**ENGINEERING ASSOCIATES**
**CONSULTING ENGINEERS & SURVEYORS**

November 6, 2020

City of Laramie
405 E. Grand Avenue
Laramie, Wyoming 82070

Attn: Mr. Darren Parkin

Re: Pope Springs Wellfield
Site Specific Investigation, Addendum #1

Dear Darren:

The City of Laramie has initiated a project (Pope Wellfield Wellhead Building Upgrades Project) to replace and upgrade the well house buildings at the Pope Springs Wellfield. Presently, the well houses are prefabricated fiberglass buildings bolted to a slab on-grade foundation. The buildings will be upgraded with a traditional spread footer with frost-wall foundation, a new concrete slab floor and the fiberglass buildings will be replaced with concrete masonry unit structures with metal roofs.

A site specific investigation (SSI) report for the Pope Springs Wellfield was prepared and submitted to the City of Laramie in the summer of 2015 by Trihydro Corporation as part of a project to perform multiple SSI studies on City of Laramie owned properties. Trihydro's SSI report for the Pope Springs Wellfield was peer reviewed by Wester-Wetstein & Associates, Inc. and the peer review document submitted to the City on September 30, 2015. Consensus from both the SSI study and the peer review was that the risks of contamination to the Casper Aquifer from the present use of the Pope Springs Wellfield parcel is low. It was recommended, however, that if additional development should be proposed in the future at the Pope Springs Wellfield, that floodplain calculations be conducted at that time.

As part of the Pope Wellfield Wellhead Building Upgrades Project, a flood hydrology analysis of the wellfield area was conducted and is summarized as follows.

## Hydrology

Flood hydrology for the Pope Springs well field was estimated using regional regression equations published by the US Geological Survey (Miller 2003). The report provides a means of estimating peak flow for ungauged watersheds in Wyoming based on basin characteristics. The project area is located within the "Eastern Mountains" region. Peak flow is dependent upon basin area, mean March precipitation, and latitude. Basin area was determined to be about 2.7-mi$^2$. The basin area is shown in Figure 1. Latitude is 41.2675$^o$. Mean March precipitation was estimated from Figure 9 of the report, as 2.25-in.



605 Plaza Court • P.O. Box 2202 • Laramie, Wyoming 82073
Phone (307) 742-9220 • FAX (307) 742-0316 • EngAssoc@EAEngineers.com

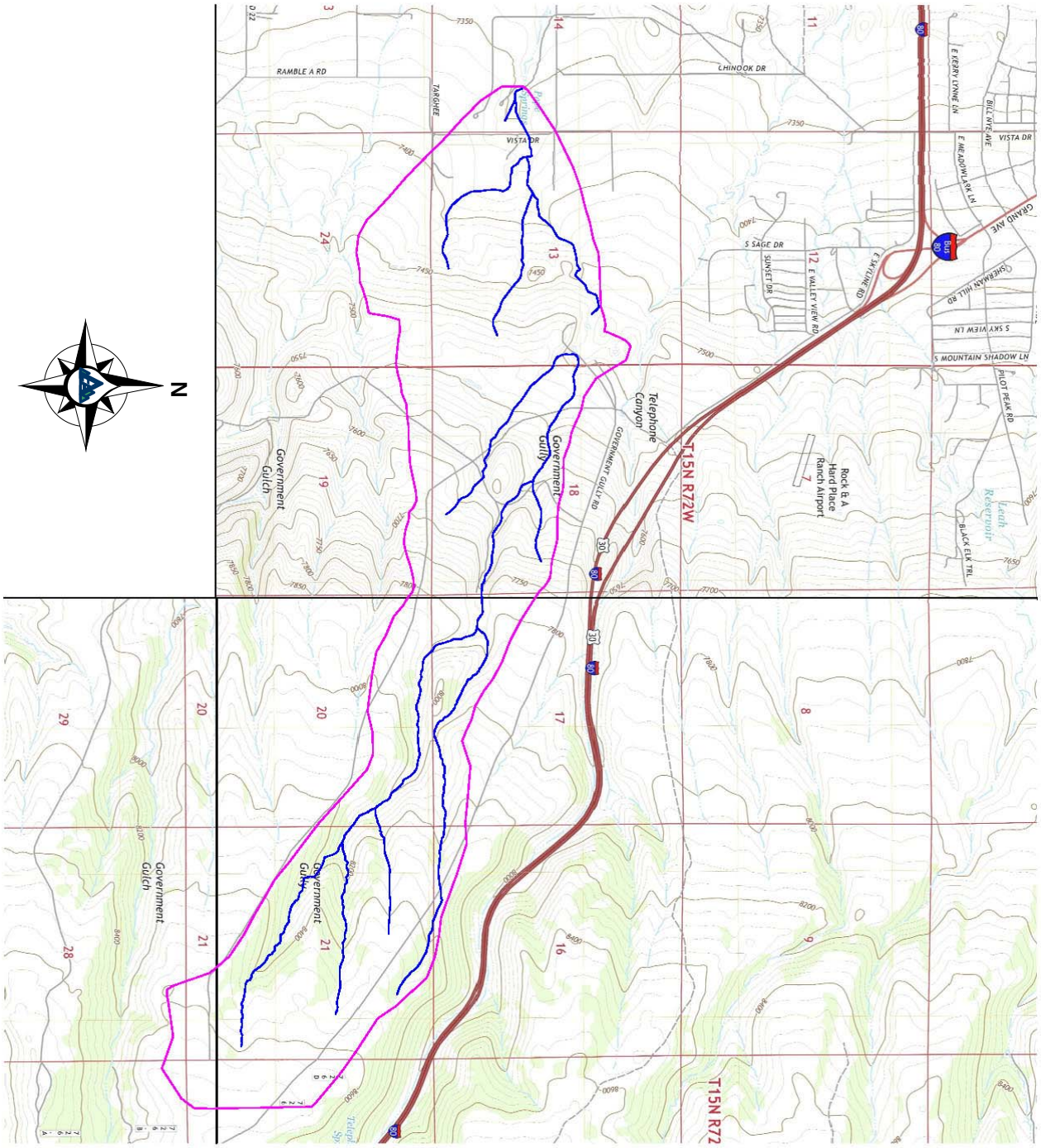



Figure 1



605 Plaza Court • P.O. Box 2202 • Laramie, Wyoming 82073
Phone (307) 742-9220 • FAX (307) 742-0316 • EngAssoc@EAEngineers.com

The regression equations provide a predicted value for peak flow, but have an inherent uncertainty resulting from the regional regression equation technique. For this project, to protect critical water supply infrastructure, the published multipliers for determining the peak flow with 95% confidence were used.

The resulting peak flow (with 95% confidence) for each recurrence interval is presented in the table below.

| Recurrence | Peak Flow (cfs) 95% Confidence |
|---|---|
| 2-yr | 81 |
| 10-yr | 209 |
| 25-yr | 292 |
| 50-yr | 366 |
| 100-yr | 446 |
| 500-yr | 691 |

**Flood Modeling**

A flood model of the project area was developed using the HEC-RAS engine within Autodesk Civil 3D. A digital terrain model of the reach was created based on surveys performed in spring 2020. A total of 3 detailed cross sections were included within the model. Manning's roughness coefficients were estimated based on site observations. The 100-yr flood flow (1% annual chance of exceedance) was modeled, and the resulting water surface elevations incorporated into the attached Exhibit B drawings.

As shown in the Exhibit B drawings, the Pope Well Nos. 1 and 2 are within the calculated 100 year flood plain. However, as the cross-sections show on page 2 of Exhibit B, the finished floor elevation (FFE) for these two well house buildings are approximately ¼ foot above the flood plain elevation. Additionally, to meet WDEQ regulations, the completion (height of discharge head) for each well in the Pope Springs wellfield is 1 foot above the FFE or approximately 1.25 feet above the 100 year flood elevation.

During the construction of the new well house buildings, the pumps in each well will be removed and the top of the casing capped to prevent construction and dirt debris from entering the well. The existing water pipelines will remain undisturbed during this project and the only trench excavation required will be at depths of less than 4 feet for new buried power lines to extend to each of the well house buildings.

Because of the thickness of the Satanka Shale cover in this area (approximately 60 feet), the potential for contamination of the Casper Aquifer from the work associated with the proposed Pope Wellfield Wellhead Building Upgrades Project is extremely low.



605 Plaza Court • P.O. Box 2202 • Laramie, Wyoming 82073
Phone (307) 742-9220 • FAX (307) 742-0316 • EngAssoc@EAEngineers.com

Once the wellhead building upgrade project is complete, operational procedures of the Pope Springs Wellfield will resume to those same procedures conducted prior to the upgrade project. As noted in the original SSI report and the peer review, the risks of contamination to the Casper Aquifer from the present use of the Pope Springs Wellfield parcel is low. The proposed upgrade to the telemetry and control at the wellfield may actually further reduce the risk to the aquifer. New remote controlled door access locks and system monitoring instrumentation (wet floor, intrusion and temperature) will allow City staff to monitor and control access to the buildings remotely which will require less trips to the wells.

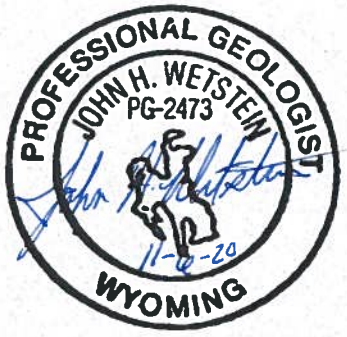
If you have questions or need additional information please let me know.

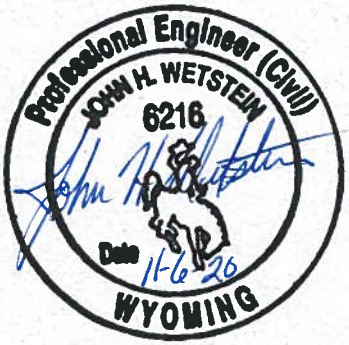
Respectfully submitted,
***Engineering Associates***

John Wetstein

**Reference**

Miller, Kirk. 2003. Peak-flow characteristics of Wyoming streams. US Geological Survey Water-Resources Investigation Report 03-4107.

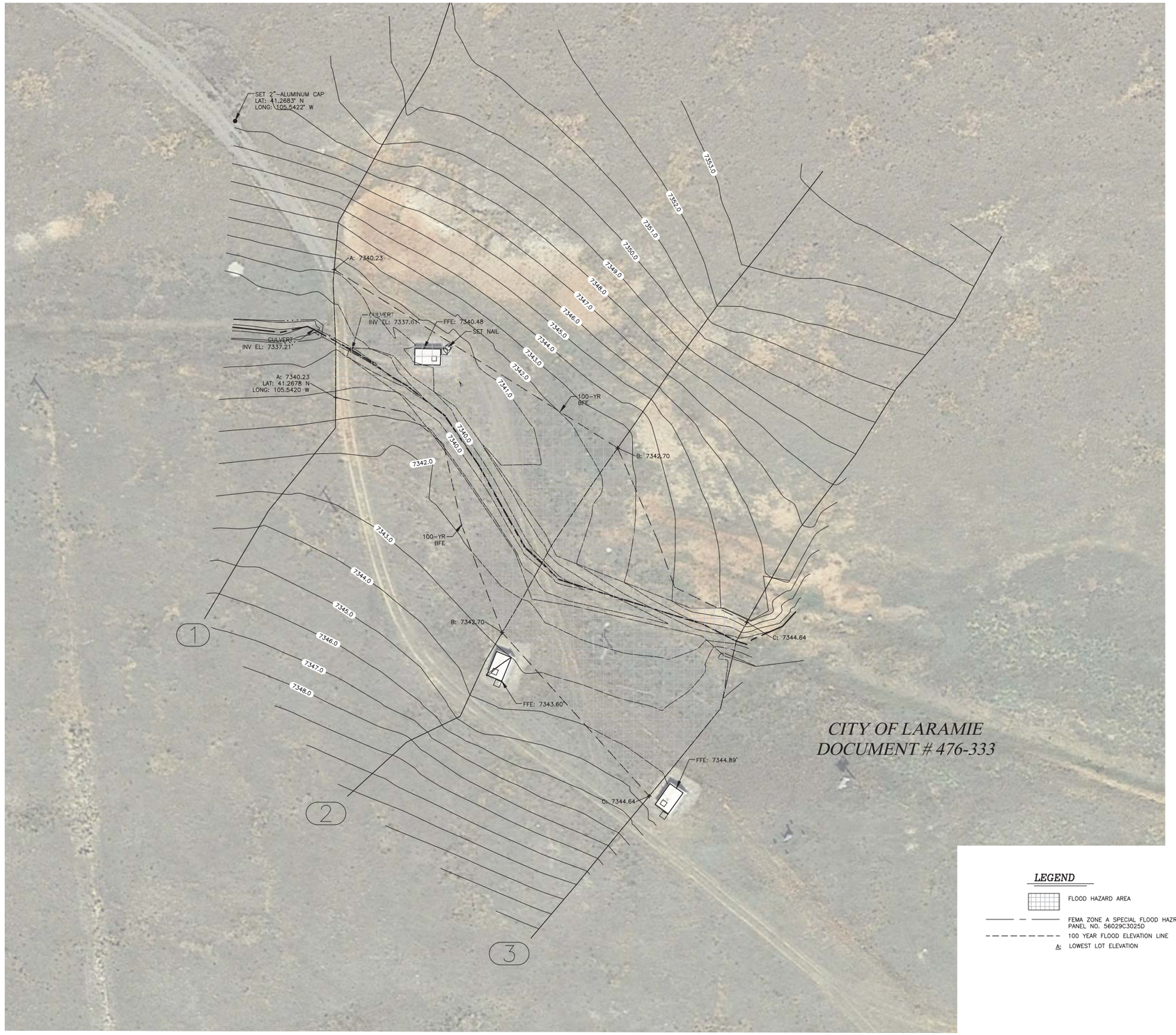


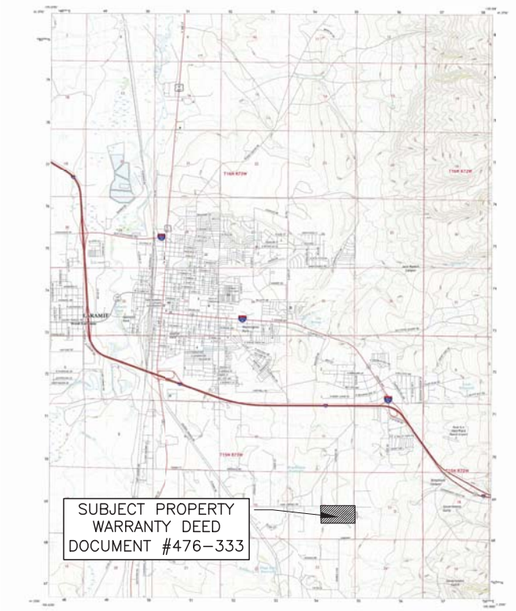



605 Plaza Court • P.O. Box 2202 • Laramie, Wyoming 82073
Phone (307) 742-9220 • FAX (307) 742-0316 • EngAssoc@EAEngineers.com

# T.73N. R.14W.




*CITY OF LARAMIE*
*DOCUMENT # 476-333*




USGS LOCATION MAP
SCALE: 1" = 1 MILE

*NOTES:*

1. FLOOD HYDROLOGY WAS ESTIMATED USING THE PUBLISHED USGS REGIONAL REGRESSION EQUATIONS FOR WYOMING, "PEAK-FLOW CHARACTERISTICS OF WYOMING STREAMS, USGS WRIR 03-4107", BY K. MILLER. THE 100-YEAR FLOOD FLOW (PROBABILITY OF ANNUAL XCEEDANCE OF 0.01) WAS FOUND TO BE 450-CFS, WITH 95% CONFIDENCE. EQUATIONS FOR THE EASTERN MOUNTAINS REGION AS PRESENTED IN THE TEXT WERE USED.
2. SURVEY DATA SHOWN HEREON WAS COLLECTED IN THE MONTH OF MARCH OF 2020.
3. ELEVATIONS SHOWN HEREON ARE BASED ON NAVD88(GEOID12A), AS DETERMINED BY SURVEY GRADE GPS DATA, CORRECTED BY THE NGS ONLINE POSITIONING USER SERVICE (OPUS).
4. THE BOUNDARY LINE DELINEATING THE AREA TO BE REMOVED FROM THE ZONE A SPECIAL FLOOD HAZARD AREA DOES NOT INTERSECT ANY EXISTING STRUCTURES, AND IS ENTIRELY ABOVE THE 100-YEAR FLOOD LINE.

| RECURENCE | PEAK FLOW (CFS) 95% CONFIDENCE |
|---|---|
| 2-YR | 81 |
| 10-YR | 209 |
| 25-YR | 292 |
| 50-YR | 366 |
| 100-YR | 446 |
| 500-YR | 691 |

N

0 20 40 80
SCALE (US FT)
1 INCH = 40 FEET

*LEGEND*

- FLOOD HAZARD AREA
- FEMA ZONE A SPECIAL FLOOD HAZRD AREA, MAP PANEL NO. 56029C3025D
- 100 YEAR FLOOD ELEVATION LINE
- A: LOWEST LOT ELEVATION

## – *EXHIBIT B* –

*Map Showing Flood Plain Analysis*

THE CITY OF
LARAMIE

*– Located In –*

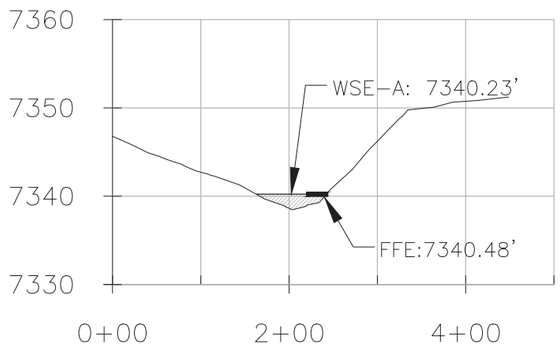
**SE SEC. OF TRACT 15,**
**T.73N., R.14W., 6TH P.M.**
**ALBANY COUNTY, WYOMING.**

*– Prepared By –*

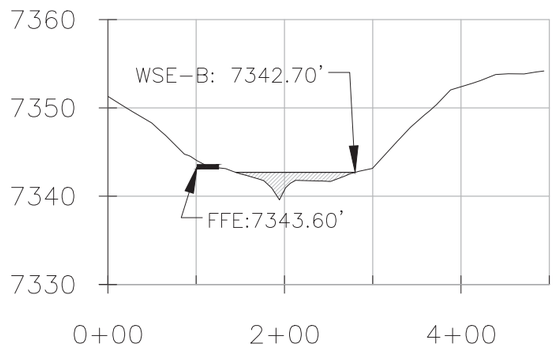
ENGINEERING ASSOCIATES, CODY, WYOMING
CONSULTING ENGINEERS & SURVEYORS

APRIL 9, 2020
FB NA 19093.00
LPU
SHEET 1 OF 2

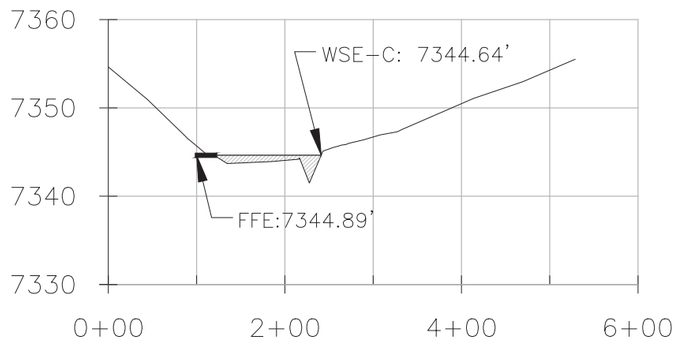
P:\2019\19093 Laramie - Wellhead Building Upgrades\Survey\19093_SURVEY-BASE.dwg EXHIBIT B 4/13/20 LANE




Profile: PF 1
Flow Discharge = 450.00 cfs
Computed Water Surface = 7340.23 ft




Profile: PF 2
Flow Discharge = 450.00 cfs
Computed Water Surface = 7342.70 ft




Profile: PF 3
Flow Discharge = 450.00 cfs
Computed Water Surface = 7344.64 ft

– *EXHIBIT B* –

*Map Showing Flood Plain Analysis*

THE CITY OF
LARAMIE

– *Located In* –

**SE SEC. OF TRACT 15,**
**T.73N., R.14W., 6TH P.M.**
**ALBANY COUNTY, WYOMING.**

– *Prepared By* –

ENGINEERING ASSOCIATES, CODY, WYOMING
CONSULTING ENGINEERS & SURVEYORS

APRIL 9, 2020
FB NA 19093.00
LPU
SHEET 2 OF 2

P:\2019\19093 Laramie - Wellhead Building Upgrades\Survey\19093_SURVEY-BASE.dwg EXHIBIT B (2) 4/13/20 LANE