

DS #:

5214

APN:

137-21-101-001

PROJECT:

Summitin West 30A - Rough Street Grading

SUBMITTAL:

1st

SCANNED BY/DATE:

CHECKED BY/DATE:



CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		November 21, 2019
TO: Land Development Services Department of Building & Safety		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:	COPIES TO:
	Summerlin West Village 30A – Rough Street Grading	Atkins
Cross Streets:	Future Lake Mead Blvd. & Park Drift Trail	Howard Hughes Company
File Number:	F:\Depot\DSMemos\DS5214A.doc	Bart Anderson, P.E., DevCo
Parcel Number:	137-21-101-001	
Zoning Action:	N/A	
FEMA Flood Zone	YES NO X	
Proposed Storm Drain	YES NO X	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1 st Submittal	11/6/2019	11/21/2019	See Comments Below	\$400.00	3638198: \$400
TOTAL FEES (LDDRS):				\$400.00	----

REMARKS:

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

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

Note that the Clark County Regional Flood Control District (District) has begun efforts to update the Hydrologic Criteria and Drainage Design Manual (HCDDM) and is requesting participation from the engineering community. The District is collecting comments and suggestions on errors, clarifications, or changes needed to the current Manual and/or content and usability enhancements to be incorporated into the updated Manual. Additional information on procedures and deadline to provide feedback and comments are available online at (<http://www.ccrfed.org/hcddmupdate.html>).

1. The approval of this drainage study is for the issuance of rough grading permit for future streets and temporary construction access only.
2. Howard Hughes Company (Summerlin) is solely responsible for the maintenance and erosion control of the interim facilities.

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

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

END OF REMARKS

ays

T/R/S: T20S/R59E/21

AREA K-21

Summerlin West Village 30A

Rough Grade Technical Drainage Memo

Prepared for The Howard Hughes Company, LLC
November 6, 2019

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL
DRAINAGE STUDY INFORMATION FORM

Name of Development: Summerlin West Village 30A Rough Grade Date: November 6, 2019
Location of Development: a) Descriptive (Cross Streets) North/South: Park Drift Trail (future)
East/West: Lake Mead Boulevard (future)
b) Section: 21 Township: 20S Range: 59E
c) APN : 137-21-101-001

Name of Owner: Howard Hughes Company, LLC
Telephone No.: (702) 791-4000 Fax No.: (702) 791-4450 E-Mail Address: chris.anderson@howardhughes.com
Address: 10801 West Charleston Blvd, Ste 300, 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:

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

1. Total Owned Land Area: At Site: +/- 2006 acres Being Developed/Disturbed: +/- 47 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.): Rough Grade
5. Approximate upstream land area which drains to the subject site: 6.8 square miles
6. Has the site drainage been evaluated in the past? ☒ YES ☐ NO If yes, please identify documentation: Overall Master Conceptual Drainage Study for Summerlin West
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: The northern portion of the rough grade discharges to the Grand Park Detention Basin, which eventually discharges to the Western Beltway Channel. The southern portion of the proposed development discharges to DB45.
8. Briefly describe your proposed schedule for the subject project: ASAP

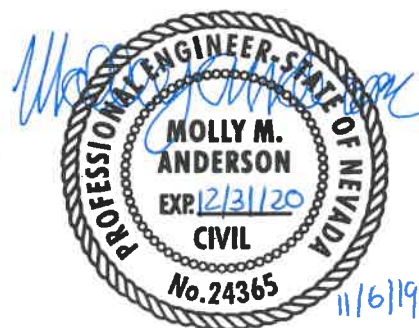
Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

***New Required Field**

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

Revision	Date

Local Entity File No. _____



Engineer's Seal

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name: Summerlin West Village 30A Rough Grade

Map ID:

Firm Name: **Atkins**

Engineer: **Molly Anderson, PE**

Address: 2270 Corporate Circle, Ste 200

City: **Henderson**

State:

NV

Zip: **89074**

Phone Number: **(702) 551-0330**

Fax Number: **(702) 263-7200**

Property Owner: **Howard Hughes Company, LLC**

Address: 10801 West Charleston Blvd, Ste 300

City: **Las Vegas**

State: **NV**

Zip: **89135**

Reviewed By:

Date Received:

Date Accepted for Review:

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

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

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

I. GENERAL REQUIREMENT

Yes

No

 x

Design Manual **Standard Form 1** with the engineer's seal and signature.

 N/A

Design Manual **Standard Form 4**.

 N/A

2 copies of the 24" x 36" Drainage Plan.

 N/A

A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge.

II. MAPS AND EXHIBITS

Yes

No

 N/A

A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.

 N/A

A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS (Continued)

Yes	No	
<u>X</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>	_____	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>	_____	Vicinity Map with local and major cross streets identified and a north arrow.

III. DRAINAGE PLAN

Yes	No	
<u>X</u>	_____	Sheet size: 24" x 36" sealed by a registered engineer in the State of Nevada.
_____	<u>N/A</u>	Minimum scale: 1" = 60'.
<u>X</u>	_____	Project name.
<u>X</u>	_____	Vicinity Map with local and major cross streets.
<u>X</u>	_____	Revision box.
<u>X</u>	_____	North arrow and bar scale.
<u>X</u>	_____	Engineer's/consultant's address and phone number.
<u>X</u>	_____	Elevation datum and benchmark.
<u>X</u>	_____	Legend for symbols and abbreviations.
<u>X</u>	_____	Cut/fill scarps, where applicable.
<u>X</u>	_____	Street names, grades, widths.
_____	<u>N/A</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>	_____	Existing contours encompassing the site and 100 feet beyond with spot elevations for important locations, where appropriate.
_____	<u>N/A</u>	Minimum finish floor elevations with top-of-curb elevations at upstream end of lot.
<u>X</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> </u>	<u>N/A</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>X</u>	<u> </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> </u>	<u>N/A</u>	Building and/or lot numbers.
<u> </u>	<u>N/A</u>	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
<u> </u>	<u>N/A</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	
☐	☒ N/A	For areas in Zone A, AE, AH, and AO, base flood elevations (BFEs) must be shown for each lot; BFEs may be listed on each lot, or in a table. Finish floor elevations must be a minimum of 18 inches above BFE.
☐	☒ N/A	Appropriately elevated "humps" 6 inches above the 100 year water surface elevation at site accesses where the intent is to protect the site from the Q_{100} flows.
☐	☒ N/A	Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.
☐	☒ 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	
☐	☒ N/A	Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.
☐	☒ N/A	Input and output information for existing conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.
☐	☒ N/A	Input and output information for future conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.
☒ X	☐	Use of correct precipitation values in and around the McCarran Airport rainfall area.
☒ X	☐	A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations.
☒ X	☐	A summary table of stormwater flows showing basin area, Q_{10} and Q_{100} for both individual basins and combined basin flows, where applicable.
☒ X	☐	Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.
☒ X	☐	On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law.
☐	☒ 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	
☐	<u>N/A</u>	Flow split calculations and supporting documentation or reference for the method of flow split calculations used.
☐	<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 ≥ 80 feet. Calculations must be labeled by street name as indicated on the Grading Plan.
<u>X</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.
☐	<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.)
☐	<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.
☐	<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.
☐	<u>N/A</u>	A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. • Field survey data. • Input and output information. • Plotted cross-sections based on survey with proper encroachments. • A map showing the location of the cross-sections. • Analysis of both sub and super-critical flow segments. • A summary table and a discussion of the results in the text of the report.
☐	<u>N/A</u>	Provide a 50 percent clogging factor in the capacity calculation for drop inlets.
<u>X</u>	☐	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>	☐	The mitigation of nuisance water, both during construction and in the fully developed condition, must be addressed.
☐	<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.)
	N/A	Copies of all conditions of approval for development related to this property. (e.g. zoning, use permit, tentative map, etc.) Verify compliance with conditions.
X		An electronic copy of the complete submittal is required to be submitted with one original hard copy of the study. Electronic documents should be on a universal computer-readable digital output device replicating your submittal. An Indexed Portable Document Format (PDF) or Print Ready CAD file formats with a minimum of 300dpi are the desired formats. If figures are in color, they must be scanned in color and saved as a separate file. <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.

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

III. Local Entity Criteria - City of Las Vegas – Manual Section 1600		
Yes	No	
	N/A	Concrete valley gutters are required in parking lots with slopes less than 1 percent. Slopes through cul-de-sac must be at a 1 percent minimum where flow is drained through the cul-de-sac.
	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.
X		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.

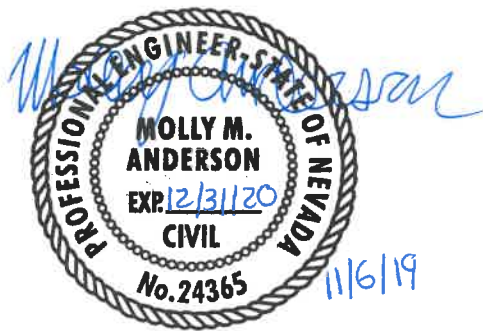
- Contact the Flood Control Section regarding the drainage study review fee. These fees are payable at the time of submittal.
- The Drainage Study must be conditionally approved prior to submitting improvement plans to the Civil and Planning Development of the Department of Building and Safety for review.

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 **Technical Drainage Memo for Summerlin West Village 30A: Rough Grade** electronic submittal matches the paper version bound into the study.



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

Executive Summary

This Technical Drainage Memo, prepared on behalf of Howard Hughes Company, LLC represents the hydrologic and hydraulic analysis for the rough grade roadway improvements of the Summerlin West Village 30A development. Summerlin West Village 30A is located in the northwest Las Vegas Valley west of the CC-215 beltway and Summerlin Parkway. The proposed rough grade street improvements detailed in this study extend from the future site of the 4125 North reservoir, west to the future street K (Park Drift Trail). Five portions of rough grade roadway are included in this study: the reservoir temporary access road, the future reservoir access road, Lake Mead Boulevard from the future access road to Street K, Street Z from Lake Mead Boulevard to Street K, and a portion of Street K from just north of the intersection with Street Z, south to the intersection with the future Sandstone Rise Drive. A detailed drainage study was performed using HEC-RAS 2D modeling software to ensure that existing hydrologic and hydraulic conditions were not negatively impacted by the proposed rough grade improvements, as well as to ensure that the proposed grading would be able to adequately handle a 100-year storm event without damage from highly erosive stormwater velocities. The following memo provides key insights and findings from the full-scale Technical Drainage Study (TDS). The complete TDS is available upon request.

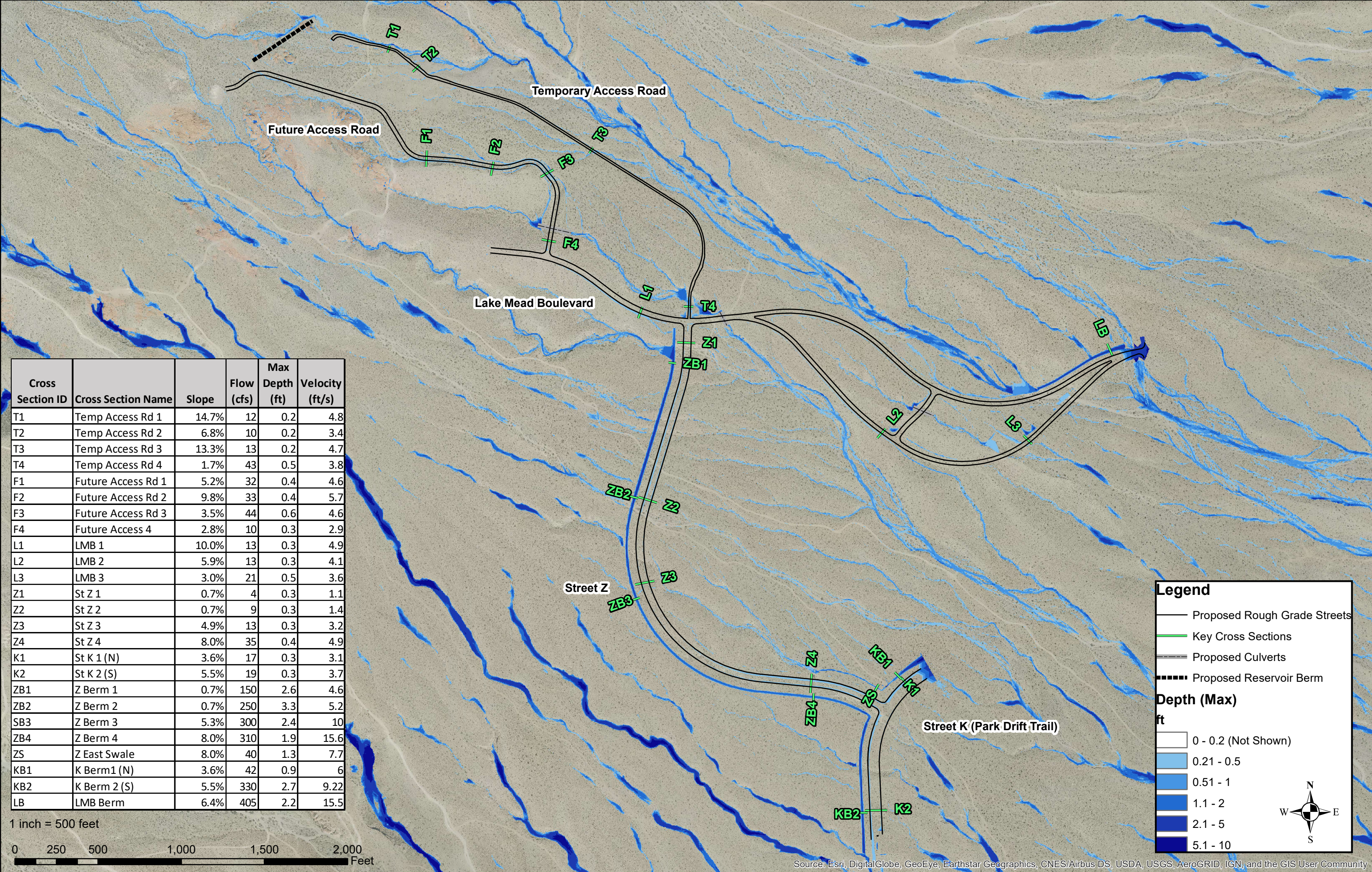


Hydrologic Analysis

Atkins developed a two-dimensional (2D) hydraulic model of existing terrain in the Summerlin West development area in August 2019 to establish baseline existing hydraulic conditions. The model was developed using the US Army Corps of Engineers HEC-RAS v. 5.0.7. The original 2D model which had four subbasins and covered 20.7 sq. mi. was reduced to one of the original subbasins of 6.8 sq. mi., after determining that no flow from the adjacent subbasins was tributary to the proposed rough grade project area. LiDAR collected by the Southern Nevada Water Authority (SNWA) in 2016 with a resolution of 1-ft was used as a primary source for digital elevation data. Proposed grading for the Village 30A rough grade project was merged with the existing grade topography at 1-ft by 1-ft grid spacing to be used at the terrain in the 2D hydraulics model. HEC-HMS v. 4.3 was used to develop rainfall excess for the project area which was then used as input into the HEC-RAS 2D model. The 2018 Las Vegas Valley Master Plan Update (LVVMPU) rainfall polygon was used to determine the average rainfall depth for the basin tributary to the proposed project site. An SDN3 storm distribution curve was used to calculate the rainfall hyetograph. A depth area reduction factor (DARF) of 0.895 was applied to the rainfall depth of the 6.8 sq. mi basin. A composite runoff curve number of 85.0 was determined from the 2018 LVVMPU soils and undeveloped land use which was used to calculate rainfall losses in HEC-HMS. The 2D model simulations were run for an 8-hour duration of the 100-year 6-hour rainfall storm event using a variable time step based on courant condition.

Hydraulic Analysis

A Manning's roughness coefficient of 0.027 was used on the surface of all proposed rough grade streets, and a roughness coefficient of 0.035 was used for the remainder of the model domain. Initial model runs highlighted the need for rip-rap on several portions of roadway as well as in interim roadside swales/berms to inhibit erosive velocities. Rip-rap calculations were performed based on HCDDM Section 705 using HEC-11 methodology. These calculations determined a median riprap particle size (D_{50}) required to resist the average channel shear stresses. Manning's roughness values representative of the median rip-rap particle size (D_{50}) were then overlain in the representative swales/berms and the 2D model was re-run accordingly. Median rip-rap sizes of 6-inches through 2-feet are needed in various areas throughout the project area. In portions of the Street Z berm where slopes are greater than 8%, and in the Lake Mead berm, grouted rip-rap is needed. Rip-rap sizes and extents are included in the detailed plan-set. To determine average depths and velocities across critical sections of roadways and swales independently from the 2D model, normal depth calculations were performed in Flowmaster 10.2. Maximum depth and velocity 2D model results are shown in Figures 1 and 2, respectively. Tabular data of flows, depths, and velocities from Flowmaster determined at critical cross sections can also be found on Figures 1 and 2. Critical cross sections for each roadway were selected where flows and slopes were the greatest.



Cross Section ID	Cross Section Name	Slope	Flow (cfs)	Max Depth (ft)	Velocity (ft/s)
T1	Temp Access Rd 1	14.7%	12	0.2	4.8
T2	Temp Access Rd 2	6.8%	10	0.2	3.4
T3	Temp Access Rd 3	13.3%	13	0.2	4.7
T4	Temp Access Rd 4	1.7%	43	0.5	3.8
F1	Future Access Rd 1	5.2%	32	0.4	4.6
F2	Future Access Rd 2	9.8%	33	0.4	5.7
F3	Future Access Rd 3	3.5%	44	0.6	4.6
F4	Future Access 4	2.8%	10	0.3	2.9
L1	LMB 1	10.0%	13	0.3	4.9
L2	LMB 2	5.9%	13	0.3	4.1
L3	LMB 3	3.0%	21	0.5	3.6
Z1	St Z 1	0.7%	4	0.3	1.1
Z2	St Z 2	0.7%	9	0.3	1.4
Z3	St Z 3	4.9%	13	0.3	3.2
Z4	St Z 4	8.0%	35	0.4	4.9
K1	St K 1 (N)	3.6%	17	0.3	3.1
K2	St K 2 (S)	5.5%	19	0.3	3.7
ZB1	Z Berm 1	0.7%	150	2.6	4.6
ZB2	Z Berm 2	0.7%	250	3.3	5.2
SB3	Z Berm 3	5.3%	300	2.4	10
ZB4	Z Berm 4	8.0%	310	1.9	15.6
ZS	Z East Swale	8.0%	40	1.3	7.7
KB1	K Berm1 (N)	3.6%	42	0.9	6
KB2	K Berm 2 (S)	5.5%	330	2.7	9.22
LB	LMB Berm	6.4%	405	2.2	15.5



Legend

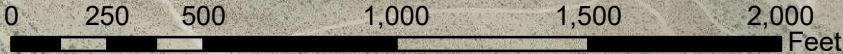
- Proposed Rough Grade Streets
- Key Cross Sections
- Proposed Culverts
- Proposed Reservoir Berm

Depth (Max)
ft

- 0 - 0.2 (Not Shown)
- 0.21 - 0.5
- 0.51 - 1
- 1.1 - 2
- 2.1 - 5
- 5.1 - 10

Cross Section ID	Cross Section Name	Slope	Flow (cfs)	Max Depth (ft)	Velocity (ft/s)
T1	Temp Access Rd 1	14.7%	12	0.2	4.8
T2	Temp Access Rd 2	6.8%	10	0.2	3.4
T3	Temp Access Rd 3	13.3%	13	0.2	4.7
T4	Temp Access Rd 4	1.7%	43	0.5	3.8
F1	Future Access Rd 1	5.2%	32	0.4	4.6
F2	Future Access Rd 2	9.8%	33	0.4	5.7
F3	Future Access Rd 3	3.5%	44	0.6	4.6
F4	Future Access 4	2.8%	10	0.3	2.9
L1	LMB 1	10.0%	13	0.3	4.9
L2	LMB 2	5.9%	13	0.3	4.1
L3	LMB 3	3.0%	21	0.5	3.6
Z1	St Z 1	0.7%	4	0.3	1.1
Z2	St Z 2	0.7%	9	0.3	1.4
Z3	St Z 3	4.9%	13	0.3	3.2
Z4	St Z 4	8.0%	35	0.4	4.9
K1	St K 1 (N)	3.6%	17	0.3	3.1
K2	St K 2 (S)	5.5%	19	0.3	3.7
ZB1	Z Berm 1	0.7%	150	2.6	4.6
ZB2	Z Berm 2	0.7%	250	3.3	5.2
SB3	Z Berm 3	5.3%	300	2.4	10
ZB4	Z Berm 4	8.0%	310	1.9	15.6
ZS	Z East Swale	8.0%	40	1.3	7.7
KB1	K Berm1 (N)	3.6%	42	0.9	6
KB2	K Berm 2 (S)	5.5%	330	2.7	9.22
LB	LMB Berm	6.4%	405	2.2	15.5

1 inch = 500 feet



Legend

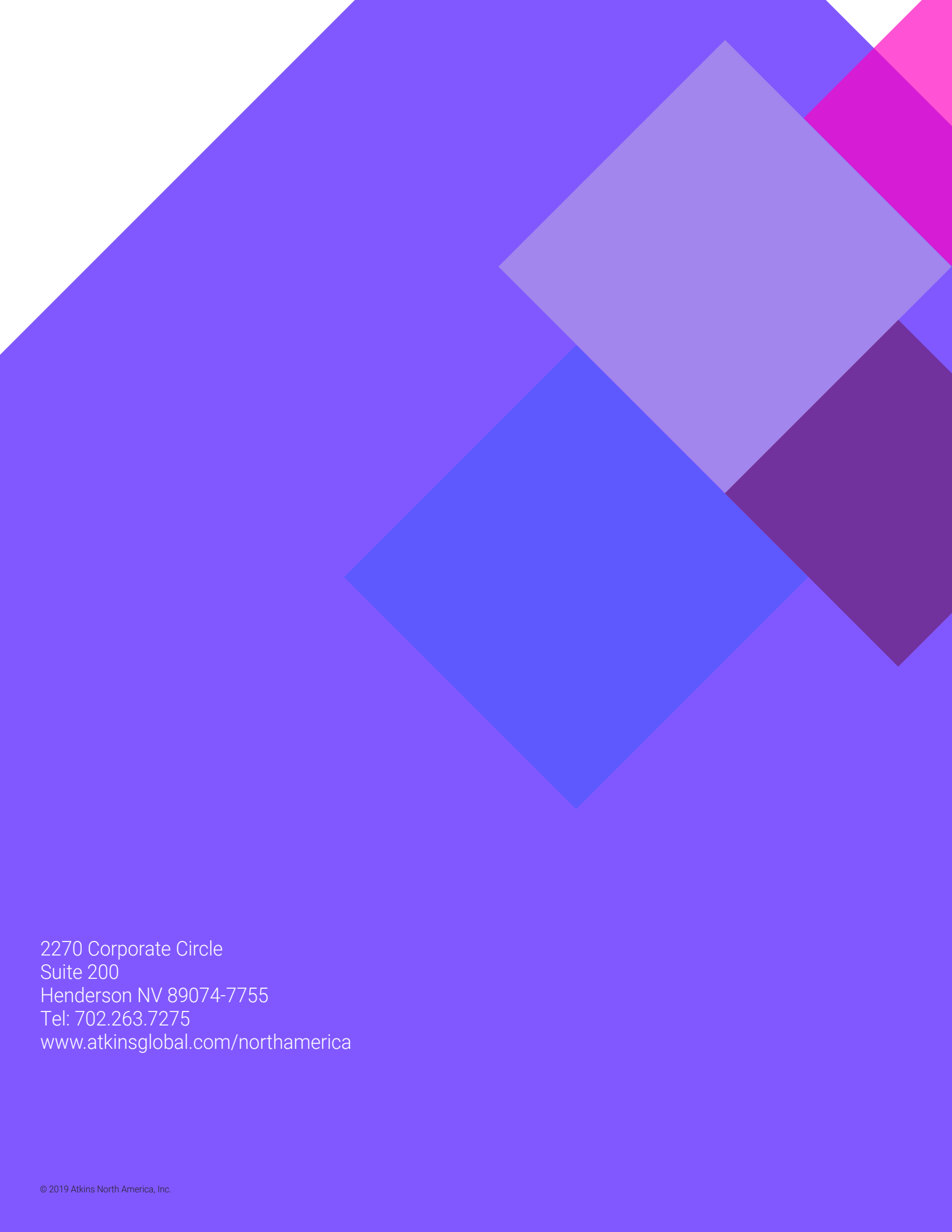
- Proposed Rough Grade Streets
- Key Cross Sections
- Proposed Culverts
- Proposed Reservoir Berm

Velocity (Max)

ft/s

High :25

Low :0



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