HURRICANE CITY
UTAH

**Mayor** Clark Fawcett

**City Manager** Kaden DeMille

**Planning Commission**

*Mark Sampson, Chair*
*Ralph Ballard - Alternate Chair.*
*Paul Farthing*
*Shelley Goodfellow*
*Brad Winder*
*Kelby Iverson*
*Michelle Smith*
*Scott Hughes*

**Hurricane Planning Commission Meeting**
**Agenda**

October 22, 2026
6:00 PM
Hurricane City Offices 147 N 870 W, Hurricane

Notice is hereby given that the Hurricane City Planning Commission will hold a Regular Meeting commencing at 6:00 p.m. at the Hurricane City Offices 147 N 870 W, Hurricane, UT.

Meeting link: HERE
Meeting number:2632 882 4836
Password:HCplanning
Host key:730111
Join by phone+1-415-655-0001 US Toll
Access code: 2632 882 4836
Host PIN: 9461
Details on these applications are available in the Planning Department at the City Office, 147 N. 870 West.

---

**6:00 p.m. - Call to Order**
**Roll Call**
**Pledge of Allegiance**
**Prayer and/or thought by invitation**
**Declaration of any conflicts of interest**
**Approval of Agenda**

**NEW BUSINESS**

1. PP26-05: Discussion and consideration of a possible approval of a preliminary plat for Kachina Ridge, a 56 lot mixed use development located at 720 E Highway 59. Kent Stephens, Applicant. Brandee Walker, Agent.

2. HIL26-01: Discussion and consideration of a recommendation to the City Council on a Sensitive Lands development plan for Kachina Ridge, a 56 lot mixed use development located at 720 E Highway 59. Kent Stephens, Applicant. Brandee Walker, Agent.

**Adjournment**

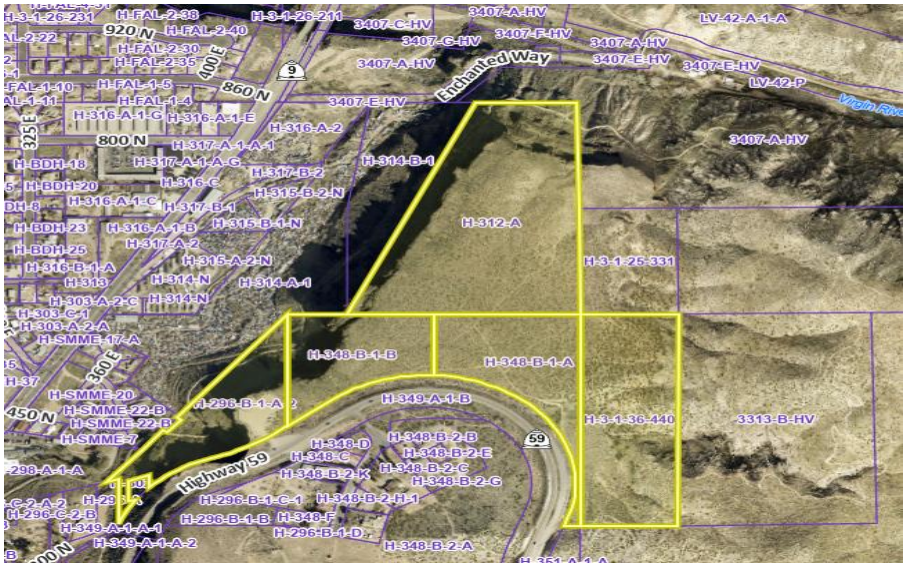
REASONABLE ACCOMMODATION: Hurricane City will make efforts to provide reasonable accommodations to disabled members of the public in accessing City programs, please contact the City Planning Technician,435-635-2811 x 112, at least 24 hours in advance if you have special needs.

PLANNING & ZONING
HURRICANE CITY
UTAH

**STAFF COMMENTS**

| | |
|---|---|
| **Agenda Date:** | **10/22/2025 - Planning Commission** |
| **Application Number:** | PP26-05 HIL26-01 |
| **Type of Application:** | Preliminary Plat and Sensitive Lands |
| **Action Type:** | Administrative |
| **Applicant:** | Kent Stephens |
| **Agent:** | Brandee Walker |
| **Request:** | Approval of a Preliminary Plat and Sensitive Lands plan. |
| **Location:** | 720 East Highway 59 |
| **Zoning:** | Planned Commercial |
| **General Plan Map:** | Mixed Use |
| **Recommendation:** | Preliminary Plat: Approve subject to staff and JUC comments.<br>Sensitive Lands: Recommend approval to the City Council. |
| **Report Prepared by:** | Fred Resch III |

**Discussion:** The applicant is applying for a preliminary plat for a mixed-use development located north of Highway 59 adjacent to the Hurricane Hill. The proposal is for 57 total lots, of which 48 are townhomes and the remaining nine are for multifamily, short-term rental, and commercial uses. The development is governed by a development agreement originally approved in 2020, and recorded in 2021, which limits the development to 566 total residential units and imposes other requirements on the development, including construction of a UDOT-approved interchange on Highway 59. The property is zoned Planned Commercial (PC).



*Vicinity Map*

**JUC Comments**

1. **Public Works:** Approved.

2. **Fire:** Second access required.

3. **Sewer:** Approved.

4. **Water:** This will require a Water Model showing how the adjacent water system will not be impacted. Engineering will be required to separate the two systems on the same service line that doesn't have water line looping.

5. **Power:** Kachina Ridge developer has agreed to pay for offsite power improvements to get power to this location.

6. **Streets:** Approved.

7. **Gas:** Approved.

8. **TDS:** [No comments received.]

9. **Infowest:** [No comments received.]

10. **Engineering:** A Traffic Impact Study must be submitted for review and approval prior to Construction Drawing Approval (including the interchange drawings) (HCS 3.9.2). The following intersections must be included in the study in addition to the on-site traffic: State Street and Main Street, Main Street and 100 South, and 100 South and 100 East. Construction plans for the interchange and water tank must be approved prior to or concurrent with the subdivision construction plans (HCS 2.1(bullet 1) & HCC 10-37-4). Engineering will participate in a coordination meeting with UDOT in December. Proposed water mains must be in public rights of way (HCS 3.6.8). The rights of way must be sized for future development to properly locate proposed water and preserve standard alignments for

other utilities (HCS 2.1(bullets 2&3) & HCS 2.2.9). Neighbor(s) must grant right of way prior to or concurrent with the subdivision construction plans. It's anticipated that the proposed sewer outfall will be bored to avoid sensitive lands concerns (see applicant's rendering). A backup alternate alignment seems possible with UDOT's and neighboring property owners' participation (Dori Tharp, and OBW Kolob, LLC). Applicant must finish an attempted lot line adjustment with Lot 10 of Shadow Mountain Mobile Home Estates (i.e. Final Plat Amendment). Cross sections need further refining (collector streets use HB30-7 curb & gutter and a proposed slope lies between the curb and gutter and trail on the east side of the main entry. It appears the dividing median on the main entry should extend between and to the intersections north and south of the interchange. The median seems to have been introduced at the Fire Districts' advice. The Traffic Impact Study must comment on the adequacy of the proposed access (HCS 3.2.4.2(K) & HCS 3.9.3(VII))

11. **Washington County Water Conservancy District:** Reviewing updates to the detention basin that could possibly be located on district property. Will provide updates to the city/developer. Washington County Water Conservancy District hereby acknowledges that based on the information provided, the project plans adequately mitigate interference with district facilities and property interests. The District reserves the right to rescind this acknowledgement if additional information becomes available. The district has not determined whether water will be available for this development and does not hereby make any guarantee of water availability. In addition, the development must conform with applicable district requirements, including but not limited to payment of fees.

**Staff Comments: Preliminary Plat**

**Analysis**

1. Land Use: The property is zoned "Planned Commercial" (PC). Planned Commercial is a mixed-use zone and this property was entitled prior to a recent code update requiring a minimum of 67 percent commercial uses and a minimum of 20 percent residential for Planned Commercial projects. The proposed preliminary plat substantially complies with the preliminary site plan approved as part of the 2020 zone change entitlement.
    - The proposed plat indicates 48 townhomes, 168 nightly rental units, and four multifamily residential pads. The development agreement states that the density cannot be more than 8.5 units per gross acre the preliminary plat states that 566 total units are proposed, and 350 multifamily units are proposed across the four out lots.
    - The development agreement allows 30% of the total dwelling units to be nightly rentals; the applicant is proposing 168 nightly rental units, which complies with the agreement.
2. Onsite Management: Per the development agreement, the nightly rental area requires onsite management, a community pool, and a clubhouse. This requirement is noted on the preliminary plat.
3. Amenities: A trailhead and 12-foot-wide asphalt trail along Highway 59 replacing and continuing the existing Hurricane Rim Trail is proposed as required by the development agreement. A 4-foot-wide gravel "chat trail" is proposed along the ridge line, which is also as required by the development agreement. Besides trails, a clubhouse, and pool area, the preliminary plat does not depict any other amenities. The development agreement requires that all residential dwelling units be within one-third mile of an outdoor recreation amenity. This will need to be verified with the final site plan applications.

4. Site Plan Requirements: Individual site plan approvals will be required for each phase. The applicant will need to ensure that 90,000 square feet of commercial development is provided as well as architectural design standards for the entire project.
5. Geologic Hazards: Portions of this property are identified as being within a rockfall hazard zone per Utah Geological Survey Special Study 127. The applicant will need to comply with Hurricane City Code (HCC) section 10-28-2(C) in the preparation of the final plat. No habitable development is proposed in the rockfall hazard areas.
6. Interchange Construction: Prior to approval of construction drawings and recordation of final plats, the applicant must submit to the city UDOT-approved plans for the interchange on Highway 59. Construction of the interchange shall be required to occur concurrently with subdivision improvements.
7. Will Serve: Will-serve letters from the water company and the sewer district have been provided.
8. Water use: To assist the Washington County Water Conservancy District (WCWCD) as the city's wholesale water provider under the 2006 Regional Water Supply Agreement, Hurricane City and other cities report monthly the number of final platted lots, preliminary platted lots, lots subject to development agreements, and lots within PID taxing areas. These numbers help the WCWCD plan for future water needs and inform the WCWCD's 20-year plan to supply water to the growing County. The 57 lots contemplated by this application were reported to WCWCD as part of the Kachina Ridge Development Agreement.

**Staff Comments: Sensitive Lands Application**

**Analysis**
Due to the conditions of the development agreement and the project location being situated on the Hurricane Cliffs (which is identified as an area of special consideration by the Sensitive Lands Ordinance), the project was required to submit an application for a sensitive lands review.

1. The applicant has provided a grading plan and slope map for the property, as well as a geotechnical report. The applicant has designed the project to limit grading on steep slopes above 30% and has depicted a "do not disturb" boundary that meets the intent and language of the sensitive lands code.
2. The applicant is requesting that an exception to the sensitive lands ordinance be approved by the City Council, due to the required sewer outfall line likely disturbing the Hurricane Cliffs. HCC 10-24-6(B) prohibits disturbance of slopes greater than 30% and HCC 10-24-7(8) discourages disturbance of the Hurricane Cliffs, but the applicant or their engineer can propose an alternative solution to these concerns under the code section HCC 10-24-3(G) cited below:

*G. Exceptions: Exceptions to the provisions of this chapter may be granted by the city council upon recommendation from the planning commission when:*

*1. An alternative solution is proposed for the protection of the sensitive land, based on sound and generally accepted engineering and land development principles, and said alternative will result in equal or better protection than development under the standards of this chapter; and is consistent with the purposes of this chapter. The alternative shall also be consistent with the general plan policies affecting sensitive lands;*

The applicant proposes that the the sewer line be bored under and through the cliffside before connecting to existing sewer within the Shadow Mountain Mobile Estates subdivision. They have

provided an exhibit depicting how they will cover up the scarring of the hillside with painted and replaced boulders. The applicant is also committed to protecting in place an historic Hurricane Canal tunnel in the vicinity and restoring the canal to its former condition when construction is complete.

There is another possible solution that may accomplish the same goal without scarring the hillside in as prominent a way (see Engineering comments above) involving several other property owners, however this proposal may not be feasible due to concerns about UDOT permitting utility installation within their right-of-way. Staff finds that the applicant's proposed Hillside Reclamation Plan provides equal or better protection for the sensitive lands area on the Hurricane Cliffs.

**Recommendation:** The Planning Commission should review this application based on standards within the Hurricane City Code. Staff recommends approval of the preliminary plat subject to staff and JUC comments and recommends the Planning Commission make a recommendation of approval to the City Council on the Sensitive Lands application.

**Kachina Ridge** March 6, 2026

Preliminary Plat Narrative

The purpose of this preliminary plat application is to further gain entitlement and to subdivide Kachina Ridge located at approximately 720 East Highway 59, Hurricane, Utah. The project consists of multiple parcels (H-296-B-1-A, H-348-B-1-B, H-348-B-1-A, H-3-1-36-440, H-3-1-25-331, H-291) totaling approximately 66.6 acres.

Kachina Ridge has a recorded development agreement with Hurricane City (Doc #20210081735) allowing for the development of residential units, amenities, commercial uses, and open spaces and trails. This application aligns with the development agreement limiting the number of residential units to 8.5 per gross acre (566 units) of which, 30% shall be designated for short-term rentals. Proposed Lot 5, as shown on the preliminary plat, is the short-term rental area indicating a maximum unit count of 168 and the requirement of a clubhouse and pool area.

The west ridge proposes 48 townhome units which will be individually subdivided and be the Phase 1 portion of development. Combining 48 townhome units and 168 short-term rental units as designated, the remaining 350 units will be allocated between Lots 2, 6, 7, and 8 respectively.

The project requires 90,000 square feet of commercial uses with no maximum limit to the amount of commercial space within the community. Lots 1, 3, and 4 are designated as commercial use. The desired commercial would include hotels, condo hotels, retail, and restaurants.

This site poses many challenges in terms of utility infrastructure and access from State Highway 59. Utility connections to sewer, water, and power have been coordinated with each provider.

Sewer

Sewer will connect at a location within 500 North Street and ascend the steep hillside entering the project within Lot 1. The property owner of H-SMME-10 has provided easement for the installation of the sewer through their private property. As the site drains both to the north and south, a sewer lift station will be required at the north low point as shown as Parcel A. The lift station will pressure feed sewer back to the gravity point of connection adjacent to townhome Unit 116. Ash Creek has requested a sewer conduit boring across the highway south to provide future expansion options. Ash Creek has reviewed the preliminary designs and offered a letter of will serve.

Water

The project requires a 850k gallon tank however, will install a 1M gallon tank at the request of the city water department offering a fee reimbursement program for the upsize. Alpha Engineering has preliminary designed the water tank, booster pump, and other water elements as shown on the preliminary plat.

Power

Power will access the project in a similar location to sewer as it traverses the hillside from Shadow Mountain Mobile Estates along 450 North. The power system has been coordinated with the city power department and the appropriate easements obtained.

UDOT Access

An interchange has been designed to provide access to both the proposed Kachina Ridge community as well as improve the accessibility to the existing residents on the south side of the highway. Access is being provided via an underpass to the site with on and off ramps in each direction. UDOT has reviewed and provided the initial approvals per applications made by Forsgren Engineering.

Sensitive Lands

Due to the steep slopes above and below the project site, a sensitive lands application is required and has been concurrently submitted with this application. The hillside has been designated and grading disturbance has been restricted beyond the slope line limits. The intent of the preliminary plat and initial subdivision improvements is to provide grading and improvement of streets, general utility infrastructure to each large lot and townhome sites. The individual large lots will require further grading and drainage improvements once a development site plan and applicable applications are made to the city at time of development request.

April 21, 2025

Hurricane City
Gary Cupp
127 N. 870 W.
Hurricane, UT 84737

**Subject: Kachina Ridge**

Gary,

There is sewer capacity for this project. The developers understand and agree that they will need to get plan approval for the sewer system.

After approval, they agree to pay all costs associated with construction and impact fees. Please let us know if you have any questions.

Sincerely,

Amber Gillette

Amber Gillette, P.E.
Engineer
Ash Creek Special Service District

1350 South Sandhollow Road, Hurricane, UT 84737
phone: 435.635.2348
email: ashcreek@infowest.com

WATER
# HURRICANE CITY
UTAH

*Kory Wright, Superintendent*

March 16, 2026

To Whom It May Concern:

Kent Stephens (the "Developer") has requested a culinary water will serve letter for the subdivision known as Kachina Ridge, located at approximately 1000 East Highway 59 in Hurricane, Utah (the "Project").

Infrastructure

The City currently does not have infrastructure in place to supply culinary water in the general area of the Project. To supply water to the Project, Developer will be responsible to connect the Project to the existing water infrastructure, including the installation of infrastructure in dedicated public streets and as otherwise required to meet City standards. In addition, developer may be required to obtain and supply a hydraulic water study to ensure the waterline will deliver required fire flows. A looped water system, tank, and booster station may be required.

Water Supply

As of the date of this letter, the City has adequate water to supply water to 566 residential connections within the Project. However, water within the City is a finite resource with limited supply. The ability of the City to supply water to previously approved projects, as well as continue to serve additional water customers, is contingent on water supplies being available from the Washington County Water Conservancy District (the "Conservancy District"). Therefore, the City's statements in this letter regarding the adequacy of water supply is (1) contingent on water being available from the Conservancy District and (2) shall expire one year from the date of this letter, after which a renewed will serve letter will be required for any property or lot that has not obtained a metered connection to the City's culinary water system. Developer is encouraged to obtain a guarantee of water from the Conservancy District.

General Requirements

In addition to the requirements and limitations described above, Developer shall be required to comply with all applicable laws, ordinances, policies, and construction and design standards. These requirements include, but are not limited to, secondary water system requirements and any obligations described in an applicable development agreement.

Sincerely,

Kory Wright
Water Department Superintendent

646 West 600 North • Hurricane, UT • 84737
Phone: (435) 635-9442 • Fax: (435) 635-2616
WEB: www.cityofhurricane.com

When Recorded return to:
Hurricane City
147 N. 870 W.
Hurricane, UT. 84737

DOC # 20210081735
Agreement Page 1 of 17
Gary Christensen Washington County Recorder
12/29/2021 02:52:00 PM Fee $ 0.00
By HURRICANE CITY

**DEVELOPMENT AGREEMENT**
**FOR**
**KACHINA RIDGE**

THIS DEVELOPMENT AGREEMENT ("Agreement") is made and entered into as of the 3rd day of December, 2021 (the "Effective Date"), by and between the CITY OF HURRICANE, a Utah municipal corporation, hereinafter referred to as "City," and Daystar Holdings LLC, a Utah limited liability company, hereinafter referred to as "Developer." The City and Developer are hereinafter collectively referred to as "Parties."

**RECITALS**

A. Developer is the owner of approximately 75.9 acres of land located within the City of Hurricane as is more particularly described on EXHIBIT A, attached hereto and incorporated herein by reference (the "Property").

B. On October 1, 2020, the City Council approved a zone change to Planned Commercial with the conditions laid out within this agreement.

C. Developer has proposed a Preliminary Site Plan EXHIBIT B, and a Preliminary Utility Plan EXHIBIT C.

D. Developer is willing to design and construct the Project in a manner that is in harmony with and intended to promote the long range policies, goals, and objectives of the City's general plan, zoning and development regulations in order to receive the benefit of vesting for certain uses and zoning designations under the terms of this Agreement as more fully set forth below.

E. The City Council accepted Developer's proffer to enter into this Agreement to memorialize the intent of Developer and City and decreed that the effective date of the Vesting for the zoning be the date of the execution and delivery of this Agreement and the recording thereof as a public record on title of the Property in the office of the Washington County Recorder.

F. The City Council further authorized the Mayor of the City to execute and deliver this Agreement on behalf of the City.

G. The City has the authority to enter into this Agreement pursuant to Utah Code Section 10-9a-102(2) and relevant municipal ordinances, and desires to enter into this Agreement with the Developer for the purpose of guiding the development of the Property in accordance with the terms and conditions of this Agreement and in accordance with applicable City Ordinances.

H. This Agreement is generally consistent with, and all preliminary and final plats within the Property are subject to and shall conform with, the City's General Plan, Zoning Ordinances, and Subdivision Ordinances, and any permits issued by the City pursuant to City Ordinances and regulations.

I. The Parties desire to enter into this Agreement to specify the rights and responsibilities of the Developer to develop the Property as expressed in this Agreement and the rights and responsibilities of the City to allow and regulate such development pursuant to the requirements of this Agreement.

J. The Parties understand and intend that this Agreement is a "development agreement" within the meaning of, and entered into pursuant to, the terms of Utah Code Ann., §10-9a-102.

K. The Parties intend to be bound by the terms of this Agreement as set forth herein.

## AGREEMENT

NOW, THEREFORE, in consideration of the mutual covenants contained herein, and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the City and the Developer hereby agree as follows:

1. Incorporation of Recitals. The foregoing Recitals are hereby incorporated into this Agreement, as a substantive part hereof.

2. Zoning. The Property shall be developed in accordance with (i) the requirements of an underlying zone of Planned Commercial, (ii) all other features as generally shown on the Preliminary Site Plan, and (iii) this Agreement. The Developer shall not seek to develop the Property in a manner that deviates materially from the attached Preliminary Site Plan in EXHIBIT B as permitted by the aforementioned zoning designations for the Property. Except as otherwise approved in writing by City, Developer shall not develop the property in a manner that deviates materially from Preliminary Site Plan attached hereto as Exhibit B.

3. Governing Standards. The Preliminary Site Plan, the record of the City Council meeting, and this Agreement (together the "Approval Documents") establish the development rights for the Project, including the use, maximum density, intensity and general configuration for the Project. The Project shall be developed by the Developer in accordance with the Approval Documents. All Developer submittals must comply generally with the Approval Documents. Non-material variations to the Preliminary Site Plan, as defined and approved by the City's Zoning Administrator, such as exact building locations, exact locations of open space and parking may be varied by the Developer without official City Council or Planning Commission approval. Such variations however shall in no way change the maximum density, use and intensity of the development of the Project.

4. Additional Specific Developer Obligations. As an integral part of the consideration for this agreement, the Developer voluntarily agrees as follows:

a. The Developer shall design and construct approved utility infrastructure. The applicant will need to submit full plans for proposed utility plans; including water lines, water tank(s), sewer lines, power facilities, or other services as required. The Developer shall be responsible for securing all rights-of-way or easements needed to provide utility services.

b. The total dwelling units for the development shall not exceed 8.5 units per gross acres.

c. Applicant shall supply a full sensitive lands application to be reviewed and approved by the City according to Hurricane City Code. If needed, the preliminary site plan shall be modified to comply with sensitive land regulations.

d. Developer shall pave the Hurricane Ridge Trail along Developer's frontage with a 12' asphalt shared use path and improve and pave the parking area for the trail access. Location of these facilities shall be shown on the preliminary plat and location may be changed based on SR-59 improvements.

e. The Developer shall build internal parks, recreation amenities, and trail space as part of the project. Each residential dwelling unit shall be located within one-third mile of an outdoor public recreation amenity. Amenities shall include an internal trail system that loops around the outside of the development and provides connection to the amenities within the development, shared open space, a park, and other amenities as proposed by the applicant and approved by the City.

f. The Developer may be allowed to designate up to 30% of the dwelling units for short-term rentals. These units shall be clustered together and may not exceed 15 units an acre. The short-term rental area must also have onsite management, a community pool, and a clubhouse.

g. The Development shall have a minimum of 90,000 sf. ft. of commercial use which could include but not limited to spas, resorts, gyms, hot springs pools, motels, hotels, condo hotels, restaurants, retail, professional office space, convenience stores, equipment rentals or any other commercial activity allowed within Planned Commercial zoning. There is no maximum limit to the amount of commercial space within the community

h. The Developer shall design and construct intersection improvements for the primary access to the development on SR-59 to UDOT and City standards, including under/overpass, traffic signals, turn lanes, and other right-of-way improvements. The Developer shall also design other access points that comply with the International Fire Code.

i. The Developer shall create architectural standards that shall apply to all buildings within the development. Buildings shall coordinate colors and styles.

j. All outdoor lighting shall be full cut-off fixtures and comply with Hurricane City code and dark sky standards.

5. Construction Standards and Requirements. All construction on the Property at the direction of the Developer shall be conducted and completed in accordance with the City Ordinances, including, but not limited to setback requirements, building height requirements, lot coverage requirements and all off-street parking requirements.

6. Vested Rights and Reserved Legislative Powers.

a. Vested Rights. As of the Effective Date, Developer shall have the vested right to develop and construct the Project in accordance with the uses, maximum permissible densities, intensities, and general configuration of development established in the Approval Documents, subject to compliance with the City Ordinances in existence on the Effective Date. The Parties intend that the rights granted to Developer under this Agreement are the contractual rights and also those rights that exist under statute, common law and at equity. The Parties specifically intend that this Agreement grants to Developer "vested rights" as that term is construed in Utah's common law and pursuant to Utah Code Ann., §10-9a-509.

i. Examples of Exceptions to Vested Rights. Notwithstanding the foregoing, the Parties understand and agree that the Project will be required to comply with future changes to City Laws that do not limit or interfere with the vested rights granted pursuant to the terms of this Agreement. The following are examples for illustrative purposes of a non-exhaustive list of the type of future laws that may be enacted by the City that would be applicable to the Project:

1. Developer Agreement. Future laws that Developer agrees in writing to the application thereof to the Project;

2. Compliance with State and Federal Laws. Future laws which are generally applicable to all properties in the City and which are required to comply with State and Federal laws and regulations affecting the Project;

3. Safety Code Updates. Future laws that are updates or amendments to existing building, plumbing, mechanical, electrical, dangerous buildings, drainage, or similar construction or safety related codes, such as the International Building Code, the APWA Specifications, AAHSTO Standards, the Manual of Uniform Traffic Control Devices or similar standards that are generated by a nationally or statewide recognized construction/safety organization, or by the State or Federal governments

and are required to meet legitimate concerns related to public health, safety or welfare; or,

4. Taxes. Taxes, or modifications thereto, so long as such taxes are lawfully imposed and charged uniformly by the City to all properties, applications, persons and entities similarly situated.

5. Fees. Changes to the amounts of fees for the processing of Development Applications that are generally applicable to all development within the City (or a portion of the City as specified in the lawfully adopted fee schedule) and which are adopted pursuant to State law.

6. Impact Fees. Impact Fees or modifications thereto which are lawfully adopted, imposed and collected.

b. Reserved Legislative Powers. The Developer acknowledges that the City is restricted in its authority to limit its police power by contract and that the limitations, reservations and exceptions set forth herein are intended to reserve to the City all of its police power that cannot be so limited. Notwithstanding the retained power of the City to enact such legislation of the police powers, such legislation shall not modify the Developer's vested right as set forth herein unless facts and circumstances are present which meet the exceptions to the vested rights doctrine as set forth in Section 10-9a-509 of the Municipal Land Use, Development, and Management Act, as adopted on the Effective Date, *Western Land Equities, Inc. v. City of Logan*, 617 P.2d 388 (Utah 1980), its progeny, or any other exception to the doctrine of vested rights recognized under state or federal law.

7. Default. An "Event of Default" shall occur under this Agreement if any party fails to perform its obligations hereunder when due and the defaulting party has not performed the delinquent obligations within sixty (60) days following delivery to the delinquent party of written notice of such delinquency. Notwithstanding the foregoing, if the default cannot reasonably be cured or if there is some reasonable basis for delay within that 60-day period, a party shall not be in default so long as that party commences to cure the default within that 60-day period and diligently continues such cure in good faith until complete.

8. Default and Remedies. Failure of a party to perform any of the Party's obligations under this Agreement within a thirty (30) day period (the "Cure Period") after written notice thereof from the other party shall constitute a default ("Default") by such failing party under this Agreement; provided, however, that if the failure cannot reasonably be cured within thirty (30) days, the Cure Period shall be extended for the time period reasonably required to cure such failure so long as the failing party commences its efforts to cure within the initial thirty (30) day period and thereafter diligently proceeds to complete the cure. Such notice shall specify the nature of the alleged Default and the manner in which such Default may be satisfactorily cured, if possible. If the Default is cured, then no Default shall exist and the noticing Party shall take no further action.

a. In the event of an uncured Default, the non-defaulting party shall, in addition to any other remedy allowed by law, be entitled to the court's imposition of specific performance and /or injunctive relief, but not monetary damages. All rights and remedies under this Agreement, and /or statute or common law shall be deemed cumulative and the selection of one of the rights or remedies shall not be deemed a waiver of any other right or remedy.

b. If City elects to consider terminating this Agreement due to a Default by Developer, then City shall give to Developer written notice of City's intent to terminate this Agreement and the matter shall be scheduled for consideration and review by City's legislative body at a duly noticed public meeting. Developer shall have the right to offer written and oral evidence prior to or at the time of said public meeting. If City's legislative body determines that a material uncured Default has occurred and is continuing, City may thereafter pursue the remedy of termination through an appropriate judicial proceeding.

9. Specific Acts of Default. The Parties hereto agree that any of the following occurrences, acts or failure to act shall constitute a Default by Developer, for which City may elect to terminate the agreement in accordance with Section 8 above: (a) the filing of a petition in bankruptcy by Developer, (b) foreclosure on any portion of the Property which has the effect of creating an unapproved or illegal subdivision under Utah law or City ordinances, (c) the Developer's failure to comply with the requirements of any Section above, or (d) Developer's failure, without good cause as determined in good faith by City, for a period of five (5) years to commence construction of improvements in any new development phase or new Development Parcel. Upon such termination, all approvals or development rights granted hereunder to Developer shall lapse and all obligations of City hereunder shall cease.

10. Notices. Any notices, requests and demands required or desired to be given hereunder shall be in writing and shall be served personally upon the party for whom intended, or if mailed, by certified mail, return receipt requested, postage prepaid, to such party at its address shown below:

To the Developer:

Phone: (801) 319-7907

To the City:

City of Hurricane
Attention: Fay Reber, City Attorney
68 S. 700 W.
Hurricane, UT 84737

11. General Term and Conditions.

a. Headings. The headings contained in this Agreement are intended for convenience only and are in no way to be used to construe or limit the text herein.

b. Binding Effect. This Agreement shall inure to the benefit of, and be binding upon, the parties hereto and their respective heirs, representatives, officers, agents, employees, members, successors and assigns (to the extent that assignment is permitted). Without limiting the generality of the foregoing, a "successor" includes a party that succeeds to the rights and interests of the Developer as evidenced by, among other things, such party's submission of land use applications to the City relating to the Property or the Project.

c. Non Liability of City Officials and Employees. No officer, representative, consultant, attorney, agent or employee of the City shall be personally liable to the Developer, or any successor in interest or assignee of the Developer, for any default or breach by the City, or for any amount which may become due to the Developer, or its successors or assignees, or for any obligation arising under the terms of this Agreement. Nothing herein will release any person from personal liability for their own individual acts or omissions.

d. Third Party Rights. Except for the Developer, the City and other parties that may succeed the Developer on title to any portion of the Property, all of whom are express intended beneficiaries of this Agreement, this Agreement shall not create any rights in and/or obligations to any other persons or parties. The Parties acknowledge that this Agreement refers to a private development and that the City has no interest in, responsibility for, or duty to any third parties concerning any improvements to the Property unless the City has accepted the dedication of such improvements

e. Further Documentation. This Agreement is entered into by the Parties with the recognition and anticipation that subsequent agreements, plans, profiles, engineering and other documentation implementing and carrying out the provisions of this Agreement may be necessary. The Parties agree to negotiate and act in good faith with respect to all such future items.

f. Relationship of Parties. This Agreement does not create any joint venture, partnership, undertaking, business arrangement or fiduciary relationship between the City and the Developer.

g. Agreement to Run With the Land. This Agreement shall be recorded in the Office of the Washington County Recorder against the Property and is intended to and shall be deemed to run with the land, and shall be binding on and shall benefit all successors in the ownership of any portion of the Property.

h. Performance. Each party, person and/or entity governed by this Agreement shall perform its respective obligations under this Agreement in a manner that will not unreasonably or materially delay, disrupt or inconvenience any other party, person and/or entity governed by this Agreement, the development of any portion of the Property or the issuance of final plats, certificates of occupancy or other approvals associated therewith.

i. Applicable Law. This Agreement is entered into under and pursuant to, and is to be construed and enforceable in accordance with, the laws of the State of Utah.

j. Construction. This Agreement has been reviewed and revised by legal counsel for both the City and the Developer, and no presumption or rule that ambiguities shall be construed against the drafting party shall apply to the interpretation or enforcement of this Agreement.

k. Consents and Approvals. Except as expressly stated in this Agreement, the consent, approval, permit, license or other authorization of any party under this Agreement shall be given in a prompt and timely manner and shall not be unreasonably withheld, conditioned or delayed. Any consent, approval, permit, license or other authorization required hereunder from the City shall be given or withheld by the City in compliance with this Agreement and the City Ordinances.

l. Approval and Authority to Execute. Each of the Parties represents and warrants as of the Effective Date this Agreement, it/he/she has all requisite power and authority to execute and deliver this Agreement, being fully authorized so to do and that this Agreement constitutes a valid and binding agreement.

m. Termination.

i. Notwithstanding anything in this Agreement to the contrary, it is agreed by the parties hereto that in the event the final plat for the Property has not been recorded in the Office of the Washington County Recorder within seven (7) years from the date of this Agreement (the "Term"), or upon the occurrence of an event of default of this Agreement that is not cured, the City shall have the right, but not the obligation, at the sole discretion of the City Council, to terminate this Agreement as to the defaulting party (*i.e.*, the Developer). The Term may be extended by mutual agreement of the Parties.

ii. Upon termination of this Agreement for the reasons set forth herein, following the notice and process required hereby, the obligations of the City and the defaulting party to each other hereunder shall terminate, but none of the licenses, building permits, or certificates of occupancy granted prior to expiration of the Term or termination of this Agreement shall be rescinded or limited in any manner.

12. Assignability. The rights and responsibilities of Developer under this Agreement may be assigned in whole or in part by Developer with the consent of the City as provided herein.

a. Notice. Developer shall give Notice to the City of any proposed assignment and provide such information regarding the proposed assignee that the City may reasonably request in making the evaluation permitted under this Section. Such Notice shall include providing the City with all necessary contact information for the proposed assignee.

b. Partial Assignment. If any proposed assignment is for less than all of Developer's rights and responsibilities, then the assignee shall be responsible for the performance of each of the obligations contained in this Agreement to which the assignee succeeds. Upon any such approved partial assignment, Developer shall be released from any future obligations as to those obligations which are assigned but shall remain responsible for the performance of any obligations that were not assigned.

c. Grounds for Denying Assignment. The City may only withhold its consent if the City is not reasonably satisfied of the assignee's reasonable financial ability to perform the obligations of Developer proposed to be assigned.

d. Assignee Bound by this Agreement. Any assignee shall consent in writing to be bound by the assigned terms and conditions of this Agreement as a condition precedent to the effectiveness of the assignment.

13. Sale or Conveyance. If Developer sells or conveys parcels of land, the lands so sold and conveyed shall bear the same rights, privileges, intended uses, configurations, and density as applicable to such parcel and be subject to the same limitations and rights of the City as when owned by Developer and as set forth in this Agreement without any required approval, review, or consent by the City except as otherwise provided herein.

14. No Waiver. Any party's failure to enforce any provision of this Agreement shall not constitute a waiver of the right to enforce such provision. The provisions may be waived only in writing by the party intended to be benefited by the provisions, and a waiver by a party of a breach hereunder by the other party shall not be construed as a waiver of any succeeding breach of the same or other provisions.

15. Severability. If any portion of this Agreement is held to be unenforceable for any reason, the remaining provisions shall continue in full force and effect.

16. Force Majeure. Any prevention, delay or stoppage of the performance of any obligation under this Agreement which is due to strikes, labor disputes, inability to obtain labor, materials, equipment or reasonable substitutes therefore; acts of nature; governmental restrictions, regulations or controls; judicial orders; enemy or hostile government actions; wars, civil commotions; fires or other casualties or other causes beyond the reasonable control of the party obligated to perform hereunder shall excuse performance of the obligation by that party for a period equal to the duration of that prevention, delay or stoppage.

17. Amendment. This Agreement may be amended only in writing signed by the Parties hereto.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement by and through their respective, duly authorized representatives as of the day and year first hereinabove written.

**CITY:**

CITY OF HURRICANE

ATTEST:

By: _____
City Recorder

By: _____
Mayor

**DEVELOPER:**

By: _____
Name:
Title: managing member

STATE OF UTAH )
:ss
COUNTY OF UTAH )

On the 3rd day of December, 2021, personally appeared before me Ted Fullerton, who being by me duly sworn, did say that he is the managing member of Day Star Holdings LLC, a Utah limited liability company, and that the within and foregoing instrument was signed on behalf of said limited liability company with proper authority and duly acknowledged to me that he executed the same.

NOTARY PUBLIC
Brienna Spencer
714562
COMMISSION EXPIRES
October 7, 2024
State of Utah

_____
Notary Public
Residing at: Hurricane UT

**EXHIBIT A**

**Legal Description Parcel:**

The following properties zoning has been changed to Planned Commercial and shall be subject to this development agreement.

**LEGAL DESCRIPTION**

BEGINNING AT NORTHEAST CORNER POF SECTION 35, TOWNSHIP 41 SOUTH, RANGE 13 WEST, SALT LAKE BASE AND MERIDIAN; THENCE N88'52'39"W, 593.32 FEET TO THE POINT OF BEGINNING; THENCE S01;03'13"W, 385.08 FEET; THENCE WESTERLY ALONG THE ARC OF A 672.95 FOOT RADIUS NON-TANGENT CURVE TO THE LEFT 556.18 FEET (CHORD BEARS: S76'03'37"W 540.48 FEET); THENCE S52'23'00"W, 258.20 FEET; THENCE N01'04'13"E, 687.11 FEET: THENCE S88'52'39"E, 723.47 FEET; BACK TO THE POINT OF BEGINNING.

CONTAINING 8.5 ACRES

**LEGAL DESCRIPTION**

BEGINNING AT NORTHEAST CORNER OF SECTION 35, TOWNSHIP 41 SOUTH, RANGE 13 WEST, SALT LAKE BASE AND MERIDIAN; THENCE N88'52'39"W, 1316.79 FEET TO THE POINT OF BEGINNING; THENCE S39'29'20"W, 1348.46 FEET; THENCE N80'05'35"E, 55.34 FEET; THENCE S01'02'22"W, 218.89 FEET; THENCE S68'13'41"E, 30.23 FEET; THENCE NORHEASTERLY ALONG THE ARC OF A 717.16 FOOT RADIUS NON-TANGENT CURVE TO THE RIGHT 578.44 FEET (CHORD BEARS: N47'53'15"E 562.89 FEET); THENCE N70'59'39"E, 24.20 FEET; THENCE NORTHEASTERLY ALONG THE ARC OF A 834.83 FOOT RADIUS NON-TANGENT CURVE TO THE LEFT 291.22 FEET (CHORD BEARS: THENCE NORTHEASTERLY ALONG THE ARC OF A 834.83 FOOT RADIUS NON-TANGENT CURVE TO THE LEFT 291.22 FEET ( CHORD BEARS: N62'16'23"E 289.74 FEET); THENCE N51'58'30"E, 87.79 FEET; THENCE N01'04'13"E, 687.11 FEET, BACK TO THE POINT OF BEGINNING.

CONTAINING 12.41 ACRES

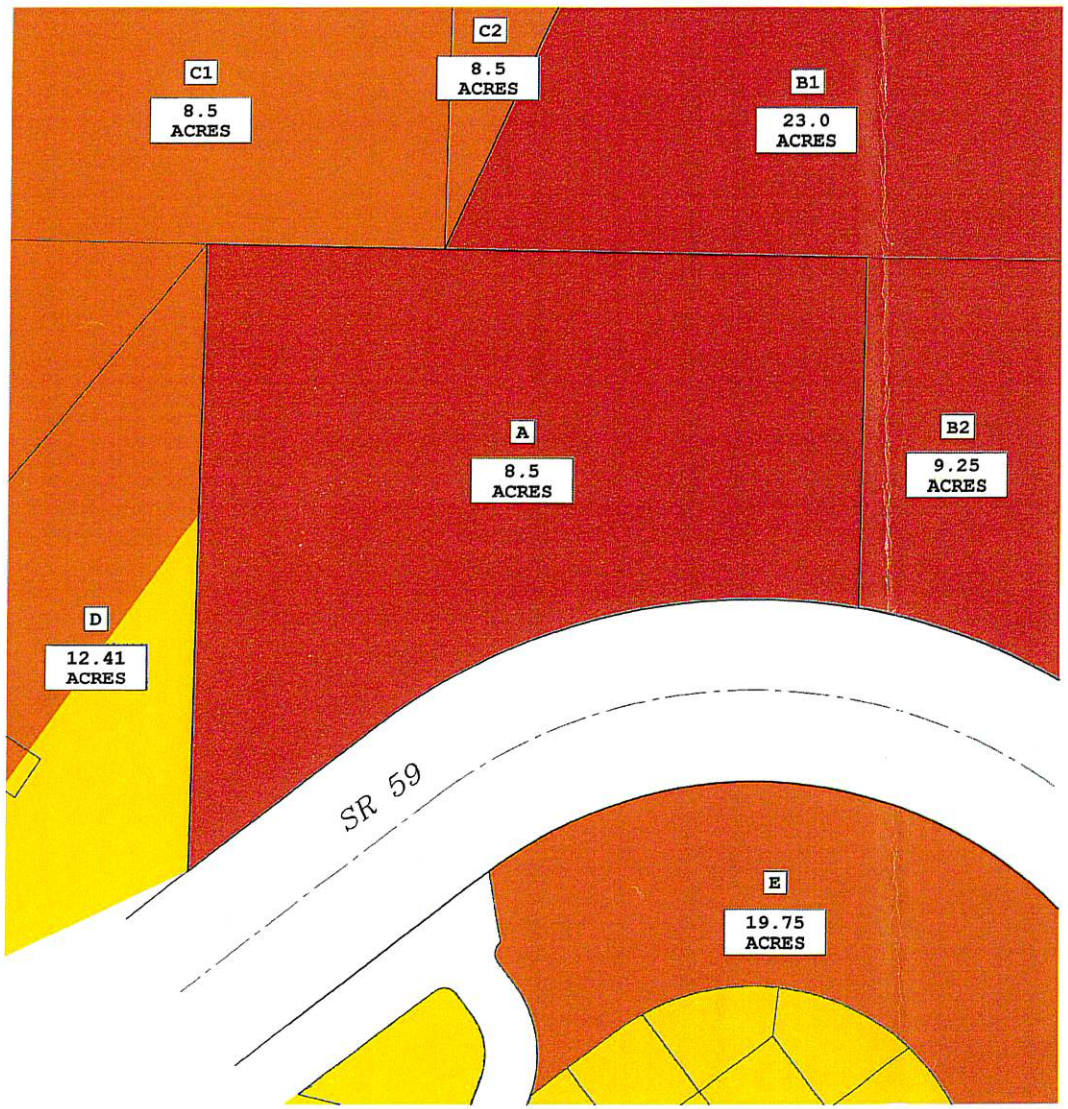
**LEGAL DESCRIPTION**

BEING A PORTION OF SECTIONS 25, 26, 35, AND 36, TOWNSHIP 41 SOUTH RANGE 13 WEST OF THE SALT LAKE BASE AND MERIDIAN, MORE PARTICULARLY DESCRIBED AS FOLLOWS: BEGINNING AT A POINT ON THE SOUTH LINE OF SAID SECTION 26 SOUTH 89'59'38"WEST 1056.0 FEET FROM THE SOUTHEAST CORNER OF SAID SECTION 26 AND RUNNING THENCE NORTH 23'30'02" EAST 1444.46 FEET; THENCE NORTH 89'59'35" EAST 462 FEET; THENCE SOUTH 00'46'45" EAST 664.71 FEET; THENCE NORTH 89'13'15" EAST 528.96 FEET: THENCE SOUTH 00'45'45 EAST 661.50 FEET; THENCE SOUTH 00'05'42"WEST 1322.23 FEET; THENCE NORTH 89'54'12" WEST 528.96 FEET: THENCE NORTH 89'58'36" WEST 71.10 FEET: THENCE NORTH 19'17'29" EAST 44.99 FEET TO A POINT ON A 673.49 FOOT RADIUS CURVE TO THE LEFT; THENCE ALONG SAID CURVE 1183.21 FEET (CHORD BEARS NORTH 31'01'27" WEST 1036.81 FEET);P THENCE NORTH 00'04'30" WEST 384.59 FEET; THENCE ALONG THE SOUTH SECTION LINE OF SAID SECTION 26, SOUTH 89"59'38" WEST 462.47 FEET TO THE POINT OF BEGINNING.

CONTAINING 54.99 ACRES.

# PROPOSED ZONE MAP FOR:
# KACHINA RIDGE

LOCATED IN SECTIONS 25, 26, 35, & 36, T41S, R13W, S.L.B.&M.
HURRICANE, WASHINGTON COUNTY, UTAH



## LEGAL DESCRIPTION

BEGINNING AT NORTHEAST CORNER POF SECTION 35, TOWNSHIP 41 SOUTH, RANGE 13 WEST, SALT LAKE BASE AND MERIDIAN; THENCE N88°52'39"W, 593.32 FEET TO THE POINT OF BEGINNING; THENCE S01°03'13"W, 383.08 FEET; THENCE WESTERLY ALONG THE ARC OF A 672.85 FOOT RADIUS NON-TANGENT CURVE TO THE left 556.18 FEET (CHORD BEARS: S76°53'37"W 540.48 FEET); THENCE S52°23'00"W, 258.20 FEET; THENCE N01°04'13"E, 687.11 FEET; THENCE S88°52'39"E, 723.47 FEET; BACK TO THE POINT OF BEGINNING.

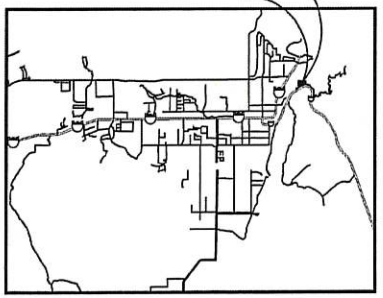
CONTAINING 8.5 ACRES

## LEGEND

- R1-15: RESIDENTIAL
- R1-10: RESIDENTIAL
- OSC-20: OPEN SPACE CONSERVATION 20 AC MIN. (WASHINGTON COUNTY ZONE)
- PC: PLANNED COMMERCIAL

| | |
|---|---|
| A | JDL INV INC – PARCEL: H-348-B-2-A |
| B1 | KACHINA RIDGE LLC – PARCEL: H-312-A |
| B2 | KACHINA RIDGE LLC – PARCEL: H-348-B-1-A |
| A4 | BALLARD RALPH & RUTH M TRUST – PARCEL: H-314-A-1 |
| C1 | BALLARD RALPH & RUTH M TRUST – PARCEL: H-314-B-1 |
| C2 | PMH LEASING LLC– PARCEL: H-348-B-1-B |
| D | CLARA BURTON – PARCEL: H-296-B-1-A |

## PROJECT LOCATION



| NO | DESCRIPTION | DATE | BY |
|---|---|---|---|
| | | | |


PROVALUE ENGINEERING, INC.
Engineers - Land Surveyors - Land Planners

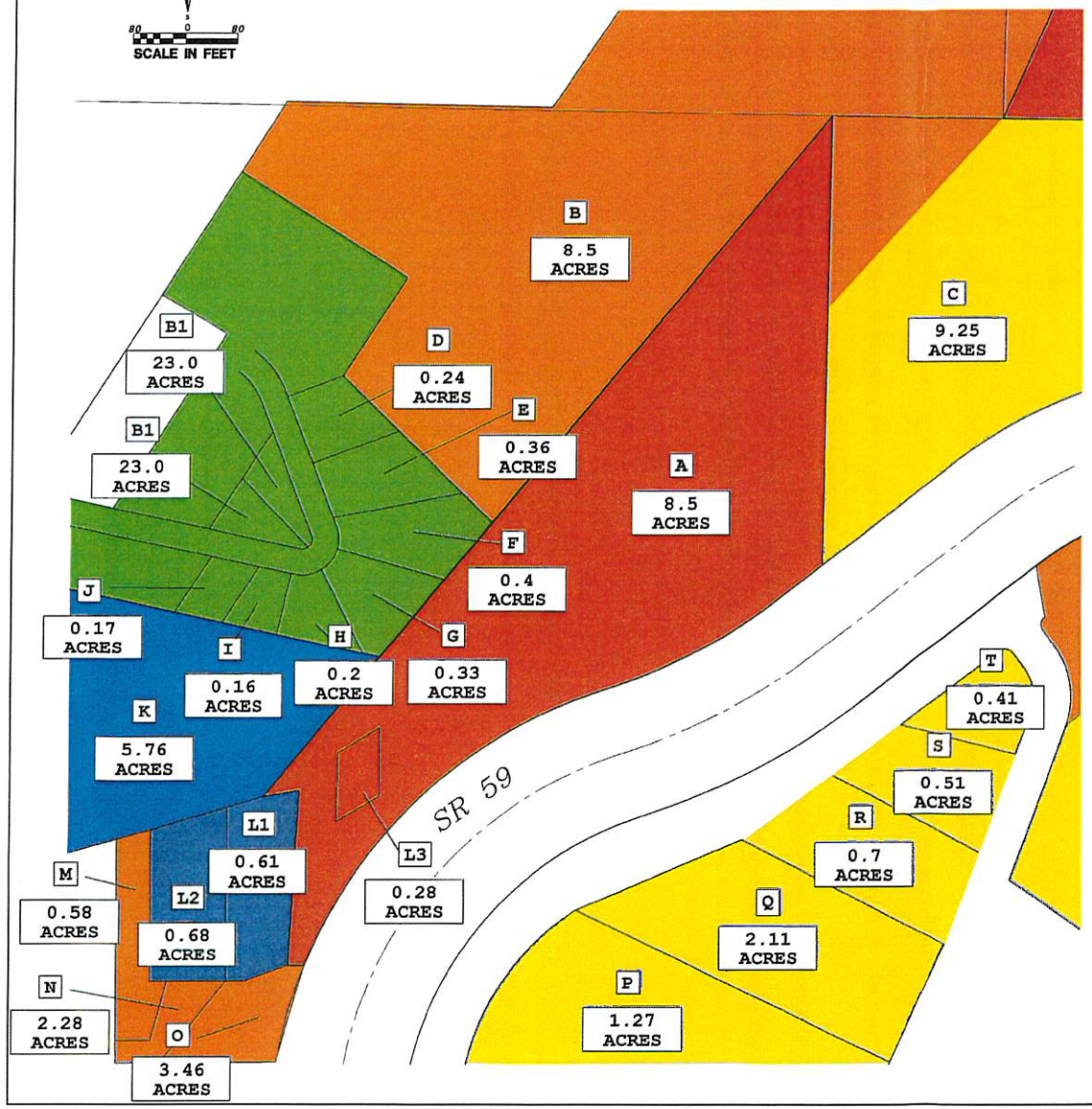

PROPOSED ZONE MAP FOR:
KACHINA RIDGE
LOCATED IN SECTIONS 25, 26, 35, & 36, T41S, R13W, S.L.B.&M.
HURRICANE, WASHINGTON COUNTY, UTAH

DATE: 9-19-2019
SCALE: 1"=60'
JOB NO: 5-19-001
SHEET NO: 2 OF 2

PROPOSED ZONE MAP

# PROPOSED ZONE MAP FOR:
# KACHINA RIDGE

LOCATED IN SECTIONS 25, 26, 35, & 36, T41S, R13W, S.L.B.&M.
HURRICANE, WASHINGTON COUNTY, UTAH




## LEGAL DESCRIPTION

BEGINNING AT NORTHEAST CORNER OF SECTION 35, TOWNSHIP 41 SOUTH, RANGE 13 WEST, SALT LAKE BASE AND MERIDIAN; THENCE N88°52'39"W, 1316.79 FEET TO THE POINT OF BEGINNING; THENCE S39°29'20"W, 1348.48 FEET; THENCE N80°05'35"E, 55.34 FEET; THENCE S01°02'22"W, 218.89 FEET; THENCE S68°13'41"E, 30.33 FEET; THENCE NORTHEASTERLY ALONG THE ARC OF A 717.16 FOOT RADIUS NON-TANGENT CURVE TO THE right 578.44 FEET (CHORD BEARS: N47°53'15"E 562.89 FEET); THENCE N70°59'39"E, 24.20 FEET; THENCE NORTHEASTERLY ALONG THE ARC OF A 834.83 FOOT RADIUS NON-TANGENT CURVE TO THE left 291.22 FEET (CHORD BEARS: N62°16'23"E 289.74 FEET); THENCE N51°58'30"E, 87.79 FEET; THENCE N01°04'13"E, 687.11 FEET, BACK TO THE POINT OF BEGINNING.

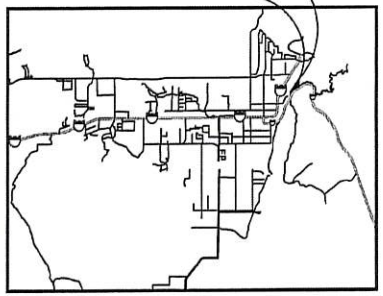
CONTAINING 12.41 ACRES

## LEGEND

- R1-15: RESIDENTIAL
- R1-10: RESIDENTIAL
- PF: PUBLIC FACILITY
- PC: PLANNED COMMERCIAL
- HC: [illegible]RE
- MH/RV: MOBILE HOME/RECREATIONAL VEHICLE

| | |
|---|---|
| A | CLARA BURTON - PARCEL: H-296-B-1-A |
| B | BALLARD RALPH & RUTH M TRUST - PARCEL: H-314-A-1 |
| C | PMH LEASING LLC- PARCEL: H-348-B-1-B |
| D | MAHAN ASPEN - PARCEL: H-SMME-12 |
| E | DAVILA FRANCISCO JAVIER & MARIA ENGRACIA TRS - PARCEL: H-SMME-2-4 |
| F | BOSI SANDRA E - PARCEL: H-SMME-10 |
| G | DIXIE HEALTH HOLDINGS LLC - PARCEL: H-SMME-9 |
| H | DIXIE HEALTH HOLDINGS LLC- PARCEL: H-SMME-8 |
| I | CANNON LLOYD A - PARCEL: H-SMME-7 |
| J | FJERMESTAD JAELIN - PARCEL: H-SMME-6 |
| K | DIXIE HEALTH HOLDINGS LLC - PARCEL: H-298-A-1-A |
| L1 | HURRICANE CITY - PARCEL: H-296-A |
| L2 | HURRICANE CITY - PARCEL: H-299 |
| L3 | HURRICANE CITY - PARCEL: H-302 |
| M | BURTON SHEILA TR - PARCEL: H-296-C-2-B |
| N | DBW KOLOB LLC - PARCEL: H-349-A-1-A-1 |
| O | THARP DALE RICHARD & DORI ANN TRS - PARCEL: H-349-A-1-A-2 |
| P | JAMESON DANIEL & LILA - PARCEL: H-296-B-1-B |
| Q | JACOBSON DANIEL & CINDY P - PARCEL: H-296-B-1-C-1 |
| R | ANTES KIRK G TR - PARCEL: H-348-B-2-K |
| S | SCHERBARTH JOHN F & CHRISTINE A TRS - PARCEL: H-348-C |
| T | SCHERBARTH JOHN F & CHRISTINE A TRS - PARCEL: H-348-D |

## PROJECT LOCATION



| NO | DESCRIPTION | DATE | BY |
|---|---|---|---|
| | REVISIONS | | |


PROVALUE ENGINEERING, INC.
Engineers - Land Surveyors - Land Planners
[illegible]


PROPOSED ZONE MAP FOR:
KACHINA RIDGE
LOCATED IN SECTIONS 25, 26, 35, & 36, T41S, R13W, S.L.B.&M.
HURRICANE, WASHINGTON COUNTY, UTAH

DATE: 9-10-2012
SCALE: 1"=80'

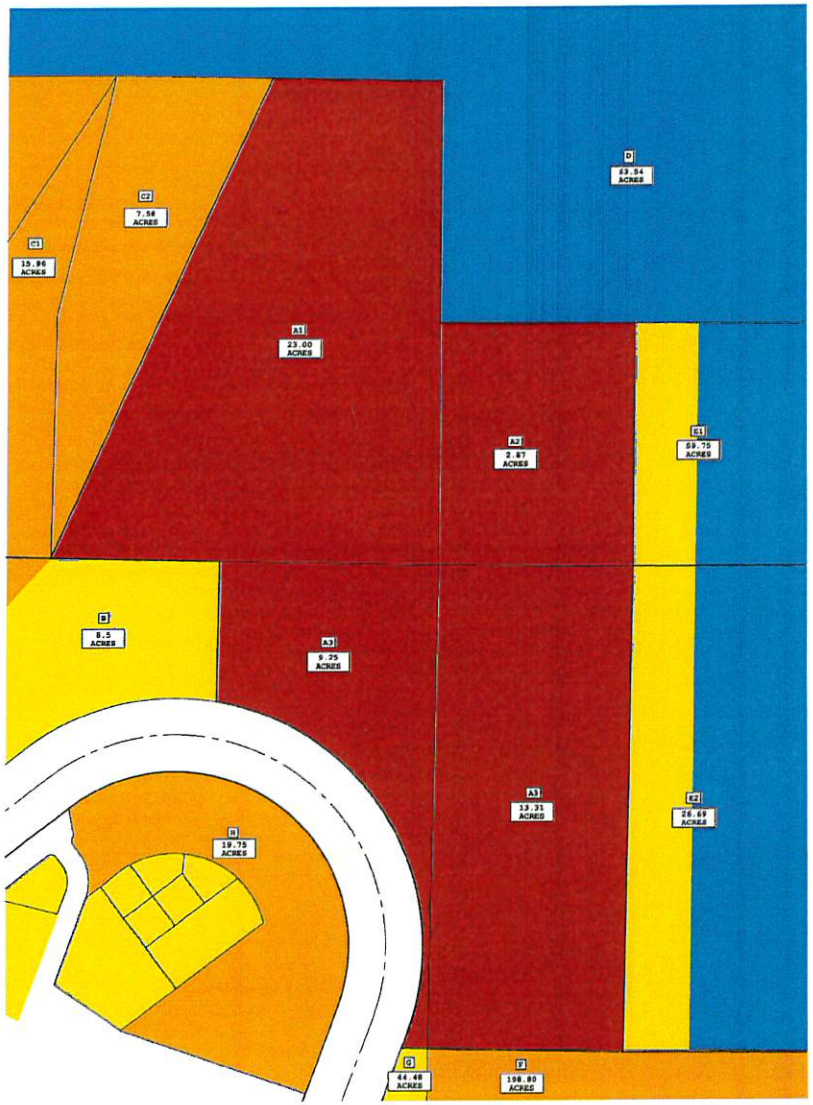
JOB NO.
545-001

SHEET NO.
2 OF 2

PROPOSED ZONE MAP

# PROPOSED ZONE MAP FOR:
# KACHINA RIDGE

LOCATED IN SECTIONS 25, 26, 35, & 36, T41S, R13W, S.L.B.&M.
HURRICANE, WASHINGTON COUNTY, UTAH




N
W E
S
150 0 150
SCALE IN FEET

## LEGAL DESCRIPTION

BEING A PORTION OF SECTIONS 25, 26, 35, AND 36, TOWNSHIP 41 SOUTH, RANGE 13 WEST OF THE SALT LAKE BASE AND MERIDIAN, MORE PARTICULARLY DESCRIBED AS FOLLOWS: BEGINNING AT A POINT ON THE SOUTH LINE OF SAID SECTION 26 SOUTH 89°59'38" WEST 1056.0 FEET FROM THE SOUTHEAST CORNER OF SAID SECTION 26 AND RUNNING THENCE NORTH 23°30'02" EAST 1444.46 FEET; THENCE NORTH 89°59'35" EAST 462.00 FEET; THENCE SOUTH 00°46'45" EAST 664.71 FEET; THENCE NORTH 89°13'15" EAST 528.98 FEET; THENCE SOUTH 00°45'45 EAST 661.50 FEET; THENCE SOUTH 00°05'42" WEST 1,322.23 FEET; THENCE NORTH 89°54'12" WEST 528.95 FEET; THENCE NORTH 89°38'36" WEST 71.10 FEET; THENCE NORTH 19°17'39" EAST 44.98 FEET TO A POINT ON A 673.49 FOOT RADIUS CURVE TO THE LEFT; THENCE ALONG SAID CURVE 1183.21 FEET (CHORD BEARS NORTH 31°01'27" WEST 1036.81 FEET); THENCE NORTH 00°04'30" WEST 384.59 FEET; THENCE ALONG THE SOUTH SECTION LINE OF SAID SECTION 26, SOUTH 89°59'38" WEST 462.47 FEET TO THE POINT OF BEGINNING.

CONTAINING 54.99 ACRES

## LEGEND

- R1-15: RESIDENTIAL
- R1-10: RESIDENTIAL
- OSC-20: OPEN SPACE CONSERVATION 20 AC MIN. (WASHINGTON COUNTY ZONE)
- PC: PLANNED COMMERCIAL

| | |
|---|---|
| A1 | KACHINA RIDGE LLC – PARCEL: H-312-A |
| A2 | KACHINA RIDGE LLC – PARCEL: H-3-1-25-331 |
| A3 | KACHINA RIDGE LLC – PARCEL: H-348-B-1-A |
| A4 | KACHINA RIDGE LLC – PARCEL: H-3-1-36-440 |
| B | PMH LEASING LLC– PARCEL: H-348-B-1-B |
| C1 | BALLARD RALPH & RUTH M TRUST – PARCEL: H-314-A-1 |
| C2 | BALLARD RALPH & RUTH M TRUST – PARCEL: H-314-B-1 |
| D | WASHINGTON COUNTY WATER CONSERVANCY DIS. – PARCEL: 3407-A-HIV |
| E1 | LEE & LOWNEY LLC – PARCEL: 3407-B-1-HV |
| E2 | LEE & LOWNEY LLC – PARCEL: 3313-B-HV |
| F | UTAH STATE – PARCEL: H-331.3 |
| G | JDL INV INC – PARCEL: H-351-A-1-A |
| H | JDL INV INC – PARCEL: H-348-B-2-A |

COPYRIGHT © 2012 PROVALUE ENGINEERING, INC.

| NO | DESCRIPTION | DATE | BY |
|---|---|---|---|
| | | | |

PROVALUE ENGINEERING, INC.
Engineers • Land Surveyors • Land Planners
36 East 100 North, Suite 1-F
Hurricane City, Utah 84737
Phone (435) 635-3658
Fax (435) 635-3659

PROPOSED ZONE MAP FOR:
KACHINA RIDGE
LOCATED AT IN SECTIONS 25, 26, 35, & 36, T41S, R13W, S.L.B.&M.
HURRICANE, WASHINGTON COUNTY, UTAH

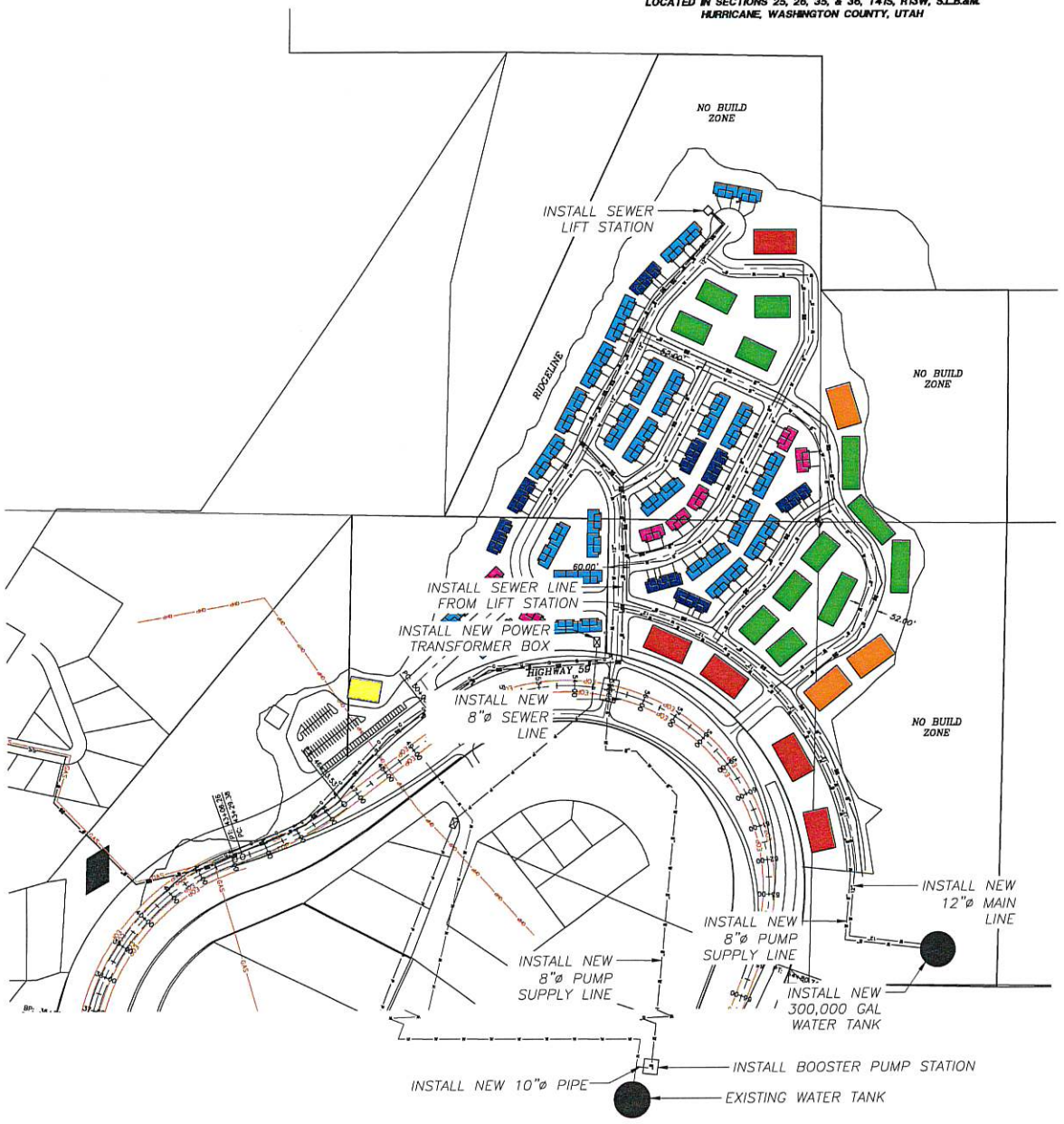
DATE: 1/25/2012
SCALE: 1"=150'
JOB NO: 345-001
SHEET NO: 2 OF 2

PROPOSED ZONE MAP

**EXHIBIT B**
**Site Plan**

# MASTER UTILITY PLAN FOR:
# KACHINA RIDGE

**LOCATED IN SECTIONS 25, 26, 35, & 36, T41S, R13W, S.L.B.&M.**
**HURRICANE, WASHINGTON COUNTY, UTAH**




**LEGEND**

- PROPERTY LINE
- ADJACENT PROPERTY LINE
- CENTER LINE
- EXISTING WATER LINE
- PROPOSED WATER LINE (SIZE SHOWN)
- ESISTING 8"ø SEWER LINE
- PROPOSED 8"ø SEWER LINE
- EXISTING GAS LINE
- PROPOSED GAS LINE
- EXISTING OVERHEAD POWER LINE
- PROPOSED POWER LINE

- DUPLEX
- TRIPLEX
- FOURPLEX
- 16 UNITS
- 18 – 24 UNITS LOWER FLOOR W/ COMMERICAL
- 24 UNITS, LOWER FLOOR W/COMMERCIAL

SECTION CORNER AS DESCRIBED

N

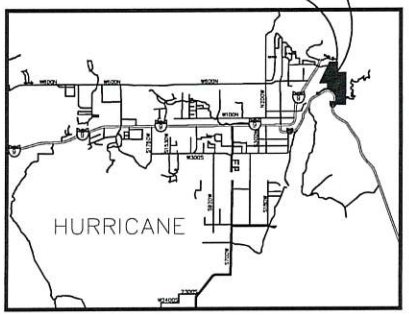
150 0 150

SCALE IN FEET

CONSTRUCTION DOCUMENTS WILL BE PROVIDED AFTER THE ZONE CHANGE APPROVAL OF THE NEW PARCELS AND WILL INCLUDE:

1. FINALIZED HIGHWAY IMPROVEMENTS AND ACCESS POINT DESIGNS
2. DETAILED SEWER DESIGNS INCLUDING THE PUMP STATION AND OFF–SITE SEWER SYSTEM
3. EASEMENTS FOR OFFSITE UTILITIES
4. DETAILED WATER DESIGNS INCLUDING NUMBER OF CONNECTIONS, TANK SIZE, WATER MODEL REPORT, AND ALL ASSOCIATED DETAILS
5. PLAN AND PROFILES OF ALL STREETS INCLUDED IN THE DESIGN.

**PROJECT LOCATION**




COPYRIGHT © 2021 PROVALLUE ENGINEERING INC.

| NO | DESCRIPTION | DATE | BY |
|---|---|---|---|
| | REVISIONS | | |

PROVALLUE ENGINEERING, INC.
Engineers - Land Surveyors - Land Planners
36 South 868 East, Suite 1
Hurricane, UT 84737
(435) 635-8377
Fax (866) 438-3078

MASTER UTILITY PLAN FOR:
KACHINA RIDGE
LOCATED IN SECTIONS 25, 26, 35, & 36, T41S, R13W, S.L.B.&M.
HURRICANE, WASHINGTON COUNTY, UTAH

DATE: 9-16-2020
SCALE: 1"=150'

JOB NO.
545-001

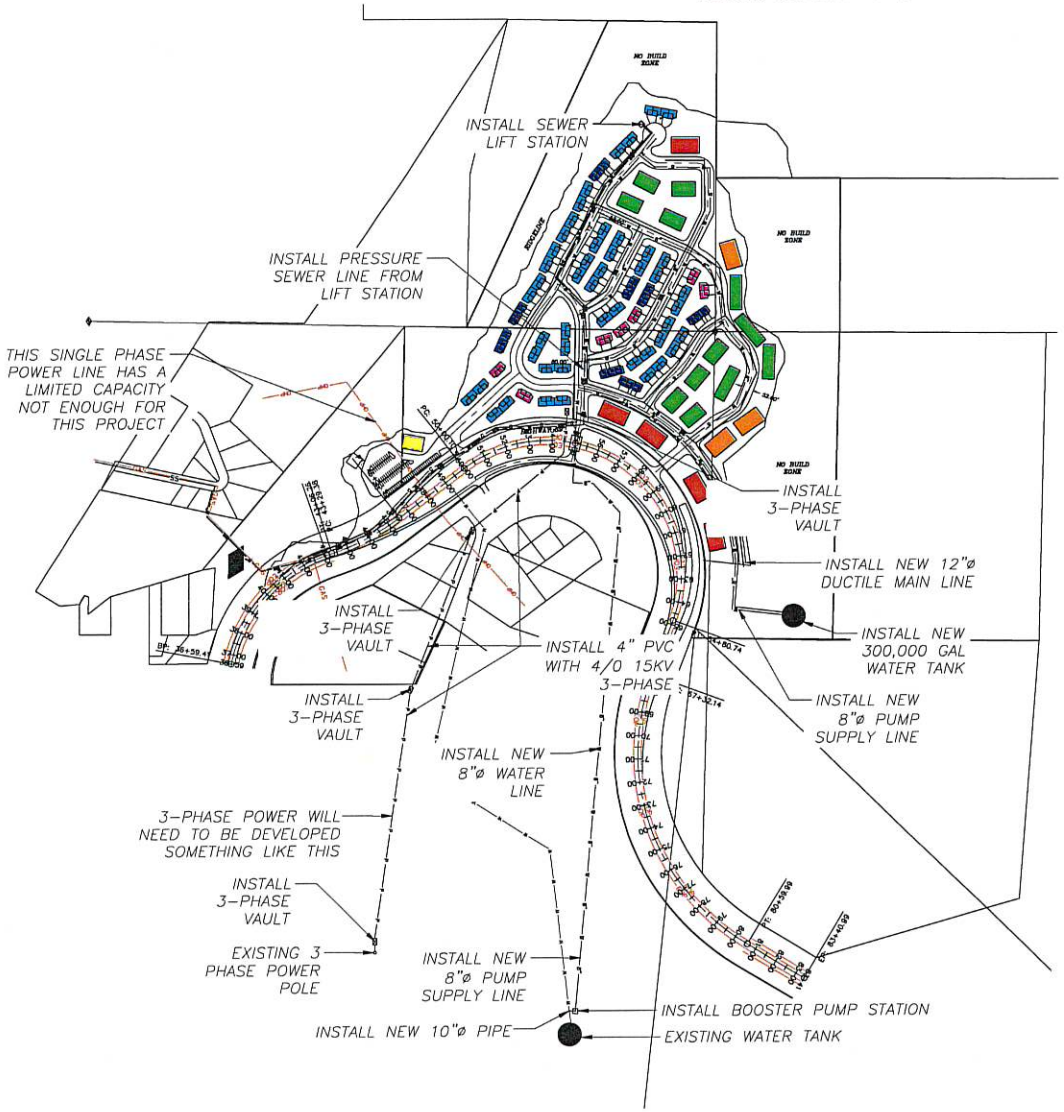
SHEET NO.
2 OF 2

MASTER UTILITY PLAN

**EXHIBIT C**
**Preliminary Utility Master Plan**

# MASTER UTILITY PLAN FOR:
# KACHINA RIDGE

**LOCATED IN SECTIONS 25, 26, 35, & 36, T41S, R13W, S.L.B.&M.**
**HURRICANE, WASHINGTON COUNTY, UTAH**




## LEGEND

- PROPERTY LINE
- ADJACENT PROPERTY LINE
- CENTER LINE
- EXISTING WATER LINE
- PROPOSED WATER LINE (SIZE SHOWN)
- ESISTING 8"ø SEWER LINE
- PROPOSED 8"ø SEWER LINE
- EXISTING GAS LINE
- PROPOSED GAS LINE
- EXISTING OVERHEAD POWER LINE
- PROPOSED POWER LINE

- DUPLEX
- TRIPLEX
- FOURPLEX
- 16 UNITS
- 18 - 24 UNITS LOWER FLOOR W/ COMMERICAL
- 24 UNITS, LOWER FLOOR W/COMMERCIAL
- PROPOSED RESTAURANT
- SECTION CORNER AS DESCRIBED

N
W E
S
250 0 250
SCALE IN FEET

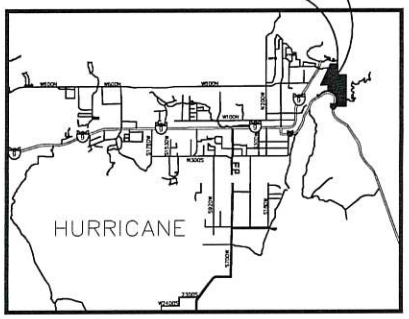
CONSTRUCTION DOCUMENTS WILL BE PROVIDED AFTER THE ZONE CHANGE APPROVAL OF THE NEW PARCELS AND WILL INCLUDE:

1. FINALIZED HIGHWAY IMPROVEMENTS AND ACCESS POINT DESIGNS
2. DETAILED SEWER DESIGNS INCLUDING THE PUMP STATION AND OFF-SITE SEWER SYSTEM
3. EASEMENTS FOR OFFSITE UTILITIES
4. DETAILED WATER DESIGNS INCLUDING NUMBER OF CONNECTIONS, TANK SIZE, WATER MODEL REPORT, AND ALL ASSOCIATED DETAILS
5. PLAN AND PROFILES OF ALL STREETS INCLUDED IN THE DESIGN.

## HURRICANE CITY APPROVAL OF CONCEPT

| | |
|---|---|
| STREETS/PUBLIC WORKS DEPARTMENT | DATE |
| ASH CREEK SEWER DISTRICT | DATE |
| WATER DEPARTMENT | DATE |
| PLANNING DEPARTMENT | DATE |
| POWER DEPARTMENT | DATE |
| CITY ENGINEER | DATE |

## PROJECT LOCATION




| NO | DESCRIPTION | DATE | BY |
|---|---|---|---|
| | REVISIONS | | |


PROVALUE ENGINEERING, INC.
Engineers - Land Surveyors - Land Planners
36 South 868 West, Suite I
Hurricane, Utah 84737
Phone: (435) 668-8587
Fax: (866) 435-3916


MASTER UTILITY PLAN FOR:
KACHINA RIDGE
LOCATED IN SECTIONS 25, 26, 35, & 36, T41S, R13W, S.L.B.&M.
HURRICANE, WASHINGTON COUNTY, UTAH

DATE: 3-16-2020
SCALE: 1"=250'

JOB NO.
3-41-2161

SHEET NO.
1 OF 2

MASTER UTILITY PLAN

COPYRIGHT © 2011 PROVALUE ENGINEERING, INC.

# GEOTECHNICAL INVESTIGATION REPORT

Prepared for:

MRCI
Attn: Ted Fullerton
782 South River Road # 289
St. George, Utah 84790

November 17, 2021

## Kachina Ridge - Revised

Prepared by:

795 East Factory Drive
St. George, UT 84790

Landmark Project No: 210793

November 17, 2021

MRCI
Attn: Ted Fullerton
782 South River Road #289
St. George, Utah 84790

Subject: Geotechnical Investigation Report
Kachina Ridge
Hurricane, Utah
Landmark Project No.: 210793

Ted:

As requested, we have completed our Geotechnical Investigation for the above noted project. Our geotechnical recommendations, along with our field and laboratory data are presented in this report.

Our field investigation for this project consisted of seven (7) borings and five (5) test pits located across the site. The borings extended to between 14 and 21.5 feet below the ground surface. The test pits each extended to between 2 and 9 feet below the ground surface. Soils on-site predominantly consisted of sands and silts with varying amounts of gravel and relatively thin layers of weak to moderately hard mudstone underlain by limestone and basalt bedrock. On-site soils were loose to very dense and dry to slightly moist. Ground water was not encountered in the borings or test pits at the time of our investigation. Site grading and general foundation recommendations are detailed in Section 5.0 of this report. Foundation recommendations are provided in Section 6.0 of this report. The on-site sandy and silty soils, free from organics and other debris are suitable for use as structural fill.

Please feel free to contact our office at (435) 986-0566 if you have any questions.

Sincerely,
**LANDMARK TESTING AND ENGINEERING**

**Steven Wells, P.E.**
Geotechnical Manager

# TABLE OF CONTENTS

## GEOTECHNICAL INVESTIGATION REPORT
## KACHINA RIDGE
## HURRICANE, UTAH


1.0 INTRODUCTION ..... 1

2.0 PROPOSED CONSTRUCTION ..... 1

3.0 SITE SETTING ..... 1

3.1 SURFACE CONDITIONS ..... 1
3.2 GEOLOGIC SETTING ..... 2
3.3 GEOLOGIC HAZARDS ..... 2
3.4 SEISMICITY ..... 3

4.0 INVESTIGATION ..... 4

4.1 FIELD INVESTIGATION ..... 4
4.2 LABORATORY TESTING ..... 5
4.3 ANALYSIS and CONCLUSIONS ..... 5

5.0 SITE GRADING AND EARTHWORK ..... 5

5.1 GENERAL GRADING ..... 5
5.1.1 TOWNHOUSES, CONDOS, AND HOTELS ..... 6
5.1.2 UNDERPASS ..... 6
5.1.3 POOLS ..... 7
5.1.4 RECREATIONAL COURTS ..... 7
5.2 FILL PLACEMENT AND COMPACTION ..... 8
5.3 LIGHTLY LOADED ELEMENTS ..... 9

6.0 FOUNDATION & CONSTRUCTION CONSIDERATIONS ..... 9

6.1 TWO-STORY STRUCTURES ..... 9
6.2 THREE- to FIVE-STORY STRUCTURES ..... 10
6.3 UNDERPASS ..... 11

7.0 FLOOR SLABS ..... 11

8.0 LATERAL EARTH PRESSURES ..... 11

9.0 MOISTURE CONTROL ..... 12

10.0 ASPHALT PAVEMENT DESIGN ..... 13

11.0 SOIL CORROSIVITY ..... 14

12.0 LOW IMPACT DEVELOPMENT (LID) SITE SOILS DATA ..... 14

13.0 FOUNDATION REVIEW AND TESTING ..... 15

14.0 LIMITATIONS ..... 15

# TABLE OF FIGURES

**GEOTECHNICAL INVESTIGATION REPORT**
**KACHINA RIDGE**
**HURRICANE, UTAH**

## APPENDIX A


| | |
|---|---|
| **FIGURE A-1:** | **VICINITY MAP** |
| **FIGURES A-2A and A-2B:** | **SITE MAPS** |
| **FIGURES A-3 through A-9:** | **BORING LOGS** |
| **FIGURES A-10 through A-12:** | **TEST PIT LOGS** |
| **FIGURE A-13:** | **UNIFIED SOIL CLASSIFICATION SYSTEM** |
| **FIGURE A-14:** | **LABORATORY SUMMARY** |


## APPENDIX B


| | |
|---|---|
| **FIGURES B-1 through B-4:** | **CONSOLIDATION CURVES** |
| **FIGURES B-5 through B-20:** | **LABORATORY TEST SHEETS** |


## APPENDIX C


**IBC SITE CLASSIFICATION**

**LID RESEARCH DATA**

# 1.0 INTRODUCTION

This report presents the results of Landmark Testing & Engineering's geotechnical investigation for a 34-acre project site in Hurricane, Utah with residential and commercial development. Figure A-1 is a Vicinity Map showing the project location relative to surrounding features. Figure A-2A is a Site Map showing the proposed project layout and the approximate location of the borings and test pits completed for this investigation.

This investigation was completed to assist in developing opinions and recommendations concerning site earthwork and foundation design.

# 2.0 PROPOSED CONSTRUCTION

We understand that construction will consist of high-density housing, commercial buildings, and pools. Structures will include condos, townhomes, and a hotel with amenities and associated roadways and parking. The condos and hotel are anticipated to be 4- to 5-stories. Townhomes are expected to be 2-stories. We understand that many structures are to have below ground parking. Access to the site from Highway 59 will include an underpass. We anticipate that typical cuts and fills on the site will be on the order of 8 feet with localized areas of fill approximately 15 feet.

Anticipated structural loads for two story townhouses and any other one to two story structures will be on the order of 1,200 to 2,500 pounds per lineal foot.

Structural loads for the 4- to 5- story buildings have not been provided. However, we anticipate structural loads for columns to be on the order of 500 kips. Strip loads for the 4- to 5- story buildings are expected to be on the order of 6 to 10 kips per lineal foot. Recommendations based on these anticipated loads are provided in Section 6 of this report. Any significant changes to the anticipated development and structural loads should be reviewed by Landmark to evaluate the continued applicability of the recommendations contained in this report.

# 3.0 SITE SETTING

## *3.1 SURFACE CONDITIONS*

The projected trace of the Hurricane Fault line is located to the west and east of the project site. The project site is approximately 300 to 350 feet higher than the valley to the west and 500 feet higher than the Virgin River to the north.

The project site is located to the north of Highway 59 at the top of the hill to the east of the City of Hurricane. There is a general slope down to the north with an elevation difference of approximately 30 to 50 feet across the site. The site is undeveloped with moderate vegetation consisting of desert shrubbery, field grasses, and cacti. There are occasional dirt roads traversing the site. To the east of the site the land rises up to 300 feet.

### *3.2 GEOLOGIC SETTING*

The site traverses multiple geologic units. The western portion of the project site is mapped as part of the Volcano Mountain lava flow (middle Pleistocene, Qbv). The eastern portion of the site is mapped as Fossil Mountain Member of the Kaibab Formation (Lower Permian, Leonardian, Pkf). The middle portion of the site is mapped as alluvial and colluvial deposits (Holocene to upper pliestocene, Qac) underlain by the two bedrock formations. These geologic formations are outlined as follows:

**Qbv:** Medium- to dark-gray to grayish-black, fine- to medium-grained alkali basalt (Qbv) with sparse olivine phenocrysts; erupted from a vent at Volcano Mountain (Qbvc) southwest of Hurricane

**Pkf:** Lithologically uniform, light-gray, thick-bedded, fossiliferous limestone and cherty limestone, abundant reddish-brown, brown, and black ribbon chert and irregular chert nodules that locally make up 20 to 40% of the rock; forms a prominent cliff in the Hurricane Cliffs and Beaver Dam Mountains

**Qac:** 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.

### *3.3 GEOLOGIC HAZARDS*

**Fault Rupture**

At the project location the projected trace of the Hurricane Fault branches out from the bottom of the hill to the west to the east as shown on Figure 2A. Therefore, the site is surrounded by the hurricane Fault to the east and west. As such the project side is mapped as a "surface-fault-rupture-hazard special-study zone. The special-study zones established for well-defined faults extend for 500 feet on the downthrown side and 250 feet on the upthrown side of each fault. Normal faults are classified as well defined of Utah Geological Survey. Because their location is uncertain, the special-study areas around buried or approximately located faults are broader, extending 1000 feet on each side of the suspected trace of the faults."[1]

Exposed traces of the Hurricane Fault are present north and south of the project. It should be understood that the exact location of fault lines is not always known and that fault lines do not consist of one single line. It is likely that there is evidence of the Hurricane Fault located throughout the project site. Depending on the final layout of the project, additional studies may be required to better define fault traces to ensure adequate setbacks for residences.

The trace of the Volcano Mountain Faults is located approximately 2.5 miles to the west of the site. The Washington fault is located approximately 11.5 miles west of the site. The most recent movement of the Volcano Mountain, Washington faults is considered Quaternary, which classifies the faults as active. Strong ground motion associated with movement along the Volcano Mountain,

1 Geologic Hazard Mapping and Data Custom Report, https://geology.utah.gov/apps/jay/tests/hazards/report/, retrieved October 28, 2021

Washington, Hurricane faults or other faults associated with the Intermountain Seismic Belt is possible.

**Liquefaction**

Liquefaction is the sudden loss of shear strength in the soil due to the build-up of excess pore water pressure.[2] This can occur when the soil is subjected to intense shaking such as during a seismic event. The soils that are most susceptible to liquefaction are loose, saturated sandy soils with a low fines content (material passing the #200 sieve).

The soils on site consisted of loose to dense sands and silts with varying amounts of gravel and a relatively high fines content. Groundwater was not encountered in the borings or test pits at the time of our investigation. Therefore, the potential for liquefaction is considered low.

**Rockfall**

The north side and west side of the project site are mapped as being in a moderate and high rockfall hazard area, respectively. "High rockfall hazard areas include canyon cliffs and other near-vertical slopes not undercut by erosion of underlying units and lack obvious discontinuities and overhanging rock masses but are still capable of producing damaging rockfall. These areas also include steep mountainous areas (slopes greater than 20 degrees) where bedrock units highly susceptible to rockfall crop out in the slope rather than forming a capping unit. Also included are mountainous areas where bedrock units moderately susceptible to rockfall crop out on slopes greater than 35 degrees.

"Moderate rockfall hazard includes areas where bedrock units moderately susceptible to rockfall crop out on 20- to 35-degree slopes, and where bedrock units with low rockfall susceptibility crop out on slopes greater than or equal to 35 degrees."[3]

The areas on site mapped as having a moderate and high rockfall hazard are to the east and north of the anticipated construction.

**Instability of Basalt Slope**

The basalt along the western and northern sides of the project site is highly fractured in columnar jointing and leans away from the main body of the basalt. Columnar jointing of the basalt is common during cooling. Typically, these joints extend back away from the slope. We recommend that structures be constructed a minimum of 30 feet from the edge of basalt slopes to minimize damage from potential slope instability. IBC recommends a setback from the toe of ½ times the slope height or a maximum of 15 feet. A setback of 1/3 of the slope height or a maximum of 40 feet is recommended for structures built adjacent to slope crests.

## *3.4 SEISMICITY*

The average shear wave velocity of the upper 100 ft ($Vs_{,100}$) of the site soil profile on the project was determined by conducting a seismic refraction survey in accordance with the Refraction

2 Coduto, Donald P. (1999), Geotechnical Engineering: Principles and Practices, Prentice Hall, Upper Saddle River, NJ
3 Geologic Hazard Mapping and Data Custom Report, https://geology.utah.gov/apps/jay/tests/hazards/report/, retrieved October 28, 2021

Microtremor (ReMi) method. The location of where the seismic survey was conducted is shown on Figure A-2A. The result of the ReMi shows that the $Vs_{,100}$ of the site is 1,768 ft/sec, which classifies the site as "C." These results correlate well with soils encountered in the borings. Bedrock was encountered between 14 and 19 feet in two of the borings and between 2.5 and 6 feet in two of the test pits. The shear wave velocity, as shown on the Shear Wave Velocity Profile in Appendix C, dramatically increases at 17 feet, indicating the presence of bedrock. This depth correlates well with the depth at which bedrock was encountered in our borings.

Seismicity at the site was determined using the Structural Engineers Association (SEA), OSHPD Seismic Design Maps website. The following values are presented to assist with seismic design.

- Latitude = 37.18558 North, Longitude = 113.27494 West
- Site Class = C (Very Dense Soil and Soft Rock), based on ASCE 7-16 (Table 20.3.1) as referenced in 2018 IBC 1613.2

| Period (sec) | Sa (g) | Site Class |
|---|---|---|
| 0.2 | 0.613 $S_S$ | B/C |
| 1.0 | 0.202 $S_1$ | B/C |
| 0.2 | 0.513 $S_{DS}$ | C |
| 1.0 | 0.202 $S_{D1}$ | C |

(2016 ASCE-7-16, SEA, Structural Engineers Association, https://seismicmaps.org/)

# 4.0 INVESTIGATION

## *4.1 FIELD INVESTIGATION*

In 2005 Landmark completed a geotechnical report for proposed construction on-site. Thirteen test pits were excavated to a depth of 2 to 10 feet below the existing grade. Soils encountered in the 2005 investigation consisted of gravels, silty sand, silt, lean clay and basalt.

To investigate the subsurface soil conditions for the current proposed construction, a total of 7 borings and 5 test pits were completed in the proposed construction. Borings were excavated across the site and test pits were focused along Highway 59 on the southern portion of the project.

Soils encountered in the test pits and borings consisted of loose to dense silty sand and sandy silt with varying amounts of gravel. There were occasional layers of mudstone between 0.5 and 1.5 feet thick located between 9.5 and 21 feet. Basalt bedrock was encountered in borings and test pits along the western portion of the project site and limestone bedrock along the eastern portion of the project site.

For a detailed description of the subsurface soils encountered in the borings and test pits, please see the boring logs and test pit logs on Figures A-3 through A-12. A key to the symbols and soil classifications used on the logs is presented on Figure A-13.

### *4.2 LABORATORY TESTING*

Samples from the borings and test pits were returned to our St. George, Utah laboratory for testing. Tests performed on the samples included moisture content and unit weight tests, mechanical sieve analyses and Atterberg Limits tests to aid in soil classification, consolidation tests to aid in excavation recommendations, and a soluble sulfate test. Laboratory test results are shown on the boring and test pit logs on Figures A-3 through A-12 and on the laboratory summary sheet on Figure A-14.

Mechanical sieve analyses and Atterberg Limits tests predominantly classified the samples from the borings and test pits as silts and sands with varying amounts of gravel.

Moisture contents of the soils ranged from 1.0 to 11.6 percent with an average moisture content of approximately 5 percent. Dry unit weights of samples from the borings ranged from 74.7 to 108.2 pcf with an average dry density of approximately 98.5 pcf.

A total of 4 consolidation/swell tests were completed on samples from the borings. The samples from borings B-3 at 10.5 feet and boring B-7 at 21 feet collapsed 0.7 and 3.9 percent, respectively, showing a low to high collapse potential. The samples from borings B-4 at 11 feet and B-5 at 21 feet swelled 0.2 and 2.1 percent, respectively, showing a low to high swell potential. Consolidation curves are shown on Figures 15 through 18.

### *4.3 ANALYSIS and CONCLUSIONS*

Our field and laboratory test results indicate that the soils on-site predominantly consisted of loose to dense silty sands and sandy silts with varying amounts of gravel. Groundwater was not encountered in the borings or test pits. Occasional layers of clayey mudstone were encountered in borings B-3, B-5, and B-6. Mudstone layers were easily drilled and ranged between 0.5 and 1.5 feet thick.

Settlement analyses were performed on the soils based on the field conditions and consolidation tests. The results of the field and laboratory testing show that fill soils have a low to moderate collapse potential and low densities.

We recommend that loose and collapsible soils beneath footings be excavated prior to construction. Specific recommendations for heavily loaded footings are provided in section 6.2. General recommendations for the earthwork and foundations are outlined in Sections 5.0 and 6.0 of this report.

## 5.0 SITE GRADING AND EARTHWORK

### *5.1 GENERAL GRADING*

The majority of the site is covered in moderate vegetation. Initial site preparations should include clearing and grubbing the site. We anticipate that grubbing the upper 3- to 6-inches of the site will remove the majority of the roots.

A grading plan and finish floor elevations have not been provided. However, we understand that cuts and fills across the site will be on the order of 7 to 8 feet with localized cuts up to 15 feet. The

following excavation and earthwork recommendations assume minimal cuts and fills. Therefore, structures that will have significant cuts and fills will require site specific excavation recommendations.

### 5.1.1 TOWNHOUSES, CONDOS, AND HOTELS

The building pad areas should be excavated as outlined in the site map on Figure A-2B. We understand that the hotel will have underground parking. We are unaware which of the other buildings will have a basement level. Excavation requirements for structures with basements will be different than for at-grade structures. Building pad excavations should extend a minimum of 5 feet beyond the building pad, horizontally, where possible.

Footing excavations should extend to depths sufficient to allow for the minimum amount of structurally placed soils as outlined in section 6.2.

For all excavations, once the excavations are complete, the upper 8-inches of soil in the bottom of the excavations should be scarified, moisture conditioned to within 2 percent of the optimum moisture content and compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D-1557.

The excavated, on-site silty and sandy soils are suitable for use as structural fill in the lower portion of the backfill, provided they are free of organics, rocks larger than 6-inches in dimension and other deleterious materials and are placed according to structural fill standards as subsequently outlined.

Due to the high corrosive potential of the on-site soils, we recommend that the upper 1 foot of soil beneath all footings and floor slabs consist of imported, granular, structural fill.

### 5.1.2 UNDERPASS

We understand that an underpass will be constructed to provide access from Highway 59. Test pit TP-2 was excavated on the north side of Highway 59 in proximity to the underpass. Limestone bedrock was encountered in the test pit at a depth of 6 feet. We anticipate that the excavation for the underpass will encounter limestone bedrock.

Our experience shows that limestone in the area is highly corrosive. Therefore, if the excavation is terminated in limestone bedrock, we recommend that the excavation extend to allow for a minimum of 1 foot of imported, granular structural fill. We anticipate that the use of specialized construction equipment such as a single tooth ripper or a hammer hoe will be required to excavate the limestone.

If the bottom of bedrock is not encountered at the bottom of the underpass structure, we recommend that the excavation be excavated to allow for the placement of 1 foot of structural fill immediately underneath the structure.

Since the underpass will be built on a state road, structural fill underneath the underpass and as backfill against the walls of the underpass should meet UDOT Standard Specification 02056.

### 5.1.3 POOLS

The on-site soils are conducive for a pool, however; the owners should be informed of the risks involved in construction of a swimming pool. The introduction of water to subsurface soils will likely result in excessive differential movement, not only in the pools but in nearby structures as well. Moisture control recommendations to mitigate differential movement include but are not limited to the following:

- Plumbing is a significant source of leaks. All plumbing should be fully leak tested and approved prior to filling of the pool.
- The water level in the pool should be strictly monitored and any leaks repaired immediately.
- The pool should be located as far as possible from existing structures.

It should be noted that even if all these mitigation actions are followed, there is still a possibility of subsurface soils becoming saturated, causing differential movement in the pool and other nearby structures. If you have any questions, please let us know.

### 5.1.4 RECREATIONAL COURTS

We understand from the provided site map that there will be tennis/pickleball courts built to the east of the hotel. We recommend that the court be underlain by a minimum of 3 feet of structurally placed soils. The courts are located in an area with shallow anticipate bedrock. The excavation may terminate prior to 3 feet in areas where bedrock is encountered. However, if bedrock is encountered within 1 foot of the finished elevation, the excavation should extend to allow for a minimum of 1 foot of structurally placed soils underneath the court. The court should not transition from being established on bedrock to structural fill.

Consideration may be given to establishing the court of a post tensioned slab. The slabs should be established on a minimum of 2 feet of suitable structural fill, placed as previously discussed. Typically, for ease of construction and shaping, the concrete is underlain by 6-inches of road base. The road base may be included as part of the recommended 2-feet of structural fill. Depending on the structural design, a vapor barrier may or may not be required. If required, a leveling course of sand on the order of 4-inches thick should be placed over the vapor barrier to minimum damage to the barrier during concrete placement.

Post tensioning of slabs is generally performed to minimize cracking or damage due to expansive soils. The soils which will underlie the imported, structural fill are not expansive, therefore, post tensioning can be limited to BRAB Type II where reinforcing is minimal and used mainly for crack control. However, for ease of post-tensioning, a thickened edge is generally constructed to aid in the tensioning process. A minimum thickened edge 12-inches deep and extending 12-inches laterally is normal, however, if used the final dimensions of a thickened edge should be determined by the structural engineer designing the post-tensioned slab.

We do not recommend that the post-tensioned slabs be established directly on the fine grained, silty subgrade. However, if this scenario were to occur the following parameters are provided to assist with post-tensioned slab design:

1. Allowable bearing capacity - 1,800 psf for foundations established on structural fill.
2. Edge Moisture Variation Distance (Em) -
   Center Lift Condition - 5 feet
   Edge Lift Condition - 2.5 feet

3. Differential Soil Movement (Ym) -
   Center Lift Condition - 1/8 to 1/4 inches*
   Edge Lift Condition - None*
4. Clay Properties** -
   LL = 23, PI = 4

*Based on percent swell under 1,000 psf surcharge of less than 4% .
**Based on Atterberg Limits tests performed for the Geotechnical Investigation Report, Landmark Project 05571.

### *5.2 FILL PLACEMENT AND COMPACTION*

All fill to be placed for support of footings and slabs-on-grade should be considered structural fill. On-site sands and silts are suitable for use as structural fill in the lower portion of the building pad areas, provided they are free from organics and other deleterious materials and are placed according to structural fill recommendations as subsequently outlined. Imported, granular fill should be well-graded, non-expansive, and free of organics and all deleterious materials. Cobbles and boulders up to 24 inches in dimension are acceptable in lower portions of the fill. Soils used for granular, imported, structural fill within 2 feet of the bottom of footings should meet the following specifications and preferably would classify as gravel.

| GRADATION | PERCENT PASSING |
|---|---|
| 3- inch | 100 |
| 1 ½ -inch | 80-100 |
| No. 200 sieve | 10-25 |
| **ATTERBERG LIMITS** | |
| Liquid Limit | 30 or less |
| Plasticity Index | 9 or less |

Material not meeting the above requirements may be suitable for use as structural fill at the discretion of the geotechnical engineer. Samples of structural fill should be submitted for testing prior to being transported to the site.

Any on-site soils used as structural fill or imported structural fill should be compacted to the following specifications.

| FILL PLACEMENT AND COMPACTION | |
|---|---|
| Maximum lift thickness | 8-inch (loose) |
| Minimum compaction | 95% ASTM D-1557 |
| Compacted Moisture Content | within 2% of optimum |

Compaction of structural fill should be completed with equipment suitable for the conditions encountered in the field such that compaction requirements are met, including those areas that may be inaccessible to large rolling compactors. All structural fill should be evenly spread on a horizontal plane in eight-inch loose lifts. Each eight-inch lift of structural fill material placed at the site should be tested for compliance with the required relative compaction and moisture content prior to proceeding with additional lifts.

### *5.3 LIGHTLY LOADED ELEMENTS*

Exterior concrete slabs on grade should be established on a minimum of 6-inches of imported, granular structural fill underlain by one foot of structurally placed, on-site soils and 8-inches of scarified and recompacted on-site soils. Structural fill, including any road base, should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D-1557. Compaction and gradations of soils underlying curb and gutter and sidewalks should meet Hurricane City specifications.

## 6.0 FOUNDATION & CONSTRUCTION CONSIDERATIONS

Soil preparations for footings will vary by the location of the structure on site and the structural load on the footing. The following sections provide recommendations for footings for the relatively light 2-story structures and heavier 3- to 5-story structures. Landmark has not been provided with a grading plan. Therefore, structures with large cuts and fills will require site specific excavation recommendations. Due to the high corrosive potential of on-site soils, all footings should be underlain by a minimum of 1 foot of imported, granular fill.

### *6.1 TWO-STORY STRUCTURES*

The following recommendations apply to conventional strip and spot footings for the two-story townhouses and condos. Footings may be established on a minimum of 12-inches of structurally placed, imported, granular, structural fill overlying structurally placed, on-site soils as indicated in section 5.0. Foundation excavations should be visually observed and tested by qualified personnel prior to placement of reinforcing steel or concrete. Additional foundation recommendations are subsequently presented.

| DESCRIPTION | VALUE |
|---|---|
| Foundation Type | Continuous or spread footings |
| Bearing Material | Structurally placed, imported, granular, fill overlying on-site soils |

| DESCRIPTION | VALUE |
|---|---|
| Allowable Bearing Capacity | 2,000 psf on structural fill* |
| Minimum embedment depth below finished grade | 12-inches (for frost and confinement) |
| Minimum footing width | 12 inches (continuous) for single-story<br>18-inches for two stories<br>24-inches (isolated spread) |
| Total estimated settlement | 1-inch |
| Total differential settlement | less than 3/4 inch |

The allowable bearing capacity is based upon dead load plus long-term live load. A one-third increase in allowable bearing capacity for short duration loads such as wind or seismic loads is permitted with the alternative load combinations given in Section 1605.3.2 of the IBC.

* The allowable bearing capacity of 2,000 psf is for footings established 1 foot below finished grade. This capacity may be increased 250 psf for every foot the foundations are established below 1 foot below finished grade up to a maximum bearing capacity of 2,500 psf.

### *6.2 THREE- to FIVE-STORY STRUCTURES*

To adequately support anticipated footing loads for 3- to 5-story condos and hotels, we recommend that excavations for heavily loaded spread and spot footings be excavated to allow for the specified imported, granular, structural fill. Excavation recommendations include:

| FOUNDATION TYPE | DEPTH OF STRUCTURAL FILL BELOW FOOTINGS* | MINIMUM WIDTH OF FOOTING* |
|---|---|---|
| Isolated columns 50 to 100 kips | 2 feet | 7 feet |
| Isolated columns 100 to 200 kips | 3 feet | 10 feet |
| Isolated columns 200 to 300 kips | 5 feet | 12.5 feet |
| Isolated columns 300 to 400 kips | 5.5 feet | 14.25 feet |
| Isolated columns 400 to 500 kips | 6.5 feet | 16 feet |
| Continuous footings up to 10 klf | 2 feet | 5 feet |

*Footing widths and depth of imported granular fill for columns with different loads than those assumed can be provided upon request. Footing widths and depth of structural fill may change depending upon subsurface conditions. Excavations may terminate shallower than specified in the table if bedrock is encountered in the bottom of the excavation.

### *6.3 UNDERPASS*

We anticipate that the underpass structure will consist of cast in place footing and floor slab and precast concrete sections. The structural load will be distributed across the width of the bottom slab of the sections. The tunnel will not have footings. The bottom slab of the precast concrete sections at the bottom of the tunnel will distribute the loads.

We recommend that the excavation for the tunnel extend to allow for a minimum of 2 feet of structural fill to be placed immediately below the bottom of the tunnel. Due to the presence of highly corrosive on-site soils, we recommend that the upper 1 foot of structural fill be imported structural fill.

If limestone or basalt bedrock are encountered within 2 feet of the footings, the allowable bearing capacity of the soil will be 4,000 psf. If bedrock is not encountered within 2 feet of the bottom of the footing elevations, the bearing capacity will decrease by 500 psf for each foot more than 2 feet above bedrock to a minimum bearing capacity of 2,000 psf.

## 7.0 FLOOR SLABS

It is recommended that concrete floor slabs be constructed on a pad that has been prepared as previously indicated. A minimum of 4-inches of relatively free-draining material should be used beneath the slab in order to help distribute floor loads, break the rise of capillary water, and aid in the concrete curing process. Alternatively, 6 inches of road base may be used in place of the free draining-material.

Concrete slabs should be designed using rebar reinforcement and frequent crack control joints to help control normal shrinkage and stress cracking. Concrete placement and curing should meet ACI[4] requirements including following hot or cold weather placement recommendations, when appropriate. If a moisture-sensitive floor covering will be installed, we recommend that a vapor barrier be installed beneath the concrete slab. The moisture sensitivity of floor finishes, anticipated project conditions, and the potential effects of slab curling and cracking should be considered in determining if the barrier should be placed directly beneath the slab or beneath the free-draining gravel (see ACI 302.IR-96 for more information regarding vapor barrier location). If the vapor barrier is installed directly beneath the slab, measures should be taken to minimize excessive slab curl such as reduced joint spacing and use of a low shrinkage (low water-cement ratio) mix.

## 8.0 LATERAL EARTH PRESSURES

Lateral loads imposed on footings may be resisted by the development of passive earth pressures against the sides of footings and friction between the base of the footing and the supporting soils. Lateral earth pressure values are presented in the following table.

[4] American Concrete Institute

| Case Evaluated | Soil Type | Value |
|---|---|---|
| Active | On-site sand/silt | 37 psf/ft |
| | | 58 psf/ft (with seismic) |
| At-Rest | On-site sand/silt | 56 psf/ft |
| Passive | On-site sand/silt | 390 psf/ft |
| | | 330 psf/ft (with seismic) |
| Seismic Coefficient | IBC 1610 | 0.081 |
| Coefficient of friction tan(φ*0.6) where φ = 34° | Imported, granular, structural fill | 0.37 |

The lateral earth pressures presented do not include any safety factors except where the friction angle (φ) used to determine the coefficient of friction has been multiplied by 0.6 to account for smooth contact conditions. The pressures also assume horizontal backfill and that the backfill is in a drained condition with no build-up of hydrostatic pressure. The additional effects of sloping backfill, surcharge, structural loads and groundwater conditions should be included in calculating lateral earth pressures. Backfill should be placed in accordance with the requirements of structural fill except that backfill in landscape and areas that will not be subject to structural loadings may be reduced to 90% of the maximum dry density as determined by ASTM D-1557.

Basement / retaining walls should be designed to resist the lateral earth pressured listed above. Basement backfill should be placed subsequent to floor slab and floor joist construction. Otherwise, the walls should be braced to prevent lateral movement and cracking. Backfill should be placed in accordance with the requirements of structural fill except that backfill in landscape and areas that will not be subject to structural loadings may be reduced to 90% of the maximum dry density as determined by ASTM D-1557. It is recommended that relatively light, manually propelled compactors be used within 5 feet of the walls and that compactors used beyond 5 feet be limited in weight to 3,000 pounds. We suggest that the below grade portion of the basement walls be damp-proofed with an impervious damp-proofing agent or membrane.

# 9.0 MOISTURE CONTROL

This soils report provides recommendations for site preparation and foundation design. Inadequate surface drainage or failure to control moisture will result in excessive differential movement of foundations, slabs, and walkways, and structural damage will occur regardless of the site preparation. The following moisture control measures are highly recommended:

1. The ground surface should be graded to drain surface water away from footings in all directions. A minimum grade of 5% (IBC 1803.3) in the first 10 feet is recommended. Impervious surfaces such as concrete walkways and asphalt pavement adjacent to the structures are effective in reducing the potential for water migration beneath foundations and slabs and should be considered in design. Impervious surfaces such as asphalt or concrete within 10 feet of the building foundation should be sloped a minimum of 2% away from the building.

2. Xeriscape (landscaping that eliminates the need for supplemental irrigation of plants) is recommended within 10-feet of the building foundations. Bubblers, although more efficient than sprinkler irrigation, still have a significant potential of introducing excessive water into the ground and saturating foundation soils. Bubblers are not recommended in the 10-foot buffer zone area. As an alternative, sealed bottom planter boxes may be used.

3. Grass should not be placed within 10-feet of the foundation. Grass, if planted, should have a minimum slope of 5% away from the foundation.

4. Roof runoff should be collected, and downspouts should be designed to discharge collected water a minimum of 10 feet beyond the building footprint.
5. Inadequate compaction of utility trench backfill provides a conduit for water migration. All utility trenches within the building footprint and extending 5 feet beyond the footprint should be backfilled with structural fill similar to that approved for the foundations. Backfill adjacent to structures should be compacted to at least 90 percent of the maximum dry density as determined by ASTM D-1557 and the minimum slope requirements should be followed. Backfill beneath structures should be compacted to at least 95% of the maximum dry density.

6. Grading should be such that surface water is directed away from all cut and fill slopes and collected only in channels protected against erosion. Water should not be allowed to pond on-site.

It should be emphasized that final grading and landscaping generally occurs after construction of the structure and observation of these features is outside of normal geotechnical inspection and observation. The owner/contractor is responsible to ensure that these surface drainage and moisture control recommendations are followed throughout the life of the structure.

## 10.0 ASPHALT PAVEMENT DESIGN

Design of the pavement sections is based on the procedures outlined in the 1993 Guidelines for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO). For traffic loading we assumed a traffic index T.I. of 5.5 for residential streets and the parking lots, which is standard for residential streets accommodating light traffic, and a traffic index of 7.0 for more heavily loaded areas. Based on the soils encountered in the test pits, CBR value of 6 was used in pavement design.

For pavement design, the following design parameters have been assumed:

- Pavement Design Life - 20 years
- Structural Layer Coefficients
  - Asphalt = 0.42
  - Road Base = 0.12
  - Subbase = 0.08

Based on design parameters, the following pavement section is provided.

| Street | Asphalt Thickness (inches) | Road Base Course (inches) | Subbase Course (inches) |
|---|---|---|---|
| T.I. = 5.5 | 3.0 | 8.0 | NA |
| T.I. = 7.0 | 3.5 | 8.0 | 10.0 |

Transition sections leading to and from Highway 59 should match the existing pavement sections. Initial site preparations of the asphalt paved sections should include clearing and grubbing the upper 3- to 6-inches of soil to remove all roots. Recompacted on-site soils should be compacted to a minimum of 95% of the maximum dry density as determined by ASTM D-1557. Base course and subbase soils should be from Hurricane City approved sources and should be compacted to meet Hurricane City Specifications. Asphaltic concrete and base course materials should be tested prior to site delivery and during placement for conformance with project specifications.

## 11.0 SOIL CORROSIVITY

A soluble sulfate content test was conducted on the sample from boring B-2 at 5 feet. The soluble sulfate content of the soil was shown to be 3.39 percent. As such, site soils would classify as having severe corrosive potential to concrete structures. Therefore, it is recommended that concrete mixes be designed for sulfate exposure category S3. It is recommended that all concrete be designed in accordance with ACI 318, R19.3. Buried pipes should be plastic (PVC or HDPE) instead of metal, where possible.

## 12.0 LOW IMPACT DEVELOPMENT (LID) SITE SOILS DATA

If the LID design approach is implemented on the project, we anticipate it will be based on LID guidance set forth by Dixie Storm Water Coalition (DSWC) in the document, “Green Infrastructure and Low-Impact Development Application Guidance for Washington County, Utah” updated June 12, 2020.

The site soils data provided in Table 1 is to aid the evaluation and selection process of applicable BMPs based on *Figure 2 – Applicability Matrix Flow Chart* and *Table 3: Region Applicability Matrix* found in the above-mentioned DSWC document. The data provided in Table 1 is based on our geotechnical investigation and attached report, “Custom Soil Resource Report for Washington County Area, Utah.”

| Table 1 – Site Soils Data | | |
|---|---|---|
| **Category** | **Data** | **Notes** |
| Depth to Groundwater | > 21.5 Feet | Applicable borings were drilled to max. depth of 21.5 feet with no indication of groundwater. |
| Depth to Bedrock | 2.5 ft to | Applicable borings and test pits encountered basalt and limestone bedrock between 2.5 and |

| Table 1 – Site Soils Data | | |
|---|---|---|
| **Category** | **Data** | **Notes** |
| | > 21.5 Feet | 19 feet. There were also borings that extended to 21.5 feet where bedrock was not encountered. |
| Hydrologic Soil Group (HSG) | A | See attached report, Page 13 |
| Infiltration Rate (in/hr) | 2 to 6 | See attached report, Page 13 |
| Expansive Soils Risk* | Low | Thin layer of expansive mudstone encountered at 20 ft (2.1% swell) |
| Collapsible Soil Risk* | Low to high | Between 0.2 and 3.9% based on collapse tests |
| Gypsiferous Soils | High | As per section 11 of this report |
| Liquefaction Risk | Low | As per section 3.3 of this report |

* Minimum horizontal clearances of BMPs from infrastructures must exist to mitigate potential risk and destabilization of underlying soils. Recommended moisture control measures found in this report should be followed.

## 13.0 FOUNDATION REVIEW AND TESTING

This report has been prepared to assist in project design and construction. Variations from the conditions portrayed in the exploratory investigation may occur which are sometimes sufficient to require modifications to the design. In order to incorporate recommendations provided into actual field conditions and to confirm that the project specifications are implemented, we recommend that observation and testing be performed during construction to monitor over-excavation, grading, and preparation of soils upon which foundation elements or structural loads may be established.

Landmark does not determine the location of the over-excavations or the location of the constructed structures. The builder is responsible to ensure that the construction footprints are entirely within the improved building pad areas.

## 14.0 LIMITATIONS

The exploratory data presented in this report were collected to provide geotechnical design recommendations for this project and subsurface site descriptions represent conditions observed at the time and at the location explored. The investigations may not be indicative of subsurface conditions beyond the investigation locations and conditions may change with passage of time. If subsurface conditions are encountered that are significantly different than those reported herein, Landmark should be contacted immediately for the continued applicability of the recommendations. In the event changes to the project are made that differ from those presented in this report, Landmark should be made aware of the changes. Landmark will provide written verification that the recommendations and conclusions remain valid or that modifications are required.

This report has been prepared to assist in project design and construction. We respectfully request the opportunity to review the final design drawings and specifications in order to determine whether the assumptions and recommendations presented herein are applicable to the anticipated designs.

This report is not intended to be used as a bid document. Any information concerning the environmental conditions of the site is beyond the scope of this geotechnical study. This geotechnical report has been prepared to meet the specific needs of our client and may not be appropriate to satisfy the needs of other users.

Site conditions and standards of practice change, therefore, we should be notified to review and update the report and its recommendations if construction is not commenced within 3 years of the date it was issued.

**LANDMARK TESTING & ENGINEERING**

Kent Nelson, P.E.
Project Engineer

Reviewed by:

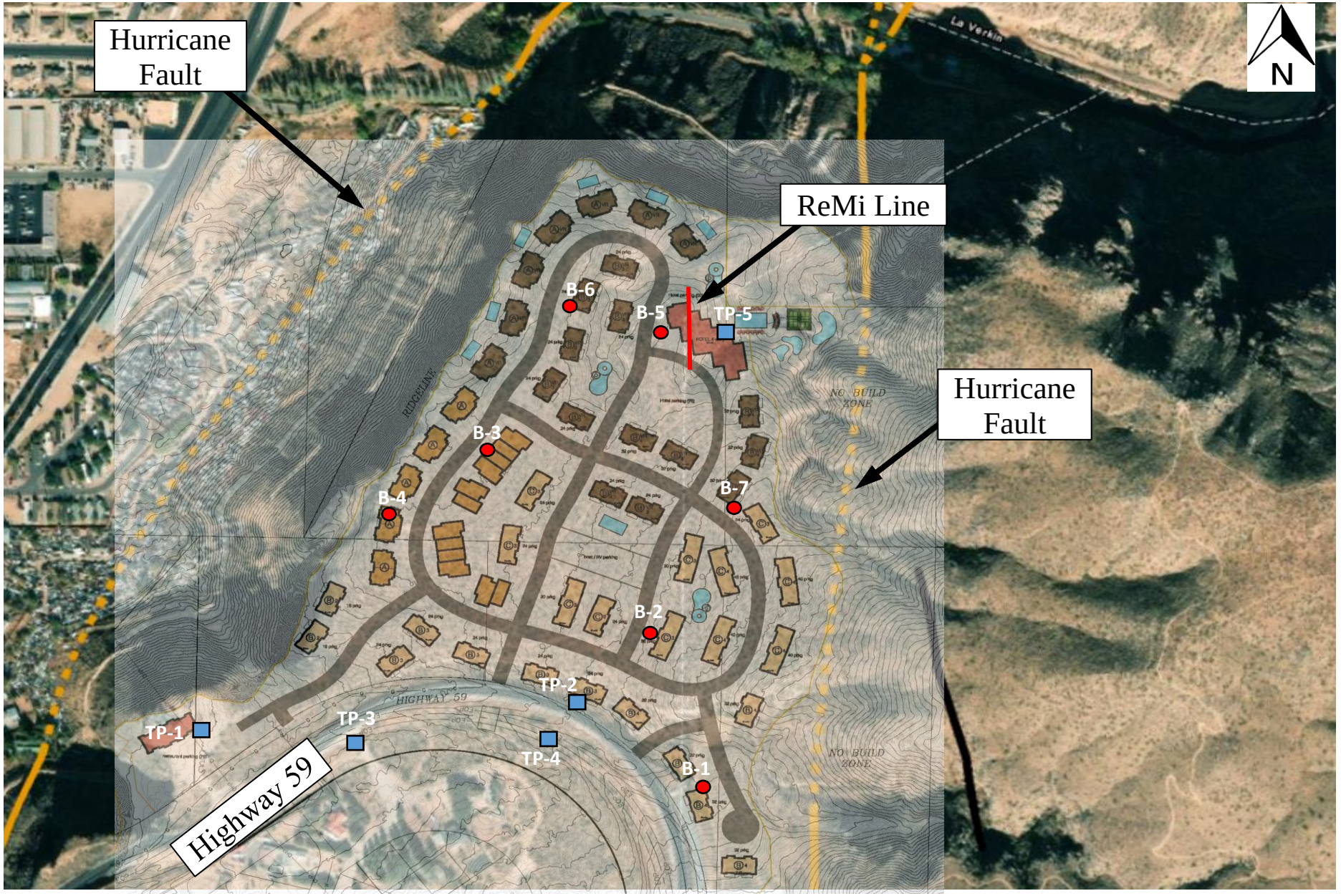
Steve Wells, P.E.
Geotechnical Manager

# Appendix A

LANDMARK TESTING & ENGINEERING

VICINITY MAP
PROJECT NUMBER 210793

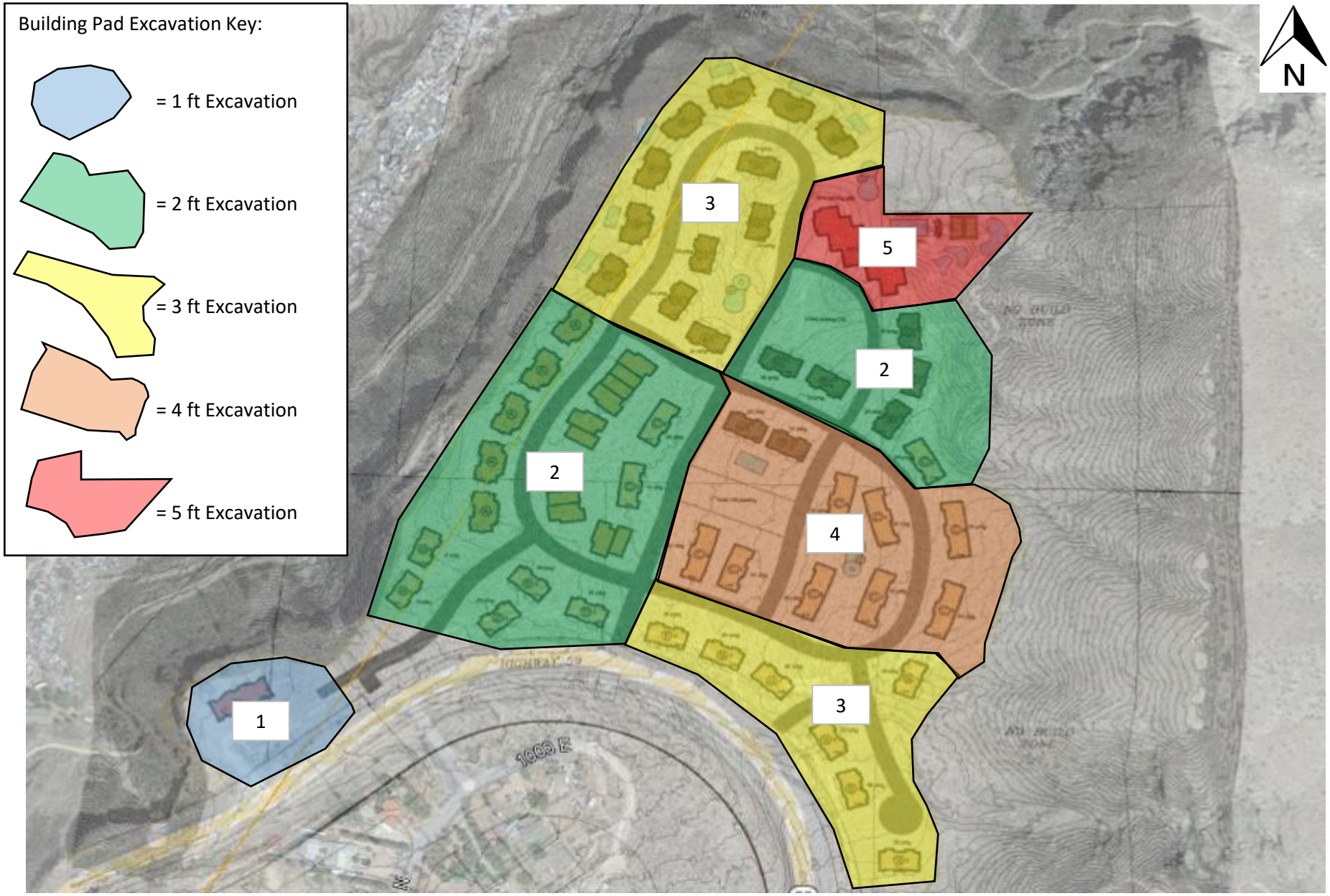
Figure 1




LANDMARK TESTING & ENGINEERING

SITE MAP
PROJECT NUMBER 210793

Figure A-2A




| | | |
|---|---|---|
| LANDMARK TESTING & ENGINEERING | SITE MAP<br>PROJECT NUMBER 210793 | Figure A-2B |

# BORING NUMBER B-1

**DATE STARTED** 9/30/21 **COMPLETED** 9/30/21 **DRILLING COMPANY** GDS **ELEVATION**

**DRILLING METHOD:** 8-inch hollow-stem auger **GROUND WATER LEVEL AT TIME OF DRILLING**

**LOGGED BY** Dave Baldazzi **CHECKED BY** Kent Nelson **GROUND WATER LEVEL ON** ---

**NOTES** **LATITUDE:** 37.18312 **LONGITUDE:** 113.27362

| DEPTH (ft) | GRAPHIC LOG | SAMPLE TYPE NUMBER | BLOWCOUNTS | MATERIAL DESCRIPTION | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | MECHANICAL GRADATION: GRAVEL (%) | MECHANICAL GRADATION: SAND (%) | MECHANICAL GRADATION: FINES (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | POORLY GRADED GRAVEL (GP), medium dense, light brown, limestone based gravel and sparse cobbles (subangular) | | | | | | | | |
| | | 1 | 50+ | SANDY SILT (ML), medium dense, dry, fine grained, abundant subangular gravel, light brown | | 3.0 | | | 8 | 32 | 60 | |
| 5 | | 2 | 46 | SILTY SAND (SM), medium dense, dry, fine to coarse grained, sparse subangular gravel up to 1 inch, reddish brown | | | | | | | | |
| 10 | | 3 | 73 | Grades with subangular limestone cobbles | 106.2 | 4.9 | | | | | | |
| | | | | POORLY GRADED GRAVEL (GP), medium dense, dry, subangular limestone cobbles up to 2 inches, gray | | | | | | | | |
| 15 | | 4 | 48 | SILTY SAND (SM), medium dense, dry, fine to coarse grained, reddish brown<br>Grinding at 18 feet | | | | | | | | |
| | | 5 | 50+ | Refusal at 19 feet in limestone<br>Bottom of borehole at 19.0 feet. | | | | | | | | |


LANDMARK TESTING & ENGINEERING

Landmark Testing & Engineering
795 East Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Fax: 435-986-0568


**PROJECT NAME** Kachina Ridge

**CLIENT** MRCI

**PROJECT NUMBER** 210793

**PROJECT LOCATION** Hurricane, Utah

**Figure No. A-3**


LANDMARK TEST HOLE - LANDMARK NEW.GDT - 11/2/21 09:06 - P:\PROJECTS\21 PROJECTS\210793 KACHINA RIDGE\GEOTECH\LOGS.GPJ

# BORING NUMBER B-2

**DATE STARTED** 9/30/21 **COMPLETED** 9/30/21 **DRILLING COMPANY** GDS **ELEVATION**

**DRILLING METHOD:** 8-inch hollow-stem auger **GROUND WATER LEVEL AT TIME OF DRILLING**

**LOGGED BY** Dave Baldazzi **CHECKED BY** Kent Nelson **GROUND WATER LEVEL ON** ---

**NOTES** **LATITUDE:** 37.18435 **LONGITUDE:** 113.27413

| DEPTH (ft) | GRAPHIC LOG | SAMPLE TYPE NUMBER | BLOWCOUNTS | MATERIAL DESCRIPTION | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | MECHANICAL GRADATION: GRAVEL (%) | MECHANICAL GRADATION: SAND (%) | MECHANICAL GRADATION: FINES (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | SILTY SAND (SM), loose, dry, fine to coarse grained, scattered subangular gravel up to 1 inch, light brown | | | | | | | | |
| | | 1 | 7 | Grades gravelly, dense, grinding from the drill rig from 2 to 2.5 feet | | | | | | | | |
| 5 | | | | Grades very loose, dry, minor coarse grained gravel, light brown | | | | | | | | |
| | | 2 | 9 | | | | | | | | | Soluble Sulfate = 3.39% |
| 10 | | | | SANDY SILT (ML), medium dense, dlightly moist, light brown | | | | | | | | |
| | | 3 | 40 | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| | | 4 | 67 | | | 6.6 | NP | NP | 0 | 10 | 90 | |
| 20 | | | | | | | | | | | | |
| | | 5 | 100 | Grades dense | 99.5 | 7.2 | | | | | | |

Bottom of borehole at 21.5 feet.


Landmark Testing & Engineering
795 East Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Fax: 435-986-0568


**PROJECT NAME** Kachina Ridge

**CLIENT** MRCI

**PROJECT NUMBER** 210793

**PROJECT LOCATION** Hurricane, Utah

**Figure No. A-4**


LANDMARK TEST HOLE - LANDMARK NEW.GDT - 11/2/21 09:06 - P:\PROJECTS\21 PROJECTS\210793 KACHINA RIDGE\GEOTECH\LOGS.GPJ

# BORING NUMBER B-3

**DATE STARTED** 9/30/21 **COMPLETED** 9/30/21 **DRILLING COMPANY** GDS **ELEVATION**

**DRILLING METHOD:** 8-inch hollow-stem auger **GROUND WATER LEVEL AT TIME OF DRILLING**

**LOGGED BY** Dave Baldazzi **CHECKED BY** Kent Nelson **GROUND WATER LEVEL ON** ---

**NOTES** **LATITUDE:** 37.18581 **LONGITUDE:** 113.27554

| DEPTH (ft) | GRAPHIC LOG | SAMPLE TYPE NUMBER | BLOWCOUNTS | MATERIAL DESCRIPTION | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | MECHANICAL GRADATION: GRAVEL (%) | MECHANICAL GRADATION: SAND (%) | MECHANICAL GRADATION: FINES (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | SILTY SAND (SM), loose, dry, minor gravel, brown | | | | | | | | |
| | | | | CALICHE, moderately well cemented, dry, light brown to white | | | | | | | | |
| | | 1 | 63 | | 99.5 | 3.5 | | | | | | |
| 5 | | 2 | 49 | Occasional subangular gravel up to 1 inch, sparse cobbles | | 5.2 | | | 18 | 41 | 41 | |
| 10 | | 3 | 52 | MUDSTONE, moderately hard, dry, abundant fine grained gypsum crystals, yellowish brown | 99.2 | 5.5 | | | | | | 0.7% Collapse @ 1000 psf |
| | | | | SILTY SAND (SM), medium dense, dry, fine grained, brown to reddish brown<br>Interbedded with silt and mudstone | | | | | | | | |
| 15 | | 4 | 31 | | | | | | | | | |
| 20 | | 5 | 31 | | | | | | | | | |

Bottom of borehole at 21.5 feet.


LANDMARK TESTING & ENGINEERING

Landmark Testing & Engineering
795 East Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Fax: 435-986-0568


**PROJECT NAME** Kachina Ridge

**CLIENT** MRCI

**PROJECT NUMBER** 210793

**PROJECT LOCATION** Hurricane, Utah

**Figure No. A-5**


LANDMARK TEST HOLE - LANDMARK NEW.GDT - 11/2/21 09:06 - P:\PROJECTS\21 PROJECTS\210793 KACHINA RIDGE\GEOTECH\LOGS.GPJ

# BORING NUMBER B-4

**DATE STARTED** 9/30/21 **COMPLETED** 9/30/21 **DRILLING COMPANY** GDS **ELEVATION**

**DRILLING METHOD:** 8-inch hollow-stem auger **GROUND WATER LEVEL AT TIME OF DRILLING**

**LOGGED BY** Dave Baldazzi **CHECKED BY** Kent Nelson **GROUND WATER LEVEL ON** ---

**NOTES** **LATITUDE:** 37.18492 **LONGITUDE:** 113.27655

| DEPTH (ft) | GRAPHIC LOG | SAMPLE TYPE NUMBER | BLOWCOUNTS | MATERIAL DESCRIPTION | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | MECHANICAL GRADATION: GRAVEL (%) | MECHANICAL GRADATION: SAND (%) | MECHANICAL GRADATION: FINES (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | SILTY SAND (SM), loose, dry, subangular gravel, light brown | | | | | | | | |
| | | 1 | 28 | Grades weakly cemented, abundant subangular gravel up to 1 inch, light brown to white | 74.7 | 5.5 | | | | | | |
| 5 | | 2 | 29 | Grades with anhedral fine gypsum | | | | | | | | |
| | | | | Grades gravelly and dense from 8 to 8.5 feet, difficult drilling | | | | | | | | |
| 10 | | | | POORLY GRADED SAND WITH SILT (SP-SM), medium dense, slightly moist, no gravel, light brown | | 1.0 | | | 0 | 91 | 9 | |
| | | 3 | 40 | MUDSTONE, soft to medium hard, light brown | 103.8 | 9.0 | | | | | | 0.2% Swell @ 1000 psf |
| | | 4 | 50+ | Basalt, dense, vesicular, difficult to drill (drills llike dense gravel | | | | | | | | |
| | | | | Refusal at 14 feet in basalt bedrock<br>Bottom of borehole at 14.0 feet. | | | | | | | | |


LANDMARK TESTING & ENGINEERING

Landmark Testing & Engineering
795 East Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Fax: 435-986-0568


**PROJECT NAME** Kachina Ridge

**CLIENT** MRCI

**PROJECT NUMBER** 210793

**PROJECT LOCATION** Hurricane, Utah

**Figure No. A-6**


LANDMARK TEST HOLE - LANDMARK NEW.GDT - 11/2/21 09:06 - P:\PROJECTS\21 PROJECTS\210793 KACHINA RIDGE\GEOTECH\LOGS.GPJ

# BORING NUMBER B-5

**DATE STARTED** 9/30/21 **COMPLETED** 9/30/21 **DRILLING COMPANY** GDS **ELEVATION**

**DRILLING METHOD:** 8-inch hollow-stem auger **GROUND WATER LEVEL AT TIME OF DRILLING**

**LOGGED BY** Dave Baldazzi **CHECKED BY** Kent Nelson **GROUND WATER LEVEL ON** ---

**NOTES** **LATITUDE:** 37.18672 **LONGITUDE:** 113.27402

| DEPTH (ft) | GRAPHIC LOG | SAMPLE TYPE NUMBER | BLOWCOUNTS | MATERIAL DESCRIPTION | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | MECHANICAL GRADATION: GRAVEL (%) | MECHANICAL GRADATION: SAND (%) | MECHANICAL GRADATION: FINES (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | POORLY GRADED GRAVEL (GP), medium dense, dry, gravel up to 2 inches, light brown | | 2.9 | | | 0 | 14 | 86 | |
| | | 1 | 26 | SANDY SILT (ML), medium dense, dry, abundant gravel, light brown to white | | | | | | | | |
| 5 | | 2 | 15 | SILTY SAND (SM), loose, , dry, fine grained, brown | | | | | | | | |
| 10 | | 3 | 32 | Grades medium dense | 95.5 | 5.6 | | | | | | |
| | | | | MUDSTONE, medium hard, dry, large gypsum vein, reddish brown | | | | | | | | |
| | | | | SILTY SAND (SM), medium dense, dry, fine grained, brown | | | | | | | | |
| 15 | | 4 | 33 | MUDSTONE, medium hard, dry, flakey, yellow brown | | 3.8 | NP | NP | 0 | 29 | 71 | |
| | | | | SILTY SAND (SM), medium dense, dry, fine grained, brown | | | | | | | | |
| 20 | | 5 | 50+ | MUDSTONE, medium hard, minor gypsum, yellow brown | 106.4 | 7.3<br>8.5 | | | 1 | 6 | 93 | 2.1% Swell @ 1000 psf |
| | | | | Refusal at 21.25 feet in basalt bedrock<br>Bottom of borehole at 21.3 feet. | | | | | | | | |


LANDMARK TESTING & ENGINEERING

Landmark Testing & Engineering
795 East Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Fax: 435-986-0568


**PROJECT NAME** Kachina Ridge

**CLIENT** MRCI

**PROJECT NUMBER** 210793

**PROJECT LOCATION** Hurricane, Utah

**Figure No. A-7**


LANDMARK TEST HOLE - LANDMARK NEW.GDT - 11/2/21 09:06 - P:\PROJECTS\21 PROJECTS\210793 KACHINA RIDGE\GEOTECH\LOGS.GPJ

# BORING NUMBER B-6

**DATE STARTED** 9/30/21 **COMPLETED** 9/30/21 **DRILLING COMPANY** GDS **ELEVATION**

**DRILLING METHOD:** 8-inch hollow-stem auger **GROUND WATER LEVEL AT TIME OF DRILLING**

**LOGGED BY** Dave Baldazzi **CHECKED BY** Kent Nelson **GROUND WATER LEVEL ON** ---

**NOTES** **LATITUDE:** 37.18692 **LONGITUDE:** 113.27334

| DEPTH (ft) | GRAPHIC LOG | SAMPLE TYPE NUMBER | BLOWCOUNTS | MATERIAL DESCRIPTION | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | MECHANICAL GRADATION: GRAVEL (%) | MECHANICAL GRADATION: SAND (%) | MECHANICAL GRADATION: FINES (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 1 | 22 | POORLY GRADED GRAVEL (GP), loose to medium dense, dry, gravel up to 2 inches (limestone gravel), gray | | | | | | | | |
| 5 | | 2 | 13 | SILTY SAND (SM), medium dense, dry, fine grained, light brown<br>Grades with minor gypsum | 97.2 | 1.5<br>4.6 | | | 3 | 60 | 37 | |
| 10 | | 3 | 41 | MUDSTONE, moderately hard, dry, flaky, gypsum veins<br>SILTY SAND (SM), medium dense, dry, fine grained, brown | | 3.4 | | | 1 | 59 | 40 | |
| | | 4 | 50+ | Refusal at 14 feet in basalt bedrock<br>Bottom of borehole at 14.0 feet. | | | | | | | | |


LANDMARK TESTING & ENGINEERING

Landmark Testing & Engineering
795 East Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Fax: 435-986-0568


**PROJECT NAME** Kachina Ridge

**CLIENT** MRCI

**PROJECT NUMBER** 210793

**PROJECT LOCATION** Hurricane, Utah

**Figure No. A-8**


LANDMARK TEST HOLE - LANDMARK NEW.GDT - 11/2/21 09:06 - P:\PROJECTS\21 PROJECTS\210793 KACHINA RIDGE\GEOTECH\LOGS.GPJ

# BORING NUMBER B-7

**DATE STARTED** 9/30/21 **COMPLETED** 9/30/21 **DRILLING COMPANY** GDS **ELEVATION**

**DRILLING METHOD:** 8-inch hollow-stem auger **GROUND WATER LEVEL AT TIME OF DRILLING**

**LOGGED BY** Dave Baldazzi **CHECKED BY** Kent Nelson **GROUND WATER LEVEL ON** ---

**NOTES** **LATITUDE:** 37.18535 **LONGITUDE:** 113.27334

| DEPTH (ft) | GRAPHIC LOG | SAMPLE TYPE NUMBER | BLOWCOUNTS | MATERIAL DESCRIPTION | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | MECHANICAL GRADATION: GRAVEL (%) | MECHANICAL GRADATION: SAND (%) | MECHANICAL GRADATION: FINES (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | SILTY SAND (SM), loose, dry, fine to coarse grained, abundant gravel, brown | | | | | | | | |
| | | | | SANDY SILT (ML), very dense, dry, limestone gravel, gray | | | | | | | | |
| | | 1 | 50+ | | | | | | | | | |
| | | | | Grades light reddish brown, minor gypsum | | | | | | | | |
| 5 | | 2 | 91 | | | 7.7 | | | 10 | 27 | 63 | |
| | | | | SILTY SAND (SM), dense to very dense, slightly moist, gravelly | | | | | | | | |
| 10 | | 3 | 50+ | Grades with limestone cobbles | | 4.8 | | | 18 | 35 | 47 | |
| | | | | SILTY SAND (SM), medium dense to dense, dry, fine to coarse grained, reddish brown | | | | | | | | |
| 15 | | 4 | 50+ | Grades cobbly from 15.5 to 16 feet<br>Grades very dense, fine to coarse grained, dry, reddish brown | 108.2 | 1.8 | | | | | | |
| | | | | Grades fine grained | | | | | | | | |
| 20 | | 5 | 50 | | 95.0 | 3.4 | | | | | | 3.9% Collapse @ 2000 psf |

Bottom of borehole at 21.5 feet.


LANDMARK TESTING & ENGINEERING

Landmark Testing & Engineering
795 East Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Fax: 435-986-0568


**PROJECT NAME** Kachina Ridge

**CLIENT** MRCI

**PROJECT NUMBER** 210793

**PROJECT LOCATION** Hurricane, Utah

**Figure No. A-9**


LANDMARK TEST HOLE - LANDMARK NEW.GDT - 11/2/21 09:06 - P:\PROJECTS\21 PROJECTS\210793 KACHINA RIDGE\GEOTECH\LOGS.GPJ

# TEST PIT NUMBER TP-1

**DATE STARTED** 10/1/21 **COMPLETED** 10/1/21 **EXCAVATION COMPANY** Redline **ELEVATION**

**LOGGED BY** Dave Baldazzi **CHECKED BY** Kent Nelson **EXCAVATION METHOD** CAT 306 Mini-ex

**NOTES** **AT TIME OF EXCAVATION** ---

| DEPTH (ft) | GRAPHIC LOG | SAMPLE TYPE NUMBER | MATERIAL DESCRIPTION | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | MECHANICAL GRADATION: GRAVEL (%) | MECHANICAL GRADATION: SAND (%) | MECHANICAL GRADATION: FINES (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | TOPSOIL, silty sand, loose, dry, fine to coarse grained, roots to 2.5 feet, brown | | | | | | | | |
| | | | Caliche cemented sand, lightly to moderately cemented, dry, light brown to white | | | | | | | | |
| | | | SILTY SAND (SM), medium dense to dense, dry, fine grained, light brown | | | | | | | | |
| 5 | | | Grades with gypsum crystals, light brown to white | | 11.6 | | | 2 | 49 | 49 | |

Bottom of test pit at 8.5 feet.

# TEST PIT NUMBER TP-2

**DATE STARTED** 10/1/21 **COMPLETED** 10/1/21 **EXCAVATION COMPANY** Redline **ELEVATION**

**LOGGED BY** Dave Baldazzi **CHECKED BY** Kent Nelson **EXCAVATION METHOD** CAT 306 Mini-ex

**NOTES** **AT TIME OF EXCAVATION** ---

| DEPTH (ft) | GRAPHIC LOG | SAMPLE TYPE NUMBER | MATERIAL DESCRIPTION | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | MECHANICAL GRADATION: GRAVEL (%) | MECHANICAL GRADATION: SAND (%) | MECHANICAL GRADATION: FINES (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | TOPSOIL, silty sand, medium dense, dry, fine to coarse grained, abundant cobbles and large rocks | | | | | | | | |
| | | | SILTY SAND (SM), loose, dry, fine grained, roots, minor pinholes, light brown | | 3.4 | | | 2 | 50 | 48 | |
| | | | Grades fine grained, loose, minor pinholes, light brown | | | | | | | | |
| 5 | | | SILTY GRAVEL WITH SAND (GM), medium dense, dry, abundant gravl and cobbles, sparse boulders | | | | | | | | |

Refusal at 6 ft in limestone bedrock
Bottom of test pit at 6.0 feet.

LANDMARK TESTING & ENGINEERING
Landmark Testing & Engineering
795 East Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Fax: 435-986-0568

**PROJECT NAME** Kachina Ridge
**CLIENT** MRCI
**PROJECT NUMBER** 210793
**PROJECT LOCATION** Hurricane, Utah

**Figure No. A-10**

LANDMARK 2 TEST PITS - LANDMARK NEW.GDT - 11/2/21 09:07 - P:\PROJECTS\21 PROJECTS\210793 KACHINA RIDGE\GEOTECH\LOGS.GPJ

# TEST PIT NUMBER TP-3

**DATE STARTED** 10/1/21 **COMPLETED** 10/1/21 **EXCAVATION COMPANY** Redline **ELEVATION** ---

**LOGGED BY** Dave Baldazzi **CHECKED BY** Kent Nelson **EXCAVATION METHOD** CAT 306 Mini-ex

**NOTES** --- **AT TIME OF EXCAVATION** ---

| DEPTH (ft) | GRAPHIC LOG | SAMPLE TYPE NUMBER | MATERIAL DESCRIPTION | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | MECHANICAL GRADATION: GRAVEL (%) | MECHANICAL GRADATION: SAND (%) | MECHANICAL GRADATION: FINES (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | FILL: SILTY SAND (SM), loose, dry to slightly moist, fine to coarse grained, brown | | | | | | | | |
| 5 | | | NATIVE: POORLY GRADED SAND (SP), loose, dry to slightly miost, light brown<br>Grades with gypsum<br>Grades with gravel up to 1 inch | | | | | | | | |

Bottom of test pit at 9.0 feet.

# TEST PIT NUMBER TP-4

**DATE STARTED** 10/1/21 **COMPLETED** 10/1/21 **EXCAVATION COMPANY** Redline **ELEVATION** ---

**LOGGED BY** Dave Baldazzi **CHECKED BY** Kent Nelson **EXCAVATION METHOD** CAT 306 Mini-ex

**NOTES** --- **AT TIME OF EXCAVATION** ---

| DEPTH (ft) | GRAPHIC LOG | SAMPLE TYPE NUMBER | MATERIAL DESCRIPTION | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | MECHANICAL GRADATION: GRAVEL (%) | MECHANICAL GRADATION: SAND (%) | MECHANICAL GRADATION: FINES (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | FILL: SILTY SAND (SM), loose to medium dense, dry, medium to coarse grained, light brown | | | | | | | | |

Stopped at 2 feet at underground utilities

Bottom of test pit at 2.0 feet.


LANDMARK TESTING & ENGINEERING

Landmark Testing & Engineering
795 East Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Fax: 435-986-0568


**PROJECT NAME** Kachina Ridge

**CLIENT** MRCI

**PROJECT NUMBER** 210793

**PROJECT LOCATION** Hurricane, Utah

**Figure No. A-11**


LANDMARK 2 TEST PITS - LANDMARK NEW.GDT - 11/2/21 09:07 - P:\PROJECTS\21 PROJECTS\210793 KACHINA RIDGE\GEOTECH\LOGS.GPJ

# TEST PIT NUMBER TP-5

**DATE STARTED** 10/1/21 **COMPLETED** 10/1/21 **EXCAVATION COMPANY** Redline **ELEVATION**

**LOGGED BY** Dave Baldazzi **CHECKED BY** Kent Nelson **EXCAVATION METHOD** CAT 306 Mini-ex

**NOTES** **AT TIME OF EXCAVATION** ---

| DEPTH (ft) | GRAPHIC LOG | SAMPLE TYPE NUMBER | MATERIAL DESCRIPTION | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | MECHANICAL GRADATION | | | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | LIQUID LIMIT | PLASTICITY INDEX | GRAVEL (%) | SAND (%) | FINES (%) | |
| 0 | | | TOPSOIL (SM), SILTY SAND WITH GRAVEL (SM), loose, dry, fine to coarse grained, minor roots, light brown | | | | | | | | |
| | | | SILTY SAND (SM), medium dense, dry, fine grained, minor pinholes, ligjht brown | | | | | | | | |
| | | | CALICHE, lightly to moderately well cemented, abundant pinholes, light brown to white | | | | | | | | |
| | | | Refusal at 2.5 feet in basalt bedrock<br>Bottom of test pit at 2.5 feet. | | | | | | | | |

LANDMARK TESTING & ENGINEERING

Landmark Testing & Engineering
795 East Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Fax: 435-986-0568

**PROJECT NAME** Kachina Ridge

**CLIENT** MRCI

**PROJECT NUMBER** 210793

**PROJECT LOCATION** Hurricane, Utah

**Figure No. A-12**

LANDMARK 2 TEST PITS - LANDMARK NEW.GDT - 11/2/21 09:07 - P:\PROJECTS\21 PROJECTS\210793 KACHINA RIDGE\GEOTECH\LOGS.GPJ

# UNIFIED SOIL CLASSIFICATION SYSTEM

| MAJOR DIVISIONS | | SYMBOLS | TYPICAL NAMES |
|---|---|---|---|
| COARSE-GRAINED SOILS (More than 50% of soil Retained on No. 200 sieve size) | GRAVELS More than 1/2 of coarse fraction > No.4 sieve size | GW | Well graded gravels or gravel-sand mixtures little or no fines. |
| | | GP | Poorly graded gravels or gravel-sand mixtures little or no fines. |
| | | GM | Silty gravels, gravel-sand-silt mixtures |
| | | GC | Clayey gravels, gravel-sand-clay mixtures |
| | SANDS More than 1/2 of coarse fraction < No.4 sieve size | SW | Well graded sands or gravelly sand mixtures little or no fines. |
| | | SP | Poorly graded sands or gravelly sand mixtures little or no fines. |
| | | SM | Silty sands, sand-silt mixtures |
| | | SC | Clayey sands, sand-clay mixtures |
| FINE-GRAINED SOILS (Less than 50% of soil Retained on No. 200 sieve size) | SILTS & CLAYS Liquid Limit < 50 | ML | Inorganic silts and very fine sands, rock flour, silty fine sands or clayey silts with slight plasticity |
| | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. |
| | | OL | Organic silts and organic silty clays of low plasticity |
| | SILTS & CLAYS Liquid Limit > 50 | MH | Inorganic silts, micaceous of diatomaceous fine sand or silty soils, elastic silts |
| | | CH | Inorganic clays of high plasticity, fat clays |
| | | OH | Organic clays of medium to high plasticity, organic silty clays, organic silts |
| HIGHLY ORGANIC SOILS | | PT | Peat and other highly organic soils |

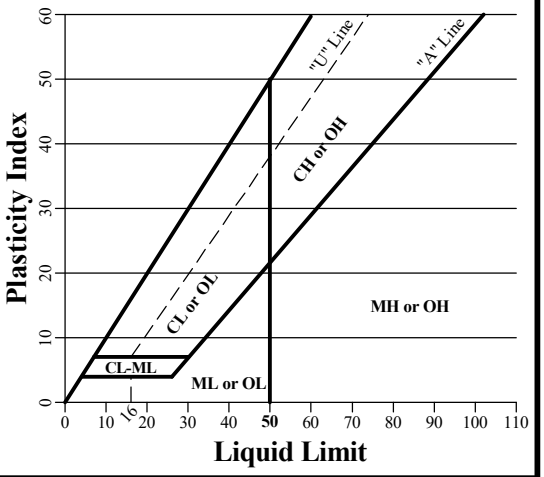
## GRAIN SIZE CHART

| CLASSIFICATION | Range of Grain Size: U.S. Standard Sieve Size | Range of Grain Size: Grain Size in Millimeters |
|---|---|---|
| **BOULDERS** | **Above 12"** | **Above 305** |
| **COBBLES** | **12" to 3"** | **305 to 76.2** |
| **GRAVEL** | **3" to No. 4** | **76.2 to 4.76** |
| Coarse | 3" to 3/4" | 76.2 to 19.1 |
| Fine | 3/4" to No. 4 | 19.1 to 4.76 |
| **SAND** | **No. 4 to No. 200** | **4.76 to 0.074** |
| Coarse | No. 4 to No. 10 | 4.76 to 2.00 |
| Medium | No. 10 to No. 40 | 2.00 to 0.42 |
| Fine | No. 40 to No. 200 | 0.420 to 0.074 |
| **SILT & CLAY** | Below No. 200 | Below 0.074 |

## SAMPLES

- Relatively Undisturbed Sample
- Block Sample
- Bag Sample
- Auger Cuttings
- B — Bucket Sample
- Core
- No Recovery

## PLASTICITY CURVE





LANDMARK TESTING & ENGINEERING

Landmark Testing & Engineering
795 East Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Fax: 435-986-0568


**PROJECT NAME** Kachina Ridge

**CLIENT** MRCI

**PROJECT NUMBER** 210793

**PROJECT LOCATION** Hurricane, Utah

**Figure No. A-13**


USCS SUMMARY - LANDMARK NEW.GDT - 11/2/21 09:07 - P:\PROJECTS\21 PROJECTS\210793 KACHINA RIDGE\GEOTECH\LOGS.GPJ

LANDMARK TESTING & ENGINEERING

# SUMMARY OF LABORATORY TEST RESULTS

**Client:** MCRI
782 South River Road # 289
St. George, Utah 84790

**Date of Report:** 10/29/2021

**Project:** Kachina Ridge

**Project #:** 210793

**Location:** Hurricane, Utah

| Test Pit / Boring Number | Depth Below Ground Surface (ft) | Blowcount | Moisture Content (%)* | In-Place Dry Desnity (pcf) | Mechanical Gradation | | | Atterberg Limits | | Swell-Consolidation Swell/Collapse @ Wetting Load (S/C @ psf) | Modified Proctor / CBR | | | Percent Finer Than 0.02 mm (%) | Sooluble Sulfate Content (%) | USCS Group Symbol |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Gravel (%) | Sand (%) | Fines (%) | Liquid Limit | Plasticity Index | | Maximum Dry Density (pcf) | Optimum Moisture Content (%) | CBR | | | |
| B-1 | 2.5 | 50+ | 3.0 | | 8 | 32 | 60 | | | | | | | | | ML |
| | 5.0 | 46 | | | | | | | | | | | | | | |
| | 10.0 | 73 | 4.9 | 106.2 | | | | | | | | | | | | |
| | 15.0 | 48 | | | | | | | | | | | | | | |
| | 19.0 | 50 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| B-2 | 2.5 | 7 | | | | | | | | | | | | | | |
| | 5.0 | 9 | | | | | | | | | | | | | 3.39 | |
| | 10.0 | 40 | | | | | | | | | | | | | | |
| | 15.0 | 67 | 6.6 | | 0 | 10 | 90 | NP | NP | | | | | | | ML |
| | 20.0 | 100 | 7.2 | 99.5 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| B-3 | 2.5 | 63 | 3.5 | 99.5 | | | | | | | | | | | | |
| | 5.0 | 49 | 5.2 | | 18 | 41 | 41 | | | | | | | | | SM |
| | 10.0 | 52 | 5.5 | 99.2 | | | | | | 0.7% C @ 1000 | | | | | | |
| | 15.0 | 31 | | | | | | | | | | | | | | |
| | 20.0 | 31 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| B-4 | 2.5 | 28 | 5.5 | 74.7 | | | | | | | | | | | | |
| | 5.0 | 29 | | | | | | | | | | | | | | |
| | 10.0 | 40 | 1.0 | | 0 | 91 | 9 | | | | | | | | | SP-SM |
| | 11.0 | 40 | 9.0 | 103.8 | | | | | | 0.2% S @ 1000 | | | | | | Mudstone |
| | 14.0 | 50+ | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| B-5 | 2.5 | 26 | 2.9 | | 0 | 14 | 86 | | | | | | | | | ML |
| | 5.0 | 15 | | | | | | | | | | | | | | |
| | 10.0 | 32 | 5.6 | 95.5 | | | | | | | | | | | | |
| | 15.0 | 33 | 3.8 | | 0 | 29 | 71 | NP | NP | | | | | | | ML |
| | 20.0 | 50+ | 8.5 | 106.4 | 1 | 6 | 93 | | | 2.1% S @ 1000 | | | | | | Mudstone |
| | | | | | | | | | | | | | | | | |
| B-6 | 2.5 | 22 | 1.5 | 97.2 | | | | | | | | | | | | |
| | 5.0 | 13 | 4.6 | | 3 | 60 | 37 | | | | | | | | | SM |
| | 10.0 | 41 | 3.4 | | 1 | 59 | 40 | | | | | | | | | SM |
| | 15.0 | 50+ | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| B-7 | 2.5 | 50+ | | | | | | | | | | | | | | |
| | 5.0 | 91 | 7.7 | | 10 | 27 | 63 | | | | | | | | | ML |
| | 10.0 | 50+ | 4.8 | | 18 | 35 | 47 | | | | | | | | | SM |
| | 15.0 | 50+ | 1.8 | 108.2 | | | | | | | | | | | | |
| | 20.0 | 50 | 3.4 | 95.0 | | | | | | 3.9% C @ 2000 | | | | | | |
| | | | | | | | | | | | | | | | | |
| TP-1 | 6.0 | 12 | | | 2 | 49 | 49 | | | | | | | | | SM |
| | | | | | | | | | | | | | | | | |
| Tp-2 | 2.5 | 3 | | | 2 | 50 | 48 | | | | | | | | | SM |

FIGURE A-14

# Appendix B

LANDMARK TESTING & ENGINEERING

# CONSOLIDATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/25/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4944

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** SM **Tested By:** J. Bracken **Date:** 10/18/2021
**Location of Sample:** Boring 3 at 10.5' **Authorized By:** Client **Date:** 9/30/2021

## COLLAPSE/SWELL CURVE

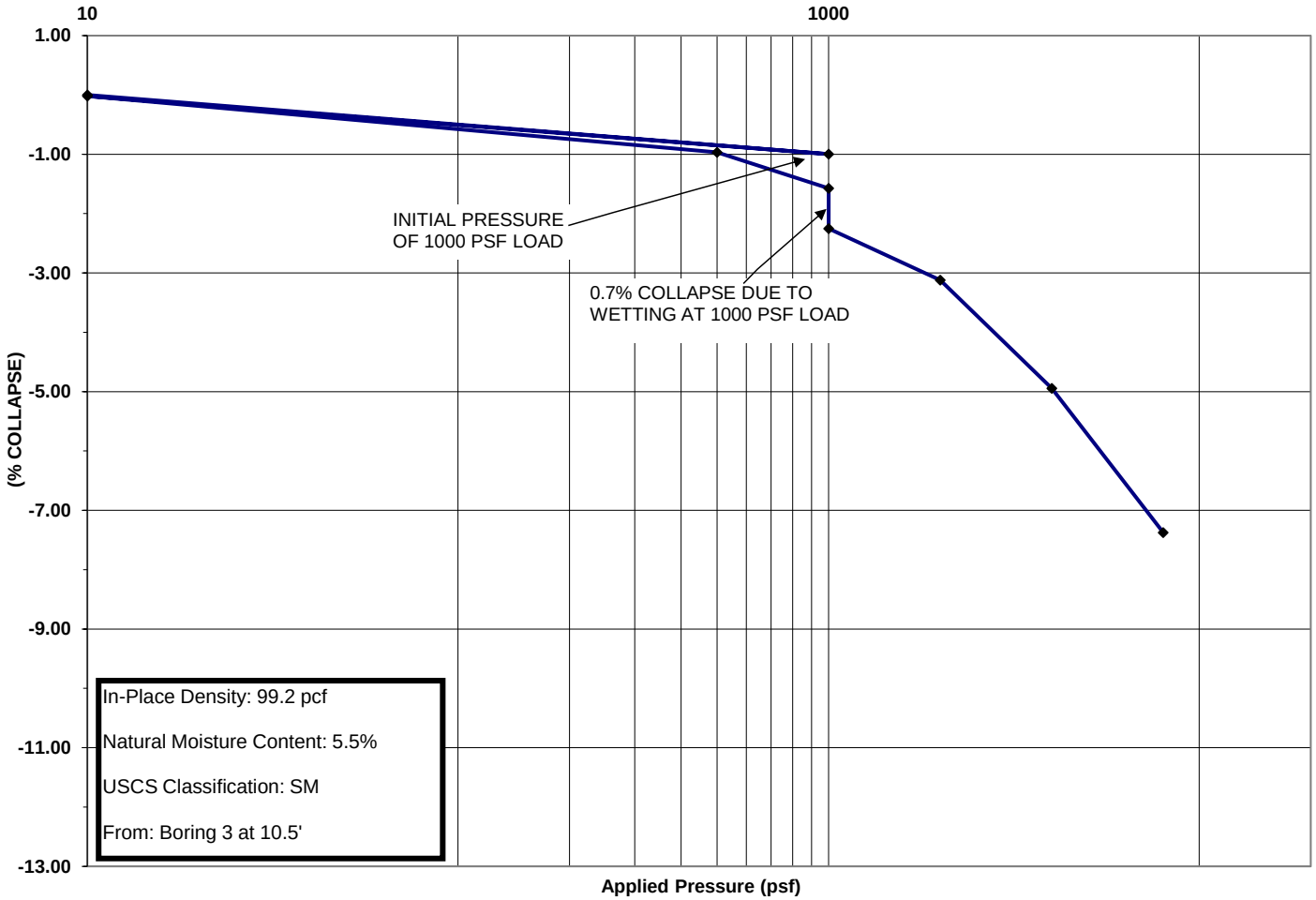



Figure B-1

LANDMARK TESTING & ENGINEERING

# CONSOLIDATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/27/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4942

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** CL **Tested By:** J. Bracken **Date:** 10/20/2021
**Location of Sample:** Boring 4 at 11-11.5' **Authorized By:** Client **Date:** 9/30/2021

## COLLAPSE/SWELL CURVE

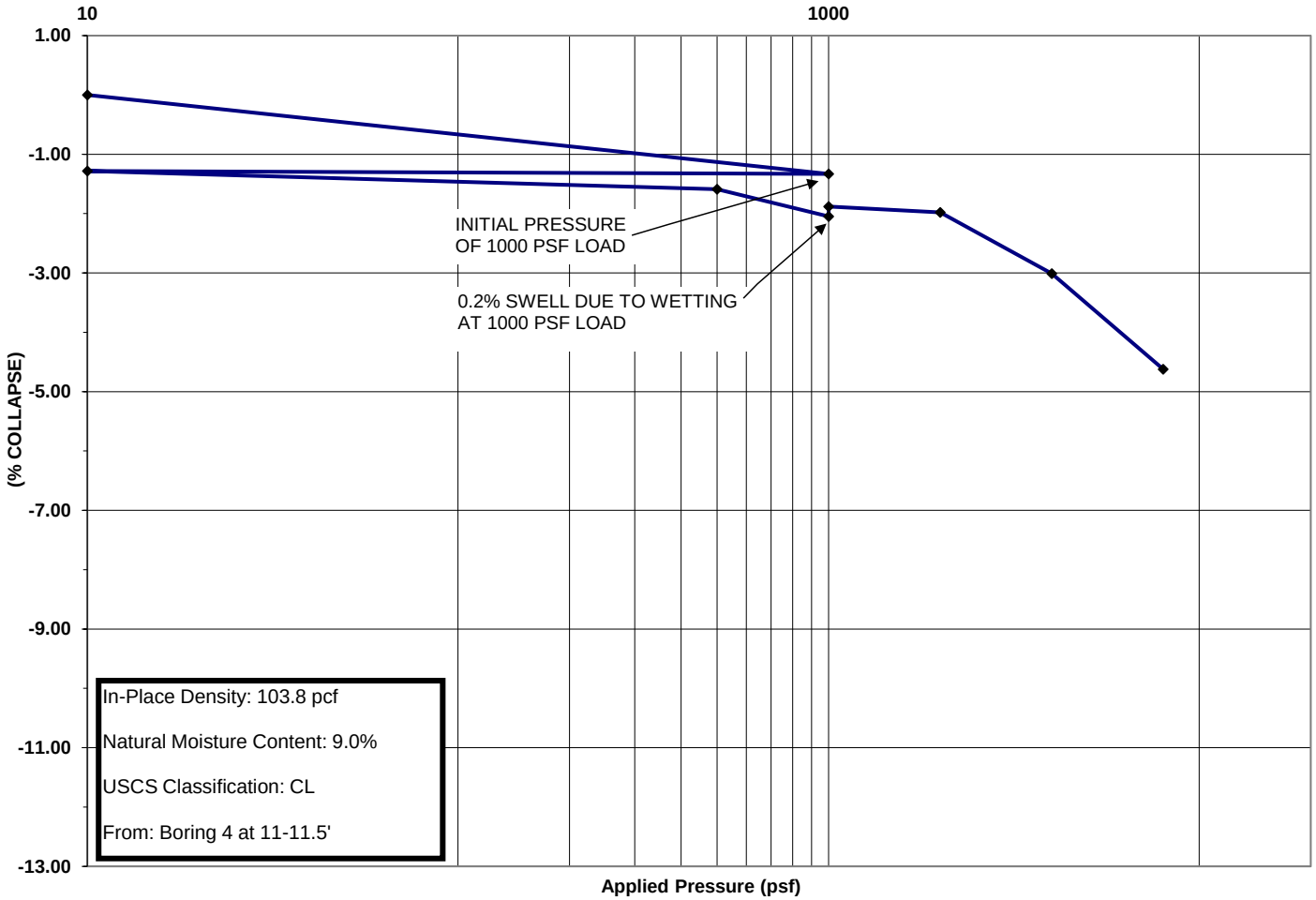



Figure B-2

LANDMARK TESTING & ENGINEERING

# CONSOLIDATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/26/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4946

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** K. Nelson **Date:** 9/30/2021
**Type of Sample:** CL **Tested By:** J. Bracken **Date:** 10/19/2021
**Location of Sample:** Boring 5 at 21-21.5' **Authorized By:** Client **Date:** 9/30/2021

## COLLAPSE/SWELL CURVE

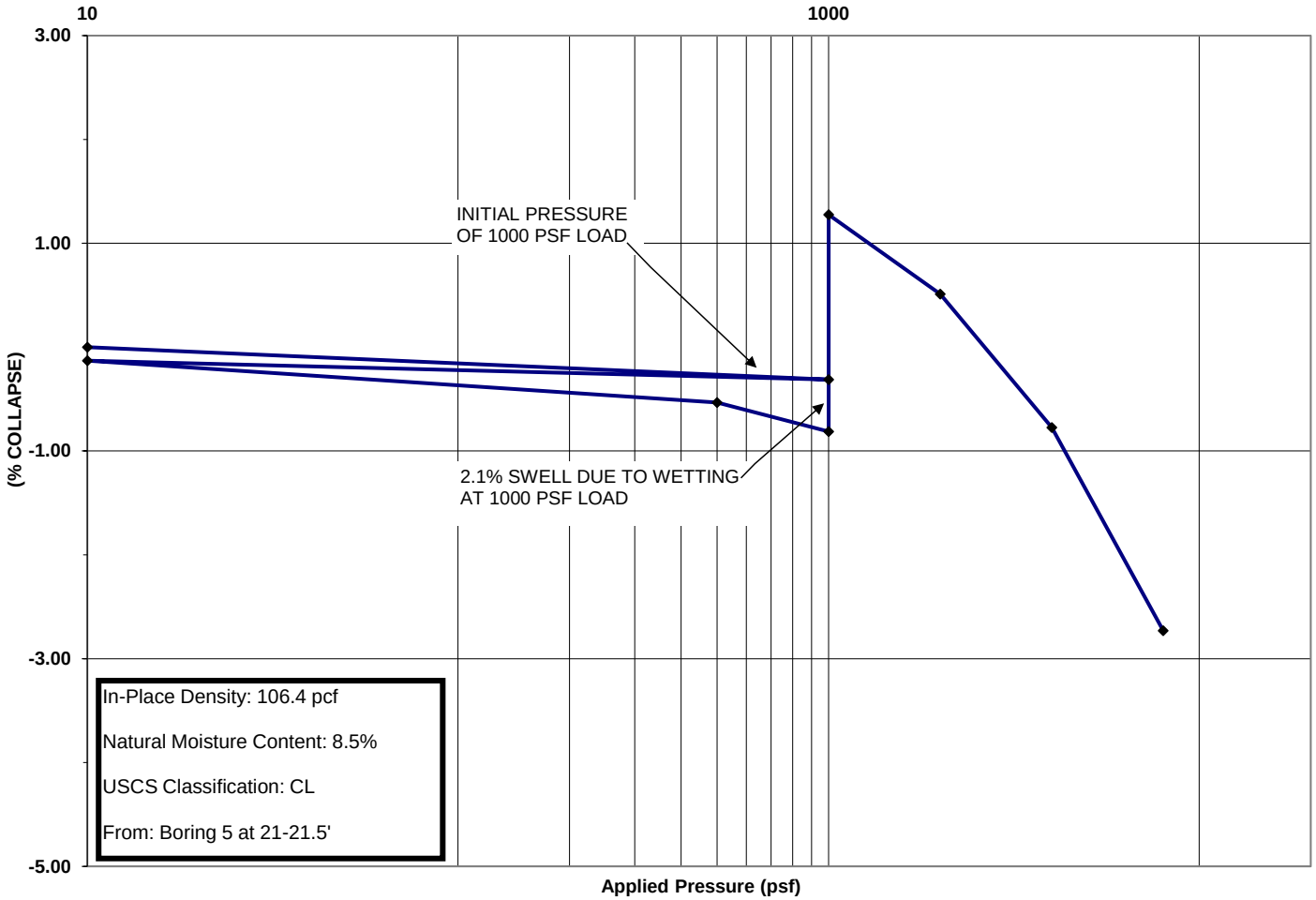



Figure B-3

LANDMARK TESTING & ENGINEERING

# CONSOLIDATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/26/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4936

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** K. Nelson **Date:** 9/30/2021
**Type of Sample:** SM **Tested By:** J. Bracken **Date:** 10/19/2021
**Location of Sample:** Boring 7 at 21' **Authorized By:** Client **Date:** 9/30/2021

## COLLAPSE/SWELL CURVE

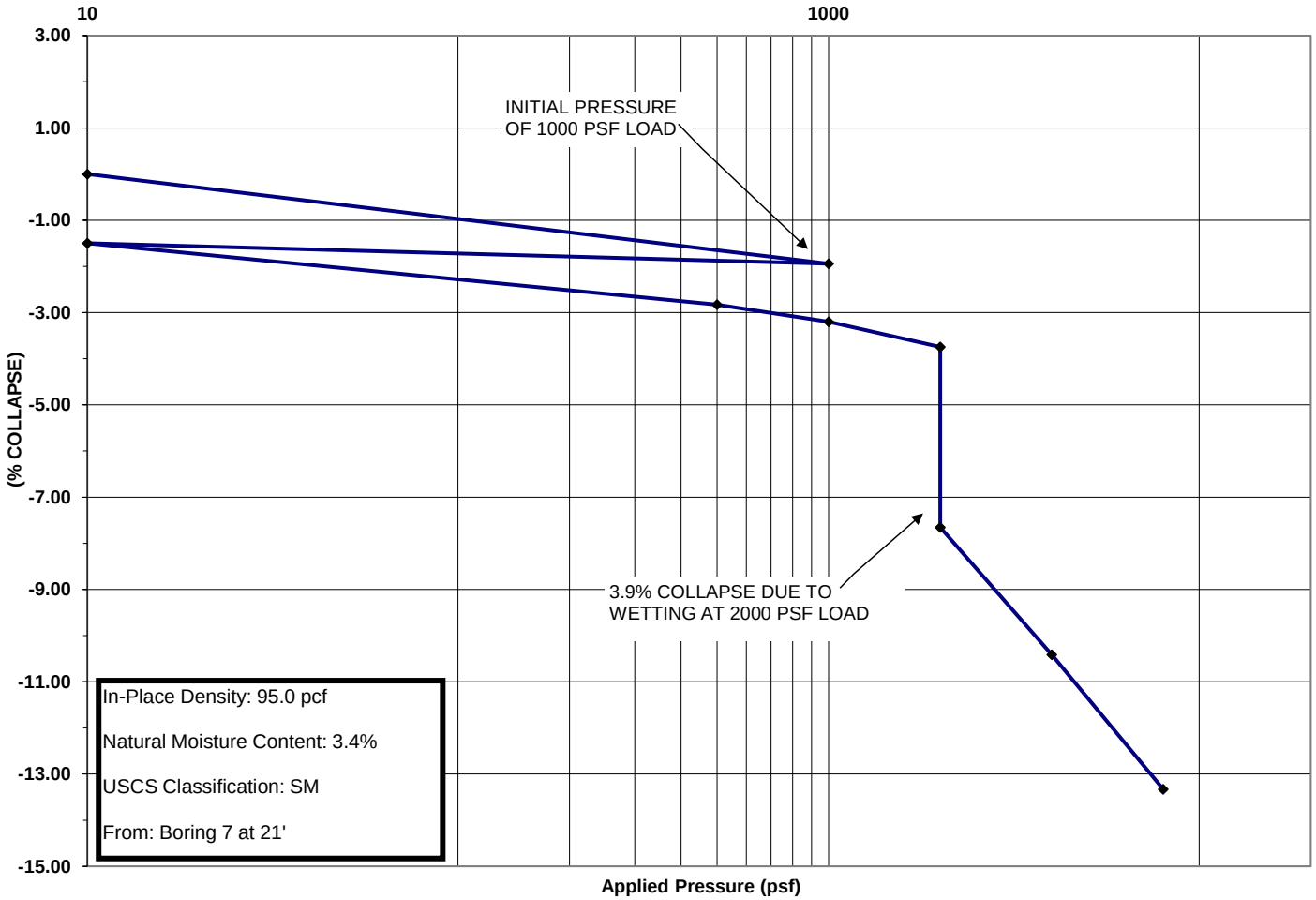



Figure B-4

LANDMARK TESTING & ENGINEERING

# UNIT WEIGHT REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/15/2021
**Reviewed By:** Z. Girsberger

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Tested By:** N. Deschamps **Date:** 10/13/2021

| | | | | | |
|---|---|---|---|---|---|
| **Location of Sample:** | Boring 1 at 11' | | | **Lab #:** | 21SG4935 |
| Mass of Sleeve & Wet Soil, g: | 1062.0 | Mass of tare & wet soil: | 922.2 | Wet Density, pcf: | 111.4 |
| Mass of Sleeve, g: | 258.2 | Mass of tare & dry soil: | 884.9 | Dry Density, pcf: | 106.2 |
| Diameter of Sleeve, Inch: | 2.421 | Mass of tare: | 125.61 | % Moisture: | 4.9 |
| Length of Sleeve, inch: | 5.972 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Location of Sample:** | Boring 2 at 21' | | | **Lab #:** | 21SG4939 |
| Mass of Sleeve & Wet Soil, g: | 1018.63 | Mass of tare & wet soil: | 1283.9 | Wet Density, pcf: | 106.6 |
| Mass of Sleeve, g: | 247.9 | Mass of tare & dry soil: | 1232.5 | Dry Density, pcf: | 99.5 |
| Diameter of Sleeve, Inch: | 2.420 | Mass of tare: | 515.32 | % Moisture: | 7.2 |
| Length of Sleeve, inch: | 5.989 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Location of Sample:** | Boring 3 at 3.5' | | | **Lab #:** | 21SG4940 |
| Mass of Sleeve & Wet Soil, g: | 967.17 | Mass of tare & wet soil: | 1261.01 | Wet Density, pcf: | 103.2 |
| Mass of Sleeve, g: | 218.83 | Mass of tare & dry soil: | 1233.9 | Dry Density, pcf: | 99.5 |
| Diameter of Sleeve, Inch: | 2.421 | Mass of tare: | 513.1 | % Moisture: | 3.8 |
| Length of Sleeve, inch: | 5.999 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Location of Sample:** | Boring 4 at 3' | | | **Lab #:** | 21SG4943 |
| Mass of Sleeve & Wet Soil, g: | 834.67 | Mass of tare & wet soil: | 697.03 | Wet Density, pcf: | 78.8 |
| Mass of Sleeve, g: | 265.35 | Mass of tare & dry soil: | 667.5 | Dry Density, pcf: | 74.7 |
| Diameter of Sleeve, Inch: | 2.422 | Mass of tare: | 127.8 | % Moisture: | 5.5 |
| Length of Sleeve, inch: | 5.972 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Location of Sample:** | Boring 5 at 11' | | | **Lab #:** | 21SG4947 |
| Mass of Sleeve & Wet Soil, g: | 990.5 | Mass of tare & wet soil: | 1256.1 | Wet Density, pcf: | 100.8 |
| Mass of Sleeve, g: | 258.3 | Mass of tare & dry soil: | 1217 | Dry Density, pcf: | 95.5 |
| Diameter of Sleeve, Inch: | 2.421 | Mass of tare: | 513.67 | % Moisture: | 5.6 |
| Length of Sleeve, inch: | 6.012 | | | | |

**Figure B-5**

LANDMARK TESTING & ENGINEERING

# UNIT WEIGHT REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/15/2021
**Reviewed By:** Z. Girsberger

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Tested By:** N. Deschamps **Date:** 10/13/2021

| | | | | | |
|---|---|---|---|---|---|
| **Location of Sample:** | Boring 6 at 4' | | | **Lab #:** | 21SG4950 |
| Mass of Sleeve & Wet Soil, g: | 970.8 | Mass of tare & wet soil: | 1224.6 | Wet Density, pcf: | 98.7 |
| Mass of Sleeve, g: | 257.6 | Mass of tare & dry soil: | 1214.1 | Dry Density, pcf: | 97.2 |
| Diameter of Sleeve, Inch: | 2.420 | Mass of tare: | 511.4 | % Moisture: | 1.5 |
| Length of Sleeve, inch: | 5.987 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Location of Sample:** | Boring 7 at 15.5' | | | **Lab #:** | 21SG4955 |
| Mass of Sleeve & Wet Soil, g: | 1014.23 | Mass of tare & wet soil: | 877.44 | Wet Density, pcf: | 110.1 |
| Mass of Sleeve, g: | 256.4 | Mass of tare & dry soil: | 864.4 | Dry Density, pcf: | 108.2 |
| Diameter of Sleeve, Inch: | 2.421 | Mass of tare: | 119.91 | % Moisture: | 1.8 |
| Length of Sleeve, inch: | 5.696 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Location of Sample:** | | | | **Lab #:** | |
| Mass of Sleeve & Wet Soil, g: | | Mass of tare & wet soil: | | Wet Density, pcf: | |
| Mass of Sleeve, g: | | Mass of tare & dry soil: | | Dry Density, pcf: | |
| Diameter of Sleeve, Inch: | | Mass of tare: | | % Moisture: | |
| Length of Sleeve, inch: | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Location of Sample:** | | | | **Lab #:** | |
| Mass of Sleeve & Wet Soil, g: | | Mass of tare & wet soil: | | Wet Density, pcf: | |
| Mass of Sleeve, g: | | Mass of tare & dry soil: | | Dry Density, pcf: | |
| Diameter of Sleeve, Inch: | | Mass of tare: | | % Moisture: | |
| Length of Sleeve, inch: | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Location of Sample:** | | | | **Lab #:** | |
| Mass of Sleeve & Wet Soil, g: | | Mass of tare & wet soil: | | Wet Density, pcf: | |
| Mass of Sleeve, g: | | Mass of tare & dry soil: | | Dry Density, pcf: | |
| Diameter of Sleeve, Inch: | | Mass of tare: | | % Moisture: | |
| Length of Sleeve, inch: | | | | | |

**Figure B-6**

LANDMARK TESTING & ENGINEERING

# WATER-SOLUBLE SULFATE IN SOIL

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/15/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4937

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Tan Silty Sand **Tested By:** N. Deschamps **Date:** 10/15/2021
**Location of Sample:** Boring 2 at 6' **Authorized By:** Client **Date:** 9/30/2021

| Test | Result % | Exposure Class | Test Standard |
|---|---|---|---|
| **Percent Water-Soluble Sulfate in Soil** | 3.39 | S3 | ASTM C1580 |

**Figure B-7**

# SOIL CLASSIFICATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/15/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4938

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Tan Silt **Tested By:** N. Deschamps **Date:** 10/14/2021
**Location of Sample:** Boring 2 at 16' **Authorized By:** Client **Date:** 9/30/2021

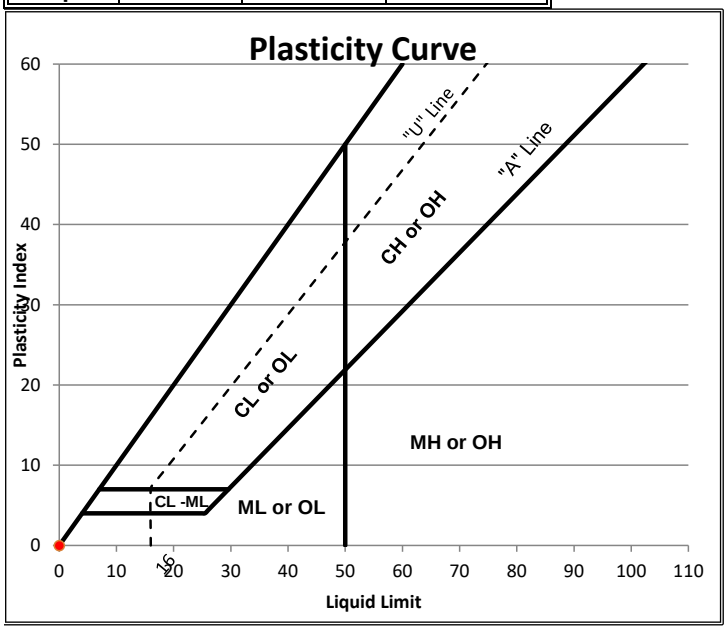
**Sieve Analysis , ASTM C136 and C117**

| Sieve Size | | % Passing Cumulative | Specification |
|---|---|---|---|
| 150 mm | 6" | | |
| 75 mm | 3" | | |
| 50 mm | 2" | | |
| 37.5 mm | 1-1/2" | | |
| 25 mm | 1" | | |
| 19 mm | 3/4" | | |
| 12.5 mm | 1/2" | | |
| 9.5 mm | 3/8" | | |
| 4.75 mm | #4 | 100 | |
| 2.00 mm | #10 | 100 | |
| 1.18 mm | #16 | 100 | |
| 425 µm | #40 | 99 | |
| 300 µm | #50 | 99 | |
| 75 µm | #200 | 89.6 | |

| Test | Result | Specification | Test Standard |
|---|---|---|---|
| Natural Moisture Content, % | 6.6 | | ASTM D 2216 |
| Liquid Limit | NP | | ASTM D 4318 |
| Plasticity Index | NP | | ASTM D 4318 |
| Unified Classification System | ML | | ASTM D 2487 |
| AASHTO Classification System | A-4(0) | | AASHTO M145 |

| % Cobble > 3" | % Gravel < 3" - #4 | % Sand < #4 - #200 | % Silt-Clay < #200 |
|---|---|---|---|
| 0.0 | 0.0 | 10.4 | 89.6 |

| Diameter $D_{60}$ | Diameter $D_{30}$ | Diameter $D_{10}$ | Coefficient of Uniformity, $C_U$ | Coefficient of Concavity, $C_C$ |
|---|---|---|---|---|
| | | | | |



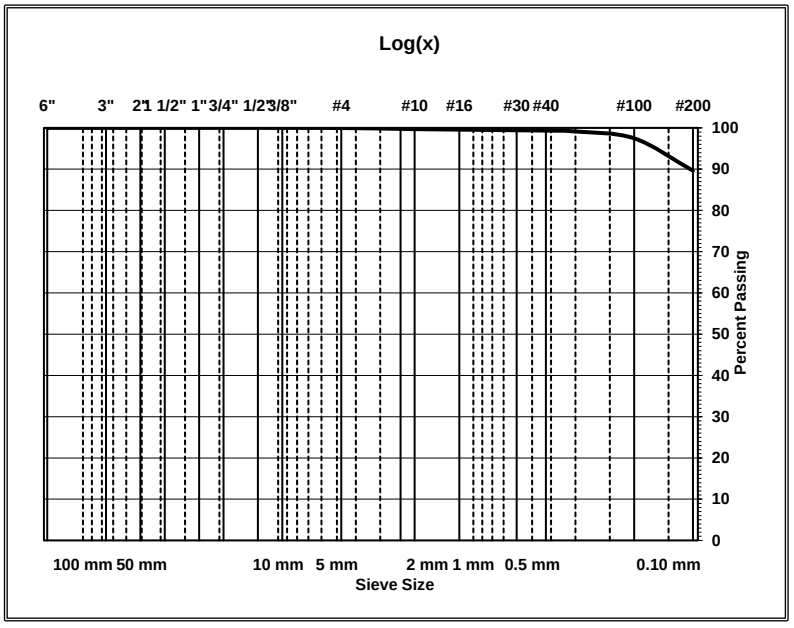




Figure B-8

# SOIL CLASSIFICATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/15/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4948

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Tan Silt with Sand **Tested By:** N. Deschamps **Date:** 10/14/2021
**Location of Sample:** Boring 5 at 15.5' **Authorized By:** Client **Date:** 9/30/2021

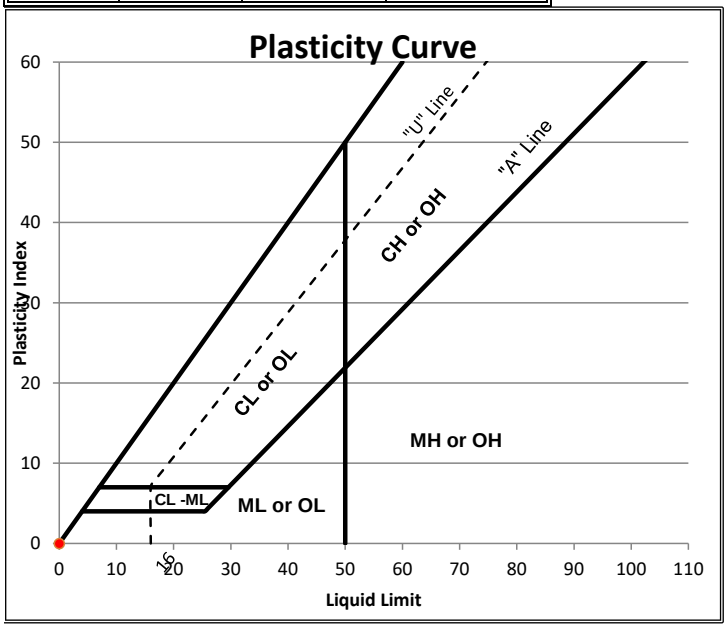
**Sieve Analysis , ASTM C136 and C117**

| Sieve Size | | % Passing Cumulative | Specification |
|---|---|---|---|
| 150 mm | 6" | | |
| 75 mm | 3" | | |
| 50 mm | 2" | | |
| 37.5 mm | 1-1/2" | | |
| 25 mm | 1" | | |
| 19 mm | 3/4" | | |
| 12.5 mm | 1/2" | | |
| 9.5 mm | 3/8" | | |
| 4.75 mm | #4 | | |
| 2.00 mm | #10 | 100 | |
| 1.18 mm | #16 | 100 | |
| 425 µm | #40 | 100 | |
| 300 µm | #50 | 100 | |
| 75 µm | #200 | 71.4 | |

| Test | Result | Specification | Test Standard |
|---|---|---|---|
| Natural Moisture Content, % | 3.8 | | ASTM D 2216 |
| Liquid Limit | NP | | ASTM D 4318 |
| Plasticity Index | NP | | ASTM D 4318 |
| Unified Classification System | ML | | ASTM D 2487 |
| AASHTO Classification System | A-4(0) | | AASHTO M145 |

| % Cobble > 3" | % Gravel < 3" - #4 | % Sand < #4 - #200 | % Silt-Clay < #200 |
|---|---|---|---|
| 0.0 | 0.0 | 28.6 | 71.4 |

| Diameter $D_{60}$ | Diameter $D_{30}$ | Diameter $D_{10}$ | Coefficient of Uniformity, $C_U$ | Coefficient of Concavity, $C_C$ |
|---|---|---|---|---|
| | | | | |



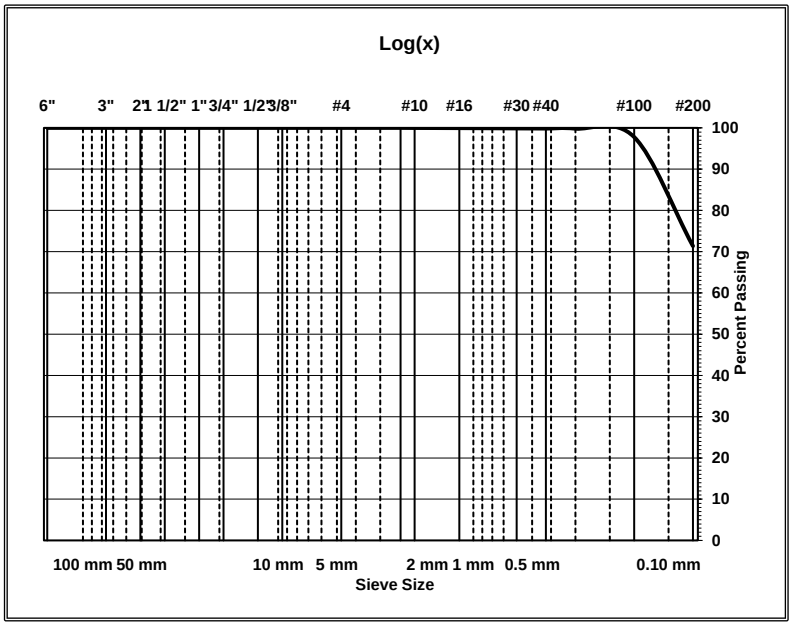




Figure B-9

# SOIL CLASSIFICATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/18/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4934

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Tan Sandy Silt **Tested By:** N. Deschamps **Date:** 10/13/2021
**Location of Sample:** Boring 1 at 3' **Authorized By:** Client **Date:** 9/30/2021

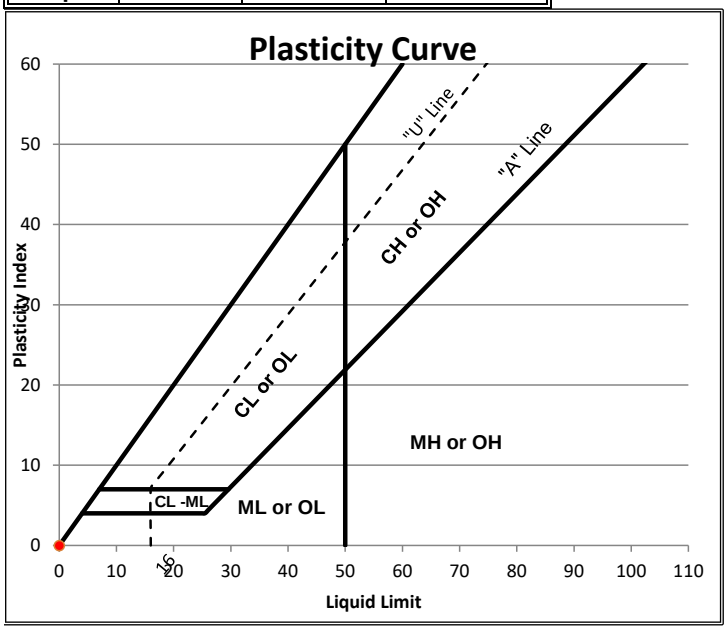
**Sieve Analysis , ASTM C136 and C117**

| Sieve Size | | % Passing Cumulative | Specification |
|---|---|---|---|
| 150 mm | 6" | | |
| 75 mm | 3" | | |
| 50 mm | 2" | | |
| 37.5 mm | 1-1/2" | | |
| 25 mm | 1" | | |
| 19 mm | 3/4" | 100 | |
| 12.5 mm | 1/2" | 99 | |
| 9.5 mm | 3/8" | 98 | |
| 4.75 mm | #4 | 92 | |
| 2.00 mm | #10 | 87 | |
| 1.18 mm | #16 | 84 | |
| 425 µm | #40 | 80 | |
| 300 µm | #50 | 79 | |
| 75 µm | #200 | 59.9 | |

| Test | Result | Specification | Test Standard |
|---|---|---|---|
| Natural Moisture Content, % | 3.0 | | ASTM D 2216 |
| Liquid Limit | | | ASTM D 4318 |
| Plasticity Index | | | ASTM D 4318 |
| Unified Classification System | | | ASTM D 2487 |
| AASHTO Classification System | | | AASHTO M145 |

| % Cobble > 3" | % Gravel < 3" - #4 | % Sand < #4 - #200 | % Silt-Clay < #200 |
|---|---|---|---|
| 0.0 | 8.0 | 32.1 | 59.9 |

| Diameter $D_{60}$ | Diameter $D_{30}$ | Diameter $D_{10}$ | Coefficient of Uniformity, $C_U$ | Coefficient of Concavity, $C_C$ |
|---|---|---|---|---|
| | | | | |



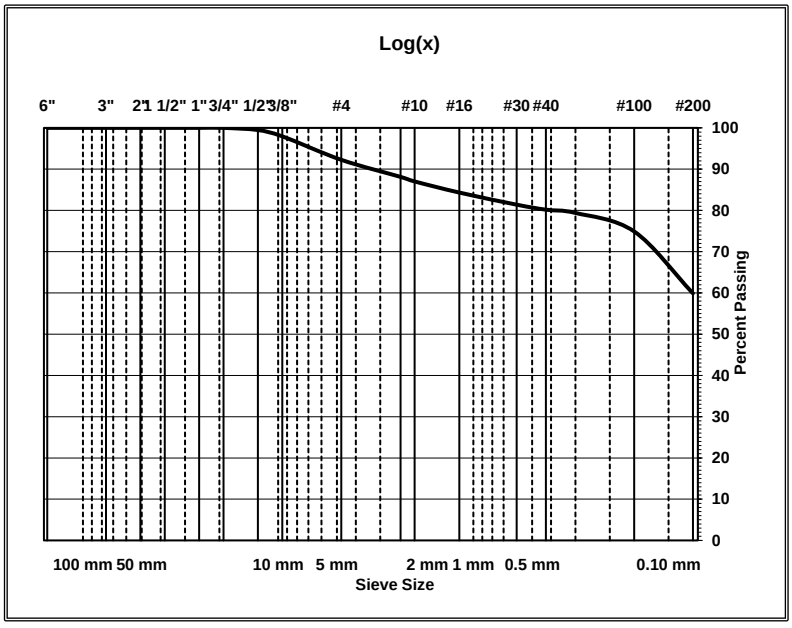




Figure B-10

# SOIL CLASSIFICATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/18/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4941

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Tan Silty Sand with Gravel **Tested By:** N. Deschamps **Date:** 10/13/2021
**Location of Sample:** Boring 3 at 6' **Authorized By:** Client **Date:** 9/30/2021

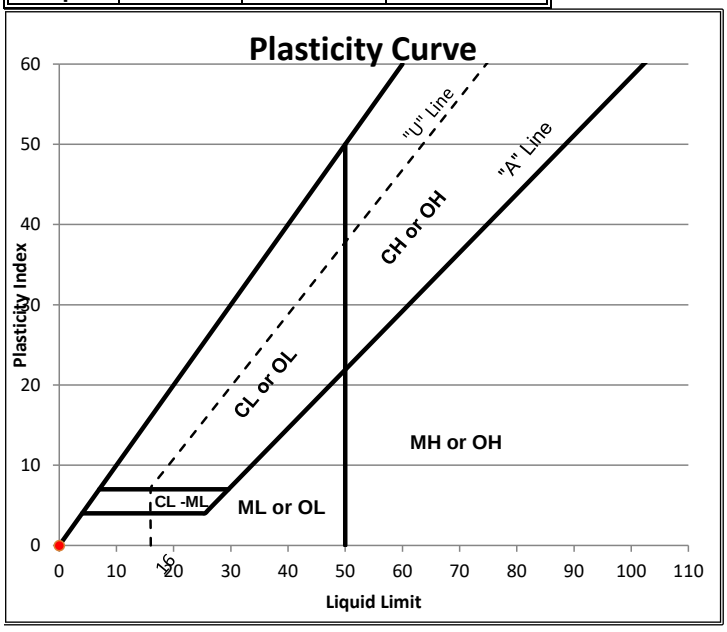
**Sieve Analysis , ASTM C136 and C117**

| Sieve Size | | % Passing Cumulative | Specification |
|---|---|---|---|
| 150 mm | 6" | | |
| 75 mm | 3" | | |
| 50 mm | 2" | | |
| 37.5 mm | 1-1/2" | | |
| 25 mm | 1" | 100 | |
| 19 mm | 3/4" | 93 | |
| 12.5 mm | 1/2" | 91 | |
| 9.5 mm | 3/8" | 88 | |
| 4.75 mm | #4 | 82 | |
| 2.00 mm | #10 | 76 | |
| 1.18 mm | #16 | 73 | |
| 425 µm | #40 | 60 | |
| 300 µm | #50 | 56 | |
| 75 µm | #200 | 40.8 | |

| Test | Result | Specification | Test Standard |
|---|---|---|---|
| Natural Moisture Content, % | 5.2 | | ASTM D 2216 |
| Liquid Limit | | | ASTM D 4318 |
| Plasticity Index | | | ASTM D 4318 |
| Unified Classification System | | | ASTM D 2487 |
| AASHTO Classification System | | | AASHTO M145 |

| % Cobble > 3" | % Gravel < 3" - #4 | % Sand < #4 - #200 | % Silt-Clay < #200 |
|---|---|---|---|
| 0.0 | 18.0 | 41.2 | 40.8 |

| Diameter $D_{60}$ | Diameter $D_{30}$ | Diameter $D_{10}$ | Coefficient of Uniformity, $C_U$ | Coefficient of Concavity, $C_C$ |
|---|---|---|---|---|
| | | | | |



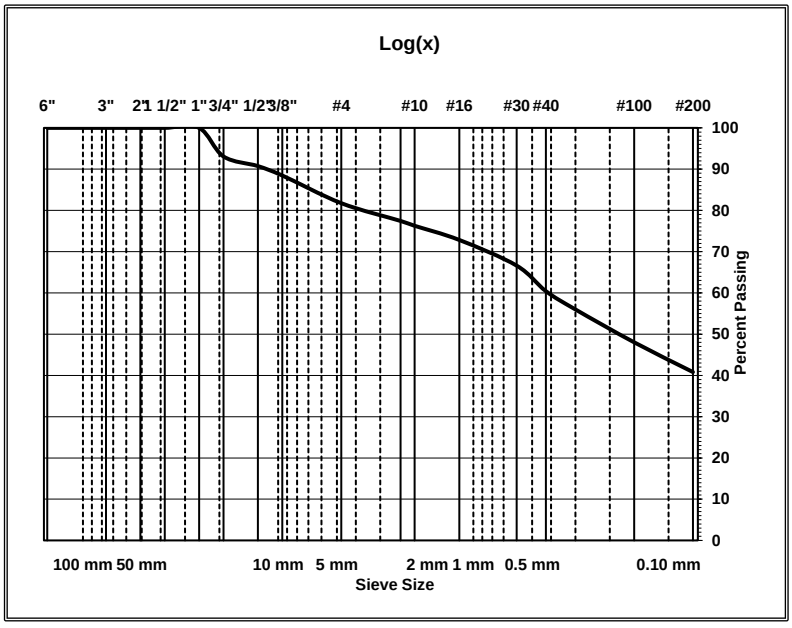




Figure B-11

# SOIL CLASSIFICATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/18/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4945

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Tan Poorly Graded Sand with Silt **Tested By:** N. Deschamps **Date:** 10/13/2021
**Location of Sample:** Boring 4 at 10.5' **Authorized By:** Client **Date:** 9/30/2021

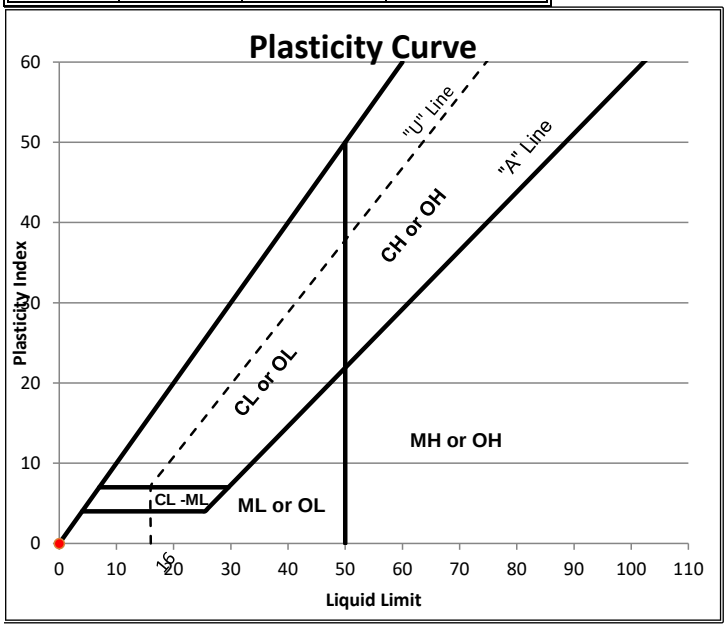
**Sieve Analysis , ASTM C136 and C117**

| Sieve Size | | % Passing Cumulative | Specification |
|---|---|---|---|
| 150 mm | 6" | | |
| 75 mm | 3" | | |
| 50 mm | 2" | | |
| 37.5 mm | 1-1/2" | | |
| 25 mm | 1" | | |
| 19 mm | 3/4" | | |
| 12.5 mm | 1/2" | | |
| 9.5 mm | 3/8" | | |
| 4.75 mm | #4 | 100 | |
| 2.00 mm | #10 | 100 | |
| 1.18 mm | #16 | 99 | |
| 425 µm | #40 | 99 | |
| 300 µm | #50 | 99 | |
| 75 µm | #200 | 9.2 | |

| Test | Result | Specification | Test Standard |
|---|---|---|---|
| Natural Moisture Content, % | 1.0 | | ASTM D 2216 |
| Liquid Limit | | | ASTM D 4318 |
| Plasticity Index | | | ASTM D 4318 |
| Unified Classification System | | | ASTM D 2487 |
| AASHTO Classification System | | | AASHTO M145 |

| % Cobble > 3" | % Gravel < 3" - #4 | % Sand < #4 - #200 | % Silt-Clay < #200 |
|---|---|---|---|
| 0.0 | 0.0 | 90.8 | 9.2 |

| Diameter $D_{60}$ | Diameter $D_{30}$ | Diameter $D_{10}$ | Coefficient of Uniformity, $C_U$ | Coefficient of Concavity, $C_C$ |
|---|---|---|---|---|
| 0.1455 | 0.1039 | 0.0762 | 1.910 | 0.974 |



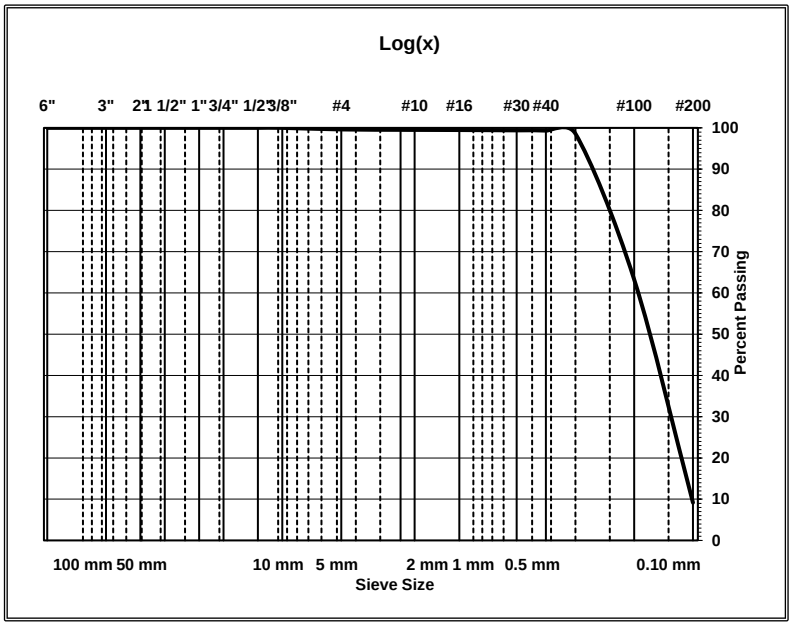




Figure B-12

# SOIL CLASSIFICATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/15/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4949

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Tan Silt **Tested By:** N. Deschamps **Date:** 10/14/2021
**Location of Sample:** Boring 5 at 20.5' **Authorized By:** Client **Date:** 9/30/2021

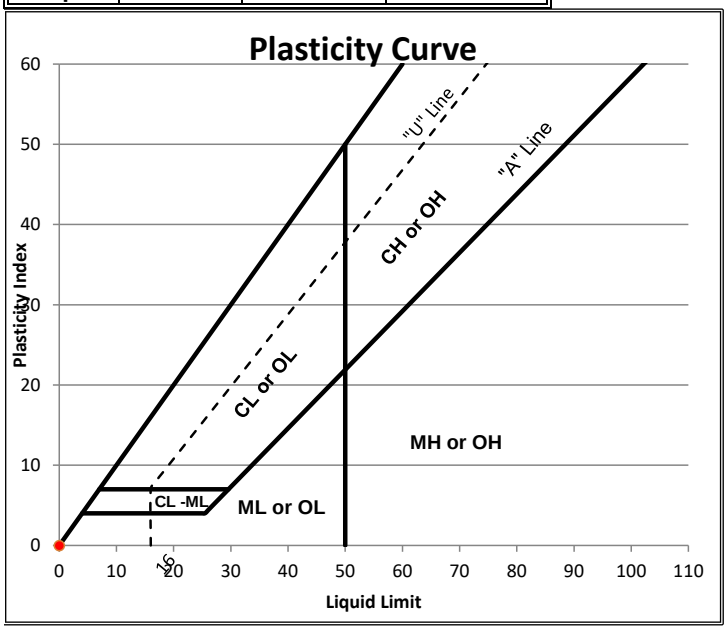
**Sieve Analysis , ASTM C136 and C117**

| Sieve Size | | % Passing Cumulative | Specification |
|---|---|---|---|
| 150 mm | 6" | | |
| 75 mm | 3" | | |
| 50 mm | 2" | | |
| 37.5 mm | 1-1/2" | | |
| 25 mm | 1" | | |
| 19 mm | 3/4" | | |
| 12.5 mm | 1/2" | | |
| 9.5 mm | 3/8" | 100 | |
| 4.75 mm | #4 | 99 | |
| 2.00 mm | #10 | 98 | |
| 1.18 mm | #16 | 98 | |
| 425 µm | #40 | 97 | |
| 300 µm | #50 | 97 | |
| 75 µm | #200 | 93.4 | |

| Test | Result | Specification | Test Standard |
|---|---|---|---|
| Natural Moisture Content, % | 7.3 | | ASTM D 2216 |
| Liquid Limit | | | ASTM D 4318 |
| Plasticity Index | | | ASTM D 4318 |
| Unified Classification System | | | ASTM D 2487 |
| AASHTO Classification System | | | AASHTO M145 |

| % Cobble > 3" | % Gravel < 3" - #4 | % Sand < #4 - #200 | % Silt-Clay < #200 |
|---|---|---|---|
| 0.0 | 1.0 | 5.6 | 93.4 |

| Diameter $D_{60}$ | Diameter $D_{30}$ | Diameter $D_{10}$ | Coefficient of Uniformity, $C_U$ | Coefficient of Concavity, $C_C$ |
|---|---|---|---|---|
| | | | | |



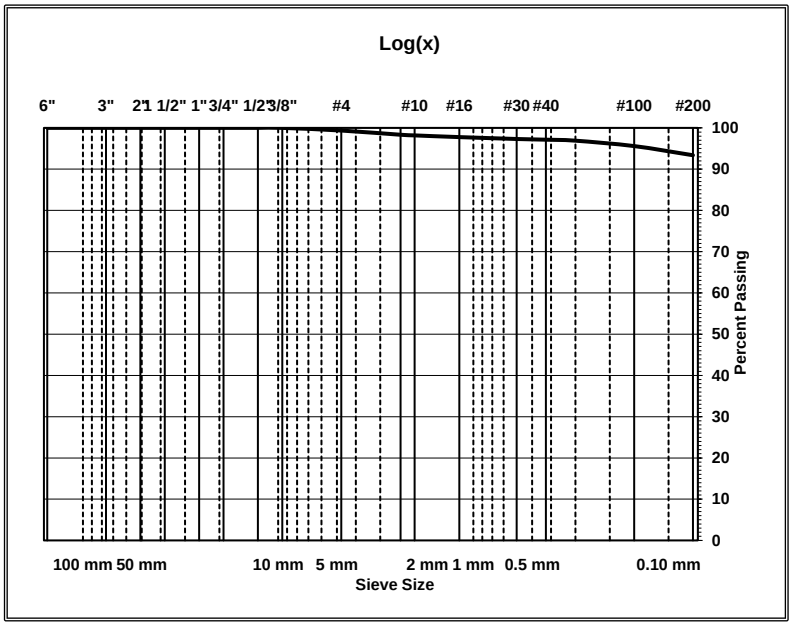




Figure B-13

# SOIL CLASSIFICATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/18/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4951

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Tan Silty Sand **Tested By:** N. Deschamps **Date:** 10/13/2021
**Location of Sample:** Boring 6 at 6' **Authorized By:** Client **Date:** 9/30/2021

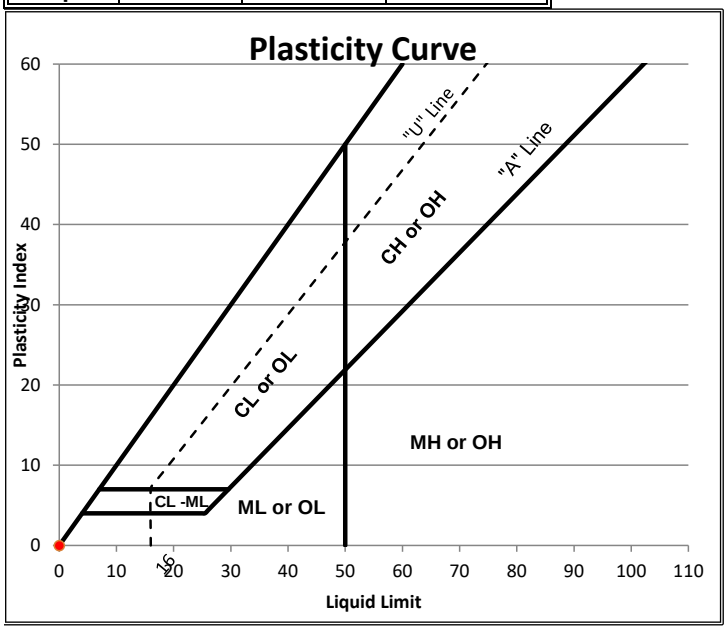
**Sieve Analysis , ASTM C136 and C117**

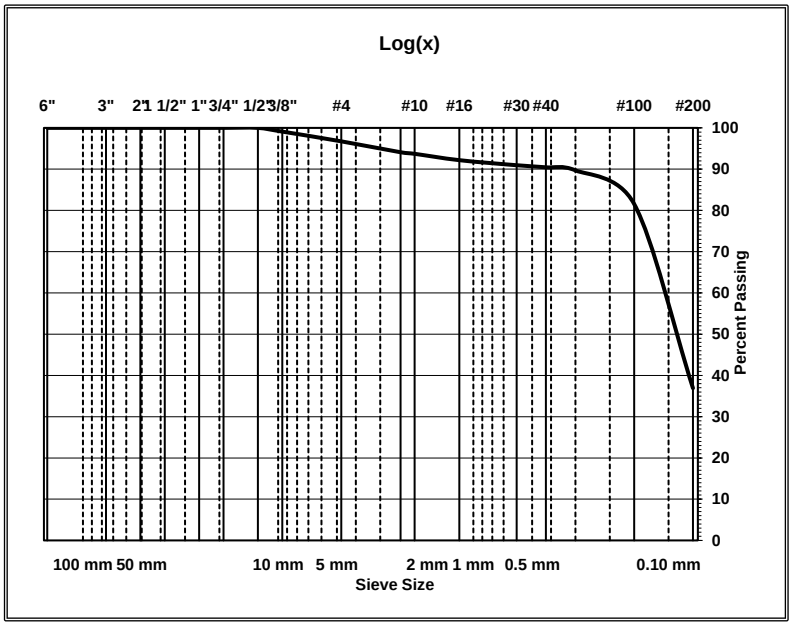
| Sieve Size | | % Passing Cumulative | Specification |
|---|---|---|---|
| 150 mm | 6" | | |
| 75 mm | 3" | | |
| 50 mm | 2" | | |
| 37.5 mm | 1-1/2" | | |
| 25 mm | 1" | | |
| 19 mm | 3/4" | | |
| 12.5 mm | 1/2" | 100 | |
| 9.5 mm | 3/8" | 99 | |
| 4.75 mm | #4 | 97 | |
| 2.00 mm | #10 | 94 | |
| 1.18 mm | #16 | 92 | |
| 425 µm | #40 | 90 | |
| 300 µm | #50 | 90 | |
| 75 µm | #200 | 36.9 | |

| Test | Result | Specification | Test Standard |
|---|---|---|---|
| Natural Moisture Content, % | 4.6 | | ASTM D 2216 |
| Liquid Limit | | | ASTM D 4318 |
| Plasticity Index | | | ASTM D 4318 |
| Unified Classification System | | | ASTM D 2487 |
| AASHTO Classification System | | | AASHTO M145 |

| % Cobble > 3" | % Gravel < 3" - #4 | % Sand < #4 - #200 | % Silt-Clay < #200 |
|---|---|---|---|
| 0.0 | 3.0 | 60.1 | 36.9 |

| Diameter $D_{60}$ | Diameter $D_{30}$ | Diameter $D_{10}$ | Coefficient of Uniformity, $C_U$ | Coefficient of Concavity, $C_C$ |
|---|---|---|---|---|
| | | | | |




Figuire B-14

# SOIL CLASSIFICATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/26/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4952

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Brown Silty Sand **Tested By:** J. Bracken **Date:** 10/20/2021
**Location of Sample:** Boring 6 at 10.5' **Authorized By:** Client **Date:** 9/30/2021

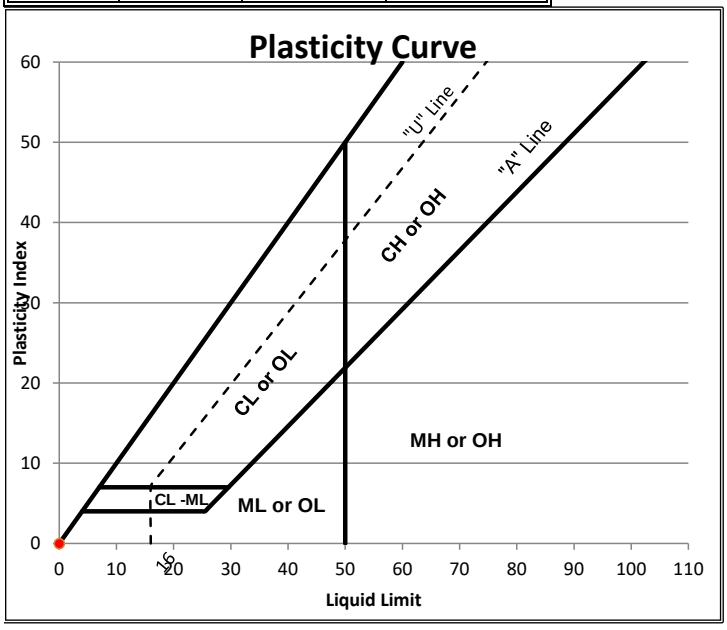
**Sieve Analysis , ASTM C136 and C117**

| Sieve Size | | % Passing Cumulative | Specification |
|---|---|---|---|
| 150 mm | 6" | | |
| 75 mm | 3" | | |
| 50 mm | 2" | | |
| 37.5 mm | 1-1/2" | | |
| 25 mm | 1" | | |
| 19 mm | 3/4" | | |
| 12.5 mm | 1/2" | 100 | |
| 9.5 mm | 3/8" | 99 | |
| 4.75 mm | #4 | 99 | |
| 2.00 mm | #10 | 98 | |
| 1.18 mm | #16 | 98 | |
| 425 µm | #40 | 97 | |
| 300 µm | #50 | 95 | |
| 75 µm | #200 | 40.0 | |

| Test | Result | Specification | Test Standard |
|---|---|---|---|
| Natural Moisture Content, % | 3.4 | | ASTM D 2216 |
| Liquid Limit | | | ASTM D 4318 |
| Plasticity Index | | | ASTM D 4318 |
| Unified Classification System | | | ASTM D 2487 |
| AASHTO Classification System | | | AASHTO M145 |

| % Cobble > 3" | % Gravel < 3" - #4 | % Sand < #4 - #200 | % Silt-Clay < #200 |
|---|---|---|---|
| 0.0 | 1.0 | 59.0 | 40.0 |

| Diameter $D_{60}$ | Diameter $D_{30}$ | Diameter $D_{10}$ | Coefficient of Uniformity, $C_U$ | Coefficient of Concavity, $C_C$ |
|---|---|---|---|---|
| | | | | |



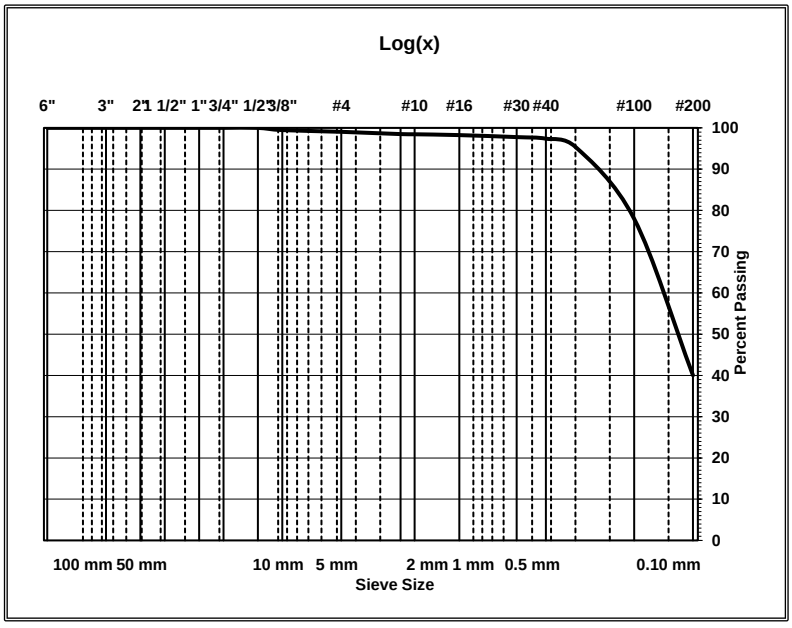




Figure B-15

# SOIL CLASSIFICATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/26/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4953

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Brown Sandy Silt **Tested By:** J. Bracken **Date:** 10/20/2021
**Location of Sample:** Boring 7 at 6' **Authorized By:** Client **Date:** 9/30/2021

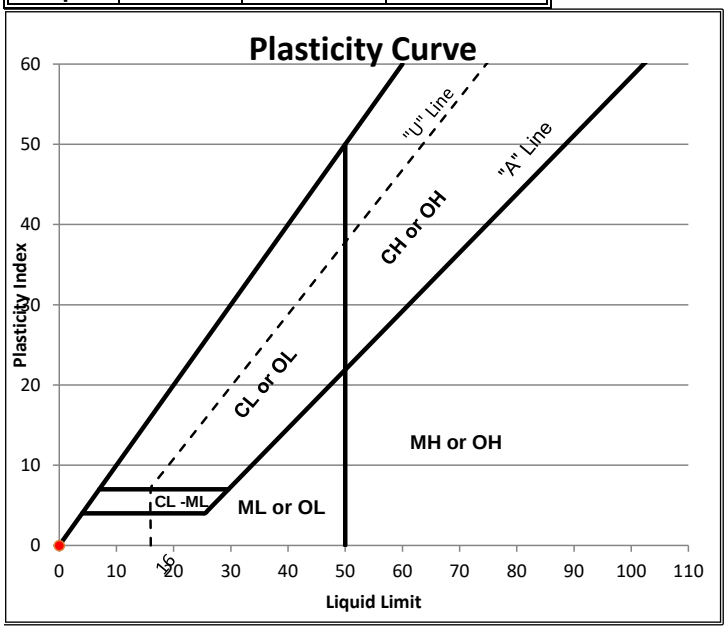
**Sieve Analysis , ASTM C136 and C117**

| Sieve Size | | % Passing Cumulative | Specification |
|---|---|---|---|
| 150 mm | 6" | | |
| 75 mm | 3" | | |
| 50 mm | 2" | | |
| 37.5 mm | 1-1/2" | | |
| 25 mm | 1" | 100 | |
| 19 mm | 3/4" | 98 | |
| 12.5 mm | 1/2" | 95 | |
| 9.5 mm | 3/8" | 95 | |
| 4.75 mm | #4 | 90 | |
| 2.00 mm | #10 | 87 | |
| 1.18 mm | #16 | 86 | |
| 425 µm | #40 | 82 | |
| 300 µm | #50 | 81 | |
| 75 µm | #200 | 63.4 | |

| Test | Result | Specification | Test Standard |
|---|---|---|---|
| Natural Moisture Content, % | 7.7 | | ASTM D 2216 |
| Liquid Limit | | | ASTM D 4318 |
| Plasticity Index | | | ASTM D 4318 |
| Unified Classification System | | | ASTM D 2487 |
| AASHTO Classification System | | | AASHTO M145 |

| % Cobble > 3" | % Gravel < 3" - #4 | % Sand < #4 - #200 | % Silt-Clay < #200 |
|---|---|---|---|
| 0.0 | 10.0 | 26.6 | 63.4 |

| Diameter $D_{60}$ | Diameter $D_{30}$ | Diameter $D_{10}$ | Coefficient of Uniformity, $C_U$ | Coefficient of Concavity, $C_C$ |
|---|---|---|---|---|
| | | | | |



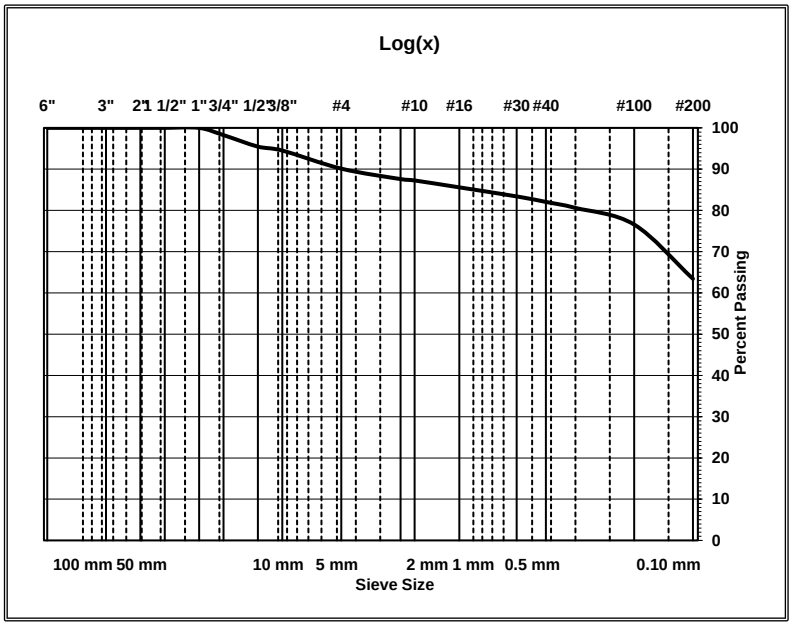




Figure B-16

# SOIL CLASSIFICATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/15/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4954

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Brown Silty Sand with Gravel **Tested By:** N. Deschamps **Date:** 10/14/2021
**Location of Sample:** Boring 7 at 10' **Authorized By:** Client **Date:** 9/30/2021

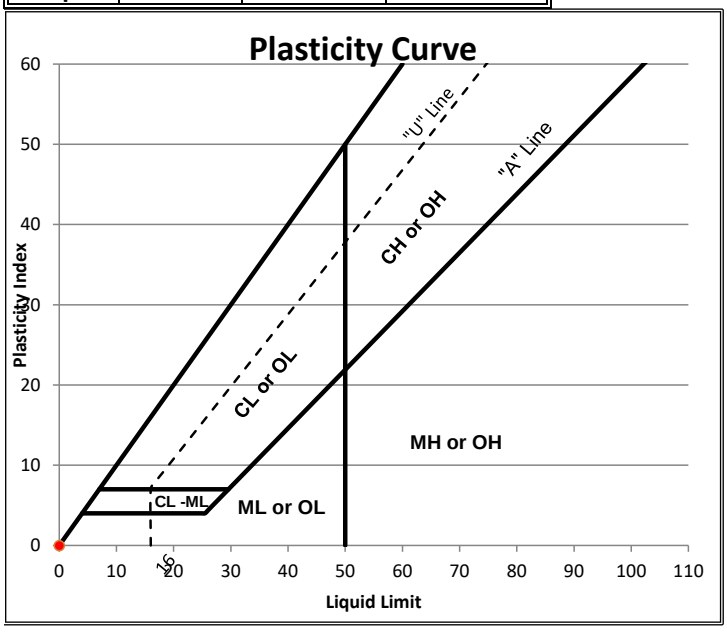
**Sieve Analysis , ASTM C136 and C117**

| Sieve Size | | % Passing Cumulative | Specification |
|---|---|---|---|
| 150 mm | 6" | | |
| 75 mm | 3" | | |
| 50 mm | 2" | | |
| 37.5 mm | 1-1/2" | 100 | |
| 25 mm | 1" | 94 | |
| 19 mm | 3/4" | 94 | |
| 12.5 mm | 1/2" | 91 | |
| 9.5 mm | 3/8" | 88 | |
| 4.75 mm | #4 | 82 | |
| 2.00 mm | #10 | 77 | |
| 1.18 mm | #16 | 75 | |
| 425 µm | #40 | 72 | |
| 300 µm | #50 | 71 | |
| 75 µm | #200 | 46.9 | |

| Test | Result | Specification | Test Standard |
|---|---|---|---|
| Natural Moisture Content, % | 4.8 | | ASTM D 2216 |
| Liquid Limit | | | ASTM D 4318 |
| Plasticity Index | | | ASTM D 4318 |
| Unified Classification System | | | ASTM D 2487 |
| AASHTO Classification System | | | AASHTO M145 |

| % Cobble > 3" | % Gravel < 3" - #4 | % Sand < #4 - #200 | % Silt-Clay < #200 |
|---|---|---|---|
| 0.0 | 18.0 | 35.1 | 46.9 |

| Diameter $D_{60}$ | Diameter $D_{30}$ | Diameter $D_{10}$ | Coefficient of Uniformity, $C_U$ | Coefficient of Concavity, $C_C$ |
|---|---|---|---|---|
| | | | | |



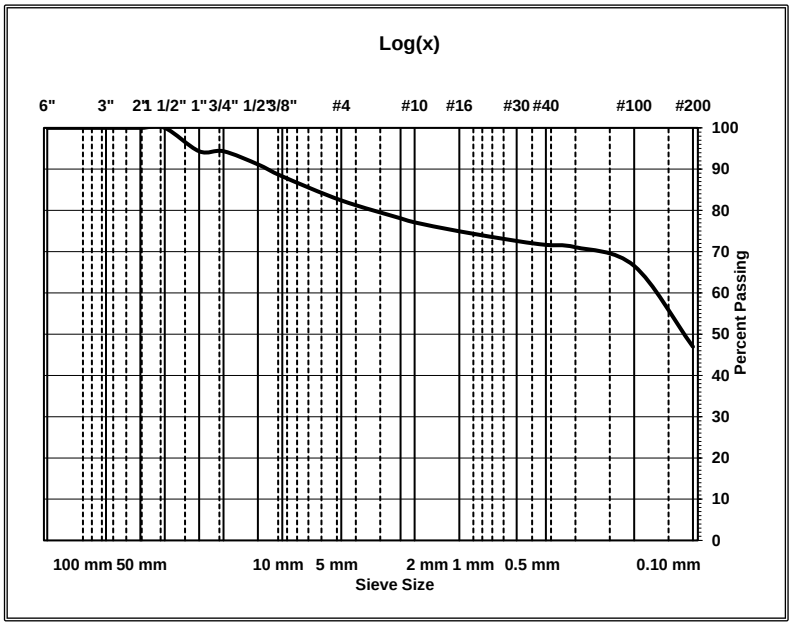




Figure B-17

# SOIL CLASSIFICATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/18/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4956

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Light Brown Silty Sand **Tested By:** N. Klingonsmith **Date:** 10/13/2021
**Location of Sample:** Test Pit 1 at 6' **Authorized By:** Client **Date:** 9/30/2021

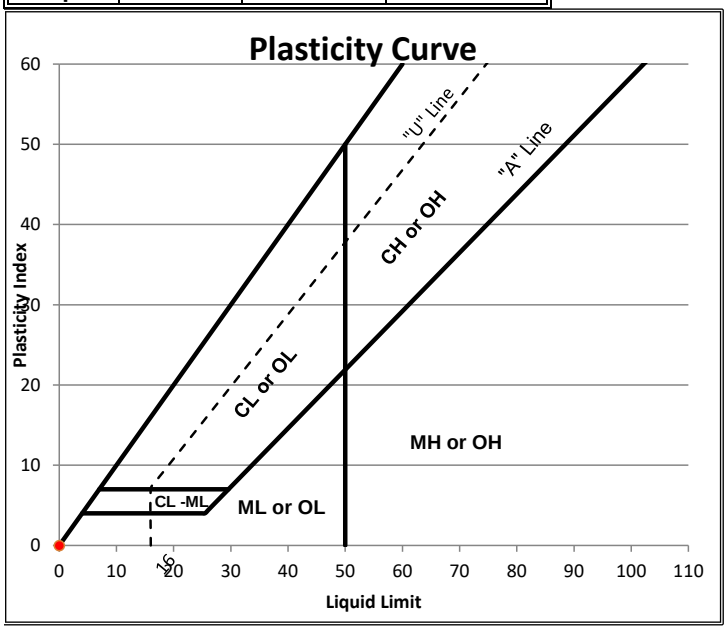
**Sieve Analysis , ASTM C136 and C117**

| Sieve Size | | % Passing Cumulative | Specification |
|---|---|---|---|
| 150 mm | 6" | | |
| 75 mm | 3" | | |
| 50 mm | 2" | | |
| 37.5 mm | 1-1/2" | | |
| 25 mm | 1" | | |
| 19 mm | 3/4" | | |
| 12.5 mm | 1/2" | | |
| 9.5 mm | 3/8" | 100 | |
| 4.75 mm | #4 | 98 | |
| 2.00 mm | #10 | 93 | |
| 1.18 mm | #16 | 91 | |
| 425 µm | #40 | 83 | |
| 300 µm | #50 | 76 | |
| 75 µm | #200 | 49.5 | |

| Test | Result | Specification | Test Standard |
|---|---|---|---|
| Natural Moisture Content, % | 11.6 | | ASTM D 2216 |
| Liquid Limit | | | ASTM D 4318 |
| Plasticity Index | | | ASTM D 4318 |
| Unified Classification System | | | ASTM D 2487 |
| AASHTO Classification System | | | AASHTO M145 |

| % Cobble > 3" | % Gravel < 3" - #4 | % Sand < #4 - #200 | % Silt-Clay < #200 |
|---|---|---|---|
| 0.0 | 2.0 | 48.5 | 49.5 |

| Diameter $D_{60}$ | Diameter $D_{30}$ | Diameter $D_{10}$ | Coefficient of Uniformity, $C_U$ | Coefficient of Concavity, $C_C$ |
|---|---|---|---|---|
| | | | | |



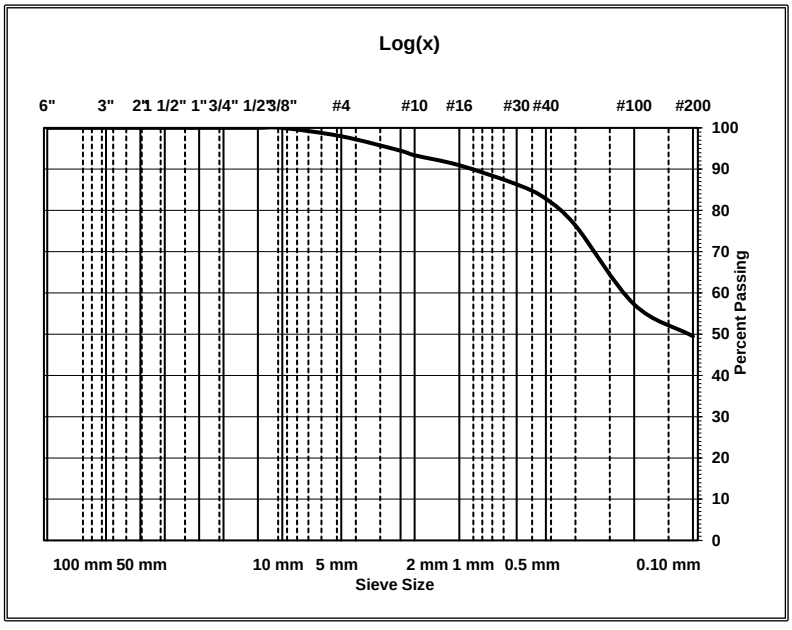




Figure B-18

# SOIL CLASSIFICATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/15/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4957

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Light Brown Silty Sand **Tested By:** N. Klingonsmith **Date:** 10/13/2021
**Location of Sample:** Test Pit 2 at 2.5' **Authorized By:** Client **Date:** 9/30/2021

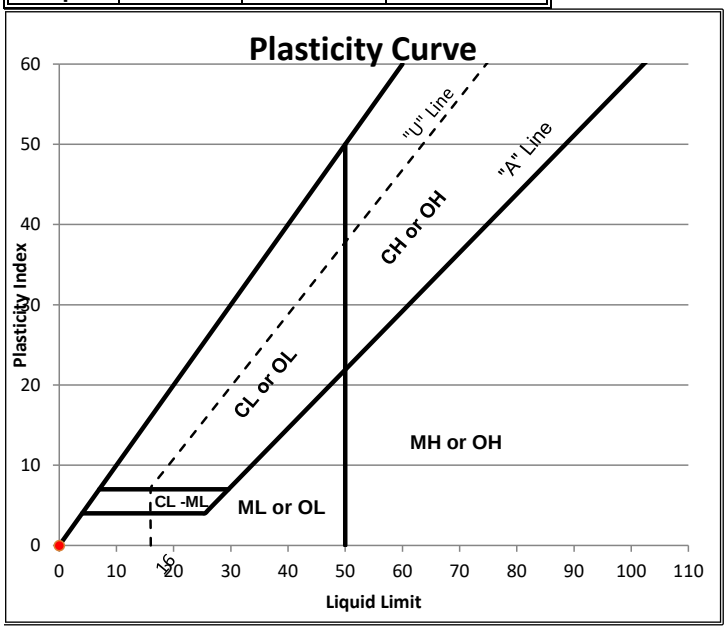
**Sieve Analysis , ASTM C136 and C117**

| Sieve Size | | % Passing Cumulative | Specification |
|---|---|---|---|
| 150 mm | 6" | | |
| 75 mm | 3" | | |
| 50 mm | 2" | | |
| 37.5 mm | 1-1/2" | | |
| 25 mm | 1" | | |
| 19 mm | 3/4" | | |
| 12.5 mm | 1/2" | | |
| 9.5 mm | 3/8" | 100 | |
| 4.75 mm | #4 | 98 | |
| 2.00 mm | #10 | 97 | |
| 1.18 mm | #16 | 96 | |
| 425 µm | #40 | 93 | |
| 300 µm | #50 | 91 | |
| 75 µm | #200 | 48.4 | |

| Test | Result | Specification | Test Standard |
|---|---|---|---|
| Natural Moisture Content, % | 3.4 | | ASTM D 2216 |
| Liquid Limit | | | ASTM D 4318 |
| Plasticity Index | | | ASTM D 4318 |
| Unified Classification System | | | ASTM D 2487 |
| AASHTO Classification System | | | AASHTO M145 |

| % Cobble > 3" | % Gravel < 3" - #4 | % Sand < #4 - #200 | % Silt-Clay < #200 |
|---|---|---|---|
| 0.0 | 2.0 | 49.6 | 48.4 |

| Diameter $D_{60}$ | Diameter $D_{30}$ | Diameter $D_{10}$ | Coefficient of Uniformity, $C_U$ | Coefficient of Concavity, $C_C$ |
|---|---|---|---|---|
| | | | | |



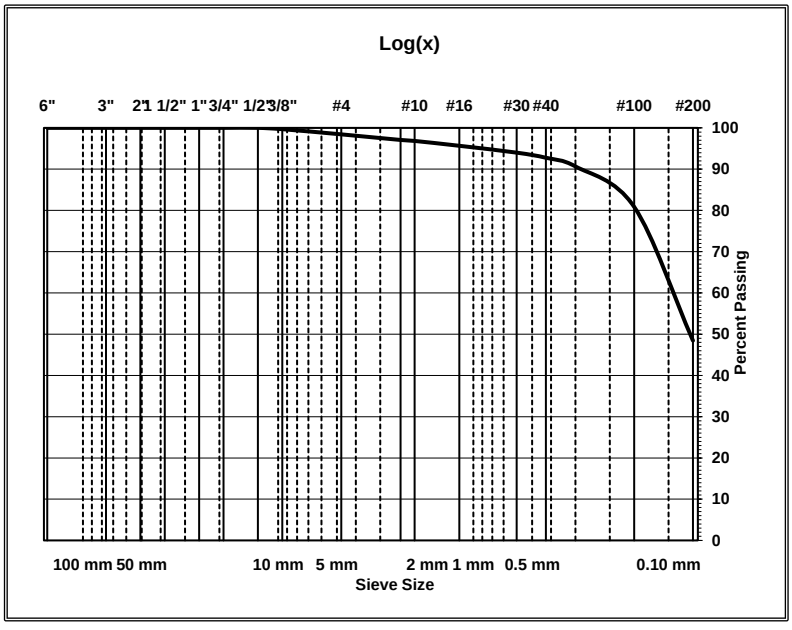




Figure B-19

# SOIL CLASSIFICATION REPORT

**Client:** MRCI
782 S River Road #289
St George, UT 84790

**Date of Report:** 10/18/2021
**Reviewed By:** Z. Girsberger
**Lab#:** 21SG4958

**Project:** Kachina Ridge **Project #:** 210793
**Location:** Hurricane **Sampled By:** D. Baldazzi **Date:** 9/30/2021
**Type of Sample:** Light Brown Silt **Tested By:** N. Klingonsmith **Date:** 10/13/2021
**Location of Sample:** Test Pit 5 at 2' **Authorized By:** Client **Date:** 9/30/2021

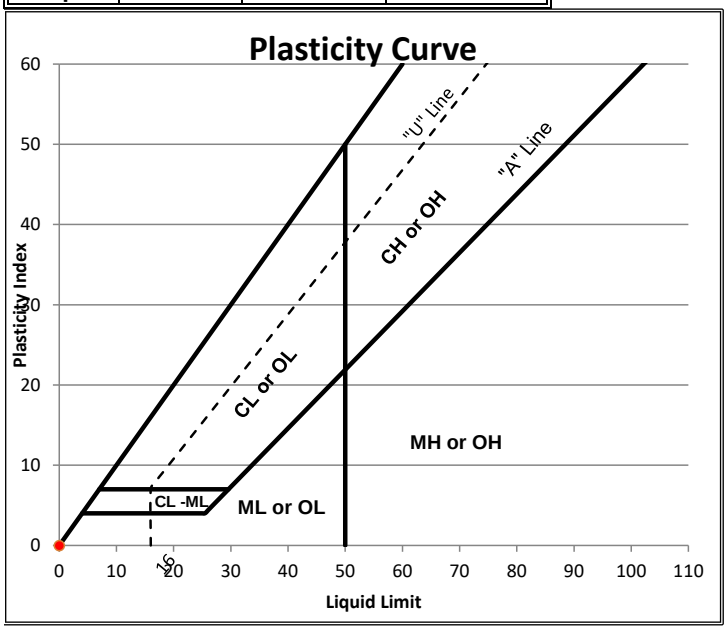
**Sieve Analysis , ASTM C136 and C117**

| Sieve Size | | % Passing Cumulative | Specification |
|---|---|---|---|
| 150 mm | 6" | | |
| 75 mm | 3" | | |
| 50 mm | 2" | | |
| 37.5 mm | 1-1/2" | | |
| 25 mm | 1" | | |
| 19 mm | 3/4" | | |
| 12.5 mm | 1/2" | | |
| 9.5 mm | 3/8" | | |
| 4.75 mm | #4 | 100 | |
| 2.00 mm | #10 | 100 | |
| 1.18 mm | #16 | 100 | |
| 425 µm | #40 | 99 | |
| 300 µm | #50 | 98 | |
| 75 µm | #200 | 86.5 | |

| Test | Result | Specification | Test Standard |
|---|---|---|---|
| Natural Moisture Content, % | 2.9 | | ASTM D 2216 |
| Liquid Limit | | | ASTM D 4318 |
| Plasticity Index | | | ASTM D 4318 |
| Unified Classification System | | | ASTM D 2487 |
| AASHTO Classification System | | | AASHTO M145 |

| % Cobble > 3" | % Gravel < 3" - #4 | % Sand < #4 - #200 | % Silt-Clay < #200 |
|---|---|---|---|
| 0.0 | 0.0 | 13.5 | 86.5 |

| Diameter $D_{60}$ | Diameter $D_{30}$ | Diameter $D_{10}$ | Coefficient of Uniformity, $C_U$ | Coefficient of Concavity, $C_C$ |
|---|---|---|---|---|
| | | | | |



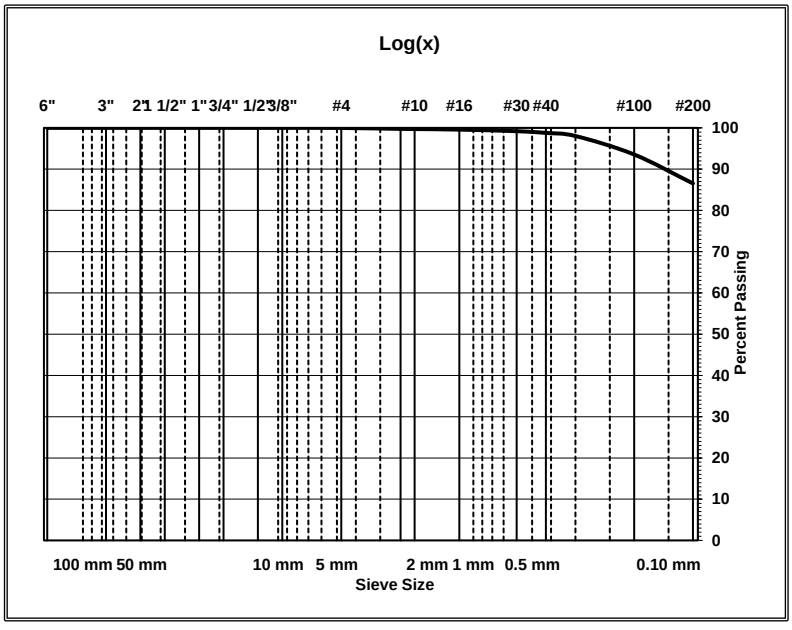



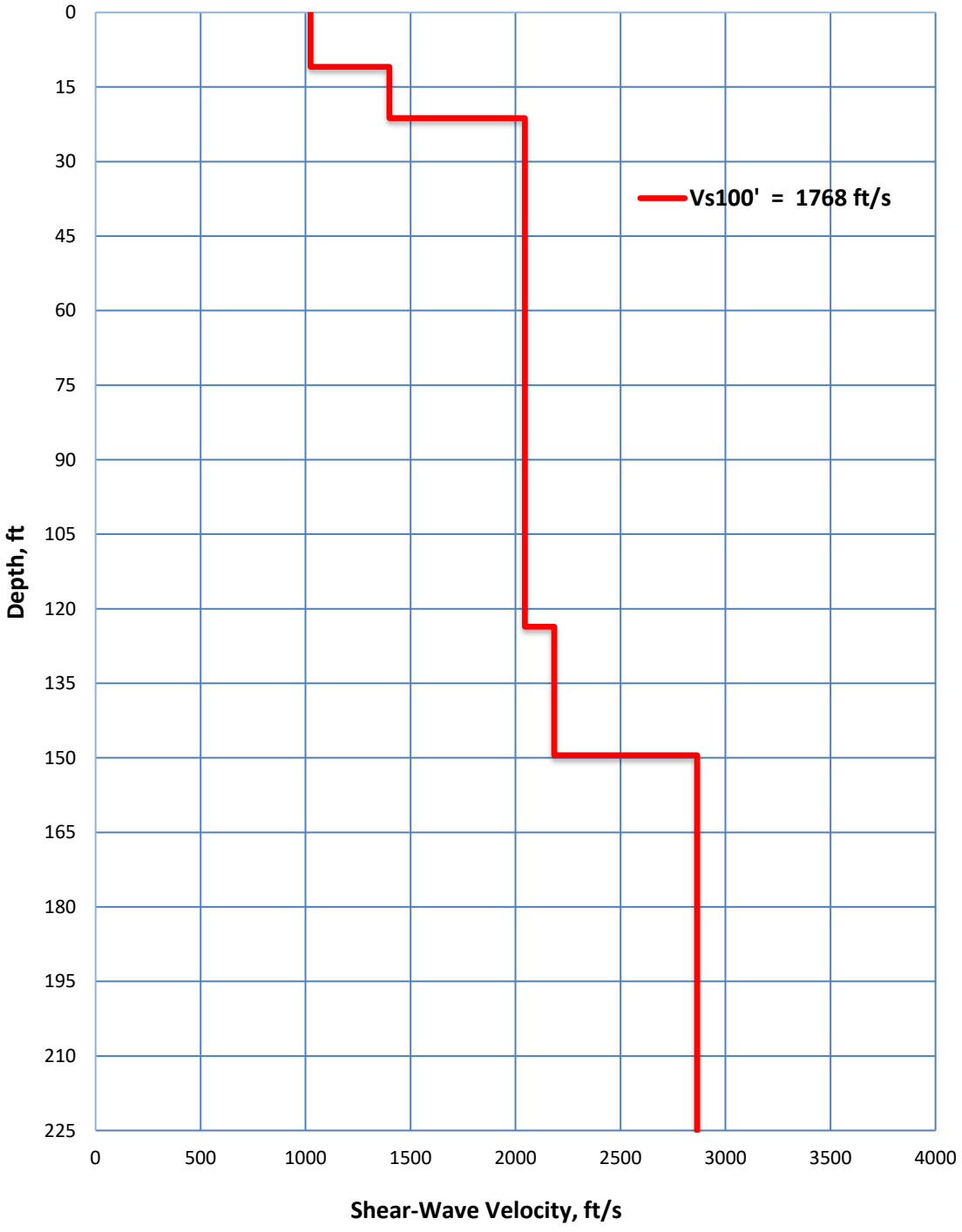

Figure B-20

# Appendix C

CASTILLO GEOPHYSICAL LTD.

# IBC Site Classification

**Landmark Testing**
**Kachina Ridge**
**Site Class C**



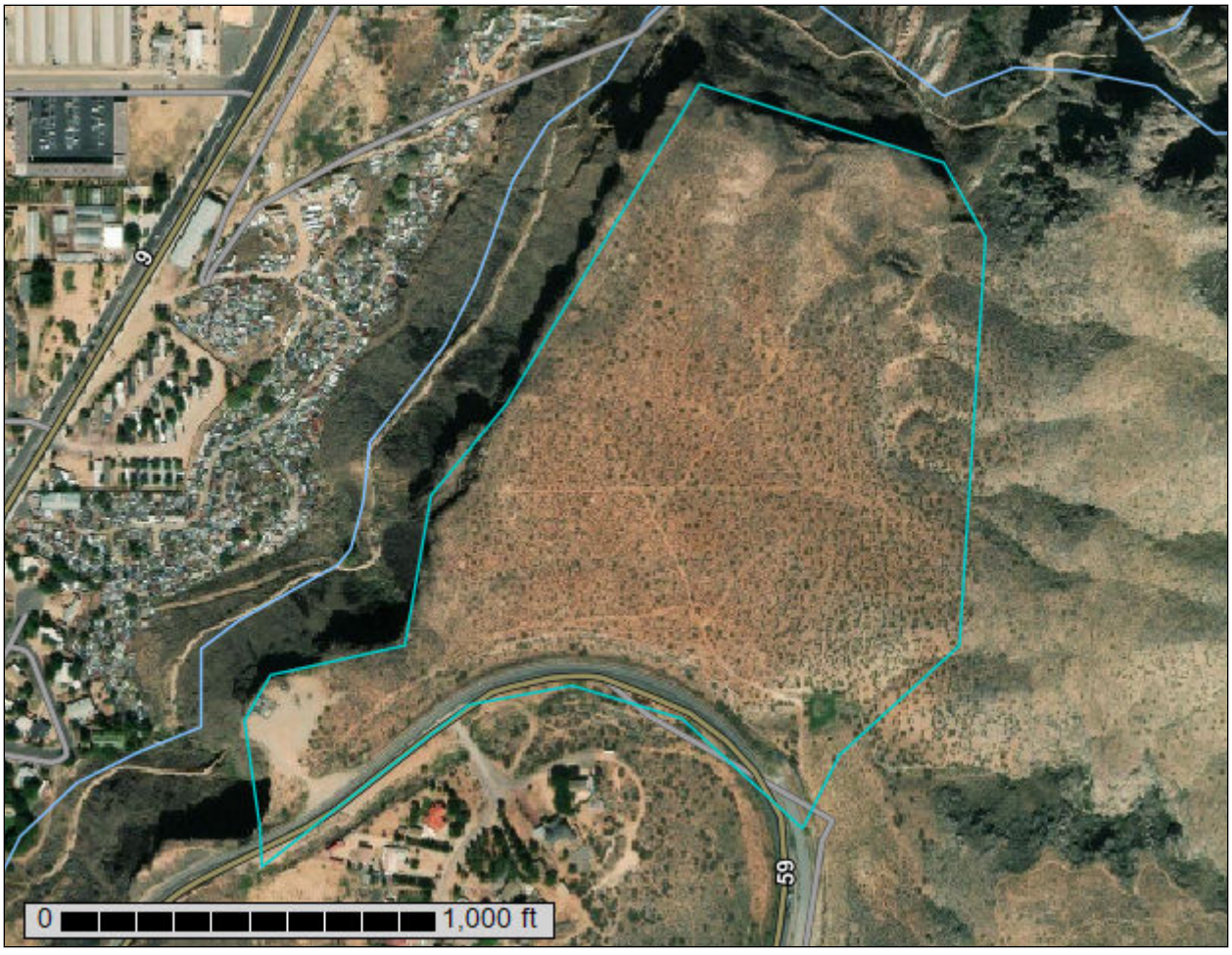
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

# Custom Soil Resource Report for Washington County Area, Utah




October 29, 2021

# Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

# Contents

**Preface**.....2
**How Soil Surveys Are Made**.....5
**Soil Map**.....8
Soil Map.....9
Legend.....10
Map Unit Legend.....11
Map Unit Descriptions.....11
Washington County Area, Utah.....13
IAF—Isom cobbly sandy loam, 3 to 30 percent slopes.....13
RP—Rock land, stony.....14
RT—Rock outcrop.....14
**References**.....15

# How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

# Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

# Custom Soil Resource Report
## Soil Map

Map Scale: 1:4,670 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

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: Mar 7, 2015—Oct 22, 2017

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

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| IAF | Isom cobbly sandy loam, 3 to 30 percent slopes | 37.3 | 75.6% |
| RP | Rock land, stony | 0.3 | 0.6% |
| RT | Rock outcrop | 11.8 | 23.8% |
| **Totals for Area of Interest** | | **49.3** | **100.0%** |

# Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the

development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

# Washington County Area, Utah

## IAF—Isom cobbly sandy loam, 3 to 30 percent slopes

### Map Unit Setting

*National map unit symbol:* j8f0
*Elevation:* 2,700 to 3,900 feet
*Mean annual precipitation:* 8 to 11 inches
*Mean annual air temperature:* 57 to 67 degrees F
*Frost-free period:* 175 to 195 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Isom and similar soils:* 90 percent
*Minor components:* 10 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Isom

#### Setting

*Landform:* Alluvial fans
*Down-slope shape:* Concave
*Across-slope shape:* Convex
*Parent material:* Cobbly alluvium derived from limestone, sandstone, and shale

#### Typical profile

*H1 - 0 to 2 inches:* very cobbly sandy loam
*H2 - 2 to 10 inches:* very cobbly sandy loam
*H3 - 10 to 22 inches:* very cobbly sandy loam
*H4 - 22 to 60 inches:* extremely cobbly sandy loam

#### Properties and qualities

*Slope:* 3 to 30 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Well drained
*Runoff class:* Low
*Capacity of the most limiting layer to transmit water (Ksat):* High (2.00 to 6.00 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 60 percent
*Gypsum, maximum content:* 10 percent
*Maximum salinity:* Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
*Sodium adsorption ratio, maximum:* 5.0
*Available water supply, 0 to 60 inches:* Low (about 3.3 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7s
*Hydrologic Soil Group:* A
*Ecological site:* R030XY134UT - Desert Shallow Loam (Creosotebush)
*Hydric soil rating:* No