NOTICE OF MEETING
HILLSIDE REVIEW BOARD
CITY OF ST. GEORGE
WASHINGTON COUNTY, UTAH

Public Notice

Notice is hereby given that the Hillside Review Board of the City of St. George, Washington County, Utah, will hold meetings at the referenced site on **Wednesday, April 27, 2022,** commencing on-site at approximately 8:30 a.m.

The estimated site times are in bold.
The agenda for the meeting is as follows:

1. Consider a request for a Hillside Development Permit to allow the applicant to develop a proposed single-family development. The applicant has provided a slope analysis, proposed drainage report and site layout for consideration. The property is located at 720 W Indian Hills Drive and is zoned Single Family Residential, minimum lot size 10,000 sf (R-1-10) The representative is Taylor Ricks Case No. 2022-HS-010. (*See 'Meeting Place' exhibit below*). **Meeting time approx. 8:30 am**

2. Consider a request to revisit and determine if the proposed location of a house on Lot 120 of Foremaster Ridge meets the 30' ridgeline setback requirement. The applicant is requesting the Hillside Review Board return to this location to determine if the proposed location of the home, setback at 33' from the rear property line, (as opposed to the recommended 35' setback from the rear property line) meets the requirement of the 30' ridgeline setback. The property is generally located at 445 S. Five Sisters Drive and is currently zoned Single Family Residential, minimum lot size 10,000 sf (R-1-10). The applicant is John Wilson. Case No. 2022-HS-011. **Meeting time approx. 9:30 am**

3. Consider approval of the meeting minutes from March 23, 2022.

Carol Davidson, AICP, CFM
Senior Planner
Development Services

Reasonable Accommodation: The City of St. George will make efforts to provide reasonable accommodations to disabled members of the public in accessing City programs. Please contact the City Human Resources Office at (435) 627-4674 at least 24 hours in advance if you have special needs.

Meeting Locations

Item #1 – Meet at Barn at approx. 720 W. Indian Hills Drive



Item #2 Foremaster Ridge Lot 120 (Approx 445 S. Five Sister's Dr)



St.George
Community Development

ITEM 2
Hillside Permit

HILLSIDE REVIEW BOARD AGENDA REPORT: 04/27/2022

SG-FORR-120 Hillside Development Permit (Case No. 2022-HS-011)		
Request:	A Hillside Development Permit to determine the ridge line on lot 120 of Foremaster Ridge for the construction of a residential home.	
Applicant:	John Wilson	
Representative:	John Wilson	
Location:	Foremaster Ridge, Lot 120 (Approximately 445 S. Five Sisters Dr.)	
General Plan:	Low Density Residential (LDR)	
Existing Zoning:	Single Family Residential, minimum lot size 10,000 sf (R-1-10)	
Surrounding Zoning:	North	R-1-10
	South	R-1-10
	East	R-1-10
	West	R-1-10
Land Area:	Approximately 0.28 acres	



BACKGROUND

This is a request from the property owners of lot 120 in the Foremaster Ridge subdivision for the Hillside Review Board (HRB) to determine where the applicant will be able to place their home in relation to the ridgeline on their lot.

The final plat for this property has a note in the General Notes section of the plat that states, “No structure shall be constructed within 30’ of the abrupt edge of ridge. Setback line is shown on this plat where applicable.” There is another note on the plat that states, “30’ setback line from abrupt edge (typical)” and has an arrow pointing to a line located inside the property boundaries 30’ from the rear property line. This wording on the final plat is deceiving, it appears as if the 30’ setback line on the plat is the actual setback. However, the location of the ridgeline on this plat was never determined, so the line shown is not necessarily accurate. In visiting the property with the applicant, staff determine the Hillside Review Board should look at the property to determine where the ridgeline officially was.

The slope on the applicant’s property is greater than 15%, and therefore, they will be eligible to receive a reduction in the front yard setback from 25’ to 20’. The hillside regulations allow for a reduction in the front setback where the slope is larger than 15%.

UPDATE: On February 23, 2022, the applicants appeared before the HRB to have the location of the ridgeline determined. During the meeting, the HRB discussed the location of the ridgeline in relationship to where the applicant wanted to place their home. There was also a discussion about the reduction of the front yard setback from 25’ to 20’. With the Ultimately, the Hillside Review Board recommended approval of the location where the home would be placed as long as it would be moved five feet forward. The recommendation was:

We recommend approval for lot 120 Foremaster Ridge that based on the drawings submitted and our onsite visit it is our opinion that if they can get a 5 foot reduction in front that the house would fit within the 30 foot setback from the abrupt edge as present onsite, also make the stipulation that during the construction process no fill soils be allowed to go over the edge of the slope and any exposed fills to create the pad be covered with retaining walls, either natural basalt rock or colored concrete that matches the surrounding area.

This item went to the Planning Commission on March 8, 2022. The Planning Commission recommended approval of the location and the acceptance of the HRB definition of the ridgeline. However, before this item went to the City Council, the applicant pulled this item because they felt that the HRB were okay with them moving the house forward only three feet instead of five feet even though the motion stated five feet. Please see the attached minutes from this meeting. The applicants are requesting that the HRB determine if the proposed location of the home, setback at 33’ from the rear property line as opposed to being setback five feet from the rear property line, meets the requirement of the 30’ ridgeline setback. This would mean the 30’ ridgeline setback would be determined as 33’ in from the rear property line (instead of 30’ as shown on the plat).

APPLICABLE ORDINANCE(S) *(Selected portions)*

10-13A-6: Building Setbacks and Additional Design Standards:

A. *Front Setback along Streets:* Along streets where the slope of the adjacent property to the street is over fifteen percent (15%), the minimum setback is twenty feet (20').

B. *Setbacks:* All setbacks shall conform to the underlying zone criteria except as provided herein. No structure or accessory structure shall be constructed within the setback area as defined below. However, a see-through wrought iron fence with at least fifty percent (50%) of the fence open, landscaping, and a nonvertical swimming pool are permitted in the setback area.

1. *Ridgelines:* All ridgelines as shown on the ridgeline map shall be subject to the setback provisions contained herein. Setbacks from ridgelines not identified on the ridgeline map shall be a minimum of thirty feet (30'), or greater if recommended in the geotechnical reports.

2. *Plateaus:* On plateaus, the setback from the ridgeline shall be a minimum of fifty feet (50') unless a greater setback is recommended in the geotechnical reports.

C. *Cuesta:* Where a ridgeline occurs on a cuesta, the minimum setback shall be one hundred feet (100') measured normal (perpendicular) to the closest point of the ridge, unless a greater setback is recommended in the geotechnical report.

D. *Additional Design Standards:*

1. Retaining walls shall be colored to blend into the surrounding natural geology.

2. Retaining wall height is limited to the heights set forth in chapter 18 of this title and the standards for rock wall construction.

3. Building exterior colors shall be earth tone and blend with the surrounding natural landscape.

4. In residential zones, “no disturbance” areas shall be held as the “common area” of a project. Common areas shall be owned and maintained by the homeowners’ association or may be deeded to the city when accepted by the city.

5. In nonresidential zones, any “no disturbance” area shall be identified on the final site plan or final plat.

6. Any required no disturbance area shall be identified on the ground with temporary fencing or other approved means to prevent accidental disturbance of the area during construction and such fencing shall be installed prior to issuance of a grading permit.

7. The building site shall be located on the flattest portion of the parcel.

8. No structure shall extend over any natural ridgeline. The structure shall be in contact with the ground at all edges. (Ord. 2019-10-002, 10-10-2019)

EXHIBITS PROVIDED

1. Exhibit A – Foremaster Ridge Subdivision
   "Exhibit A" in the packet shows the final plat of Foremaster Ridge

2. Exhibit B – Topographic Survey
   "Exhibit B" is the topographic survey of lot 120 of Foremaster Ridge

3. Exhibit C – Site Plan
   "Exhibit C" shows the property site plan

3. Exhibit D – 30' Setback examples
   "Exhibit D" shows examples of other homes in the neighborhood that have not followed the 30' ridgeline setback

4. Exhibit E – Property Slope Diagram
   "Exhibit E" shows the slope of the property is over 15%

RECOMMENDATION

The Hillside Review Board recommends approval of the location where the applicant has placed their home on their site plan for Lot 120 of the Foremaster Ridge final plat and to allow the front setback yard reduction from 25' to 20' (10-13A-6A).

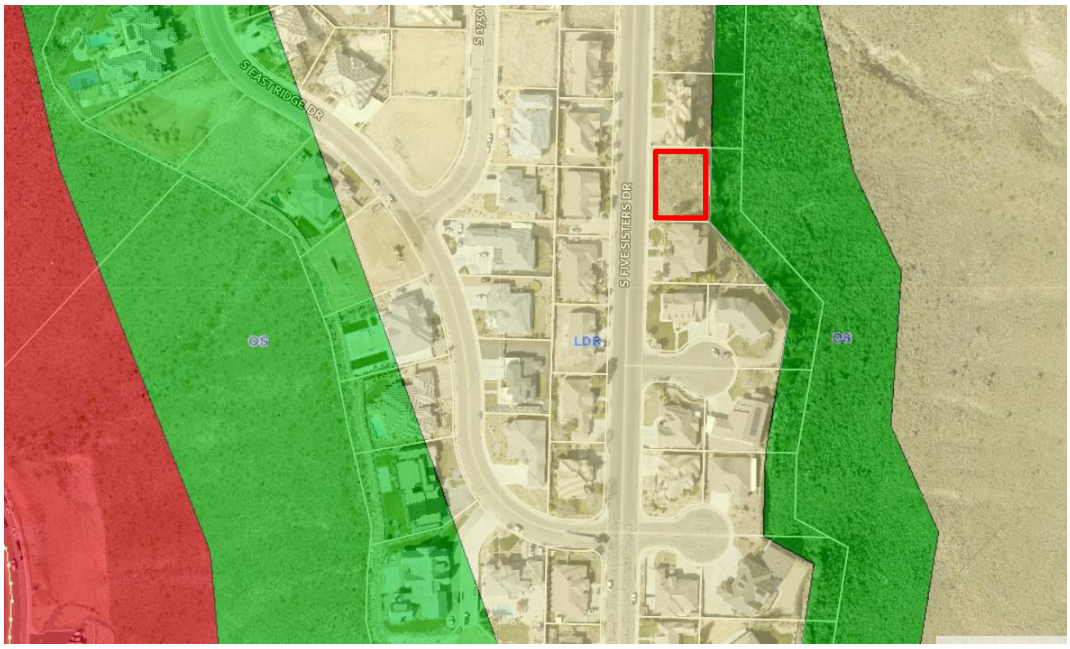
ALTERNATIVES:

1. Recommend approval as presented.
2. Recommend approval with additional conditions.
3. Recommend denial.
4. Table the proposed hillside development permit to a specific date.

POSSIBLE MOTION:

The Planning Commission recommends approval of the Foremaster Ridge Lot 120 Hillside Development Permit with the conditions outlined in the staff report.

General Plan - COM



Zoning - R-1-10



Exhibit A
FOREMASTER RIDGE Final Plat

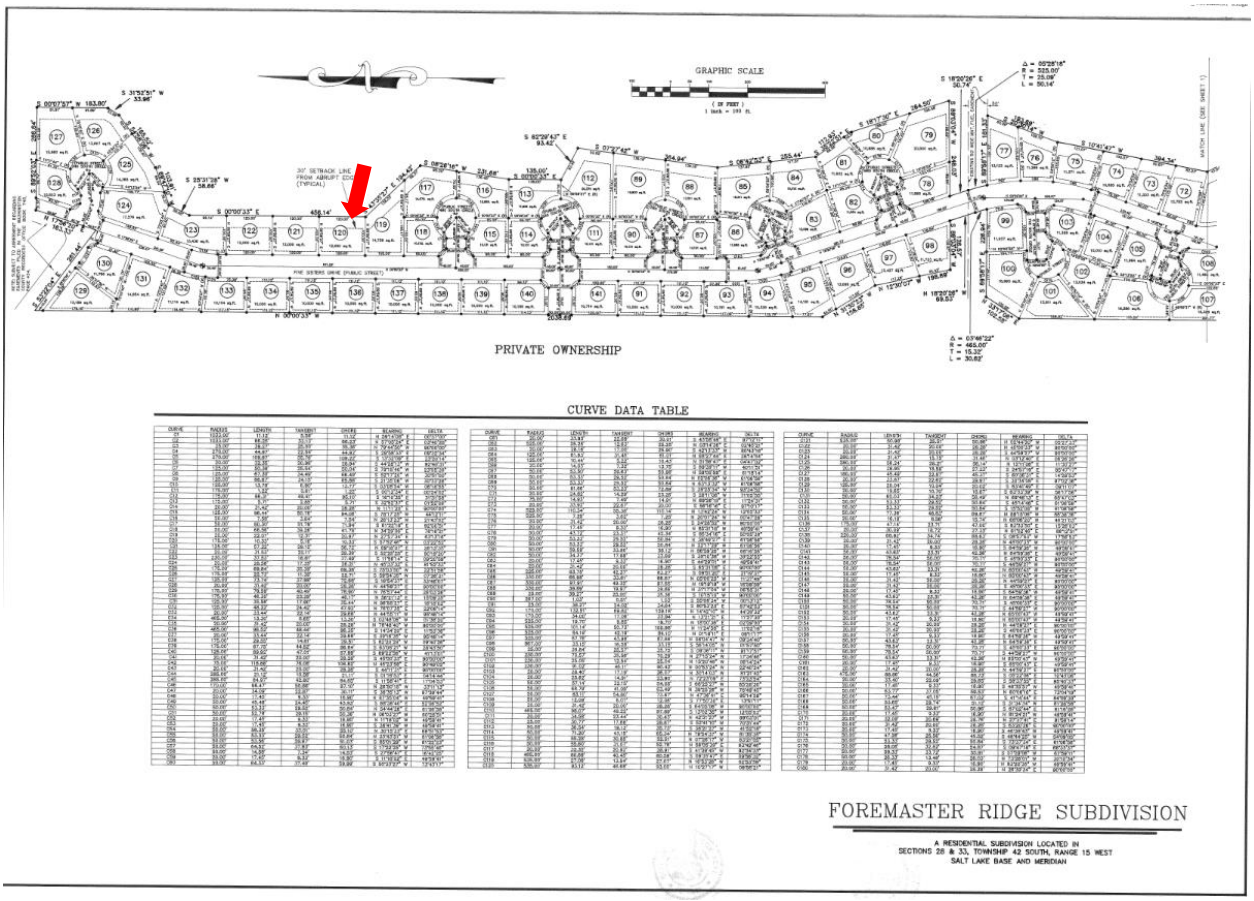


Exhibit B
SITE PLAN

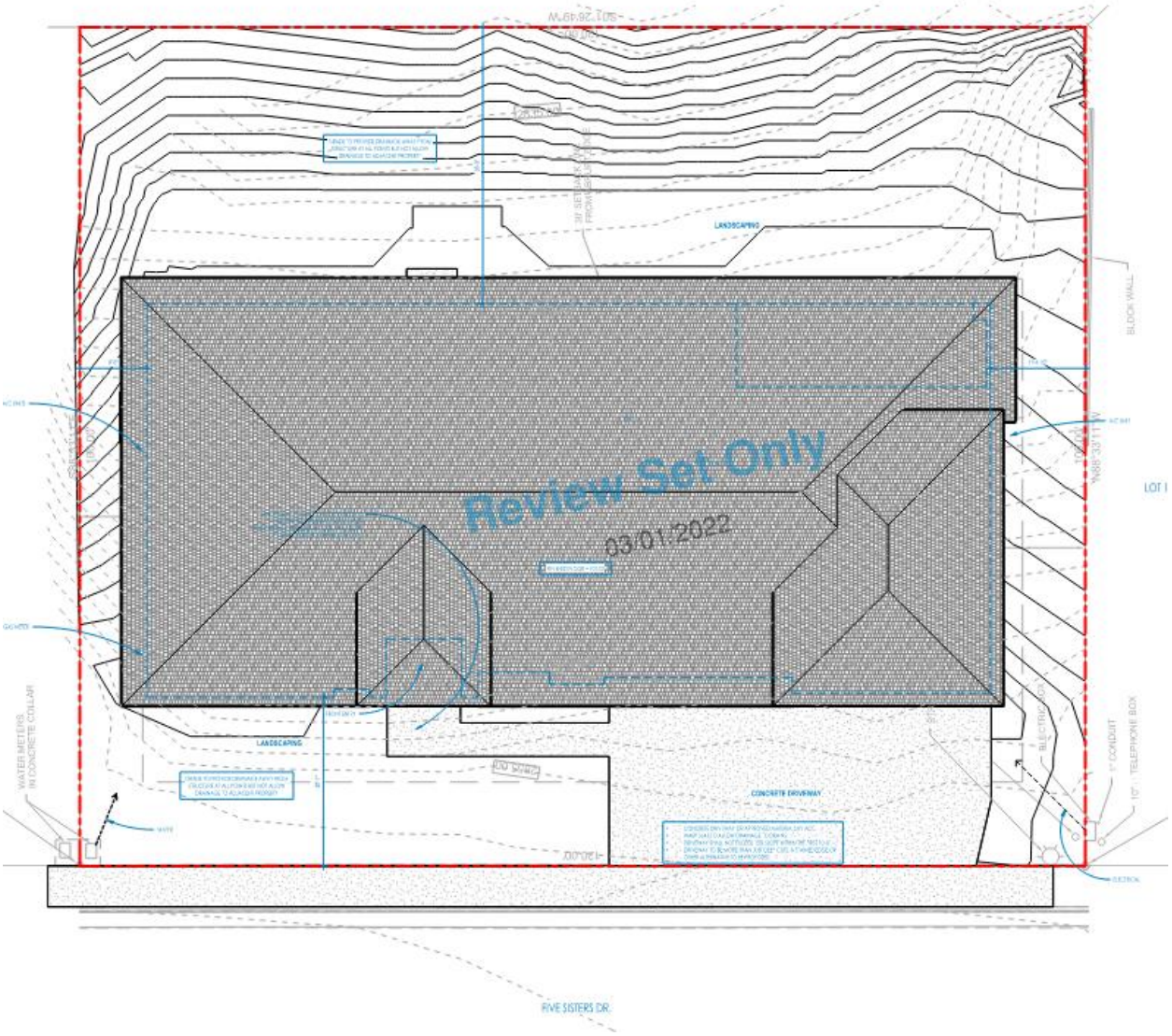


Exhibit C
SETBACK EXAMPLES



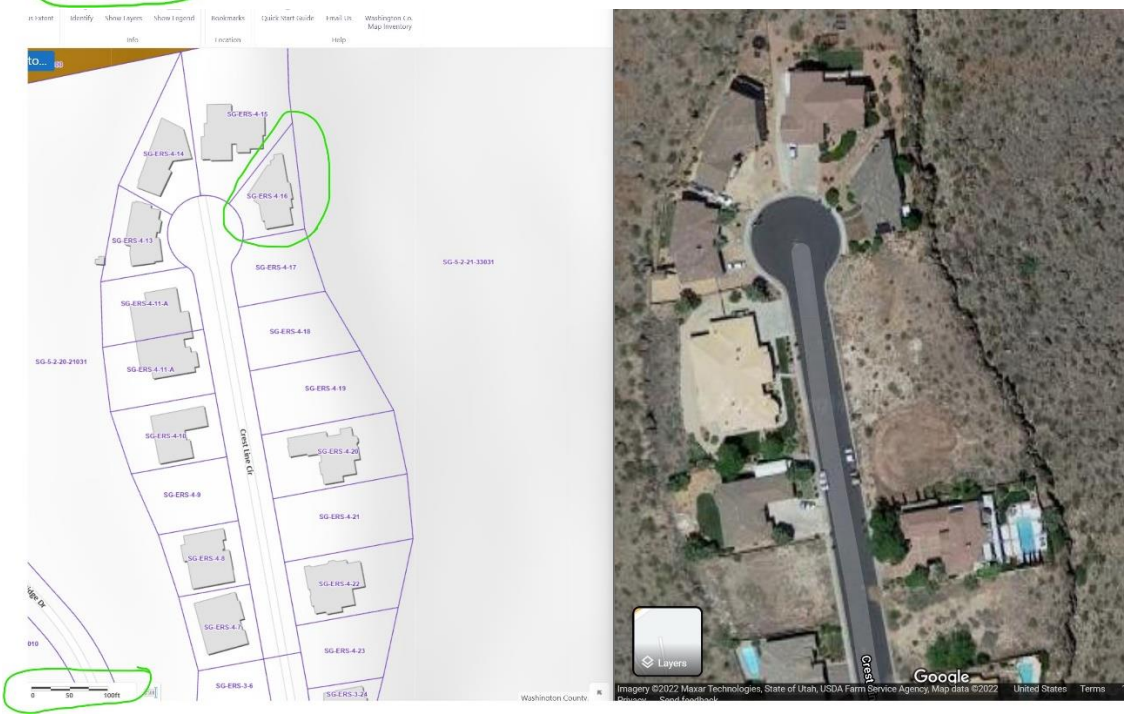
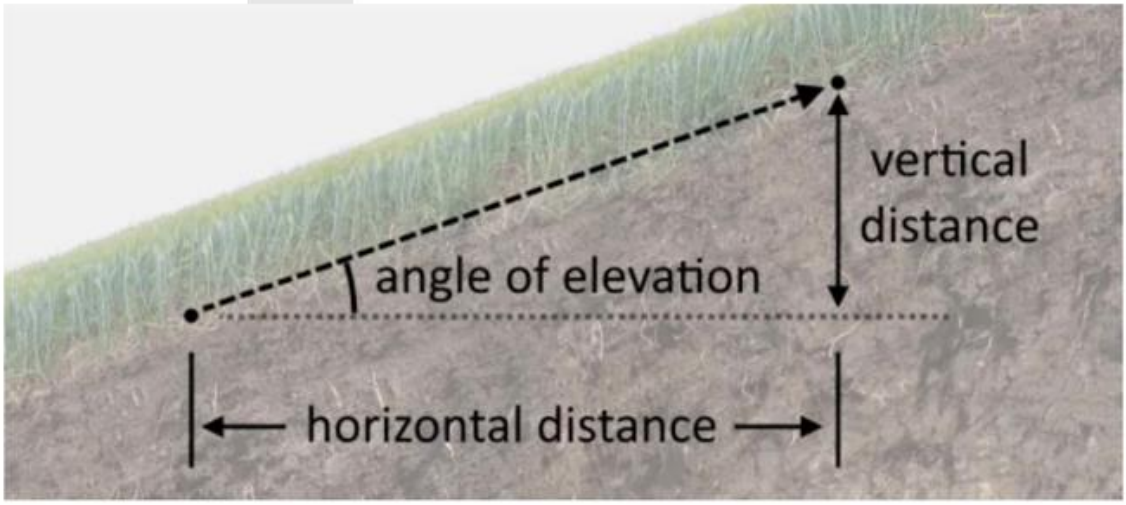


Exhibit D
PROPERTY SLOPE DIAGRAM



Vertical distance ("rise")	20	ft
Horizontal distance ("run")	100	ft
Grade	0.2	
Grade in percentage	20	%
Angle of elevation	0.1974	rad

You might also see this elevation grade expressed in the ratio of **1 in 5**. 🙂

Exhibit E
TOPOGRAPHICAL SURVEY with SETBACKS MARKED

FIVE SISTERS DRIVE

BASIS OF BEARING
N01°26'49"E 925.71'

121

FOUND RIVET IN SIDEWALK
ELEV=2856.78

WATER METERS
IN CONCRETE COLLAR

S88°33'11"E
100.00'

7.50' PUBLIC UTILITY EASEMENT

3'-0"
3'-0"

2855.00
2850.00
2845.00
2840.00
2835.00

120

30' SETBACK LINE
FROM ABRUPT EDGE

120.00'
S01°26'49"W

120.00'

10.00' PUBLIC UTILITY EASEMENT

STREET LIGHT

10" Ø TELEPHONE BOX

7.50' PUBLIC UTILITY EASEMENT

ELECTRIC BOX

3'-0"
3'-0"

100.00'
N88°33'11"W

1" CONDUIT

10" Ø TELEPHONE BOX

BLOCK WALL

FOUND RIVET IN SIDEWALK
ELEV=2855.38

119

N

10 0 10 20

SCALE IN FEET

1" = 10'

ROTATION NOTE

A COUNTERCLOCKWISE ROTATION OF 1°27'22" WILL NEED TO BE APPLIED TO BEARINGS SHOWN ON THIS DRAWING TO MATCH THE REGORDED SUBDIVISION PLAT.

Location of 30' Ridgeline Setback as determined by the Hillside Review Board on 2/23/2022

Location of applicant's proposal to move the Ridgeline Setback 3' closer to the rear property line

4/1/21
DATE:

#
JOB NUMBER:

1"=10'
SCALE:

RBB
DRAWN BY:

RMB
CHECKED BY:

REVISIONS DATE

R&B SURVEYING INC.
257 E. PRICKLEY PEAR DR.
WASHINGTON, UT 84780

FOREMASTER RIDGE SUBDIVISION - LOT 120
TOPOGRAPHIC SURVEY
FOR
JOHN WILSON

SHEET NO.:
1
OF 1

Exhibit F

HILLSIDE REVIEW BOARD MEETING MINUTES 2/23/2022

NOTICE OF MEETING
HILLSIDE REVIEW BOARD
CITY OF ST. GEORGE
WASHINGTON COUNTY, UTAH

Public Notice

Notice is hereby given that the Hillside Review Board of the City of St. George, Washington County, Utah, will hold meetings at the referenced site on **Wednesday, February 23, 2022,** commencing on-site at approximately 8:30 a.m.

PRESENT:
James Sullivan
Dave Black
Jeff Mathis
James Dotson
Russ Owens

EXCUSED:

CITY STAFF:
Assistant Public Works Director, Wes Jenkins
Planner III, Dan Boles
Planner III, Carol Davidson
Development Office Supervisor, Brenda Hatch

James Sullivan called the meeting to order.

1. Consider a request for a hillside development permit at the Divario development. The applicant is proposing to construct in the area shown on the slope map labeled 20-29% and 30-39%. This is specifically in the PA-4 area which is situated in the far south west corner of the Divario development. The property is currently zoned Single-Family Residential, minimum lot size 10,000 square feet (R-1-10). The applicant is 730 St George, LLC. Case No. 2022-HS-003. This item was continued from the January 26, 2022, meeting.

   James Sullivan – We did meet out here the last meeting, we asked them to come and stake out the layout on this wash.

   Mark Teepen – Handed out papers on the revised layout. What we should do is look at where we propose items to go recognizing that along this wash we're going to have the rock walls like we do in the rest of the development. What are hope is that we could maybe move some of these stakes and maybe come out with Parks and Rec and staff to finalize what we might do instead of coming back to hillside. The engineers didn't survey it and put them exactly where they might go.

   Dave Black – How tall will the walls be?

Mark Teepen – Depending on the grading, they will be at least 8 feet. Between 16 and 4-8 feet. The stakes are going to be every lot corner along the wash.

Jeff Mathis – So this one is not the corner of the road?

Mark Teepen – I would like to take the entry and move it so that when people pull in they get the view of the wash and get some benefit out of it.

James Sullivan – Where would the drainage go with the road right here?

Mark Teepen – We intend to pipe it.

Jeff Mathis – Let's walk up there.

Mark Teepen – We have the road basically paralleling the open space.

James Dotson – Here's my first thought Mark. I feel like the 50 ft wide is a little hard to hold consistently up the whole thing because right in here, look at how nice this is. I feel like it will need to undulate a little bit. I know that makes the lot lines hard.

Mark Teepen – But we can do that. The other thing that we have worked on with Parks and Rec, and I don't know if it's eligible here, we have worked with them to put the pedestrian archway to go underneath. So, it is a matter of sewer and utility wise if we can achieve that here we would like to.

Discussion on where we are standing in relation to the layout presented to the Hillside Review Board.

Mark Teepen – Maybe some of the stakes on the other side need to be moved, the one on the corner there is the property line so I can't move it out, but I could move it to shorten up that lot. I agree we could make that adjustment and open up the wash. I think just looking at it, Wes and I and Parks could come out and maybe just take a marking can of paint and we'll just paint where they should be adjusted to, and I'll come out and resurvey it then digitize it in and adjust the lots. I'd like to do that and not have to come back to Hillside.

Discussion on what stakes should be moved, and which stakes are ok to leave where they are. The main concern being to preserve the black rocks from construction and that no construction material spill into the wash.

James Sullivan – Wes are you comfortable with what we are saying in where the stakes need to be moved?

Wes Jenkins – Yes, I can come out and take some photos and send them to you. We can say hey this is where we're at, are you guys good with those, when I send you the pictures.

James Sullivan – I would recommend when you submit it to Planning Commission and City Council that you have an aerial and you superimpose the layout showing the corners. Then they can see what we are protecting.

Dan Boles – Did you guys want to talk about the road alignment?

James Sullivan – Coming from the bottom?

Dan Boles – Yes.

Dave Black – It looks like that is lower than the area we were trying to preserve last time and so that alignment would be ok, and any adjustments lower would be fine as well. I think the road is out of the are that we were concerned about originally.

Russ Owens – I think the aerial is a good idea, I think that will help a lot.

Jeff Mathis – We definitely need to say something to the effect that the construction will not disturb the defined rock edge.

Dave Black – We could recommend they put up the orange safety fence to keep the contractor out of those.

Mark Teepen – We always stake a disturbance line, and the contractors have to fix it, but you can't fix this.

MOTION: Jeff Mathis made a motion to recommend approval of a Hillside Permit with the following conditions: the west corner of lot 3 needs to move up past the edge of the ridge to the southwest corner, the corners between lots 3 and 2 need to move back away from the wash edge and the corner between lots 2 and 1 need to come back maybe 5 feet. On the north side of the wash the corners between lots 35 and 56 against the wash move back the corner between lots 56 and 57 move back, the overall guiding principle needs to be the defined rock edge of the top of the wash shall not be affected by any new development.
SECOND: James Dotson
AYES (5)
James Sullivan
Dave Black
Jeff Mathis
James Dotson
Russ Owens
NAYS (0)
Motion carries.

2. Consider a request for a hillside development permit at the Divario development. The applicant is proposing to construct in the area shown on the slope map labeled 20-29% and open space. This is specifically in the PA-18 area which is situated in the northern portion of the Divario development. The property is currently zoned Single-Family Residential, minimum lot size 10,000 square feet (R-1-10). The applicant is 730 St George, LLC. Case No. 2022-HS-004. (*See 'Meeting Place' exhibit below*).

Mark Teepen – This is the park that you are looking at, this is Gap Canyon that we just kind of drove up. This is the neighborhood park, and we are currently working on the design. That access point is the trail going into the next subdivision. Two things are in

play here, the park design and the boundary for PA-18. In order to get the density that the builder wanted, and working with planning staff and public works, the road pushed that boundary into the wash. Our intention has always been to connect a trail from this part up to Divario Canyon Parkway. As you can see we've got a slope condition on this subdivision here. This area here will stay natural, the flood area will be filled in all the way to the road. The storm drain that dumps out from that subdivision into this wash that will be conveyed, carried through the park and through the streets, there will be no water in that wash at all. It will all be picked up with the storm drain design.

Discussion on where the trail connects to the park and what the grading would look like.

Mark Teepen – The question for hillside is can we fill that wash from that stake up to achieve the grade differential and the walls.

Discussion on what that would look like with the park and parts of the wash filled in.

Dave Black – From a hillside perspective I don't see anything we would want to preserve. I don't have any problems with what you want to do.

James Sullivan – I think you are preserving the best part of it.

Russ Owens – It's not like it's a pristine wash coming through so, the part is this.

James Sullivan – I think bringing that up will actually soften that hillside.

MOTION: James Dotson made a motion to recommend approval PA-18 park boundary adjustment and filling in the wash and creating the trail system that connects the park to Divario Canyon Drive.
SECOND: Jeff Mathis
AYES (5)
James Sullivan
Dave Black
Jeff Mathis
James Dotson
Russ Owens
NAYS (0)
Motion carries.

3. Consider a request for a hillside development permit at the South Rim at Foremaster Ridge Phase 4 development. The applicant is proposing to allow structures in the 30' ridgeline setback in anticipation of the construction of a residential home on lot 85. The property is generally located at 1709 Ridgeline Circle and is currently zoned Single Family Residential, minimum lot size 10,000 sf (R-1-10). The applicant is Robert and Rhonda Marshall. Case No. 2022-HS-007.

Please see the minutes below, both items were addressed at the same time.

MOTION:
SECOND:
AYES (5)
James Sullivan
Dave Black
Jeff Mathis
James Dotson
Russ Owens
NAYS (0)
Motion carries.

4. Consider a request for a hillside development permit at the South Rim at Foremaster Ridge Phase 4 development. The applicant is proposing to allow structures in the 30' ridgeline setback in anticipation of the construction of a residential home on lot 86. The property is generally located at 1721 Ridgeline Circle and is currently zoned Single Family Residential, minimum lot size 10,000 sf (R-1-10). The applicant is Joshua Ballantyne. Case No. 2022-HS-006.

   Wes Jenkins – As you may recall, this was approved in about 2017. At that time Alpha Engineering did the drawings, we didn't take this to hillside because they weren't disturbing any slope greater than 20% and they drew a ridgeline. They did it along the south side and this north side. That's why they came back with those other 3 lots at the last Hillside meeting. They felt like when Alpha drew that it really wasn't a ridgeline. On these two 85 and 86, you can see the pink lath, that is the property line, the wall was built with the subdivision at the 30-foot ridgeline setback. So now the request is to move the wall and bring it out to where those lath are right along there similar to the other ones. The question is, is this a ridgeline or is it a rock formation what do you think? We wanted some input from you based on that information.

   James Sullivan – The actual property is this closest lath to us?

   Wes Jenkins – Yes, 83, 84 and 85 will be bringing their walls out to that lath that goes along there. You are kind of getting into a little of the rock there.

   Jeff Mathis – It's not going to be on this side of that rock out cropping, it's going to be on the east side not the west side, right?

   Wes Jenkins – Right. I think their intent is to put the rock wall right on top of that rock.

   Dave Black – What is the height of the wall?

   Ben xxx – It's undetermined. It will probably be, I'd say around 10 ft.

   Wes Jenkins – Our maximum is only 8 ft. and then you have to step it back at least half the height of the rock wall.

James Sullivan – So in our last meeting we approved 82, 83 and 84 to come out to the property line with the walls. At this point they are just requesting the same thing. There is the 30 ft setback, are we just talking about the wall? The home is still going to be 30 ft. back.

Ben xxx – Right now, yes.

Dave Black – Is that how it reads, Wes?

Wes Jenkins – It reads for walls and basically the request is to eliminate that ridgeline setback because their argument is this is not really a ridgeline, it's more of just a rock formation.

James Dotson – So are you taking the wall to up the full height of the pad?

Ben xxx – It's got to have a walkout, so it will have a walkout. But the wall, if we go up 8 ft and then bring it back, you know we are just trying to level it off, so we don't have 3 different jogs in the lot itself.

James Dotson – I think the critical thing for me is that the mistake that was made over there, everything from those lots has been pushed out over the edge. You have over burden, and you see that from everywhere in the valley. So as long as those rock walls look and are approved like we said on the first two lots right here. That they are stained and are painted to match this then I don't see a problem. It's done, the ground is already disturbed into the 30 ft.

Wes Jenkins – We changed the ordinance a couple years ago and basically it allowed for, before we had to keep it native and you couldn't disturb it, so we changed the ordinance because we kept getting a lot of pushback from residents that they ought to be able to at least use it, put a pool in there. So as far as disturbing it, they could disturb it, they could put a pool or landscape it or so forth, but they couldn't bring a wall or a building out into that area. So basically, I guess the question is, they want to create a ridgeline now with these walls. Are we comfortable with that or do we want them to be set back the 30 ft.

Carol Davidson – The concern is what if lot 87 comes in?

Jeff Mathis – We have got to define somewhere, where does the ridge start, right?

Wes Jenkins – On the south side it was easier, that is the question.

Dave Black – I guess there are 2 questions in my mind. One, is that the ridgeline, in my opinion it is. The other question is are we ok with moving the wall out? But if we do that we go against the ordinance, right?

Wes Jenkins – Yes because you are saying that is the ridgeline.

Dave Black – And I think if we walk over here just a hundred feet you can see the natural ridgeline and this ties in and then it dies out. Am I ok if it moves out, personally, yes as

long as they did the rock and colored it and moved it out, it blends in.? But we would be going against the ordinance because I think that is the ridgeline so that is the dilemma.

James Sullivan – So in the ordinance said that they allow pools, so they are allowed to use it.

Wes Jenkins – We allowed anything below grade, so a pool works with the ordinance. The real intent of this whole thing was to keep the visual and keep that open. A pool really doesn't take away from that.

Discussion on what has happened along the rest of the ridgeline.

Ben xxx – The Newman's lot is in line with the other three that were approved, and it would look strange to step back in.

Dave Black – I think we are better off recommending what we did before, all fill slopes can't be exposed, they need to be covered with the rock. And none of the natural rock out crops can be disturbed.

Wes Jenkins – Some of my question too was is the rock wall going to go on top of the ledge right here and does it match the height of the rock wall over here on those lots? Are you ok with them coming up a little bit to that wall here?

Discussion on what the walls will look like.

Dave Black – I think we should be consistent right here on this face.

Carol Davidson – If there is a motion for approval, can I suggest that you just say the same conditions from the 82, 83, 84 except to add in no disturbance of the natural rock outcrop?

MOTION: Dave Black made a motion to recommend for approval on these 2 lots that they meet the same conditions that we had recommend previously to the adjacent lots to the south with the exception that there is no disturbance of the natural basalt rock outcrop along the property line, building out to the property line with an 8-foot rock wall with the contingency that there is no solid privacy wall above the rock wall, it has to be view fencing also the 8-foot rock wall be stained or painted to match the ridgeline rock and that there be no exposed fill slopes.
SECOND: Russ Owens
AYES (5)
James Sullivan
Dave Black
Jeff Mathis
James Dotson
Russ Owens
NAYS (0)
Motion carries.

5. Consider a request to determine the ridgeline at Foremaster Ridge Lot 120 subdivision. The applicant is proposing to build a residential home on this parcel and would like to know where the ridgeline falls on this property. The applicant would also like to receive a reduction in the front setbacks from 25' to 20'. The property is generally located at 445 S. Five Sisters Drive and is currently zoned Single Family Residential, minimum lot size 10,000 sf (R-1-10). The applicant is John Wilson. Case No. 2022-HS-008.

   James Sullivan – We are looking at an application to determine the ridgeline.

   Wes Jenkins – The plat says 30 feet from the abrupt edge, and that is where we want some guidance from you because their property lines are actually below the edge, so we need some guidance on what the abrupt ridgeline edge is.

   John Wilson – The survey that we had matches what the plat show, so the plans we have been building for the last year are based off that, we will be in real trouble if that's not the case.

   Carol Davidson – When you go down there you see that it is tiers, so it is questionable where the abrupt edge is.

   The Hillside Committee walked the lot and discussed where the abrupt edge was located and how the other homes on the ridge were built and placed in regard to the ridgeline abrupt edge.

   MOTION: Dave Black made a motion to recommend approval for lot 120 Foremaster Ridge that based on the drawings submitted and our onsite visit it is our opinion that if they can get a 5 foot reduction in front that the house would fit within the 30 foot setback from the abrupt edge as present onsite, also make the stipulation that during the construction process no fill soils be allowed to go over the edge of the slope and any exposed fills to create the pad be covered with retaining walls, either natural basalt rock or colored concrete that matches the surrounding area.
   SECOND: Jeff Mathis
   AYES (5)
   James Sullivan
   Dave Black
   Jeff Mathis
   James Dotson
   Russ Owens
   NAYS (0)
   Motion carries.

6. Consider approval of the meeting minutes from January 26, 2022.

   MOTION: Dave Black made a motion to approve the minutes from the January 26, 2022, meeting.
   SECOND: James Dotson
   AYES (5)
   James Sullivan

Dave Black
Jeff Mathis
James Dotson
Russ Owens
NAYS (0)
Motion carries.

St.George
Community Development

Item 1

Hillside Permit

HILLSIDE REVIEW BOARD AGENDA REPORT: 04/27/2022

HILLSIDE DEVELOPMENT PERMIT
Indian Hills Temple Trail
Case No. 2022-HS-010

Request: This is a request for a Hillside Development Permit to allow the applicant to develop a proposed single-family development. The applicant has provided a slope analysis, proposed drainage report and site layout for consideration.

Exhibits Provided

1) Exhibit A - Slope Analysis Maps & Site Plan
"Exhibit A" in the packet shows the overall slope analysis for the site under review. The proposed site plan for the single-family residential development.

2) Exhibit B – Rockfall Study Exhibit:
A rock fall study exhibit for the proposed development.

3) Exhibit C – Geotech Report.
Geotech Report.

4) Exhibit D – Drainage Report
Drainage report for the proposed development

Background: This is a request from the property owners at 720 W Indian Hills Drive for the Hillside Review Board to determine the location of the buildable land and any measures that are needed to mitigate the hillside. The owner is coming before the Hillside Review Board for the purpose of reviewing the slopes and to determine what needs to be done to develop the proposed single family residential subdivision on this vacant land.

Owner: Gary Carter LP

Representative: Taylor Ricks

Engineer: Mainline

APN: SG-6-2-36-40002

Location: The property is located at 720 W Indian Hills Drive.

Acreage: Approximately +/- 50 Acres

Zoning: Single Family Residential, minimum lot size 10,000 sf (R-1-10)
General Plan: LDR (Low Density Residential) & Open Space (OS)

Adjacent zones: North-R-1-10, South & East Open Space, and West-Washington County property.

Powers & Duties: Section 10-13A-8. B.1 of the "Hillside Review Board Powers and Duties" states that the hillside board can make recommendations to "adopt, modify or reject a proposal" to the Planning Commission (PC).

Permit required: Section 10-13A-7 requires that all major development (i.e., cut greater than 4', etc.) on slopes above 20% requires a 'hillside development permit' granted by the City Council upon recommendation from the Hillside Review Board and the Planning Commission.

Analysis: The Hillside Review Board will need to determine whether or not the areas to be disturbed are "significant" or not. If so, are there conditions that can be placed on the request to mitigate the impacts or is it just not feasible and warrants a denial? Applicable ordinances which may help the board in their review can be found below.

Applicable Ordinance(s):
(Selected portions)

10-13A-1: Density and Disturbance Standards

A. The hillside development overlay zone (HDOZ) limits development densities and provides specific development incentives to transfer underlying zone densities from hillsides (sending areas), to less steep slopes or more safe development areas (receiving areas), within a development.

Percent Natural Slope	Dwelling Units (DU) / Acre
0-19	See underlying zone
20-29	2 DU/acre, provided the units are clustered on 30 percent (30%) or less of the land area within this slope category. 70 percent of this slope category shall remain undisturbed. The 70 percent area is based upon the overall area/development rather than per lot. Also see subsections A1, A2, and A3 of this section.
30-39	1 DU/10 acres, provided no more than 5 percent (5%) of the site is disturbed, and 95 percent of the site remains undisturbed. If the cumulative area is at least 1 acre but less than 10 acres, the cumulative area shall be allowed 1 DU.
40	Development is not permitted (0%), **except** as provided for in subsection A4 of this section.

Section 10-13A-1: Density and Disturbance Standards

F. The applicant may:

1. Transfer all development density from steeper slope categories (sending areas), to areas within the development with natural slopes of twenty percent (20%) or less (receiving areas); and
2. Develop additional bonus density, calculated from each slope category, as follows:
    a. Natural slopes twenty percent (20%) or less transferred on a one-to-one (1:1) unit basis; plus
    b. One (1) additional density unit for each density unit transferred from natural slopes of twenty-one percent (21%) to thirty percent (30%); plus
    c. Two (2) additional density units for each density unit transferred from natural slopes of thirty-one percent (31%) to forty percent (40%).
3. Unit calculation for the receiving area shall be based on the requirements of the sending area zone.

G. Density transfers to the receiving area may occur without a zone change within the receiving area even though the resulting density or configuration may exceed the density limits of the receiving area zone. Other than density, the receiving area's zoning requirements apply to development in the receiving area. For instance, lot sizes may vary, but single-family zoning districts only allow single-family detached dwellings.

H. If the applicant proposes to develop within the twenty-one percent (21%) to forty percent (40%) slope area, the applicant cannot employ partial density transfers from the sending area and must propose a design, site development plans, and a grading plan that blends and harmonizes all aspects of the proposed development into the natural topography, and that minimizes road cuts and fills.

I. Non-disturb areas within a residential lot as shown on the slope analysis map shall not be used to calculate minimum lot size.

J. Disturbance standards do not apply to the city for limited city facilities: trails, parks, and utilities.

10-13A-2: Density and Disturbance Standards

A. Slope shall be determined for each significant portion of a development parcel.

B. *Procedure:* The applicant shall map the location of the natural slope by using the following procedure:

1. *Preparation of Contour Maps:* The applicant shall submit an accurate, current contour map, prepared and certified by a licensed professional engineer or surveyor, which shows all land contours at intervals no greater than five feet (5'), drawn at a one inch equals one hundred feet (1" = 100') scale maximum.
2. *Verification through Field Surveys:* The city engineer or designee may require the applicant to submit a field survey to verify the accuracy of the contour map.

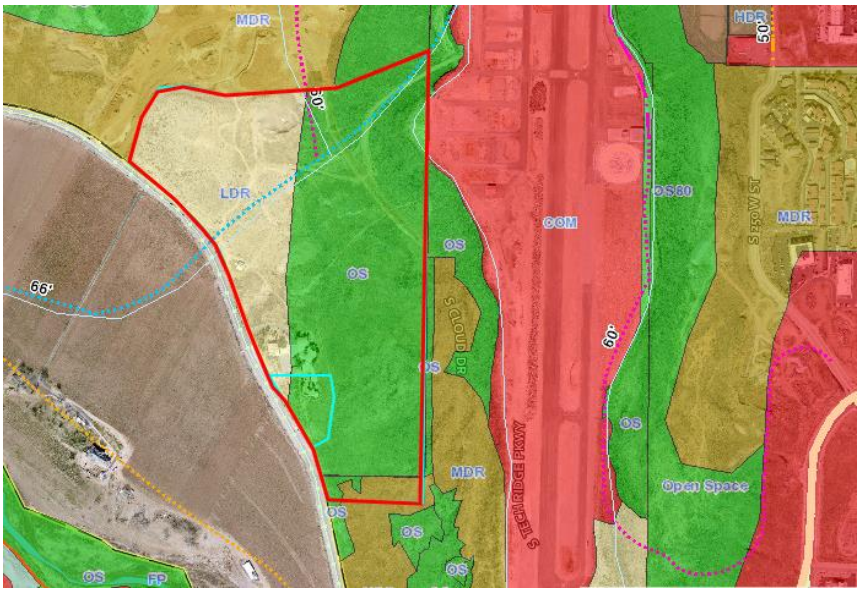
C. *Determination of Slope Areas:* Using the contour map, natural slopes shall be calculated using points identified as natural slopes of twenty percent (20%), thirty percent (30%), and forty percent (40%), and shall be located on the contour map and connected by a continuous line. That area bounded by said lines and intersecting property lines shall be used for determining project density. Small washes or outcrops, which have slopes distinctly different from surrounding property, and are not part of the contiguous topography, may be excluded from the slope determination.

Recommendation: The applicant is requesting development of a Temple Trail single family residential subdivision.

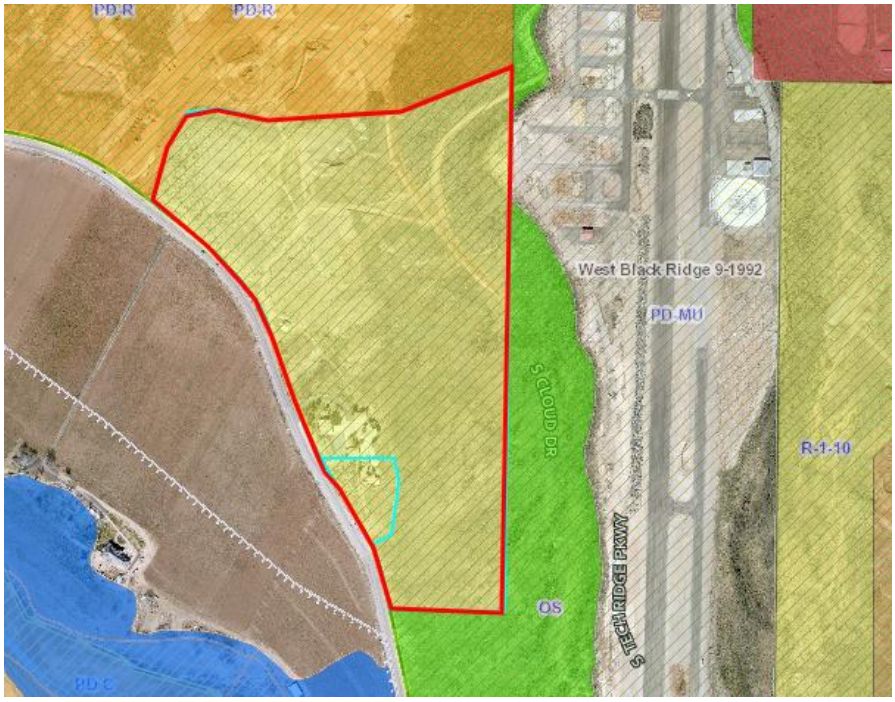
Vicinity Map

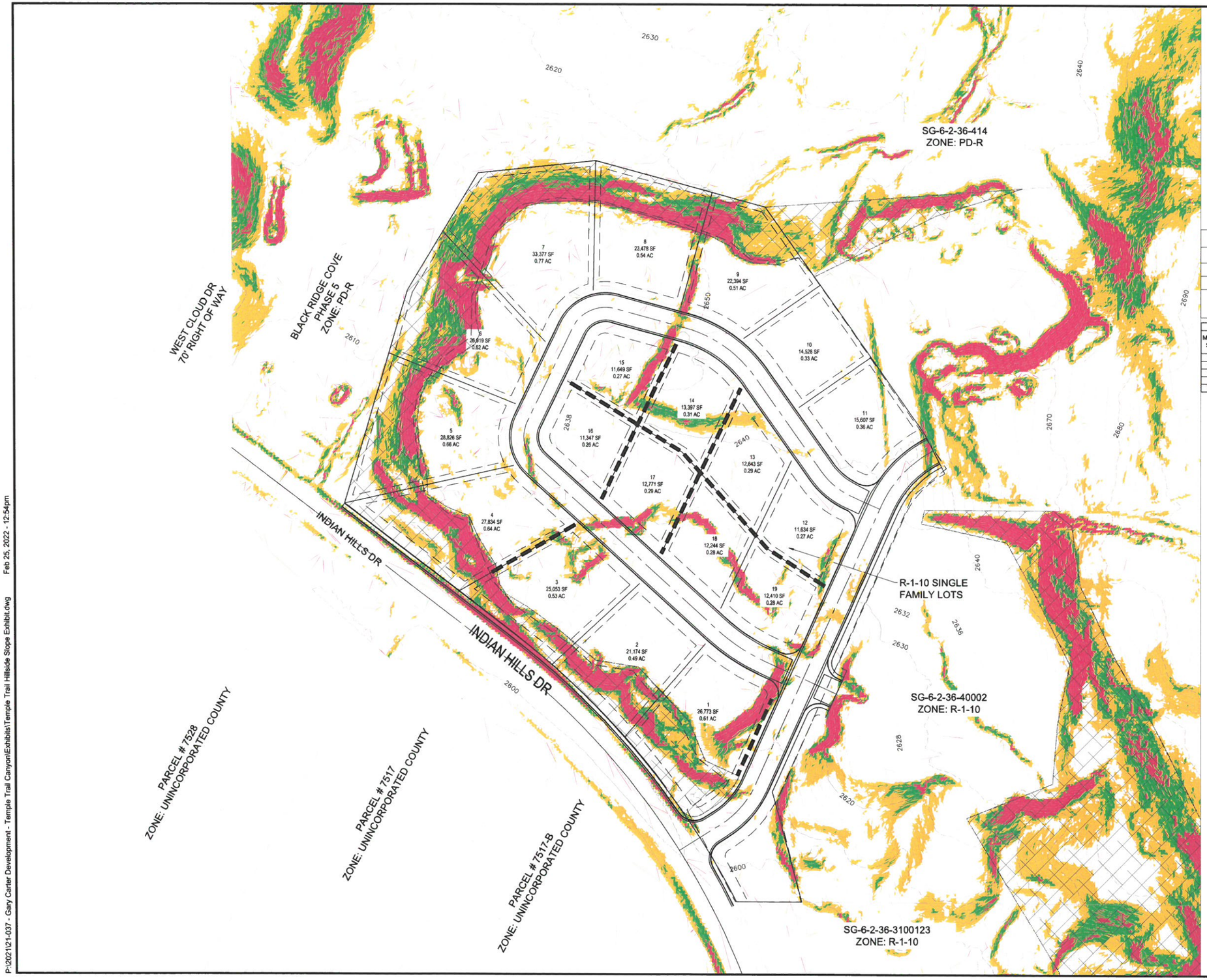


General Plan – LDR & OS



Zoning – Open Space & R-3





LEGEND

- SLOPES 20% - 30%
- SLOPES 30% - 40%
- SLOPES > 40%

AVERAGE GRADE ACROSS ENTIRE PARCEL NORTH TO SOUTH = 1.80%

AVERAGE GRADE ACROSS ENTIRE PARCEL EAST TO WEST = 2.20%

SITE DATA

DATA TYPE	VALUE
PARCEL	H-3-1-34-4400
EXIST. ZONING	R-1-10
GENERAL PLAN	R-1-10

TEMPLE TRAIL SLOPE TABLE

MINIMUM SLOPE	MAXIMUM SLOPE	AREA SQ FT	AREA ACRE	PERCENT OF TOTAL	PERCENT DISTURBED	COLOR
0.0%	19.9%	326,072	7.49	70%	95%	
20.0%	29.9%	50,573	1.16	11%	80%	
30.0%	39.9%	38,469	0.88	8%	50%	
> 40%	–	48,105	1.10	10%	10%	
TOTAL		463,219	10.63	100%	81%	

811 Know what's below. Call before you dig.

N

GRAPHIC SCALE
60 0 60 120
(IN FEET)

NO.	REVISIONS	BY	DATE

MAINLINE ENGINEERING
GARY W CARTEN LE
2230 WEST INDIAN HILLS DRIVE
ST. GEORGE, UT 84770

MAINLINE ENGINEERING
2230 WEST INDIAN HILLS DRIVE
SUITE T101
ST. GEORGE, UT 84790

PROJECT: TEMPLE TRAIL
CLIENT PROJ. #: N/A
MAINLINE PROJ. #: 21-037
SHEET NAME: HILLSIDE REVIEW SLOPE EXHIBIT
SHEET: EXHIBIT

DRAWN BY: TAR
CHECKED BY: PBG
DATE: 2/25/22

Taylor Reeves
PROFESSIONAL ENGINEER

P:\2021\21-037 - Gary Carter Development - Temple Trail Canyon\Exhibits\Temple Trail Hillside Slope Exhibit.dwg Feb 25, 2022 - 12:54pm

LEGEND

ANTICIPATED RETAINING WALL (HEIGHT VARIES 3'-8')

MINIMUM ROAD GRADE	0.50%
MAXIMUM ROAD GRADE (1150 WEST)	<8.00%

Know what's below. Call before you dig.

NO.	REVISIONS	BY	DATE

MAINLINE ENGINEERING
324 NORTH MALL DRIVE
SUITE 1101
ST. GEORGE, UT 84790

GARY W CARTER LP
7076 ESTANCIA HILLS DRIVE
ST. GEORGE, UT 84770

DATE 2/25/22 | DRAWN BY TAR | CHECKED BY PBG

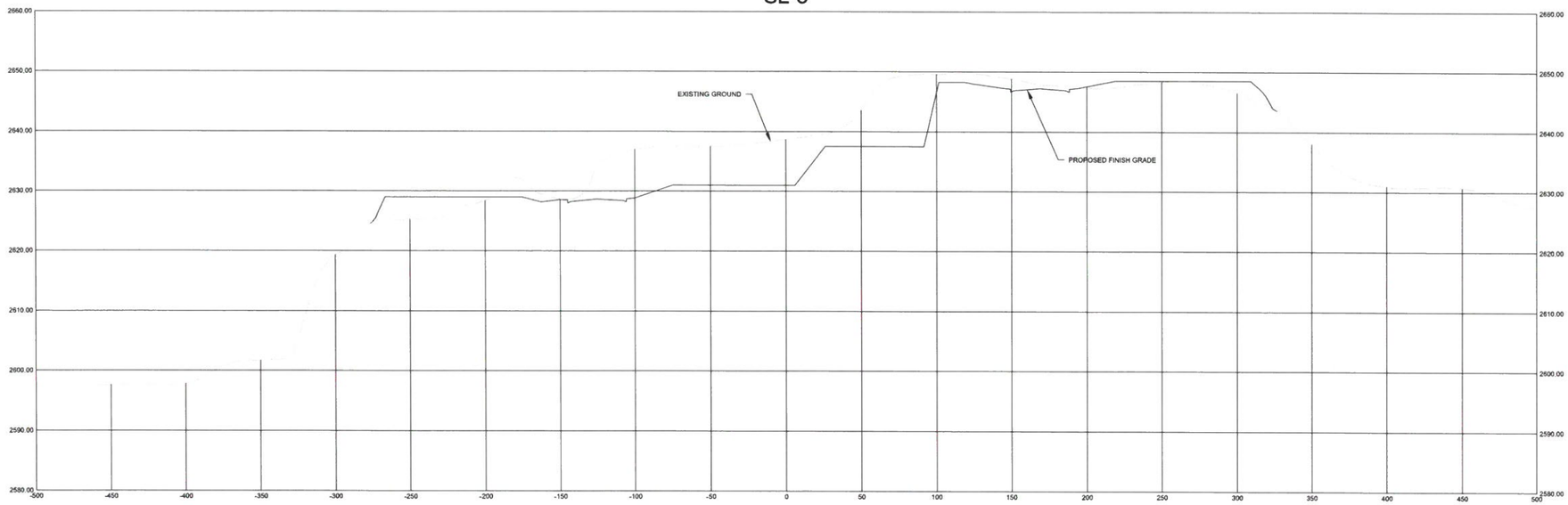
PROFESSIONAL ENGINEER

PROJECT: TEMPLE TRAIL
CLIENT PROJ.# N/A
MAINLINE PROJ.# 21-037
SHEET NAME: HILLSIDE REVIEW SLOPE EXHIBIT

SHEET EXHIBIT

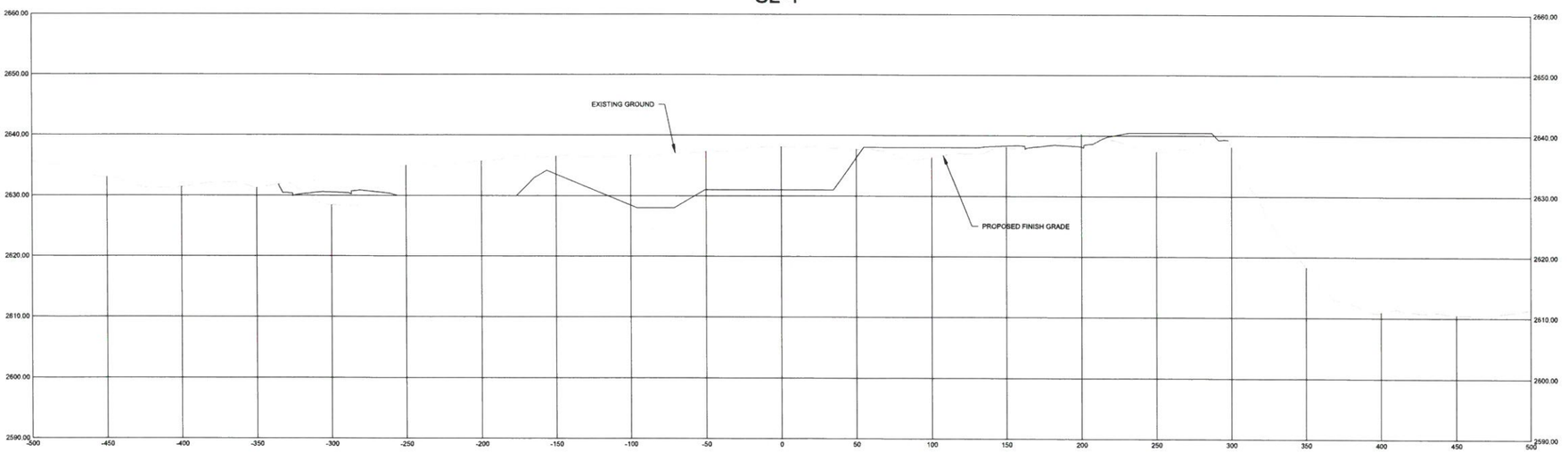
P:\202121-037 - Gary Carter Development - Temple Trail Canyon\Exhibits\Temple Trail Grading Exhibit.dwg Feb 25, 2022 - 12:56pm

SL-3



SECTION A-A

SL-4



SECTION B-B

Know what's below. Call before you dig.

N

GRAPHIC SCALE

40 0 40 80

(IN FEET)

NO.	REVISIONS	BY	DATE

MAINLINE ENGINEERING
321 NORTH MALL DRIVE
SUITE T101
ST. GEORGE, UT 84790

GARY W CARTER LP
720 WEST INDIAN HILLS DRIVE
ST. GEORGE, UT 84770

DRAWN BY: TAR
CHECKED BY: PBG
DATE: 2/25/22

Jaylon Reeves
PROFESSIONAL ENGINEER

PROJECT: TEMPLE TRAIL
CLIENT PROJ. #: N/A
MAINLINE PROJ. #: 21-037
SHEET NAME: HILLSIDE REVIEW CROSS SECTION EXHIBIT

SHEET: EXHIBIT

P:\2021\21-037 - Gary Carter Development - Temple Trail Canyon\Exhibits\Temple Trail Grading Exhibit.dwg Feb 25, 2022 - 12:47pm

March 24, 2022

Feller Enterprises
708 East 1100 South
St George, Utah 84790

Attention: Tyson Feller
EMAIL: tyson@fellerent.com

Subject: Rockfall Hazard Assessment
Temple Trail Canyon Subdivision
Indian Hills Drive
St George, Utah
Project No. 2220105

Mr. Feller:

Applied Geotechnical Engineering Consultants, Inc. (AGEC) was requested to evaluate potential rockfall hazard for the proposed Temple Trail Canyon Subdivision located on the north side of Indian Hills Drive across from Gubler Lane in St George, Utah.

PROPOSED CONSTRUCTION

We understand the area is planned for single-family residences.

GEOLOGY

The geology of the site is mapped by Hayden and Willis (2011) to consist predominantly of Quaternary alluvium, some colluvium and some areas of bedrock. The bedrock underlying the site is mapped as the Triassic Petrified Member of the Chinle Formation. The nearest outcrops that would produce rockfall material is the Quaternary Cedar Bench Lava Flow exposed near the top of the airport bluff east of the site.

SITE DESCRIPTION

Much of the site appears to have been mined for gravel. It is currently undeveloped land.

Vegetation at the site consists of a sparse coverage of grass and brush.

The general topography of the site consists of relatively level ground through the middle and moderate slopes along the north, south and west sides.

There is residential development under construction to the north and west and undeveloped land to the south and east. Indian Hills Drive borders the south side of the property.

ROCKFALL EVALUATION

A site visit was performed and finds no evidence of rockfall source close enough to the site to be a hazard for the proposed development. The closest cliffs with rock outcrops that could produce rockfall material are located approximately 780 feet east of the east side of the development. Assuming a conservative shadow angle of 20 degrees from the cliff base, the proposed subdivision is at least 400 feet beyond the potential rock-runout zone. Rockfall is not considered to be a hazard for the proposed development.

LIMITATIONS

This letter has been prepared in accordance with generally accepted geologic engineering practices in the area for the use of the client. The conclusions included in the letter are based on conditions observed during our site visit and the topographic information obtained from the Utah AGRC website.

If you have questions or if we can be of further service, please call.

Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Douglas R. Hawkes, P.E., P.G.

Reviewed by JEN, P.E.

DRH/rs

Reference:

Hayden, J.M. and Willis, G.C. 2011; Geologic map of the St George quadrangle, Washington County, Utah, Utah Geological Survey Map 251DM.

AGEC

Applied GeoTech

GEOTECHNICAL INVESTIGATION

TEMPLE TRAIL SUBDIVISION
APPROXIMATELY 720 WEST INDIAN HILLS DRIVE
ST. GEORGE, UTAH

PREPARED FOR:

FELLER ENTERPRISES

706 EAST 1100 SOUTH
ST. GEORGE, UTAH 84790

ATTENTION: TYSON FELLER

PROJECT NO. 2220105

APRIL 21, 2022

1420 South 270 East • St. George, Utah 84790 • (435) 673-6850 • FAX (435) 673-1044

TABLE OF CONTENTS

SUMMARY. . . . . Page 1

SCOPE. . . . . Page 3

SITE CONDITIONS. . . . . Page 4

FIELD STUDY.. . . . . Page 5

SUBSURFACE SOIL CONDITIONS. . . . . Page 5

SUBSURFACE WATER. . . . . Page 6

PROPOSED CONSTRUCTION. . . . . Page 7

RECOMMENDATIONS. . . . . Page 7
- A. Site Grading. . . . . Page 8
- B. Foundation Recommendations. . . . . Page 14
- C. Concrete Slab-on-Grade. . . . . Page 15
- D. Lateral Earth Pressures.. . . . . Page 15
- E. Seismicity. . . . . Page 17
- F. Soil Corrosion. . . . . Page 18
- G. Pavement. . . . . Page 19
- H. Construction Testing and Observations.. . . . . Page 20
- I. Geotechnical Recommendations Review. . . . . Page 21

LIMITATIONS. . . . . Page 22

FIGURES AND TABLE

Vicinity Map	Figure 1
Site Plan	Figure 2
Geologic Map	Figure 3
Landslide Hazard Map	Figure 3a
Rockfall Hazard Map	Figure 3b
Logs of Test Pits	Figures 4
Legend and Notes of Test Pits	Figure 5
Rockfall Hazard Report	Appendix A
Site Photos	Appendix B

SUMMARY

1. The subsurface soils were evaluated during a previous study by AGEC (formerly Southwest Testing Inc.) In 1996. AGEC has utilized the previous data along with review of the property for geologic hazards review. AGEC has also conducted the study for the Blackridge Cove and Cloud Drive projects adjacent to the property. The data from these studies was reviewed as a part of our evaluation.

   The subsurface profile observed within the test pits excavated varied across the site with the majority of the site containing silty gravel overlying mudstone bedrock. Silty sand, clayey sand and lean clay was encountered. The mudstone is known in the area as "blue clay" and is moderately to highly expansive when wetted and is anticipated to exist below the entire site. The gravels varied from non to moderately cemented (conglomerate like).

2. Groundwater was not encountered within the test pits to the depths investigated. AGEC has found groundwater to the north and northwest of the site within the Black Ridge Cove development. The groundwater is generally perched over the underlying mudstone. The mudstone to the north is a significantly lower depths. The groundwater generally follows the wash adjacent the north and west sides of the property.

3. The site consists of a previous ridge that has been partially excavated and terraced with slopes down to the west, north and south along Indian Hills Drive. The site has been mined for gravel purposes in the past. The ridge continues up to the east. Based on the proposed grading, cuts and fills from 1 to 6 feet. Larger fills may be needed along the perimeter of the lots.

4. AGEC has reviewed the geologic literature (See Figure 3 for geologic map of the site) and has visited the site to review the potential hazards on the site. The potential hazards identified consist of expansive mudtsone (blue clay), rockfall and landslides.

   The landslide hazard map indicates the hillside to the east is part of a larger landslide (See Figure 3a). AGEC has previously evaluated the landslide as a part of the Cloud Drive evaluation. Based on our evaluation, the proposed subdivision is outside the limits of the landslide.

   AGEC has also evaluated the site for the Rockfall Hazard that the property is mapped within a high rockfall zone (See Figure 3b). AGEC has also evaluated the potential for rockfall on the property and has previously submitted our findings in a report dated, March 24, 2022. Our evaluation indicates that the potential for rockfall hazard on the site is very low.

5. The proposed residential structures may be supported on conventional spread footings bearing on properly compacted structural fill. Due to the expansive mudstone, we recommend to provide at least 15 feet of separation between the expansive mudstone and pad grade. The pads may be raised to provide the necessary separation. Alternatively, the residences may be supported on a deep foundation system. These recommendations are not provided within this report. We understand it is planned to overexcavate and/or raise

the building pads to provide the recommended separation. If deep foundations are desired, AGEC can provide detailed recommendations in the future.

6. The on-site non-mudstone soils free of organics and debris, are suitable for use as structural fill, site grading fill, and utility trench backfill. The on-site mudstone is not suitable for use as structural fill. The mudstone may be used as trench backfill, provided it is properly moisture conditioned and placed at least 4 feet below grade. The mudstone may also be considered to be used by mixing with non expansive soils and placed in the deeper portion of the pad overexcavations.

7. The cemented gravels will be difficult to excavate and may require heavy duty equipment or the use of a hammer-hoe if thicker zones of the cemented gravel are encountered.

8. Detailed recommendations for subgrade preparation, pavements, materials, foundations, and drainage are included in the report.

9. The information provided in this summary should not be used independent of that provided within the body of this report.

SCOPE

This report presents the results of a geotechnical investigation for the proposed Temple Trail Subdivision to be located in St. George, Utah, as shown in Figure 1. This report presents the subsurface conditions encountered, laboratory test results, and recommendations for the project. AGEC has utilized previous studies conducted on or adjacent the project including along with the available geologic literature and grading plan:

1. Geotechnical Investigation, Temple Trail Subdivision, by AGEC for Gary Carter, Project No. 960037, dated March 5, 1997. Includes the property.

2. Geotechnical Investigation, by AGEC, “Indian Hills Drive Widening”, - In 2013, St. George City with UDOT widened and reconstructed portions of Indian Hills Drive.

3. Geotechnical Investigation and Hillside Review, Black Ridge Cove (formerly Temple Trail Subdivision), prepared for Tech Ridge, LLC. Report dated September 21, 2018, Project No. 2180672. Located adjacent and to the north of the project site.

4. Addendum to Geotechnical Investigation, Black Ridge Cove, prepared for Tech Ridge, LLC, Report dated December 23, 2019, Project No. 2180672.

5. Slope Evaluation, Cloud Drive (Tech Ridge South Access Road), Project No. 2180295, Report dated October 19, 2018, Clarification Report dated December 17, 2008.

6. Utah Geological Survey, Special Study 127, “Geologic hazrds and Adverse Construction Conditions, St. George-Hurricane metropolitan area, Washington County, Utah, Lund et al, 2008.

7. Utah Geologic Survey, Map 251DM, Geologic Map of the St. George 7.5" Quadrangel, Washington County, Utah, Hayden and Willis, 2011.

8. Grading Plan, prepared by Mainline Engineering, dated 2022.

In addition to the review of these references, AGEC has utilized the subsurface information from Reference No. 1 above that was conducted on this site in 1996. During this study, the data from the field exploration was used to obtain information on the subsurface conditions and to obtain samples for laboratory testing. Information obtained from the field and laboratory was used to define conditions at the site and to develop recommendations for the proposed development.

This report has been prepared to summarize the data obtained during the study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to construction are included in this report.

SITE CONDITIONS

The property is located at the toe of the west side of the West Black Ridge in St. George, Utah as shown on Figure 1. The property is located north and slightly east of Indian Hills Drive. To the north of the property is the recently completed Black Ridge Cove project. Located to the east is a partially graded hillside or the west slope of the west Black Ridge. Cloud Drive that extends from Indian Hills drive through Black Ridge Cove and up the ridge to the east and southeast. Indian Hills Drive is located to the south. Across Indian Hills Drive to the south are agricultural fields. There is also vacant property to the southeast east of Indian Hills Drive with a residence further to the south.

The area of the proposed subdivision has been partially graded while being used as a borrow site. The majority of the site is relatively flat with terraced areas. There are slopes down to the west, south and north around the perimeter of the site. The topography of the site is shown on Figure 2.

There are sparse amounts of vegetation consisting of desert brush and weeds and grasses. Several photos of the site are included in the Appendix section of this report.

FIELD STUDY

On January 8 and August 26, 1996, a representative from AGEC (formerly Southwest Testing, Inc.) visited the site and observed the excavation of 13 test pits at the approximate locations shown on the Site Plan, Figure 2. The test pits were excavated with a rubber tire backhoe. The subsurface soil profile was logged and soil samples were obtained at this time for laboratory testing.

SUBSURFACE SOIL CONDITIONS

The site was evaluated by excavating 13 test pits at the locations shown on Figure 2. The locations and elevations of the test pits were measured by pacing from existing land features and the elevations were determined from interpolation between contours on the site plan provided by Mainline Engineering..

The subsurface profile observed within the test pits excavated varied across the site with the majority of the site containing silty gravel overlying mudstone bedrock. Silty sand, clayey sand and lean clay was encountered along the eastern portion of the site. The mudstone is known in the area as “blue clay” and is moderately to highly expansive when wetted. The gravels varied from non to moderately cemented (conglomerate like).

Descriptions of the soil and bedrock types encountered follow:

Sand and Gravel: The sand and gravel contained varied amounts of silt and clay. The gravel contained cobbles to occasional small boulders. The gravel was generally subrounded and was dense to very dense. Portions of the gravel was moderately cemented and practical refusal was encountered in several of the test pits.

Lean Clay - The lean clay contains varied amounts of sand and is medium stiff to very stiff, moist and red to brown in color.

Mudstone Bedrock - The mudstone bedrock is soft to moderately hard, moist and is purple to grey to red in color.

The Logs of Test Pits are shown on Figures 3 and 4. The Legend and Notes of Test Pits are shown on Figure 4. Laboratory test results are also shown on test pit logs.

SUBSURFACE WATER

Groundwater was not encountered within the test pits to the depths investigated. During previous studies, groundwater was encountered within the Black Ridge Cove subdivision to the north. It appears that the groundwater is perched on the underlying mudstone bedrock. We anticipate fluctuations in the groundwater level will occur over time. Our study does not include an evaluation of the fluctuations.

PROPOSED CONSTRUCTION

The proposed Temple Trail Subdivision is proposed as shown on Figures 2 and 2A. The project will include 19 single family lots. The site is proposed to be graded by cutting and filling on the order of 1 to 6 feet with larger fills possible around the perimeter of the site. The perimeter of the slopes will remain undisturbed. We anticipate some retaining may be provided at the top of the slope areas.

We anticipate that the residential structures will be single-family, slab on grade residences We anticipate the residences will be constructed using conventional spread footings with slab-on-grade floors, and will likely be constructed with wood framing, stucco or rock veneer, and tile roofs.

For design purposes, we have assumed wall loads of up to 2 kips per linear foot and column loads of up to 30 kips. As part of the development, we understand that roadways, utilities and city improvements will also be included. For design purposes, we have utilized a traffic index (TI) of 5 for the interior roads in accordance with the St. George City standards.

If the proposed construction, or building loads are significantly different from those listed, we should be notified so that we can reevaluate our recommendations.

GEOLOGIC HAZARDS

Based on our review of the literature (Ref No.'s 6 and 7) and our site observations, AGEC identified the site as having 3 potential geologic hazards. These included:

1. **Landslide** - The slope of the west facing side of the Black Ridge has been mapped as a landslide. AGEC has conducted a previous study (Ref No. 5) that concluded that the hillside has a potential for future movement. The study and subsequent studies on the east side of the Black Ridge have shown that the factor of safety is generally less than 1.5. The mapping (See Figure 3a) shows the site is not a part of the overall landslide and that the potential movement of the slide should not affect the residences within the development.

2. **Rockfall** - AGEC has previously evaluated the potential rockfall. Our conclusions are included in Appendix A.

3. **Expansive Mudstone** - The investigation has noted that expansive mudstone is encountered within the majority of the explorations and is anticipated to exist through out the property at some depth. Recommendations are provided for mitigation of structures and improvements by treatment of overexcavation and replacement.

RECOMMENDATIONS

Based on our experience in the area, the subsurface conditions encountered, our engineering analysis, and the proposed construction, the following recommendations are provided:

A. Site Grading

Based on the subsurface conditions and proposed grading provided by Kuma Engineering, the following recommendations are provided:

1. Subgrade Preparation

General: Prior to placing structural fill, site grading fill or concrete, the site should be grubbed to remove vegetation and soil containing roots and organics.

Roadways - As a minimum, we recommend the depth of overexcavation (beneath roadways, flatwork or other surface improvements) should extend at least 1 foot below the existing ground surface or 1 foot below the bottom of the proposed subgrade elevation whichever is greater. If mudstone is encountered within 3 feet of the proposed subgrade, the subgrade should be overexcavated to a depth of 3 feet and replaced with low permeable fill . The limits of overexcavation should extend at least 2 feet beyond the limits of the proposed improvements.

Subsequent to overexcavation of the right-of-ways and prior to placing site grading fill, the exposed subgrade should be scarified to a depth of at least 6 inches, properly moisture conditioned, and compacted. The removed soil may then be replaced in properly moisture conditioned and compacted lifts.

Expansive Mudstone/Clay Soil - (Residences): In areas where the expansive mudstone is encountered within 15 feet of pad grade, the mudstone should be removed by overexcavation. We anticipate the majority of the residences will require removal of mudstone.

Construction of pools or below grade structures has not been evaluated. If a pool or below grade structure is desired, further subsurface investigation, laboratory testing and engineering analysis is recommended. Typically, a similar separation is recommended for below grade structures and pools.

2. Excavation/Slopes

Permanent cut slopes excavated into the overburden soils cut no steeper than 2:1 (horizontal to vertical). Cut slopes excavated in the underlying bedrock should be excavated no steeper than 1:1 (horizontal to vertical). The bedrock cut slopes will

remain stable irrespective of height, but the total height of the exposed bedrock cut slopes may be limited by building codes, zoning or subdivision regulations.

Erosion/raveling of the exposed bedrock cut face should be anticipated due to weathering processes. The mudstone will dry, shrink and shallow slumps may occur. This could result in accumulation of soil deposits at the toe of the cut slope and will require maintenance to remove the deposits over time.

To control erosion and weathering, the bedrock cut slopes should be faced with rockery facing backfilled with angular, crushed stone or reinforced gunnite facing attached with soil nails. This would be particularly critical where softer mudstone is exposed. Benches may also be cut into the slopes to assist in controlling drainage and erosion. Benches should be at least 5 feet in width and should be constructed at intervals in accordance with the 2018 IBC. In lieu of facing shale or mudstone cuts, they could be flattened to a 3:1 (horizontal to vertical) slope.

Fill slopes constructed with on-site granular soils should be constructed no steeper than 2:1 (horizontal to vertical). Fill slopes should be constructed by overbuilding the slope and then cutting back the slope face to the desired grade to provide a properly compacted slope face. Fill placed on existing slopes steeper than 3:1 (horizontal to vertical) should be keyed into the existing slope using a benching procedure. Benches should be of sufficient width to allow for operation of compaction equipment.

Steeper cut and fill slopes may be necessary with the granular soils. Steeper slopes should be properly retained or reinforced. Additional analysis and design will be necessary to properly support the taller slopes and to ensure stability.

Water should be directed around slopes using drainage swales to reduce potential erosion in accordance with a site specific drainage plan. Soil slopes may also be protected from erosion with an appropriate geotextile or riprap underlain with filter fabric. More detailed recommendations for riprap erosion control can be provided

if requested. A lot specific drainage study should be conducted on lots adjacent to the hillside.

Utility trenches excavated in the on-site soils should be excavated in accordance with OSHA requirements using a OSHA Soil Class C (1½:1 Horizontal:Vertical) for overburden soils and Soil Class A (½:1) for trenches excavated into the bedrock. Steeper trenches may require the use of shoring or a trench box to provide as safe work environment. Safe trench excavation is the responsibility of the contractor.

3. Materials

Import materials should be non-expansive, non-gypsiferous, granular soil. Listed below are the materials recommended for imported fill.

Area	Fill Type	Recommendations
Pads/Foundations/slabs	Site grading/ structural fill	**-200** <35%, **LL** <30% Maximum size: 4 inches Solubility < 1%
Roadways	Base course	CBR>50%, **200** <12% Maximum size: ¾ inch
Underslab	Base course	**-200** <12% Maximum size: 1 inch

-200 = Percent Passing the No. 200 Sieve
LL = Liquid Limit

The on-site sandy lean clay, sand and gravel soils free of organics and debris, are suitable for use as structural fill, site grading fill, and utility trench backfill. The on-site mudstone is suitable for use as utility trench backfill, provided it is placed at least 3 feet below subgrade. The mudstone may be considered to be mixed and placed in the lower 5 feet of the pad overexcavation zone. The mix ratio will depend on the type of non-expansive material use as a the mixture. Typical ratios are 2:1 (non expansive to mudstone) and should be verified by testing prior to use.

4. Compaction

Compaction of fill materials placed at the site should equal or exceed the following percentages when compared to the maximum dry density as determined by ASTM D-698 or ASTM D-1557:

Area	Percent Compaction ASTM D-1557
Subgrade	90
Footings/foundations	95
Slabs/Pad Fill (over excavation)	95
Utility trench backfill (Structural Areas)	95
Wall Backfill (Structural Areas)	95

Fill should be placed in lifts which do not exceed the capability of the equipment used. Generally 6 to 8 inch lifts are adequate for heavy rubber tire equipment. Lift thicknesses should be reduced to 4 inches for hand compaction equipment. Fill placed at the site should be properly moisture conditioned prior to placement and should be tested to verify proper compaction.

Fill materials should be properly moisture conditioned prior to placement. Fine-grained, low permeable fill should be moisture conditioned to 2 to 4 percentage points over the optimum moisture content as determined by ASTM D-698. Granular soil should be moisture conditioned to within 2 percentage points of the optimum moisture content as determined by ASTM D-1557.

5. Drainage

The following drainage recommendations should be implemented:

- Positive site drainage should be maintained during the course of construction. In no case should water be allowed to pond adjacent to buildings/foundations.

- After construction has been completed, positive drainage of surface water away from the structures should be maintained throughout the life of the structures. We recommend a minimum slope of 6 inches in the first 10 feet from the perimeter of the structures. Hard or impermeable surfaces may be used to direct water away from buildings.

- Roof gutters should also be utilized with downspouts which extend out away and down slope from buildings. Preferably, downspouts should discharge off-site.

- We also recommend that desert landscaping, which requires no water, be used adjacent to concrete or masonry walls which will be backfilled to reduce salt migration of soluble salts and the subsequent salt weathering on cement containing elements. Further, the below grade portions of walls/fences which are backfilled with soil should be protected with an impermeable membrane and a subsurface drain. A gravel covered, perforated PVC pipe should also be placed at the base of the wall to carry water to a discharge point. This is intended to reduce the potential for salt weathering and sulfate attack on concrete/masonry.

6. Low Impact Development (LID)

AGEC has reviewed the planned areas for surface infiltration areas shown as LID on the grading plans and the Dixie Storm Water Coalition Guide (DSWCG) for Low Impact Development (Dixie Storm Water Coalition Guide, June 20, 2020) and provided the following evaluation:

Using the USDA, Natural Resources Conservation Services, Web Soil Survey, (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) for determining the USDA mapped soil, the soil types vary across the site with a GP - Gravel Pit for 80% of the parcel and IAF - Isom cobbly sand loam, 3 -30% slopes on the southeast portion of the site and SY- Stony colluvial land on the northeast portion of the site. Each of the mapped units have a have a Hydrologic Soil Group of A.

Our evaluation Geotech evaluation has shown that the near surface soils are primarily sand and gravel as mapped by the USDA, however the underlying mudstone is significantly different in hyrdologic properties.

Using the DSWCG, Figure 2 (flow chart), and based on the soil types and conditions, Steps- 1-3 are “No” due to the shallow mudstone bedrock on the site. Based on the rock conditions, we do not recommend using any of the Best Method Practices (BMP’s) within Reference No. 1.

The following parameters may be used in the application form:

Subsurface Information	
Groundwater	
Depth to Groundwater (ft)	>15 ft
Historical High Depth to Groundwater if known (ft)	>15 ft
Source	Geotech Study
Groundwater Contamination at Site:	N/A
Soil Information	
Infiltration Rate (in/hr) (Source = UCEA.net)	<1*
Hydrologic Soil Group/Map Unit Symbol:	D
Source:	USDA Web Soil Survey
Soil Contamination at Site:	N/A

The underlying bedrock consists primarily of mudstone which may result in the perching of groundwater and heave of the surface soils. It will also result in weakened lateral strength and reduced slope stability. The perching may result in lateral movement of water and resulting in the introduction of water to locations that may be a concern, such as utility trenches, next to slopes that would reduce stability

and cause seepage concerns. We would recommend that infiltration be limited and that the basin areas be allowed to overflow into storm drainage that allows water to leave the property to regional drainage, particularly to the west to the Black Ridge Cove Drainage system.

B. Foundation Recommendations

Based on the subsurface conditions and proposed grading provided Kuma Engineering, the following foundation recommendations are provided for support of slab on grade homes.

1. Foundations

   The proposed residences may be supported on conventional spread footings with slab-on-grade floors supported on a properly prepared subgrade as indicated in the Subgrade Preparation section of this report.

2. Bearing Material

   Footings should bear on properly compacted structural fill as recommended in the Subgrade Preparation section of this report.

3. Bearing Pressure

   Spread footings bearing on properly compacted structural fill may be designed for a net allowable bearing pressure of 2,000 psf.

4. Temporary Loading Conditions

   The bearing pressure indicated above may be increased by one-half for temporary wind and seismic loads.

5. Footing Width and Embedment

Spread footings should have a minimum width of 18 inches and exterior or unheated footings should be embedded at least 12 inches below the lowest adjacent grade.

6. Settlement/Heave

Based on the subsoil conditions encountered and the anticipated building loads, we estimate a total settlement/heave for the foundation designed as indicated above to be up to approximately 1 inch. Differential settlement is estimated to be approximately ½ inch.

C. Concrete Slab-on-Grade

1. Slab Support

Concrete slabs may be supported on a properly compacted subgrade. Fill placed in slab areas should be tested to verify compaction meets the recommendations provided within this report.

2. Underslab Base Course

A 4-inch layer of properly compacted base course should be placed below slabs to provide a firm and consistent subgrade and promote even curing of the concrete.

3. Vapor Barrier

A vapor barrier may be placed below slabs in areas which will receive floor coverings sensitive to moisture or coverings which are impermeable.

D. Lateral Earth Pressures

1. Lateral Resistance for Footings

Lateral resistance for spread footings is controlled by sliding resistance developed between the footing and the subgrade soil. An ultimate friction value of 0.45 may

be used in design for ultimate lateral resistance of footings bearing on on-site granular soils.

2. Retaining Structures

The following equivalent fluid weights are given for design of subgrade walls and retaining structures. The active condition is where the wall moves away from the soil. The passive condition is where the wall moves into the soil and the at-rest condition is where the wall does not move. We recommend the basement walls be designed in an at-rest condition.

The values listed below assume a horizontal surface adjacent the top and bottom of the wall.

Description	Active	At-Rest	Passive
Granular backfill (sand or gravel)	35 pcf	50 pcf	350 pcf
Fine Grained soil - silt and clay	40 pcf	55 pcf	300 pcf

The above values account for the lateral earth pressures due to the soil and level backfill conditions and do not account for hydrostatic pressures or surcharge loads.

Lateral loading should be increased to account for surcharge loading using the appropriate earth pressure coefficient and a rectangular distribution if structures are placed above the wall and are within a horizontal distance equal to the height of the wall. If the ground surface slopes up away from the wall, the equivalent fluid weights should also be increased.

Care should be taken to prevent percolation of surface water into the backfill material adjacent to the retaining walls. The risk of hydrostatic buildup can be reduced by placing a subdrain behind the walls consisting of free-draining gravel wrapped in a filter fabric.

3. Seismic Conditions

Under seismic conditions, the equivalent fluid weight should be modified as follows according to the Mononobe-Okabe method assuming a level backfill condition:

Lateral Earth Pressure Condition	Seismic Modification (2% PE in 50 yrs)	
	Granular Backfill	Fine-Grained Backfill
Active	9 pcf increase	10 pcf increase
At-rest	no increase	no increase
Passive	22 pcf decrease	16 pcf decrease

The resultant of the seismic increase should be placed up ½ the distance up from the base of the wall.

4. Safety Factors

The values recommended assume mobilization of the soil to achieve the assumed soil strength. Conventional safety factors used for structural analysis for such items as overturning and sliding resistance should be used in design.

E. Seismicity, Liquefaction and Faulting

1. Listed below is a summary of the site parameters as required by the 2018 International Building Code and ASCE 7-16:

Description	Seismic Parameter
	2,500 yr event (≈2% PE in 50 yrs)
Site Class	C
Ss (0.2 second period)	0.5g
S1 (1 second period)	0.16g
PGA	0.22g
F_a	1.3
Fv	1.5
F_{pga}	1.2

The values provided above were generated using the ASCE 7-16 Seismic Hazard Tool. Based on the observed subsurface conditions, a ground motion hazard analysis (GMHA) as per ASCE 7-16 is not required by the 2018 International Building Code.

2. Liquefaction

Based on subsurface conditions encountered in the borings and the test pits, the subsurface soils and bedrock observed are non-liquefiable during a seismic event.

3. Faulting

Based on a review of available geologic literature, there are no mapped faults extending near or through the site.

F. Soil Corrosion

Based upon our experience in the area, the on-site soils, bedrock, and many imported sources may contain sulfates in sufficient concentration to be corrosive to concrete. Therefore, we recommend concrete elements that will be exposed to the on-site soils be designed in accordance with provisions provided in the American Concrete Institute Manual of Concrete Practice (ACI) 318-14. Tables 19.3.1.1 and 19.3.2.1 of ACI 318-14 should be referenced for design of concrete elements utilizing a Sulfate Exposure Class of S2.

Consideration should also be given to cathodic protection of buried metal pipes. We recommend utilizing PVC pipes where local building codes allow.

G. Pavement

Based on the subsoil conditions encountered and the laboratory test results, the following recommendations are given:

1. Analysis

   Asphaltic Concrete: The flexible pavement analysis is based on UDOT and AASHTO design methods and a 20 year design life. The following parameters were considered for our analysis:

   - Base course that meets specifications which would correspond to a Structural Coefficient (a_2) of at least 0.12. Asphalt that provides a Structural Coefficient (a_1) of at least 0.40.
   - Drainage Coefficient = 1.0.
   - The subgrade support soils consists generally a low permeable fill or granular soils. Based on the on-site soils, a M_R value of 7,500 psi was used for the subgrade based upon an estimated CBR value of 5 percent and the relationship between CBR and Resilient Modulus (M_R).
   - Serviceability Index: P_o=4.2, P_t=2.5.
   - Reliability of 90 percent.
   - Standard Deviation (S_o) = 0.45.

2. Subgrade Support

   We anticipate the subgrade materials will consist of compacted sandy lean clay or on site granular materials. Our design assumes a properly compacted subgrade. Prior to placing base course or pavement area grading fill, the subgrade should be prepared as recommended in the Subgrade Preparation section of this report.

3. Pavement Thickness

Based on the anticipated traffic, a 20 year design life, PCC and AASHTO design methods, the following pavement sections are recommended.

	Flexible Pavement	
Area	Asphaltic concrete (inches)	Base Course (inches)
Interior roadways (TI=5)	2½	8

4. Pavement Materials

The pavement materials should meet AASHTO and St. George City Specifications for gradation and quality. The pavement thicknesses indicated above assume that the base course is high quality material with a CBR of at least 60 percent. Asphalt material should have a Marshall stability of at least 1,800 pounds.

5. Drainage

The collection and diversion of drainage away from the pavement surface is extremely important to the satisfactory performance of the pavement section. Proper drainage should be provided. We further recommend a yearly maintenance program including crack sealing and a surface treatment such as a “slurry seal” to extend the pavement life and reduce water infiltration into the subsurface soils.

H. Construction Testing and Observations

We recommend testing fill, concrete, and asphalt materials at a frequency which meets or exceeds St. George City minimum testing frequency requirements for city improvements. We also recommend the following testing and observations be done as a minimum:

1. Verify the subgrade is properly prepared/compacted in accordance with the recommendations provided in the Subgrade Preparation section of this report. The building pad overexcavation limits should be determined by the contractor by survey

and documented. The base of the excavation should be verified by AGEC. The replacement fill in each excavation should be tested on a periodic basis. We recommend each foot of fill placed be tested.

2. Verify that foundation subgrade is properly compacted prior to placement of concrete.
3. Conduct construction materials testing of soils, concrete and asphalt materials as required for the proposed construction by St. George City.

I. Geotechnical Recommendation Review

The client should familiarize themselves with the information contained in this report. If specific questions arise or if the client does not fully understand the conclusions/recommendations provided, AGEC should be contacted to provide clarification.

LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the subsurface study, laboratory test results and our experience in the area. Variations in the subsurface conditions may not become evident until excavation is conducted. If the subsurface conditions or groundwater level are found to be significantly different from those described above, we should be notified to reevaluate our recommendations.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

G. Wayne Rogers, P.E.

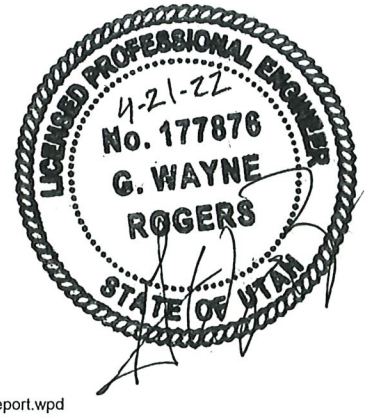
Reviewed by: JE, P.E.

P:\2022 Project Files\2220100\2220105 - GT -Temple Trail Canyon\report.wpd

LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the subsurface study, laboratory test results and our experience in the area. Variations in the subsurface conditions may not become evident until excavation is conducted. If the subsurface conditions or groundwater level are found to be significantly different from those described above, we should be notified to reevaluate our recommendations.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



G. Wayne Rogers, P.E.

Reviewed by: JE, P.E.

P:\2022 Project Files\2220100\2220105 - GT -Temple Trail Canyon\report.wpd



TEMPLE TRAIL SUBDIVISION
ST. GEORGE, UTAH

N

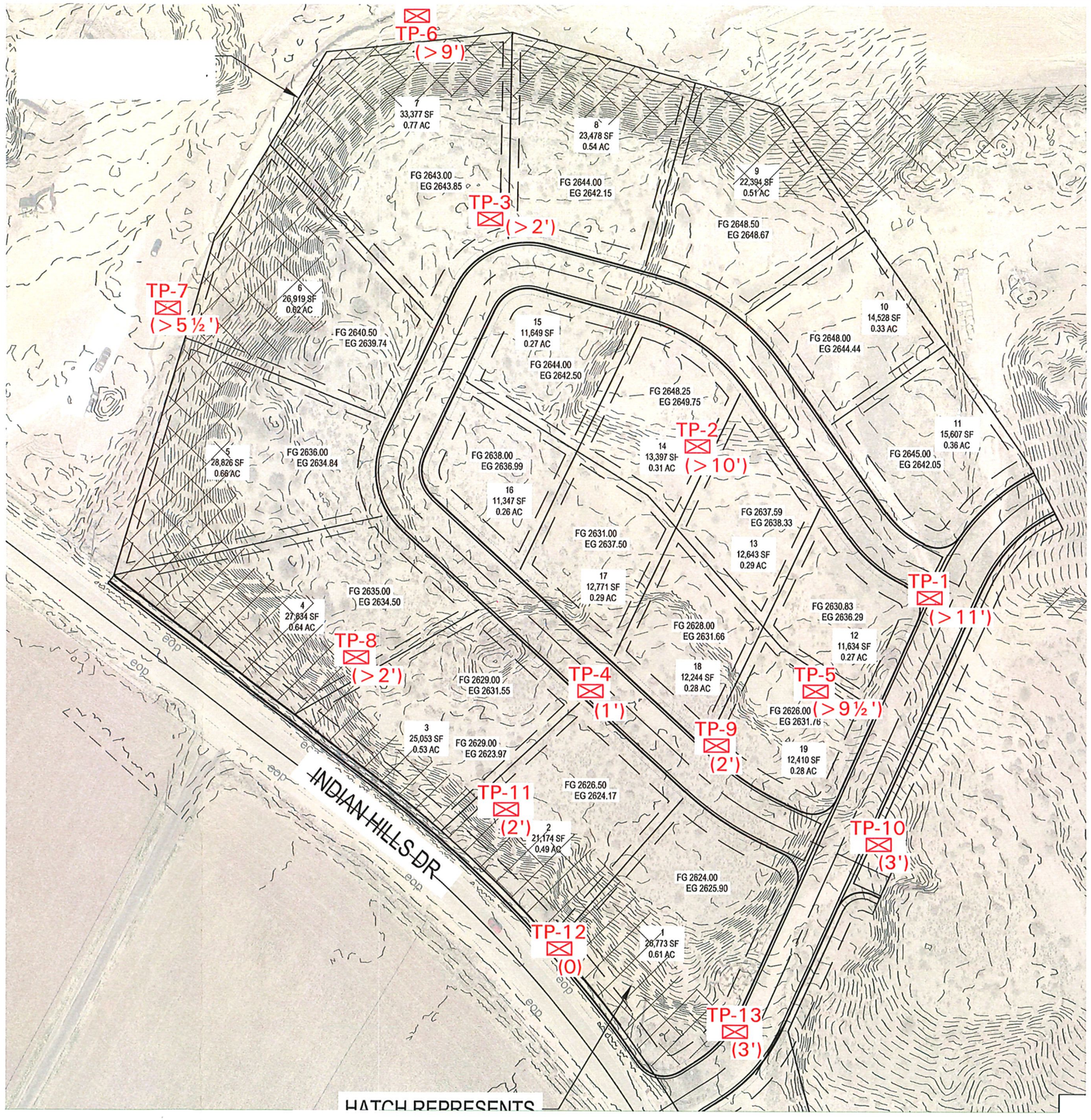
Not to Scale

2220105	AGEC	Vicinity Map	Figure 1

TEMPLE TRAIL SUBDIVISION
ST. GEORGE, UTAH

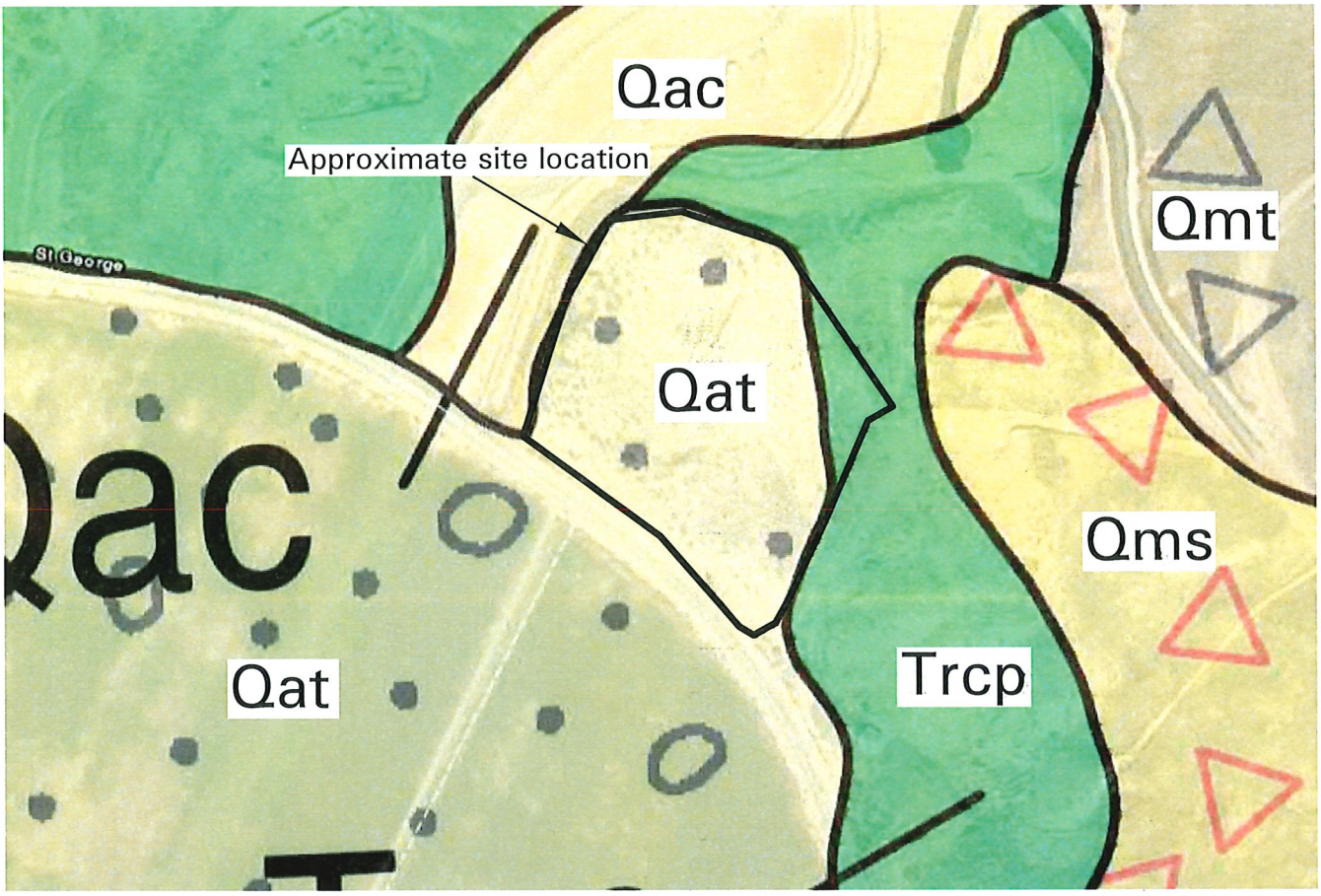
⊠ Approximate test pit location

(#') Approximate depth to mudstone bedrock



N
Not to Scale

2220105	AGEC	Site Plan	Figure 2



Geologic Map of the St. 7.5' Quadrangle, Washington County, Utah, UGS Map 251DM, 2011, Janice M. Haden and Grant C. Willis

Key:

TRcp: Petrified Forest Member (Upper Triassic); Varicolored, typically gray to purple mudstone, claystone, and siltstone,

Qat: Old river and stream deposits (Holocene to middle Pleistocene); Stratified, moderately to well-sorted alluvial gravel, sand, silt, and minor clay that forms level to gently sloping terraces above modern drainages;

Qms: Landslide deposits (Holocene to middle[?] Pleistocene); Poorly sorted, clay- to boulder-size, locally derived material deposited by rotational and translational landslide movement; characterized by hummocky topography and small ponds

Qmt: Talus (Holocene to upper Pleistocene); Poorly sorted, angular boulders and finer-grained interstitial sediment deposited principally by rock fall on and at the base of steep slopes; typically grades downslope into colluvial deposits and may include colluvial deposits where impractical to differentiate the two;

Qac: Alluvial and colluvial deposits (Holocene to upper Pleistocene); Poorly to moderately sorted, generally poorly stratified, clay- to boulder-size, locally derived sediment deposited principally in swales, small drainages, and the upper reaches of large streams by fluvial, slope-wash, and creep processes;

TEMPLE TRAIL SUBDIVISION
ST. GEORGE, UTAH

N

Not to Scale

2220105	AGEC	Geology Map	Figure 3



Landslide-Hazard Map for the St. George-Hurricane Metropolitan Area, Washington County, Utah, UGS Special Study 127 2008, W.R. Lund, T.R. Knudson, G.S. Vice and L.M. Shaw

Key

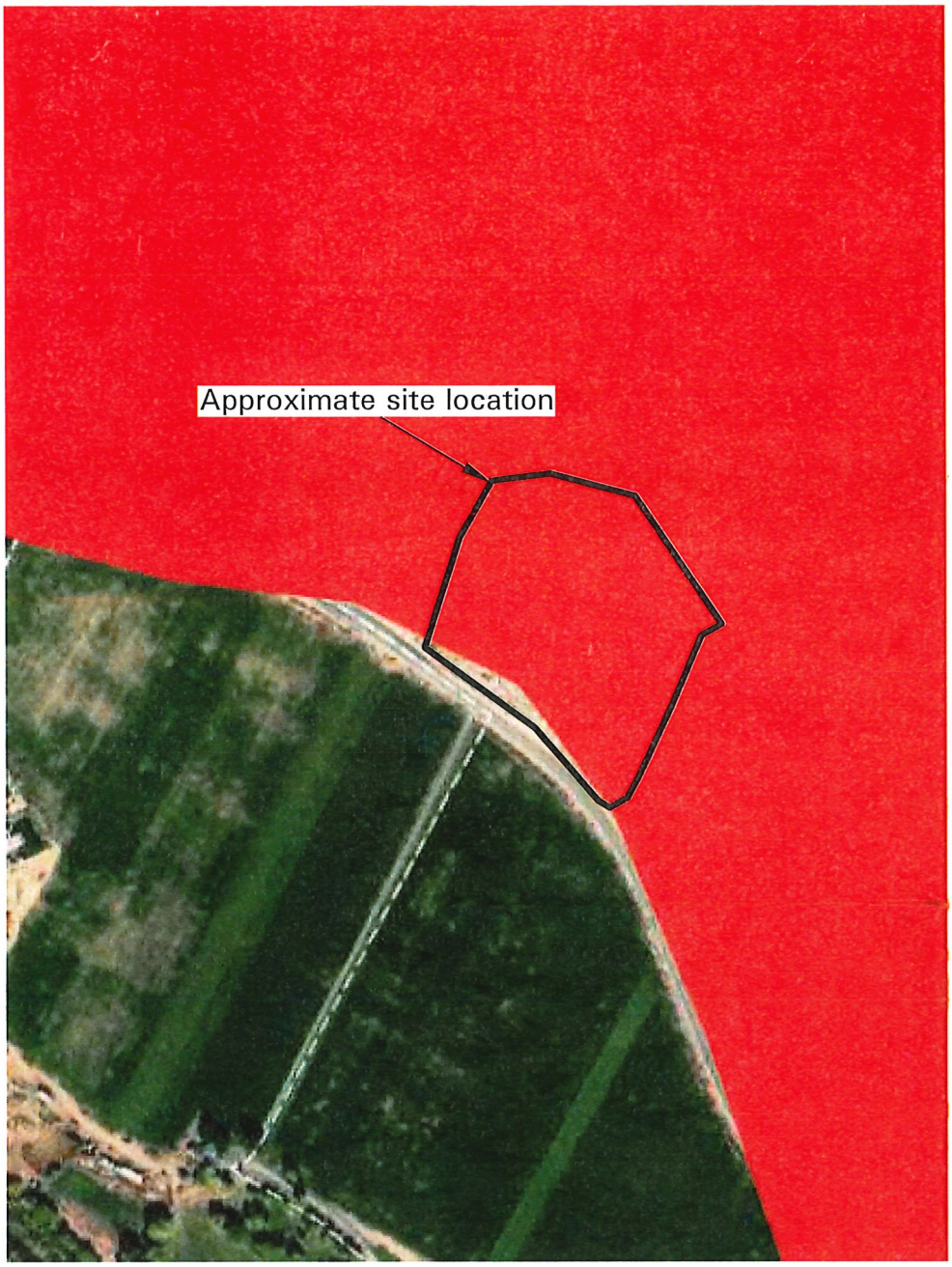
Very High: existing landslides (Category A)

TEMPLE TRAIL SUBDIVISION
ST. GEORGE, UTAH

N

Not to Scale

2220105	AGEC	Landslide Map	Figure 3a



Rock-Fall-Hazard Map for the St. George-Hurricane Metropolitan Area, Washington County, Utah, UGS Special Study 127 2008, W.R. Lund, T.R. Knudson, G.S. Vice and L.M. Shaw

Key

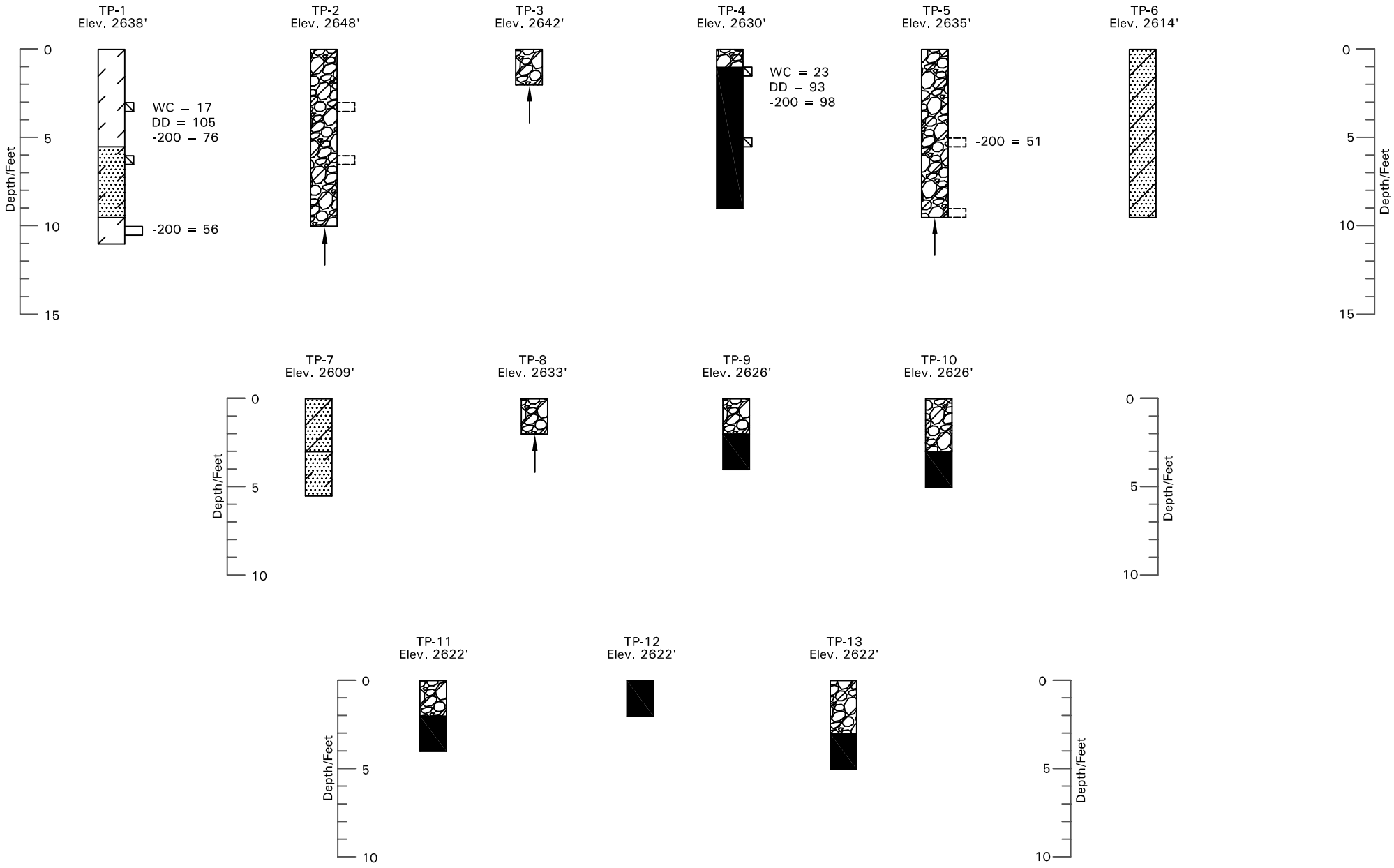
High Hazard

TEMPLE TRAIL SUBDIVISION
ST. GEORGE, UTAH

N

Not to Scale

2220105	AGEC	Rock-Fall Hazard Map	Figure 3b



2220105	AGEC	Logs of Test Pits	Figure 4

LEGEND:



Sandy Lean Clay (CL); soft to medium stiff, dry to slightly moist, red to purple.



Clayey Sand with Gravel (SC); medium dense, slightly moist, red-brown.



Silty Sand (SM); medium dense, moist, light brown in color.



Silty Gravel with Sand (GM); dense to hard, zones of high cementation, cobbles and occasional boulders, dry to slightly moist, grey-brown.



Mudstone Bedrock (Blue Clay); soft to medium hard, slightly moist, purple to red and grey.



Indicates relatively undisturbed hand drive sample taken.



Indicates disturbed sample taken.

Indicates practical backhoe refusal on cemented gravel.

NOTES:

1. The test pits were excavated on January 8 and August 26, 1996 with a mini excavator.
2. The locations of the test pits were measured by pacing from features shown on the site plan provided.
3. The elevations of the test pit were estimated by interpolating between the contours shown on the site plan provided.
4. The test pit locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between the materials shown on the test pit logs represent the approximate boundaries between material types and the transitions may be gradual.
6. Free water was not encountered in the test pits at the time of excavation.
7. WC = water content (%);
   DD = dry density (pcf);
   -200 = percent passing No. 200 sieve.

APPENDIX A

Rockfall Hazard Evaluation Report

March 24, 2022

Feller Enterprises
708 East 1100 South
St George, Utah 84790

Attention: Tyson Feller
EMAIL: tyson@fellerent.com

Subject: Rockfall Hazard Assessment
Temple Trail Canyon Subdivision
Indian Hills Drive
St George, Utah
Project No. 2220105

Mr. Feller:

Applied Geotechnical Engineering Consultants, Inc. (AGEC) was requested to evaluate potential rockfall hazard for the proposed Temple Trail Canyon Subdivision located on the north side of Indian Hills Drive across from Gubler Lane in St George, Utah.

PROPOSED CONSTRUCTION

We understand the area is planned for single-family residences.

GEOLOGY

The geology of the site is mapped by Hayden and Willis (2011) to consist predominantly of Quaternary alluvium, some colluvium and some areas of bedrock. The bedrock underlying the site is mapped as the Triassic Petrified Member of the Chinle Formation. The nearest outcrops that would produce rockfall material is the Quaternary Cedar Bench Lava Flow exposed near the top of the airport bluff east of the site.

SITE DESCRIPTION

Much of the site appears to have been mined for gravel. It is currently undeveloped land.

Vegetation at the site consists of a sparse coverage of grass and brush.

The general topography of the site consists of relatively level ground through the middle and moderate slopes along the north, south and west sides.

There is residential development under construction to the north and west and undeveloped land to the south and east. Indian Hills Drive borders the south side of the property.

ROCKFALL EVALUATION

A site visit was performed and finds no evidence of rockfall source close enough to the site to be a hazard for the proposed development. The closest cliffs with rock outcrops that could produce rockfall material are located approximately 780 feet east of the east side of the development. Assuming a conservative shadow angle of 20 degrees from the cliff base, the proposed subdivision is at least 400 feet beyond the potential rock-runout zone. Rockfall is not considered to be a hazard for the proposed development.

LIMITATIONS

This letter has been prepared in accordance with generally accepted geologic engineering practices in the area for the use of the client. The conclusions included in the letter are based on conditions observed during our site visit and the topographic information obtained from the Utah AGRC website.

If you have questions or if we can be of further service, please call.

Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Douglas R. Hawkes, P.E., P.G.

Reviewed by JEN, P.E.

DRH/rs

Reference:

Hayden, J.M. and Willis, G.C. 2011; Geologic map of the St George quadrangle, Washington County, Utah, Utah Geological Survey Map 251DM.

APPENDIX B

Site Photos



Photo No. 1, View of northeast portion of the site looking west.



Photo No. 2, View of east edge of site looking south along proposed access road.

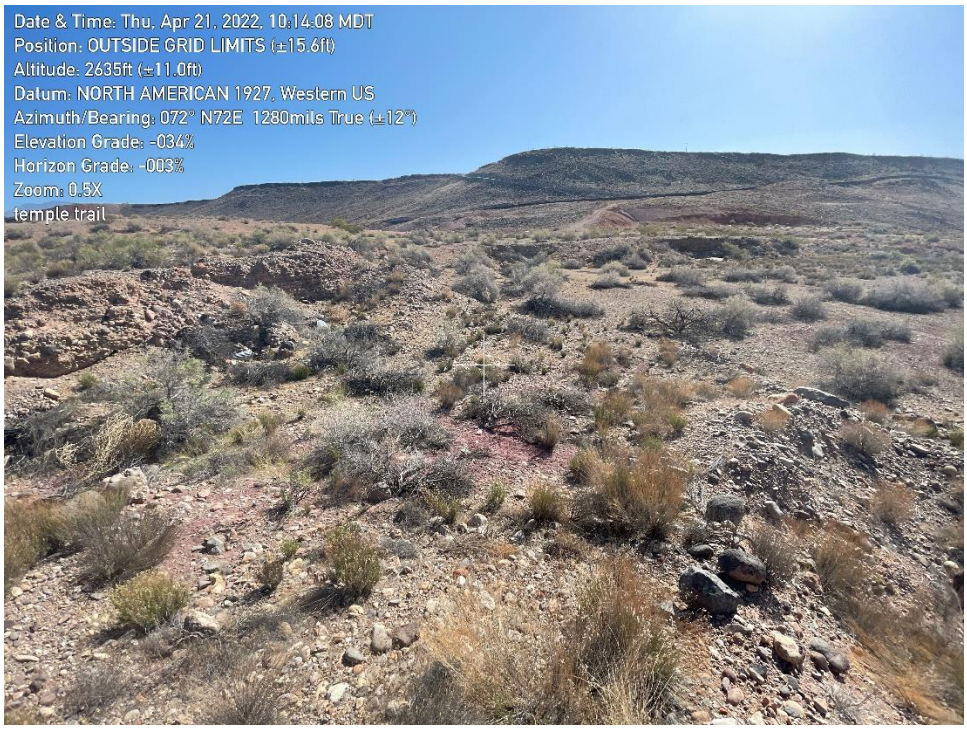


Photo No. 3, View of site looking east, from near west edge of the site.



Photo No. 4, View of south edge of site near SWC, looking southeast along Indian Hills Drive.



Photo No. 5, View of west edge of site looking north.



Photo No. 6, View of northwest corner of the site looking west.



Photo No. 7, View of site looking south from near north center of the site.



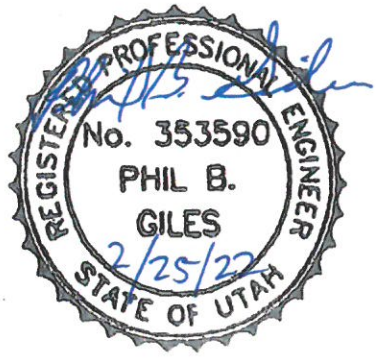
Photo No. 8, View of east edge of site looking south.

Preliminary
Drainage Study Report

Temple Trail Canyon Subdivision – Phase 1

Owner:
Gary W Carter LP

Prepared by:
Mainline Engineering LLC
Phil Giles, PE
321 N. Mall Drive, Ste. T101
St. George, UT 84790
435-669-4810



Prepared February, 2022

Table of Contents

Section 1: Introduction 4

1.1 Background 4

1.2 Purpose and Need 4

1.3 Reference Materials 4

Section 2: Property Description 4

2.1 Existing Property Description 4

2.2 Proposed Property Improvements 5

Section 3: Off-Site Drainage Description 5

Section 4: On-Site Drainage Description 5

Section 5: Master Planned Drainage 6

Section 6: FEMA Floodplain Requirements 6

Section 7: Other Drainage Studies Affecting the Property 6

Section 8: Description of Proposed Drainage Facilities 6

8.1 Grading 6

8.2 Roadway Improvements 6

8.3 Conveyance Improvements 6

Section 9: Compliance with Local and FEMA Requirements 7

Section 10: Design Runoff Computations 7

10.1 Selection of Hydrologic Model 7

10.2 Model Input Parameters 7

10.3 Curve Number 7

10.4 Watershed Area 8

10.5 SCS Lag Time 8

10.6 Rainfall Depth 8

10.7 Time Distribution of Rainfall 8

10.8 Model Output 9

Section 11: Drainage Facility Design Calculations 9

11.1 Storm Improvements 9

11.2 Roadway Improvements 9

11.3 Detention Requirements 9

Section 12: Required Drainage Easement and Rights-of-Way 10

Section 13: FEMA Floodway and Floodplain Calculations 10

Section 14: Low Impact Development 10
Section 15: Conclusions and Statement of Compliance 10
14.1 Conclusions 10
Appendix A – Figures, References & Calculations 11
Figure A1 Project Location Map 11
Figure A2 Existing Drainage Conditions 11
Figure A3 Developed Drainage Conditions 11
Figure A4 Floodplain Boundary Map (FIRM) 11
Figure A5 Soils Map 11
Figure A6 NOAA Atlas 14 Site-Specific Precipitation Frequency 11
Figure A7 Unimproved Site Conditions 11
Figure A8 Improved Site Conditions 11
Figure A9 Modified Type II Storm 3-Hour Rainfall Data (Farmer Fletcher Distribution) 11
Figure A10 SCS Rainfall Data & Detention Routing 11
Figure A11 NRCS Soil Data and Properties 11
Figure A12 Orifice Sizing / Discharge Pipe Size Calculator 11
Figure A13 Detention Outfall – Storm Drain Pipe Sizing 11
Figure A14 Detention Basin and Discharge Layout (not included with draft) 11
Figure A15 LID Storm Water Quality Report (not included with draft) 11

Section 1: Introduction

1.1 Background

The following Drainage Control Plan and Report is submitted in support of the proposed Temple Trail Canyon Subdivision – Phase 1, located in St. George, Utah in the southwest 1/4 of the northwest 1/4 and the southeast 1/4 of the northwest 1/4 of Section 36, Township 42 South, Range 16 West, Salt Lake Base and Meridian.

1.2 Purpose and Need

This report has been prepared to evaluate the drainage needs affecting the proposed construction of the project site. The 10+ acre subdivision with a R-1-10-Overlay will consist of 19 residential lots and associated streets. The purpose of this study is to:

- determine the drainage patterns of the stormwater within the proposed site improvements, both prior to, and following, project construction;
- estimate peak runoff amounts and subsequent storage capacity for stormwater detention; and
- design hydraulic improvements as required by Hurricane City Standards.

1.3 Reference Materials

This study references and demonstrates compliance with the following published documents:

- St. George City General Plan adopted July 11, 2002 – publicly available on St. George City's website.
- St. George Stormwater Management Plan 2.0 Update January 2020 – publicly available on St. George City's website.
- St. George City Drainage Manual May 2009 – publicly available on St. George City's website.

Additional reference materials prepared as part of this report can be found in the following appendices:

- Appendix A, Figures, Maps, and Calculations

Section 2: Property Description

2.1 Existing Property Description

The undeveloped site is covered in native vegetation with varying slopes draining from northeast to southwest. There is a natural drainage to the north of the proposed subdivision. No impacts are proposed for the existing wash. The site consists primarily of gravelly and rocky soils with shallow clay. The site discharges to the existing Indian Hills Drive. See Appendix A, Figure 2 for existing watershed boundary and topographic information. The site is relatively flat with some steeper slopes ranging from 5% to 50%.

Bordering properties including Indian Hills Drive to the west, Black Ridge Cove to the north, and the remaining area is surrounded by the owners' private property.

2.2 Proposed Property Improvements

The proposed Temple Trail Canyon Subdivision – Phase 1 has a R-1-10 Overlay consisting of 19 residential lots. The subdivision includes 10.6 acres but on 8.64 acres will be improved. The remaining area will be left undisturbed. These lot sizes and the planned roadways comply with St. George's current General Plan. There are no existing irrigation facilities on the site and no downstream irrigation facilities that will be negatively impacted by modification of the drainage patterns within the local site.

Roadways within the proposed development and adjacent to the proposed development include the following:

- Indian Hills Drive collector roadway (66' ROW) running north/south along the west boundary of the proposed subdivision. It will be widened along the proposed project frontage.
- All proposed roadways within the subdivision will be 50' ROW local public roadways.

Existing private property owned by the owner borders the project to the east and south. Neither of these properties will be improved with this project. The proposed site grading plan will convey water through the subdivision by a combination of lot grading and street improvements to a detention facility located at the low point of the subdivision at the southwest corner of the property. All streets will have a minimum running slope of 0.5% and a cross slope of 2%. Detention will be used to limit offsite discharges which will outfall to the existing drainage system in Indian Hills Drive.

Refer to Appendix A, Figure A3 for developed conditions.

Section 3: Off-Site Drainage Description

Due to the existing topography, there are no offsite sheet flow or point discharges onto the proposed subdivision. There is an existing drainage channel on the northwest side of the project that will not be impacted by the improvements. The undeveloped portion of the subdivision will continue to drain into the existing wash. All drainage leaves the developed portion of the project to the south and west. There are no other storm drain systems, washes, or conveyance that need to be considered with the project.

Section 4: On-Site Drainage Description

The undeveloped site drains to the south and west boundaries. There is no existing storm infrastructure adjacent to the project site and all storm water from the project site surface flows down to Indian Hills Drive.

The proposed site grading plan will continue to convey water to the south and west through the subdivision by a combination of lot grading, street improvements, and a storm drain system. Both the existing site and the developed site were modeled using the area determined from the proposed developed areas. A composite curve number was used to represent the developed site.

Section 5: Master Planned Drainage

The FPBP has been developed and approved through the City and meets the Master Planned Drainage requirements. This project will comply with providing detention for any increased flow from the developed conditions.

Section 6: FEMA Floodplain Requirements

According to the FEMA Flood Insurance Rate Map number 49053C0845G, dated April 2, 2009 the site is located in Zone X. Zone X is defined as "Area of Minimal Flood Hazard" or "Areas Determined to be Outside the 0.2% Annual Chance Floodplain". The web-based dynamic FIRM is located in Appendix A as Figure A4. This site is not located in any floodplain or floodways as designated by FEMA.

Section 7: Other Drainage Studies Affecting the Property

There are no other drainage studies that are specific to the subject site that would need to be considered as part of the evaluation herein.

Section 8: Description of Proposed Drainage Facilities

The proposed project drainage improvements will include site grading and roadway improvements. All proposed interior drainage improvements were designed in accordance with the City of St. George Drainage Manual using the 10-year, 3-hour storm event runoff values for the minimum initial system (storm drain) and the Farmer Fletcher distribution for the 3-hour 10-year and 100-year events, and the SCS Type II distribution for the 24-hour, 10-yr and 100-year storm event runoff values for the major system (site improvements). The 100-year, 24-hr event was used to calculate the discharge. The design complies with the Drainage Manual for site improvements, open channel, culvert, and detention analyses. Detention was designed for the 100-year, 3-hour event. This event produced the greatest discharge from the site. No emergency spillway will be provided due to the small basin size and the fact that it is adjacent to the existing roadway. The basin will include 1 foot of freeboard to offset any potential increased volume. Refer to Appendix A for output tables and worksheets.

8.1 Grading

The proposed grading plans include the establishment of proposed building pads to be above the street flow lines in accordance with St. George City requirements.

8.2 Roadway Improvements

There are currently no roadways within the proposed site. Planned roads will be built to convey the 100-year, 3-hour storm event inside the right-of-way.

8.3 Conveyance Improvements

No significant conveyance improvements will be constructed with this project.

Section 9: Compliance with Local and FEMA Requirements

The hydrologic calculations, hydraulic design, and construction recommendations summarized in this report were performed in accordance with standard and accepted engineering practice. Other calculations, design methods, and assumptions utilized in this report not specifically addressed in the Hydrology Manual or by FEMA were based on civil engineering practices acceptable to the industry, with specific references cited in the report. No part of this project is located within, or adjacent to, a floodplain designated by FEMA.

The only deviation from the St. George City Drainage Manual was to use site-specific rainfall data from the NOAA Atlas 14 rather than a generic city-wide rainfall event. No other deviations from the processes approved in the Drainage Manual were made during the analysis of the subject site or preparation of this report.

Section 10: Design Runoff Computations

10.1 Selection of Hydrologic Model

Storm run-off (or discharge) resulting from a precipitation event is the portion of the rainfall that remains after losses from reservoir storage, interception by vegetation, and infiltration into the soil. The amount of rainfall that is lost depends on soil type and moisture content, vegetation type and cover density, rainfall rate and duration, and amount and location of impervious surfaces. Several methods have been developed for estimating the run-off rate and volume from a watershed in response to rainfall when statistical information is not available. The NRCS WinTR-55 software was used for the evaluation in this study.

10.2 Model Input Parameters

The input parameters selected for computing discharge were derived in accordance with procedures developed by the City of Hurricane. The model uses the following input parameters to compute peak flow runoff values for each sub-area evaluated:

- SCS Curve number, used to estimate loss rates and resulting storm water run-off excess, based on soil type, land use and vegetation type and cover density.
- Watershed area
- SCS Lag Time, the time required for a particle of water to flow hydraulically from the most distant point in the watershed to the outlet or design point.
- Rainfall depth for a given storm duration.
- Time distribution of rainfall, describes how the total rainfall depth is distributed over the storm duration.

10.3 Curve Number

Table 10-1 lists the estimated SCS run-off curve number for the pre- and post-developed site, which is based upon soil type, land use, vegetation type, and vegetation cover density. Site soil type was identified as Soil Group C using the NRCS Soils Hydrologic Soil Group (HSG) county map. The majority of the project was listed as gravel pit without a hydrologic soil group list, but based on preliminary geotechnical investigations, the gravel is underlayne by clayey material. Therefore a Soil Group C was

used to better reflect the native material. The post-developed site consists of residential development of single-family residential lots.

10.4 Watershed Area

The watershed boundary was delineated for both the existing site and the proposed developed site, and is illustrated in Appendix A, Figures A2 and A3, and summarized in Table 10-2.

10.5 SCS Lag Time

Watershed lag time (t_p) is the time from the center of mass of rainfall excess to the peak of the storm runoff hydrograph. This was determined using the SCS lag equation and are summarized in Table 10-2. Watershed calculations can be found in Appendix A. For this model, the kinematic wave method was used to simulate rainfall runoff routing. This method simulates the travel time for overland flow, gutter flow and collector pipe flow. Utilizing this method in WinTR-55 will attenuate and translate basin rainfall to runoff.

10.6 Rainfall Depth

A 100-year, 3-hour cloudburst design storm was used to determine peak flows at the site. 10-year and 100-year, 24-hour design storms were calculated to evaluate storm runoff detention volumes. The NOAA Atlas 14 was used to obtain site-specific precipitation for the 3-hour, 100-year rainfall depth of 1.64 inches, the 24-hour, 10-year rainfall depth of 1.51 inches, and the 24-hour, 100-year rainfall depth of 2.21 inches.

10.7 Time Distribution of Rainfall

The Farmer-Fletcher distribution was used for the 3-hour 10-year and 100-year events. The SCS Type II distribution was used for the 24-hour, 100-year event. Table 10-2 summarizes additional model input data that was used to calculate the storm data.

TABLE 10-1 - CURVE NUMBER DEVELOPMENT

Cover Type	CN	Pre-Development		Post-Development	
		Area (SF)	% Area	Area (SF)	% Area
Undeveloped (Desert, good)	81	376,460	100%		
Natural Desert Landscaping	88			132,960	35.3%
Lawn	80			76,000	20.2%
Impervious Area	98			167,500	44.5%
Total (Sq Ft)		**376,460**	**100%**	**376,460**	**100%**
Total (Ac)		**8.64**		**8.64**	
Composite CN			**81**		**89**

TABLE 10-2 - SUB-BASIN CHARACTERISTICS AND MODEL INPUT

Basin Name	Area		Avg Slope	SCS Curve #	Longest Length	t_c
	(ac)	(sq mi)	%		L_o (Feet)	(min)
Pre-Development	8.64	0.014	5.3%	81	852	15.7
Post-Development	8.64	0.014	4.2%	89	1,385	23.0

10.8 Model Output

Table 10-3 provides detail for the model output including maximum discharge rates, piped flow rates, and detention discharge rates. The routing of 24-hour flows (10 year & 100 year) was performed in Microsoft Excel using time-data output from the WinTR-55 model for post-developed flows and is shown in the appendices.

TABLE 10-3 - PEAK FLOWS			
		POST-DEVELOPMENT	
STORM EVENT	PRE-DEVELOPMENT PEAK FLOW (CFS)	ENTERING DETENTION BASIN (CFS)	LEAVING DETENTION BASIN (CFS)
10-YR, 24-HR	2.83	5.06	2.80
100-YR, 3-HR	7.96	15.53	7.10
100-YR, 24-HR	7.42	10.50	7.10

The post-development flow leaving the detention basin was calculated as 7.10 cfs.

See calculation sheets in the appendix.

Section 11: Drainage Facility Design Calculations

11.1 Storm Improvements

Onsite runoff from the 10-year, 24-hour storm event will be contained within the streets without overtopping the curb and will be captured by a pipe/catch basin system and conveyed to the onsite detention basin.

All storm drain improvements will be maintained through public right of way and maintenance access easements.

11.2 Roadway Improvements

Runoff from the 100-year, 24-hour storm event will be contained in the interior streets without overtopping the curb.

11.3 Detention Requirements

The 10-year, 24-hour storm event will be discharged from the detention basin using appropriately sized orifices. The 100-year, 24-hour storm event requires 3,034 cubic feet of detention. This detention will be accommodated by a newly developed detention basin located at the southwest corner of the subdivision. To control the discharge from the detention basin area, an outlet structure will be constructed including accommodations for initial discharge, overflow discharge, and emergency overflow. A circular 18-inch pipe outlet will accommodate discharge flows from each detention basin. Calculation sheets are included in the appendix.

Access to the detention basin for maintenance of the facilities will be from Indian Hills Drive which borders the proposed basins on the west side.

Section 12: Required Drainage Easement and Rights-of-Way

No easements or rights-of-way will be required beyond the use of public street rights-of-way for storm drainage collection and conveyance.

Section 13: FEMA Floodway and Floodplain Calculations

This site is not located in or next to any floodplain or floodways as designated by FEMA. Refer to Sections 6 and 9 for a detailed description.

Section 14: Low Impact Development

Low impact development will be accomplished by providing a retention/infiltration basin as part of the detention basin. The water level of the retention basin will be controlled by installing 2 - 6" orifices at an elevation that will allow retention in the basin. The details of these Water Quality BMPs are included in the Appendices as part of the "Improved Analysis..." worksheet and the Storm Water Quality Report.

Section 15: Conclusions and Statement of Compliance

14.1 Conclusions

The following conclusions summarize the recommendations proposed for this development:

A. Offsite Drainage: No offsite drainage will be considered with this project.
B. Onsite Drainage: Storm water will be collected in interior streets. Runoff from the subdivided lots will run southwesterly through the public rights-of-way and pipes/catch basin system to the southwest corner of the subdivision where it will be discharged into the detention/retention basin. The detention basin will be discharged at pre-development rates to the Indian Hills Drive existing 30" storm drain system.
C. Detention and Retention Requirements: Total volume for the project was calculated as 3,034 cubic feet. Additional capacity will be provided for freeboard and an emergency spillway.
D. FEMA Floodplain: This site is not located inside any floodplains designated by FEMA.

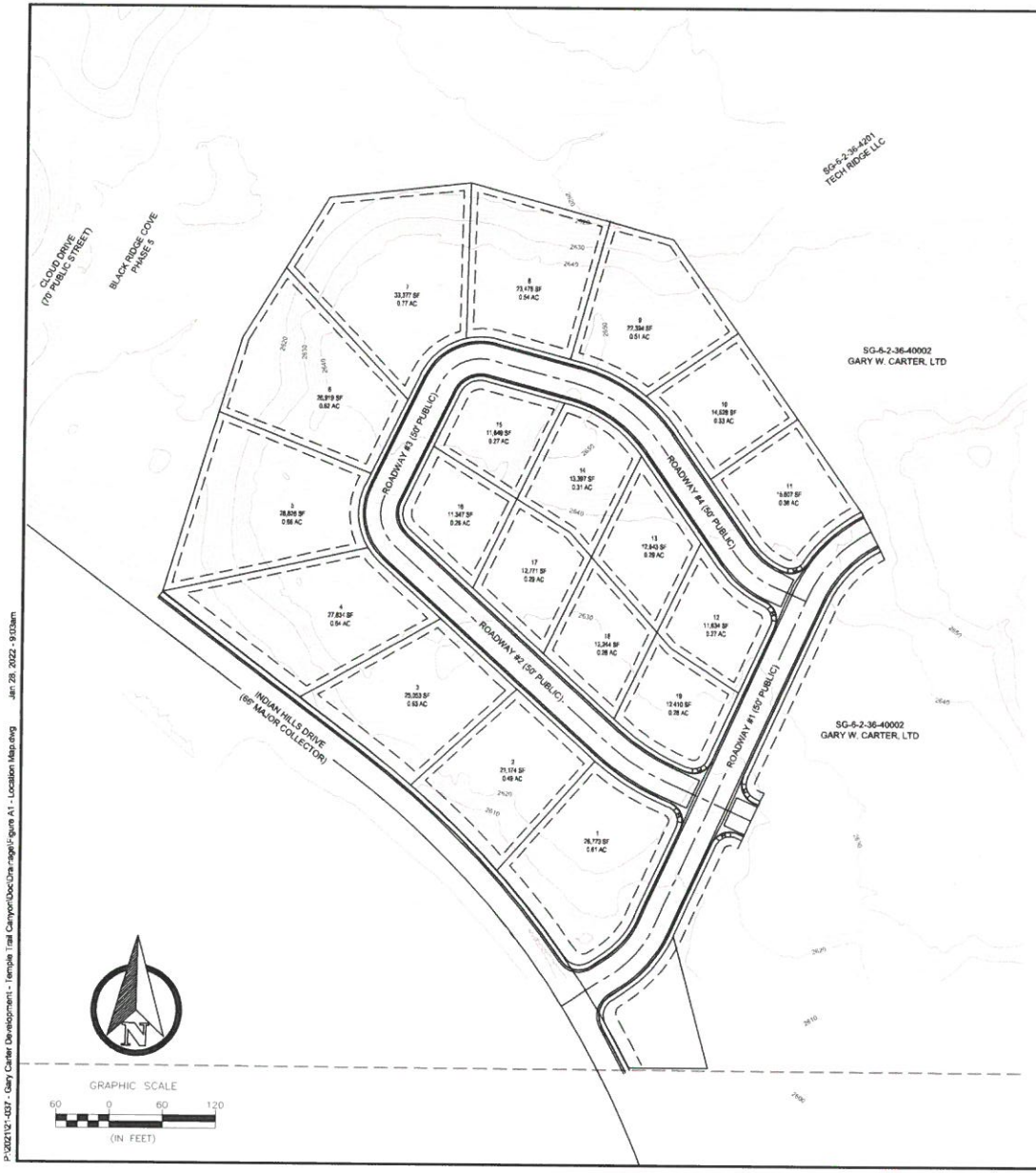
Appendix A – Figures, References & Calculations

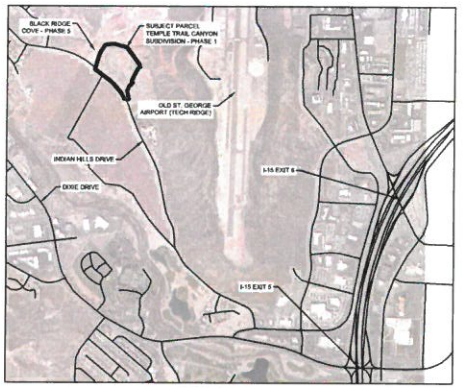
Figure A1 Project Location Map
Figure A2 Existing Drainage Conditions
Figure A3 Developed Drainage Conditions
Figure A4 Floodplain Boundary Map (FIRM)
Figure A5 Soils Map
Figure A6 NOAA Atlas 14 Site-Specific Precipitation Frequency
Figure A7 Unimproved Site Conditions
Figure A8 Improved Site Conditions
Figure A9 Modified Type II Storm 3-Hour Rainfall Data (Farmer Fletcher Distribution)
Figure A10 SCS Rainfall Data & Detention Routing
Figure A11 NRCS Soil Data and Properties
Figure A12 Orifice Sizing / Discharge Pipe Size Calculator
Figure A13 Detention Outfall – Storm Drain Pipe Sizing
Figure A14 Detention Basin and Discharge Layout (not included with draft)
Figure A15 LID Storm Water Quality Report (not included with draft)

LOCATION MAP FOR

TEMPLE TRAIL CANYON SUBDIVISION - PHASE 1

IN ST. GEORGE CITY





VICINITY MAP

MAINLINE ENGINEERING

MAINLINE ENGINEERING
321 NORTH MALL DRIVE
SUITE 101
ST. GEORGE, UT 84790

GARY W. CARTER LP
726 WEST INDIAN HILLS DRIVE
ST. GEORGE, UT 84770

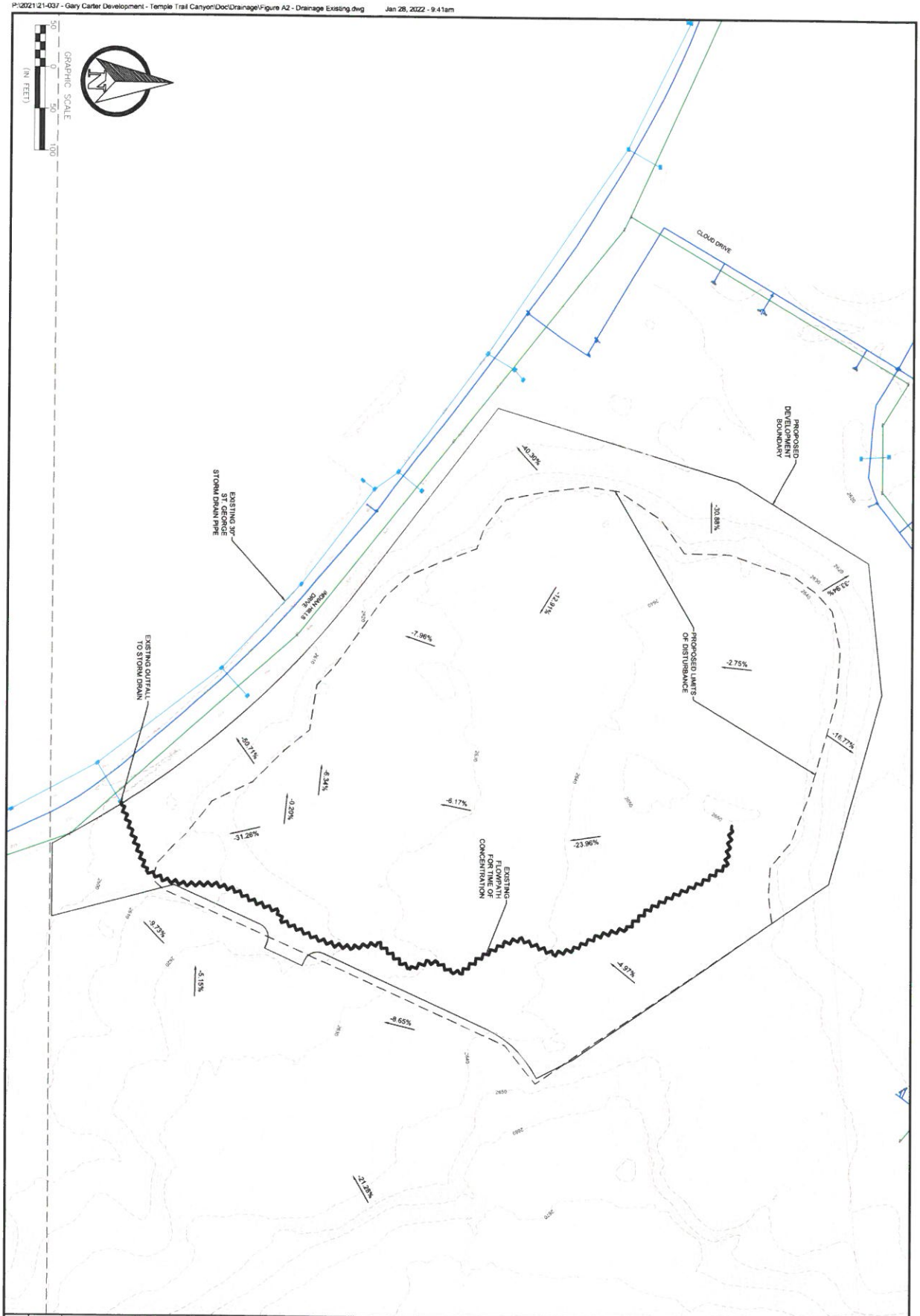
NO	REVISIONS	BY	DATE

PROJECT	TEMPLE TRAIL
CLIENT PROJ. #	N/A
MAINLINE PROJ. #	21-037
SHEET NAME	PROJECT LOCATION MAP
DATE	1/28/22
DRAWN BY	TAR
CHECKED BY	PBG
SHEET	A1

PROFESSIONAL ENGINEER

P:\2021\21-037 - Gary Carter Development - Temple Trail Canyon\Doc\Drawings\Figure A1 - Location Map.dwg Jan 28, 2022 - 9:03am

P:\2021\21-037 - Gary Carter Development - Temple Trail Canyon\Doc\Drainage\Figure A2 - Drainage Existing.dwg Jan 28, 2022 - 9:41am



SHEET A2	PROJECT	TEMPLE TRAIL	DATE 1/28/22	DRAWN BY TAR	CHECKED BY PBG
	CLIENT PROJ. #	N/A	MAINLINE PROJ. #	21-037	
	SHEET NAME	EXISTING DRAINAGE CONDITIONS			

Taylor Ricks
PROFESSIONAL ENGINEER

MAINLINE ENGINEERING

MAINLINE ENGINEERING
321 NORTH MALL DRIVE
SUITE T101
ST. GEORGE, UT 84790

GARY W CARTER LP
730 WEST INDIAN HILLS DRIVE
ST. GEORGE, UT 84770

NO.	REVISIONS	BY	DATE

NO	REVISIONS	BY	DATE

MAINLINE ENGINEERING
321 NORTH MALL DRIVE
SUITE T101
ST. GEORGE, UT 84770

GARY W CARTER LP
730 WEST INDIAN HILLS DRIVE
ST. GEORGE, UT 84770

PROFESSIONAL ENGINEER

DATE	DRAWN BY	CHECKED BY
1/28/22	TAR	PBG

PROJECT	TEMPLE TRAIL		
CLIENT	N/A	MAINLINE PROJ. #	21-037
SHEET NAME	DEVELOPED DRAINAGE CONDITIONS		

SHEET A2

National Flood Hazard Layer FIRMette

FEMA

113°36'22"W 37°5'37"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000

113°35'44"W 37°5'8"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/27/2022 at 12:38 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Soil Map—Washington County Area, Utah



Map Scale: 1:2,560 if printed on A portrait (8.5" x 11") sheet.

N

0 35 70 140 210 Meters

0 100 200 400 600 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

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

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

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

Soil Survey Area: Washington County Area, Utah
Survey Area Data: Version 15, Sep 7, 2021

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

Date(s) aerial images were photographed: Jun 1, 2018—Aug 1, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
GA	Gullied land	1.4	7.6%
GP	Gravel pits	8.4	46.0%
IAF	Isom cobbly sandy loam, 3 to 30 percent slopes	3.9	21.2%
LeB	Leeds silty clay loam, 1 to 2 percent slopes	0.7	3.6%
SY	Stony colluvial land	3.9	21.5%
Totals for Area of Interest		**18.3**	**100.0%**

NOAA Atlas 14, Volume 1, Version 5
Location name: Ephraim, Utah, USA*
Latitude: 39.4°, Longitude: -111.6°
Elevation: 5445.64 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.101 (0.091-0.114)	0.130 (0.116-0.149)	0.182 (0.163-0.206)	0.226 (0.199-0.257)	0.297 (0.255-0.339)	0.359 (0.303-0.411)	0.431 (0.355-0.498)	0.512 (0.411-0.599)	0.641 (0.491-0.765)	0.751 (0.557-0.907)
10-min	0.153 (0.138-0.174)	0.198 (0.176-0.226)	0.277 (0.248-0.314)	0.344 (0.303-0.392)	0.452 (0.388-0.515)	0.547 (0.461-0.626)	0.655 (0.540-0.758)	0.780 (0.625-0.913)	0.975 (0.747-1.16)	1.14 (0.847-1.38)
15-min	0.190 (0.171-0.215)	0.245 (0.218-0.280)	0.344 (0.307-0.389)	0.426 (0.376-0.486)	0.560 (0.481-0.639)	0.678 (0.571-0.777)	0.812 (0.670-0.940)	0.967 (0.775-1.13)	1.21 (0.926-1.44)	1.42 (1.05-1.71)
30-min	0.256 (0.230-0.290)	0.330 (0.293-0.377)	0.463 (0.414-0.524)	0.574 (0.506-0.654)	0.754 (0.648-0.861)	0.913 (0.769-1.05)	1.09 (0.902-1.27)	1.30 (1.04-1.52)	1.63 (1.25-1.94)	1.91 (1.42-2.31)
60-min	0.317 (0.285-0.359)	0.409 (0.363-0.467)	0.573 (0.512-0.648)	0.710 (0.626-0.810)	0.933 (0.802-1.07)	1.13 (0.951-1.29)	1.35 (1.12-1.57)	1.61 (1.29-1.89)	2.02 (1.54-2.40)	2.36 (1.75-2.85)
2-hr	0.389 (0.350-0.435)	0.490 (0.444-0.553)	0.653 (0.593-0.730)	0.804 (0.720-0.897)	1.03 (0.900-1.15)	1.23 (1.06-1.39)	1.46 (1.22-1.67)	1.73 (1.41-1.99)	2.15 (1.67-2.52)	2.52 (1.89-3.00)
3-hr	0.445 (0.407-0.493)	0.555 (0.510-0.612)	0.720 (0.662-0.799)	0.864 (0.784-0.957)	1.08 (0.964-1.20)	1.26 (1.11-1.41)	1.48 (1.27-1.69)	1.74 (1.47-2.00)	2.16 (1.74-2.53)	2.53 (1.98-3.03)
6-hr	0.581 (0.533-0.637)	0.724 (0.669-0.790)	0.897 (0.830-0.983)	1.04 (0.959-1.14)	1.25 (1.13-1.38)	1.42 (1.27-1.58)	1.62 (1.42-1.82)	1.83 (1.58-2.07)	2.25 (1.89-2.60)	2.61 (2.14-3.06)
12-hr	0.733 (0.677-0.792)	0.897 (0.833-0.970)	1.09 (1.01-1.18)	1.25 (1.15-1.35)	1.46 (1.34-1.59)	1.63 (1.48-1.78)	1.80 (1.62-1.98)	1.99 (1.77-2.21)	2.28 (1.98-2.62)	2.62 (2.24-3.09)
24-hr	0.886 (0.816-0.974)	1.09 (1.01-1.20)	1.33 (1.22-1.46)	1.52 (1.39-1.66)	1.77 (1.62-1.94)	1.97 (1.80-2.15)	2.17 (1.96-2.38)	2.37 (2.13-2.61)	2.64 (2.35-2.91)	2.84 (2.51-3.15)
2-day	0.992 (0.919-1.08)	1.22 (1.13-1.33)	1.48 (1.37-1.61)	1.69 (1.56-1.84)	1.98 (1.82-2.15)	2.20 (2.02-2.40)	2.43 (2.22-2.65)	2.67 (2.42-2.92)	2.98 (2.67-3.28)	3.22 (2.86-3.56)
3-day	1.07 (0.986-1.17)	1.31 (1.21-1.44)	1.59 (1.47-1.74)	1.82 (1.68-1.98)	2.13 (1.96-2.32)	2.38 (2.17-2.59)	2.64 (2.39-2.88)	2.90 (2.61-3.17)	3.25 (2.89-3.57)	3.52 (3.11-3.90)
4-day	1.14 (1.05-1.25)	1.41 (1.30-1.54)	1.70 (1.57-1.86)	1.95 (1.79-2.12)	2.29 (2.09-2.49)	2.56 (2.33-2.79)	2.84 (2.56-3.10)	3.13 (2.81-3.42)	3.52 (3.12-3.87)	3.82 (3.36-4.23)
7-day	1.34 (1.24-1.46)	1.65 (1.53-1.81)	1.99 (1.84-2.17)	2.27 (2.10-2.46)	2.64 (2.43-2.87)	2.93 (2.68-3.18)	3.21 (2.94-3.50)	3.50 (3.18-3.83)	3.88 (3.50-4.27)	4.17 (3.72-4.60)
10-day	1.50 (1.39-1.64)	1.85 (1.72-2.02)	2.23 (2.06-2.42)	2.53 (2.34-2.74)	2.93 (2.70-3.16)	3.23 (2.97-3.49)	3.53 (3.23-3.82)	3.82 (3.47-4.15)	4.20 (3.78-4.58)	4.47 (4.01-4.91)
20-day	1.93 (1.79-2.09)	2.37 (2.19-2.57)	2.85 (2.64-3.08)	3.23 (2.99-3.48)	3.70 (3.42-4.00)	4.06 (3.74-4.38)	4.40 (4.05-4.75)	4.72 (4.33-5.12)	5.14 (4.68-5.60)	5.43 (4.92-5.93)
30-day	2.28 (2.11-2.46)	2.81 (2.60-3.04)	3.37 (3.12-3.63)	3.80 (3.51-4.09)	4.36 (4.03-4.69)	4.77 (4.40-5.15)	5.18 (4.76-5.59)	5.57 (5.10-6.03)	6.06 (5.51-6.60)	6.41 (5.80-7.02)
45-day	2.85 (2.65-3.07)	3.50 (3.25-3.77)	4.16 (3.87-4.48)	4.67 (4.34-5.01)	5.31 (4.93-5.69)	5.77 (5.36-6.17)	6.20 (5.75-6.64)	6.59 (6.11-7.07)	7.04 (6.52-7.58)	7.34 (6.78-7.93)
60-day	3.37 (3.14-3.62)	4.14 (3.86-4.45)	4.92 (4.60-5.27)	5.52 (5.15-5.89)	6.27 (5.85-6.68)	6.80 (6.33-7.25)	7.30 (6.78-7.80)	7.76 (7.19-8.31)	8.30 (7.67-8.92)	8.66 (7.98-9.32)

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

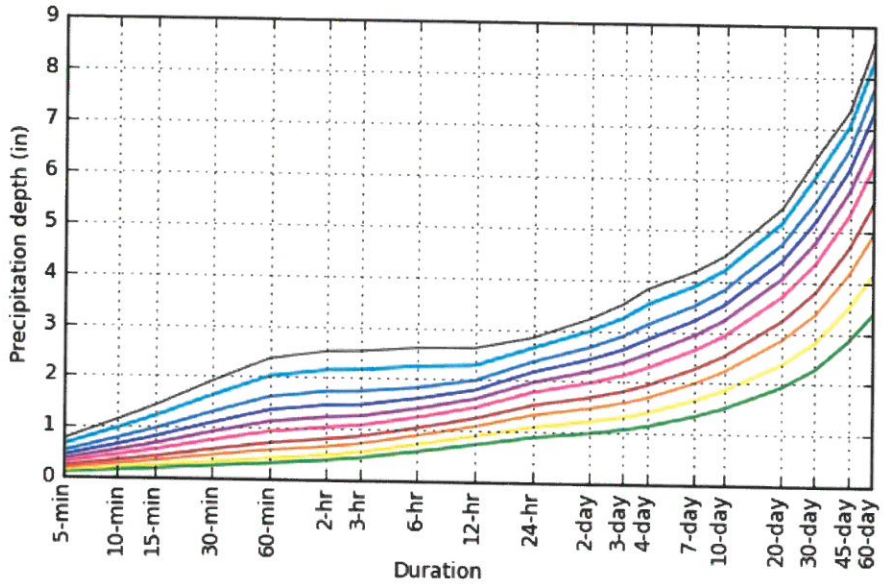
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper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

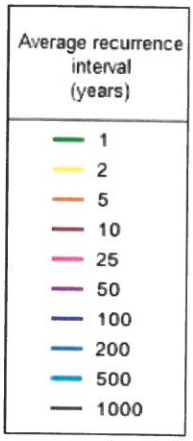
Please refer to NOAA Atlas 14 document for more information.

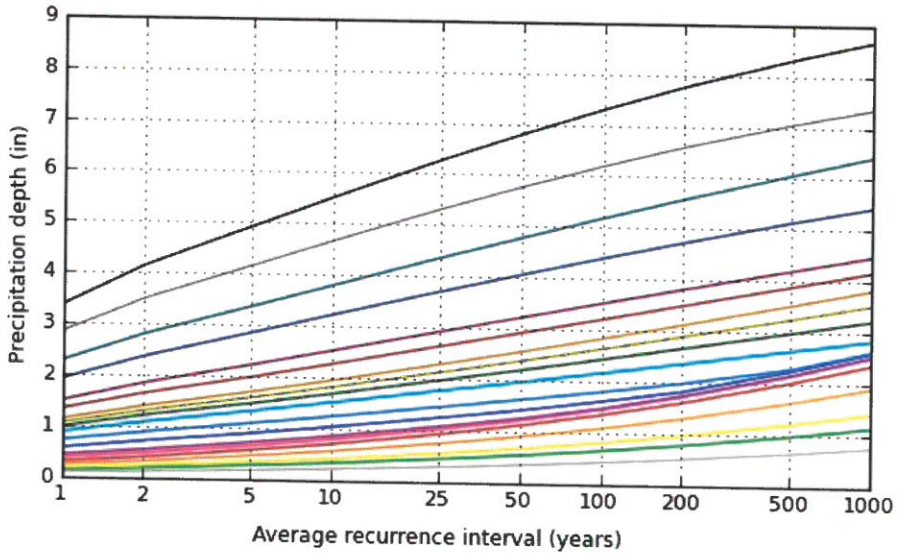
Back to Top

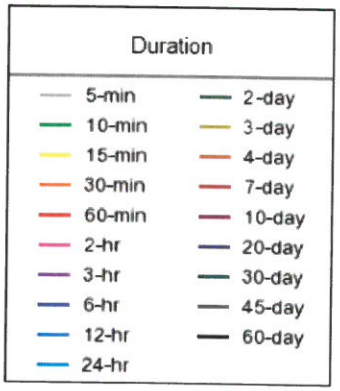
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 39.4000°, Longitude: -111.6000°









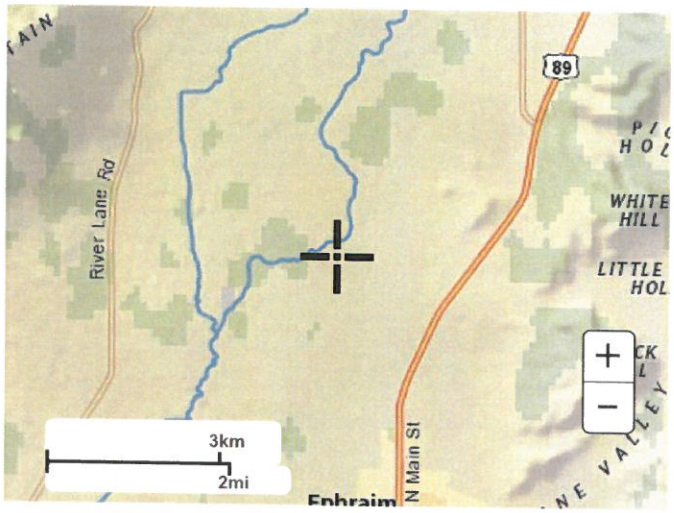
NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Thu Jan 27 17:42:58 2022

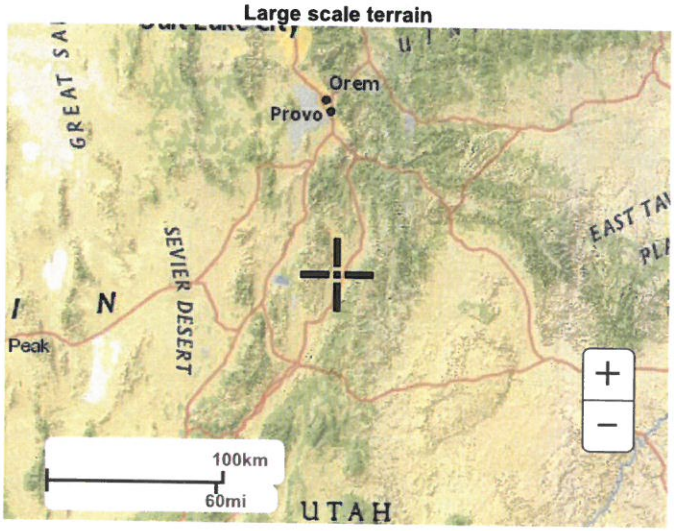
Back to Top

Maps & aerials

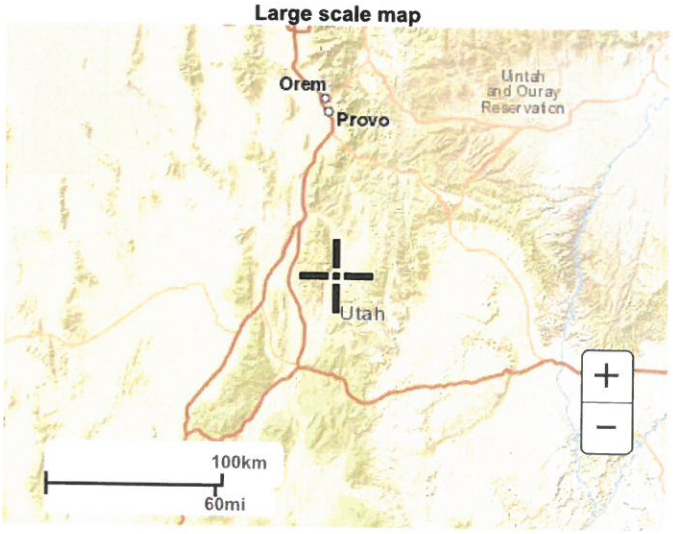
Small scale terrain



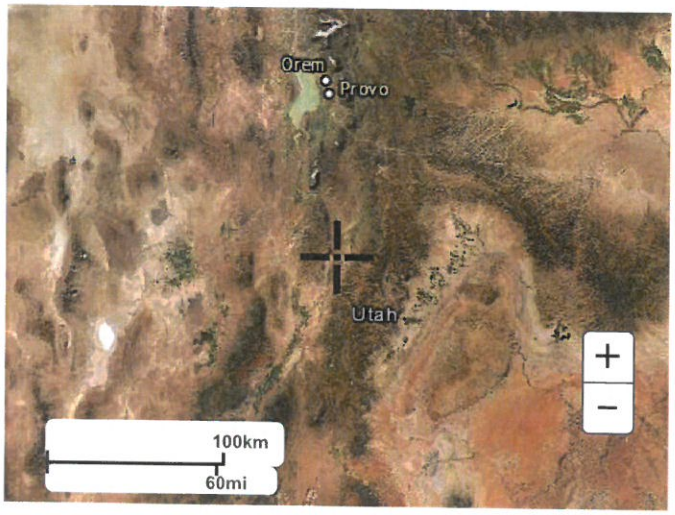
Large scale terrain



Large scale map



Large scale aerial



Back to Top

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

Disclaimer

NOAA Atlas 14, Volume 1, Version 5
Location name: Ephraim, Utah, USA*
Latitude: 39.4°, Longitude: -111.6°
Elevation: 5445.64 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.21 (1.09-1.37)	1.56 (1.39-1.79)	2.18 (1.96-2.47)	2.71 (2.39-3.08)	3.56 (3.06-4.07)	4.31 (3.64-4.93)	5.17 (4.26-5.98)	6.14 (4.93-7.19)	7.69 (5.89-9.18)	9.01 (6.68-10.9)
10-min	0.918 (0.828-1.04)	1.19 (1.06-1.36)	1.66 (1.49-1.88)	2.06 (1.82-2.35)	2.71 (2.33-3.09)	3.28 (2.77-3.76)	3.93 (3.24-4.55)	4.68 (3.75-5.48)	5.85 (4.48-6.98)	6.86 (5.08-8.28)
15-min	0.760 (0.684-0.860)	0.980 (0.872-1.12)	1.38 (1.23-1.56)	1.70 (1.50-1.94)	2.24 (1.92-2.56)	2.71 (2.28-3.11)	3.25 (2.68-3.76)	3.87 (3.10-4.52)	4.84 (3.70-5.77)	5.67 (4.20-6.84)
30-min	0.512 (0.460-0.580)	0.660 (0.586-0.754)	0.926 (0.828-1.05)	1.15 (1.01-1.31)	1.51 (1.30-1.72)	1.83 (1.54-2.09)	2.19 (1.80-2.53)	2.60 (2.09-3.05)	3.26 (2.49-3.89)	3.82 (2.83-4.61)
60-min	0.317 (0.285-0.359)	0.409 (0.363-0.467)	0.573 (0.512-0.648)	0.710 (0.626-0.810)	0.933 (0.802-1.07)	1.13 (0.951-1.29)	1.35 (1.12-1.57)	1.61 (1.29-1.89)	2.02 (1.54-2.40)	2.36 (1.75-2.85)
2-hr	0.194 (0.175-0.218)	0.245 (0.222-0.276)	0.326 (0.296-0.365)	0.402 (0.360-0.448)	0.516 (0.450-0.577)	0.615 (0.529-0.692)	0.732 (0.612-0.834)	0.866 (0.704-0.996)	1.08 (0.836-1.26)	1.26 (0.943-1.50)
3-hr	0.148 (0.136-0.164)	0.185 (0.170-0.204)	0.240 (0.220-0.266)	0.288 (0.261-0.319)	0.360 (0.321-0.398)	0.420 (0.368-0.470)	0.492 (0.424-0.561)	0.581 (0.488-0.665)	0.720 (0.581-0.841)	0.842 (0.659-1.01)
6-hr	0.097 (0.089-0.106)	0.121 (0.112-0.132)	0.150 (0.139-0.164)	0.174 (0.160-0.191)	0.209 (0.189-0.230)	0.237 (0.213-0.264)	0.270 (0.238-0.303)	0.305 (0.264-0.346)	0.375 (0.315-0.433)	0.435 (0.357-0.511)
12-hr	0.061 (0.056-0.066)	0.074 (0.069-0.081)	0.091 (0.084-0.098)	0.104 (0.096-0.112)	0.121 (0.111-0.132)	0.135 (0.123-0.148)	0.149 (0.134-0.164)	0.165 (0.146-0.183)	0.189 (0.164-0.218)	0.218 (0.186-0.256)
24-hr	0.037 (0.034-0.041)	0.045 (0.042-0.050)	0.055 (0.051-0.061)	0.063 (0.058-0.069)	0.074 (0.068-0.081)	0.082 (0.075-0.090)	0.090 (0.082-0.099)	0.099 (0.089-0.109)	0.110 (0.098-0.121)	0.118 (0.105-0.131)
2-day	0.021 (0.019-0.022)	0.025 (0.024-0.028)	0.031 (0.028-0.034)	0.035 (0.033-0.038)	0.041 (0.038-0.045)	0.046 (0.042-0.050)	0.051 (0.046-0.055)	0.056 (0.050-0.061)	0.062 (0.056-0.068)	0.067 (0.060-0.074)
3-day	0.015 (0.014-0.016)	0.018 (0.017-0.020)	0.022 (0.020-0.024)	0.025 (0.023-0.028)	0.030 (0.027-0.032)	0.033 (0.030-0.036)	0.037 (0.033-0.040)	0.040 (0.036-0.044)	0.045 (0.040-0.050)	0.049 (0.043-0.054)
4-day	0.012 (0.011-0.013)	0.015 (0.013-0.016)	0.018 (0.016-0.019)	0.020 (0.019-0.022)	0.024 (0.022-0.026)	0.027 (0.024-0.029)	0.030 (0.027-0.032)	0.033 (0.029-0.036)	0.037 (0.033-0.040)	0.040 (0.035-0.044)
7-day	0.008 (0.007-0.009)	0.010 (0.009-0.011)	0.012 (0.011-0.013)	0.014 (0.012-0.015)	0.016 (0.014-0.017)	0.017 (0.016-0.019)	0.019 (0.017-0.021)	0.021 (0.019-0.023)	0.023 (0.021-0.025)	0.025 (0.022-0.027)
10-day	0.006 (0.006-0.007)	0.008 (0.007-0.008)	0.009 (0.009-0.010)	0.011 (0.010-0.011)	0.012 (0.011-0.013)	0.013 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.014-0.017)	0.017 (0.016-0.019)	0.019 (0.017-0.020)
20-day	0.004 (0.004-0.004)	0.005 (0.005-0.005)	0.006 (0.006-0.006)	0.007 (0.006-0.007)	0.008 (0.007-0.008)	0.008 (0.008-0.009)	0.009 (0.008-0.010)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.011 (0.010-0.012)
30-day	0.003 (0.003-0.003)	0.004 (0.004-0.004)	0.005 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.006-0.007)	0.007 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.007-0.008)	0.008 (0.008-0.009)	0.009 (0.008-0.010)
45-day	0.003 (0.002-0.003)	0.003 (0.003-0.003)	0.004 (0.004-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.005)	0.005 (0.005-0.006)	0.006 (0.005-0.006)	0.006 (0.006-0.007)	0.007 (0.006-0.007)	0.007 (0.006-0.007)
60-day	0.002 (0.002-0.003)	0.003 (0.003-0.003)	0.003 (0.003-0.004)	0.004 (0.004-0.004)	0.004 (0.004-0.005)	0.005 (0.004-0.005)	0.005 (0.005-0.005)	0.005 (0.005-0.006)	0.006 (0.005-0.006)	0.006 (0.006-0.006)

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

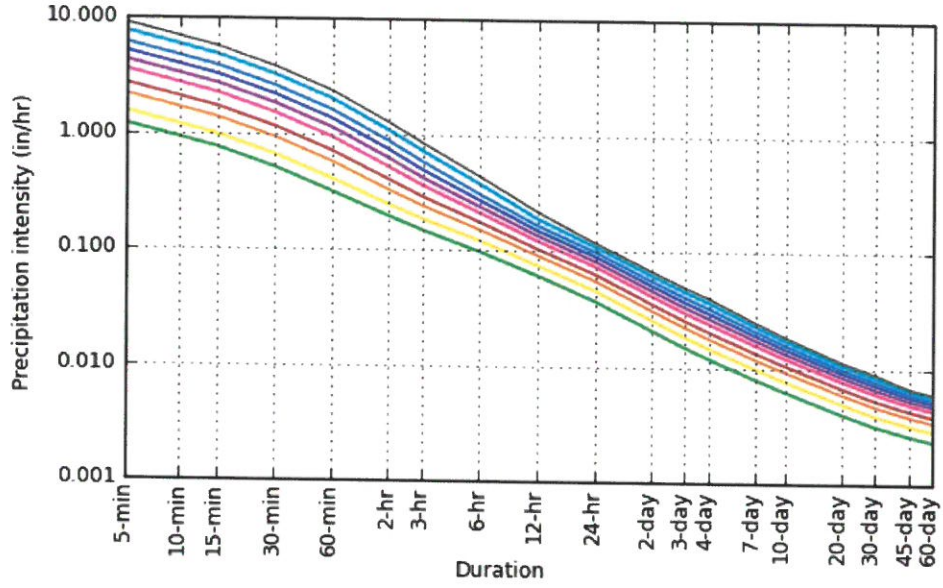
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper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

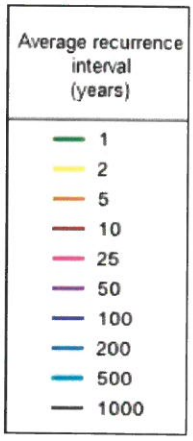
Please refer to NOAA Atlas 14 document for more information.

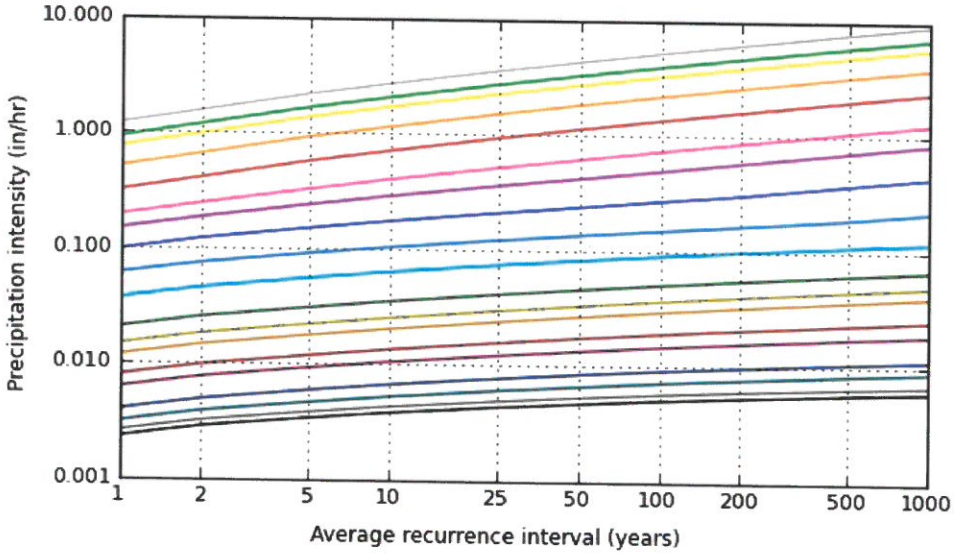
Back to Top

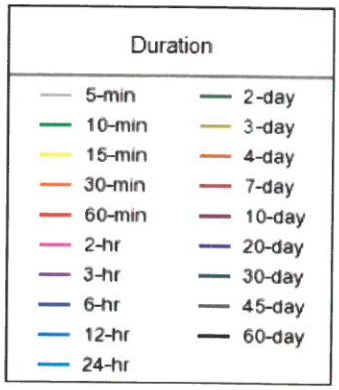
PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 39.4000°, Longitude: -111.6000°









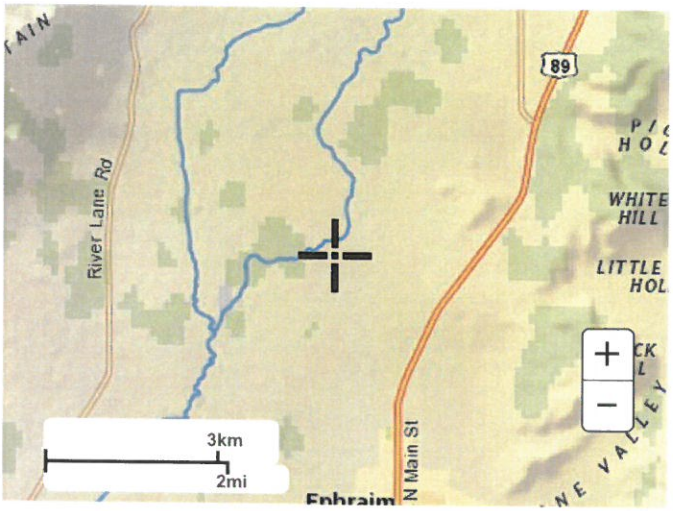
NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Thu Jan 27 17:54:26 2022

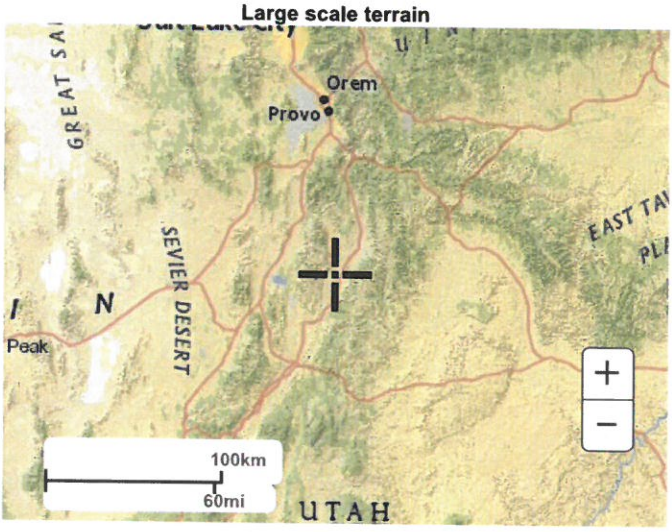
Back to Top

Maps & aerials

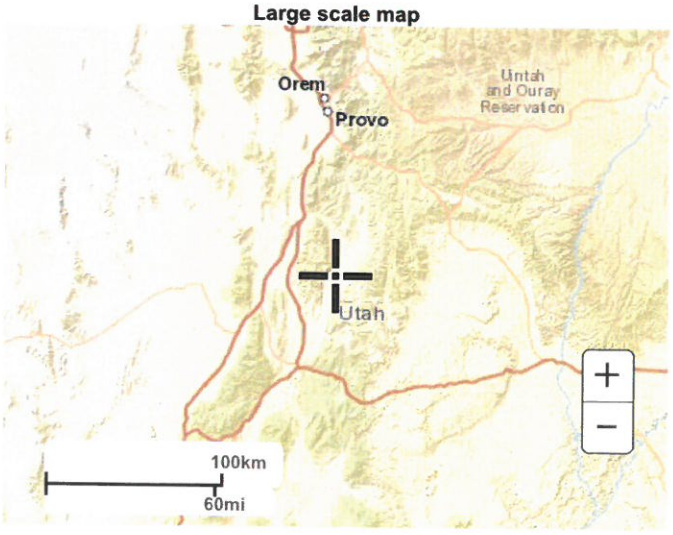
Small scale terrain



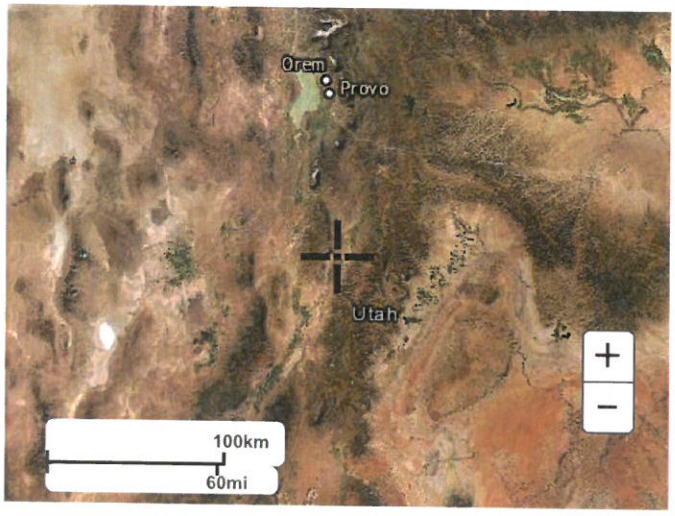
Large scale terrain



Large scale map



Large scale aerial



Back to Top

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

Disclaimer

UNIMPROVED ANALYSIS FOR

Temple Trail Canyon Subdivision - Phase 1

UNIMPROVED CONDITION (TR-55)

Description of Area	*Area (SF)*	*Area (Ac)*	*Curve No.*	*% of Area*
Undeveloped (Desert, fair)	376,460	8.64	81	100.0%
Natural Desert Landscaping			85	0.0%
Lawn			74	0.0%
Impervious Area			98	0.0%
Total Area (SF) & Composite CN	**376,460**	**8.64**	**81**	**100.0%**

Max Retention (S)	2.35	inches
Initial Abstraction	0.47	inches
Time of Concentration	15.7	min

Storm --->	**10y 24hr**	**100y 24hr**	**10y 3hr**	**100y 3hr**
Runoff Depth (in)	0.33	0.71	0.06	0.30
Runoff Vol (CF)	10,200	22,428	1,785	9,551
Runoff Vol (Gal)	76,295	167,762	13,351	71,439
Ia/P	0.30	0.20		
Unit Discharge	613.8	663.4		
Theoretical Peak Discharge (cfs)	2.7	6.4		
Calc'd Peak Discharge (cfs)	2.83	7.42	1.5	8.0

Time of Conc. Calc	**Lenth (ft)**	**Slope**	**Manning n**
Sheet	100	3.30%	0.13
Shallow Concentrated	752	6.00%	Unpaved

IMPROVED ANALYSIS FOR

Temple Trail Canyon Subdivision - Phase 1

DEVELOPED CONDITION (TR-55)

Description of Area	*Area (SF)*	*Area (Ac)*	*Curve No.*	*% of Area*
Undeveloped (Desert, fair)			81	0.0%
Natural Desert Landscaping	132,960	3.052	85	35.3%
Lawn	76,000	1.745	74	20.2%
Impervious Area	167,500	3.845	98	44.5%
Total Area (SF) & Composite CN	**376,460**	**8.642**	**89**	**100.0%**

Max Retention (S)	1.29	inches
Initial Abstraction	0.26	inches
Time of Concentration	23.0	min

Storm --->	**10y 24hr**	**100y 24hr**	**10y 3hr**	**100y 3hr**
Runoff Depth (in)	0.62	1.14	0.19	0.59
Runoff Vol (CF)	19,562	35,795	6,068	18,633
Runoff Vol (Gal)	146,322	267,748	45,385	139,376
Ia/P	0.15	0.10		
Unit Discharge	577.3	603.4		
Theoretical Peak Discharge (cfs)	4.9	9.3		
Calc'd Peak Discharge (cfs)	5.42	10.5	5.1	15.5

Time of Conc. Calc	**Lenth (ft)**	**Slope**	**Manning n**	
Sheet	100	0.80%	0.13	
Shallow Concentrated	85	1.76%	Unpaved	
Channel	800	1.02%	0.012	
Channel Addt'l	Area	1.68	WP	12.4

Retention Analysis

% Impervious	**44%**	
R_{new} (Runoff Coefficient)	**0.150**	
$P_{80\%}$ (80th Perc. Precip.)	**0.44**	in
WQRV (Retention Volume)	**0.048**	ac-ft
WQRV (Retention Volume)	**2,072**	cu-ft
# Lots	**23**	
WQRV per Lot	**90.1**	cu-ft
Reduction Factor (Table 3 LID)	**0.45**	
Reduced WQRV	**933**	cu-ft

Volumetric Summary

Description	*Required*	*Provided*	*Units*
Total Detention	2,101	3,996	CF
Total Retention	933	1,053	CF
Total Detention + Retention	3,034	5,049	CF

Site-Specific Modified Type II Storm 3-Hour Rainfall Data
Farmer Fletcher Distribution

						Qmax							
								1.49	7.96			5.06	15.53
		Precip.				Runoff Pre-dev (delay timestep by Tc)				Runoff Post-dev (delay timestep by Tc)			
		Cumulative		Incremental		Cumulative		Incremental		Cumulative		Incremental	
Minutes	Distribution (%)	10y3h	100y3h	10y3h	100y3h	10y3h (CF)	100y3h (CF)	10y3h (CF)	100y3h (CF)	10y3h (CF)	100y3h (CF)	10y3h (CF)	100y3h (CF)
5	0	0.000	0.000	0.000	0.000	0	0	0	0	0	0	0	0
10	0	0.000	0.000	0.000	0.000	0	0	0	0	0	0	0	0
15	1	0.009	0.015	0.009	0.015	18	96	18	96	61	186	61	186
20	1	0.009	0.015	0.000	0.000	18	96	0	0	61	186	0	0
25	2	0.017	0.030	0.009	0.015	36	191	18	96	121	373	61	186
30	2	0.017	0.030	0.000	0.000	36	191	0	0	121	373	0	0
35	3	0.026	0.044	0.009	0.015	54	287	18	96	182	559	61	186
40	28	0.242	0.414	0.216	0.370	500	2,674	446	2,388	1,699	5,217	1,517	4,658
45	48	0.415	0.710	0.173	0.296	857	4,584	357	1,910	2,912	8,944	1,214	3,727
50	62	0.536	0.918	0.121	0.207	1,107	5,921	250	1,337	3,762	11,553	849	2,609
55	71	0.613	1.051	0.078	0.133	1,267	6,781	161	860	4,308	13,229	546	1,677
60	77	0.665	1.140	0.052	0.089	1,374	7,354	107	573	4,672	14,347	364	1,118
65	81	0.700	1.199	0.035	0.059	1,446	7,736	71	382	4,915	15,093	243	745
70	84	0.726	1.243	0.026	0.044	1,499	8,023	54	287	5,097	15,652	182	559
75	86	0.743	1.273	0.017	0.030	1,535	8,214	36	191	5,218	16,024	121	373
80	88	0.760	1.302	0.017	0.030	1,571	8,405	36	191	5,339	16,397	121	373
85	90	0.778	1.332	0.017	0.030	1,606	8,596	36	191	5,461	16,770	121	373
90	91	0.786	1.347	0.009	0.015	1,624	8,691	18	96	5,521	16,956	61	186
95	92	0.795	1.362	0.009	0.015	1,642	8,787	18	96	5,582	17,142	61	186
100	93	0.804	1.376	0.009	0.015	1,660	8,882	18	96	5,643	17,329	61	186
105	93	0.804	1.376	0.000	0.000	1,660	8,882	0	0	5,643	17,329	0	0
110	94	0.812	1.391	0.009	0.015	1,678	8,978	18	96	5,704	17,515	61	186
115	94	0.812	1.391	0.000	0.000	1,678	8,978	0	0	5,704	17,515	0	0
120	94	0.812	1.391	0.000	0.000	1,678	8,978	0	0	5,704	17,515	0	0
125	95	0.821	1.406	0.009	0.015	1,696	9,073	18	96	5,764	17,701	61	186
130	95	0.821	1.406	0.000	0.000	1,696	9,073	0	0	5,764	17,701	0	0
135	96	0.829	1.421	0.009	0.015	1,713	9,169	18	96	5,825	17,888	61	186
140	96	0.829	1.421	0.000	0.000	1,713	9,169	0	0	5,825	17,888	0	0
145	97	0.838	1.436	0.009	0.015	1,731	9,264	18	96	5,886	18,074	61	186
150	97	0.838	1.436	0.000	0.000	1,731	9,264	0	0	5,886	18,074	0	0
155	97	0.838	1.436	0.000	0.000	1,731	9,264	0	0	5,886	18,074	0	0
160	98	0.847	1.450	0.009	0.015	1,749	9,360	18	96	5,946	18,260	61	186
165	98	0.847	1.450	0.000	0.000	1,749	9,360	0	0	5,946	18,260	0	0
170	99	0.855	1.465	0.009	0.015	1,767	9,455	18	96	6,007	18,447	61	186
175	99	0.855	1.465	0.000	0.000	1,767	9,455	0	0	6,007	18,447	0	0
180	100	0.864	1.480	0.009	0.015	1,785	9,551	18	96	6,068	18,633	61	186
185	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
190	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
195	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
200	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
205	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
210	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
215	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
220	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
225	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
230	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
235	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
240	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
245	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
250	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
255	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
260	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
265	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
270	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
275	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
280	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
285	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
290	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
295	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
300	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
305	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
310	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
315	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
320	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
325	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
330	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
335	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
340	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
345	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
350	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
355	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0
360	100	0.864	1.480	0.000	0.000	1,785	9,551	0	0	6,068	18,633	0	0

Site-Specific SCS Type II Storm

Allowable Rate Discharge: 7.42 cfs

Allowable Vol. Discharge: 2671.2 cf in 0.1 hrs

Time (hours)	Distribution (%)	Cumulative (in)		Incremental (in)		100y24h Cum. Inflow (CF)	100y24h Incremental Inflow (CF)	Detained in Period (CF)	Cum Detained (CF)
		10y24h	100y24h	10y24h	100y24h				
0	0.00%	0.000	0.000	0.000	0.000	0	0	0	0
0.1	0.10%	0.002	0.002	0.002	0.002	36	36	0	0
0.2	0.20%	0.003	0.004	0.002	0.002	72	36	0	0
0.3	0.31%	0.005	0.007	0.002	0.002	109	37	0	0
0.4	0.41%	0.006	0.009	0.002	0.002	146	37	0	0
0.5	0.51%	0.008	0.011	0.002	0.002	184	38	0	0
0.6	0.62%	0.009	0.013	0.002	0.002	221	38	0	0
0.7	0.73%	0.011	0.016	0.002	0.002	260	38	0	0
0.8	0.83%	0.013	0.018	0.002	0.002	298	38	0	0
0.9	0.94%	0.014	0.020	0.002	0.002	337	39	0	0
1	1.05%	0.016	0.023	0.002	0.002	376	39	0	0
1.1	1.16%	0.018	0.025	0.002	0.002	416	40	0	0
1.2	1.27%	0.019	0.028	0.002	0.002	455	40	0	0
1.3	1.39%	0.021	0.030	0.002	0.002	496	40	0	0
1.4	1.50%	0.023	0.033	0.002	0.002	536	40	0	0
1.5	1.61%	0.025	0.035	0.002	0.002	577	41	0	0
1.6	1.73%	0.026	0.037	0.002	0.002	619	41	0	0
1.7	1.85%	0.028	0.040	0.002	0.003	660	42	0	0
1.8	1.96%	0.030	0.043	0.002	0.003	702	42	0	0
1.9	2.08%	0.032	0.045	0.002	0.003	745	43	0	0
2	2.20%	0.033	0.048	0.002	0.003	787	43	0	0
2.1	2.32%	0.035	0.050	0.002	0.003	831	43	0	0
2.2	2.44%	0.037	0.053	0.002	0.003	874	43	0	0
2.3	2.57%	0.039	0.056	0.002	0.003	918	44	0	0
2.4	2.69%	0.041	0.058	0.002	0.003	962	44	0	0
2.5	2.81%	0.043	0.061	0.002	0.003	1,007	45	0	0
2.6	2.94%	0.045	0.064	0.002	0.003	1,052	45	0	0
2.7	3.07%	0.047	0.067	0.002	0.003	1,097	45	0	0
2.8	3.19%	0.049	0.069	0.002	0.003	1,143	45	0	0
2.9	3.32%	0.050	0.072	0.002	0.003	1,189	46	0	0
3	3.45%	0.052	0.075	0.002	0.003	1,235	46	0	0
3.1	3.58%	0.054	0.078	0.002	0.003	1,282	47	0	0
3.2	3.71%	0.056	0.081	0.002	0.003	1,329	47	0	0
3.3	3.85%	0.058	0.083	0.002	0.003	1,376	48	0	0
3.4	3.98%	0.060	0.086	0.002	0.003	1,424	48	0	0
3.5	4.11%	0.063	0.089	0.002	0.003	1,472	48	0	0
3.6	4.25%	0.065	0.092	0.002	0.003	1,521	48	0	0
3.7	4.39%	0.067	0.095	0.002	0.003	1,570	49	0	0
3.8	4.52%	0.069	0.098	0.002	0.003	1,619	49	0	0
3.9	4.66%	0.071	0.101	0.002	0.003	1,668	50	0	0
4	4.80%	0.073	0.104	0.002	0.003	1,718	50	0	0
4.1	4.94%	0.075	0.107	0.002	0.003	1,769	50	0	0

Site-Specific SCS Type II Storm

Allowable Rate Discharge: 7.42 cfs

Allowable Vol. Discharge: 2671.2 cf in 0.1 hrs

Time (hours)	Distribution (%)	Cumulative (in)		Incremental (in)		100y24h Cum. Inflow (CF)	100y24h Incremental Inflow (CF)	Detained in Period (CF)	Cum Detained (CF)
		10y24h	100y24h	10y24h	100y24h				
4.2	5.08%	0.077	0.110	0.002	0.003	1,820	51	0	0
4.3	5.23%	0.079	0.113	0.002	0.003	1,872	52	0	0
4.4	5.38%	0.082	0.117	0.002	0.003	1,924	53	0	0
4.5	5.53%	0.084	0.120	0.002	0.003	1,978	53	0	0
4.6	5.68%	0.086	0.123	0.002	0.003	2,032	54	0	0
4.7	5.83%	0.089	0.126	0.002	0.003	2,087	55	0	0
4.8	5.98%	0.091	0.130	0.002	0.003	2,142	55	0	0
4.9	6.14%	0.093	0.133	0.002	0.003	2,198	56	0	0
5	6.30%	0.096	0.137	0.002	0.003	2,255	57	0	0
5.1	6.46%	0.098	0.140	0.002	0.003	2,313	58	0	0
5.2	6.62%	0.101	0.144	0.002	0.004	2,371	58	0	0
5.3	6.79%	0.103	0.147	0.003	0.004	2,430	59	0	0
5.4	6.96%	0.106	0.151	0.003	0.004	2,490	60	0	0
5.5	7.13%	0.108	0.155	0.003	0.004	2,550	60	0	0
5.6	7.30%	0.111	0.158	0.003	0.004	2,612	61	0	0
5.7	7.47%	0.114	0.162	0.003	0.004	2,674	62	0	0
5.8	7.64%	0.116	0.166	0.003	0.004	2,736	63	0	0
5.9	7.82%	0.119	0.170	0.003	0.004	2,800	63	0	0
6	8.00%	0.122	0.174	0.003	0.004	2,864	64	0	0
6.1	8.18%	0.124	0.178	0.003	0.004	2,928	65	0	0
6.2	8.36%	0.127	0.181	0.003	0.004	2,994	66	0	0
6.3	8.55%	0.130	0.186	0.003	0.004	3,060	66	0	0
6.4	8.74%	0.133	0.190	0.003	0.004	3,127	67	0	0
6.5	8.93%	0.136	0.194	0.003	0.004	3,195	68	0	0
6.6	9.12%	0.139	0.198	0.003	0.004	3,263	68	0	0
6.7	9.31%	0.141	0.202	0.003	0.004	3,332	69	0	0
6.8	9.50%	0.144	0.206	0.003	0.004	3,402	70	0	0
6.9	9.70%	0.147	0.211	0.003	0.004	3,472	71	0	0
7	9.90%	0.150	0.215	0.003	0.004	3,544	71	0	0
7.1	10.10%	0.154	0.219	0.003	0.004	3,616	72	0	0
7.2	10.30%	0.157	0.224	0.003	0.004	3,688	73	0	0
7.3	10.51%	0.160	0.228	0.003	0.004	3,762	73	0	0
7.4	10.72%	0.163	0.233	0.003	0.004	3,836	74	0	0
7.5	10.93%	0.166	0.237	0.003	0.005	3,911	75	0	0
7.6	11.14%	0.169	0.242	0.003	0.005	3,986	76	0	0
7.7	11.35%	0.173	0.246	0.003	0.005	4,062	76	0	0
7.8	11.56%	0.176	0.251	0.003	0.005	4,139	77	0	0
7.9	11.78%	0.179	0.256	0.003	0.005	4,217	78	0	0
8	12.00%	0.182	0.260	0.003	0.005	4,295	78	0	0
8.1	12.23%	0.186	0.265	0.003	0.005	4,376	81	0	0
8.2	12.46%	0.189	0.270	0.004	0.005	4,460	84	0	0
8.3	12.71%	0.193	0.276	0.004	0.005	4,548	88	0	0

Site-Specific SCS Type II Storm

Allowable Rate Discharge: 7.42 cfs

Allowable Vol. Discharge: 2671.2 cf in 0.1 hrs

Time (hours)	Distribution (%)	Cumulative (in)		Incremental (in)		100y24h Cum. Inflow (CF)	100y24h Incremental Inflow (CF)	Detained in Period (CF)	Cum Detained (CF)
		10y24h	100y24h	10y24h	100y24h				
8.4	12.96%	0.197	0.281	0.004	0.006	4,639	91	0	0
8.5	13.23%	0.201	0.287	0.004	0.006	4,734	95	0	0
8.6	13.50%	0.205	0.293	0.004	0.006	4,832	98	0	0
8.7	13.79%	0.210	0.299	0.004	0.006	4,934	102	0	0
8.8	14.08%	0.214	0.306	0.004	0.006	5,040	106	0	0
8.9	14.39%	0.219	0.312	0.005	0.007	5,149	109	0	0
9	14.70%	0.223	0.319	0.005	0.007	5,262	113	0	0
9.1	15.02%	0.228	0.326	0.005	0.007	5,376	115	0	0
9.2	15.34%	0.233	0.333	0.005	0.007	5,491	115	0	0
9.3	15.66%	0.238	0.340	0.005	0.007	5,606	115	0	0
9.4	15.98%	0.243	0.347	0.005	0.007	5,720	115	0	0
9.5	16.30%	0.248	0.354	0.005	0.007	5,835	115	0	0
9.6	16.63%	0.253	0.361	0.005	0.007	5,952	117	0	0
9.7	16.97%	0.258	0.368	0.005	0.007	6,075	123	0	0
9.8	17.33%	0.263	0.376	0.005	0.008	6,204	129	0	0
9.9	17.71%	0.269	0.384	0.006	0.008	6,339	135	0	0
10	18.10%	0.275	0.393	0.006	0.009	6,479	140	0	0
10.1	18.51%	0.281	0.402	0.006	0.009	6,626	147	0	0
10.2	18.95%	0.288	0.411	0.007	0.009	6,782	156	0	0
10.3	19.41%	0.295	0.421	0.007	0.010	6,947	165	0	0
10.4	19.89%	0.302	0.432	0.007	0.011	7,120	173	0	0
10.5	20.40%	0.310	0.443	0.008	0.011	7,302	182	0	0
10.6	20.94%	0.318	0.454	0.008	0.012	7,496	193	0	0
10.7	21.52%	0.327	0.467	0.009	0.013	7,703	208	0	0
10.8	22.14%	0.337	0.480	0.009	0.013	7,925	222	0	0
10.9	22.80%	0.347	0.495	0.010	0.014	8,161	236	0	0
11	23.50%	0.357	0.510	0.011	0.015	8,412	251	0	0
11.1	24.27%	0.369	0.527	0.012	0.017	8,687	275	0	0
11.2	25.13%	0.382	0.545	0.013	0.019	8,996	309	0	0
11.3	26.09%	0.397	0.566	0.015	0.021	9,340	344	0	0
11.4	27.15%	0.413	0.589	0.016	0.023	9,718	378	0	0
11.5	28.30%	0.430	0.614	0.018	0.025	10,130	412	0	0
11.6	30.68%	0.466	0.666	0.036	0.052	10,983	853	0	0
11.7	35.44%	0.539	0.769	0.072	0.103	12,684	1,701	0	0
11.8	43.08%	0.655	0.935	0.116	0.166	15,420	2,736	65	65
11.9	56.79%	0.863	1.232	0.208	0.297	20,327	4,906	2,235	2,300
12	66.30%	1.008	1.439	0.145	0.206	23,732	3,406	734	3,034
12.1	68.20%	1.037	1.480	0.029	0.041	24,411	679	0	3,034
12.2	69.86%	1.062	1.516	0.025	0.036	25,008	597	0	3,034
12.3	71.30%	1.084	1.547	0.022	0.031	25,523	515	0	3,034
12.4	72.52%	1.102	1.574	0.018	0.026	25,957	434	0	3,034
12.5	73.50%	1.117	1.595	0.015	0.021	26,309	352	0	3,034

Site-Specific SCS Type II Storm

Allowable Rate Discharge: 7.42 cfs

Allowable Vol. Discharge: 2671.2 cf in 0.1 hrs

Time (hours)	Distribution (%)	Cumulative (in)		Incremental (in)		100y24h Cum. Inflow (CF)	100y24h Incremental Inflow (CF)	Detained in Period (CF)	Cum Detained (CF)
		10y24h	100y24h	10y24h	100y24h				
12.6	74.34%	1.130	1.613	0.013	0.018	26,612	302	0	3,034
12.7	75.14%	1.142	1.630	0.012	0.017	26,895	283	0	3,034
12.8	75.88%	1.153	1.647	0.011	0.016	27,160	265	0	3,034
12.9	76.56%	1.164	1.661	0.010	0.015	27,406	246	0	3,034
13	77.20%	1.173	1.675	0.010	0.014	27,634	228	0	3,034
13.1	77.80%	1.182	1.688	0.009	0.013	27,847	213	0	3,034
13.2	78.36%	1.191	1.700	0.009	0.012	28,051	203	0	3,034
13.3	78.90%	1.199	1.712	0.008	0.012	28,244	193	0	3,034
13.4	79.42%	1.207	1.723	0.008	0.011	28,427	183	0	3,034
13.5	79.90%	1.214	1.734	0.007	0.011	28,600	173	0	3,034
13.6	80.36%	1.221	1.744	0.007	0.010	28,765	165	0	3,034
13.7	80.80%	1.228	1.753	0.007	0.010	28,923	157	0	3,034
13.8	81.22%	1.235	1.762	0.006	0.009	29,073	150	0	3,034
13.9	81.62%	1.241	1.771	0.006	0.009	29,216	143	0	3,034
14	82.00%	1.246	1.779	0.006	0.008	29,352	136	0	3,034
14.1	82.37%	1.252	1.787	0.006	0.008	29,483	131	0	3,034
14.2	82.73%	1.257	1.795	0.005	0.008	29,612	129	0	3,034
14.3	83.08%	1.263	1.803	0.005	0.008	29,738	126	0	3,034
14.4	83.42%	1.268	1.810	0.005	0.007	29,862	123	0	3,034
14.5	83.76%	1.273	1.818	0.005	0.007	29,983	121	0	3,034
14.6	84.09%	1.278	1.825	0.005	0.007	30,102	118	0	3,034
14.7	84.42%	1.283	1.832	0.005	0.007	30,218	116	0	3,034
14.8	84.74%	1.288	1.839	0.005	0.007	30,331	113	0	3,034
14.9	85.05%	1.293	1.846	0.005	0.007	30,443	111	0	3,034
15	85.35%	1.297	1.852	0.005	0.007	30,551	108	0	3,034
15.1	85.65%	1.302	1.859	0.005	0.006	30,658	106	0	3,034
15.2	85.94%	1.306	1.865	0.004	0.006	30,761	103	0	3,034
15.3	86.22%	1.311	1.871	0.004	0.006	30,862	101	0	3,034
15.4	86.49%	1.315	1.877	0.004	0.006	30,961	98	0	3,034
15.5	86.76%	1.319	1.883	0.004	0.006	31,057	96	0	3,034
15.6	87.02%	1.323	1.888	0.004	0.006	31,150	93	0	3,034
15.7	87.28%	1.327	1.894	0.004	0.006	31,242	91	0	3,034
15.8	87.53%	1.330	1.899	0.004	0.005	31,330	88	0	3,034
15.9	87.77%	1.334	1.905	0.004	0.005	31,416	86	0	3,034
16	88.00%	1.338	1.910	0.004	0.005	31,500	83	0	3,034
16.1	88.23%	1.341	1.915	0.003	0.005	31,582	82	0	3,034
16.2	88.46%	1.345	1.919	0.003	0.005	31,663	81	0	3,034
16.3	88.68%	1.348	1.924	0.003	0.005	31,743	80	0	3,034
16.4	88.90%	1.351	1.929	0.003	0.005	31,822	79	0	3,034
16.5	89.12%	1.355	1.934	0.003	0.005	31,900	78	0	3,034
16.6	89.34%	1.358	1.939	0.003	0.005	31,978	77	0	3,034
16.7	89.55%	1.361	1.943	0.003	0.005	32,054	77	0	3,034

Site-Specific SCS Type II Storm

Allowable Rate Discharge: 7.42 cfs

Allowable Vol. Discharge: 2671.2 cf in 0.1 hrs

Time (hours)	Distribution (%)	Cumulative (in)		Incremental (in)		100y24h Cum. Inflow (CF)	100y24h Incremental Inflow (CF)	Detained in Period (CF)	Cum Detained (CF)
		10y24h	100y24h	10y24h	100y24h				
16.8	89.76%	1.364	1.948	0.003	0.005	32,130	76	0	3,034
16.9	89.97%	1.368	1.952	0.003	0.005	32,205	75	0	3,034
17	90.18%	1.371	1.957	0.003	0.004	32,278	74	0	3,034
17.1	90.38%	1.374	1.961	0.003	0.004	32,351	73	0	3,034
17.2	90.58%	1.377	1.966	0.003	0.004	32,423	72	0	3,034
17.3	90.78%	1.380	1.970	0.003	0.004	32,495	71	0	3,034
17.4	90.98%	1.383	1.974	0.003	0.004	32,565	70	0	3,034
17.5	91.17%	1.386	1.978	0.003	0.004	32,634	69	0	3,034
17.6	91.36%	1.389	1.983	0.003	0.004	32,703	68	0	3,034
17.7	91.55%	1.392	1.987	0.003	0.004	32,770	68	0	3,034
17.8	91.74%	1.394	1.991	0.003	0.004	32,837	67	0	3,034
17.9	91.92%	1.397	1.995	0.003	0.004	32,903	66	0	3,034
18	92.10%	1.400	1.999	0.003	0.004	32,967	65	0	3,034
18.1	92.28%	1.403	2.002	0.003	0.004	33,031	64	0	3,034
18.2	92.46%	1.405	2.006	0.003	0.004	33,094	63	0	3,034
18.3	92.63%	1.408	2.010	0.003	0.004	33,157	62	0	3,034
18.4	92.80%	1.411	2.014	0.003	0.004	33,218	61	0	3,034
18.5	92.97%	1.413	2.017	0.003	0.004	33,278	60	0	3,034
18.6	93.14%	1.416	2.021	0.003	0.004	33,338	59	0	3,034
18.7	93.30%	1.418	2.025	0.002	0.004	33,397	59	0	3,034
18.8	93.46%	1.421	2.028	0.002	0.003	33,454	58	0	3,034
18.9	93.62%	1.423	2.032	0.002	0.003	33,511	57	0	3,034
19	93.78%	1.425	2.035	0.002	0.003	33,567	56	0	3,034
19.1	93.93%	1.428	2.038	0.002	0.003	33,622	55	0	3,034
19.2	94.08%	1.430	2.042	0.002	0.003	33,676	54	0	3,034
19.3	94.23%	1.432	2.045	0.002	0.003	33,729	53	0	3,034
19.4	94.38%	1.435	2.048	0.002	0.003	33,782	52	0	3,034
19.5	94.52%	1.437	2.051	0.002	0.003	33,833	52	0	3,034
19.6	94.66%	1.439	2.054	0.002	0.003	33,884	50	0	3,034
19.7	94.80%	1.441	2.057	0.002	0.003	33,934	50	0	3,034
19.8	94.94%	1.443	2.060	0.002	0.003	33,982	49	0	3,034
19.9	95.07%	1.445	2.063	0.002	0.003	34,030	48	0	3,034
20	95.20%	1.447	2.066	0.002	0.003	34,077	47	0	3,034
20.1	95.33%	1.449	2.069	0.002	0.003	34,124	47	0	3,034
20.2	95.46%	1.451	2.071	0.002	0.003	34,170	46	0	3,034
20.3	95.59%	1.453	2.074	0.002	0.003	34,216	46	0	3,034
20.4	95.72%	1.455	2.077	0.002	0.003	34,262	46	0	3,034
20.5	95.84%	1.457	2.080	0.002	0.003	34,308	46	0	3,034
20.6	95.97%	1.459	2.083	0.002	0.003	34,353	45	0	3,034
20.7	96.10%	1.461	2.085	0.002	0.003	34,399	45	0	3,034
20.8	96.22%	1.463	2.088	0.002	0.003	34,444	45	0	3,034
20.9	96.35%	1.465	2.091	0.002	0.003	34,489	45	0	3,034

Site-Specific SCS Type II Storm

Allowable Rate Discharge 7.42 cfs

Allowable Vol. Discharge 2671.2 cf in 0.1 hrs

Time (hours)	Distribution (%)	Cumulative (in)		Incremental (in)		100y24h Cum. Inflow (CF)	100y24h Incremental Inflow (CF)	Detained in Period (CF)	Cum Detained (CF)
		10y24h	100y24h	10y24h	100y24h				
21	96.48%	1.466	2.094	0.002	0.003	34,533	45	0	3,034
21.1	96.60%	1.468	2.096	0.002	0.003	34,578	45	0	3,034
21.2	96.72%	1.470	2.099	0.002	0.003	34,623	44	0	3,034
21.3	96.85%	1.472	2.102	0.002	0.003	34,667	44	0	3,034
21.4	96.97%	1.474	2.104	0.002	0.003	34,711	44	0	3,034
21.5	97.09%	1.476	2.107	0.002	0.003	34,755	44	0	3,034
21.6	97.22%	1.478	2.110	0.002	0.003	34,799	44	0	3,034
21.7	97.34%	1.480	2.112	0.002	0.003	34,842	44	0	3,034
21.8	97.46%	1.481	2.115	0.002	0.003	34,886	43	0	3,034
21.9	97.58%	1.483	2.117	0.002	0.003	34,929	43	0	3,034
22	97.70%	1.485	2.120	0.002	0.003	34,972	43	0	3,034
22.1	97.82%	1.487	2.123	0.002	0.003	35,015	43	0	3,034
22.2	97.94%	1.489	2.125	0.002	0.003	35,057	43	0	3,034
22.3	98.06%	1.490	2.128	0.002	0.003	35,100	43	0	3,034
22.4	98.18%	1.492	2.130	0.002	0.003	35,142	42	0	3,034
22.5	98.29%	1.494	2.133	0.002	0.003	35,185	42	0	3,034
22.6	98.41%	1.496	2.136	0.002	0.003	35,226	42	0	3,034
22.7	98.53%	1.498	2.138	0.002	0.003	35,268	42	0	3,034
22.8	98.64%	1.499	2.141	0.002	0.003	35,310	42	0	3,034
22.9	98.76%	1.501	2.143	0.002	0.003	35,351	42	0	3,034
23	98.88%	1.503	2.146	0.002	0.002	35,393	41	0	3,034
23.1	98.99%	1.505	2.148	0.002	0.002	35,434	41	0	3,034
23.2	99.10%	1.506	2.151	0.002	0.002	35,475	41	0	3,034
23.3	99.22%	1.508	2.153	0.002	0.002	35,515	41	0	3,034
23.4	99.33%	1.510	2.155	0.002	0.002	35,556	40	0	3,034
23.5	99.44%	1.512	2.158	0.002	0.002	35,596	40	0	3,034
23.6	99.56%	1.513	2.160	0.002	0.002	35,636	40	0	3,034
23.7	99.67%	1.515	2.163	0.002	0.002	35,676	40	0	3,034
23.8	99.78%	1.517	2.165	0.002	0.002	35,716	40	0	3,034
23.9	99.89%	1.518	2.168	0.002	0.002	35,756	40	0	3,034
24	100.00%	1.520	2.170	0.002	0.002	35,795	39	0	3,034

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties–Washington County Area, Utah

Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
IAF—Isom cobbly sandy loam, 3 to 30 percent slopes														
Isom	90	A	0-2	Very cobbly sandy loam	SM, GM	A-1-b, A-2	0- 0- 0	40-45-50	55-60-65	50-55-60	30-35-40	20-25-30	15-20-25	NP-3 -5
			2-10	Very cobbly sandy loam	SM	A-1-b	0- 0- 0	30-35-40	65-73-80	60-68-75	35-45-50	20-25-30	15-20-25	NP-3 -5
			10-22	Very cobbly sandy loam	SM, GM	A-2, A-1-b	0- 0- 0	40-45-50	55-60-65	50-55-60	30-35-40	20-25-30	15-20-25	NP-3 -5
			22-60	Extremely cobbly sandy loam	GM	A-1-b	0- 0- 0	50-60-70	40-48-55	35-43-50	20-25-30	10-15-20	15-20-25	NP-3 -5
LeB—Leeds silty clay loam, 1 to 2 percent slopes														
Leeds	85	C	0-8	Silty clay loam	CL	A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	80-85-90	30-35-40	10-15-20
			8-15	Silty clay loam	CL	A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	80-85-90	30-35-40	10-15-20
			15-23	Sandy loam	SC	A-4, A-2-4	0- 0- 0	0- 0- 0	100-100-100	95-98-100	60-65-70	30-35-40	15-20-25	5-8 -10
			23-60	Silt loam	CL-ML, CL	A-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	70-80-90	20-25-30	5-10-15

Data Source Information

Soil Survey Area: Washington County Area, Utah
Survey Area Data: Version 15, Sep 7, 2021

Hydrologic Soil Group and Surface Runoff

This table gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

Surface runoff refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

Report—Hydrologic Soil Group and Surface Runoff

Absence of an entry indicates that the data were not estimated. The dash indicates no documented presence.

Hydrologic Soil Group and Surface Runoff–Washington County Area, Utah			
Map symbol and soil name	**Pct. of map unit**	**Surface Runoff**	**Hydrologic Soil Group**
GA—Gullied land			
Gullied land	100	—	—

Hydrologic Soil Group and Surface Runoff–Washington County Area, Utah			
Map symbol and soil name	**Pct. of map unit**	**Surface Runoff**	**Hydrologic Soil Group**
GP—Gravel pits			
Gravel pit	100	—	—
IAF—Isom cobbly sandy loam, 3 to 30 percent slopes			
Isom	90	Low	A
SY—Stony colluvial land			
Stony colluvial land	100	—	—

Data Source Information

Soil Survey Area: Washington County Area, Utah
Survey Area Data: Version 15, Sep 7, 2021

Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Report—Physical Soil Properties

Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Physical Soil Properties–Washington County Area, Utah														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
GA—Gullied land														
Gullied land	—	—	—	—	—	—	—	—	—					
GP—Gravel pits														
Gravel pit	—	—	—	—	—	—	—	—	—					
IAF—Isom cobbly sandy loam, 3 to 30 percent slopes														
Isom	0-2	-68-	-24-	5- 9- 12	1.35-1.43 -1.50	14.11-28.23-42. 34	0.05-0.06-0. 07	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.05	.17	5	6	48
	2-10	-68-	-24-	5- 9- 12	1.40-1.48 -1.55	14.11-28.23-42. 34	0.05-0.07-0. 08	0.0- 1.5- 2.9	0.0- 0.5- 1.0	.10	.28			
	10-22	-68-	-24-	5- 9- 12	1.40-1.48 -1.55	14.11-28.23-42. 34	0.05-0.06-0. 07	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.10	.28			
	22-60	-68-	-24-	5- 9- 12	1.40-1.48 -1.55	14.11-28.23-42. 34	0.04-0.05-0. 06	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.05	.28			

Physical Soil Properties–Washington County Area, Utah														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
LeB—Leeds silty clay loam, 1 to 2 percent slopes														
Leeds	0-8	-18-	-51-	27-31- 35	1.15-1.23 -1.30	0.42-0.92-1.41	0.16-0.17-0. 18	3.0- 4.5- 5.9	1.0- 1.5- 2.0	.37	.37	5	4L	86
	8-15	-18-	-51-	27-31- 35	1.15-1.23 -1.30	0.42-0.92-1.41	0.16-0.17-0. 18	3.0- 4.5- 5.9	0.5- 1.3- 2.0	.43	.43			
	15-23	-66-	-19-	10-15- 20	1.30-1.38 -1.45	14.11-28.23-42. 34	0.10-0.11-0. 12	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.24	.24			
	23-60	-22-	-55-	18-23- 27	1.25-1.33 -1.40	4.23-9.17-14.11	0.17-0.18-0. 19	3.0- 4.5- 5.9	0.0- 0.5- 1.0	.43	.43			
SY—Stony colluvial land														
Stony colluvial land	—	—	—	—	—	—	—	—	—					

Data Source Information

Soil Survey Area: Washington County Area, Utah
Survey Area Data: Version 15, Sep 7, 2021

Figure A12 - Orifice Size Calculation

(Initial Discharge - 10 Year, 24 Hour)		
Orifice Discharge Coefficient (C)	0.51	Borda
Depth of reservoir (h)	3	ft (vertical distance from center of orifice to liquid surface)
Q (max flow rate)	2.83	cfs
Q (use for orifice)	2.8	cfs
Gravitation Constant (g)	32.2	ft/s^2
Orifice Diameter (d)	8.5	inches
Equiv. Two Orifice Diameter (d)	6	inches (diameter of 2 orifices with equivalent area)

(Staged Discharge - 100 Year, 24 Hour)		
Orifice Discharge Coefficient (C)	0.51	Borda
Depth of reservoir (h)	1	ft (vertical distance from center of orifice to liquid surface)
Q (max flow rate)	7.1	cfs
Q (actual flow rate)	4.3	cfs (after subtracting 10 year discharge)
Gravitation Constant (g)	32.2	ft/s^2
Orifice Diameter (d)	13.9	inches
Equiv. Two Orifice Diameter (d)	9.8	inches (diameter of 2 orifices with equivalent area)
Equiv. Three Orifice Diameter (d)	8	inches (diameter of 3 orifices with equivalent area)

Figure A13 - Manning Flow Calculator

Detention Discharge - Peak Discharge = 7.42 CFS

Units =	CFS	(Drop-down)		
Level =	9.60	inches		
Diameter =	12.00	inches		
Slope =	0.0200	ft./ft.	*(1%=.01 ft./ft.)*	
Pipe Material =	Plastic	(Drop-down)		
n =	0.009	(Manning coefficient)		
d/D =	0.8			
A/D^2 =	0.6736		**R/D =**	0.3042
A =	0.6736	$ft.^2$	**R =**	0.3042 ft.

$$Q = \frac{1.49\ A\ R^{2/3}\ S^{1/2}}{n}$$

$$Q = \frac{1.49 \times 0.6736 \times 0.3042^{2/3}\ 0.0200^{1/2}}{0.009}$$

Q =	**7.13 CFS**	<-- Capacity
	7.4 CFS	<-- Modeled Flow

NOTICE OF MEETING
HILLSIDE REVIEW BOARD
CITY OF ST. GEORGE
WASHINGTON COUNTY, UTAH

Public Notice

Notice is hereby given that the Hillside Review Board of the City of St. George, Washington County, Utah, will hold meetings at the referenced site on **Wednesday, March 23, 2022,** commencing on-site at approximately 8:30 a.m.

PRESENT:
Dave Black
Jeff Mathis
James Dotson
Russ Owens

EXCUSED:
James Sullivan

CITY STAFF:
Assistant Public Works Director, Wes Jenkins
Planner III, Dan Boles
Planner III, Carol Davidson
Development Office Supervisor, Brenda Hatch

Dave Black nominated Jeff Mathis to be the Pro-tem Chair.
James Dotson Seconded
AYES
Dave Black
James Dotson
Russ Owens
Motion Carries

Jeff Mathis called the meeting to order at 8:30 am.

1. Consider a request for a hillside development permit at the Commerce Point Development. The applicant is proposing to construct in the area shown on the slope map labeled 20-30%, 30-40% and 40% and above. The property is located at Southeast quadrant of the intersection of Auto Mall Drive and Blackridge Drive. The property is currently zoned Highway Commercial (C-2). The applicant is Commerce Point, LC. Case No. 2022-HS-005. (*See 'Meeting Place' exhibit below*).

   Wes Jenkins – There are some areas here on the analysis map, the dark red is the 40% then the other is the 30 to 40%. Their proposal is to disturb all of this area over here. The question is, has it already been disturbed, is it consistent or should they not be disturbing the 40% and make sure they comply with the 30-40%. The way I understand it is their proposal is to disturb all of this with the argument that it is not consistent with the

topography that is around it and it is really disturbed material from the construction of Blackridge Drive.

Dave Black – I might make a suggestion that we break this up into at least 2 parts. And that we talk about that first and then we vote on that and decide on that. And then we can look at the overall plans and address that separately.

Jeff Mathis – It appears to me those 40% slopes are coming off the fills for the road, aren't they?

Dave Black – I would agree that mostly that is the case. Personally, I don't see any issues with disturbing the areas that they have planned, and I think we've made similar motions in the past, what do we call that? Non-contiguous?

James Dotson – Or man-made even.

Dave Black – Yes, so they are man-made slopes, they are non-contiguous slopes and so I don't see an issue of disturbing those.

Russ Owens – I agree, I don't see anything.

MOTION: Jeff Mathis made a motion that we approve the areas on the packet that are shown to be disturbing over the 40% slopes, they are non-contiguous areas and man-made areas. We recommend they be allowed to affect those areas.
SECOND: Dave Black
AYES (4)
Dave Black
Jeff Mathis
James Dotson
Russ Owens
NAYS (0)
Motion carries.

Dave Black – The second part is that in the plans they have submitted to us, they have indicated the cut slopes are 40 ft high against Blackridge Drive. That in itself goes against the hillside ordinance. The question I have is how do you mitigate that? That will leave a big scar, are there plans to address the cut slope? Is it going to be decorative rock? Stacked rock, is it going to be just left disturbed? How would plan to mitigate the scars left behind?

Austin Akin – It's in our scope to landscape or otherwise improve everything up the hill that we can. We're not going to leave a big scar. Chris and I have talked about it a little bit and it would be a good idea to stack rock up. We are more than happy to make sure it looks nice.

Jeff Mathis – So you're not going to use that access?

Austin Akin – It is just too steep, that was before I was around, but it seems like a pretty mutual decision not to use that access. We just have the one major road that comes through here.

Russ Owens – In the technical report that we were given to review it talks about minimal cuts with 3:1 slopes and kind of keeping the overall slopes to what it is now, that seems to have been followed in a lot of this. I know the City is requiring a landslide study, which I guess this is the result of that. So, we haven't had time to review that at all. I think that will be a big issue out here, not only visually but with stability but also with landslide so I would think that needs to be addressed.

Dave Black – I would think that if the Landmark report is not going to be used, that there needs to be a separate updated report from GTS that addresses stable cut and fill slopes and retaining walls and there are expansive soils at this site, maybe revisit the recommendations for foundations.

Discussion continued on what reports will be used.

Dave Black – I don't know that we have enough information for us to review right now and give approval. We probably need to get with GTS and give them the opportunity to tell us what's in their report and any issues or concerns that they have seen.

Chris Volksen – Geotechnical Testing Services did a grading plan for this, and unfortunately our grading report for this portion of this development was not included in the packet. It did address slopes in there.

Wes Jenkins – So it's different than this?

Chris Volksen – Yes, it's a grading report. The purpose of the grading report was just to prepare rough pads.

Austin Akin – So we could go in and do mass grading because we don't know exactly what we are going to build.

Chris Volksen – It's a grading report, so there is a difference between a grading report and a geotechnical report. Once the buildings are established, once they have a tenant, once they know exactly everything with the building then we will do the geotechnical investigation. The intention was to basically to make the site look good so a tenant could come look at it and say that's a nice site we want to be here.

Wes Jenkins – Would your grading report address what Dave is talking about, the cuts and stabilizing those and all of that?

Chris Volksen – Yes, and so we have done some follow up which is what I just gave you here, after we had a 3rd party review with the City on the proposed cuts and the overall stability of the slopes. There was very little affect a .006 affect on the overall slope. What we will do is look at the grading report and I think it addresses slopes in there, it's just been a year since we've done it. It addresses the slopes and the drainage on the slopes and landscape on the slopes. Then we would do a geotechnical investigation for each structure as they are going to be done.

Dave Black – I do think we need to a portion of it now until we receive the report and then if anybody had any comments or anything they wanted to address we could do that in the next meeting.

Wes Jenkins – But you are saying you've done that report, it just wasn't in here?

Chris Volksen – Yes, and if it needs to be updated, I'll update it.

Russ Owens – So can you do a grading study not knowing what they are going to build here? Are you just going to say these buildings have to fit this pad?

Austin Akin – Yes, with the grading that we have planned it's going to narrow what we can do a bit, but it's not setting in stone.

Dave Black – So if you were to grade it now, you would use this plan and have the cut slopes that are on the drawing and then it would be mass graded.

Austin Akin – So the things we would be committing to would be the buildings will be here, the underground utilities here, the driveways here.

Jeff Mathis – So you are going utilities and surface improvements?

Austin Akin – Yes, we would like to. As much as we can.

Russ Owens – So if you did rough grading and it took 3 or 4 years for a client to come in then what would you do with the site?

Austin Akin – We would make sure it was maintained properly.

Chris Volksen – So I know that some of the discussion was that there is going to be a retaining wall along the backside over there, they are not planning on putting that in right now, they are just going to grade that down and just leave the slope.

Dave Black – So that could be a concern. Say you leave a cut slope for 4 years and it sits there.

Wes Jenkins – It has to be treated as a permanent slope, you can't say that it is temporary because the problem is say they sell it off to someone else, they need to understand that it is permanent.

Dave Black – So the landscaping would that go in now?

Wes Jenkins – Not the landscaping but the slope and the treatment of it would need to be dealt with at the initial phase.

Discussion on what the slope would look like and how it should be treated.

Wes Jenkins – From a City standpoint we would require it to be in permanent condition when they walk away from here. So, whatever that slope is, it would have to be in a condition that it could remain in forever.

Dave Black – I understand that, but we would also want the slope dressing on it to mitigate the exposed cut.

Wes Jenkins – Yes it would need to be treated so that the erosion is addressed, and the slope stability is addressed, all of that would have to happen. As far as landscaping around the buildings it won't have to be in.

Jeff Mathis – I think that is understood, what we are concerned about are these 40 ft cuts. It sounds like it's going to be phased, mass grading and so forth anyway.

Austin Akin – We are not planning on this sitting for 3-5 years.

Wes Jenkins – So I'm assuming with your mass grading you are going to come in and pad it out, parking lots established and everything?

Austin Akin – Yes. We are happy to address the cut slope stuff, we can get with Chris and talk about it. I know we don't have any intention of putting water in there, not even for landscaping or anything like that.

Dave Black – Do you have maybe a tall building that could hide something like that, or will they all be single story?

Austin Akin – The ones in the front, we're not doing any retaining. The idea is that yes, we have taller, bigger buildings back here. If you look on the drawings there will be bigger buildings where we are doing the retaining.

Dave Black – So when you come back, that might be part of your mitigation strategy. Address the slope and put taller buildings.

Discussion on how taller buildings will block the cut slope from the road and what type of treatment can be done to the slope.

MOTION: Dave Black made a motion that we table the rest of it. SECOND: Jeff Mathis AYES (4) Dave Black Jeff Mathis James Dotson Russ Owens NAYS (0) Motion carries.

2. Consider a request to amend the hillside overlay map by adding approximately 23 acres to the existing Middleton Ridge hillside overlay area. The property is generally located

north of Red Hills Drive and Middleton Drive and approximately 2200-2300 East. The applicant is the City of St. George. Case No. 2022-HS-009.

Wes Jenkins – We are wanting to revise the hillside overlay zone. If you look on the packet, the hillside overlay zone does not come into this area here on top. For some reason they left out this area right here. The proposal is to amend the hillside overlay zone to incorporate this parcel into the hillside overlay zone.

Jeff Mathis – In essence it would come down to the frontage road and then all the way along St. George City's boundary behind here.

Wes Jenkins – Yes.

Jeff Mathis – Is there a reason that you didn't stop at this road, and you took it clear out to there?

Wes Jenkins – I think we took it to the property lines.

Russ Owens – Have you got a development that is looking at building on this? Is that going to impact their overall scheme of things?

Wes Jenkins – Years ago they submitted an application, and it was for a water park, basically they stayed off of that and the slides came off a pole, so there was no disturbance. I'm not even sure if they have submitted anything. Some of their discussion now is to take the slides and put them up on the slope and disturb the slope. So, we got into that, and the City felt like that was a prominent enough hillside feature that it should be protected because it falls within the slope categories. So that is kind of the question, is it a prominent feature that you would like to protect?

MOTION: Dave Black made a motion that we recommend approval for the addition of the area indicated in the packet.
Jeff Mathis – I have one more discussion item, they had a grading permit they had all their things in place, right? So, are we doing something that going to change what was?
Wes Jenkins – No because whatever they had before has now lapsed.
Jeff Mathis – So at that point they were going to put things on poles and now you've heard discussion they want to come in and put things on the slopes.
Wes Jenkins – Yes and that alerted us to A. this is a prominent feature and should be protected because it's not in the hillside. We always though it was in the hillside. We were caught off guard.
Russ Owens – Say they want to go up there with a landing pad, walk up there and come down?
Wes Jenkins – They would have to go through the hillside, if they wanted to disturb it they would have to do a slope analysis and would have to go through that process and see if there are portions of it that could actually be disturbed. We just want to make bring it in to make it part of the hillside review.
SECOND: James Dotson
AYES (4)
Dave Black
Jeff Mathis

James Dotson
Russ Owens
NAYS (0)
Motion carries.

3. Consider approval of the meeting minutes from February 23, 2022.

MOTION: Dave Black made a motion to approve the minutes from the February 23, 2002, meeting.
SECOND: James Dotson
AYES (4)
Dave Black
Jeff Mathis
James Dotson
Russ Owens
NAYS (0)
Motion carries.

Jeff Mathis made a motion to adjourn.