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September 30, 2015

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
Pope Springs Wellfield
Technical Review

Dear Mr. Parkin:

This letter serves to present the findings of our technical review of the site specific investigation prepared by Trihydro Corporation (Trihydro) for the City of Laramie for the City owned Pope Springs Wellfield parcel of land 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.

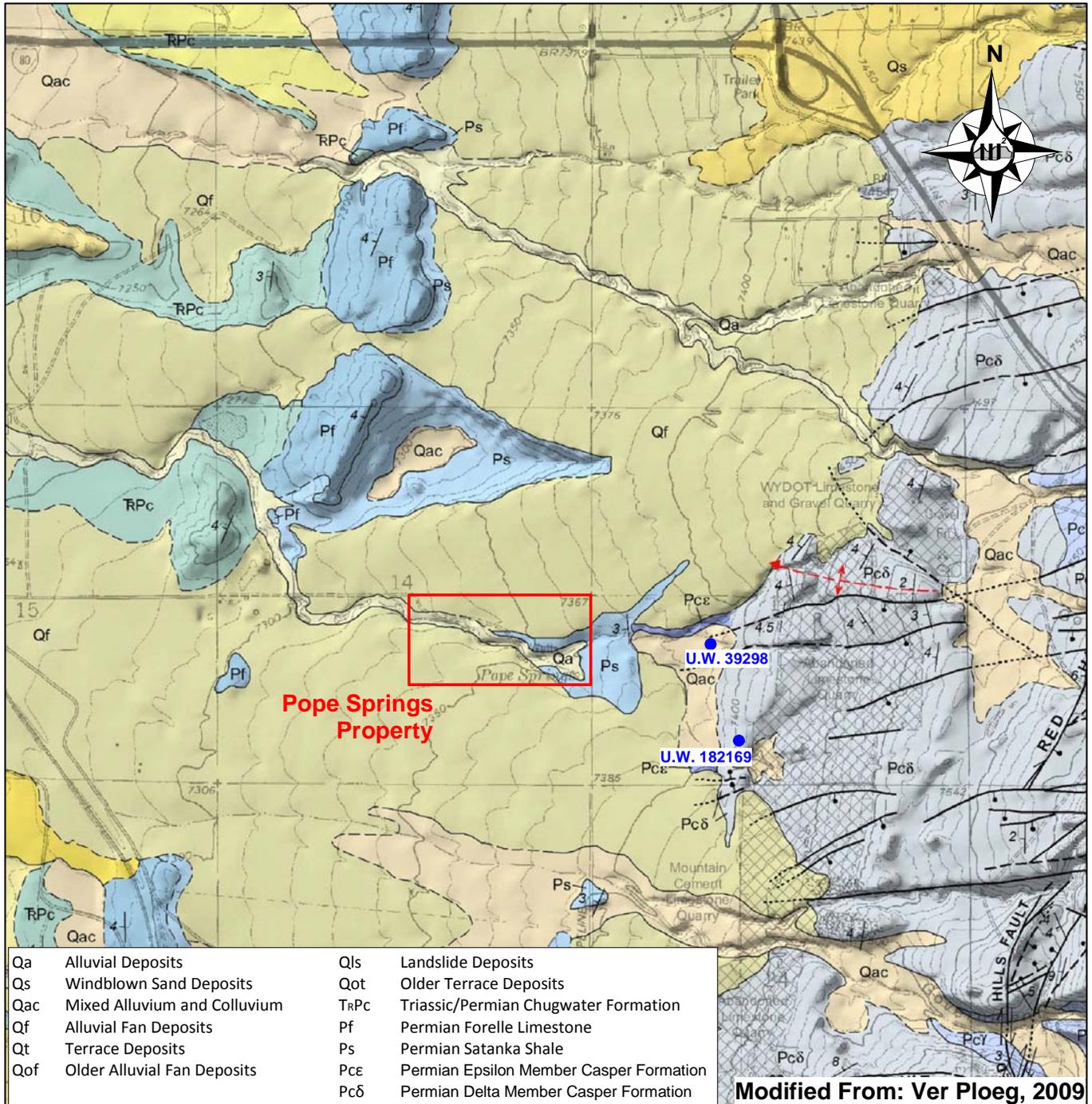
15.08.040.A.8(d)(i) A literature search to determine the presence of mapped faults, folds, fractures, and other evidence of conduit flow on the subject property.

Trihydro's literature search to address the presence of mapped faults, folds, fractures, and other evidence of conduit flow on the site of the proposed parcel of land is adequate. Trihydro identified three mapped vulnerable features; two unnamed east-west trending normal faults and an intermittent drainage that transects the property in an east to west direction. The SSI further points out the evidence for conduit flow by the presence of Pope Spring as a result of the fracturing in the Casper and overlying Satanka Formations by the structural features present in the area.

Some of the lithologic units shown on Trihydro's geology map (Figure 1) are difficult to read and discern. The color of the lithologic units on the map appear to be more washed out than the associated color blocks in the map legend. This makes it difficult to correlate between the legend and the map. Figure 1 was constructed by Trihydro utilizing the geologic map prepared by Alan J. Ver Ploeg as the background (Ver Ploeg, Alan J., 2009, Revised Geologic Map of the Laramie Quadrangle, Albany County, Wyoming, Wyoming State Geological Survey, Map Series 50. A copy of a portion of Ver Ploeg's map with the City of Laramie Pope Springs acreage called out is shown on the following page. The color scheme of this map makes it a little easier to distinguish the different mapped lithologic units.

One item that was researched and discussed in later sections of Trihydro's SSI, but not listed in this section of their report, were the State Engineer's Office completion records for the 47 wells within approximately ½ mile of the subject property area. A review of the statement of completion records for these wells reveals that "lost circulation" and/or "fractured/broken sandstone" was encountered in two of these wells – the Strom #1 well (U.W. 39298) and the Beardog #1 well (U.W. 182169). Lost circulation is typically an indication of very permeable

zones which in this area would be primarily from fractures and voids. The locations of these two wells are shown in the figure below.



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.

As described in Trihydro's SSI report, the City's property is presently undeveloped with the exception of the fiberglass well houses at the four Pope well locations, the 12-inch cast iron transmission pipeline and the old abandoned concrete cistern.

A review of the WDEQ Solid and Hazardous Waste Division's website and EPA's Enviromapper databases shows that there have been no recorded contaminant releases and we concur that there is no evidence of any contaminant releases on the project site.

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 the north half of the southeast quarter of Section 14 of Township 15 North, Range 73 West since Trihydro prepared the SSI. Therefore, based on the data presented in the SSI report and as discussed in the site investigation narrative, Trihydro has confirmed that other than the production wells: Pope No. 1 well (U.W. 153); Pope No. 2 (U.W. 154 and U.W. 72690); Pope No. 3 (U.W. 155, U.W. 55505 and U.W. 72691); and Pope No. 4 (U.W. 55506 and U.W. 72692) there are no other wells on the project site.

With the data presented, and from their narrative with respect to their contaminant release and well research, Trihydro 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.

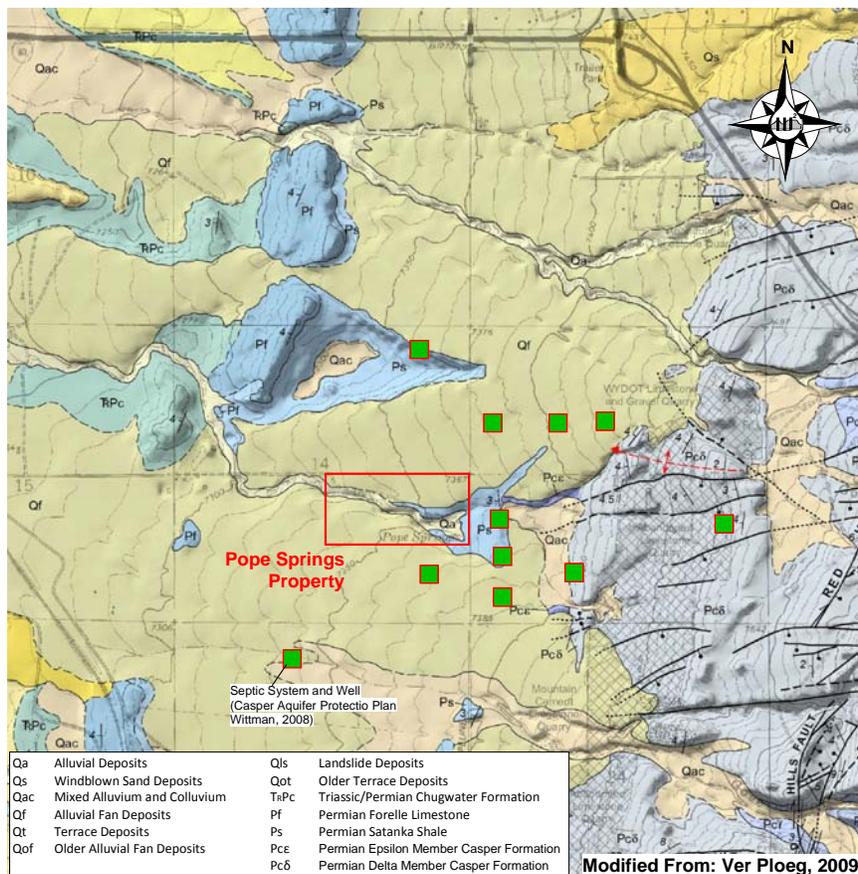
The SSI prepared by Trihydro indicates that the only planned improvement for the Pope Springs Wellfield property is to construct a chain link security fence around the immediate wellfield facilities. The two fencing options were shown on figure 2 in the Trihydro SSI report. This figure serves as the site plan to satisfy the requirements of the City of Laramie's Unified Development Code, subsection 15.08.040.A.8. The ground contour information specified was not presented, and based on the proposed improvements is not essential information. The SSI report did present a surface geology map that has the Laramie USGS 7.5 Minute topographic map as a background (Figure 1). However, the contour interval for this figure is 50 feet and provides only a very general definition of the topographic conditions on the eastern half of the Pope Springs Property. More complete contour information for the wellfield is shown in the figure on page 2 of this review letter report. The contour interval for this figure is 10 feet.

In general we agree with the concept presented in the SSI report that the information provided is adequate to demonstrate the proposed development plans for this parcel of land. However, we feel it would be beneficial to the City to include some of the requested information such as a topographic map, a discussion of the existing land use practices in the area and some general

their current use, their condition and the condition of the area around them (enclosed area, corral, shop area, etc.). One of these wells, Strom #1 (U.W. 39298) was identified earlier as having drilling characteristics (lost circulation) consistent with fracturing in the formation.

The figure below is the geology map of the area (Ver Ploeg, 2009) with the locations of the wells and septic systems in the area of Pope Springs Property. These septic system/well locations were transferred to this map from Figure 4-2a from the Casper Aquifer Protection Plan (Wittman, 2008). The Casper Aquifer Protection Plan identifies eleven (11) septic systems that are cross-gradient or up-gradient from Pope Springs. This figure shows that most of these septic systems and wells are located in areas that appear to have been structurally disturbed based upon their location with respect to the mapped faulting in the area and their position with respect to these mapped faults and the Pope Wells which are known to have encountered fractures in the Casper Formation. The location of these septic systems in these fractured areas will increase the potential for conduit flow and the rapid movement of potential contaminants through the aquifer. We agree with Trihydro's assessment that due to limited number of developed acreages in the area, these systems due not present a substantial threat to the aquifer. Studies have shown that both viruses and bacteria are effectively removed within the first 2 to 3 feet of soil beneath the leach field. With respect to an increased nitrate concentration from these few septic systems, it is not anticipated that the nitrate level will increase noticeably because of the dilution of the leachate in the Casper Aquifer. However, it should be noted that

WWC in their City of Laramie Water Supply Master Plan – Level 1 Report (1995) reported that there is “excellent hydraulic connection” between the Pope Wellfield and Soldier Springs. It is believed that this communication is most probably along the Red Hills Fault system located approximately 1¼ miles east of Pope Springs. Most of the existing domestic wastewater systems are located west (down-gradient) of this major north-south trending fault system. If development does extend eastward over the Red Hill fault area, the contributing number of septic systems impacting both Pope Springs and Soldier Springs would increase and the benefit of dilution will become more compromised.



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.

The requirements of this section were met by the Trihydro SSI. A field inspection was conducted on May 15, 2015 and the wells on the property were identified in the text and in Figures 1 and 2 of the report. These figures provide the requested distance and direction information of the wells. Other wells in the immediate area of the City's Pope Springs Property were not identified. These wells have been shown in this technical review document on page 4 and are tabulated in Table 1.

**TABLE 1
 LIST OF SEO WELLS IN POPE SPRINGS WELLFIELD AREA**

	WR Number	Priority Date	First Name	Last Name	Facility Name	Uses	Tw	Rng	Sec	Qtr-Qtr	Appropriation (GPM)	Total depth (Ft)	SWL (Ft)
1	P153.0C	06/10/1937			POPE #1	MUN	015N	073W	14	NE1/4SE1/4	550	156.00	15.5
2	P154.0C	06/17/1938			POPE #2	MUN	015N	073W	14	NE1/4SE1/4	515	162.00	12
3	P155.0C	06/30/1939			POPE #3	MUN	015N	073W	14	NE1/4SE1/4	590	158.00	13
4	P430.0C	12/31/1938	NORMAN E.	STROM	BIG HOLLOW #3	STK	015N	073W	14	NW1/4NE1/4	25	200.00	-4
5	P30940.0W	09/18/1975	YRAMIRIS P.	TRACY	YRAMIRIS #1	STK	015N	073W	14	SE1/4SE1/4	5	145.00	55
6	P31362.0W	11/06/1975	YRAMIRIS P.	TRACY	PAUL #1	STK	015N	073W	14	NW1/4SW1/4	20	80.00	50
7	P31363.0W	11/06/1975	YRAMIRIS P.	TRACY	FREDERICK #1	STK	015N	073W	14	NE1/4SW1/4	25	100.00	-4
8	P36531.0W	03/09/1977	DONALD S. & BONNIE S.	SWIATEK	KNOWLTON #2	DOM_GW; STK	015N	073W	14	NE1/4NW1/4	15	307.00	-4
9	P39298.0W	06/08/1977	RICHARD E.	STROM	STROM #1	DOM; IRR; STK	015N	073W	13	NE1/4SW1/4	15	177.00	68
10	P39844.0W	09/01/1977	DONALD R. & SHIRLEY C.	JONES	JODY #1	DOM_GW	015N	073W	14	NE1/4NE1/4	20	170.00	8
11	P43721.0W	06/13/1978	DONALD S. & BONNIE S.	SWIATEH	KNOWLTON #3	STK	015N	073W	14	NE1/4NW1/4	5	260.00	-1
12	P52906.0W	07/15/1980			SETA #1	MIS	015N	073W	15	SW1/4SE1/4	10	85.00	26
13	P55506.0W	01/30/1981			POPE #4	MUN	015N	073W	14	NE1/4SE1/4	1750	350.00	31
14	P57005.0W	06/08/1981			PRENTICE #1	DOM_GW	015N	073W	14	SE1/4NW1/4	20	100.00	36
15	P64826.0W	06/29/1983			EISENHAEUER #1	DOM_GW	015N	073W	14	NE1/4NW1/4	25	135.00	28
16	P66932.0W	04/11/1984	ROBERT ROTEN & MARTHA	HANSCOM	HANSCOM #1	DOM_GW	015N	073W	14	SE1/4NW1/4	13	375.00	-4
17	P72411.0W	04/28/1986	ROGER & JONEL	WILMOT	WILMOT #2	DOM_GW; STK	015N	073W	14	SW1/4NW1/4	15	460.00	-4
18	P84983.0W	05/02/1991			OLSON #2	DOM_GW	015N	073W	15	SE1/4SE1/4	13	100.00	20
19	P92168.0W	06/30/1993			AHR001	DOM_GW	015N	073W	15	SE1/4SE1/4	13	90.00	28
20	P14875.0W	08/09/1972	GARY L	OLSON	OLSON #1	DOM_GW	015N	073W	15	SE1/4SE1/4	20	51.00	29
21	P15665.0W	08/21/1972	RALPH W.	FUCHS	FUCHS #001	DOM_GW	015N	073W	15	SE1/4SE1/4	20	60.00	34
22	P16922.0P	12/31/1955	CINDY	AVERY	PIPER #6	DOM_GW; STK	015N	073W	13	NW1/4NW1/4	25	500.00	80
23	P100005.0W	08/10/1995			D. OLSON	DOM_GW	015N	073W	15	SE1/4SE1/4	15	390.00	3
24	P102061.0W	04/16/1996	ANDREW	GENTRY	GENTRY #1	DOM_GW	015N	073W	14	SE1/4SE1/4	18	150.00	53
25	P102084.0W	04/24/1996			AHROO2	DOM_GW	015N	073W	15	SE1/4SE1/4	15	380.00	1
26	P110152.0W	05/22/1998			SCHILT #1	DOM_GW	015N	073W	14	SW1/4SW1/4	13	300.00	14
27	P116191.0W	06/07/1999			WALSH 1	DOM_GW; STK	015N	073W	13	NW1/4SW1/4	10	160.00	40
28	P116195.0W	06/08/1999	DOUGLAS L & KELLEY D	GAPTER	GAPTER #1	DOM_GW; STK	015N	073W	13	SW1/4SW1/4	25	160.00	61
29	P124026.0W	03/17/2000			Walsh #5	DOM_GW; STK	015N	073W	13	NE1/4SW1/4	25	160.00	41
30	P124407.0W	03/27/2000			M. PAXTON #1	DOM_GW	015N	073W	15	NW1/4SE1/4	20	480.00	-4
31	P144071.0W	04/24/2002			MICHAUD -1	DOM_GW; STK	015N	073W	13	SE1/4NW1/4	20	123.00	55
32	P152206.0W	07/07/2003			DALE #1	DOM_GW	015N	073W	13	NW1/4NE1/4	10	200.00	106
33	P156466.0W	02/27/2004			SCHOEN-3	STK	015N	073W	14	SE1/4SE1/4	10	120.00	50
34	P157586.0W	03/30/2004			SCHLEGL-1	DOM_GW	015N	073W	15	SE1/4SE1/4	13	360.00	-4
35	P159105.0W	05/17/2004	LEONARD A	SINNER, JR	SINNER #1	DOM_GW	015N	073W	13	SE1/4NW1/4	13	180.00	79
36	P170154.0W	10/05/2005			WILHELM #1	DOM_GW; STK	015N	073W	15	SW1/4NE1/4	20	160.00	1
37	P173877.0W	03/16/2006			SWECKARD POPE - 1	MIS	015N	073W	15	NE1/4SE1/4	40	480.00	0
38	P175461.0W	06/27/2006	ROBERT	MOORE	M & M #1	DOM_GW	015N	073W	13	NE1/4SW1/4	25	300.00	100
39	P180646.0W	03/12/2007			CARLISLE-1	DOM_GW	015N	073W	15	SW1/4SE1/4	10	440.00	0
40	P180848.0W	04/02/2007			KEELER-1	DOM_GW	015N	073W	15	NW1/4NE1/4	15	120.00	5
41	P182169.0W	07/20/2007			BEARDOG #1	DOM_GW; STK	015N	073W	13	SE1/4SW1/4	13	140.00	80
42	P186159.0W	03/25/2008	CHRISTOPHER R AND APRIL M	CLEVEN	CLEVEN-001	DOM_GW; STK	015N	073W	15	SW1/4NE1/4	22	130.00	9
43	P186667.0W	04/25/2008	MICHAEL AND LAURIE	ROYLANCE	ROYLANCE 1	DOM_GW	015N	073W	15	NE1/4NE1/4	5	600.00	0
44	P186967.0W	05/22/2008	CLINT AND DEB	SWIERCZEK	SWIERCZEK-1	DOM_GW	015N	073W	13	NE1/4NW1/4	15	180.00	92
45	P186973.0W	05/23/2008			L AND L - 1	DOM_GW	015N	073W	15	SW1/4NE1/4	18	560.00	0
46	P186973.0W	05/23/2008			SWECKARD SEVEN - 1	DOM_GW	015N	073W	15	SE1/4NE1/4	16	140.00	37
47	P200743.0W	07/25/2013	JOEL PARKER AND ANDREA DAWN	SENIOR	SENIORJ-1	DOM_GW; STK	015N	073W	15	SE1/4NE1/4	25	120.00	10

Since the property is presently not secured with a security fence, a discussion with respect to the vulnerability of the wells would be beneficial.

Onsite wastewater systems are not proposed for future development of the property. Therefore, a deep pit soil analysis for this SSI was not required and was not conducted.

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, although technically meet the requirements of this section, they are somewhat limited in providing a complete understanding of the topographic and hydrologic conditions at the subject property. For example, in Figure 2, the drainage associate with Pope Springs is shown; however, it is difficult to determine the full extent of this creek's drainage area from this figure. Since this drainage represents a potential source of contamination to the aquifer, the associated activity within the entire drainage area of this intermittent stream source is critical to the protection of the aquifer. Also, labeling of the drainages on the figures is recommended.

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.

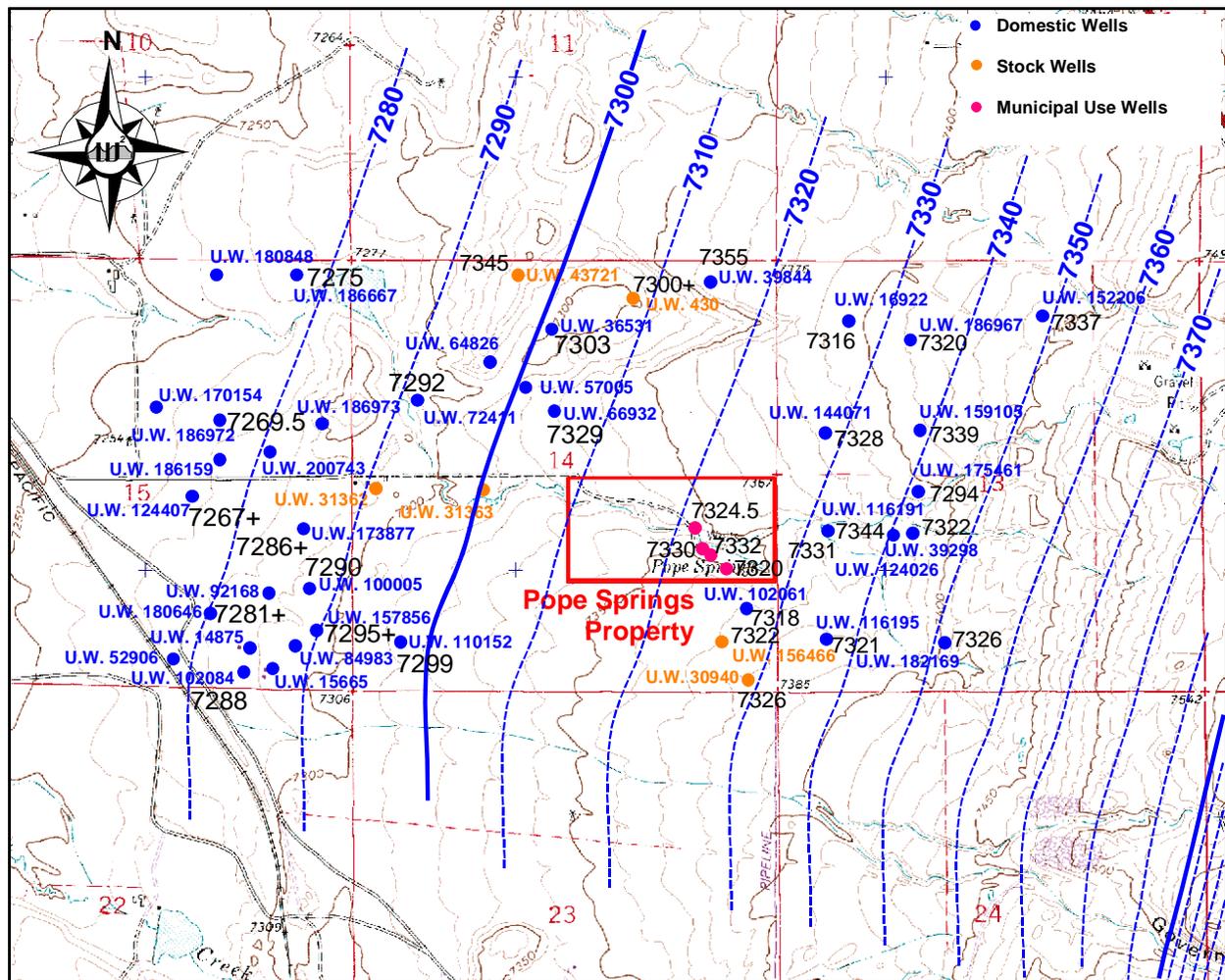
The report narrative satisfies the requirements of this section. Wester-Wetstein agrees with Trihydro's conclusion that the proposed development (chain link security) fence will not be significantly impacted by a 100-year flood event and we agree with their recommendation that if additional development should be proposed in the future that the floodplain calculations be conducted at that time.

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.

The SSI prepared by Trihydro does not address this section as they state: "Future development at the property will not require a water supply or sewage system. Therefore, an evaluation of potential risks associated with these facilities is not needed." Because of the critical nature of the water supply and its vulnerability, it is strongly recommended that no future development involving the installation of an on-lot septic system be proposed for this acreage.

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.

Trihydro's SSI has attempted to satisfy this requirement, however, the potentiometric contours for the Casper Aquifer that were superimposed upon the surface geologic map (Figure 1) are located over one mile to the east of the subject property. The potentiometric surface elevation at the Pope Springs Wellfield property was never identified in the SSI Report. Using the potentiometric surface contours from Trihydro's SSI, which were based upon data from the Laramie Water Management Study, Level II (2006), and depth to water data from the SEO Statement of Completions for the wells in the area, a potentiometric surface map of the Casper Aquifer was constructed and shown in the figure below. The potentiometric contours indicate that groundwater in the Casper Aquifer beneath the wellfield property is moving in a westerly direction under a gradient of approximately 10 feet per 1,400 feet. The potentiometric surface elevation of the Casper Aquifer at Pope Springs Wellfield ranges from approximately 7,330 feet to 7,310 feet.



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.

Wester-Wetstein agrees with Trihydro's evaluation that the risk of impacts to the Casper Aquifer from storm water runoff is very minimal.

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.

As stated by Trihydro, a maintenance plan and agreement will probably not be needed since it is not anticipated that retention, detention or other stormwater management facilities will be constructed on this site.

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.

Wester-Wetstein agrees with the conclusion provided by Trihydro that the risks of contamination to the Casper Aquifer from the present use of the Pope Springs Wellfield parcel and the proposed construction of a security fence is low. Although the thickness of the Satanka Shale, as reported by Trihydro, increases to the west and appears to be sufficient to protect the aquifer from a surface contamination source, it is our recommendation that no additional development within the Pope Springs Wellfield acreage that could potentially impact the aquifer be allowed. There has been a documented decrease in the potentiometric surface of the Casper Aquifer in the Pope Wellfield area due to the production from the Pope Wells (WWC, 1995). Therefore, during the operation of the wellfield, there will be a reverse gradient within the wellfield area. This reversal of flow, in combination with the documented fracturing present in the wellfield area, increases the chances of a contaminant within the Satanka Shale Formation being introduced into the Casper Aquifer.

Although this SSI was written to address the impact to the Casper Aquifer from the present and proposed use of the wellfield property, there are some actions that the City of Laramie may entertain to help them monitor and potentially limit the impacts to the Casper Aquifer from the surrounding area. These suggestions are listed below.

1. Review the wells and septic systems in the area where conduit flow between these systems and the Pope Springs wellfield is very likely. A review of the figure on page 5 of this SSI Review letter indicates that there may be as many as 6 septic systems and several wells that are in potential conduit flow areas.
2. Develop a relationship with the landowners of these septic systems and wells. Research the design, age and condition of the facilities.
3. Ask if the City personnel would be allowed access to the property to observe and record the condition of the septic system and well (i.e. conditions around well, status of well seal/cap, etc.). Obtain permission from the landowner to visit the site annually to witness and record any changes to the land use around primarily the well and point out any potential impacts to the aquifer that these changes may represent.
4. Discuss with the landowner any recommended changes that would minimize the potential to compromise the aquifer. The City should compensate the landowner for his efforts/costs to implement these recommended changes.
5. Ask the landowner to inform the City of his/her intentions to replace their wastewater system and offer to compensate the landowner to upgrade their system (if possible) to an enhanced system that will lower the nitrate levels in the leachate.

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

The SSI has adequately addressed and identified the requirements as mandated by this section of the City of Laramie's Unified Development Code.

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

Respectfully submitted,
Wester-Wetstein & Associates, Inc.



John Wetstein

