



June 1, 2018

City of Laramie
City Manager's Office
P.O. Box C
Laramie, Wyoming 82073

Attn.: Mr. Darren Parkin
Water Resources Manager

Re: Site Specific Investigation
Upland Heights B5
Technical Review

Dear Mr. Parkin:

This letter serves to present the findings of our technical review of the site specific investigation prepared by WWC Engineering (WWC) and presented to City of Laramie for the future development of the Upland Heights B5 Lot located within the Casper Aquifer Protection Area. Our review comments will be presented to address the adequacy of this site specific investigation in fulfilling the requirements of the City of Laramie's Unified Development Code, subsection 15.08.040.A.8.

15.08.040.A.8(d)(i) A literature search to determine the presence of mapped faults, folds, fractures, and other evidence of conduit flow on the subject property.

WWC's literature search to address the presence of mapped faults, folds, fractures, and other evidence of conduit flow on the site of the proposed subdivision is adequate. Additional information that could also have been reviewed are the following SSI reports in the Upland Heights area:

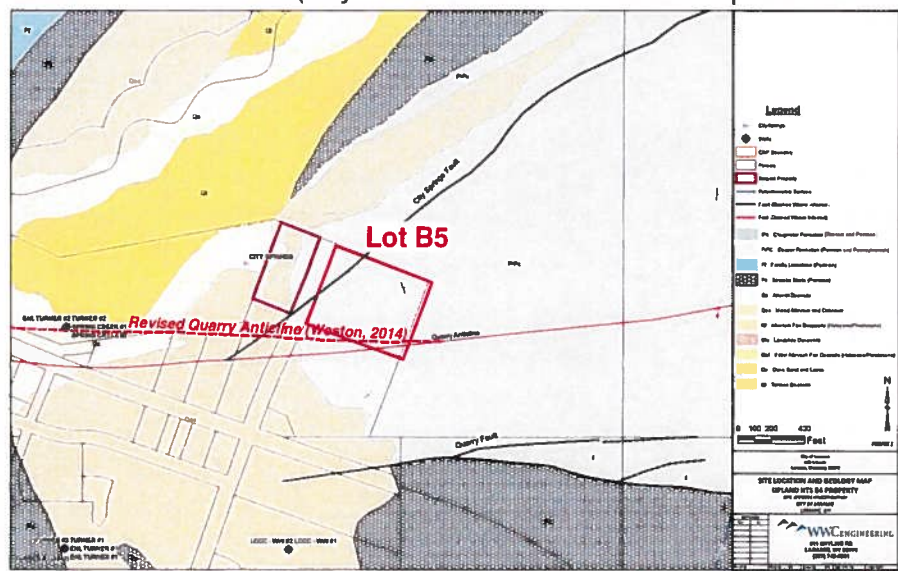
- Final Site-Specific Investigation Report, Laramie Ford Expansion, Revision No. 3, Prepared by Trihydro Corporation for Groathouse Construction, November 12, 2012.
- Technical Review of: SSI Report Laramie Ford Expansion, Groathouse Construction, Laramie, Wyoming. Revised June 7, 2011 by Trihydro Corporation. Technical review prepared and submitted by Wyoming Groundwater, LLC, June 10, 2011.
- Technical Review of: SSI Report Laramie Ford Expansion, Groathouse Construction, Laramie, Wyoming. Revised June 7, 2011 by Trihydro Corporation. Technical review prepared and submitted by Wyoming Groundwater, LLC, November 23, 2012.
- Addendum to Site-Specific Investigation for White's University Motors for Commercial Building Services Inc. Prepared by Trihydro Corporation, May 2, 2014.
- Technical Review of: Addendum to Site-Specific Investigation for White's University Motors for Commercial Building Services Inc. May 2, 2014, by Trihydro Corporation. Technical review prepared and submitted by Wyoming Groundwater, LLC, June 10, 2014.
- Site-Specific Geologic and Hydrogeologic Investigation Report Wyoming State Bank Addition. Prepared by Weston Engineering for Snowy Range Investments, LLC, March 2012.



ENGINEERING ASSOCIATES
CONSULTING ENGINEERS & SURVEYORS

- Technical Review of the Site-Specific Geologic and Hydrogeologic Investigation Report Wyoming State Bank Building Addition Provided by Weston Engineering to the City of Laramie. Technical review prepared and submitted by InterTech Environmental & Engineering, LLC, March 22, 2012.
- Site-Specific Investigation Report for City of Laramie, City Springs Chlorination Application Site Improvements. Prepared by WWC Engineering for the City of Laramie, June 10, 2010.
- Technical Review of: SSI Report for City Springs Chlorination Application Site Improvements. June 10, 2010, by WWC Engineering. Technical review prepared and submitted by Wyoming Groundwater, LLC, July 1, 2010.
- Site-Specific Geologic and Hydrogeologic Investigation Report, American National Bank Exterior Improvements Project. Prepared by Weston Engineering for Realty Management Group, September 15, 2014.
- Technical Review of the Site-Specific Geologic and Hydrogeologic Investigation Report Upland Heights Block 2 Lot 1, prepared by Trihydro Corporation for the City of Laramie by Wester-Wetstein & Associates, Inc., September 16, 2015.
- Technical Review of the Site-Specific Geologic and Hydrogeologic Investigation Report Upland Heights Block 3 Tract A, prepared by Trihydro Corporation for the City of Laramie by Wester-Wetstein & Associates, Inc., September 11, 2015.
- Ver Ploeg, A.J., 2009, Revised Geologic Map of the Laramie Quadrangle, Albany County, Wyoming: American National Geological Survey Map Series MS 50, Scale 1:24,000.

WWC identified three structural features near Upland Heights B5 Lot – two faults (City Springs and Quarry Faults) and a structural fold (Quarry Anticline). The Quarry Fault is well outside of the required vulnerable feature setback distance of 100 feet (City of Laramie Unified Development Code, subsection 15.08.040.A.7(b)). WWC has indicated that the City Springs fault cuts through the northwest quarter of the lot. The third feature, the Quarry Anticline hinge, is described in the WWC SSI report as crossing the southeast corner of the lot. Based on field work performed by Weston Engineering, they proposed that the fold axis of the Quarry Anticline may actually be located further to the north than that mapped by Ver Ploeg (2009) as shown in the adjacent figure. This





placement of the fold axis would bisect most of the southern section of the lot, and as described by WWC, results in the north limb of this structural fold encompassing a majority of Lot B5.

Three smaller drainages are located on the northern and southern boundaries of the parcel with the third located near the middle of the lot. These smaller drainages have been slightly accentuated by the excavation and corresponding leveling of this lot. These smaller drainages, although not specifically mentioned in the SSI report, were addressed when WWC evaluated the volume of surface water runoff through the lot area.

15.08.040.A.8(d)(ii) A site narrative that includes historical information on previous land use, contaminant releases, abandoned wells, underground storage tanks, and septic systems as well as any other information relevant to the site.

The SSI prepared by WWC provides a thorough and descriptive narrative of the land parcel and its development history including a brief summary of future developmental requirements. WWC stated that Wyoming Department of Environmental Quality (WDEQ) does not list any underground storage tanks or contaminated releases on the property from a review of the 10-3-2017 contaminated site reports. The lack of contaminant releases and underground storage tanks was verified by a review of the WDEQ Solid and Hazardous Waste Division's 4-2-2018 contaminated site reports and EPA's Enviromapper databases.

Our review of the Wyoming State Engineer's Office (SEO) E-Permit website indicates that there have been no wells permitted with the SEO in Section 35 of Township 16 North, Range 73 West and since WWC prepared the SSI. Therefore, based on the data presented in the SSI report as discussed in the site investigation narrative, WWC has confirmed that there are no wells on the project site.

With the data presented, and from their narrative with respect to their well research and septic system investigation, WWC has met the requirements of this section.

15.08.040.A.8(d)(iii) A site plan showing the proposed use and zoning of the property including existing and proposed ground contours accurate to a two-foot interval as referenced to the USGS contour map for the area or other specified elevation standard as required by the city, and for a distance of at least five hundred feet beyond any proposed development activity, existing and proposed structures, parking areas, driveways, landscaping areas, setbacks, surface and subsurface drainage facilities, potential contaminant storage locations and methods of storage, above ground storage tanks, best management practices, utilities, roads, stormwater management, and a vicinity map. Where necessary, specific construction details shall be provided to assure adequacy to accepted design standards.

This SSI review did not include a site plan because at the time of the review there were no plans for the development of this property. The review was performed to aid in the valuation of this parcel of land and therefore, no site plan was required.

15.08.040.A.8(d)(iv) Identification of potential contaminants and amounts stored, generated or handled on the subject property.

Because there is no current known plans for the development of this parcel, WWC's discussion relative to the potential for potential contaminants was limited to a very generalized assessment based on the



zoning of the lot. This, in our opinion, satisfies this requirement based on the limited information available.

15.08.040.A.8(d)(v) A field inspection shall be conducted to verify the presence or absence of vulnerable features as defined in subsection 15.08.040.A.7.a A summary of the field inspection shall include a written report, maps identifying the vulnerable features, and the distance and direction of the nearest well and vulnerable feature. Where subsurface wastewater disposal is proposed, the investigator shall conduct deep pit soil analysis to a depth at least five feet below the proposed bottom of the leaching system to establish that there are no obstructions such as bedrock, water table or other forms of refusal that could interfere with the proper functioning of the wastewater disposal system.

As discussed under the 15.08.040.A.8(d)(i) section, there are several vulnerable features located in Lot B5 or within the setback distance. WWC conducted a site investigation of this area on August 17, 2017 and March 29, 2018 to verify the existing mapping of the vulnerable features and to document any additional features. WWC's narrative describes three of these vulnerable features – the City Springs Fault, City Springs and its associated drainage and the Quarry Anticline. The SSI report mentions the potential existence of fractures in the rock units as a result of the folding associated with the Quarry Anticline, however, it did not mention that the City Springs Fault may also cause significant fracturing to occur. It should also be pointed out that downhole video logging of Casper Formation wells in the Laramie area shows that horizontal or bedding plane fractures or solution caverns are prominent in many of these wells. The picture below was taken along the cut face of the outcropping Casper Formation in the Upland Heights Lot B5 area and shows the voids in the formation associated with the bedding planes and some horizontal fracturing.



Subsurface wastewater disposal was not addressed in the SSI, however, the location of the lot would require connection to the City's sewer system.

15.08.040.A.8(d)(vi) A map showing the area and types of exposed bedrock, marshes, perennial drainages, intermittent drainages, ephemeral drainages, creeks, and other bodies of water on the subject property.

The report maps and report narrative meet the requirements of this section. The ephemeral drainages located near the middle and on the north and south side of the lot are the only drainage and/or body of



water located in the development area. The nearest well is the City's Turner No. 2 well which is located approximately 1000 feet to the west – southwest of Lot B5.

15.08.040.A.8(d)(vii) Where the 100-year flood plain mapping is unavailable, the professional geologist and/or engineer will calculate the 100-year flood plain for the drainage. The flood plain mapping will be provided on a site map with a scale not to exceed 1 inch equals 200 feet. Engineering Associates reviewed Federal Emergency Management Administration (FEMA) Flood Insurance Rate Map (FIRM) Panel NO 56001C1770E for Albany County, Wyoming with an effective date of June 16, 2011 available online at the FEMA Map Service Center website. A review of this map confirms that the project area is classified as “Zone X Other Areas” which is defined as “Areas determined to be outside the 0.2% (100 year flood) annual chance floodplain.” As mapped by FEMA, the flood channel associated with Spring Creek is nearly 1,400 feet to the west of the subject parcel and as documented by WWC the vertical relief between the contributing drainage to Spring Creek located approximately 400 feet to the west of the lot will eliminate any potential flooding from this smaller drainage source.

15.08.040.A.8(d)(viii) An evaluation of the water supply and sewage system that includes the potential effects or risks of the systems to the Casper Aquifer and its recharge area and the adequacy and safety of the systems. Items such as floor drains and plumbing schematics and the locations of potential contaminants, waste storage, and liquid transfer area locations shall be provided.

WWC's SSI report correctly indicates that future water and sewer utilities for Lot B5 will be provided by the City of Laramie. There is a 16-inch water main in Boulder Drive that is adjacent to the entire west boundary of the lot.

15.08.040.A.8(d)(ix) A map(s) depicting the potentiometric surface of the Casper Aquifer at the subject property using data from historical water level measurements and published potentiometric surface maps. No new wells shall be drilled for the purpose of determining the potentiometric surface.

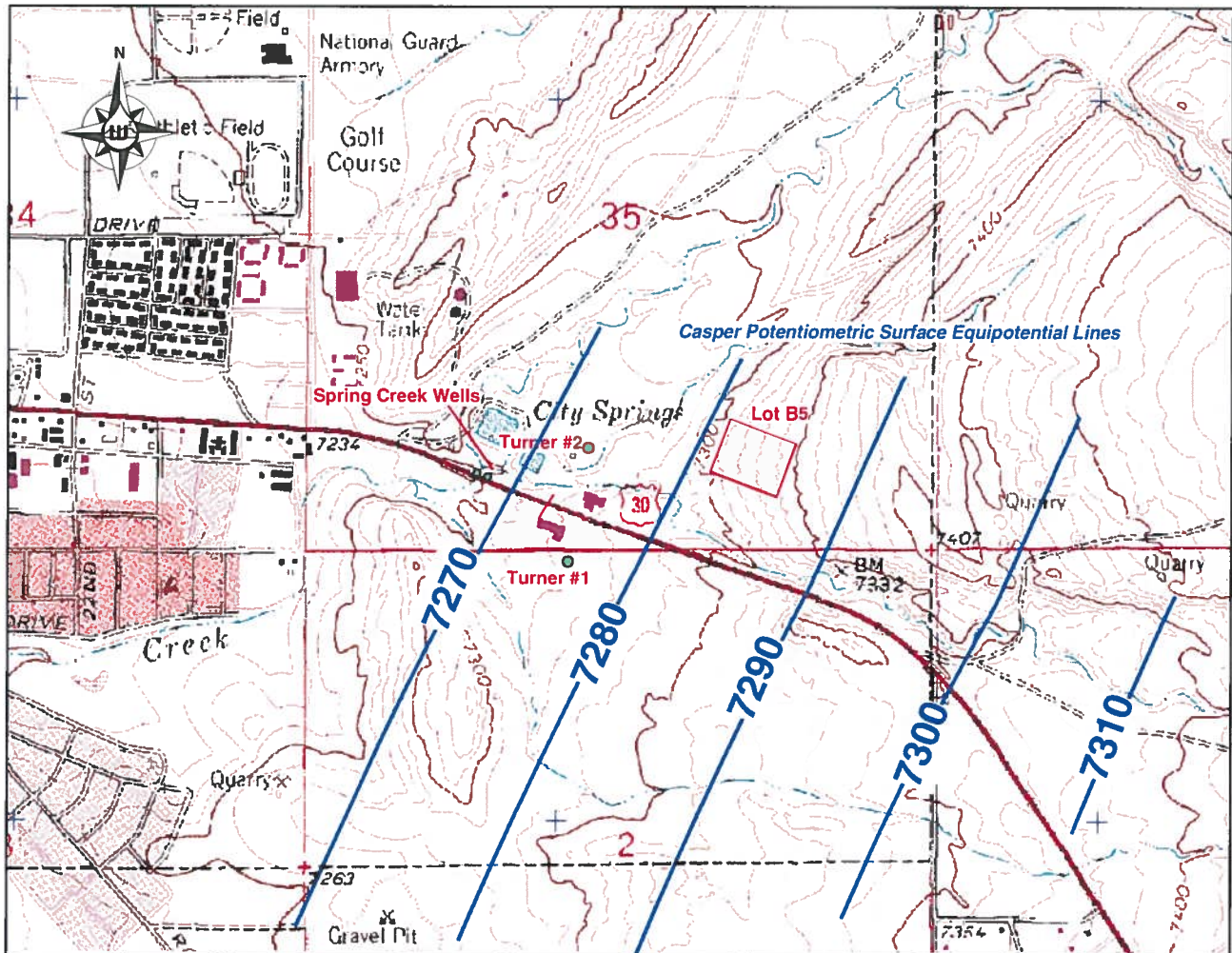
WWC's potentiometric surface map for the Casper Aquifer is very limited in data. There is only one equipotential line visible in the very southeast corner of Figure 1 which shows the 7,300 foot equipotential line for the Casper Aquifer potentiometric surface. Their narrative is correct in that with a surface elevation of the subject property ranging from 7,314 feet to 7,332 feet that the depth to the Casper potentiometric surface will range between 30 and 50 feet. The figure on the following page was developed by the author of this review from several previous studies in the area and it depicts the potentiometric surface a little more definitively than that shown by Figure 1 in WWC's SSI report.

15.08.040.A.8(d)(x) A surface water risk assessment and mitigation plan for any impacts caused by storm water runoff, retention and/or detention basins on the city water supply and the Casper Aquifer.

WWC performed a very thorough review of the potential surface water flows in the subject area. Figure 3 would have been a little easier to read if the elevation contours would have been labeled. It is difficult to perform a risk assessment and provide a mitigation plan without a site plan for the lot. Without the



site plan information, Engineering Associates feels that the information provided by WWC (i.e. the 100 year storm event runoff) is the extent of information that can be provided for this section of the SS1.



15.08.040.A.8(d)(xi) A maintenance plan and agreement for any retention and/or detention basins and associated improvements will be required. Such plan and agreements shall be recorded in the Albany County Clerk's Office.

Engineering Associates agrees with WWC's assessment that without a site plan, the requirement for a retention or detention basin(s) cannot be determined at this time.

15.08.040.A.8(d)(xii) A groundwater risk assessment and mitigation plan to respond to any evidence of contamination or vulnerability which is the result of the development. Such plan shall not limit the liability of any Person for impacts to the Casper Aquifer.

WWC performed a very elaborate evaluation of the potential risk to the Casper Aquifer which resulted in a ranking of a very high risk factor. WWC's methodology compared the Upland B5 lot with all of the



other Casper Aquifer Protection Area (CAPA) parcels which resulted in a risk factor in the 10th percentile and is therefore said to be considerably more vulnerable to aquifer contamination than the other CAPA parcels.

Engineering Associates agrees with WWC's evaluation of the potential risk to the Casper Aquifer, however, we arrived at this risk assessment value in a much more generalized fashion based on the hydrogeologic conditions in the subject area. Prior to the importing of the fill material and the leveling of the lot, the Delta Member of the Casper Formation was mapped as outcropping in essentially the entire Lot B5 area (Ver Ploeg, 2009). Therefore, there is a very thin layer of loose fill material separating the surface of Lot B5 from the underlying Casper Formation and near the border of the lot, the Casper Formation outcrops. As stated previously, the depth to the potentiometric surface of the Casper Aquifer is only approximately 30 feet. In addition to the thin veneer of loose fill over the Casper Formation and the shallow depth to the potentiometric surface, there are also several mapped vulnerable features located within the lot. These include the City Springs Fault and the Quarry Anticline. The production from the Turner No. 1 and No. 2 wells in the near vicinity to Lot B5 are very indicative of the degree of fracturing that is present in the Casper Aquifer in the Lot B5 area. Given the potential for an extensive fracture system to be present beneath Lot B5 and the trend of both the City Springs Fault and the Quarry Anticline to extend through the Lot B5 area and on into the City's Turner Wells production area, it is our assessment that potential risk to the Casper Aquifer is very high in the Upland Lot B5 area.

Due to the lack of a development plan it is impossible to develop a mitigation plan to respond to the perceived risk to the aquifer. However, we are in agreement with WWC's assessment that this parcel will be very hard to develop due to the presence of these geologic features.

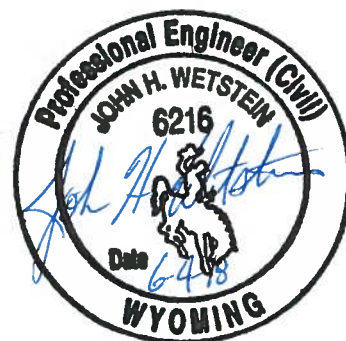
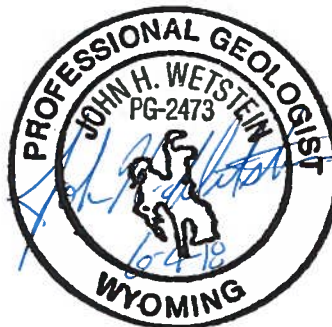
15.08.040.A.8(d)(xiii) Demonstration of compliance with all applicable city standards.

Engineering Associates is in agreement with the statement provided by WWC in their SSI report. Verification of this section of the SSI cannot, at this time, be performed and/or verified.

If you have any questions, please do not hesitate to call.

Respectfully submitted,
Engineering Associates

John Wetstein



References:

Ver Ploeg, Alan J., 2009, Revised Geologic Map of the Laramie Quadrangle, Albany County, Wyoming, Wyoming State Geological Survey, Map Series 50.

Weston, 2014, Site-Specific Geologic and Hydrogeologic Investigation Report, American National Bank Exterior Improvements Project. Prepared by Weston Engineering for Realty Management Group, September 15, 2014.