Midway City Council
20 September 2022
Regular Meeting

The Village /
Underground Garages

Midway

CITY COUNCIL MEETING STAFF REPORT

DATE OF MEETING:	September 20, 2021
NAME OF PROJECT:	The Village
NAME OF APPLICANT:	Midway Heritage Development, LLC
AUTHORIZED REPRESENTATIVE:	Daniel Luster
AGENDA ITEM:	Below Grade Garages
LOCATION OF ITEM:	541 East Main Street
ZONING DESIGNATIONS:	C-2

ITEM: 17

Dan Luster, agent for Midway Heritage Development LLC, is proposing to build below grade garages for some of the units in The Village. Per the approved master plan agreement, the developer is can petition the City Council for the ability to build below grade garages for the residential units. The Village contains 143 dwellings on 27.47 acres. The property located at 541 East Main is in the C-2 zone.

BACKGROUND:

Dan Luster, agent for Midway Heritage Development LLC, is proposing to build below grade garages for some of the units in The Village. Per the approved master plan agreement, the developer may petition the City Council for the ability to build below grade garages for the residential units. Staff has concerns about below grade parking because the initial geotechnical report on the property that was submitted to the City. In the report, two of the test pits encountered ground water at a relatively shallow depth. This was concerning because if the development is built with below grade garages, and

the below grade garages were to flood, then all the vehicles for those residences would park on the surface streets of the development. Frankly, there is not enough surface area parking to handle all the parking demands if this scenario were to occur and the development would not function properly, to the point that there would most likely be safety concerns. It is likely that in this scenario the extra vehicles parking on the surface streets would create access issues for safety personnel because of the width of the roads and the limited parking areas.

A plan was created to address the issue that consisted of the following.

- The developer would hire CMT Engineering, the firm that created the first reports, to study the issue further.

- Midway would hire (paid for by the developer) Loughlin Water Associates, LLC to review the multiple reports produced by CMT Engineering that were submitted by the developer and would include their findings and recommendations.

- A French drain system and pumps would be installed around buildings with subgrade garages to pump the water to a Midway Irrigation Company Ditch that crosses the property.

An alternative idea was created that would require the developer to purchase adjacent property, large enough to contain a parking area that would accommodate all the lost subgrade parking if those garages were to flood. The developer would also need to bond for the construction of the parking lot.

The developer would like to build below grade garages for several reasons. Some of the reasons why subgrade garages are important for the developer include:

- The residences will have more living area on the ground floor which will make them more livable and more marketable.

- The buildings will be better designed which will greatly impact the streetscape and the overall character of the neighborhood.

- The value of the units will be greater.

Staff would also like to subgrade garages to be built if the concerns are resolved and the proper contingency plans are in place that will assure that parking will not be an issue, especially a safety issue, if the below grade garages were to flood. Some of the reasons why subgrade garages are important for staff include the following:

- The buildings will be better designed which will greatly impact the streetscape and the overall character of the neighborhood.

- There will be more garage area for parking and storage which will help make it possible that surface street parking will be minimal.

LAND USE SUMMARY:

- 27.47 acres
- 8.81 acres of open space
- C-2 zone
- Five phases
- 143 dwellings
- 7 commercial buildings
- All roads and alleys are private (with a public access easement), including the connector road to River Road.
- Private roads, alleys, parking areas, and open space will be maintained by the HOA or POA

ANALYSIS:

Geotechnical Reports – CMT Engineering has performed multiple studies on the property and have submitted reports and letters which include the following (all reports are available in the Planning Office for review, they have not been attached to this report because they contain hundreds of pages):

- Geotechnical Report 2017a
- Geotechnical Report 2017b
- Geotechnical Report 2021a
- Geotechnical Report 2021b (Summary of the December 2017 report and the March 2021 Village report)
- Geotechnical Report and Letter 2022a
- Geotechnical Letter 2022b

Loughlin Water Associates, LLC reviewed all the reports and letters and submitted a letter titled "Hydrogeologic Assessment – Proposed "The Village" Subdivision for Horrocks Engineers, Inc." The attached letter has been included in this report and arrives at the following conclusion:

> *The Village does not appear to have shallow groundwater. However, that does not mean that conditions could not change in the future. Shallow groundwater elevations west of The Village are higher in elevation (around 5,600 feet) than the site excavations (down to 5,555 feet), and irrigation return from the north and the west have the potential to impact soil moisture in the future. Additionally, return from forced irrigation and seepage from a proposed central surface water feature have the potential to impact subgrade structures. We assume that the current irrigation will be maintained but contained in a pipe during and following the construction of The Village. The design criteria of 30 gpm recommended by CMT (2022b) for subdrains is based on aquifer testing of a nearby well and may not be applicable to flow into horizontal drains in areas of transient water occurrence.*
>
> *It is not feasible to develop perimeter foundation subdrain system based on a transient (short term) occurrence of water in the slotted pipes. Therefore, we recommend that The Village:*
>
> > • *Engage a qualified geotechnical engineer or hydrogeologist to observe foundation and storm drain and sewer line excavations to the proposed invert elevations for the presence and quantity of shallow groundwater during the first phase of development.*
> >
> > • *Include the installation of perimeter foundation subdrains with cleanouts to the lowest slab grade elevations below subgrade floors and garages. Final sizing of the subdrains can be based on the observations made during the initial excavation phase, but the initial design should be a minimum diameter of 4 inches.*

POSSIBLE FINDINGS:

- CMT Engineering concluded that the development does not appear to have shallow groundwater.
- Loughlin Water Associates, LLC concluded that the development does not appear to have shallow groundwater.
- If subgrade parking is allowed, the buildings will be better designed which will greatly impact the streetscape and the overall character of the neighborhood.

- If subgrade parking is allowed, there will be more garage area for parking and storage which will help make it possible that surface street parking will be minimal.

ALTERNATIVE ACTIONS:

1. Approval (conditional). This action can be taken if the City Council finds the proposal complies with the requirements of the code.

    a. Accept staff report
    b. List accepted findings
    c. Place condition(s) if needed

2. Continuance. This action can be taken if the City Council finds that there are unresolved issues.

    a. Accept staff report
    b. List accepted findings
    c. Reasons for continuance
        i. Unresolved issues that must be addressed
    d. Date when the item will be heard again

3. Denial. This action can be taken if the City Council finds that the request does not comply with the requirements of the code.

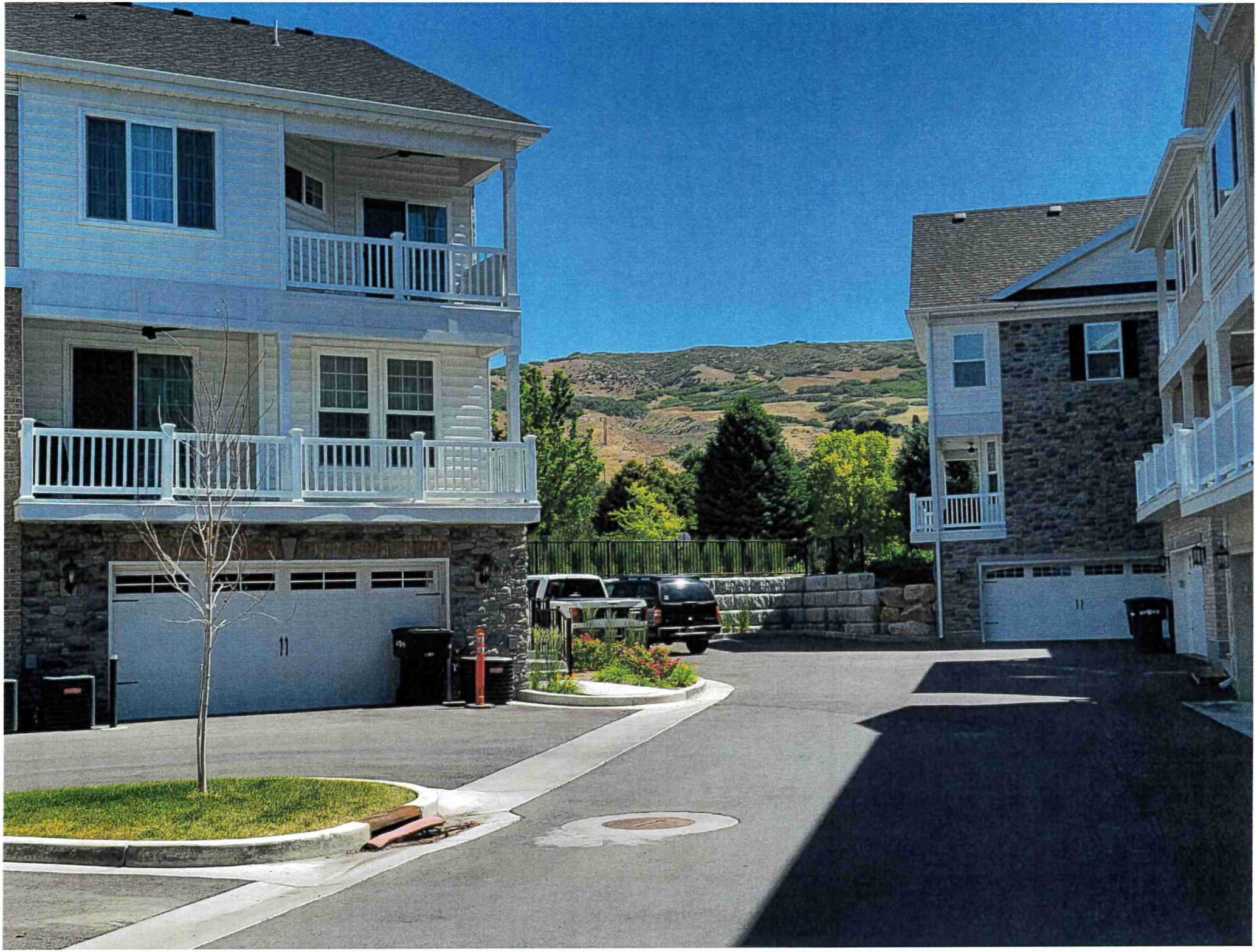
    a. Accept staff report
    b. List accepted findings
    c. Reasons for denial

PROPOSED CONDITIONS:

1. A qualified geotechnical engineer or hydrogeologist observes foundation and storm drain and sewer line excavations to the proposed invert elevations for the presence and quantity of shallow groundwater during the first phase of development.

2. Include the installation of perimeter foundation subdrains with cleanouts to the lowest slab grade elevations below subgrade floors and garages. Final sizing of the subdrains can be based on the observations made during the initial excavation phase, but the initial design should be a minimum diameter of four inches.

3. The retaining areas for the subgrade parking use landscaping rocks and fencing, very similar to the examples attached to this report, that are found at the Riverwoods in Provo.



LOUGHLIN
WATER ASSOCIATES ♦ LLC

August 15, 2022

Horrocks Engineers
Attn: Mr. Wes Johnson, P.E.
728 West 100 South, #2
Heber, UT 84032

Subject: **Hydrogeologic Assessment - Proposed "The Village" Subdivision**
Midway City, Wasatch County, Utah
for Horrocks Engineers, Inc.

Dear Wes:

Loughlin Water Associates, LLC (Loughlin Water) is grateful for the opportunity to conduct a hydrogeologic assessment of the proposed "*The Village*" Subdivision (The Village) for Midway City (Midway) for Horrocks Engineers, Inc. (Horrocks). We conducted our assessment and prepared our report in accordance with our proposal to Horrocks dated June 29, 2022.

BACKGROUND

Midway is reviewing The Village, which as shown on Figure 1, lies south of Memorial Hill, east of River Road, and north of Main Street. The Village:

- Is at approximately 473 East Main Street in Midway City, Utah;
- Spans four fenced and undeveloped fields that are currently flood and forced-irrigated and used for hay production and cattle grazing;
- Proposes 143 residential units and several commercial units on approximately 23 acres;
- Engaged CMT Engineering Laboratories (CMT) to conduct geotechnical investigations of the property.

Mr. Daniel Luster (Luster Development) is the developer of The Village. Berg Engineering is Engineer for Luster Development and The Village. Horrocks is City Engineer for Midway.

Luster Development is considering the installation of underground garages at The Village. CMT (2017a) prepared a geotechnical report of The Village and indicated that they encountered groundwater at shallow depth in two boreholes (Borings B-2 and B-4) into which they had installed slotted pipe.

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Midway is concerned that groundwater levels could rise into and flood the proposed underground parking garages. To address shallow groundwater, Midway will require The Village to install a back-up drainage system just below the bottom of each garage. CMT (2022b) stated that the back-up drainage system should be able to accommodate a groundwater flow of 30 gallons per minute (gpm).

PREVIOUS INVESTIGATIONS

CMT (2017a, 2017b, and 2021a) performed multiple geotechnical investigations during 2017 and 2021. Figure 2 shows the locations of borings and test pits completed by CMT from 2017 to 2021. Except for borings B-1A, B-2A, and B-3A, CMT test pits and borings intercepted thin soils overlying tufa deposits.

We understand that CMT:

- Conducted an initial geotechnical investigation (CMT, 2017a) for Beaugency Development, the original developer of The Village, in which they:
    - Drilled and logged five borings to depths of about 9 to 14 feet;
    - Identified intervals of tufa ranging in thickness from about 1 foot to total depth in each boring;
    - Indicated in the text of the report that groundwater was not initially encountered in Borings B-1, B-2, and B-4, but indicated on the drill logs that groundwater was encountered during drilling in borings B-2 and B-4;
    - Placed slotted pipe in Borings B-1, B-2, and B-4 for further monitoring and assessment of groundwater;
    - Measured groundwater at depths of 6 feet in Boring B-1 and 1.5 feet in Boring B-4 about 10 days after the borings were drilled; and
    - Presented their findings in a report (CMT, 2017a) in which they recommended that (1) footings be placed no deeper than 1.0 foot below grade, (2) site grading fill be used to raise the elevation above the recommended frost depth of 36 inches, and (3) basements, or any structures below a depth of 1.5 feet should not be considered.
- Conducted a second geotechnical investigation for Beaugency Development (CMT, 2017b) to the north of the initial investigation in which they (1) drilled and logged three borings to 16.5 feet through clays (see Figure 2 for locations), (2) did not encounter groundwater, and (3) presented their findings in a report dated December 20, 2017.

- Conducted a third geotechnical investigation during 2021 (CMT, 2021a), this time for The Village, in which they:

    - Excavated and logged 10 test pits to a depth of about 10 feet below ground surface, two of which were excavated adjacent to Borings B-2 and B-4 and were dry (see Figure 2 for locations);

    - Did not encounter groundwater in the test pits, and concluded that the groundwater initially encountered in B-2 and B-4 and reported in the April 2021 Report (CMT, 2021b) was from the surface and was not groundwater; and

    - Presented their findings in a report (CMT, 2021a) and (1) concluded that groundwater at The Village is deeper than 9 feet, (2) recommended that perimeter foundation subdrains be installed wherever floor slabs will be placed deeper than about 7 feet below the existing ground surface, and (3) cautioned that "*Groundwater levels can fluctuate seasonally. Numerous other factors such as heavy precipitation, irrigation of neighboring land, and other unforeseen factors, may also influence ground water elevations at the site. The detailed evaluation of these and other factors, which may be responsible for ground water fluctuations, is beyond the scope of this study.*"

- Produced a fourth report (CMT, 2021b) in which they combined and summarized the November and December 2017 Beaugency, and March 2021 Village reports.

- Conducted a fourth geotechnical investigation during 2022 (CMT, 2022a) in which they:

    - Re-excavated test pits TP-2 and TP-3 to a depth of 16 feet and TP-9 to a depth of 10.5 feet, and placed slotted PVC pipe in each test pit for future groundwater level measurements;

    - Did not observe groundwater or signs of groundwater within the re-excavated test pits and concluded that groundwater is not present within the upper 10 feet at the site; and

    - Summarized their findings in a letter dated May 12, 2022 (Addendum to Geotechnical Study); and

- Produced a second letter report (CMT, 2022b) in which they reviewed Well Driller Reports (well logs) for nearby domestic water supply wells and (1) concluded that groundwater levels at the site, even during years of abundant precipitation, will be at least 27 feet below the ground surface and (2) stated that pumping test rates of two nearby wells that ranged from 20 to 30 gpm "*...which is useful for designing drain systems of below-ground facilities.*"

FINDINGS

GEOLOGY

Alluvial-fan deposits derived from creeks originating in the highlands that surround Heber Valley coalesce in lower elevation areas near the Provo River. Unconsolidated valley-fill deposits in Heber Valley range in thickness from less than 100 to as much as 375 feet (Roark and others, 1991).

Midway is in the western part of Heber Valley. Figure 3 is modified from Biek (2019) to show the surficial geology of The Village and Midway areas. Unconsolidated deposits near The Village include eastward-sloping alluvial fans of Quaternary-age unconsolidated sediments that include poorly to moderately sorted, weakly to non-stratified, clay-to boulder-sized sediment shed from the Wasatch Mountains. These sediments were deposited principally by debris flows and debris floods at the mouths of active drainages such as Snake Creek and form alluvial fans (Biek, 2019). Well logs indicate the unconsolidated valley-fill deposits primarily consist of lenticular and discontinuous beds of poorly sorted material ranging in size from clay to boulders. In Midway, these unconsolidated deposits are interlayered with tufa (hot spring) deposits.

Tufa is exposed at the ground surface in several areas of Midway, typically around hot springs to the north-northwest of The Village. Tufa underlies most of The Village property and is a light brown to pale-grayish-yellow, highly porous, and vuggy calcareous spring deposit that forms mounds and broad terraces. Tufa is deposited from thermal (warm to hot) springs and results from the deep circulation of precipitation and snowmelt in the nearby Wasatch Range (Biek, 2019). Groundwater rises to the surface along minor faults at the north edge of the area and through fractures along the crest of the anticline (upwarp in bedrock) that underlies Midway (Kohler, 1979).

Figure 3 shows that the inferred anticline plunges (dives) to the southeast, towards, but ends north of Memorial Hill before reaching The Village. The tufa deposits are locally more than 100 feet thick and are underlain by alluvium (Kohler, 1979). The thickness of unconsolidated deposits overlying bedrock is confirmed in some of the well logs in Attachment 1. Tufa deposits crop out or interfinger with unconsolidated valley-fill deposits at shallow depths in the vicinity of Midway (Roark and others, 1991).

Memorial Hill, located immediately to the north of The Village and consists of south dipping (tilting) Triassic-age bedrock of the Thaynes and Woodside formations. Quaternary-age unconsolidated sediments are interbedded with Tufa deposits on all sides of the older bedrock (Thaynes Formation) that forms Memorial Hill.

REGIONAL GROUNDWATER

Unconsolidated valley fill deposits are the principal source of groundwater to domestic wells in the Heber area (Roark, 1991). Figure 4 is modified from Baker (1970) to show the elevation of groundwater in the principal aquifer in Heber Valley during the 1960s. Figure 4 indicates that the elevation of groundwater in the principal aquifer below The

Village was about 5,550 to 5,575 feet with a flow direction to the southeast. Current groundwater elevations in the principal valley fill aquifer may be lower than shown on Figure 4 based on more recent measurements and may be closer to 5,550 than 5,575 feet below The Village.

Multiple aquifers are present in the Midway area and include (1) deeply circulated thermal groundwater which is artesian (elevation above the ground surface) in areas below the tufa north of 600 North in the Southwest Quarter of Section 26 and (2) cooler groundwater under confined and unconfined conditions in Sections 26 and 35 within or below the tufa. The elevation of shallow groundwater ranges from about 5,606 feet at Memorial Hill Drive in Well (D-3-4)35abc-1 to about 5,625 feet near 250 East, which is near the West Quarter corner Section 35, about 2,500 feet west of The Village; see Figure 1 for well locations. Groundwater flow in the shallow aquifer is to the south-southeast, following the expression of the topographic surface. The groundwater gradient of the shallow aquifer in Section 35 is about 0.02 feet per foot (ft/ft).

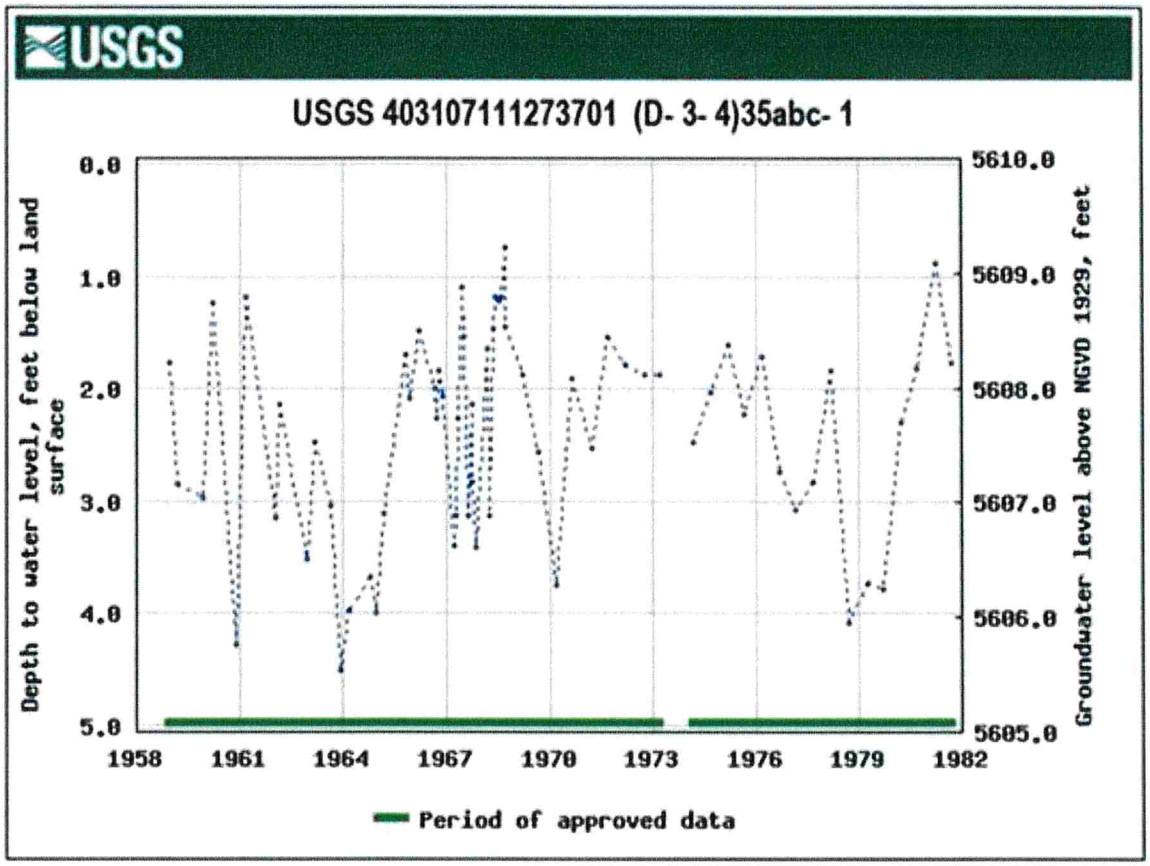
SHALLOW GROUNDWATER

Figure 5 shows the location of The Village and areas in Midway where groundwater is found at depths of 3 feet or less including:

- Along the Pine Creek and Snake Creek streambeds;
- Between Memorial Hill and 1050 North (Burgi Lane) and west to Snake Creek; and
- In the lowest elevation areas between Highway 40 and the Provo River, just north of its intersection with Route 113.

Springs, hot springs, tufa hotpots, and wetlands are typically associated with shallow groundwater in these areas in Midway. We did not identify these features on The Village property during our two site visits. Groundwater in the shallow aquifer, where present, appears to fluctuate seasonally by about 1 to 3 feet.

The U.S. Geological Survey (USGS) monitored the water level in Observation Well (D-3-4)35abc-1 (the USGS Observation Well) from the late 1950s until 1982. Figure 1 shows the location of the well. We were not able to find a well log in the Utah Division of Water Rights (DWRi) online database, but (1) the USGS indicates that the well is completed to a depth of 21 feet and (2) based on its location and depth the well is likely completed in tufa. Water levels in this well appear to be representative of the shallow groundwater system in the Northwest Quarter of Section 35. The following is a plot of groundwater level versus time (hydrograph) in the well between 1959 and 1982. This plot indicates that shallow groundwater was consistently present and that the level fluctuated seasonally by about 1 to 3 feet. The USGS has not monitored this well since 1982.



Reference: USGS National Water Information System, 2022

CMT (2022b) evaluated nearby wells and estimated groundwater levels and flow rates for the purpose of designing perimeter foundation subdrains at The Village. However, this approach may not be suitable for design purposes. To date, the dry test pits and test pits equipped with slotted pipes have indicated the presence of transient (short term) water that likely represents irrigation return and not the presence of saturated groundwater conditions.

We obtained and reviewed well logs in The Village area from the DWRi (2022) online database. Attachment 1 provides copies of well logs and Table 1 summarizes information for these wells.

TABLE 1
SUMMARY OF NEARBY WELLS

Water Right No./WIN	Approximate Distance from The Village	Drilled Depth (feet)	Depth to Water (feet)	Month /Year Measured	Comments
55-937 3227	450 feet East	92	+58[a]	January 1960	Flowing artesian well; groundwater encountered at 92 feet in limestone sand and gravel and rose to 58 feet above ground surface.
55-8139 3211	2,000 feet North	173	+5	June 1991	Flowing artesian well; groundwater encountered at 150 feet and then rose to 5 feet above ground surface. Groundwater described as brackish.
55-5343 3232	1,200 feet East	107	40	September 1975	Groundwater encountered in gravel below tufa at 91 feet and rose to 40 feet below ground surface.
55-12282 431699	1,250 feet Northeast	125	38.5	August 2008	Groundwater encountered in gravel interbed within tufa at 46 feet and rose to 38.5 feet below ground surface
55-8088 7969	1,170 feet Northwest	100	3	January 1995	Groundwater encountered in sand and gravel interbedded with tufa at 30 feet and rose to a depth of 3 feet. Shallow water could have been cased-off in this well.
55-4722 3133	1,800 feet Southeast	125	60	July 1976	Groundwater encountered in gravel at 110 feet and rose to a depth of 60 feet.

WIN means Well Identification Number.
[a] *"+" means that groundwater level was above the ground surface.*

Wells in Table 1 indicate:

- Confined groundwater conditions exist to the east, southeast, north, and northwest of The Village property;
- Groundwater was either encountered during drilling below 30 feet and rose to shallower depths, or was encountered in gravels below the tufa (about 90 to 150 feet) and rose to close to or above the ground surface; and
- Groundwater in WIN 3227, the closest well to the Village, was first encountered at 92 feet, and then rose to almost 60 feet above and flowed at the ground surface.

GROUNDWATER AT THE VILLAGE

Apparent observations of groundwater at The Village are not consistent with known occurrences of shallow groundwater to the northwest in Section 35. CMT excavated 13 test pits and drilled 8 borings. All the test pits were dry. All but 2 borings were dry. CMT

logs for the initial borings show that groundwater was encountered in B-2 and B-4 on October 16, 2017 during drilling. CMT installed slotted pipes in Borings B-1, B-2, and B-4. CMT did not install slotted pipes in borings B-3 and B-5. On or about October 27, 2017 (about 10 days later), CMT measured groundwater in (1) B-2 at 6 feet below grade (5,561 feet), and (2) B-4 at 1.5 feet below grade (5,574 feet). Boring B-1 was dry. Subsequent measurements of these three borings were dry. These apparent groundwater level elevations of 5,561 to 5,574 are above the projected regional groundwater elevation of about 5,550.

During the 3-month period from August 1, 2017, to October 31, 2017, The Village area received only 2.18 inches of rainfall; see Attachment 2. Rainfall is measured and recorded at Rivendell Farm, a meteorological station at the approximate location shown on Figure 1. During the 10-day period (October 16 to October 27, 2017), between drilling and the apparent observation of groundwater in Borings B-2 and B-4, the area received only 0.01 inches of rain. CMT (2017a) did not report whether the slotted pipes placed in Borings B-1, B-2 and B-4 were gravel packed or sealed from the ground surface. If the slotted pipes were not gravel packed and sealed, surface water from flood and forced irrigation at The Village property could have saturated the thin silty loam layer that overlies the tufa and flowed into the borings. Attachment 3 indicates that the silty loam material has a low permeability of about 0.06 inches per hour.

Table 2 summarizes water levels measured by CMT (October 2017 to May 2022) and Loughlin Water (June 24 and July 20, 2022):

TABLE 2
WATER LEVELS MEASURED IN BORINGS AND TEST PITS

Date of Measurement	Boring/Test Pit Number	Estimated Ground Surface Elevation	Depth to Water (feet)	Depth of Boring/Test Pit Pipe (feet)	Estimated Water Level Elevation (feet)
10/16/2017	B-1	5,569	Dry	14	Dry
10/16/2017	B-2	5,567	6	12.5	5,561
10/16/2017	B-4	5,575.5	1.5	9	5,574
10/27/2017	B-1	5,569	Dry	14	Dry
10/27/2017	B-2	5,567	6	12.5	5,561
10/27/2017	B-4	5,575.5	1.5	9	5,574
3/23/2021	B-2	5,567	Dry	12.5	Dry
3/8/2022	TP-2	5,575.5	Dry	9.5	Dry
3/8/2022	TP-3	5,567	Dry	9.4	Dry
3/8/2022	TP-9	5,562	Dry	10.1	Dry
5/11/2022	TP-2	5,575.5	Dry	9.5	Dry
5/11/2022	TP-3	5,567	Dry	9.4	Dry
5/11/2022	TP-9	5,562	Dry	10.1	Dry
6/24/2022	TP-2	5,575.5	Dry	9.5	Dry
6/24/2022	TP-3	5,567	8.34	9.4	Dry
6/24/2022	TP-9	5,562	Dry	10.1	Dry
7/20/2022	TP-2	5,575.5	Dry	9.5	Dry
7/20/2022	TP-3	5,567	Dry	9.4	Dry

See Figure 2 for locations of borings and test pits.

About 0.94 feet of water was measured the slotted pipe in Test Pit TP-3 on June 24, 2022; however, Table 2 shows TP-3 as "*Dry*" because the pipe was in a water-filled depression and the measurement is believed to be suspect. The water levels measured in Borings B-2 and B-4 (estimated elevations between 5,559 to 5,574 feet) lie above the elevations of the regional aquifer (estimated at about 5,550 feet). These elevations are also higher than the proposed design of the storm and sewer drains (Berg, 2022).

The data indicate that The Village has been predominantly dry over a nearly 5-year period, as indicated in Table 2.

CMT LABORATORY SOIL MOISTURES

Moisture levels in the split-spoon (SPT) and Shelby Tube samples collected from borings and test pits, as reported by CMT, ranged from about 5 percent in the tufa to 24 percent in the silty sand samples. CMT moisture content data, are shown below:

Lab Summary Table

Test Pit	Depth (feet)	Soil Class	Sample Type	Moisture Content (%)	Dry Denstiy (pcf)	Gradation			Atterberg Limits			Collapse (-) or Expansion (+)
						Grav	Sand	Fines	LL	PL	PI	
B-1	1	SC	SPT	18		22	54	24	38	21	17	
B-2	2.5	SM	SPT	22		4	72	24		NP		
B-5	5	SM	SPT	21		13	63	24				

Lab Summary Table

Test Pit	Depth (feet)	Soil Class	Sample Type	Moisture Content (%)	Dry Denstiy (pcf)	Gradation			Atterberg Limits			Collapse (-) or Expansion (+)
						Grav	Sand	Fines	LL	PL	PI	
B-1	5	CL	Shelby Tube	18	105.8				33	19	14	
B-2	7.5	CL	Shelby Tube	19	101.6				34	18	16	
B-3	10	SM	SPT	24		10	54	36				

LAB SUMMARY TABLE

EXPLORATION	DEPTH (feet)	SOIL CLASS	SAMPLE TYPE	MOISTURE CONTENT(%)	DRY DENSITY (pcf)	GRADATION			ATTERBERG LIMITS			COLLAPSE (-)/ EXPANSION(+)
						GRAV.	SAND	FINES	LL	PL	PI	
B-1	1	Tufa (SC)	SPT	18		22	54	24	38	21	17	
B-2	2.5	Tufa (SC)	SPT	22		4	72	24				
B-5	5	Tufa (SC)	SPT	21		13	63	24				
B-1A	5	CL	Shelby Tube	18	106				33	19	14	-0.2%
B-2A	7.5	CL	Shelby Tube	19	102				34	18	16	-0.2%
B-3A	10	SM	SPT	24		10	54	36		NP	NP	
TP-4	8	Tufa(SP-SC)	Bag	7		38	53	9				
TP-6	6	Tufa(GP-GC)	Bag	6		48	41	11				
TP-10	4	Tufa(GP-GC)	Bag	5		47	46	7				

Reference: CMT, 2017a, 2017b, 2021a

Saturation is the threshold at which all the pores (empty spaces between the solid soil particles) are filled with water. The volumetric water content for the saturation threshold varies from 30 percent in sandy soils to 60 percent in clay soils (Oklahoma, 2017). Soil moisture contents presented in the lab summary tables indicate that the CMT split spoon soil samples from borings and test pits to a depth of 10 feet have soil-moisture contents below the level (in percent) that would indicate saturated conditions. Soils at The Village did not exceed 24 percent moisture. The coarser tufa was very dry, whereas interbedded clay deposits collected with the Shelby Tube sampler indicated very soft conditions, minor collapse potential, and relatively low moisture content for a clay.

SURFACE WATER IRRIGATION

The Village property has both flood and forced irrigation. Figure 6 shows surface water features on the site.

On June 24, 2022, Loughlin Water observed the following at The Village:

- Low spots, shown on Figure 6 containing ponded surface water, we assume, from forced site irrigation of overlying low-permeability soil;
- A dry irrigation ditch on the east side of the property draining to a subgrade 4-inch diameter corrugated high-density polyethylene (HDPE) pipe;
- A 2-inch diameter HDPE pipe discharging into an east-west shallow channel that dispersed water to the southeast (at the approximate location shown on Figure 6) via flood irrigation; and
- An unlined irrigation ditch conveying water from west to east through the northern part of the property

Nearly all these surface water features are at elevations that are higher than the water levels observed in slotted pipe in borings B-2 and B-4 on October 27, 2017. We measured a small amount of water in TP-3, but also observed surface water ponded around the pipe. Ponded locations on the surface soils confirm the NRCS assessment that the surface soil has a low vertical infiltration rate; see Attachment 3.

On July 20, 2022, Loughlin Water observed the following at The Village:

- The 2-inch diameter pipe produced less water than in June, about 2 gpm;
- Surface water was ponding in low spots near fence lines;
- An approximately 0.02-acre pond near the northwest corner of the property;
- Flows of about 0.5 to 0.65 cubic feet per second (CFS), equivalent to about 225 to 290 gpm, in the active irrigation ditch in the northern portion of the property; and

- No water (dry conditions) in the slotted casings in TP-2 and TP-3.

Due to the (1) limited access, (2) heavy vegetative growth, and (3) irregularity of the irrigation ditch profile, it was not feasible to assess whether losses were occurring to the subsurface along the irrigation ditch alignment.

CONCLUSIONS

We conclude the following from our review of (1) information provided by CMT, (2) our observations of conditions at The Village, (3) information for nearby wells, (4) rainfall data from Rivendell Farm meteorological station, (5) soil data from the NRCS, (6) engineering drawings, and (7) our experience drilling wells and conducting hydrogeologic studies of area:

- The Village does not contain surface water features (springs, hot springs, tufa hotpots, and wetlands) that are typically associated with the shallow aquifer in the northwest quarter of Section 35 or in Midway. However, The Village design will incorporate surface landscaped ponds and the developer must take measures to ensure that there will be no leakage from these proposed ponds.

- The elevation of groundwater in the shallow aquifer to the east and west of The Village, where present, varies by only a few feet on a seasonal basis and is not transient.

- CMT did not observe groundwater or saturated soil conditions during the drilling of borings or excavation of test pits.

- CMT laboratory soil moisture contents do not indicate the presence of saturated conditions.

- The observation of water in Borings B-2 and B-4 represents a transient event.

- Limited groundwater monitoring data indicate that The Village has been predominantly dry over a nearly 5-year period.

- The Village has an undetermined amount of forced and flood irrigation which could be the source of the water observed in Borings B-2 and B-4 during October 2017 which was also a period of low rainfall; see Attachment 2. The surficial soils have a low permeability (see Attachment 3). If the slotted pipes were not sealed from the ground surface, irrigation water could have flowed into the borings.

- Only 0.01 inches of rainfall fell in the area during October 2017 between the time the first slotted pipes were installed and when water was observed in Borings B-2 and B-4. Therefore, it is reasonable to assume that rainfall was not the source of the water observed in Borings B-2 and B-4.

- Groundwater beneath the site is inferred to be under confined conditions. Groundwater levels in some of the closest wells are above the ground surface.

Groundwater is typically found in tufa interbeds of clay, sandy clay, or gravel, possibly as shallow as 30 feet below The Village, but that is uncertain. The closest well (WIN 3227) indicates groundwater was first encountered at a depth of 92 feet and then rose to 58 feet above the ground surface.

RECOMMENDATIONS

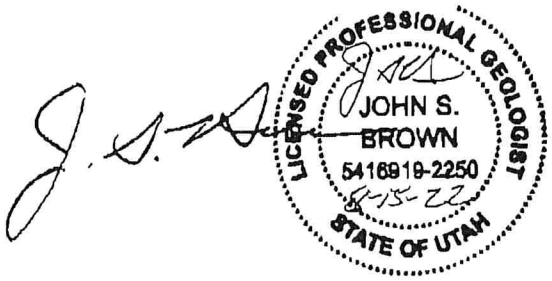
The Village does not appear to have shallow groundwater. However, that does not mean that conditions could not change in the future. Shallow groundwater elevations west of The Village are higher in elevation (around 5,600 feet) than the site excavations (down to 5,555 feet), and irrigation return from the north and the west have the potential to impact soil moisture in the future. Additionally, return from forced irrigation and seepage from a proposed central surface water feature have the potential to impact subgrade structures. We assume that the current irrigation will be maintained but contained in a pipe during and following the construction of The Village. The design criteria of 30 gpm recommended by CMT (2022b) for subdrains is based on aquifer testing of a nearby well and may not be applicable to flow into horizontal drains in areas of transient water occurrence.

It is not feasible to develop perimeter foundation subdrain system based on a transient (short term) occurrence of water in the slotted pipes. Therefore, we recommend that The Village:

- Engage a qualified geotechnical engineer or hydrogeologist to observe foundation and storm drain and sewer line excavations to the proposed invert elevations for the presence and quantity of shallow groundwater during the first phase of development.

- Include the installation of perimeter foundation subdrains with cleanouts to the lowest slab grade elevations below subgrade floors and garages. Final sizing of the subdrains can be based on the observations made during the initial excavation phase, but the initial design should be a minimum diameter of 4 inches.

If you have any questions or need more information, please do not hesitate to call John (JB) Brown at (435) 649-4005 (office) or (801) 580-4530 (mobile).



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Senior Hydrogeologist

William D. Loughlin, P.G.
Manager, Principal Hydrogeologist

Table 1 – Summary of Nearby Wells
Table 2 – Water Levels Measured in Borings and Test Pits

Figure 1 – Location Map
Figure 2 – Locations of Test Pits, Borings, and Site Features
Figure 3 – Geologic Map
Figure 4 – Groundwater Elevation Map
Figure 5 – Shallow Groundwater in Heber Valley
Figure 6 – Surface Water Flow and Site Features

Attachment 1 – Well Driller Reports
Attachment 2 – Meteorological Data – Rivendell Farms, Midway, Utah
Attachment 3 – NRCS Custom Soil Report for The Village, Midway, Utah

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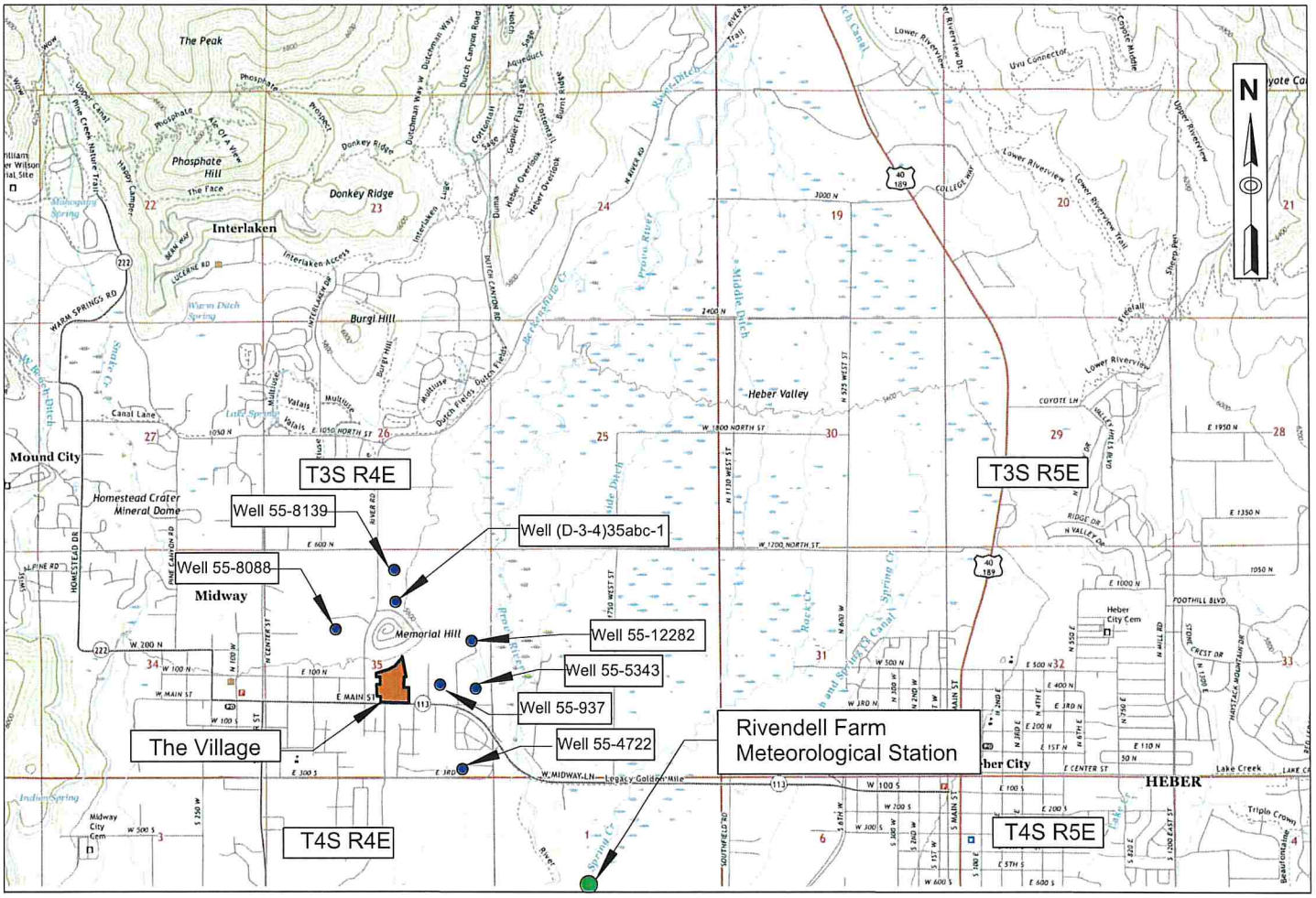

:cale Topographic Map - Heber, Utah, 2020

All locations are approximate

0 1500 3000

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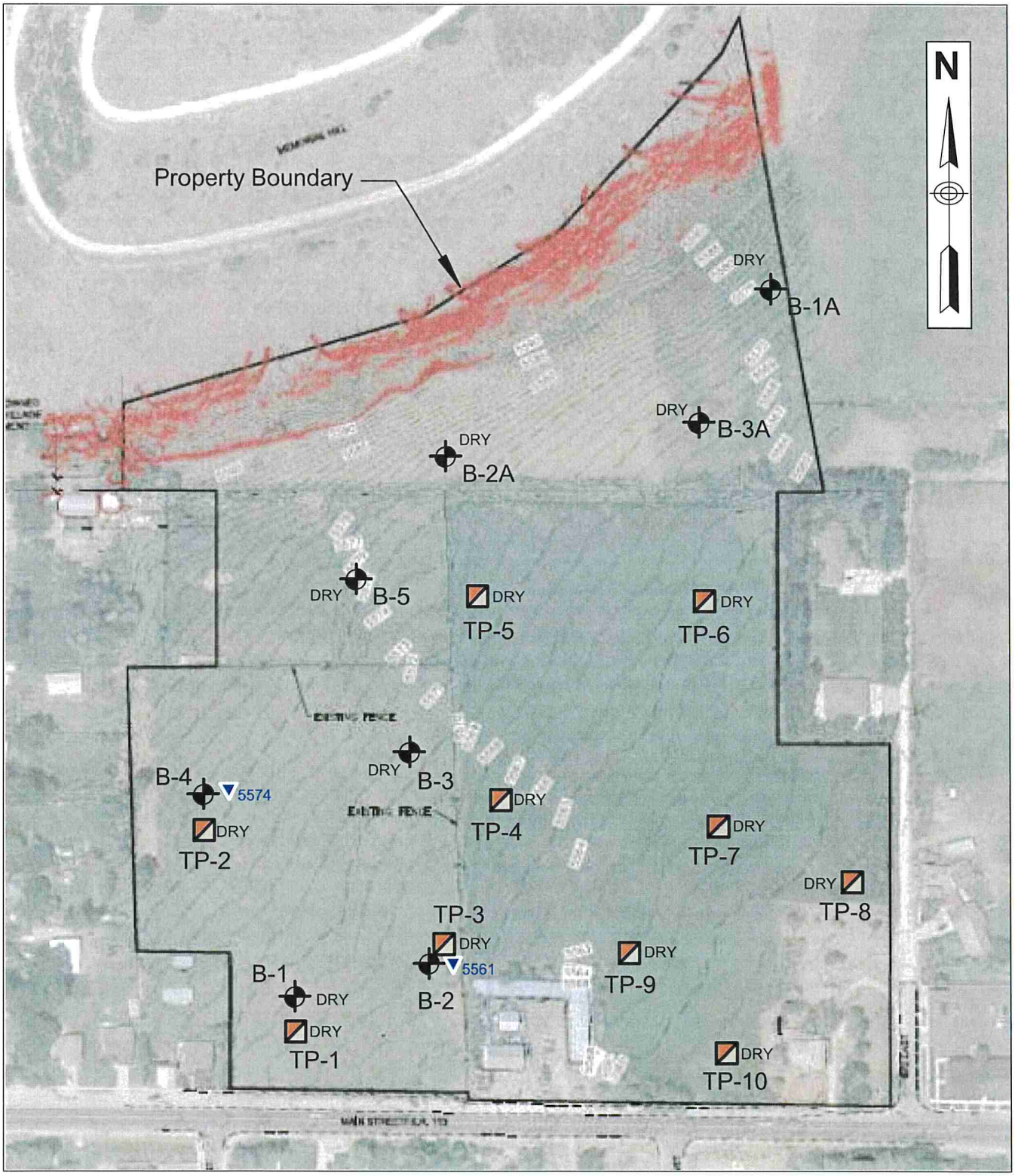
The Village
Location Map
Figure 1



Reference:Berg Engineering - Sensitive Lands Map, Sheet 2, May 25, 2022

KEY

Test Pit (March 23, 2021)

Soil Boring (October 17, 2017 and December 8, 2017)

5561 Estimated Water Level Elevation October 25, 2017

0 100 200

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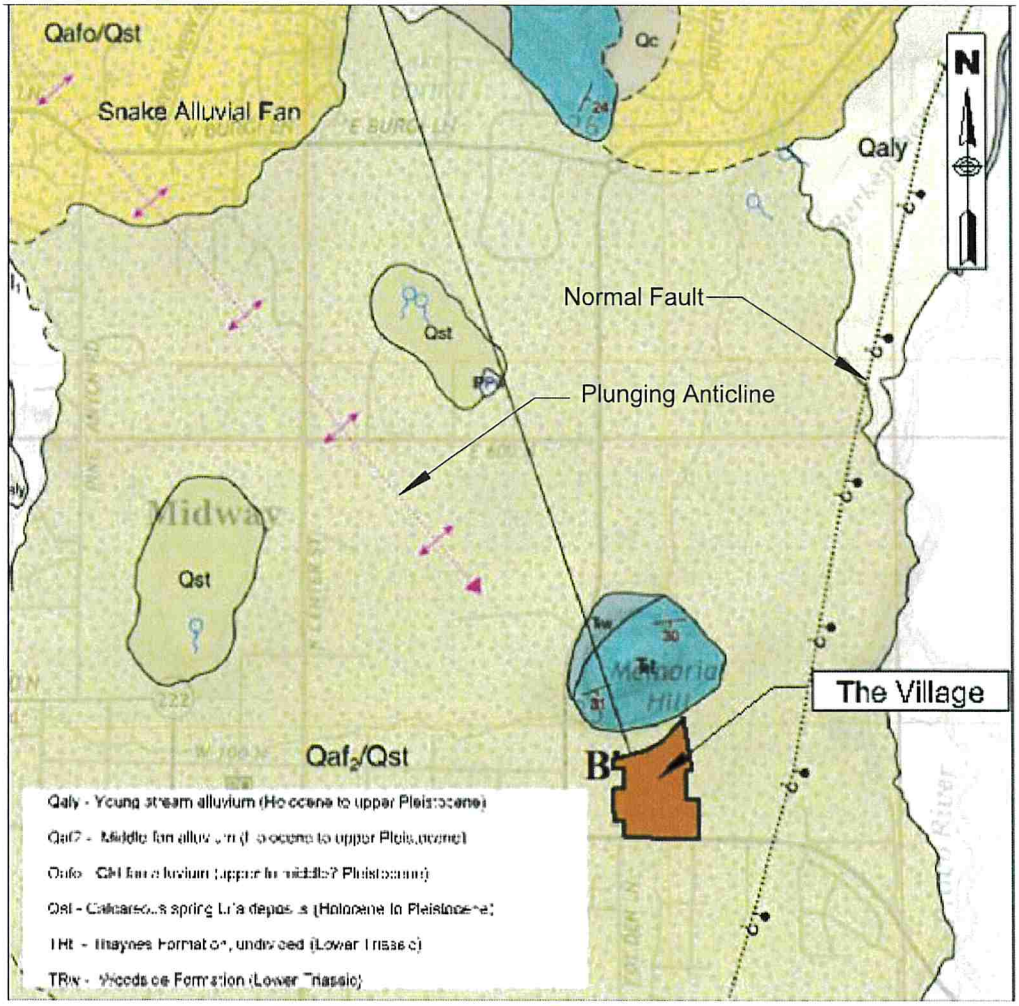
The Village
Location of CMT Test Pits, Borings and Site Features

Figure 2



Reference:Biek, 2019

0 1/8 1/4

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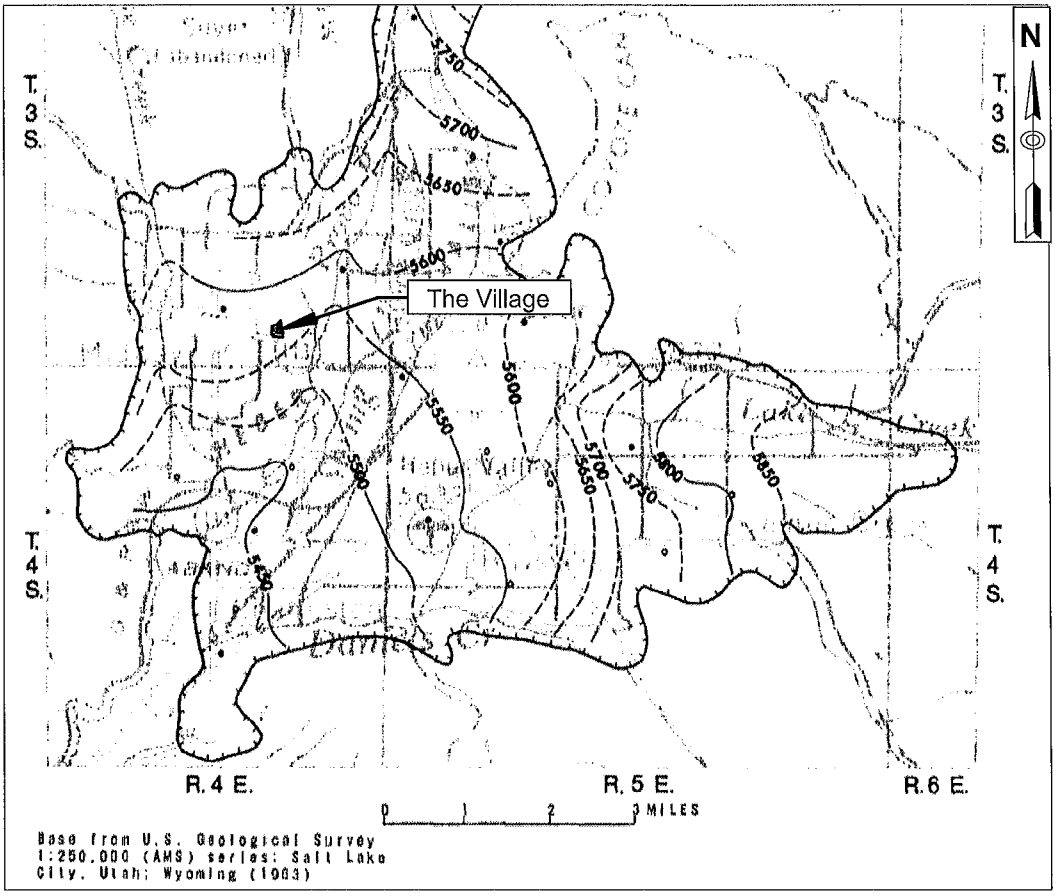
The Village
Geologic Map
Figure 3



Reference:Baker, 1970, Figure 10

All Locations are approximate

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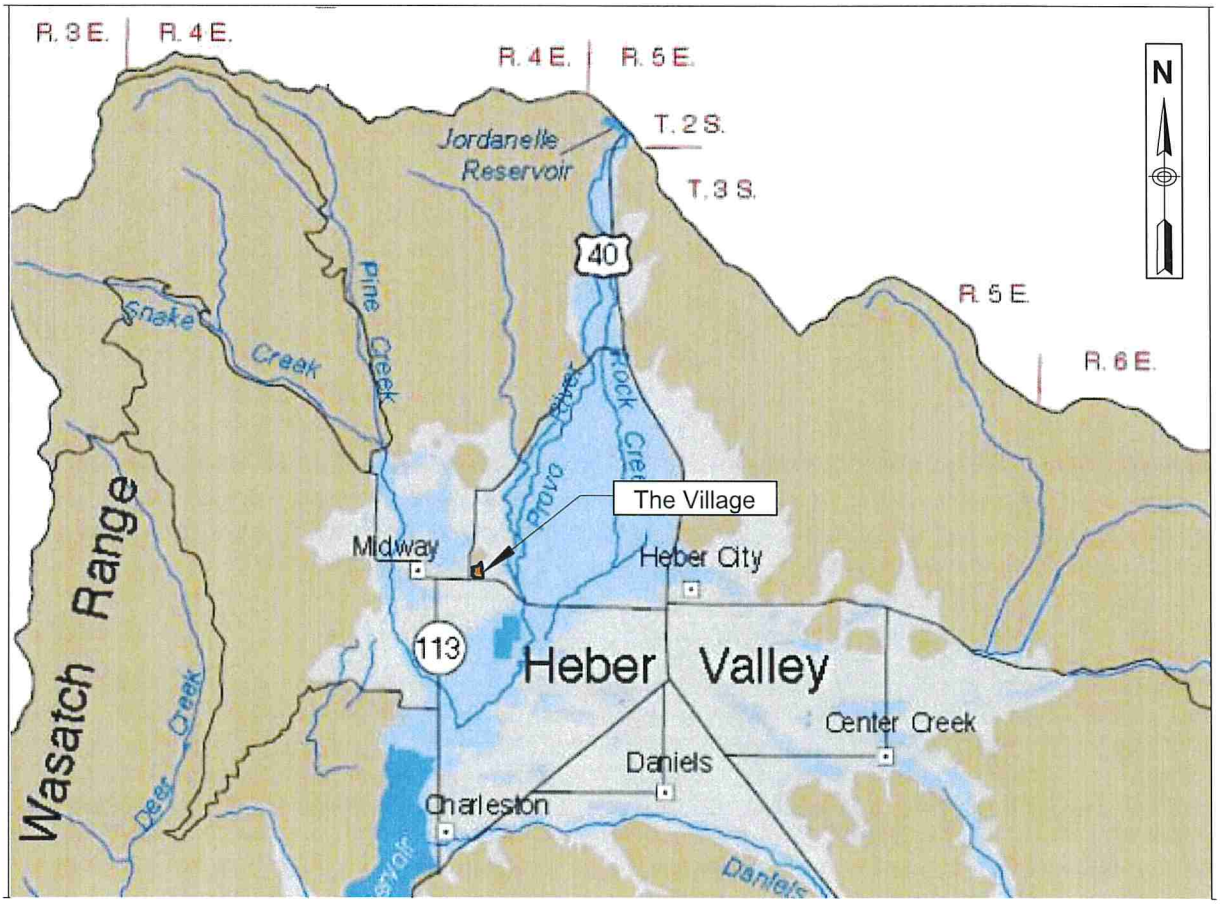
Heber Valley
Groundwater Elevation Map

Figure 3



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Depth to Ground Water
- Less than or equal to 3 feet
- No data
- Bedrock
- Water bodies

0 1 2
APPROXIMATE SCALE IN MILES

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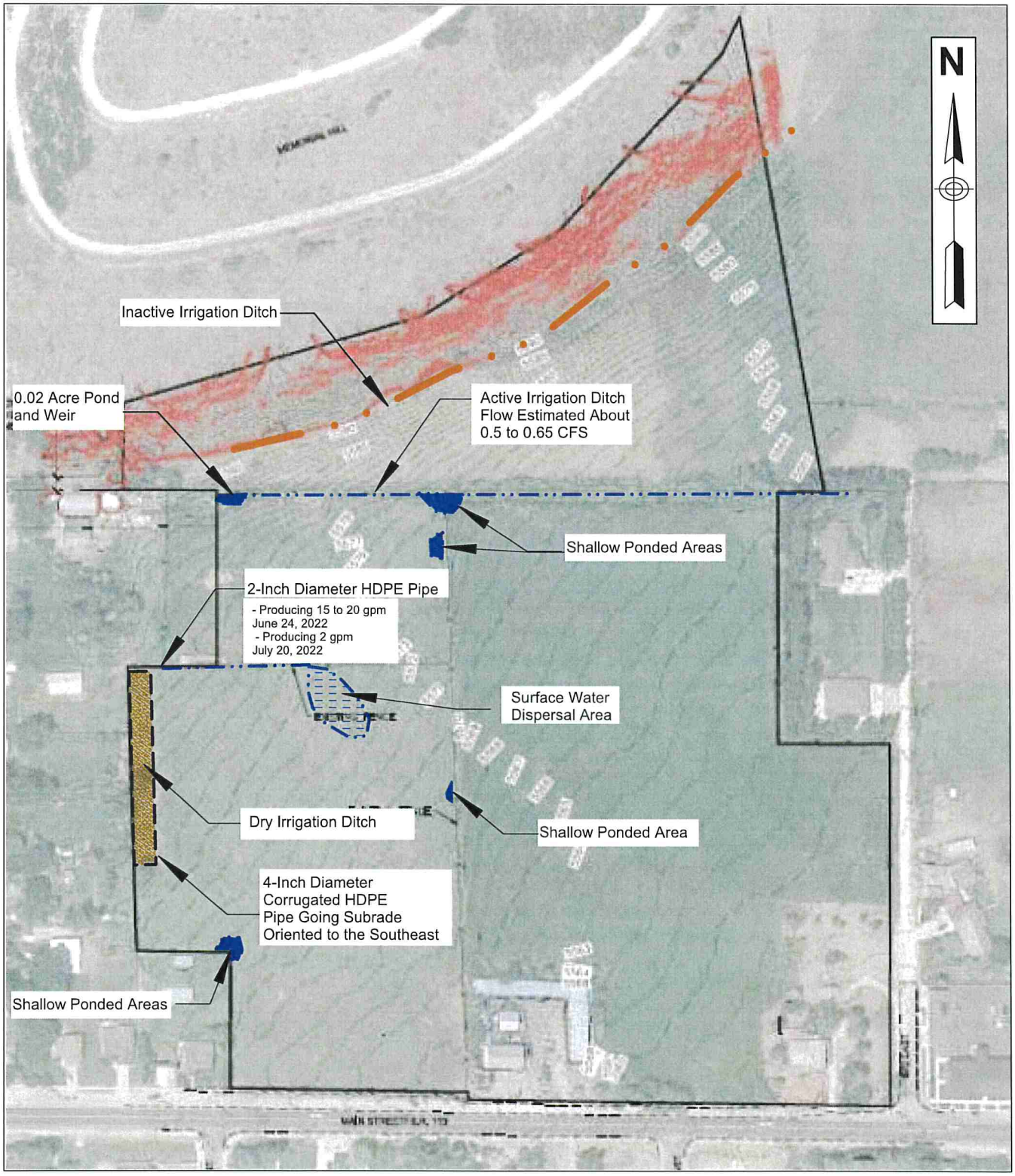
Shallow Groundwater in Heber Valley

Figure 5



Reference:Berg Engineering - Sensitive Lands Map, Sheet 2, May 25, 2022

Loughlin Water observations on June 24 and July 20, 2022

0 100 200

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Location of Surface Water Flow and Site Features

Figure 6

LOUGHLIN WATER ASSOCIATES, LLC