstream Velocity     | Infinity ft/s       |
| Normal Depth          | 0.8 ft              |
| Critical Depth        | 0.8 ft              |
| Channel Slope         | 0.023 ft/ft         |
| Critical Slope        | 0.025 ft/ft         |

## Cross Section for Trapezoidal Channel - Swale C (min slope)

| Project Description   |                 |
|-----------------------|-----------------|
| Friction Method       | Manning Formula |
| Solve For             | Normal Depth    |
| Input Data            |                 |
| Roughness Coefficient | 0.037           |
| Channel Slope         | 0.023 ft/ft     |
| Normal Depth          | 0.8 ft          |
| Left Side Slope       | 3.000 H:V       |
| Right Side Slope      | 3.000 H:V       |
| Bottom Width          | 5.00 ft         |
| Discharge             | 24.00 cfs       |



V: 1  
H: 1

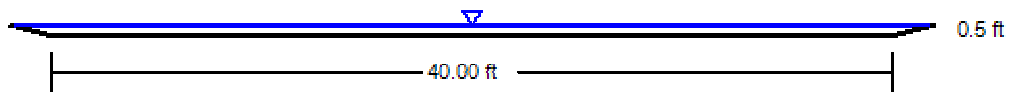
## Worksheet for A-1-1 Trap

|                       |                      |
|-----------------------|----------------------|
| Project Description   |                      |
| Friction Method       | Manning<br>Formula   |
| Solve For             | Normal Depth         |
| Input Data            |                      |
| Roughness Coefficient | 0.035                |
| Channel Slope         | 0.064 ft/ft          |
| Left Side Slope       | 4.000 H:V            |
| Right Side Slope      | 4.000 H:V            |
| Bottom Width          | 40.00 ft             |
| Discharge             | 120.00 cfs           |
| Results               |                      |
| Normal Depth          | 0.5 ft               |
| Flow Area             | 19.3 ft <sup>2</sup> |
| Wetted Perimeter      | 43.8 ft              |
| Hydraulic Radius      | 0.4 ft               |
| Top Width             | 43.69 ft             |
| Critical Depth        | 0.6 ft               |
| Critical Slope        | 0.021 ft/ft          |
| Velocity              | 6.22 ft/s            |
| Velocity Head         | 0.60 ft              |
| Specific Energy       | 1.06 ft              |
| Froude Number         | 1.649                |
| Flow Type             | Supercritical        |
| GVF Input Data        |                      |
| Downstream Depth      | 0.0 ft               |
| Length                | 0.0 ft               |
| Number Of Steps       | 0                    |
| GVF Output Data       |                      |
| Upstream Depth        | 0.0 ft               |
| Profile Description   | N/A                  |
| Profile Headloss      | 0.00 ft              |
| Downstream Velocity   | Infinity ft/s        |
| Upstream Velocity     | Infinity ft/s        |
| Normal Depth          | 0.5 ft               |
| Critical Depth        | 0.6 ft               |
| Channel Slope         | 0.064 ft/ft          |
| Critical Slope        | 0.021 ft/ft          |



## Cross Section for A-1-1 Trap

| Project Description   |              |
|-----------------------|--------------|
| Friction Method       | Manning      |
|                       | Formula      |
| Solve For             | Normal Depth |
| Input Data            |              |
| Roughness Coefficient | 0.035        |
| Channel Slope         | 0.064 ft/ft  |
| Normal Depth          | 0.5 ft       |
| Left Side Slope       | 4.000 H:V    |
| Right Side Slope      | 4.000 H:V    |
| Bottom Width          | 40.00 ft     |
| Discharge             | 120.00 cfs   |



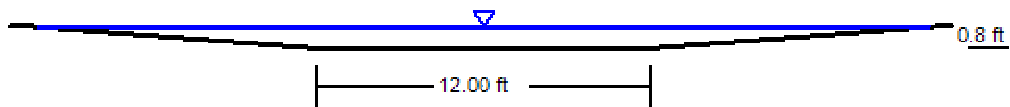
V: 1  
H: 1

## Worksheet for A-1-2 Trap

|                       |                      |
|-----------------------|----------------------|
| Project Description   |                      |
| Friction Method       | Manning<br>Formula   |
| Solve For             | Normal Depth         |
| Input Data            |                      |
| Roughness Coefficient | 0.037                |
| Channel Slope         | 0.067 ft/ft          |
| Left Side Slope       | 13.000 H:V           |
| Right Side Slope      | 13.000 H:V           |
| Bottom Width          | 12.00 ft             |
| Discharge             | 118.00 cfs           |
| Results               |                      |
| Normal Depth          | 0.8 ft               |
| Flow Area             | 17.3 ft <sup>2</sup> |
| Wetted Perimeter      | 32.3 ft              |
| Hydraulic Radius      | 0.5 ft               |
| Top Width             | 32.27 ft             |
| Critical Depth        | 1.0 ft               |
| Critical Slope        | 0.023 ft/ft          |
| Velocity              | 6.84 ft/s            |
| Velocity Head         | 0.73 ft              |
| Specific Energy       | 1.51 ft              |
| Froude Number         | 1.649                |
| Flow Type             | Supercritical        |
| GVF Input Data        |                      |
| Downstream Depth      | 0.0 ft               |
| Length                | 0.0 ft               |
| Number Of Steps       | 0                    |
| GVF Output Data       |                      |
| Upstream Depth        | 0.0 ft               |
| Profile Description   | N/A                  |
| Profile Headloss      | 0.00 ft              |
| Downstream Velocity   | Infinity ft/s        |
| Upstream Velocity     | Infinity ft/s        |
| Normal Depth          | 0.8 ft               |
| Critical Depth        | 1.0 ft               |
| Channel Slope         | 0.067 ft/ft          |
| Critical Slope        | 0.023 ft/ft          |

## Cross Section for A-1-2 Trap

| Project Description   |              |
|-----------------------|--------------|
| Friction Method       | Manning      |
|                       | Formula      |
| Solve For             | Normal Depth |
| Input Data            |              |
| Roughness Coefficient | 0.037        |
| Channel Slope         | 0.067 ft/ft  |
| Normal Depth          | 0.8 ft       |
| Left Side Slope       | 13.000 H:V   |
| Right Side Slope      | 13.000 H:V   |
| Bottom Width          | 12.00 ft     |
| Discharge             | 118.00 cfs   |



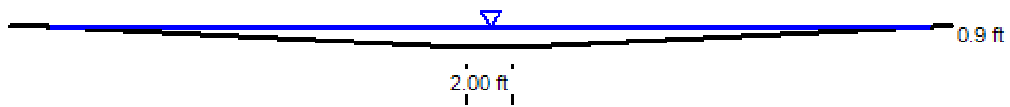
V: 1  
H: 1

## Worksheet for A-1-3 Trap

|                       |                      |
|-----------------------|----------------------|
| Project Description   |                      |
| Friction Method       | Manning<br>Formula   |
| Solve For             | Normal Depth         |
| Input Data            |                      |
| Roughness Coefficient | 0.035                |
| Channel Slope         | 0.066 ft/ft          |
| Left Side Slope       | 20.000 H:V           |
| Right Side Slope      | 20.000 H:V           |
| Bottom Width          | 2.00 ft              |
| Discharge             | 109.00 cfs           |
| Results               |                      |
| Normal Depth          | 0.9 ft               |
| Flow Area             | 16.8 ft <sup>2</sup> |
| Wetted Perimeter      | 36.8 ft              |
| Hydraulic Radius      | 0.5 ft               |
| Top Width             | 36.75 ft             |
| Critical Depth        | 1.1 ft               |
| Critical Slope        | 0.022 ft/ft          |
| Velocity              | 6.48 ft/s            |
| Velocity Head         | 0.65 ft              |
| Specific Energy       | 1.52 ft              |
| Froude Number         | 1.687                |
| Flow Type             | Supercritical        |
| GVF Input Data        |                      |
| Downstream Depth      | 0.0 ft               |
| Length                | 0.0 ft               |
| Number Of Steps       | 0                    |
| GVF Output Data       |                      |
| Upstream Depth        | 0.0 ft               |
| Profile Description   | N/A                  |
| Profile Headloss      | 0.00 ft              |
| Downstream Velocity   | Infinity ft/s        |
| Upstream Velocity     | Infinity ft/s        |
| Normal Depth          | 0.9 ft               |
| Critical Depth        | 1.1 ft               |
| Channel Slope         | 0.066 ft/ft          |
| Critical Slope        | 0.022 ft/ft          |

## Cross Section for A-1-3 Trap

| Project Description   |              |
|-----------------------|--------------|
| Friction Method       | Manning      |
|                       | Formula      |
| Solve For             | Normal Depth |
| Input Data            |              |
| Roughness Coefficient | 0.035        |
| Channel Slope         | 0.066 ft/ft  |
| Normal Depth          | 0.9 ft       |
| Left Side Slope       | 20.000 H:V   |
| Right Side Slope      | 20.000 H:V   |
| Bottom Width          | 2.00 ft      |
| Discharge             | 109.00 cfs   |



V: 1  
H: 1

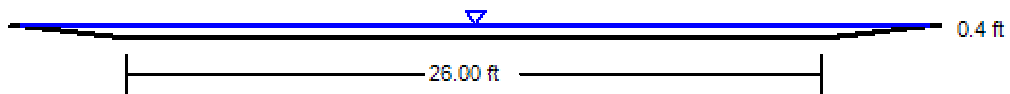
## Worksheet for A-1-4 Trap

|                       |                      |
|-----------------------|----------------------|
| Project Description   |                      |
| Friction Method       | Manning<br>Formula   |
| Solve For             | Normal Depth         |
| Input Data            |                      |
| Roughness Coefficient | 0.035                |
| Channel Slope         | 0.066 ft/ft          |
| Left Side Slope       | 9.000 H:V            |
| Right Side Slope      | 9.000 H:V            |
| Bottom Width          | 26.00 ft             |
| Discharge             | 78.00 cfs            |
| Results               |                      |
| Normal Depth          | 0.4 ft               |
| Flow Area             | 13.3 ft <sup>2</sup> |
| Wetted Perimeter      | 34.1 ft              |
| Hydraulic Radius      | 0.4 ft               |
| Top Width             | 34.01 ft             |
| Critical Depth        | 0.6 ft               |
| Critical Slope        | 0.022 ft/ft          |
| Velocity              | 5.85 ft/s            |
| Velocity Head         | 0.53 ft              |
| Specific Energy       | 0.98 ft              |
| Froude Number         | 1.645                |
| Flow Type             | Supercritical        |
| GVF Input Data        |                      |
| Downstream Depth      | 0.0 ft               |
| Length                | 0.0 ft               |
| Number Of Steps       | 0                    |
| GVF Output Data       |                      |
| Upstream Depth        | 0.0 ft               |
| Profile Description   | N/A                  |
| Profile Headloss      | 0.00 ft              |
| Downstream Velocity   | Infinity ft/s        |
| Upstream Velocity     | Infinity ft/s        |
| Normal Depth          | 0.4 ft               |
| Critical Depth        | 0.6 ft               |
| Channel Slope         | 0.066 ft/ft          |
| Critical Slope        | 0.022 ft/ft          |



## Cross Section for A-1-4 Trap

|                       |                 |
|-----------------------|-----------------|
| Project Description   |                 |
| Friction Method       | Manning Formula |
| Solve For             | Normal Depth    |
| Input Data            |                 |
| Roughness Coefficient | 0.035           |
| Channel Slope         | 0.066 ft/ft     |
| Normal Depth          | 0.4 ft          |
| Left Side Slope       | 9.000 H:V       |
| Right Side Slope      | 9.000 H:V       |
| Bottom Width          | 26.00 ft        |
| Discharge             | 78.00 cfs       |



V: 1  
H: 1

## Worksheet for A-2-1

|                     |                 |
|---------------------|-----------------|
| Project Description |                 |
| Friction Method     | Manning Formula |
| Solve For           | Normal Depth    |
| Input Data          |                 |
| Channel Slope       | 0.072 ft/ft     |
| Discharge           | 48.00 cfs       |

### Section Definitions

| Station<br>(ft) | Elevation<br>(ft) |
|-----------------|-------------------|
| 0+00            | 3,550.96          |
| 0+01            | 3,550.75          |
| 0+02            | 3,550.44          |
| 0+04            | 3,549.88          |
| 0+04            | 3,549.88          |
| 0+04            | 3,549.77          |
| 0+04            | 3,549.68          |
| 0+05            | 3,549.57          |
| 0+05            | 3,549.57          |
| 0+05            | 3,549.46          |
| 0+06            | 3,549.29          |
| 0+06            | 3,549.29          |
| 0+06            | 3,549.18          |
| 0+06            | 3,549.11          |
| 0+07            | 3,549.01          |
| 0+07            | 3,549.01          |
| 0+07            | 3,548.88          |
| 0+08            | 3,548.69          |
| 0+08            | 3,548.69          |
| 0+08            | 3,548.58          |
| 0+08            | 3,548.53          |
| 0+09            | 3,548.41          |
| 0+09            | 3,548.41          |
| 0+09            | 3,548.30          |
| 0+09            | 3,548.25          |
| 0+10            | 3,548.13          |
| 0+10            | 3,548.13          |
| 0+10            | 3,548.00          |
| 0+10            | 3,547.96          |
| 0+11            | 3,547.82          |
| 0+11            | 3,547.82          |
| 0+11            | 3,547.70          |
| 0+11            | 3,547.67          |
| 0+12            | 3,547.54          |
| 0+12            | 3,547.54          |
| 0+12            | 3,547.41          |
| 0+12            | 3,547.39          |
| 0+13            | 3,547.26          |

## Worksheet for A-2-1

### Section Definitions

| Station<br>(ft) | Elevation<br>(ft) |
|-----------------|-------------------|
| 1+51            | 3,551.11          |
| 1+51            | 3,551.11          |
| 1+51            | 3,551.11          |

### Roughness Segment Definitions

| Start Station    | Ending Station   | Roughness Coefficient |
|------------------|------------------|-----------------------|
| (0+00, 3,550.96) | (1+51, 3,551.11) | 0.035                 |

#### Options

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

#### Results

|                  |                          |
|------------------|--------------------------|
| Normal Depth     | 0.6 ft                   |
| Elevation Range  | 3,543.6 to<br>3,551.1 ft |
| Flow Area        | 10.8 ft <sup>2</sup>     |
| Wetted Perimeter | 44.8 ft                  |
| Hydraulic Radius | 0.2 ft                   |
| Top Width        | 44.73 ft                 |
| Normal Depth     | 0.6 ft                   |
| Critical Depth   | 0.7 ft                   |
| Critical Slope   | 0.027 ft/ft              |
| Velocity         | 4.43 ft/s                |
| Velocity Head    | 0.30 ft                  |
| Specific Energy  | 0.90 ft                  |
| Froude Number    | 1.585                    |
| Flow Type        | Supercritical            |

#### GVF Input Data

|                  |        |
|------------------|--------|
| Downstream Depth | 0.0 ft |
| Length           | 0.0 ft |
| Number Of Steps  | 0      |

#### GVF Output Data

|                     |               |
|---------------------|---------------|
| Upstream Depth      | 0.0 ft        |
| Profile Description | N/A           |
| Profile Headloss    | 0.00 ft       |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity   | Infinity ft/s |
| Normal Depth        | 0.6 ft        |

## Worksheet for A-2-1

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### GVF Output Data

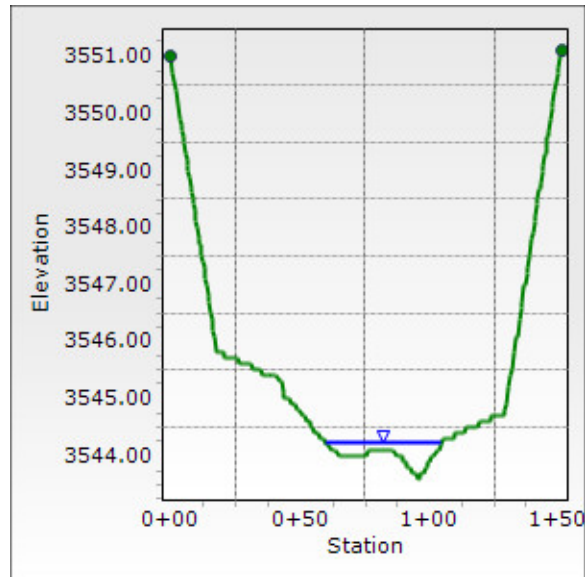
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|                |             |
|----------------|-------------|
| Critical Depth | 0.7 ft      |
| Channel Slope  | 0.072 ft/ft |
| Critical Slope | 0.027 ft/ft |

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## Cross Section for A-2-1

|                     |                 |
|---------------------|-----------------|
| Project Description |                 |
| Friction Method     | Manning Formula |
| Solve For           | Normal Depth    |
| Input Data          |                 |
| Channel Slope       | 0.072 ft/ft     |
| Normal Depth        | 0.6 ft          |
| Discharge           | 48.00 cfs       |



## Worksheet for A-2-2

|                     |                    |
|---------------------|--------------------|
| Project Description |                    |
| Friction Method     | Manning<br>Formula |
| Solve For           | Normal Depth       |
| Input Data          |                    |
| Channel Slope       | 0.075 ft/ft        |
| Discharge           | 42.00 cfs          |

### Section Definitions

| Station<br>(ft) | Elevation<br>(ft) |
|-----------------|-------------------|
| 0+00            | 3,567.07          |
| 0+00            | 3,567.07          |
| 0+01            | 3,567.06          |
| 0+01            | 3,567.06          |
| 0+02            | 3,567.05          |
| 0+02            | 3,567.04          |
| 0+02            | 3,567.03          |
| 0+02            | 3,567.03          |
| 0+03            | 3,567.01          |
| 0+03            | 3,567.00          |
| 0+03            | 3,567.00          |
| 0+04            | 3,566.99          |
| 0+04            | 3,566.99          |
| 0+04            | 3,566.98          |
| 0+05            | 3,566.97          |
| 0+05            | 3,566.97          |
| 0+05            | 3,566.97          |
| 0+05            | 3,566.96          |
| 0+06            | 3,566.95          |
| 0+06            | 3,566.94          |
| 0+06            | 3,566.94          |
| 0+06            | 3,566.94          |
| 0+07            | 3,566.94          |
| 0+07            | 3,566.94          |
| 0+07            | 3,566.94          |
| 0+07            | 3,566.93          |
| 0+08            | 3,566.91          |
| 0+08            | 3,566.90          |
| 0+08            | 3,566.90          |
| 0+08            | 3,566.90          |
| 0+09            | 3,566.90          |
| 0+09            | 3,566.89          |
| 0+09            | 3,566.89          |
| 0+09            | 3,566.89          |
| 0+10            | 3,566.88          |
| 0+10            | 3,566.87          |
| 0+11            | 3,566.84          |
| 0+12            | 3,566.83          |



## Worksheet for A-2-2

### Section Definitions

| Station<br>(ft) | Elevation<br>(ft) |
|-----------------|-------------------|
| 1+23            | 3,567.54          |
| 1+23            | 3,567.61          |
| 1+23            | 3,567.61          |
| 1+23            | 3,567.68          |
| 1+24            | 3,567.83          |
| 1+24            | 3,567.90          |
| 1+24            | 3,567.90          |
| 1+24            | 3,567.96          |
| 1+25            | 3,568.12          |
| 1+25            | 3,568.18          |
| 1+25            | 3,568.18          |
| 1+25            | 3,568.24          |
| 1+26            | 3,568.48          |
| 1+26            | 3,568.48          |
| 1+26            | 3,568.54          |
| 1+27            | 3,568.71          |
| 1+27            | 3,568.77          |
| 1+27            | 3,568.77          |
| 1+27            | 3,568.82          |
| 1+28            | 3,569.00          |
| 1+28            | 3,569.05          |
| 1+28            | 3,569.05          |
| 1+28            | 3,569.10          |
| 1+29            | 3,569.30          |
| 1+29            | 3,569.36          |
| 1+29            | 3,569.36          |
| 1+30            | 3,569.55          |
| 1+30            | 3,569.55          |
| 1+30            | 3,569.55          |

### Roughness Segment Definitions

| Start Station    | Ending Station   | Roughness Coefficient |
|------------------|------------------|-----------------------|
| (0+00, 3,567.07) | (1+30, 3,569.55) | 0.035                 |

#### Options

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

#### Results

|                 |                       |
|-----------------|-----------------------|
| Normal Depth    | 0.4 ft                |
| Elevation Range | 3,562.7 to 3,569.5 ft |

## Worksheet for A-2-2

---

### Results

---

|                  |                     |
|------------------|---------------------|
| Flow Area        | 9.6 ft <sup>2</sup> |
| Wetted Perimeter | 42.1 ft             |
| Hydraulic Radius | 0.2 ft              |
| Top Width        | 42.03 ft            |
| Normal Depth     | 0.4 ft              |
| Critical Depth   | 0.5 ft              |
| Critical Slope   | 0.027 ft/ft         |
| Velocity         | 4.36 ft/s           |
| Velocity Head    | 0.29 ft             |
| Specific Energy  | 0.74 ft             |
| Froude Number    | 1.603               |
| Flow Type        | Supercritical       |

---

---

### GVF Input Data

---

|                  |        |
|------------------|--------|
| Downstream Depth | 0.0 ft |
| Length           | 0.0 ft |
| Number Of Steps  | 0      |

---

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### GVF Output Data

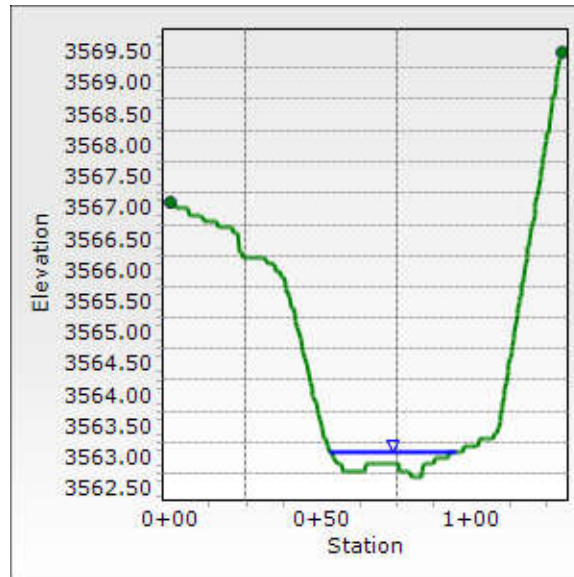
---

|                     |               |
|---------------------|---------------|
| Upstream Depth      | 0.0 ft        |
| Profile Description | N/A           |
| Profile Headloss    | 0.00 ft       |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity   | Infinity ft/s |
| Normal Depth        | 0.4 ft        |
| Critical Depth      | 0.5 ft        |
| Channel Slope       | 0.075 ft/ft   |
| Critical Slope      | 0.027 ft/ft   |

---

## Cross Section for A-2-2

|                     |                 |
|---------------------|-----------------|
| Project Description |                 |
| Friction Method     | Manning Formula |
| Solve For           | Normal Depth    |
| Input Data          |                 |
| Channel Slope       | 0.075 ft/ft     |
| Normal Depth        | 0.4 ft          |
| Discharge           | 42.00 cfs       |



## Worksheet for A-2-3

|                     |                 |
|---------------------|-----------------|
| Project Description |                 |
| Friction Method     | Manning Formula |
| Solve For           | Normal Depth    |
| Input Data          |                 |
| Channel Slope       | 0.077 ft/ft     |
| Discharge           | 36.00 cfs       |

### Section Definitions

| Station<br>(ft) | Elevation<br>(ft) |
|-----------------|-------------------|
| 0+00            | 3,611.03          |
| 0+01            | 3,610.81          |
| 0+01            | 3,610.81          |
| 0+01            | 3,610.78          |
| 0+02            | 3,610.54          |
| 0+02            | 3,610.50          |
| 0+02            | 3,610.50          |
| 0+02            | 3,610.46          |
| 0+03            | 3,610.26          |
| 0+03            | 3,610.22          |
| 0+03            | 3,610.22          |
| 0+03            | 3,610.18          |
| 0+04            | 3,609.98          |
| 0+04            | 3,609.93          |
| 0+04            | 3,609.89          |
| 0+05            | 3,609.70          |
| 0+05            | 3,609.65          |
| 0+05            | 3,609.60          |
| 0+06            | 3,609.34          |
| 0+06            | 3,609.34          |
| 0+06            | 3,609.29          |
| 0+07            | 3,609.12          |
| 0+07            | 3,609.06          |
| 0+07            | 3,609.00          |
| 0+08            | 3,608.84          |
| 0+08            | 3,608.77          |
| 0+08            | 3,608.77          |
| 0+08            | 3,608.71          |
| 0+09            | 3,608.56          |
| 0+09            | 3,608.49          |
| 0+09            | 3,608.49          |
| 0+09            | 3,608.42          |
| 0+10            | 3,608.27          |
| 0+10            | 3,608.11          |
| 0+11            | 3,607.98          |
| 0+11            | 3,607.90          |
| 0+11            | 3,607.90          |
| 0+11            | 3,607.82          |

## Worksheet for A-2-3

### Section Definitions

| Station<br>(ft) | Elevation<br>(ft) |
|-----------------|-------------------|
| 2+09            | 3,609.37          |
| 2+10            | 3,609.62          |
| 2+10            | 3,609.66          |
| 2+10            | 3,609.66          |
| 2+10            | 3,609.70          |
| 2+11            | 3,610.00          |
| 2+12            | 3,610.22          |
| 2+12            | 3,610.25          |
| 2+12            | 3,610.25          |
| 2+12            | 3,610.28          |
| 2+13            | 3,610.54          |
| 2+13            | 3,610.56          |
| 2+13            | 3,610.56          |
| 2+13            | 3,610.58          |
| 2+14            | 3,610.86          |
| 2+14            | 3,610.87          |
| 2+14            | 3,610.89          |
| 2+15            | 3,611.15          |
| 2+15            | 3,611.16          |
| 2+15            | 3,611.16          |
| 2+15            | 3,611.17          |
| 2+16            | 3,611.46          |
| 2+16            | 3,611.47          |
| 2+16            | 3,611.47          |
| 2+16            | 3,611.47          |
| 2+16            | 3,611.58          |
| 2+16            | 3,611.58          |
| 2+16            | 3,611.58          |

### Roughness Segment Definitions

| Start Station    | Ending Station   | Roughness Coefficient |
|------------------|------------------|-----------------------|
| (0+00, 3,611.03) | (2+16, 3,611.58) | 0.035                 |

#### Options

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

#### Results

|                 |                       |
|-----------------|-----------------------|
| Normal Depth    | 0.4 ft                |
| Elevation Range | 3,602.3 to 3,611.6 ft |
| Flow Area       | 8.8 ft <sup>2</sup>   |

## Worksheet for A-2-3

### Results

|                  |               |
|------------------|---------------|
| Wetted Perimeter | 42.8 ft       |
| Hydraulic Radius | 0.2 ft        |
| Top Width        | 42.72 ft      |
| Normal Depth     | 0.4 ft        |
| Critical Depth   | 0.5 ft        |
| Critical Slope   | 0.028 ft/ft   |
| Velocity         | 4.10 ft/s     |
| Velocity Head    | 0.26 ft       |
| Specific Energy  | 0.65 ft       |
| Froude Number    | 1.595         |
| Flow Type        | Supercritical |

### GVF Input Data

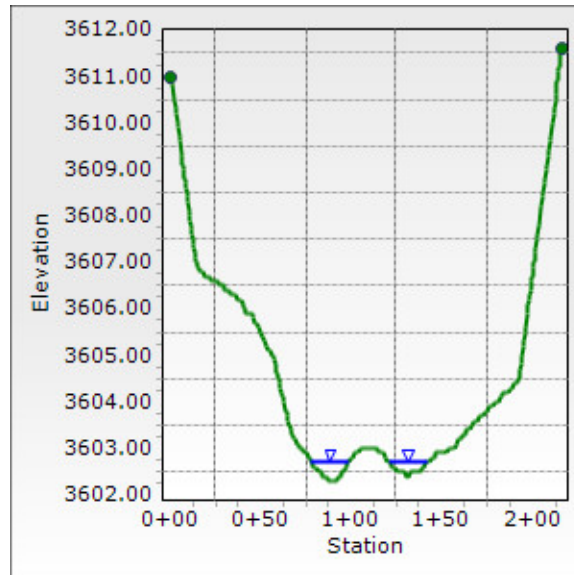
|                  |        |
|------------------|--------|
| Downstream Depth | 0.0 ft |
| Length           | 0.0 ft |
| Number Of Steps  | 0      |

### GVF Output Data

|                     |               |
|---------------------|---------------|
| Upstream Depth      | 0.0 ft        |
| Profile Description | N/A           |
| Profile Headloss    | 0.00 ft       |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity   | Infinity ft/s |
| Normal Depth        | 0.4 ft        |
| Critical Depth      | 0.5 ft        |
| Channel Slope       | 0.077 ft/ft   |
| Critical Slope      | 0.028 ft/ft   |

## Cross Section for A-2-3

|                     |              |
|---------------------|--------------|
| Project Description |              |
| Friction Method     | Manning      |
| Solve For           | Formula      |
|                     | Normal Depth |
| Input Data          |              |
| Channel Slope       | 0.077 ft/ft  |
| Normal Depth        | 0.4 ft       |
| Discharge           | 36.00 cfs    |



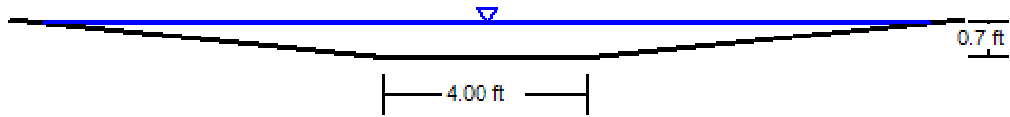


## Worksheet for B-1-1 Trap

|                       |                     |
|-----------------------|---------------------|
| Project Description   |                     |
| Friction Method       | Manning Formula     |
| Solve For             | Normal Depth        |
| Input Data            |                     |
| Roughness Coefficient | 0.035               |
| Channel Slope         | 0.057 ft/ft         |
| Left Side Slope       | 10.000 H:V          |
| Right Side Slope      | 10.000 H:V          |
| Bottom Width          | 4.00 ft             |
| Discharge             | 41.00 cfs           |
| Results               |                     |
| Normal Depth          | 0.7 ft              |
| Flow Area             | 7.3 ft <sup>2</sup> |
| Wetted Perimeter      | 17.6 ft             |
| Hydraulic Radius      | 0.4 ft              |
| Top Width             | 17.53 ft            |
| Critical Depth        | 0.8 ft              |
| Critical Slope        | 0.023 ft/ft         |
| Velocity              | 5.63 ft/s           |
| Velocity Head         | 0.49 ft             |
| Specific Energy       | 1.17 ft             |
| Froude Number         | 1.540               |
| Flow Type             | Supercritical       |
| GVF Input Data        |                     |
| Downstream Depth      | 0.0 ft              |
| Length                | 0.0 ft              |
| Number Of Steps       | 0                   |
| GVF Output Data       |                     |
| Upstream Depth        | 0.0 ft              |
| Profile Description   | N/A                 |
| Profile Headloss      | 0.00 ft             |
| Downstream Velocity   | Infinity ft/s       |
| Upstream Velocity     | Infinity ft/s       |
| Normal Depth          | 0.7 ft              |
| Critical Depth        | 0.8 ft              |
| Channel Slope         | 0.057 ft/ft         |
| Critical Slope        | 0.023 ft/ft         |

## Cross Section for B-1-1 Trap

| Project Description   |              |
|-----------------------|--------------|
| Friction Method       | Manning      |
|                       | Formula      |
| Solve For             | Normal Depth |
| Input Data            |              |
| Roughness Coefficient | 0.035        |
| Channel Slope         | 0.057 ft/ft  |
| Normal Depth          | 0.7 ft       |
| Left Side Slope       | 10.000 H:V   |
| Right Side Slope      | 10.000 H:V   |
| Bottom Width          | 4.00 ft      |
| Discharge             | 41.00 cfs    |



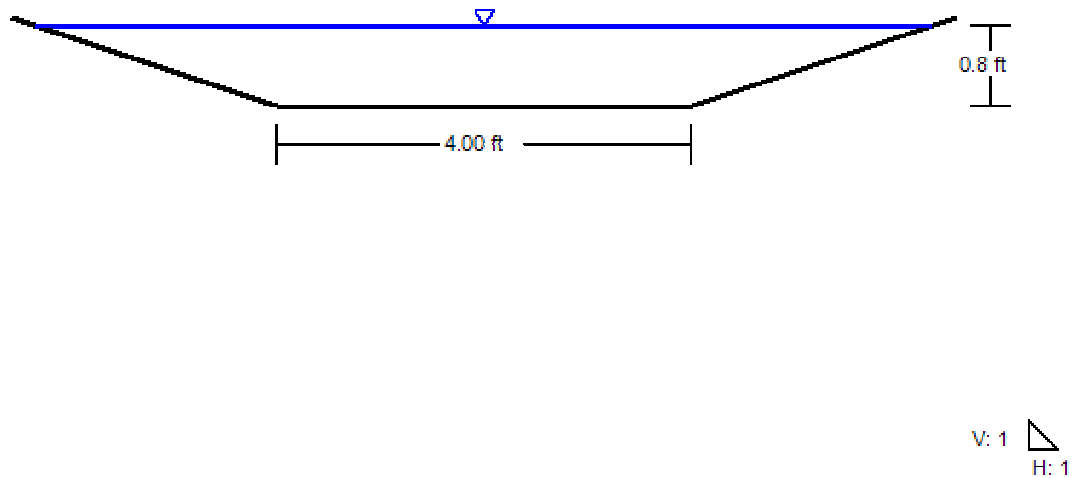
V: 1  
H: 1

## Worksheet for B-1-2 Trap

|                       |                     |
|-----------------------|---------------------|
| Project Description   |                     |
| Friction Method       | Manning<br>Formula  |
| Solve For             | Normal Depth        |
| Input Data            |                     |
| Roughness Coefficient | 0.035               |
| Channel Slope         | 0.056 ft/ft         |
| Left Side Slope       | 3.000 H:V           |
| Right Side Slope      | 3.000 H:V           |
| Bottom Width          | 4.00 ft             |
| Discharge             | 33.00 cfs           |
| Results               |                     |
| Normal Depth          | 0.8 ft              |
| Flow Area             | 4.9 ft <sup>2</sup> |
| Wetted Perimeter      | 8.9 ft              |
| Hydraulic Radius      | 0.6 ft              |
| Top Width             | 8.64 ft             |
| Critical Depth        | 1.0 ft              |
| Critical Slope        | 0.021 ft/ft         |
| Velocity              | 6.74 ft/s           |
| Velocity Head         | 0.71 ft             |
| Specific Energy       | 1.48 ft             |
| Froude Number         | 1.580               |
| Flow Type             | Supercritical       |
| GVF Input Data        |                     |
| Downstream Depth      | 0.0 ft              |
| Length                | 0.0 ft              |
| Number Of Steps       | 0                   |
| GVF Output Data       |                     |
| Upstream Depth        | 0.0 ft              |
| Profile Description   | N/A                 |
| Profile Headloss      | 0.00 ft             |
| Downstream Velocity   | Infinity ft/s       |
| Upstream Velocity     | Infinity ft/s       |
| Normal Depth          | 0.8 ft              |
| Critical Depth        | 1.0 ft              |
| Channel Slope         | 0.056 ft/ft         |
| Critical Slope        | 0.021 ft/ft         |

## Cross Section for B-1-2 Trap

| Project Description   |              |
|-----------------------|--------------|
| Friction Method       | Manning      |
|                       | Formula      |
| Solve For             | Normal Depth |
| Input Data            |              |
| Roughness Coefficient | 0.035        |
| Channel Slope         | 0.056 ft/ft  |
| Normal Depth          | 0.8 ft       |
| Left Side Slope       | 3.000 H:V    |
| Right Side Slope      | 3.000 H:V    |
| Bottom Width          | 4.00 ft      |
| Discharge             | 33.00 cfs    |

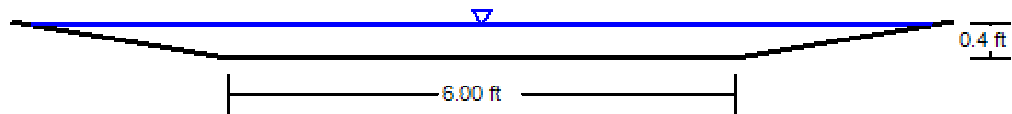


## Worksheet for B-1-3 Trap

|                       |                     |
|-----------------------|---------------------|
| Project Description   |                     |
| Friction Method       | Manning<br>Formula  |
| Solve For             | Normal Depth        |
| Input Data            |                     |
| Roughness Coefficient | 0.035               |
| Channel Slope         | 0.085 ft/ft         |
| Left Side Slope       | 6.000 H:V           |
| Right Side Slope      | 6.000 H:V           |
| Bottom Width          | 6.00 ft             |
| Discharge             | 18.00 cfs           |
| Results               |                     |
| Normal Depth          | 0.4 ft              |
| Flow Area             | 3.2 ft <sup>2</sup> |
| Wetted Perimeter      | 10.7 ft             |
| Hydraulic Radius      | 0.3 ft              |
| Top Width             | 10.66 ft            |
| Critical Depth        | 0.5 ft              |
| Critical Slope        | 0.024 ft/ft         |
| Velocity              | 5.57 ft/s           |
| Velocity Head         | 0.48 ft             |
| Specific Energy       | 0.87 ft             |
| Froude Number         | 1.782               |
| Flow Type             | Supercritical       |
| GVF Input Data        |                     |
| Downstream Depth      | 0.0 ft              |
| Length                | 0.0 ft              |
| Number Of Steps       | 0                   |
| GVF Output Data       |                     |
| Upstream Depth        | 0.0 ft              |
| Profile Description   | N/A                 |
| Profile Headloss      | 0.00 ft             |
| Downstream Velocity   | Infinity ft/s       |
| Upstream Velocity     | Infinity ft/s       |
| Normal Depth          | 0.4 ft              |
| Critical Depth        | 0.5 ft              |
| Channel Slope         | 0.085 ft/ft         |
| Critical Slope        | 0.024 ft/ft         |

## Cross Section for B-1-3 Trap

| Project Description   |              |
|-----------------------|--------------|
| Friction Method       | Manning      |
|                       | Formula      |
| Solve For             | Normal Depth |
| Input Data            |              |
| Roughness Coefficient | 0.035        |
| Channel Slope         | 0.085 ft/ft  |
| Normal Depth          | 0.4 ft       |
| Left Side Slope       | 6.000 H:V    |
| Right Side Slope      | 6.000 H:V    |
| Bottom Width          | 6.00 ft      |
| Discharge             | 18.00 cfs    |



V: 1   
H: 1

## Worksheet for C-1-1

|                     |                    |
|---------------------|--------------------|
| Project Description |                    |
| Friction Method     | Manning<br>Formula |
| Solve For           | Normal Depth       |
| Input Data          |                    |
| Channel Slope       | 0.065 ft/ft        |
| Discharge           | 13.00 cfs          |

### Section Definitions

| Station<br>(ft) | Elevation<br>(ft) |
|-----------------|-------------------|
| 0+00            | 3,581.52          |
| 0+00            | 3,581.55          |
| 0+01            | 3,581.61          |
| 0+02            | 3,581.69          |
| 0+03            | 3,581.74          |
| 0+03            | 3,581.79          |
| 0+03            | 3,581.79          |
| 0+03            | 3,581.81          |
| 0+04            | 3,581.84          |
| 0+04            | 3,581.84          |
| 0+04            | 3,581.87          |
| 0+04            | 3,581.90          |
| 0+04            | 3,581.90          |
| 0+05            | 3,581.94          |
| 0+05            | 3,581.99          |
| 0+05            | 3,582.00          |
| 0+05            | 3,581.99          |
| 0+05            | 3,581.99          |
| 0+06            | 3,581.84          |
| 0+07            | 3,581.71          |
| 0+07            | 3,581.71          |
| 0+07            | 3,581.65          |
| 0+07            | 3,581.56          |
| 0+08            | 3,581.44          |
| 0+08            | 3,581.26          |
| 0+09            | 3,581.06          |
| 0+09            | 3,581.05          |
| 0+09            | 3,581.05          |
| 0+09            | 3,581.00          |
| 0+10            | 3,580.86          |
| 0+10            | 3,580.73          |
| 0+10            | 3,580.73          |
| 0+10            | 3,580.67          |
| 0+11            | 3,580.59          |
| 0+11            | 3,580.59          |
| 0+11            | 3,580.47          |
| 0+11            | 3,580.40          |
| 0+11            | 3,580.40          |



## Worksheet for C-1-1

### Section Definitions

| Station<br>(ft) | Elevation<br>(ft) |
|-----------------|-------------------|
| 0+85            | 3,575.08          |
| 0+85            | 3,575.08          |
| 0+85            | 3,575.08          |

### Roughness Segment Definitions

| Start Station    | Ending Station   | Roughness Coefficient |
|------------------|------------------|-----------------------|
| (0+00, 3,581.52) | (0+85, 3,575.08) | 0.035                 |

#### Options

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

#### Results

|                  |                       |
|------------------|-----------------------|
| Normal Depth     | 0.3 ft                |
| Elevation Range  | 3,574.8 to 3,582.0 ft |
| Flow Area        | 4.1 ft <sup>2</sup>   |
| Wetted Perimeter | 25.4 ft               |
| Hydraulic Radius | 0.2 ft                |
| Top Width        | 25.42 ft              |
| Normal Depth     | 0.3 ft                |
| Critical Depth   | 0.3 ft                |
| Critical Slope   | 0.032 ft/ft           |
| Velocity         | 3.19 ft/s             |
| Velocity Head    | 0.16 ft               |
| Specific Energy  | 0.45 ft               |
| Froude Number    | 1.403                 |
| Flow Type        | Supercritical         |

#### GVF Input Data

|                  |        |
|------------------|--------|
| Downstream Depth | 0.0 ft |
| Length           | 0.0 ft |
| Number Of Steps  | 0      |

#### GVF Output Data

|                     |               |
|---------------------|---------------|
| Upstream Depth      | 0.0 ft        |
| Profile Description | N/A           |
| Profile Headloss    | 0.00 ft       |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity   | Infinity ft/s |
| Normal Depth        | 0.3 ft        |

## Worksheet for C-1-1

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### GVF Output Data

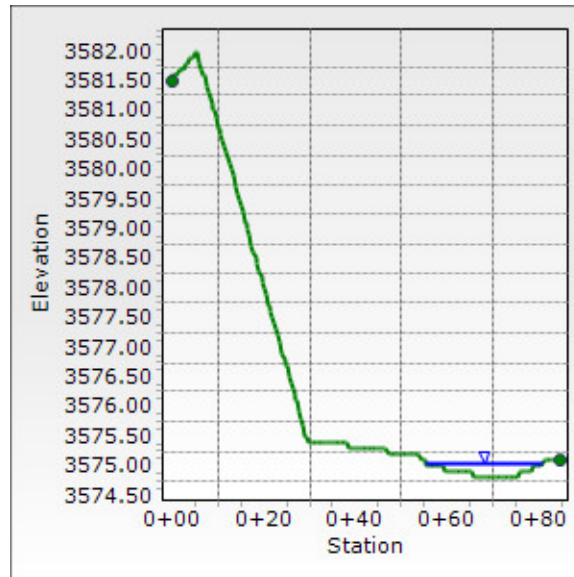
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|                |             |
|----------------|-------------|
| Critical Depth | 0.3 ft      |
| Channel Slope  | 0.065 ft/ft |
| Critical Slope | 0.032 ft/ft |

---

## Cross Section for C-1-1

|                     |              |
|---------------------|--------------|
| Project Description |              |
| Friction Method     | Manning      |
| Solve For           | Formula      |
|                     | Normal Depth |
| Input Data          |              |
| Channel Slope       | 0.065 ft/ft  |
| Normal Depth        | 0.3 ft       |
| Discharge           | 13.00 cfs    |



## C.2 Riprap Calculations

# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale A-a (max)

Conditions: Q = 196 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{\text{avg}} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{\text{avg}}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{\text{sg}} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{\text{sf}} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{\text{sg}} C_{\text{sf}}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 5     | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.023 | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 1.4   | ft      |                           |
| Flow area =                            | 26.1  | sqft    |                           |
| Wetted perimeter =                     | 19.1  | ft      |                           |
| Top width =                            | 18.4  | ft      |                           |
| Average channel velocity =             | 7.5   | fps     |                           |
| Depth of flow =                        | 2.2   | ft      |                           |
| Side slope horizontal (H:1) =          | 3     |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 0.67  | ft      |                           |

Balance w/ Manning's n until results match input FlowMaster

## Calculations:

$$\theta = 18.4 \text{ degrees}$$

$$K_1 = 0.876$$

$$d_{\text{avg}} = 1.42 \text{ ft}$$

$$\text{Manning's } n = 0.088$$

$$\text{Bank } D_{50} = 0.29 \text{ ft}$$

$$\text{Bed } D_{50} = 0.35$$

$$C_{\text{sf}} = 1.128$$

$$C_{\text{sg}} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.33 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.40 \text{ ft}$$

Stable? **Yes**

$$t_o = 2.0 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 2.8 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 1.38 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.037 \text{ OK}$$

$$Y/d_{50} = 3.3 \text{ (Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.060 \text{ Yes}$$

$$d_{50} = 0.64 \text{ ft (Eq. 734)}$$

$$d_{50} = 1.37 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 1.07 \text{ ft (Eq. 736 for } S_e = S)$$

## Stability Factor:

- 1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.
- 1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.
- 1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

= Values referenced in flow master

Spreadsheet not for pier scour or wave action

# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale A-a (min)

Conditions: Q = 196 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{\text{avg}} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{\text{avg}}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{\text{sg}} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{\text{sf}} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{\text{sg}} C_{\text{sf}}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 5     | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.02  | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 1.4   | ft      |                           |
| Flow area =                            | 27.5  | sqft    |                           |
| Wetted perimeter =                     | 19.6  | ft      |                           |
| Top width =                            | 18.85 | ft      |                           |
| Average channel velocity =             | 7.12  | fps     |                           |
| Depth of flow =                        | 2.3   | ft      |                           |
| Side slope horizontal (H:1) =          | 3     |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 0.67  | ft      |                           |

Balance w/ Manning's n until results match input FlowMaster

## Calculations:

$$\theta = 18.4 \text{ degrees}$$

$$K_1 = 0.876$$

$$d_{\text{avg}} = 1.46 \text{ ft}$$

$$\text{Manning's } n = 0.084$$

$$\text{Bank } D_{50} = 0.25 \text{ ft}$$

$$\text{Bed } D_{50} = 0.30$$

$$C_{\text{sf}} = 1.128$$

$$C_{\text{sg}} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.28 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.34 \text{ ft}$$

Stable? **Yes**

$$t_o = 1.8 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 2.8 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 1.41 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.037 \text{ OK}$$

$$Y/d_{50} = 3.4 \text{ (Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.060 \text{ Yes}$$

$$d_{50} = 0.55 \text{ ft (Eq. 734)}$$

$$d_{50} = 1.20 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 0.97 \text{ ft (Eq. 736 for } S_e = S)$$

## Stability Factor:

- 1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.
- 1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.
- 1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

= Values referenced in flow master

Spreadsheet not for pier scour or wave action

# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale A-b (max/min)

Conditions: Q =217 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{\text{avg}} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{\text{avg}}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{\text{sg}} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{\text{sf}} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{\text{sg}} C_{\text{sf}}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 5     | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.052 | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 1.25  | ft      |                           |
| Flow area =                            | 22.1  | sqft    |                           |
| Wetted perimeter =                     | 17.7  | ft      |                           |
| Top width =                            | 17.03 | ft      |                           |
| Average channel velocity =             | 9.83  | fps     |                           |
| Depth of flow =                        | 2.01  | ft      |                           |
| Side slope horizontal (H:1) =          | 3     |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 1.00  | ft      |                           |

Balance w/ Manning's n until results match input FlowMaster

## Calculations:

$$\theta = 18.4 \text{ degrees}$$

$$K_1 = 0.876$$

$$d_{\text{avg}} = 1.30 \text{ ft}$$

$$\text{Manning's } n = 0.122$$

$$\text{Bank } D_{50} = 0.68 \text{ ft}$$

$$\text{Bed } D_{50} = 0.83$$

$$C_{\text{sf}} = 1.128$$

$$C_{\text{sg}} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.77 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.94 \text{ ft}$$

Stable? **Yes**

$$t_o = 4.1 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 4.2 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 1.25 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.040 \quad \text{Formula Under Predicts n Value}$$

$$Y/d_{50} = 2.0 \quad (\text{Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.077 \quad \text{Yes}$$

$$d_{50} = 1.44 \text{ ft (Eq. 734)}$$

$$d_{50} = 2.64 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 2.20 \text{ ft (Eq. 736 for } S_e = S)$$

## Stability Factor:

1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.

1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.

1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

= Values referenced in flow master

Spreadsheet not for pier scour or wave action

# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale B (max)

Conditions: Q = 56 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{\text{avg}} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{\text{avg}}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{\text{sg}} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{\text{sf}} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{\text{sg}} C_{\text{sf}}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 5     | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.063 | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 0.67  | ft      |                           |
| Flow area =                            | 7.3   | sqft    |                           |
| Wetted perimeter =                     | 10.9  | ft      |                           |
| Top width =                            | 10.6  | ft      |                           |
| Average channel velocity =             | 7.7   | fps     |                           |
| Depth of flow =                        | 0.93  | ft      |                           |
| Side slope horizontal (H:1) =          | 3     |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 0.67  | ft      |                           |

Balance w/ Manning's n until results match input FlowMaster

## Calculations:

$$\theta = 18.4 \text{ degrees}$$

$$K_1 = 0.876$$

$$d_{\text{avg}} = 0.69 \text{ ft}$$

$$\text{Manning's } n = 0.145$$

$$\text{Bank } D_{50} = 0.45 \text{ ft}$$

$$\text{Bed } D_{50} = 0.55$$

$$C_{\text{sf}} = 1.128$$

$$C_{\text{sg}} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.51 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.62 \text{ ft}$$

Stable? **Yes**

$$t_o = 2.6 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 2.8 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 0.67 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.037 \quad \text{Formula Under Predicts } n \text{ Value}$$

$$Y/d_{50} = 1.4 \quad (\text{Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.087 \quad Y/d_{50} \text{ Not Within Limits}$$

$$d_{50} = 0.95 \text{ ft (Eq. 734)}$$

$$d_{50} = 1.46 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 1.23 \text{ ft (Eq. 736 for } S_e = S)$$

## Stability Factor:

- 1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.
- 1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.
- 1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

= Values referenced in flow master

Spreadsheet not for pier scour or wave action



# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale B (min)

Conditions: Q = 56 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{\text{avg}} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{\text{avg}}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{\text{sg}} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{\text{sf}} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{\text{sg}} C_{\text{sf}}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 5     | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.032 | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 0.77  | ft      |                           |
| Flow area =                            | 9.3   | sqft    |                           |
| Wetted perimeter =                     | 12    | ft      |                           |
| Top width =                            | 11.67 | ft      |                           |
| Average channel velocity =             | 6.04  | fps     |                           |
| Depth of flow =                        | 1.11  | ft      |                           |
| Side slope horizontal (H:1) =          | 3     |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 0.67  | ft      |                           |

Balance w/ Manning's n until results match input FlowMaster

## Calculations:

$$\theta = 18.4 \text{ degrees}$$

$$K_1 = 0.876$$

$$d_{\text{avg}} = 0.80 \text{ ft}$$

$$\text{Manning's } n = 0.110$$

$$\text{Bank } D_{50} = 0.20 \text{ ft}$$

$$\text{Bed } D_{50} = 0.25$$

$$C_{\text{sf}} = 1.128$$

$$C_{\text{sg}} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.23 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.28 \text{ ft}$$

Stable? **Yes**

$$t_o = 1.5 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 2.8 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 0.77 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.037 \quad \text{Formula Under Predicts } n \text{ Value}$$

$$Y/d_{50} = 1.7 \quad (\text{Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.079 \quad \text{Yes}$$

$$d_{50} = 0.46 \text{ ft (Eq. 734)}$$

$$d_{50} = 0.80 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 0.75 \text{ ft (Eq. 736 for } S_e = S)$$

## Stability Factor:

1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.

1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.

1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

= Values referenced in flow master

Spreadsheet not for pier scour or wave action

# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale C (max)

Conditions: Q = 24 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{\text{avg}} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{\text{avg}}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{\text{sg}} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{\text{sf}} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{\text{sg}} C_{\text{sf}}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 5     | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.092 | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 0.42  | ft      |                           |
| Flow area =                            | 3.5   | sqft    |                           |
| Wetted perimeter =                     | 8.4   | ft      |                           |
| Top width =                            | 8.2   | ft      |                           |
| Average channel velocity =             | 6.83  | fps     |                           |
| Depth of flow =                        | 0.53  | ft      |                           |
| Side slope horizontal (H:1) =          | 3     |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 0.67  | ft      |                           |

Balance w/ Manning's n until results match input FlowMaster

## Calculations:

$$\theta = 18.4 \text{ degrees}$$

$$K_1 = 0.876$$

$$d_{\text{avg}} = 0.43 \text{ ft}$$

$$\text{Manning's } n = 0.181$$

$$\text{Bank } D_{50} = 0.40 \text{ ft}$$

$$\text{Bed } D_{50} = 0.49$$

$$C_{\text{sf}} = 1.128$$

$$C_{\text{sg}} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.45 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.55 \text{ ft}$$

Stable? **Yes**

$$t_o = 2.4 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 2.8 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 0.42 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.037 \quad \text{Formula Under Predicts } n \text{ Value}$$

$$Y/d_{50} = 0.8 \quad (\text{Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.138 \quad Y/d_{50} \text{ Not Within Limits}$$

$$d_{50} = 0.85 \text{ ft (Eq. 734)}$$

$$d_{50} = 1.09 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 1.03 \text{ ft (Eq. 736 for } S_e = S)$$

## Stability Factor:

1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.

1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.

1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

= Values referenced in flow master

Spreadsheet not for pier scour or wave action

# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale C (min)

Conditions: Q = 24 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{\text{avg}} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{\text{avg}}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{\text{sg}} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{\text{sf}} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{\text{sg}} C_{\text{sf}}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 5     | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.023 | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 0.58  | ft      |                           |
| Flow area =                            | 5.7   | sqft    |                           |
| Wetted perimeter =                     | 9.9   | ft      |                           |
| Top width =                            | 9.67  | ft      |                           |
| Average channel velocity =             | 4.21  | fps     |                           |
| Depth of flow =                        | 0.78  | ft      |                           |
| Side slope horizontal (H:1) =          | 3     |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 0.67  | ft      |                           |

Balance w/ Manning's n until results match input FlowMaster

## Calculations:

$$\theta = 18.4 \text{ degrees}$$

$$K_1 = 0.876$$

$$d_{\text{avg}} = 0.59 \text{ ft}$$

$$\text{Manning's } n = 0.101$$

$$\text{Bank } D_{50} = 0.08 \text{ ft}$$

$$\text{Bed } D_{50} = 0.10$$

$$C_{\text{sf}} = 1.128$$

$$C_{\text{sg}} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.09 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.11 \text{ ft}$$

Stable? **Yes**

$$t_o = 0.8 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 2.8 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 0.57 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.037 \quad \text{Formula Under Predicts n Value}$$

$$Y/d_{50} = 1.2 \quad (\text{Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.097 \quad Y/d_{50} \text{ Not Within Limits}$$

$$d_{50} = 0.20 \text{ ft (Eq. 734)}$$

$$d_{50} = 0.33 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 0.38 \text{ ft (Eq. 736 for } S_e = S)$$

## Stability Factor:

1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.

1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.

1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

= Values referenced in flow master

Spreadsheet not for pier scour or wave action

# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale A-1 Section 1

Conditions: Q = 120 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{avg} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{avg}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{sg} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{sf} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{sg} C_{sf}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 40    | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.064 | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 0.4   | ft      |                           |
| Flow area =                            | 19.3  | sqft    |                           |
| Wetted perimeter =                     | 43.8  | ft      |                           |
| Top width =                            | 43.69 | ft      |                           |
| Average channel velocity =             | 6.22  | fps     |                           |
| Depth of flow =                        | 0.5   | ft      |                           |
| Side slope horizontal (H:1) =          | 4     |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 0.50  | ft      |                           |

Balance w/ Manning's n until  
results match input FlowMaster

## Calculations:

$$\theta = 14.0 \text{ degrees}$$

$$K_1 = 0.929$$

$$d_{avg} = 0.44 \text{ ft}$$

$$\text{Manning's } n = 0.159$$

$$\text{Bank } D_{50} = 0.32 \text{ ft}$$

$$\text{Bed } D_{50} = 0.36$$

$$C_{sf} = 1.128$$

$$C_{sg} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.37 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.41 \text{ ft}$$

Stable? **Yes**

$$t_o = 1.8 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 2.2 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 0.44 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.035 \quad \text{Formula Under Predicts n Value}$$

$$Y/d_{50} = 1.0 \quad (\text{Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.104 \quad Y/d_{50} \text{ Not Within Limits}$$

$$d_{50} = 0.62 \text{ ft (Eq. 734)}$$

$$d_{50} = 0.86 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 0.64 \text{ ft (Eq. 736 for } S_b = S)$$

## Stability Factor:

- 1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.
- 1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.
- 1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

**[Blue Box]** = Values referenced in flow master

Spreadsheet not for pier scour or wave action

# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale A-1 Section 2

Conditions: Q = 118 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{avg} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{avg}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{sg} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{sf} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{sg} C_{sf}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 12    | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.067 | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 0.5   | ft      |                           |
| Flow area =                            | 17.3  | sqft    |                           |
| Wetted perimeter =                     | 32.3  | ft      |                           |
| Top width =                            | 32.27 | ft      |                           |
| Average channel velocity =             | 6.84  | fps     |                           |
| Depth of flow =                        | 0.8   | ft      |                           |
| Side slope horizontal (H:1) =          | 13    |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 0.66  | ft      |                           |

Balance w/ Manning's n until  
results match input FlowMaster

## Calculations:

$$\theta = 4.4 \text{ degrees}$$

$$K_1 = 0.993$$

$$d_{avg} = 0.54 \text{ ft}$$

$$\text{Manning's } n = 0.156$$

$$\text{Bank } D_{50} = 0.43 \text{ ft}$$

$$\text{Bed } D_{50} = 0.44$$

$$C_{sf} = 1.128$$

$$C_{sg} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.49 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.49 \text{ ft}$$

Stable? **Yes**

$$t_o = 2.2 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 3.2 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 0.53 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.037 \quad \text{Formula Under Predicts n Value}$$

$$Y/d_{50} = 1.2 \quad (\text{Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.094 \quad Y/d_{50} \text{ Not Within Limits}$$

$$d_{50} = 0.76 \text{ ft (Eq. 734)}$$

$$d_{50} = 1.09 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 1.00 \text{ ft (Eq. 736 for } S_b = S)$$

## Stability Factor:

- 1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.
- 1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.
- 1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

**[Blue Box]** = Values referenced in flow master

Spreadsheet not for pier scour or wave action

# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale A-1 Section 3

Conditions: Q = 109 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{avg} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{avg}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{sg} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{sf} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{sg} C_{sf}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 2     | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.066 | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 0.5   | ft      |                           |
| Flow area =                            | 16.8  | sqft    |                           |
| Wetted perimeter =                     | 36.8  | ft      |                           |
| Top width =                            | 36.75 | ft      |                           |
| Average channel velocity =             | 6.48  | fps     |                           |
| Depth of flow =                        | 0.9   | ft      |                           |
| Side slope horizontal (H:1) =          | 20    |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 0.50  | ft      |                           |

Balance w/ Manning's n until  
results match input FlowMaster

## Calculations:

$$\theta = 2.9 \text{ degrees}$$

$$K_1 = 0.997$$

$$d_{avg} = 0.46 \text{ ft}$$

$$\text{Manning's } n = 0.155$$

$$\text{Bank } D_{50} = 0.40 \text{ ft}$$

$$\text{Bed } D_{50} = 0.40$$

$$C_{sf} = 1.128$$

$$C_{sg} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.45 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.45 \text{ ft}$$

Stable? **Yes**

$$t_o = 1.9 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 2.4 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 0.44 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.035 \quad \text{Formula Under Predicts n Value}$$

$$Y/d_{50} = 1.8 \quad (\text{Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.072 \quad \text{Yes}$$

$$d_{50} = 0.68 \text{ ft (Eq. 734)}$$

$$d_{50} = 0.96 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 1.10 \text{ ft (Eq. 736 for } S_b = S)$$

## Stability Factor:

- 1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.
- 1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.
- 1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

**[Blue Box]** = Values referenced in flow master

Spreadsheet not for pier scour or wave action

# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale A-1 Section 4

Conditions: Q = 78 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{avg} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{avg}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{sg} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{sf} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{sg} C_{sf}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 26    | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.066 | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 0.4   | ft      |                           |
| Flow area =                            | 13.3  | sqft    |                           |
| Wetted perimeter =                     | 34.1  | ft      |                           |
| Top width =                            | 34.01 | ft      |                           |
| Average channel velocity =             | 5.85  | fps     |                           |
| Depth of flow =                        | 0.4   | ft      |                           |
| Side slope horizontal (H:1) =          | 9     |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 0.50  | ft      |                           |

Balance w/ Manning's n until results match input FlowMaster

## Calculations:

$$\theta = 6.3 \text{ degrees}$$

$$K_1 = 0.986$$

$$d_{avg} = 0.39 \text{ ft}$$

$$\text{Manning's } n = 0.161$$

$$\text{Bank } D_{50} = 0.31 \text{ ft}$$

$$\text{Bed } D_{50} = 0.32$$

$$C_{sf} = 1.128$$

$$C_{sg} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.35 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.36 \text{ ft}$$

Stable? **Yes**

$$t_o = 1.6 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 2.4 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 0.40 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.035 \quad \text{Formula Under Predicts n Value}$$

$$Y/d_{50} = 0.8 \quad (\text{Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.129 \quad Y/d_{50} \text{ Not Within Limits}$$

$$d_{50} = 0.55 \text{ ft (Eq. 734)}$$

$$d_{50} = 0.74 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 0.49 \text{ ft (Eq. 736 for } S_b = S)$$

## Stability Factor:

- 1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.
- 1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.
- 1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

**[Blue Box]** = Values referenced in flow master

Spreadsheet not for pier scour or wave action

# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale B-1 Section 1

Conditions: Q = 41 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{avg} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{avg}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{sg} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{sf} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{sg} C_{sf}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 4     | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.057 | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 0.4   | ft      |                           |
| Flow area =                            | 7.3   | sqft    |                           |
| Wetted perimeter =                     | 17.6  | ft      |                           |
| Top width =                            | 17.53 | ft      |                           |
| Average channel velocity =             | 5.63  | fps     |                           |
| Depth of flow =                        | 0.7   | ft      |                           |
| Side slope horizontal (H:1) =          | 10    |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 0.50  | ft      |                           |

Balance w/ Manning's n until  
results match input FlowMaster

## Calculations:

$$\theta = 5.7 \text{ degrees}$$

$$K_1 = 0.988$$

$$d_{avg} = 0.42 \text{ ft}$$

$$\text{Manning's } n = 0.152$$

$$\text{Bank } D_{50} = 0.27 \text{ ft}$$

$$\text{Bed } D_{50} = 0.28$$

$$C_{sf} = 1.128$$

$$C_{sg} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.31 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.31 \text{ ft}$$

Stable? **Yes**

$$t_o = 1.5 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 2.4 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 0.40 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.035 \quad \text{Formula Under Predicts n Value}$$

$$Y/d_{50} = 1.4 \quad (\text{Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.082 \quad Y/d_{50} \text{ Not Within Limits}$$

$$d_{50} = 0.49 \text{ ft (Eq. 734)}$$

$$d_{50} = 0.68 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 0.75 \text{ ft (Eq. 736 for } S_b = S)$$

## Stability Factor:

- 1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.
- 1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.
- 1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

**[Blue Box]** = Values referenced in flow master

Spreadsheet not for pier scour or wave action



# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale B-1 Section 2

Conditions: Q = 33 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{avg} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{avg}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{sg} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{sf} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{sg} C_{sf}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 4     | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.056 | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 0.6   | ft      |                           |
| Flow area =                            | 4.9   | sqft    |                           |
| Wetted perimeter =                     | 8.9   | ft      |                           |
| Top width =                            | 8.64  | ft      |                           |
| Average channel velocity =             | 6.74  | fps     |                           |
| Depth of flow =                        | 0.8   | ft      |                           |
| Side slope horizontal (H:1) =          | 3     |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 0.50  | ft      |                           |

Balance w/ Manning's n until results match input FlowMaster

## Calculations:

$$\theta = 18.4 \text{ degrees}$$

$$K_1 = 0.876$$

$$d_{avg} = 0.57 \text{ ft}$$

$$\text{Manning's } n = 0.142$$

$$\text{Bank } D_{50} = 0.33 \text{ ft}$$

$$\text{Bed } D_{50} = 0.41$$

$$C_{sf} = 1.128$$

$$C_{sg} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.38 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.46 \text{ ft}$$

Stable? **Yes**

$$t_o = 1.9 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 2.1 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 0.54 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.035 \quad \text{Formula Under Predicts n Value}$$

$$Y/d_{50} = 1.6 \quad (\text{Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.076 \quad \text{Yes}$$

$$d_{50} = 0.70 \text{ ft (Eq. 734)}$$

$$d_{50} = 1.05 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 0.94 \text{ ft (Eq. 736 for } S_b = S)$$

## Stability Factor:

- 1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.
- 1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.
- 1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

**[Blue Box]** = Values referenced in flow master

Spreadsheet not for pier scour or wave action

# HEC-11 RIPRAP SIZING CALCULATIONS

Location: Swale B-1 Section 3

Conditions: Q = 18 cfs

Equations:

$$K_1 = [1 - (\sin^2 \theta / \sin^2 \Phi)]^{0.5} \quad (\text{eq. 7, pg. 30})$$

$$d_{avg} = \text{Flow Area} / \text{Top Width}$$

$$n = 0.39 S_f^{0.38} R^{-0.16} \quad (\text{eq. 4, pg. 23})$$

(slopes > 0.002 ft/ft and D50 > 0.2 ft)

$$\text{Bank \& Bed } D_{50} = 0.001 V_a^3 / (d_{avg}^{0.5} K_1^{1.5}) \quad (\text{eq. 6, pg. 30})$$

$$C_{sg} = 2.12 / (S_g - 1)^{1.5} \quad (\text{eq. 8, pg. 31})$$

$$C_{sf} = (SF / 1.2)^{1.5} \quad (\text{eq. 9, pg. 31})$$

$$\text{Stability Factor} = 1.3 \quad (\text{Table 1 pg 31})$$

Gradually Varying Flow; Moderate Bed Curvature (30 > curve radius/channel width > 10)

Impact from waves or floating debris moderate

$$C = C_{sg} C_{sf}$$

$$D'_{50} = C D_{50}$$

## Input Variables:

|                                        |       |         |                           |
|----------------------------------------|-------|---------|---------------------------|
| Channel BW =                           | 6     | ft      |                           |
| Energy Grade Slope "S <sub>f</sub> " = | 0.085 | ft/ft   |                           |
| Hydraulic Radius "R" =                 | 0.3   | ft      |                           |
| Flow area =                            | 3.2   | sqft    |                           |
| Wetted perimeter =                     | 10.7  | ft      |                           |
| Top width =                            | 10.66 | ft      |                           |
| Average channel velocity =             | 5.57  | fps     |                           |
| Depth of flow =                        | 0.4   | ft      |                           |
| Side slope horizontal (H:1) =          | 6     |         |                           |
| Riprap angle of repose "Φ" =           | 41    | degrees | (Chart 4, pg. 129 HEC-11) |
| Rock riprap specific gravity =         | 2.65  |         |                           |
| Stability Factor =                     | 1.3   |         |                           |
| D <sub>50</sub> =                      | 0.50  | ft      |                           |

Balance w/ Manning's n until results match input FlowMaster

## Calculations:

$$\theta = 9.5 \text{ degrees}$$

$$K_1 = 0.968$$

$$d_{avg} = 0.30 \text{ ft}$$

$$\text{Manning's } n = 0.185$$

$$\text{Bank } D_{50} = 0.30 \text{ ft}$$

$$\text{Bed } D_{50} = 0.32$$

$$C_{sf} = 1.128$$

$$C_{sg} = 1.000$$

$$C = 1.128$$

$$\text{Bank } D'_{50} = 0.34 \text{ ft}$$

$$\text{Bed } D'_{50} = 0.36 \text{ ft}$$

Stable? **Yes**

$$t_o = 1.6 \text{ lb/ft}^2 \text{ (average shear stress on channel)}$$

$$t_c = 2.3 \text{ lb/ft}^2 \text{ (critical shear stress-resistance to movement)}$$

Stable? **Yes**

## CCRFCD Equations (d<sub>50</sub> Eq.s use Eq. 732 for Manning's n)

$$R_h = 0.29 \text{ ft (Eq. 732 for } R_h > 2d_{50})$$

$$n = 0.035 \text{ Formula Under Predicts n Value}$$

$$Y/d_{50} = 0.8 \text{ (Eq. 733 for } 1.5 < Y/d_{50} < 185)$$

$$n = 0.129 \text{ Y/d50 Not Within Limits}$$

$$d_{50} = 0.55 \text{ ft (Eq. 734)}$$

$$d_{50} = 0.66 \text{ ft (Eq. 735, generally larger sizes)}$$

$$d_{50} = 0.65 \text{ ft (Eq. 736 for } S_b = S)$$

## Stability Factor:

- 1.0 - 1.2 Uniform flow; straight or mildly curving reach (curve radius/channel width > 30); impact from wave action and floating debris is minimal; little or no uncertainty in design parameters.
- 1.3 - 1.6 Gradually varying flow; moderate bend curvature (30 > curve radius/channel width > 10); impact from waves or floating debris moderate.
- 1.6 - 2.0 Approaching rapidly varying flow; sharp bend curvature (10 > curve radius/channel width); significant impact potential from floating debris and/or ice; significant wind and/or boat generated waves (1-2 ft); high flow turbulence; turbulently mixing flow at bridge abutments; significant uncertainty in design parameters.

**[Blue Box]** = Values referenced in flow master

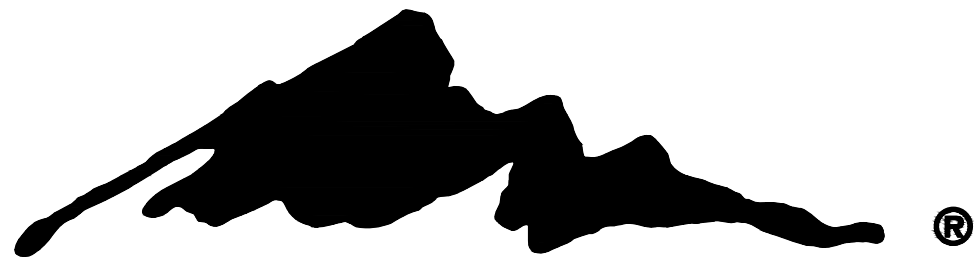
Spreadsheet not for pier scour or wave action

## Appendix D. CD-ROM



| SHEET INDEX |                           |              |
|-------------|---------------------------|--------------|
| 1           | COVER SHEET               |              |
| 2           | LEGENDS AND ABBREVIATIONS |              |
| 3           | GENERAL NOTES             |              |
| 4           | MASTER DRAINAGE PLAN      |              |
| 5           | GRADING PLAN              | STOCK PILE 1 |
| 6           | GRADING PLAN              | STOCK PILE 2 |
| 7           | GRADING PLAN              | STOCK PILE 3 |
| 8           | PROFILE                   | STOCK PILE 1 |
| 9           | PROFILE                   | STOCK PILE 2 |
| 10          | PROFILE                   | STOCK PILE 3 |

SUMMERLIN WEST VILLAGE 25  
IMPROVEMENT PLANS FOR:  
HIGH SCHOOL STAGING STOCKPILE  
APN 137-22-301-006  
APN 137-15-801-002



SUMMERLIN®

UTILITY NOTE

UTILITY LOCATIONS SHOWN HEREON ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE EXACT VERTICAL AND HORIZONTAL LOCATION OF ALL EXISTING UNDERGROUND 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.

CALL BEFORE YOU DIG: 1-800-642-2444

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 BE INSTALLED WHENEVER THE PRESSURE EXCEEDS 80 PSI. PRV'S ARE THE DEVELOPER'S RESPONSIBILITY AND WILL NOTE BE INSPECTED OR INCLUDED IN THE ACCEPTANCE OF THE LAS VEGAS VALLEY WATER DISTRICT FACILITIES.

NOTICE OF INTENT NOTE

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 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/BWPC/STORM01.HTM](http://www.state.nv.us/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 APPROPRIATE FILLING FEE.

NPDES PERMIT NOTE

THE ENGINEER SHOULD CONTACT THE NEVADA DIVISION OF ENVIRONMENTAL PROTECTION (NDEP) TO OBTAIN A NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT PRIOR TO CONSTRUCTION. ALL CONSTRUCTION PROJECTS ONE ACRE OR LARGER MUST APPLY FOR THE PERMIT THROUGH NDEP. ALL QUESTIONS REGARDING THE NPDES PERMIT REQUIREMENTS SHOULD BE DIRECTED TO THE NDEP AT (775) 687-9429.

DISCLAIMER NOTE

EXISTING UTILITY LOCATIONS SHOWN HEREON ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE EXACT VERTICAL AND HORIZONTAL LOCATION OF ALL EXISTING UNDERGROUND 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 IN THEIR PROPER LOCATION.

FEMA FLOOD ZONE INFORMATION

THE PROJECT SITE IS LOCATED WITHIN A FEMA DESIGNATED ZONE X (UNSHADED) AS DEPICTED ON FLOOD INSURANCE RATE MAP (FIRM) PANEL 32003C2150E, DATED 9/27/2002. A ZONE X (UNSHADED) IS DESCRIBED AS AN AREA DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOOD PLAIN.

PROPOSED RIGHT-OF-WAY ACREAGE  
0.00 AC

PROPOSED DISTURBED AREA ACREAGE  
39.44 AC

GEOTECHNICAL ENGINEER  
PREPARED BY: NOVA GEOTECHNICAL & INSPECTION SERVICES  
4480 W. HACIENDA AVENUE, SUITE 104, LAS VEGAS, NV 89118  
PHONE: 702-873-3478  
PROJECT NO.: G-19-026  
DATED: JUNE 18, 2020

OWNER /DEVELOPER

OWNER

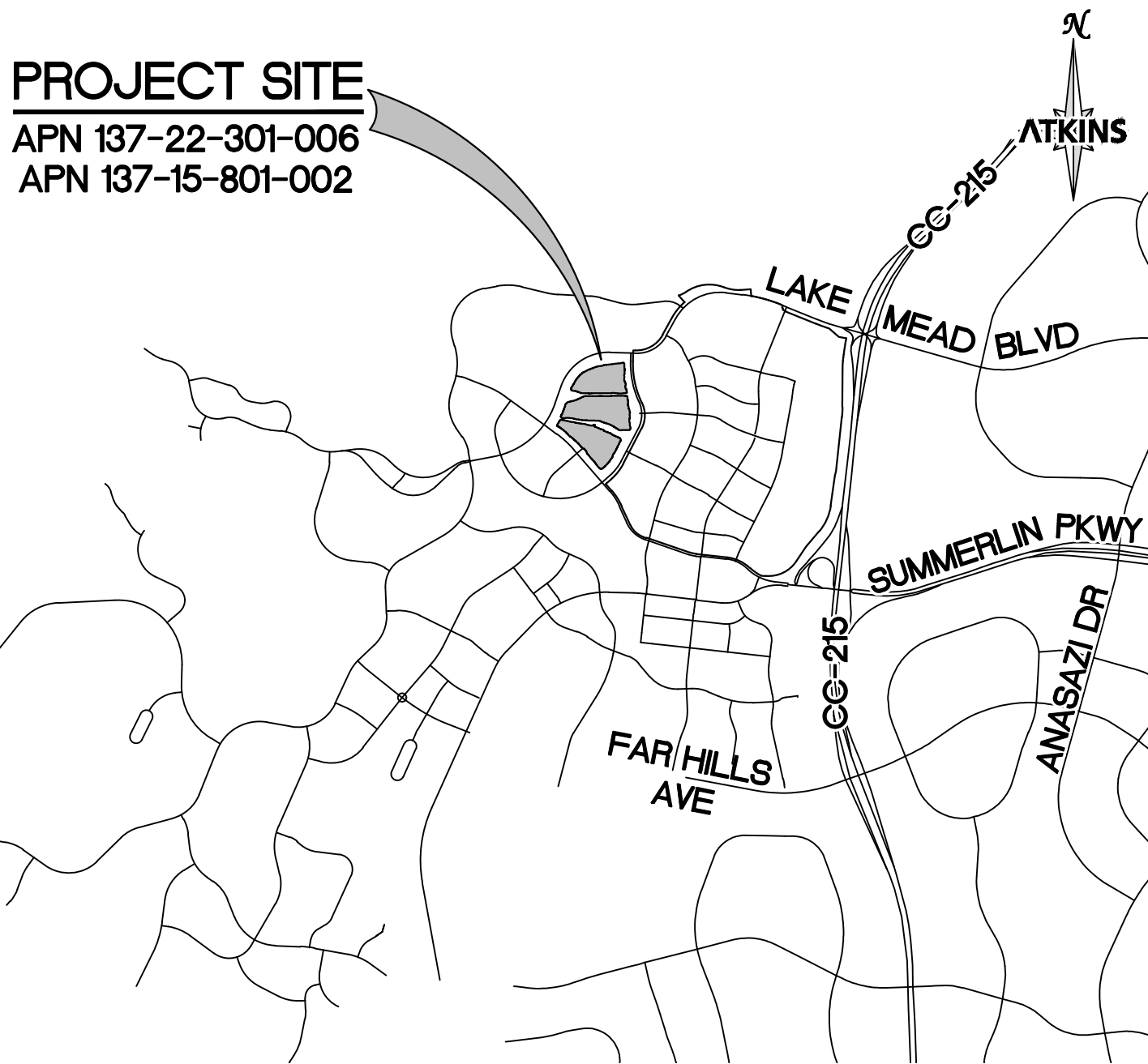
CONTACT: KEVIN ORROCK  
HOWARD HUGHES COMPANY LLC, A DELAWARE LIMITED LIABILITY COMPANY  
10801 W. CHARLESTON BLVD., 3rd FLOOR  
LAS VEGAS, NEVADA 89135

ENGINEER / CONSULTANT

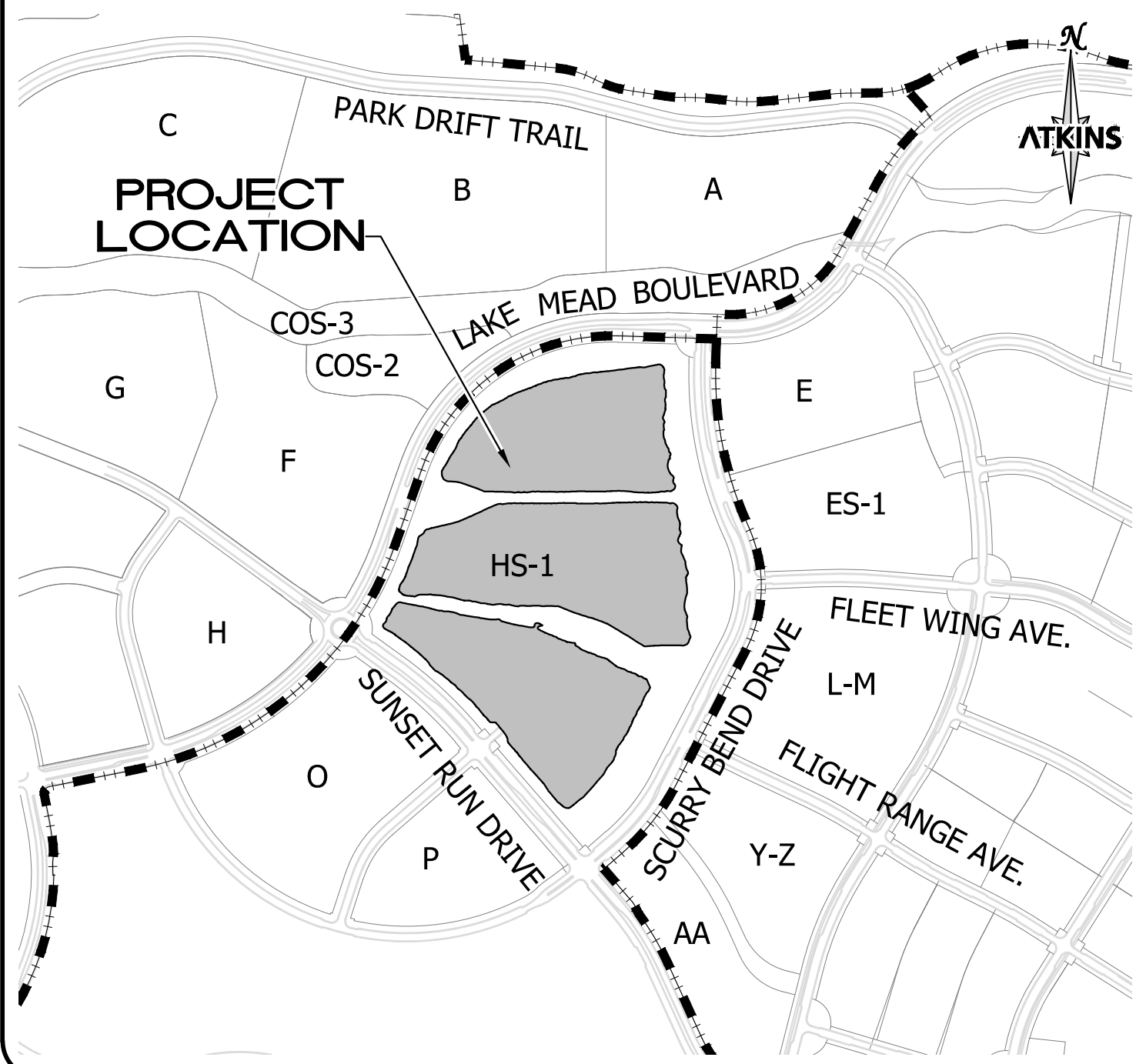
CIVIL

CONTACT: DAVID WILSON P.E.  
ATKINS  
2270 CORPORATE CIRCLE SUITE 200  
HENDERSON, NEVADA 89074  
(702) 263-7275

LOCATION MAP



VICINITY MAP



APPROVALS

HOWARD HUGHES COMPANY LLC, A DELAWARE LIMITED LIABILITY COMPANY

KEVIN T. ORROCK, VICE PRESIDENT

DATE

ALLEN PAVELKA, P.E. #9029  
CITY ENGINEER

DATE

APPROVAL OF THESE PLANS IS LIMITED TO STOCKPILING ONLY

CITY OF LAS VEGAS PLANNING DEVELOPMENT

DATE

NOTE:  
THIS PLAN CONFORMS TO THE APPLICABLE STANDARDS OF THE PLANNING DEPARTMENT.

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 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: 400,000.00 M (1,312,333.3333 FTUS)

EASTING AT CENTRAL MERIDIAN: 300,000 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: D368 (REVISED 2008)

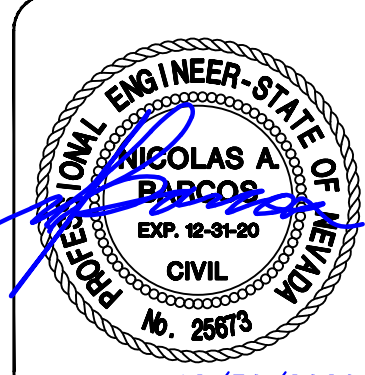
NAVD88 ELEVATION: 989.574 METERS (3,246.63 FEET)

FND USC&GS DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD. & WEST OF DETENTION BASIN.

T21S,R59E,S03

LEGAL DESCRIPTION

BEING A PORTION OF LOT 1 AS SHOWN ON THE MAP THEREOF IN BOOK 125 OF PLATS, PAGE 15, OFFICIAL RECORDS, CITY OF LAS VEGAS CLARK COUNTY, NEVADA



REVISIONS

| REV. | DESCRIPTION | BY | DATE | APPROVAL |
|------|-------------|----|------|----------|
|      |             |    |      |          |
|      |             |    |      |          |
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|      |             |    |      |          |

**ATKINS**  
2270 Corporate Circle Suite 200  
Henderson, Nevada 89074  
Telephone: +17022637275  
Fax: +17022637200

SUMMERLIN®

SUMMERLIN WEST VILLAGE 25  
HIGH SCHOOL STAGING STOCKPILE

COVER SHEET

DESIGNED BY: J. TORRELLA  
DRAWN BY: G. BALAJADA  
CHECKED BY: CN BARCOS  
DATE: DECEMBER, 2020  
DRAWING NO.:  
VERT.: NONE  
1 / 10  
JOB NO. 100072736







CITY OF LAS VEGAS GENERAL NOTES

1. ALL CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION OFFSITE IMPROVEMENTS, CLARK COUNTY AREA NEVADA", LATEST ISSUE; THE "UNIFORM STANDARD DRAWINGS FOR PUBLIC WORKS CONSTRUCTION, CLARK COUNTY AREA NEVADA", LATEST REVISED EDITION; THE "SUMMERLIN IMPROVEMENT STANDARDS" FOR WORK IN THE SUMMERLIN AREA; AND OTHER APPLICABLE APPROVED STANDARDS ISSUED BY THE CONTROLLING AGENCY; THE UNIFORM BUILDING CODE; AND ALL LOCAL CITY CODES AND ORDINANCES APPLICABLE, EXCEPT AS NOTED ON THIS SHEET AS "DEVIATIONS FROM STANDARDS".
2. THE EXISTENCE AND LOCATION OF ANY OVERHEAD OR UNDERGROUND UTILITY LINES, PIPES, OR STRUCTURES SHOWN ON THESE PLANS ARE OBTAINED BY A RESEARCH OF THE AVAILABLE RECORDS. EXISTING UTILITIES AS SHOWN FROM CLV PLANS LIBRARY ARE APPROXIMATE AND FOR RECORD PURPOSES. EXISTING UTILITIES ARE LOCATED ON PLANS ONLY FOR THE CONVENIENCE OF THE CONTRACTOR. EXISTING UTILITY SERVICE LATERALS MAY NOT BE SHOWN ON THE THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, LOCATE ALL UNDERGROUND AND OVERHEAD INTERFERENCE'S WHICH MAY AFFECT HIS OPERATION DURING CONSTRUCTION AND SHALL TAKE ALL NECESSARY PRECAUTIONS TO AVOID DAMAGE TO SAME. THE CONTRACTOR SHALL USE EXTREME CAUTION WHEN WORKING NEAR OVERHEAD UTILITIES SO AS TO SAFELY PROTECT ALL PERSONNEL AND EQUIPMENT, AND SHALL BE RESPONSIBLE FOR ALL COST AND LIABILITY IN CONNECTION THEREWITH.
3. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT EXISTING UTILITY LINES, STRUCTURES AND STREET IMPROVEMENTS WHICH ARE TO REMAIN IN PLACE, FROM DAMAGE, AND ALL SUCH IMPROVEMENTS OR STRUCTURES DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE REPAIRED OR REPLACED SATISFACTORY TO THE CITY ENGINEER AND OWNING UTILITY COMPANY AT THE EXPENSE OF THE CONTRACTOR.
4. ALL CONSTRUCTION SHALL BE AS SHOWN ON THESE PLANS, ANY REVISIONS SHALL HAVE THE PRIOR WRITTEN APPROVAL OF THE CITY ENGINEER.
5. TYPE V CEMENT SHALL BE USED IN ALL OFF-SITE CONCRETE WORK. CONCRETE TO BE 3000 P.S.I. MINIMUM @ 28 DAYS. MIX DESIGNS TO BE APPROVED BY THE CITY, PRIOR TO THE USE ON THE PROJECT.
6. PERMITS ARE REQUIRED FOR ANY WORK IN THE PUBLIC RIGHT-OF-WAY. THE CONTRACTOR SHALL SECURE ALL PERMITS AND INSPECTIONS REQUIRED FOR THIS CONSTRUCTION.
7. EXPANSION JOINTS REQUIRED, MAXIMUM EVERY 300' IN EXTRUDED-TYPE CURB.
8. AC PAVEMENT TO BE ONE-HALF" INCH (1/2") ABOVE LIP OF ALL GUTTERS AFTER COMPACTION, EXCEPT AT SIDEWALK RAMPS AND CROSS GUTTERS.
9. CURB AND GUTTER FOUND TO BE UNACCEPTABLE TO THE CITY OF LAS VEGAS SHALL BE REMOVED AND REPLACED PER STANDARD DRAWING 218.
10. SIDEWALK RAMPS SHALL BE CONSTRUCTED IN EACH QUADRANT OF AN INTERSECTION PER STANDARD DRAWING 235. EXACT LOCATION OF RAMPS MAY BE ADJUSTED IN THE FIELD BY A CITY INSPECTOR.
11. CONTRACTOR SHALL PROVIDE ALL NECESSARY HORIZONTAL AND VERTICAL TRANSITIONS BETWEEN NEW CONSTRUCTION AND EXISTING SURFACES TO PROVIDE FOR PROPER DRAINAGE AND FOR INGRESS AND EGRESS TO NEW CONSTRUCTION. THE EXTENT OF THE TRANSITIONS TO BE AS SHOWN ON PLANS.
12. ALL GRADING WORK SHALL CONFORM TO THE SOILS REPORT AS PREPARED BY THE (COMPANY, REPORT #, DATE ) APPROVED BY THE CITY ENGINEER, AND AS SHOWN ON THESE PLANS.
13. EXACT LOCATION OF ALL SAWCUT LINES MAY BE ADJUSTED OR DETERMINED IN THE FIELD BY A CITY OF LAS VEGAS ENGINEER IF LOCATION ON PLANS IS NOT CLEARLY SHOWN, OR EXISTING PAVEMENT CONDITION REQUIRES RELOCATIONS.
14. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONS NECESSARY TO PROTECT EXISTING PERMANENT SURVEY MONUMENTS. ANY MONUMENTS DISTURBED SHALL BE REPLACED AND ADJUSTED PER AVAILABLE RECORDS IN ACCORDANCE WITH STATUTE NO. 625.350 & CITY OF LAS VEGAS TITLE 18, APPENDIX D.
15. UTILITY COMPANY METER BOXES, MANHOLE LIDS, VALVE COVERS, ETC., SHALL BE LOCATED OUT OF DRIVEWAYS, DRIVEWAY APRONS, FLOWLINES, AND CROSS GUTTERS UNLESS WRITTEN APPROVAL IS GRANTED BY THE UTILITY COMPANY AND THE CITY ENGINEER.

WALL NOTES:

16. ALL WALLS, NEW OR EXISTING, ARE ONLY SHOWN ON CIVIL PLANS FOR THE PURPOSE OF REVIEWING GRADING RELATIONSHIPS; FLOOD CONTROL AND SIGHT DISTANCE AT INTERSECTIONS. NEW WALLS REQUIRE A SEPARATE PERMIT AND INSPECTION BY THE BUILDING DEPARTMENT.
17. ASPHALT MIX DESIGN MUST BE SUBMITTED AND APPROVED BY THE CITY ENGINEER PRIOR TO THE PLACEMENT OF ASPHALT WITHIN CITY RIGHT OF WAY.
18. CONTRACTOR SHALL ADJUST ALL NEW AND EXISTING INLETS, VALVE BOXES, MANHOLE RIMS, AND SEWER CLEAN OUTS, ETC., TO FINISH GRADE AS APPLICABLE WHETHER OR NOT THEY ARE SHOWN ON THE PLANS.
19. MATERIALS, HANDLING AND PLACEMENT OF PORTLAND CEMENT CONCRETE SHALL BE IN ACCORDANCE WITH APPLICABLE SECTIONS OF MDOT OR THE CLARK COUNTY AREA SPECIFICATIONS (AS APPLICABLE) AND THE PLANS AND DETAILS SHOWN HEREON.
20. WHEN INSTALLING UNDERGROUND FACILITIES THAT REQUIRE UNDERGROUND LOCATING DEVICES SUCH AS MARKER BALLS, LOCATING RIBBON, ETC., THE CONTRACTOR SHALL PROVIDE WRITTEN DOCUMENTATION TO OFFSITE INSPECTION AND TESTING CERTIFYING THAT ALL DEVICES HAVE BEEN PLACED AND VERIFIED TO BE IN GOOD WORKING CONDITION PRIOR TO THE CONSTRUCTION OF ANY ROAD BASE.
21. SANITARY SEWER AND STORM DRAIN FINAL LOCATION MAP(S) SHALL BE PROVIDED TO THE CITY AND APPROVED PRIOR TO ACCEPTANCE OF FACILITY VIDEO INSPECTION. THE MAP(S) SHALL INCLUDE THE HORIZONTAL AND VERTICAL (INVERT) LOCATION OF PUBLIC SEWER MANHOLES, STORM DRAIN MANHOLES AND TRANSITION STRUCTURES, STORM DRAIN LATERALS AT THE CONNECTION TO THE STORM DRAIN MAIN AND AT THE CONNECTION TO A DROP INLET, THE CONNECTION OF SEWER SERVICE LATERALS TO THE SEWER MAIN AND WHERE THE SEWER SERVICE LATERALS EXIT THE PUBLIC RIGHT-OF-WAY, FOR SEWER AND STORM DRAIN MAIN ALIGNMENT, INCLUDING DEFLECTION POINTS. THE LOCATION SHALL BE DESCRIBED BY COORDINATES WHICH SHALL BE BASED ON THE OFFICIAL HORIZONTAL AND VERTICAL CONTROL NETWORKS OF THE CITY OF LAS VEGAS. FINAL LOCATION MAPS MUST BE SEALED AND CERTIFIED BY A NEVADA PROFESSIONAL LAND SURVEYOR TO HAVE POSITIONAL CERTAINITIES OF ± 0.09 METERS (± 0.3 FEET) HORIZONTALLY AND VERTICALLY. A SEPARATE ELECTRONIC COMMA DELIMITED FILE FOR THE SANITARY SEWER AND STORM DRAIN COORDINATES SHALL ALSO ACCOMPANY THE SANITARY SEWER AND STORM DRAIN FINAL LOCATION MAP(S).
22. CCTV VIDEO INSPECTION IS REQUIRED FOR ALL SEWER AND STORM DRAINS. THE CCTV VIDEO INSPECTIONS NEED TO BE PERFORMED PER THE DESIGN AND CONSTRUCTION STANDARDS FOR WASTEWATER COLLECTION SYSTEMS LATEST EDITION.
23. A SEPARATE BORING PERMIT IS REQUIRED FOR ALL BORING ACTIVITIES.

REVISED 06/04/2018

CITY OF LAS VEGAS GRADING NOTES

1. IN THE EVENT THAT ANY UNFORESEEN CONDITIONS NOT COVERED BY THESE NOTES ARE ENCOUNTERED DURING GRADING OPERATIONS, THE OWNER/ENGINEER SHALL BE IMMEDIATELY NOTIFIED FOR DIRECTION.
2. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO PERFORM ALL NECESSARY CUTS AND FILLS WITHIN THE LIMITS OF THIS PROJECT AND THE RELATED OFF-SITE WORK, SO AS TO GENERATE THE DESIRED SUBGRADE, FINISH GRADES AND SLOPES SHOWN.
3. CONTRACTOR SHALL TAKE FULL RESPONSIBILITY FOR ALL EXCAVATION. ADEQUATE SHORING SHALL BE DESIGNED AND PROVIDED BY THE CONTRACTOR TO PREVENT UNDERMINING OF ANY ADJACENT FEATURES OR FACILITIES AND/OR CAVING OF THE EXCAVATION.
4. THE CONTRACTOR IS WARNED THAT AN EARTHWORK BALANCE WAS NOT NECESSARILY THE INTENT OF THIS PROJECT. ANY ADDITIONAL MATERIAL REQUIRED OR LEFTOVER MATERIAL FOLLOWING EARTHWORK OPERATIONS BECOMES THE RESPONSIBILITY OF THE CONTRACTOR.
5. THE GRADING CONTRACTOR IS RESPONSIBLE TO COORDINATE WITH THE OWNER TO PROVIDE FOR THE REQUIREMENTS OF THE PROJECT STORM WATER POLLUTION PREVENTION PLAN (SWPPP) AND ASSOCIATED PERMIT.
6. CONTRACTOR SHALL GRADE TO THE LINES AND ELEVATIONS SHOWN ON THE PLANS WITHIN THE FOLLOWING HORIZONTAL AND VERTICAL TOLERANCES AND DEGREES OF COMPACTION, IN THE AREAS INDICATED:
- |                           | HORIZONTAL | VERTICAL       | COMPACTION       |
|---------------------------|------------|----------------|------------------|
| A. PAVEMENT AREA SUBGRADE | 0.1'+      | +0.0' TO -0.1' | SEE SOILS REPORT |
| B. ENGINEERED FILL        | 0.5'+      | +0.1' TO -0.1' | SEE SOILS REPORT |
- COMPACTION TESTING WILL BE PERFORMED BY THE OWNER OR HIS REPRESENTATIVE.
7. ALL CUT AND FILL SLOPES SHALL BE PROTECTED UNTIL EFFECTIVE EROSION CONTROL HAS BEEN ESTABLISHED.
8. THE USE OF POTABLE WATER WITHOUT A SPECIAL PERMIT FOR BUILDING OR CONSTRUCTION PURPOSES INCLUDING CONSOLIDATION OF BACKFILL OR DUST CONTROL IS PROHIBITED. THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS FOR CONSTRUCTION WATER.
9. THE CONTRACTOR SHALL MAINTAIN THE STREETS, SIDEWALKS AND ALL OTHER PUBLIC RIGHT-OF-WAY IN A CLEAN, SAFE AND USABLE CONDITION OF SOIL, SHALL'S OF SOIL, ROCK OR CONSTRUCTION DEBRIS SHALL BE PROMPTLY REMOVED FROM THE PUBLICLY OWNED PROPERTY DURING CONSTRUCTION AND UPON COMPLETION OF THE PROJECT. ALL ADJACENT PROPERTY, PRIVATE OR PUBLIC SHALL BE MAINTAINED IN A CLEAN, SAFE AND USABLE CONDITION.
10. IN THE EVENT THAT ANY TEMPORARY CONSTRUCTION ITEM IS REQUIRED THAT IS NOT SHOWN ON THESE DRAWINGS, THE OWNER AGREES TO PROVIDE AND INSTALL SUCH ITEM AT HIS OWN EXPENSE AND AT THE DIRECTION OF THE CITY ENGINEER. TEMPORARY CONSTRUCTION INCLUDES DITCHES, BERMS, ROAD SIGNS AND BARRICADES, ETC.
11. STOCKPILE MATERIALS SHALL CONSIST OF CLEAN EARTH FILL UNLESS OTHERWISE APPROVED BY THE CITY OF LAS VEGAS
12. STOCKPILES WITH HEIGHT OVER 4 FT MUST BE PROVIDED WITH TEMPORARY FENCING
13. THE CITY WILL NOT ISSUE A STOCK PILE PERMIT PRIOR TO THE DUST MITIGATION PLAN APPROVED BY THE CLARK COUNTY. STOCKPILE TO COMPLY WITH APPROVED CLARK COUNTY DUST MITIGATION PLAN #46575

GENERAL NOTES

1. THE CONTRACTOR SHALL NOTIFY ALL AFFECTED PUBLIC ENTITIES, THE PROJECT ENGINEER AND CLARK COUNTY AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF WORK.
2. ALL CONSTRUCTION SHALL BE AS SHOWN ON THESE CONTRACT DRAWINGS. ANY REVISIONS SHALL HAVE THE PRIOR WRITTEN APPROVAL OF THE PROJECT ENGINEER.
3. ALL CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA NEVADA", LATEST ISSUE; THE "UNIFORM STANDARD DRAWINGS FOR PUBLIC WORKS CONSTRUCTION, CLARK COUNTY AREA NEVADA", LATEST ISSUE; AND OTHER APPLICABLE APPROVED STANDARDS ISSUED BY THE CONTROLLING AGENCY; THE UNIFORM BUILDING CODE; AND ALL LOCAL CITY CODES AND ORDINANCES APPLICABLE.
4. LOCATIONS OF UNDERGROUND UTILITIES SHOWN ON THE DRAWINGS WERE OBTAINED FROM INFORMATION RECEIVED FROM THE APPLICABLE UTILITY COMPANIES. NEITHER THE OWNER NOR ENGINEER ASSUMES ANY RESPONSIBILITY FOR UTILITIES OR STRUCTURES NOT SHOWN, OR NOT IN THE LOCATION SHOWN ON THE DRAWINGS. CONTRACTOR TO VERIFY EXACT LOCATION OF UTILITIES PRIOR TO START OF CONSTRUCTION. THE CONTRACTOR'S RESPONSIBILITY REGARDING UTILITIES SHALL BE AS REQUIRED UNDER SECTION 107.17 OF THE "UNIFORM STANDARD SPECIFICATIONS FOR CLARK COUNTY AREA, NEVADA" AND AS PROVIDED IN THE SPECIFICATIONS.
5. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES TO PROTECT EXISTING UTILITY LINES, STRUCTURES, AND STREET IMPROVEMENTS WHICH ARE TO REMAIN IN PLACE, FROM DAMAGE. ALL SUCH IMPROVEMENTS OR STRUCTURES DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE REPAIRED OR REPLACED TO THE SATISFACTION OF THE COUNTY ENGINEER OR OWNING UTILITY COMPANY AT THE EXPENSE OF THE CONTRACTOR.
6. THE CONTRACTOR SHALL NOT REMOVE TREES, SHRUBS, LAWNS, WALLS, FENCES, SIGNS, STRUCTURES, LIGHTS, OR ANY OTHER EXISTING IMPROVEMENTS OUTSIDE OF STREET RIGHT-OF-WAY, EXCEPT WHERE REQUIRED TO DO SO BY THE CONTRACT DRAWINGS OR THE PROJECT ENGINEER. REPLACEMENT, RELOCATION OR RECONSTRUCTION OF ALL EXISTING IMPROVEMENTS INCLUDING SPRINKLER SYSTEMS, LAWNS, FENCES, WALLS, SIGNS, STEPS, SIDEWALKS, DRIVEWAYS, LAWN LIGHTS, AND ALL OTHER ITEMS APPLICABLE TO THIS CONTRACT SHALL BE REQUIRED BY THE PROJECT ENGINEER.
7. THE CONTRACTOR SHALL BACKFILL AND FINE GRADE ALL CUT OR FILL SLOPES TO MATCH EXISTING CONDITIONS TO THE SATISFACTION OF THE PROJECT ENGINEER, WHERE EXISTING LAWNS ARE DAMAGED BY THE CONTRACTOR'S OPERATIONS THE CONTRACTOR WILL SOD THE AFFECTED AREA TO A CONDITION EQUAL TO OR BETTER THAN THAT WHICH EXISTED PRIOR TO CONSTRUCTION.
8. THE CONTRACTOR SHALL PROVIDE ALL NECESSARY HORIZONTAL AND VERTICAL TRANSITIONS BETWEEN NEW CONSTRUCTION AND EXISTING SURFACES TO PROVIDE FOR PROPER DRAINAGE AND FOR INGRESS AND EGRESS TO NEW CONSTRUCTION. THE EXTENT OF TRANSITIONS TO BE AS SHOWN PER CONTRACT DRAWINGS.
9. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONS NECESSARY TO PROTECT EXISTING PERMANENT SURVEY MONUMENTS. ANY MONUMENTS DISTURBED SHALL BE REPLACED AND ADJUSTED PER AVAILABLE RECORDS IN ACCORDANCE WITH N.R.S. STATUTE NO. 625.550.
10. THE ACTUAL LOCATIONS OF SAW CUT LINES, LIMITS OF COLD MILLING, LIMITS OF DRIVEWAY TRANSITIONS, AND LANDSCAPE REPAIR SHALL BE DETERMINED IN THE FIELD BY THE RESIDENT PROJECT REPRESENTATIVE.
11. THE ACTUAL LIMITS OF EXISTING OPEN GRADE REMOVAL AND UDACS APPLICATION SHALL BE DETERMINED IN THE FIELD BY THE RESIDENT PROJECT REPRESENTATIVE.
12. ALL STANDARD DRAWINGS REFERENCED IN THIS SET ARE BASED ON THE CURRENT "UNIFORM STANDARD DRAWINGS REVISION SET II-1997 RELEASE".
13. UNLESS OTHERWISE SHOWN ON THE CONTRACT DRAWINGS, THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL OR RELOCATION OF ALL WATER SERVICES AND METERS WHICH INTERFERE WITH IMPROVEMENTS SHOWN ON THE CONTRACT DRAWINGS.
14. THE CONTRACTOR SHALL MAINTAIN AN ONGOING REMOVAL PROCESS OF ALL SPILLAGE OF EXCAVATION MATERIAL ON ALL PAVED STREETS.
15. CURB AND GUTTER OF A GRADE OF LESS THAN 4/10 OF ONE PERCENT SHALL BE CONSTRUCTED BY FORMING. EACH JOINT SHALL BE CHECKED FOR GRADE PRIOR TO CONSTRUCTION AND WATER TESTED AS SOON AS POSSIBLE AFTER CONSTRUCTION.
16. THE CONTRACTOR SHALL VERIFY IN THE FIELD ALL DIMENSIONS, EXISTING CONDITIONS AND POINTS OF CONNECTION WITH ADJOINING PROPERTY (PUBLIC AND PRIVATE). ANY DISCREPANCIES SHALL BE CALLED TO THE ATTENTION OF THE PROJECT ENGINEER PRIOR TO PROCEEDING WITH THE WORK.
17. REMOVAL OR RELOCATION OF POWER POLES, TELEPHONE POLES, JOINTLY-OWNED POLES, AND APPURTENANCES WHICH INTERFERE WITH IMPROVEMENTS REQUIRED TO BE CONSTRUCTED UNDER THIS CONTRACT, SHALL BE THE RESPONSIBILITY OF THE RESPECTIVE UTILITY COMPANY. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATION WITH THE UTILITY COMPANIES FAR ENOUGH IN ADVANCE SO AS TO NOT IMPACT THE SCHEDULE.
18. COX COMMUNICATIONS SHALL BE RESPONSIBLE FOR THE VERTICAL OR HORIZONTAL ADJUSTMENT OF ALL CATV FACILITIES WHICH INTERFERE WITH IMPROVEMENTS SHOWN ON THE CONTRACT DRAWINGS, UNLESS NOTED OTHERWISE.
19. NV ENERGY SHALL BE RESPONSIBLE FOR THE RELOCATION OF UNDERGROUND OR OVERHEAD POWER LINES THAT INTERFERE WITH THE REQUIRED IMPROVEMENTS AS SHOWN ON THE CONTRACT DRAWINGS.
20. EMBARK SHALL BE RESPONSIBLE FOR THE VERTICAL OR HORIZONTAL ADJUSTMENT OF ALL TELEPHONE FACILITIES WHICH INTERFERE WITH IMPROVEMENTS SHOWN ON CONTRACT DRAWINGS, UNLESS NOTED OTHERWISE.

LAS VEGAS VALLEY CONSTRUCTION SITE BMP GUIDELINES

1. THE OWNER, SITE DEVELOPER, CONTRACTOR, AND/OR THEIR AUTHORIZED AGENTS SHALL EACH DAY REMOVE ALL SEDIMENT, MUD, CONSTRUCTION DEBRIS, OR OTHER POTENTIAL POLLUTANTS THAT MAY HAVE BEEN DISCHARGED TO, OR ACCUMULATED IN, THE PUBLIC RIGHTS OF WAY OF CLARK COUNTY AS A RESULT OF CONSTRUCTION ACTIVITIES ASSOCIATED WITH THIS SITE DEVELOPMENT OR CONSTRUCTION PROJECT. SUCH MATERIALS SHALL BE PREVENTED FROM ENTERING THE STORM SEWER SYSTEM.
2. ADDITIONAL CONSTRUCTION SITE DISCHARGE BEST MANAGEMENT PRACTICES MAY BE REQUIRED OF THE OWNER AND HIS OR HER AGENTS DUE TO UNFORESEEN EROSION PROBLEMS OR IF THE SUBMITTED PLAN DOES NOT MEET THE PERFORMANCE STANDARDS SPECIFIED IN CLARK COUNTY TITLE 24.40 AND IN THE LAS VEGAS VALLEY CONSTRUCTION SITE BMP GUIDANCE MANUAL.
3. TEMPORARY OR PERMANENT STABILIZATION PRACTICES WILL BE INSTALLED ON DISTURBED AREAS AS SOON AS PRACTICABLE AND NO LATER THAN 14 DAYS AFTER THE CONSTRUCTION ACTIVITY IN THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED. SOME EXCEPTIONS MAY APPLY. REFER TO THE NEVADA STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NVR100000, SECTION III.A.5.
4. AT A MINIMUM, THE CONTRACTOR OR HIS AGENT SHALL INSPECT ALL DISTURBED AREAS, AREAS USED FOR STORAGE OF MATERIALS AND EQUIPMENT THAT ARE EXPOSED TO PRECIPITATION, VEHICLE ENTRANCE AND EXIT LOCATIONS, AND ALL BMPs WEEKLY, AND WITHIN 24 HOURS AFTER ANY RAIN EVENT OF 0.5 INCHES OR MORE. THE CONTRACTOR OR HIS AGENT SHALL UPDATE OR MODIFY THE STORMWATER POLLUTION PREVENTION PLAN AS NECESSARY. SOME EXCEPTIONS TO WEEKLY INSPECTIONS MAY APPLY. SUCH AS SUSPENSION OF LAND DISTURBANCE ACTIVITIES. REFER TO THE NEVADA STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NVR100000, SECTION III.A.12.
5. ACCUMULATED SEDIMENT IN BMPs SHALL BE REMOVED WITHIN SEVEN DAYS AFTER A STORMWATER RUNOFF EVENT OR PRIOR TO THE NEXT ANTICIPATED STORM EVENT, WHICHEVER IS EARLIER. SEDIMENT MUST BE REMOVED WHEN BMP DESIGN CAPACITY HAS BEEN REDUCED BY 50 PERCENT OR MORE.

GRADING NOTES

1. INDICATED GRADES OTHER THAN TC, FG & GUTTER FL ARE ROUGH GRADES.
2. THE ROUGH GRADING PLANS SHALL BE ON THE JOB SITE AT ALL TIMES. THE ROUGH GRADING SHALL BE FINISHED IN CONFORMANCE WITH THE LINES AND GRADES SHOWN ON THE PLANS. THE GRADING QUANTITIES ARE BASED ON THE ELEVATION AND DETAILS SHOWN ON THE PLANS. ANY DEVIATIONS FROM THE PLAN WILL RESULT IN QUANTITY CHANGES.
3. SOILS REPORT PREPARED BY: NOVA GEOTECHNICAL & INSPECTION SERVICES 4480 W. HACIENDA AVENUE, SUITE 104, LAS VEGAS, NV 89118, PHONE: 702-873-3478, PROJECT NO. : G-19-026, DATED: JUNE 18, 2020.
4. EARTHWORK QUANTITIES (RAW):
- CUT = 4,600 CUBIC YARDS
  - FILL = 439,600 CUBIC YARDS
  - NET FILL = 435,000 CUBIC YARDS
- A. THE ABOVE QUANTITIES DO NOT REFLECT LOSSES DUE TO SUBSIDENCE OR SHRINKAGE.
- B. THE ABOVE QUANTITIES DO REFLECT USING NATIVE MATERIAL IN LIEU OF TYPE 1 GRAVEL BASE MATERIAL FOR STREET SECTIONS.
- C. THE ABOVE QUANTITIES DO NOT REFLECT ANY EARTHWORK WHICH MAY BE REQUIRED BY THE ENGINEER TO CONSTRUCT ADDITIONAL PROTECTIVE DITCHES OR BERMS NOT SHOWN ON THESE DRAWINGS.

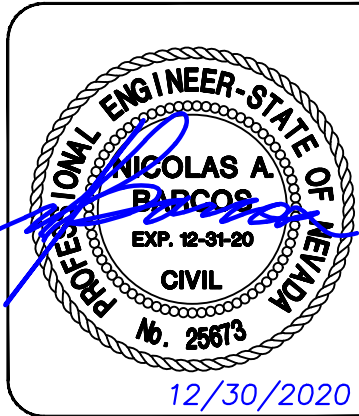
TEMPORARY STORAGE NOTE

1. MAXIMUM ALLOWED TIME FOR STORAGE IS TWELVE (12) MONTHS.

PLAN CONCURRENCE NOTE

THE FOLLOWING EXISTING & FUTURE VILLAGE 25/VILLAGE 27 ROADWAY IMPROVEMENTS PLANS ARE TO BE USED FOR THE CONSTRUCTION OF THIS STOCKPILE.

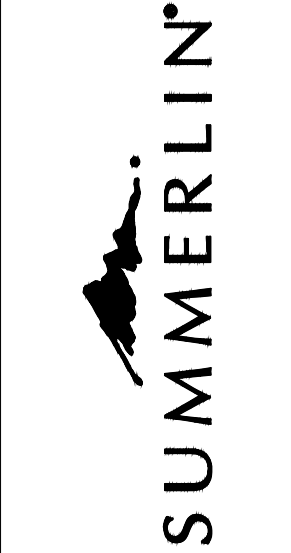
1. SCURRY BEND DRIVE: SUNSET RUN DRIVE TO LAKE MEAD BOULEVARD.
2. SUNSET RUN DRIVE: SCURRY BEND DRIVE TO LAKE MEAD BOULEVARD.
3. LAKE MEAD BOULEVARD: SCURRY BEND DRIVE TO SUNSET RUN DRIVE.



|                             |                          |                      |
|-----------------------------|--------------------------|----------------------|
| DESIGNED BY:<br>J. TORRELLA | DATE:<br>DECEMBER, 2020  | DRAWING NO.<br>3 /10 |
| DRAWN BY:<br>G. BALAJADIA   | CHECKED BY:<br>M. CARLOS | VERT.:               |
| JOB NO. 100072736           |                          |                      |

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**ATKINS**  
2270 Corporate Circle Suite 200  
Henderson, Nevada 89074  
Telephone: +1 702 263 7275  
Fax: +1 702 263 7200



SUMMERLIN WEST VILLAGE 25  
HIGH SCHOOL STAGING STOCKPILE  
GENERAL NOTES



HOWARD HUGHES COMPANY, LLC  
LOT 4 OF PARCEL MAP 126, PAGE 16

HOWARD HUGHES COMPANY, LLC  
LOT 4 OF PARCEL MAP 126, PAGE 16

FUTURE LAKE MEAD  
BOULEVARD  
(PUBLIC)

FUTURE SUNSET RUN  
DRIVE  
(PUBLIC)  
(ROUGH GRADE PER  
L20-01355)

HOWARD HUGHES COMPANY, LLC  
LOT 1 OF PARCEL MAP 125, PAGE 15

HOWARD HUGHES COMPANY, LLC  
LOT 1 OF PARCEL MAP 125, PAGE 15

STOCKPILE 1  
NET FILL: 120,400 CY  
CUT: 800 CY  
FILL: 121,200 CY

SHEET 5

STOCKPILE 2  
NET FILL: 176,100 CY  
CUT: 2,900 CY  
FILL: 179,000 CY

SHEET 6

STOCKPILE 3  
NET FILL: 138,500 CY  
CUT: 900 CY  
FILL: 139,400 CY

SHEET 7

HOWARD HUGHES COMPANY, LLC  
LOT 1 - SUMMERLIN WEST VILLAGE 22 - UNIT 1

HOWARD HUGHES COMPANY, LLC  
LOT 1 - SUMMERLIN WEST VILLAGE 22 - UNIT 1

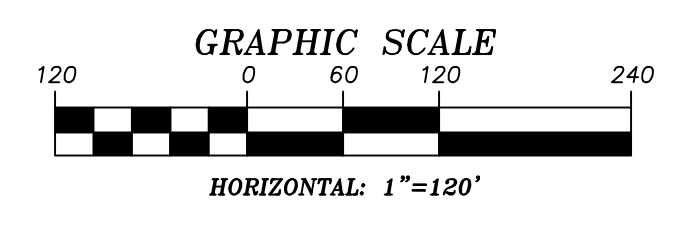
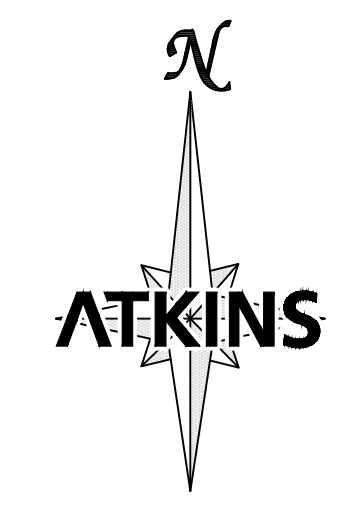
FUTURE FLEET  
WING AVENUE  
(PUBLIC)

FUTURE SCURRY BEND  
DRIVE  
(PUBLIC)  
(ROUGH GRADE PER  
L20-01986)

HOWARD HUGHES COMPANY, LLC  
LOT 1 - SUMMERLIN WEST VILLAGE 22 - UNIT 1

HOWARD HUGHES COMPANY, LLC  
LOT 1 - SUMMERLIN WEST VILLAGE 22 - UNIT 1

FUTURE FLIGHT  
RANGE AVENUE  
(PUBLIC)



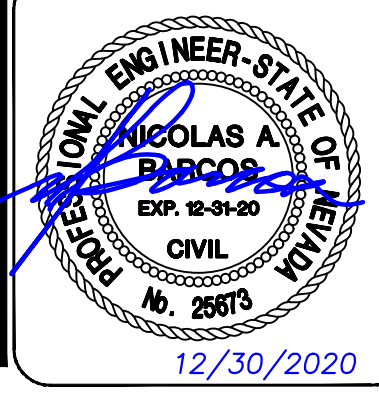
| GRADING PLAN CERTIFICATION                                                                                                                         |          |      |
|----------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|
| NICOLAS BARCOS                                                                                                                                     | PE#25673 | DATE |
| CERTIFY THAT THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY FOR THIS SITE ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT. |          |      |
| DS#----                                                                                                                                            |          |      |

| BASIS OF BEARING                                                                                                                                                                                                                         | BENCHMARK                                                                                                                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 COINCIDENT WITH 114°58' WEST OF THE GREENWICH MERIDIAN. | CITY OF LAS VEGAS BENCHMARK: D368 (REVISED 2008)<br>NAVD88 ELEVATION: 989.574 METERS (3,246.63 FEET)<br>FND USC&GS DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD. & WEST OF DETENTION BASIN.<br>T215.R59E.S03 |

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TOLL FREE 1-800-642-2444

Call before you dig  
811  
1-702-227-2929

UTILITY LOCATIONS SHOWN HEREON ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO DETERMINE THE EXACT VERTICAL AND HORIZONTAL LOCATION OF ALL EXISTING UNDERGROUND 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.



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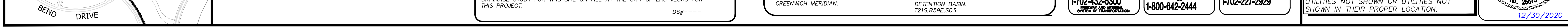
2270 Corporate Circle Suite 200  
Henderson, Nevada 89074  
Telephone: +1-702-263-7275  
Fax: +1-702-263-7200

| SUMMERLIN WEST VILLAGE 25<br>HIGH SCHOOL STAGING STOCKPILE |                      |
|------------------------------------------------------------|----------------------|
| DESIGNED BY:<br>J. TORRELLA                                | MASTER DRAINAGE PLAN |
| DRAWN BY:<br>G. BALAJADA                                   |                      |
| CHECKED BY:<br>NICOLAS BARCOS                              |                      |
| DATE:<br>DECEMBER, 2020                                    |                      |
| DRAWING NO.<br>4/10                                        |                      |

12/30/2020

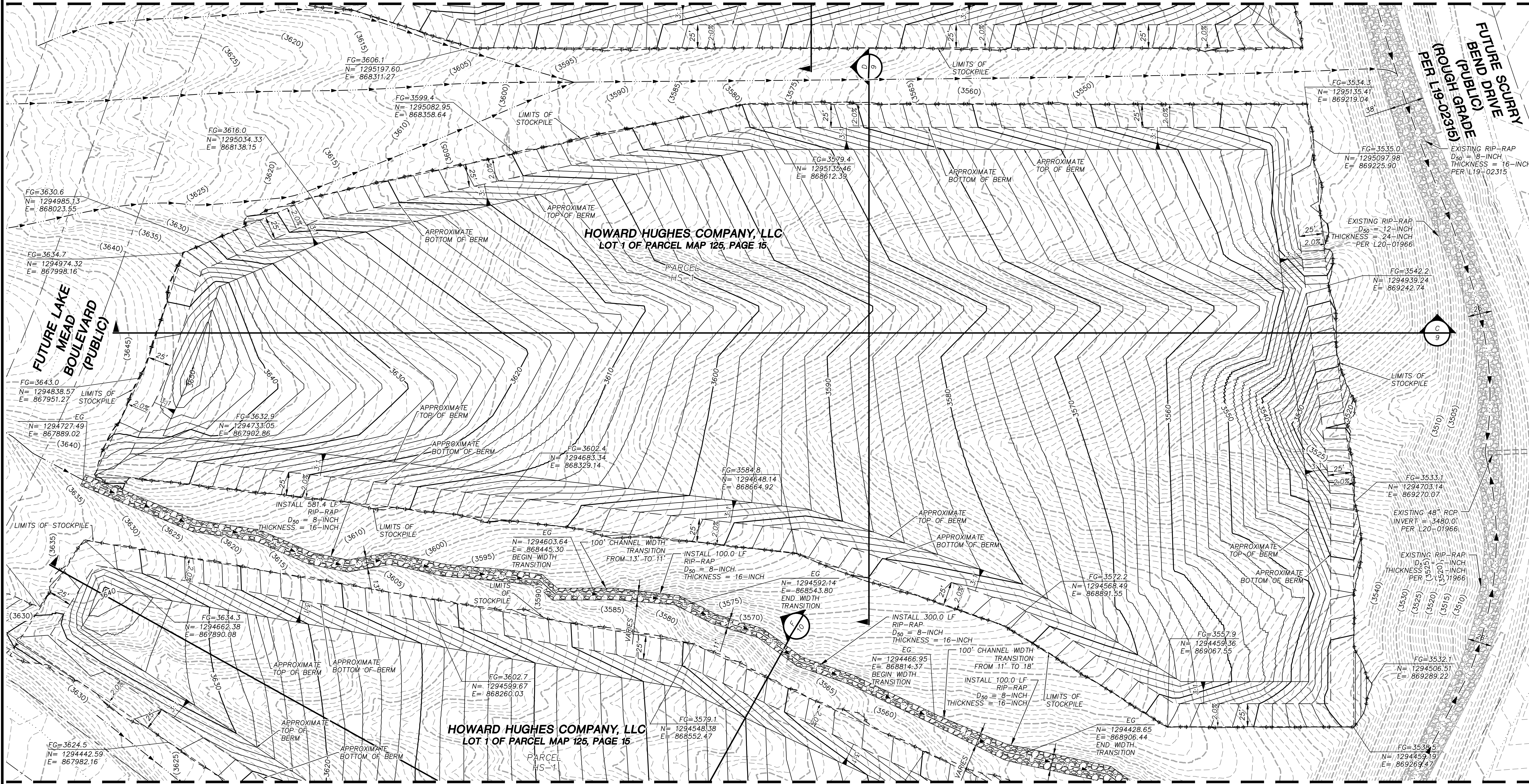
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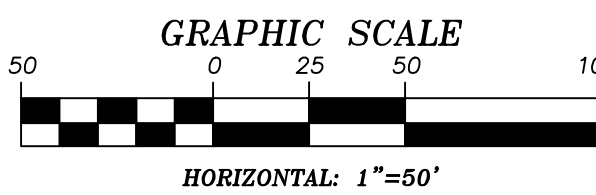
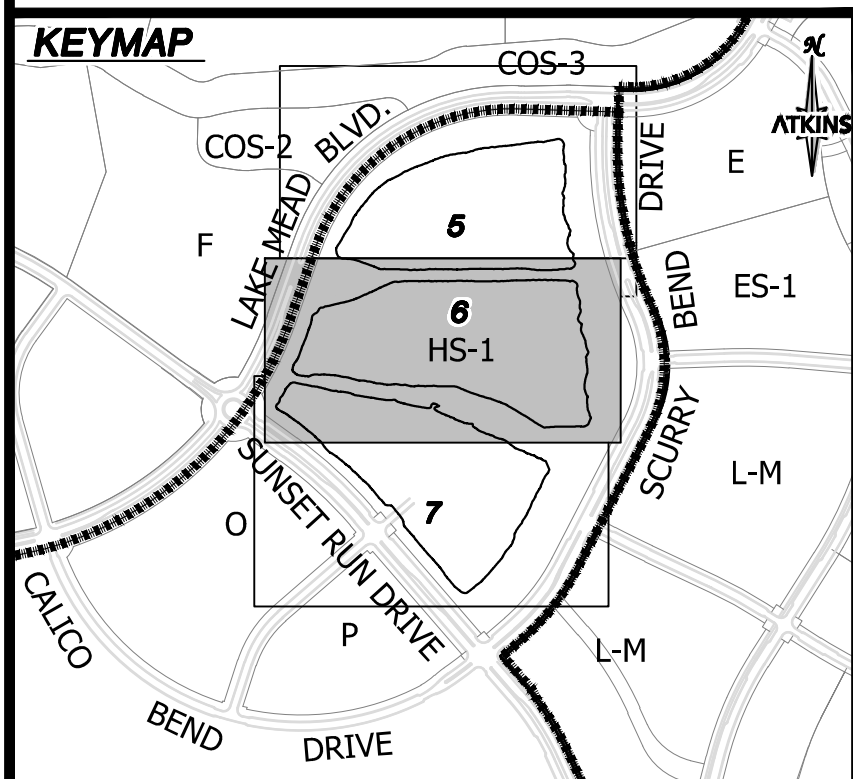
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SEE SHEET 5 FOR CONTINUATION



SEE SHEET 7 FOR CONTINUATION



GRADING PLAN CERTIFICATION

NICOLAS BARCOS PE#25673 DATE

CERTIFY THAT THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY FOR THIS SITE ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

DS#----

BASIS OF BEARING

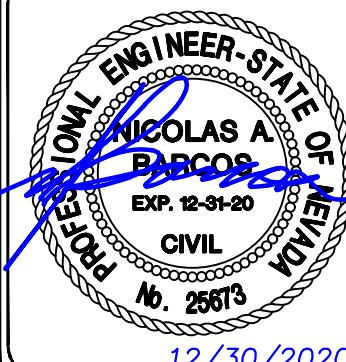
GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM (NCRS), LAS VEGAS HIGH ELEVATION ZONE, NORTH AMERICAN DATUM OF 1983; SAID MERIDIAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWICH MERIDIAN.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK: D368 (REVISED 2008) NAVD88 ELEVATION: 989.574 METERS (3,246.63 FEET) FND USC&GS DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD. & WEST OF DETENTION BASIN. 1215.R59E.S03



UTILITY LOCATIONS SHOWN HEREON ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO DETERMINE THE EXACT VERTICAL AND HORIZONTAL LOCATION OF ALL EXISTING UNDERGROUND 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.



DESIGNED BY: J. TORRELLA  
DRAWN BY: G. BALAJADA  
CHECKED BY: G. BALAJADA  
DATE: DECEMBER, 2020  
DRAWING NO. 6/10  
JOB NO. 100072736

SUMMERLIN WEST VILLAGE 25  
HIGH SCHOOL STAGING STOCKPILE

GRADING PLAN  
STOCK PILE 2

ATKINS  
2270 Corporate Circle Suite 200  
Henderson, Nevada 89074  
Telephone: +1702263775  
Fax: +17022637200

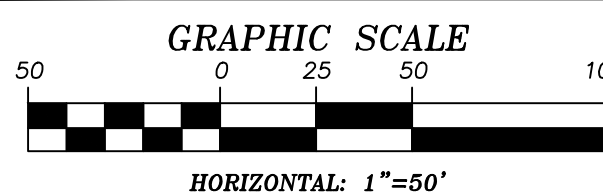
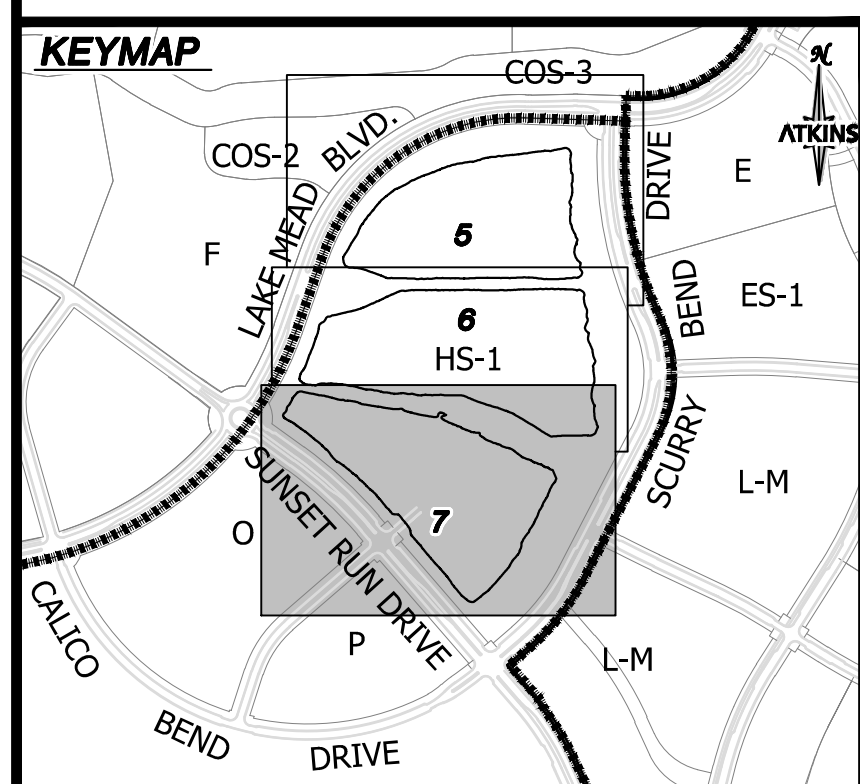
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12/30/2020

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CERTIFY THAT THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY FOR THIS SITE ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

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 COINCIDENT WITH 114°58' WEST OF THE GREENWICH MERIDIAN.

CITY OF LAS VEGAS BENCHMARK: D368  
(REVISED 2008)  
NAVD88 ELEVATION: 989.574 METERS  
(3,246.63 FEET)  
FND USC&GS DISC SET IN ROCK RIDGE  
SOUTH OF CHARLESTON BLVD. & WEST  
DETENTION BASIN.

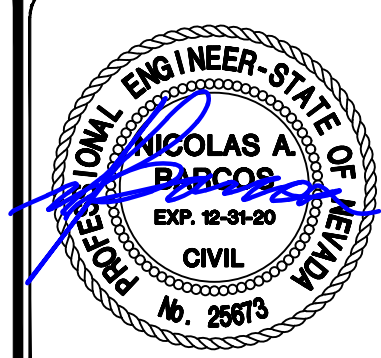


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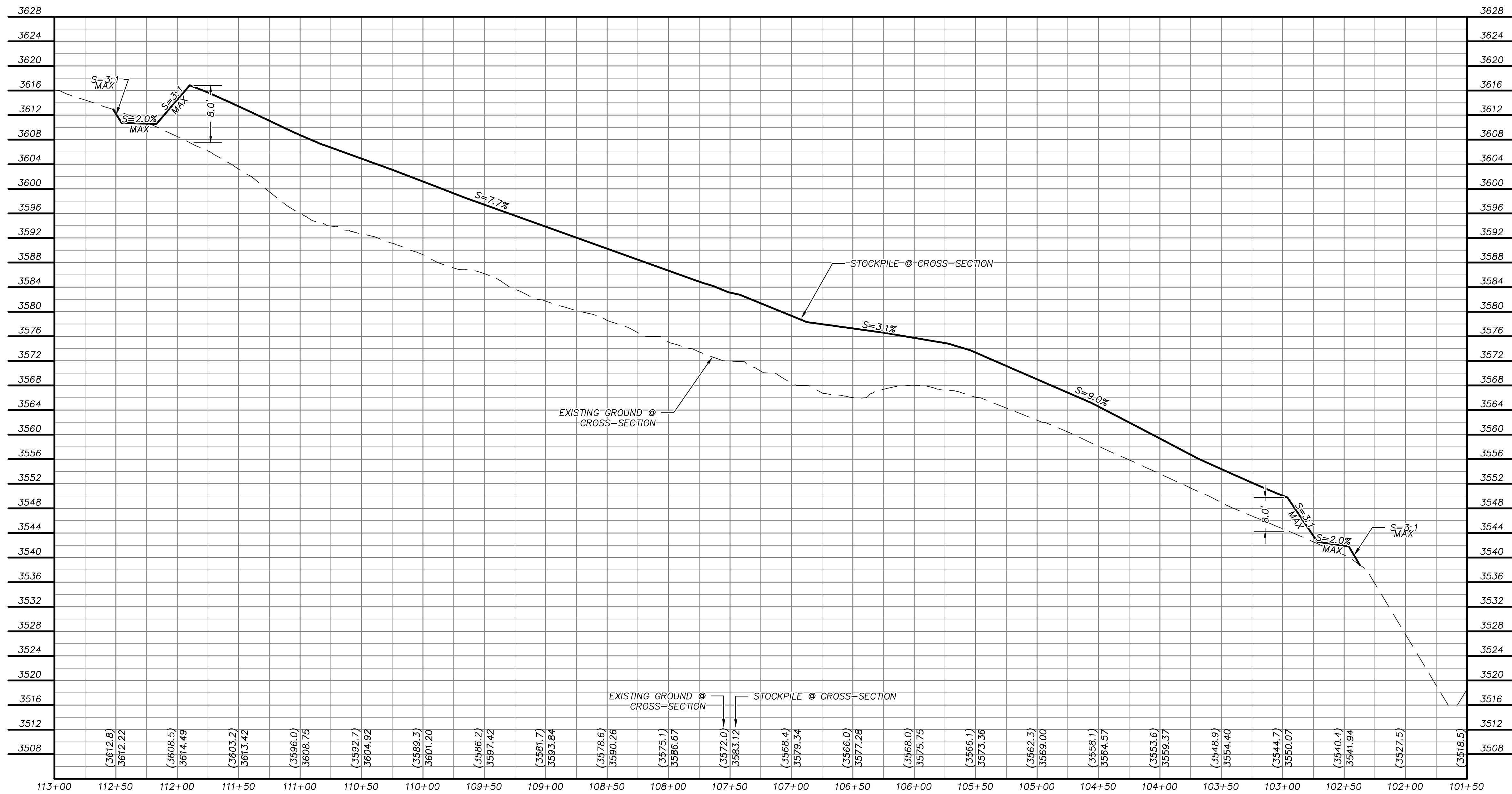
**Call**  
**811**  
OR  
**1-800-642-2444**



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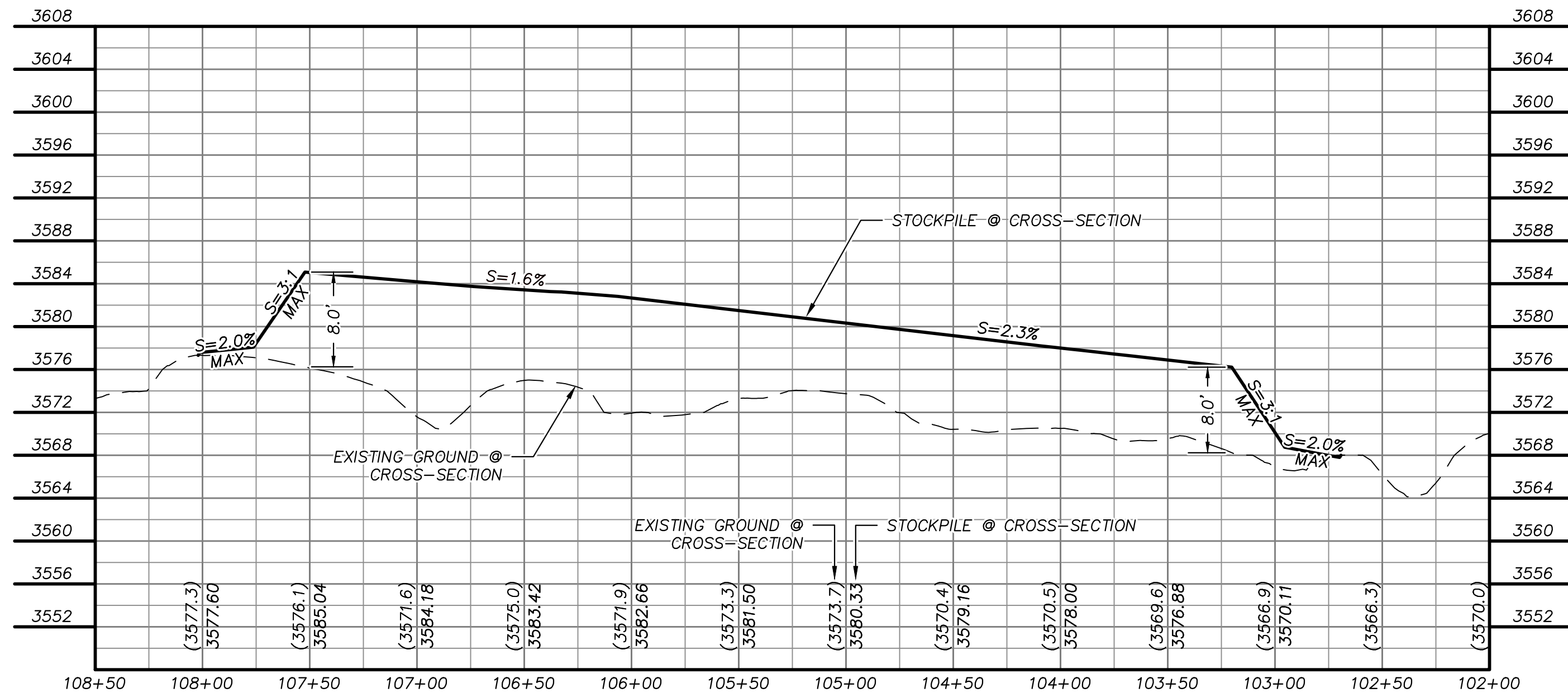
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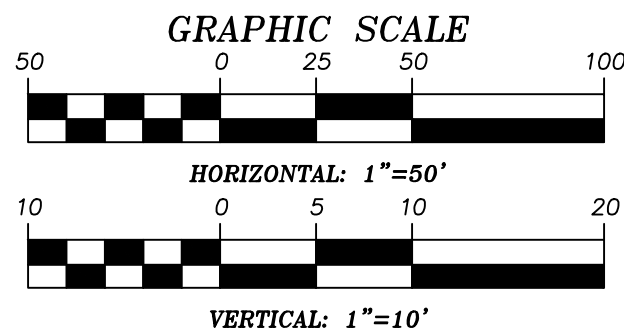
STOCK PILE 1 EAST - WEST PROFILE

SHEET 5



STOCK PILE 1 NORTH - SOUTH PROFILE

SHEET 5



GRADING PLAN CERTIFICATION

NICOLAS BARCOS

PE#25673

DATE

CERTIFY THAT THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY FOR THIS SITE ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

DS#----

BASIS OF BEARING

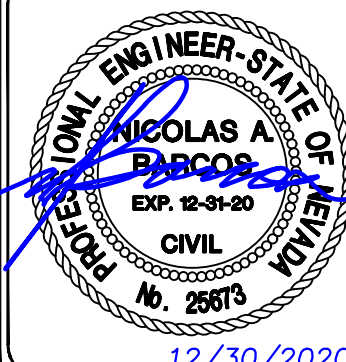
GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM (NCRS). LAS VEGAS HIGH ELEVATION ZONE, NORTH AMERICAN DATUM OF 1983; SAID MERIDIAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWICH MERIDIAN.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK: D368 (REVISED 2008) NAVD88 ELEVATION: 989.574 METERS (3,246.63 FEET) FND USC&GS DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD. & WEST OF DETENTION BASIN. T215,R59E,S03



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DESIGNED BY: J. TORRELLA  
DRAWN BY: G. BALAJADA  
CHECKED BY: J. TORRELLA  
DATE: DECEMBER, 2020  
DRAWING NO. 8 / 10  
JOB NO. 100072736

SUMMERLIN WEST VILLAGE 25  
HIGH SCHOOL STAGING STOCKPILE

PROFILE  
STOCK PILE 1

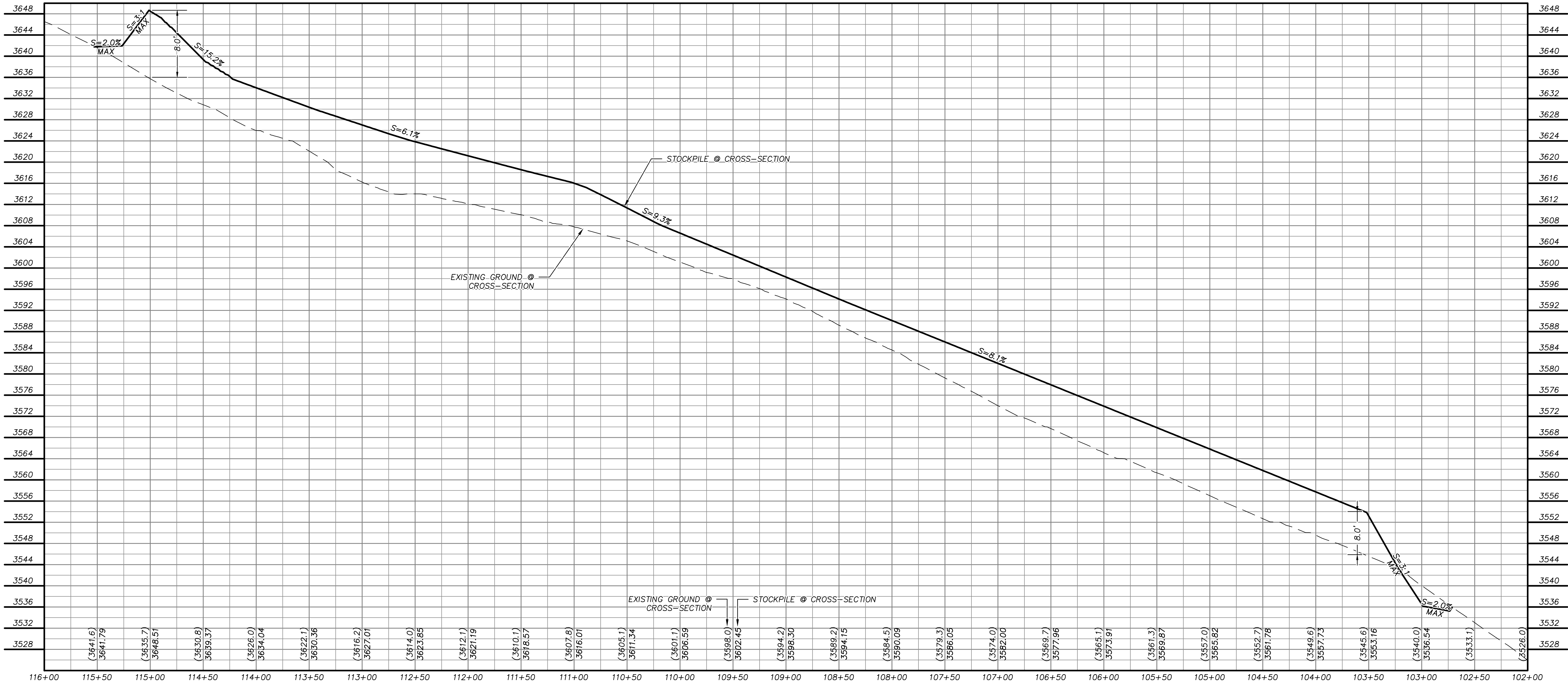
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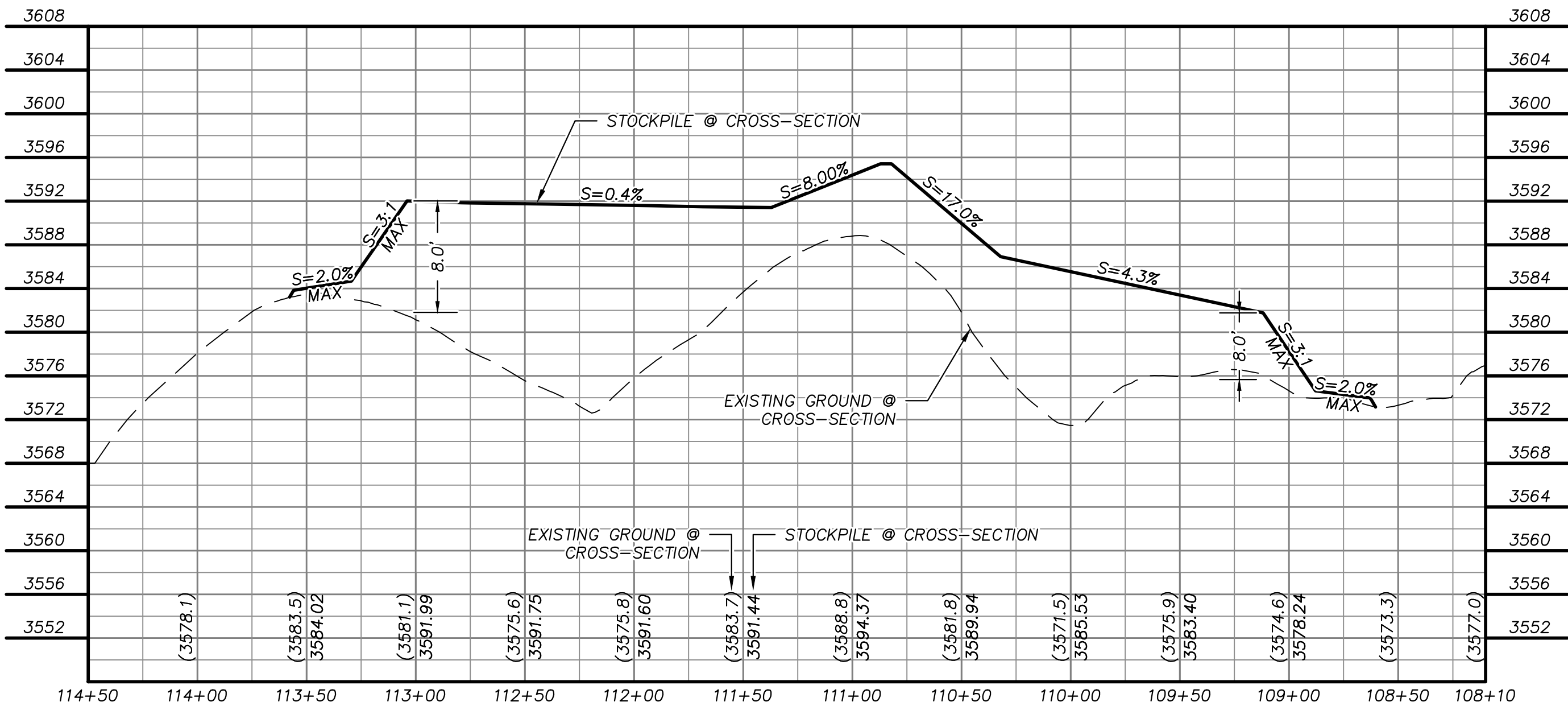
**ATKINS**  
2270 Corporate Circle Suite 200  
Henderson, Nevada 89074  
Telephone: +1702.263.775  
Fax: +1702.263.7200



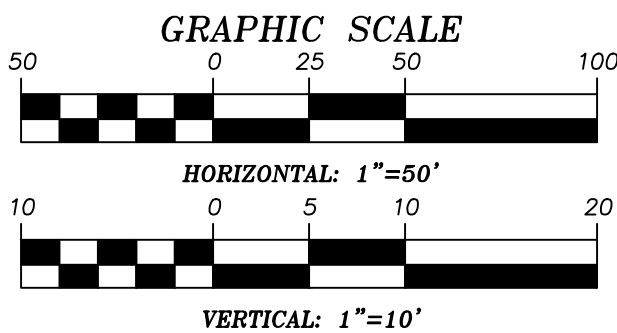




STOCK PILE 2 EAST - WEST PROFILE  
SHEET 6



STOCK PILE 2 NORTH - SOUTH PROFILE  
SHEET 6



GRADING PLAN CERTIFICATION

NICOLAS BARCOS

PE#25673

DATE

CERTIFY THAT THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY FOR THIS SITE ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

DS#----

BASIS OF BEARING

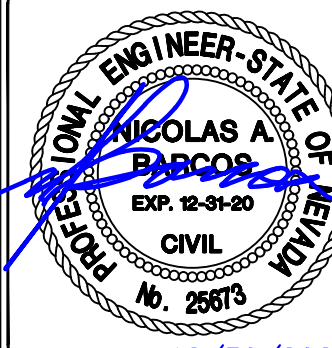
GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM (NCRS), LAS VEGAS HIGH ELEVATION ZONE, NORTH AMERICAN DATUM OF 1983; SAID MERIDIAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWICH MERIDIAN.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK: D368 (REVISED 2008)  
NAVD88 ELEVATION: 989.574 METERS (3,246.63 FEET)  
FND USC&GS DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD. & WEST OF DETENTION BASIN.  
T215,R59E,S03



UTILITY LOCATIONS SHOWN HEREON ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO DETERMINE THE EXACT VERTICAL AND HORIZONTAL LOCATION OF ALL EXISTING UNDERGROUND 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.



DESIGNED BY: J. TORRELLA  
DRAWN BY: G. BALAJADA  
CHECKED BY: G. BALAJADA  
DATE: DECEMBER, 2020  
DRAWING NO. 9/10  
JOB NO. 100072736

SUMMERLIN WEST VILLAGE 25  
HIGH SCHOOL STAGING STOCKPILE

PROFILE  
STOCK PILE 2

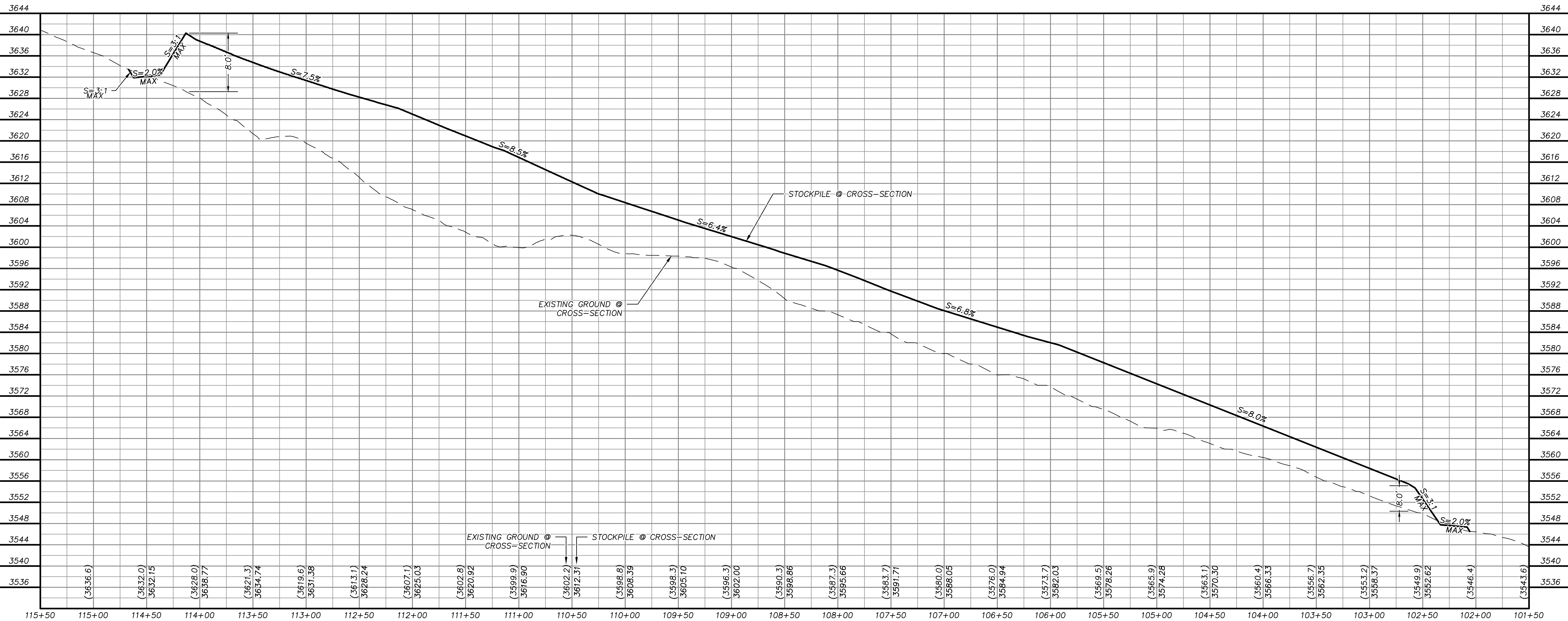
REVISIONS

| REV. | DESCRIPTION | BY | DATE | APPROVAL |
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|      |             |    |      |          |

**ATKINS**  
2270 Corporate Circle Suite 200  
Henderson, Nevada 89074  
Telephone: +1702263775  
Fax: +17022637200

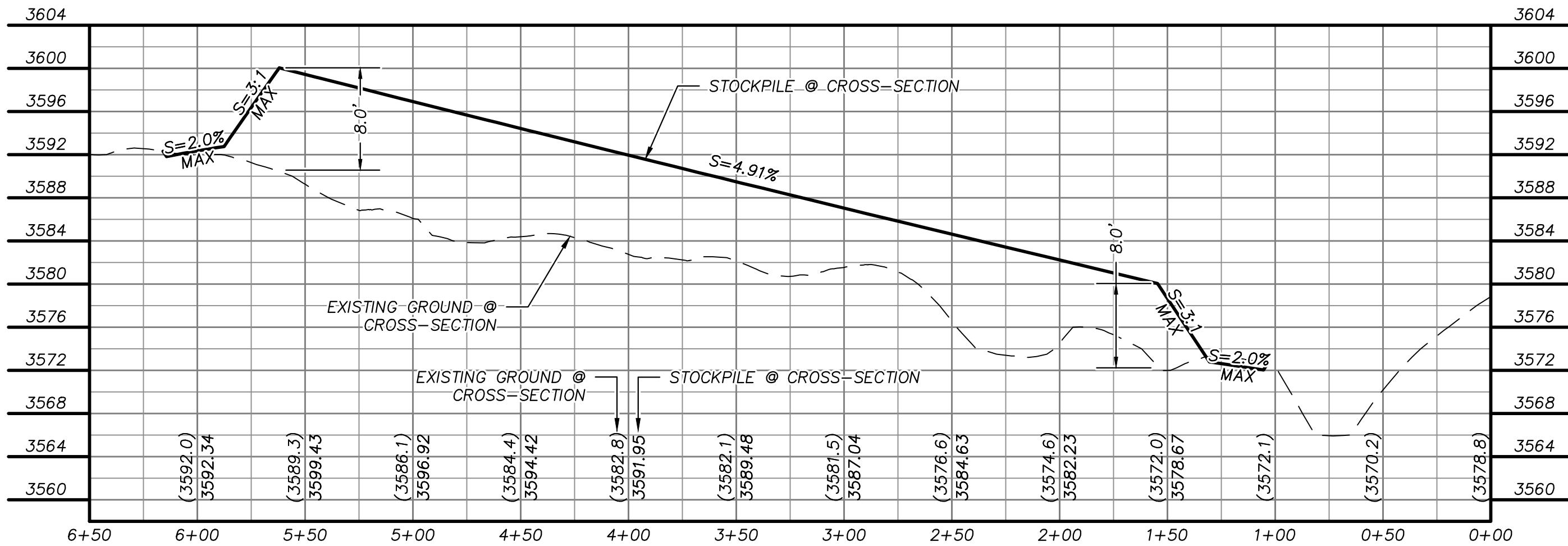






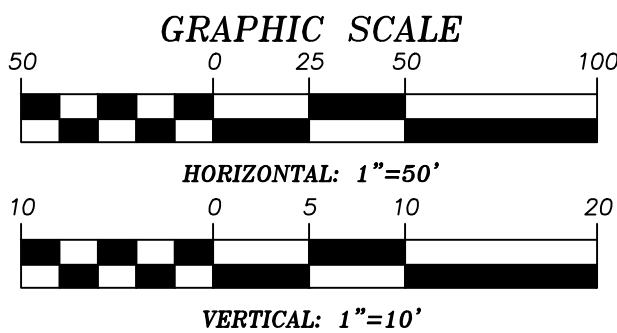
STOCK PILE 3 EAST - WEST PROFILE

SHEET 7



STOCK PILE 3 NORTH - SOUTH PROFILE

SHEET 7



GRADING PLAN CERTIFICATION

NICOLAS BARCOS

PE#25673

DATE

CERTIFY THAT THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY FOR THIS SITE ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

DS#----

BASIS OF BEARING

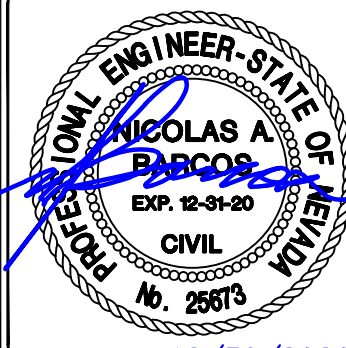
GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM (NCRS), LAS VEGAS HIGH ELEVATION ZONE, NORTH AMERICAN DATUM OF 1983; SAID MERIDIAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWICH MERIDIAN.

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CITY OF LAS VEGAS BENCHMARK: D368 (REVISED 2008) NAVD88 ELEVATION: 989.574 METERS (3,246.63 FEET) FND USC&GS DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD. & WEST OF DETENTION BASIN. T21S,R59E,S03



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|              |                |
|--------------|----------------|
| DESIGNED BY: | J. TORRELLA    |
| DRAWN BY:    | G. BALAJADA    |
| CHECKED BY:  | CH. BARCOS     |
| HORIZ. 1" =  | 50'            |
| VERT. 1" =   | 10'            |
| DATE:        | DECEMBER, 2020 |
| DRAWING NO.  | 10/10          |

SUMMERLIN WEST VILLAGE 25  
HIGH SCHOOL STAGING STOCKPILE

PROFILE  
STOCK PILE 3

REVISIONS

| REV. | DESCRIPTION | BY | DATE | APPROVAL |
|------|-------------|----|------|----------|
|      |             |    |      |          |
|      |             |    |      |          |
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