

**Fairchild Air Force Base: On-Base Groundwater Flow Directions Evaluation
TECHNICAL MEMORANDUM**

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FROM: Tehama, LLC

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SUBJECT: Fairchild Air Force Base: On-Base Groundwater Flow Directions Evaluation

1. Introduction

Tehama LLC (Tehama) was tasked by U.S. Army Corp of Engineers (USACE) Seattle District (Contract # W9128F-16-D-0044, Delivery Order # W912DW17F2107, dated 29 Sep 17) to conduct a Drinking Water Protection Study (DWPS) at Fairchild Air Force Base (FAFB), WA regarding per- and polyfluorinated alkyl substances (PFAS). The lead organization for the DWPS is the Air Force Civil Engineering Center (AFCEC).

PFAS are synthetic organofluorine compounds that were used in firefighting foams such as aqueous film forming foam (AFFF). Five AFFF Release Areas have been identified at FAFB (Figure 1). Every groundwater sample collected during the site inspection (SI) for AFFF exceeded the Health Advisory limit (HAL) except for one groundwater sample at AFFF Area 4 (MW-451). Evaluating the on-Base groundwater flow directions near (and downgradient from) AFFF release areas is critical to understanding the fate and transport of PFAS.

Potentiometric surface maps were developed in 2012 by AECOM based on a 2012 synoptic well gauging event (SWGE) for two hydrostratigraphic units: (1) alluvium and (2) Basalt A. These potentiometric surface maps are illustrated on Figures 2 and 3, respectively. On these figures the five AFFF release areas have been added. The 2012 potentiometric surface maps cover much (but not all) of the Base. Additionally, the map for Basalt A (Figure 3) includes the Craig Road Landfill (CRL) area located off the northeast corner of the Base. Since 2012, additional depth to groundwater measurements have been collected for specific portions of the Base and/or CRL, but none of those events has been as comprehensive as the 2012 SWGE.

During initial Technical Planning Process (TPP) calls and meetings for the DWPS, AFCEC indicated they believed the understanding of on-Base groundwater flow directions was sufficient for performing the DWPS, such that no SWGEs would be merited as part of the DWPS. However, during subsequent TPP calls on 23 January 2019 and 29 January 2019 a consensus was developed to perform a review of previous on-Base water level data and document the understanding of groundwater flow directions. Based on that review, consensus could then be developed regarding the need for one or more SWGEs for on-Base water levels, for part or all of

the Base, before that part of original DWPS scope (synoptic water level map) is removed from the project scope in a contact modification.

The goal of this technical memorandum is to:

- Review the 2012 SWGE and water level information collected subsequent to the 2012 SWGE;
- Evaluate the groundwater flow directions developed from previous potentiometric surface maps as they relate to AFFF Release Areas at FAFB and potential transport of PFAS in the subsurface; and
- Determine if the understating of on-Base groundwater flow directions is sufficient for the DWPS based on previously collected data, and if not, recommend specific SWGE activities to include in the DWPS (e.g., Base-wide SWGE or targeted SWGE at specific locations).

Although CRL was included in the 2012 SWGE, this technical memorandum focuses on-Base. There have been numerous SWGEs and potentiometric surface maps for CRL and the area just east of CRL.

2. Brief Overview of Hydrogeologic Setting

The subsurface includes unconsolidated sediments over fractured basalt. Figure 4 is a conceptual illustration of these subsurface layers. A summary of the layering is provided below (AEI, 2018; GSI 2015):

- The unconsolidated sediments, or “soil”, is typically encountered from approximately 0 to 50 ft below ground surface (bgs) and consists of sand and gravel with some silt and clay. These unconsolidated sediments are interchangeably referred to as alluvium/alluvial deposits. The thickest alluvial deposits in the vicinity of the Base (in some cases much greater than 50 feet thick) occur in river valleys and/or paleochannels that were scoured by large glacial floods, which incised the layers below.
- Underlying the alluvial deposit is a thick sequence of layered basalt associated with the regional Columbia River Basalt Group. The uppermost sequence of basalts includes the Wanapum Basalt (also called “Basalt A”) and the Grande Ronde Basalt (also called “Basalt B”). Basalt layers are separated by low-permeability clays called the Latah Formation. The interbed between Basalt A and Basalt B is called “Latah Interbed A”. Basalt A is approximately 160 to 190 feet thick.
- The basalt flows are underlain by massive granitic rock (also referred to as “basement”). The interbed between Basalt B and the granite is called “Latah Interbed I”.

The PFAS DWPS focusses on the alluvium and Basalt A.

The regional groundwater table at Fairchild AFB is located approximately 3 to 12 feet bgs, within the alluvium (or in places within the upper portion of weathered and fractured basalt). In

some locations, a high degree of hydraulic connection exists between the alluvium and Basalt A, and in other areas in other areas a low permeability silt/clay layer separates the alluvium from Basalt A (AECOM, 2012).

Seasonal variations in water levels are small at FAFB, with approximately 2 ft variation from a drought to an abnormally wet period (AECOM, 2012). We confirmed this previous observation of small seasonal variation based on review of water level data through 2019 at four locations, two of which are screened in the unconsolidated formation (MW-102, MW-12) and two of which are screened in Basalt A (MW-128 and MW-75). These wells were selected because of a long history of measurements in the Environmental Restoration Program Information Management System (ERPIMS) database and continued gauging after the 2012 SWGE. Long term variations were greater in the Basalt A compare to the unconsolidated unit, but seasonal variations were generally limited to a few feet or less.

Fairchild AFB obtains drinking water predominantly from the Fort Wright well field (Water Supply Annex No. 1), located 12 miles east of the base. On-base Supply Well No. 2 (Water Supply Annex No. 2) is located at the southern end of the base (location illustrated on Figure 1) and is periodically used as a backup supply. The Fairchild AFB water supply (including Supply Well No. 2) has been tested for PFOS and PFOA and measured concentrations were approximately 3 to 4 parts per trillion (ppt) (Tetra Tech, 2019), below the HAL value of 70 ppt.

3. Review of On-Base Water Level Information

3.1. Previous Base-wide to Site-Wide Potentiometric Surface Maps (June 2012)

The last Base-wide SWGE was a component of a Base-wide CSM (AECOM, 2012). That SWGE occurred between 6 June and 11 June 2012. Although 336 measurements were indicated in the report text, only 334 entries were in the corresponding report table. Of the 334 entries in the corresponding report table, only 315 depth to water measurements were reported; the remaining entries were blank.

The water level measurements were used to generate two potentiometric surface maps in the 2012 Base-Wide CSM: 1) Alluvium groundwater contour map with sand channel (Figure 2); and 2) Basalt-A groundwater contour map (Figure 3). Measuring point elevations (top of casing) were also surveyed as part of that effort.

No water level measurements were posted on the two potentiometric surface maps. A table was provided with well names, coordinates, and measurements; in some cases, well names were repeated with different coordinates and measurements (assumed to be mislabeled wells resulting in duplicate or triplicate well names). For example, MW-004 was assigned twice and MW-4 was assigned once; in the 2018 Base-wide Well Inventory there is only one well named MW-004 with an alias of MW-4. This complicates relating well names to the screened interval in the 2018 Base-wide Well Inventory (discussed below).

A significant limitation is that the 2012 Base-wide CSM Report did not indicate which wells measured in the 2012 SWGE were used to develop each of the two potentiometric surface maps. However, by comparing the list of wells included in the overall SWGE event to well

classifications in 2018 Base-wide Well Inventory (Bay West, 2019b), the following classifications can be approximated for the 334 reported wells (given the limitations of the repeated well names noted above):

- Unconsolidated (150 wells)
- Unconsolidated/Basalt A (29 wells)
- Basalt A (100 wells)
- Basalt B (5 wells: MW-074, MW-079, MW-101, MW-115, MW-116)
- Unknown (50 wells)

The five Basalt B wells, all near CRL, are not used in the potentiometric surface map for Basalt A. Groundwater elevations for these Basalt B wells are more than 50 ft lower than the adjacent groundwater contours.

The lack of documentation regarding which wells were used to develop the potentiometric surface maps, duplicate well names in the table of measurements, and a lack of posting of the groundwater elevations on the corresponding potentiometric surface maps all hamper evaluation of the quality of the potentiometric surface maps reported for the 2012 Base-wide SWGE. One approach to address this issue is to compare the potentiometric surface maps from the 2012 SWGE to potentiometric surface maps for other SWGE events, which are for more limited areas, to see if the interpretations are consistent. That is discussed later in this technical memorandum.

Based on the potentiometric surface maps from the 2012 SWGE (Figures 2 and 3), groundwater elevations between the two main hydrostratigraphic units (the unconsolidated material and Basalt A) are not sufficiently consistent to infer the groundwater flow directions in one unit based on flow direction in the other unit. For example, near the well pair MW-400 (Basalt A) and MW-401 (Unconsolidated), groundwater flow directions differ by nearly 90° based on potentiometric surface maps (Figures 2 and 3) for the 2012 Base-wide SWGE, and groundwater elevation was 5.7 ft higher in the Basalt A well compared to the unconsolidated well (9.4 ft away). In general, for areas of limited well coverage in both hydrostratigraphic units, this issue cannot be resolved by a SWGE at existing wells; rather, additional monitoring wells would need to be installed.

Based on the potentiometric surface maps from the 2012 SWGE, paleochannels and basalt highs control groundwater flow directions in both hydrostratigraphic units, with groundwater bifurcating around a basalt high east of the base; resulting in two main flow patterns: (1) groundwater flowing southeast towards AFFF Release Area 1 and off FAFB between the basalt high to the east and to the south; and (2) groundwater flowing towards the north and off FAFB. The locations of the paleochannels and basalt highs will be confirmed/refined as a component of the environmental-sequence stratigraphy (ESS) work being conducted as part of the DPWS.

Based on the 2012 potentiometric surface maps (Figures 2 and 3) a groundwater flow divide is present near the runway that separates groundwater leaving FAFB to the north and groundwater leaving FAFB to the east near AFFF Release Area 1. The exact location of this divide is uncertain (discussed in more detail later in this technical memorandum). Based on the 2012 potentiometric surface maps, AFFF Release Areas 1 and 2 likely flow towards the east and off-base, and AFFF Release Areas 3 and 5 likely flow northeast and north off-base. PFAS from

AFFF Release Area 4 likely flows east towards AFFF Release Area 1, but that is uncertain because the location of the divide is not sufficiently known. Furthermore, alluvial water levels are not drawn near AFFF Release Area 4 on the 2012 potentiometric surface maps, so those maps do not definitely preclude alluvial flow in other directions (e.g., to the southwest) near AFFF Release Area 4.

3.2. ERPIMS Database and the 2018 Base-wide Well Inventory

3.2.1. ERPIMS Database

The most recent depth to groundwater measurement in the ERPIMS database evaluated for this technical memorandum (accessed June 2019) was collected on 29 January 2019. The ERPIMS database was used to identify previous SWGEs that included many wells. This was done by calculating the number of depth to water measurements per day, and then looking at the number of measurements per day as well as totals across 3-day, 5-day and 10-day periods. These time intervals were used to identify discrete SWGEs across multiple day periods. This method does not highlight SWGEs at a small number of locations, such as 20 measurements at one particular installation remediation program (IRP) site, but does capture larger, discrete events that may have included development of potentiometric surface maps for relatively large areas. Specific remediation areas and IRP sites of interest are shown in Figure 5, for reference.

Table 1. SWGEs Identified from the ERPIMS Database

Year	Event	Number of Wells Gauged	Corresponding Report
2008	March 10-13	80	Remedial Action Operations Report Fourth Quarter and Annual 2008 (CH2MHILL, 2008)
2008	September 15-17	78	Remedial Action Operations Report Fourth Quarter and Annual 2008 (CH2MHILL, 2008)
2011	December 1-9	134	n/a
2012	June 6-11	394	Basewide Conceptual Site Model (AECOM, 2012)
2013	August 5-16	192	August 2013 Synoptic Groundwater Monitoring Event for Site SS-39 (CH2MHill, 2014)
2013	December 5-19	198	Final Remedial Action Operations Report Fourth Quarter and Annual 2013 (Bhate, 2015b)
2014	March 11-19	109	n/a
2014	June 2-13	207	Final Remedial Action Operations Report Second Quarter 2014 (Bhate, 2015a)
2014	November 17-25	150	Final Remedial Action Operations Report Fourth Quarter and Annual 2014 (Bhate, 2016)
2015	December 1-11	152	Final SS039 2015 Annual Groundwater Monitoring Report (Bay West, 2017)
2017	June 13-23	151	SS039 2017 Annual Groundwater Monitoring Report (Bay West, 2018e)
2017	October 31-November 9	145	SS039 2017 Annual Groundwater Monitoring Report (Bay West, 2018e)

n/a = no corresponding report was determined from the AR

With respect to the June 2012 SWGE discussed in Section 3.1, although AECOM reported 336 measurements in the report text and 334 measurements in the corresponding report table (and only 315 depth to water measurements were reported), the ERPIMS database indicates 394 entries and 379 depth to water measurements during this time period. Of these 379 measurements in the ERPIMS database, there are 326 unique locations measured; some wells were gauged multiple times. For example, MW-031 has three depth to water measurements of 9.1, 6.93, and 6.88 ft; only one of those values (6.93 ft) was reported in the corresponding 2012 Base-wide SWGE table.

Water level measurements for the events in Table 1 primarily pertain to the SS039 site. With respect to other areas, the events in March 2008 had a greater portion of wells gauged in WP003 and FT004 (Figure 5). The event in June 2017 had multiple wells gauged at SD037 but there are no corresponding potentiometric surface maps.

Interpretation of previous SWGEs is complicated due to the way the data are reported and presented. For example, 187 wells were gauged in November 2016 based on the SS039 2016 Annual Groundwater Monitoring Report (Bay West, 2018d). The associated report contained several potentiometric surface maps for November 2016 water levels, but those maps do not include posted values and do not indicate which wells were used to make the contours. Additionally, only 98 depth to water measurements appear in the ERPIMS database for November 2016, much less than the number of wells gauged based on the report.

3.2.2. Current Well Summary (2018 Base-wide Well Inventory)

There are 679 wells listed in the 2018 Base-wide Well Inventory (Bay West, 2019f). The status of each well is identified based on the following classifications provided:

- *Current Sampling* (268)
- *Not in use* (319)
- *Damage* (1)
- *Inactive* (5); reserved for extraction wells
- *Active* (12); reserved for extraction wells
- *Water levels* (71)
- *Unknown* (3)

In the 2018 Base-wide Well Inventory, the location data is listed as “Unknown” or “Data not available” for 43 wells. In addition, there are 194 decommissioned wells identified in the 2018 Base-wide Well Inventory. The 2018 Base-wide Well Inventory also includes the screened formation of the wells (Table 2).

Table 2. Screened Formations of Non-Decommissioned Wells,
2018 Base-wide Well Inventory

Screened Formation	Number of wells
Unconsolidated	299
Unconsolidated/Basalt A	55
Basalt A	211
Basalt B	7
Basalt B/Latah Formation	1
Unknown/Data not available	106

These well locations are illustrated in Figures 6 to 8. These figures are intended to illustrate the universe of existing wells potentially available for water level measurement as part of a future SWGE. Figure 6 shows wells screened over the unconsolidated unit, including units screened over multiple intervals (e.g., unconsolidated/Basalt A). Figure 7 shows any wells screened over Basalt A, including those screened over multiple intervals (e.g., unconsolidated/Basalt A). Consequently, wells that are listed as screened over multiple formations are represented on multiple maps. Figure 8 shows the remaining wells including wells screened in the granite, Basalt B, and the wells without a listed screened formation (i.e., “*Unknown*”).

3.3. New Wells Constructed After the 2012 Base-wide SWGE

Based on the 2018 Base-wide Well Inventory, there have been 216 additional wells completed from June 2012 to 2018 (Figure 9). In the 2018 Base-wide Well Inventory, 118 wells are listed as *Unknown* for the *Date Completed*; therefore, there could be more than 216 if some of those wells were installed after the 2012 SWGE. Not all of the wells in the 2018 Base-wide Well Inventory have corresponding easting/northing coordinates. Five wells (MW-437 through MW-441) were installed the first week of June 2012, prior to the last Base-wide SWGE in 2012, but only two of those five wells (MW-339 and MW-441) were gauged in the 2012 Base-wide SWGE. The status of these 216 wells include 75 “*Currently Sampling*”, 12 “*Water Levels*”, 128 “*Not in use*”, and 1 “*Inactive*”. The wells are screened over the following units:

- 143 unconsolidated wells (11 Water Levels, 36 Currently Sampling, 96 Not in use)
- 22 unconsolidated/Basalt A (4 Currently Sampling, 17 Not in use, 1 Inactive)
- 47 Basalt A wells (1 Water Levels, 35 Currently Sampling, 15 Not in use)

This does not include four new wells since 2012 that have been since decommissioned (RW-451, RW-452, WDF-MP-10, and WDF-MP-9).

Limited wells were installed near AFFF Areas 1, 2, and 4 since the 2012 SWGE:

- One (now “*Not in use*”) well was installed near AFFF Area 2 (DP024-MW-01).
- Four of these new (post-June 2012) wells were installed at TU503 located slightly southeast of AFFF Release Area 4.

3.4. New Wells Since the 2018 Basewide Well Inventory

Additional soil borings and drilling logs were provided as part of the initial site investigation (SI) (Amec, 2019) but no new monitoring wells were installed as part of this effort. No new monitoring wells identified at and nearby the AFFF Release Areas based on review of documents available in the administrative record (AR).

4. Understanding of Groundwater Flow Direction in Specific Areas

The following areas were specifically evaluated to determine if on-Base groundwater flow directions are sufficiently understood, based on their relatively high importance with respect to PFAS releases and/or PFAS detections:

1. AFFF Release Area 1, FT004 (FT01), plus WP003 located immediately to the north
2. AFFF Release Area 2, Calibration Area and nearby DP024 and OT017
3. AFFF Release Area 3, Aircraft Crash Location SS008 (PS-4/9) and nearby TU500 and TU502
4. AFFF Release Area 4, B-52 Crash Location 1994, and nearby RW011, SS019, ST010, and TU503
5. AFFF Release Area 5, Fire Station 1 (Building 3)
6. SS039, Orphan TCE Plumes – based on large areal footprint and frequent SWGEs
7. Main portion of SD037 (northeastern portion of FAFB) and Vicinity– On-Base area with PFAS detections
8. On-base Water Supply Well (Well #2) – based on concern for future PFAS impacts

Each area was qualitatively assessed based on the following items:

- Spatial coverage;
- Consistency of measurements;
- Recency of measurements; and
- Frequency of measurements.

Existing groundwater contour maps with posted water level data were identified from site reports to augment the potentiometric surface maps from the 2012 SWGE that are illustrated on Figures 2 and 3. These additional groundwater contour maps are included in Appendix A and are summarized on Table 3.

Table 3. Summary of Additional Water Level Maps with Posted Water Levels, By Area

Area	Figure(s) in Appendix A	Date and Unit	GW Flow Direction from This Figure	Comments
AFFF Release Area 1 <i>FT004 plus WP003 located immediately to the north</i>	A-1	Sep. 2008 – Alluvium (FT004)	Just south of east	- The 2012 SWGE identified groundwater flow in the alluvium just south of east near FT004 and southeast near WP003 – these additional maps are consistent with that interpretation - Figures A-3 to A-5 are based on only 3 or 4 measurements and therefore flow direction is less precise on those maps versus the others - The majority of wells in this are screened over the alluvium. Few are screened over Unconsolidated/ Basalt A, Basalt A and some are listed as unknown. Each of these maps is for the alluvium and no maps were identified in this area for Basalt A (other than Figure 3 from the 2012 SWGE). - The spatial coverage is sufficiently high.
	A-2	Feb. 2013 - Alluvium (FT004)	Just south of east	
	A-3	Mar. 2016 – Alluvium (FT004)	East	
	A-4	Sep. 2016 – Alluvium (FT004)	East	
	A-5	Feb. 2017 – Alluvium (FT004)	East	
	A-6	Sep. 2008 – Alluvium (WP003)	East/Southeast	
	A-7	Feb. 2013 - Alluvium (WP003)	Southeast	
	A-8	Mar. 2016 – Alluvium (WP003)	Southeast	
	A-9	Sep. 2016 – Alluvium (WP003)	Southeast	
AFFF Release Area 2 <i>Calibration Area and nearby DP024 and OT017</i>	A-10	Dec. 1995. – Alluvium (FT1/FT2)	East	- For alluvium, the 2012 SWGE identified groundwater flow impacted by a basalt high located near Area 2, with groundwater flow to the northeast just west of Release Area 2 and groundwater flow to the southeast just south of Release Area 2. - For Basalt A, the 2012 SWGE identified similar flow directions as for the alluvium. - The western part of the December 1995 map (Figure A-10) includes AFFF Release Area 2 and the eastern part of that map includes AFFF Release Area 1. - Only one current well is nearby (DP024-MW-01) and it is classified as ‘not in use”, so spatial coverage at this site is poor. Wells used for the December 1995 map (Figure A-10) have been decommissioned. - Water levels in this area have been infrequently gauged. - GW flow directions are poorly documented in this area but based on available information it appears very likely that groundwater from this area ultimately flows to the east or east/southeast towards Release Area 1.

Area	Figure(s) in Appendix A	Date and Unit	GW Flow Direction from This Figure	Comments
AFFF Release Area 3 <i>Aircraft Crash Location SS008 PS-4/9), plus TU500 (~2,000 feet east) and TU502 (~1,000 ft north)</i>	A-11	May 2017 – Alluvium (SS008)	Northeast	- AFFF Release Area 3 is contained entirely within SS039 (discussed below) - The 2012 SWGE identified groundwater flow just north of east in both the alluvium and Basalt A. Figure A-11 suggests flow more to the northeast but is based on only 4 locations. - Figures A-13 to A-15 for TU502 indicate localized flow to the south and southeast (depending on location), but also note that flow direction is anomalous relative to regional flow which is believed to be to the northeast based on SS039 water levels - The spatial coverage of wells is low at AFFF Release Area 3, but high within 1,000 ft of this release area, and since this area is contained within SS039, nearby wells have been gauged frequently and recently. - TCE sampling for SS039 includes relatively non-impacted wells to the southeast, further suggesting groundwater flow in this area is to the northeast as indicated by the 2012 SWGE.
	A-12	Nov. 2016 – Alluvium (TU500)	Northeast	
	A-13	Nov. 2016 - Alluvium (TU502)	South and southeast	
	A-14	Mar. 2017 – Alluvium (TU502)	South and southeast	
	A-15	Aug. 2017 – Alluvium (TU502)	South and southeast	
AFFF Release Area 4 <i>B-52 Crash Location 1994, and nearby RW011, SS019, ST010, and TU503</i>	A-16	May 2017 – Alluvium (TU503)	Southeast and south	- For the alluvium, groundwater contours for the 2012 SWGE do not extend to this release area. It is conceivable that groundwater flow in the alluvium could be in a different direction (e.g., to the south consistent with topography) rather than east/northeast observed in many other parts of the Base. - For Basalt A, the 2012 SWGE identified groundwater flow generally northeast in this release area, though it is not clear what wells this interpretation was based on. - The PFAS SI indicates northeast groundwater flow in the alluvium at Release Area 4 but does not provide a basis, since no groundwater elevations were measured in this area as part of that effort. - Spatial coverage at this area is poor. Water levels in nearby wells have been gauged infrequently. - The southeast/south flow directions in adjacent area TU503 measured in 2017 (Figures A-16 and A-17) further suggests alluvial groundwater could potentially flow to the south in the southwest part of the Base.
	A-17	Sep. 2017 – Alluvium (TU503)	Southeast and south	

Area	Figure(s) in Appendix A	Date and Unit	GW Flow Direction from This Figure	Comments
AFFF Release Area 5 <i>Fire Station 1 (Building 3)</i>	A-18	Nov. 2016 – Alluvium (TU506)	East-Northeast	- AFFF Release Area 5 is contained entirely within SS039 (discussed below) - For alluvium, the 2012 SWGE identified groundwater flow directions generally to the northeast. - For the Basalt A, the 2012 SWGE indicated groundwater flow directions are generally towards the southeast, then changing to east and northeast further downgradient. - For the alluvium, groundwater flow direction on Figure A-18 is consistent with the 2012 SWGE map. There is no map identified to make a similar comparison for Basalt A. - Given this area is contained within SS039 and TU506 areas, spatial coverage is good and nearby wells have been gauged frequently and recently. - TCE sampling for SS039 includes relatively non-impacted wells to the southeast, further suggesting groundwater flow in this area is to the northeast as indicated by the 2012 SWGE.
SS039, Orphan TCE Plumes <i>Based on large areal footprint and frequent SWGEs</i>	A-19	Aug. 2013 – Basalt A (proximal and central plume)	Highly variable; mostly east	- SS-39 extends more than two miles from the west end of the runway to the northern edge of FAFB. - AFFF Release Areas 3 and 5 are contained entirely within SS-39 - The potentiometric surface map from the 2012 Base-wide SWGE indicates a generally east to north groundwater flow direction, depending on location. - The main differences between the 2012 and 2013 event are along the 2435-ft contour in the Basalt A potentiometric surface map, specifically near AFFF Release Area 3, where the 2012 SWGE shows a more prominent southerly flow component. - Spatial coverage of wells at SS-39 is high and wells are consistently gauged. - Near the northern edge of the base boundary, groundwater flow is not well defined. - TCE sampling for SS039 includes relatively non-impacted wells to the southeast, further suggesting groundwater flow in this area is to the northeast and then north as indicated by the 2012 SWGE.
	A-20	Aug. 2013 – Basalt A and alluvium (distal plume)	North	
	A-21	Aug. 2013 – Alluvium (proximal and central plume)	Northeast	
	A-22	Dec. 2013 - Alluvium	Northeast to North-Northeast	
	A-23	Jun. 2014 - Alluvium	Northeast to North-Northeast	
	A-24	Jun. 2014 - Alluvium	Northeast to North-Northeast	
	A-25	Dec. 2015 – Alluvium	Northeast	
	A-26	Mar. 2014 – Alluvium	North	

Area	Figure(s) in Appendix A	Date and Unit	GW Flow Direction from This Figure	Comments
Main portion of SD037 (northeastern portion of FAFB) and Vicinity On-Base area with PFAS detections	A-27	Mar. 2014- Alluvium	North in the northern part of area, East in the eastern part of area	- The main portion of SD037 is included because this site has PFAS detected below the HAL in wells SD037-MW555 (38.5 ppt) and SD037-MW557 (39.1 ppt). Note: the 2018 Basewide Well Inventory does not include the “SD037-“ prefix for these wells. - For alluvium, the 2012 SWGE identified groundwater flow towards the northeast; part of the groundwater flow was inferred. - For Basalt A, the 2012 SWGE identified similar flow directions as for the alluvium; with a slightly more easterly flow component towards the southern end of the area. - For Figures A-27 to A-33 wells with groundwater elevations posted in the figures belong to both the unconsolidated material and Basalt A such that the corresponding unit cannot be determined; or, both units were used in generating the potentiometric surface map - Groundwater flow directions are highly variable and vary from southeast to northwest, depending on the location. The most consistent direction was towards the northeast, roughly consistent with the northeast directions from the 2012 SWGE. - Generally, spatial coverage is high and water levels in wells are frequently gauged have been gauged multiple times.
	A-28	Aug. 2000 – unit cannot be determined	Southeast (map limited to eastern part of area)	
	A-29	Dec. 2000- unit cannot be determined	Southeast (map limited to eastern part of area)	
	A-30	Sep. 2001- unit cannot be determined	East to Southeast	
	A-31	Oct. 2001- unit cannot be determined	East to North	
	A-32	Nov. 2001- unit cannot be determined	Highly variable	
	A-33	Dec. 2001- unit cannot be determined	North to East	
On-base Water Supply Well (Well #2) <i>Based on concern for future PFAS impacts</i>	None Identified	None Identified	None because no additional maps identified	- No water levels are available near On-base Water Supply Well (Well #2). - Well #2 is perforated from 205-215 and 380-400 ft and draws from the Wanapum Basalt and the Grande Ronde Basalt. - No potentiometric surface maps developed thus far indicate any possible pathway from AFFF Release Areas 1 through 5 to this supply well. - Groundwater flow directions are unknown near this location and will remain unknown unless additional wells are installed nearby.

5. Potential Options for Additional SWGEs as Part of the PFAS DWPS

The 2012 Base-wide SWGE was not well-documented with respect to:

- which particular wells were used for a given potentiometric surface (Alluvium vs. Basalt A);
- the treatment of wells screened over multiple hydrostratigraphic units (e.g., wells screened in both Alluvium and over the Basalt A unit); and.
- the generation of the potentiometric surface, including which wells were excluded (if any) or the gridding details and method.

Since the last Base-wide SWGE in 2012, there have been additional wells installed that increase the available information (Figure 9), but some wells have also been decommissioned since the 2012 SWGE.

Potential options for additional SWGEs as part of the DWPS include the following:

- Option 1 - Potential Base-wide SWGE
- Option 2 - Potential Localized SWGE(s)
- Option 3 - No SWGEs as part of DWPS

Key considerations relevant to the PFAS DWPS for evaluating these options include the following:

- Understanding where groundwater containing PFAS potential exits the Base
 - A specific uncertainty is the groundwater flow direction near AFFF Release Area 4, which could potentially be to the south based on topography, surface drainage, and water levels in nearby TU503.
- Location of the groundwater flow divide (near the flightline) which separates groundwater flow towards the eastern and northern Base boundaries.
- Potential groundwater pathway from AFFF release areas to backup production Well #2.
- Source of PFAS detections in the northwest part of the Base near SD037 (two wells [SD037-MW555 and SD037-MW557] with PFAS detected below the HAL).

Table 4 summarizes Options 1 to 3 with respect to the considerations listed above.

Table 4. Summary of SWGE Options with Respect to PFAS DWPS Considerations

SWGE Option	Discussion
Option 1: Potential Base-wide SWGE	• Groundwater flow directions are already well understood over most of the Base from existing maps developed for previous SWGEs. • The current CSM indicates that PFAS from AFFF Release Areas 1 and 2 in groundwater likely exits the Base along the eastern boundary (near AFFF Release Area 1) and PFAS from AFFF Release Areas 3 and 5 likely exists the Base along the northern boundary (distal part of SS039), and a new Base-wide SWGE is unlikely to change that CSM. • Uncertainty of groundwater flow direction near AFFF Release Area 4 will not be resolved by Base-wide SWGE at existing wells; rather that uncertainty would require new wells south and/or southwest of AFFF Release Area 4, with subsequent SWGE (and ideally PFAS sampling) that includes those new wells and existing wells near TU503. New wells are not likely a possibility within the scope/timeframe of the DWPS. • Given the lack of existing wells near the flightline (Figures 6 to 8) a new Base-wide SWGE at existing wells will likely not resolve the location of the flow divide that separates groundwater exiting the eastern boundary from groundwater exiting the northern boundary. However, better definition of this flow divide may not be critical for the PFAS DWPS since groundwater with PFAS already is believed to exit both the eastern and northern boundaries, and further investigation or remediation under the flightline is not likely feasible. • No monitoring wells are located near Well #2, so a new Base-wide SWGE at existing wells will not clarify groundwater pathways from AFFF release areas to Well #2, unless new monitoring wells are installed before the SWGE. That is not likely a possibility within the scope/timeframe of the DWPS. • At the wells impacted by PFAS near SD037 (MW-555 and MW-557) groundwater flow direction is uncertain. Per Figures 6 and 7, there is a large gap in existing wells between the SS039 Area monitoring network and the SD037 Area. Base-Wide SWGE at existing wells would likely fully not resolve the groundwater flow direction between those two areas, without prior addition of monitoring locations between the two areas.

SWGE Option	Discussion
Option 2: Potential Localized SWGE(s)	- Localized SWGEs would cost slightly less than a Base-wide SWGE, though the vast majority of the cost would still be incurred because there would still be planning, mobilization, field work, data reduction, development of potentiometric maps, and reporting in both cases. - Uncertainty of groundwater flow direction near AFFF Release Area 4 will not be resolved by localized SWGE at existing wells; rather, that uncertainty would require new wells south and/or southwest of AFFF Release Area 4, followed by localized SWGE (and PFAS sampling) at those new wells plus wells near TU503. That is not likely a possibility within the scope/timeframe of the DWPS. - Given the lack of existing wells near the flightline (Figures 6 to 8) localized SWGE at existing wells will likely not resolve the location of the flow divide that separates groundwater exiting the eastern boundary from groundwater existing the northern boundary. Refining the location of this flow divide may not be critical for the PFAS DWPS since groundwater with PFAS already exits both the eastern and northern boundaries. - No monitoring wells are located near Well #2, so a localized SWGE at existing wells will not clarify groundwater pathways from AFFF release areas to Well #2 (unless new wells are installed before the SWGE). That is not likely a possibility within the scope/timeframe of the DWPS. - Resolving uncertainty of groundwater flow directions near SD037 (northwest part of base) to better understand the source of low-level PFAS detections at two wells could be attempted with a localized SWGE. However, there appears to be a recent SWGE (June 2017) that includes water level measurements for this area, but a corresponding report and/or potentiometric surface interpretation for that event has not been identified. Before contemplating a new localized SWGE in this area, it would be preferable to determine if there is an adequate evaluation of the June 2017 water level data near SD037, and if not, to perform such an evaluation using the existing data. Additional PFAS sampling in the area would also help identify potential PFAS sources for the observed impacts; PFAS sampling previously identified in this area has been limited to the two wells impacted below the HAL (MW-555 and MW-557), plus one well further west (at the base boundary) that was non-detect for PFAS (MW-307).
Option 3: No SWGEs as part of DWPS	- This option allows DWPS funding to be focused on other CSM elements including geologic interpretation on-Base and off-Base as well as searching for historical information regarding groundwater flow directions off-Base. - This option presumes that key CSM elements regarding groundwater flow direction on-Base are adequately understood, or that the current understanding (even if uncertain) would not be substantively improved by conducting SWGE at existing wells. - As identified above, there are several locations where addition of new monitoring wells would allow CSM refinement based on SWGE, if conducted after such wells are installed. These include the area northwest of Well #2 and the area south and southwest of AFFF Release Area 4.

6. Recommendations

As detailed in Table 4, groundwater flow directions are already well understood over most of the Base from existing maps developed for previous SWGEs, and a Base-wide SWGE would not address many of the uncertainties that pertain to the PFAS DWPS unless new wells are added first in key areas. New wells are not likely a possibility within the scope/timeframe of the DWPS. Therefore, Tehama recommends no on-Base SWGE for the DWPS, with the following caveats:

- If new alluvial monitoring wells are added south and southwest of AFFF Release Area 4, then localized SWGE in that area would be recommended, including the new wells plus wells existing near TU503.

- If at least three new Basalt-A monitoring wells were added northwest of Well #2 then localized SWGE would be recommended at those new wells to attempt to better understand flow directions near Well #2.
- If groundwater flow directions near SD037 cannot be better resolved by identifying reports with existing potentiometric surface maps for the June 2017 monitoring, and/or by performing independent evaluation of water levels from that monitoring as part of the DWPS, then localized SWGE near SD037 may be merited.

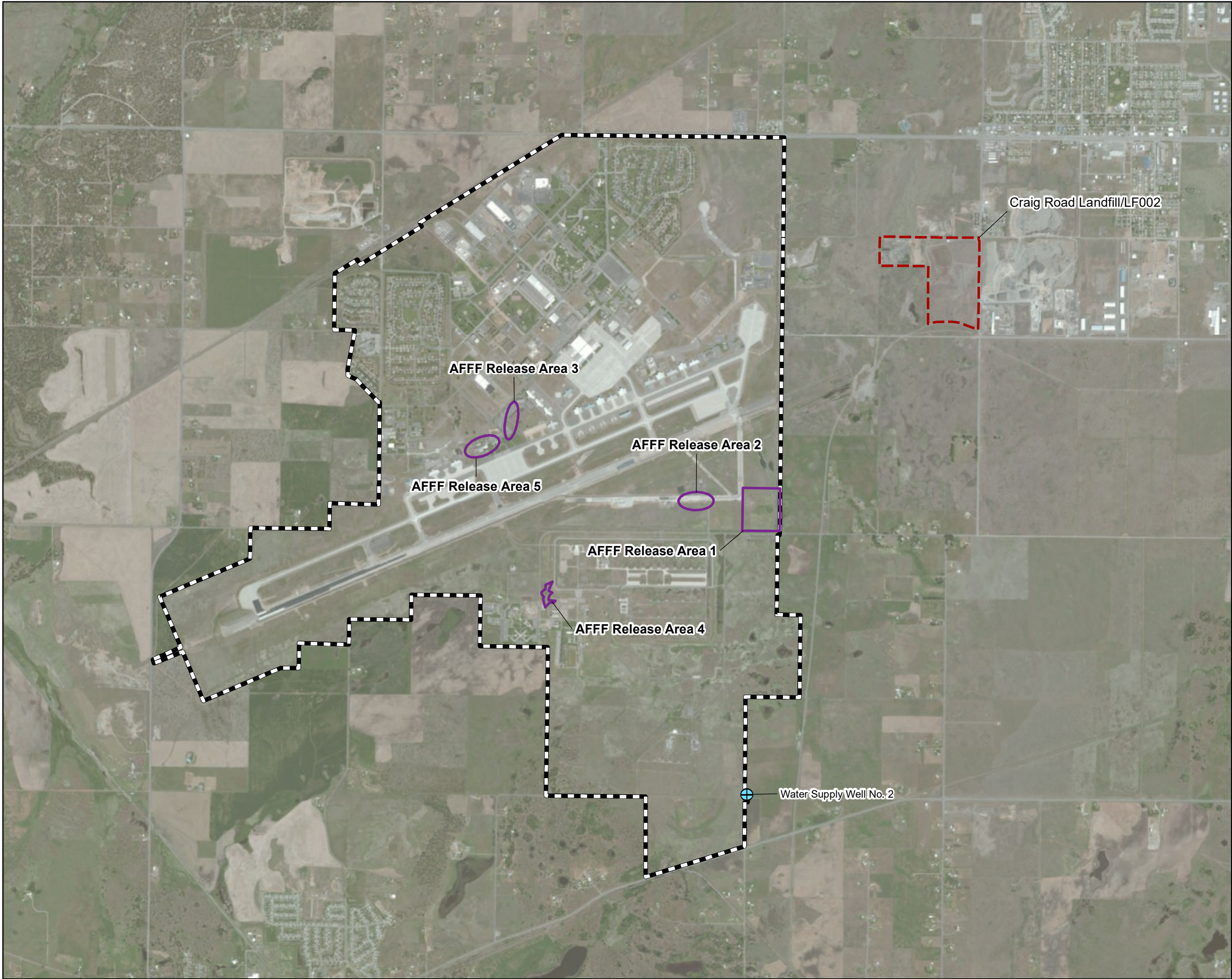
As noted in Table 4, given the lack of existing wells near the flightline (Figures 6 to 8) a Base-wide SWGE or localized SWGE at existing wells will likely not resolve the location of the flow divide that separates groundwater exiting the eastern boundary from groundwater existing the northern boundary. However, better definition of this flow divide may not be critical for the PFAS DWPS since groundwater with PFAS already exits both the eastern and northern boundaries. Therefore addition of wells near the flightline, followed by SWGE to refine the flow divide location, is not a priority for the PFAS DWPS.

7. References

- AECOM, 2012. *Conceptual Site Model for Fairchild Air Force Base*. November. {No AR Number}
- AEI, 2018. [Working Copy] *Site Inspection Report, Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas, Environmental Programs Worldwide, Fairchild Air Force Base, Washington*, February. {No AR Number}
- Amec Foster Wheeler, 2019. *Site Inspection Report, Fairchild Air Force Base, Washington. Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas Environmental Programs Worldwide*. January 2019.
- Bay West, 2017. *Final SS039 2015 Annual Groundwater Monitoring Report*. March 2017. AR#2189.
- Bay West, 2018a. *Final SS039 2016 Annual Groundwater Monitoring Report*. February 2018. AR#2104.
- Bay West, 2018b. *Remedial Action Operations Report Fourth Quarter and Annual 2016*. February 2018. AR#2109.1-2109.4
- Bay West, 2018c. *Final Uniform Federal Policy – Quality Assurance Project Plan Addendum-I Site LF002 (SW-8)*. March 2018. AR#2140.
- Bay West, 2018d. *Consolidated Site TU500 Remedial Investigation Work Plan Addendum*. June 2018. AR#2161.
- Bay West, 2018e. *Consolidated Site TU506 Remedial Investigation Work Plan Addendum*. June 2018. AR#2161.
- Bay West, 2018f. *Voluntary Cleanup Program Remedial Investigation at TU502*. August 2018. AR#2152
- Bay West, 2018g. *Pre-Design Investigation Report Site WP003 (Industrial Wastewater Lagoon System, WW-1)*. September 2018. AR#2151
- Bay West, 2018h. *SS039 2017 Annual Groundwater Monitoring Report*. November 2018.
- Bay West, 2019a. *Final Initial Investigation/Site Hazard Assessment and No Further Action at OW055*. February 2019. AR#2216
- Bay West, 2019b. *2018 Basewide Well Inventory Through 31 December 2018. Performance-Based Remediation, Fairchild Air Force Base, Washington. Contract FA8903-14-C-0011*. April 2019. Draft Revision 01.
- Bay West, 2019c. *Final Voluntary Cleanup Program Remedial Investigation at TU503 (SS-C503, Facility 1212)*. May 2019.

- Bhate, 2015a. Remedial Action Operations Report Second Quarter 2014, Fairchild Air Force Base, Spokane, Washington. May 2015
- Bhate, 2015b. Remedial Action Operations Report Fourth Quarter and Annual 2013, Fairchild Air Force Base, Spokane, Washington. October 2015.
- Bhate, 2015c. Remedial Action Operations Report Fourth Quarter and Annual 2015, Fairchild Air Force Base, Spokane, Washington. November 2015.
- Bhate, 2016. Remedial Action Operations Report Fourth Quarter and Annual 2014, Fairchild Air Force Base, Spokane, Washington. May 2016.
- CH2MHill, 2008. Second Five-Year Review Report for Priority One and Two Sites, Fairchild Air Force Base, Washington. June 2008. AR#1988.
- CH2MHill, 2009. Remedial Action Operations Report Fourth Quarter and Annual 2008. Priority One and Priority Two Sites, Fairchild Air Force Base, Washington Revision 2. July 2009. AR#1987.
- CH2MHill, 2014. August 2013 Synoptic Groundwater Event for Site SS-39, Fairchild AFB. May 2014.
- EA Engineering, Science, and Technology, 1996. Site Investigation Report for Eight Areas of Concern, Sites SW-6 (RW-11) and SW-13 (OT-15) and Orphan Trichloroethene Plumes. November 1996. AR#1577.
- GSI Water Solutions, Inc., INTERA, Inc., GeoEngineers, Inc., and Carlstad Consulting, 2015. *Hydrogeologic Framework and Conceptual Groundwater Flow Model, Review of Groundwater Conditions in the West Plains Area, Spokane County, Washington*. June. {No AR Number}
- Tetra Tech, 2019. Fourth Five-Year Review Report for Multiple Sites at Fairchild Air Force Base, Washington. January 2019.
- URS, 2002. Final Remedial Investigation Report, Site SD-37, Volume 1. February 2002. AR#1873.

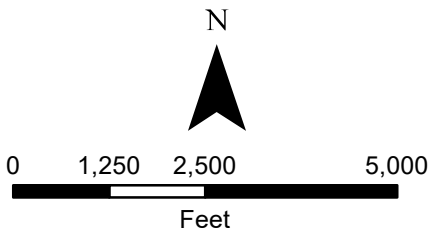
FIGURES



Legend

-  Water Supply Well No. 2
-  AFFF Release Area
-  Craig Road Landfill/LF002
-  Fairchild Air Force Base

Note:
AFFF=aqueous film forming foam



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Fairchild Air Force Base
Spokane, Washington

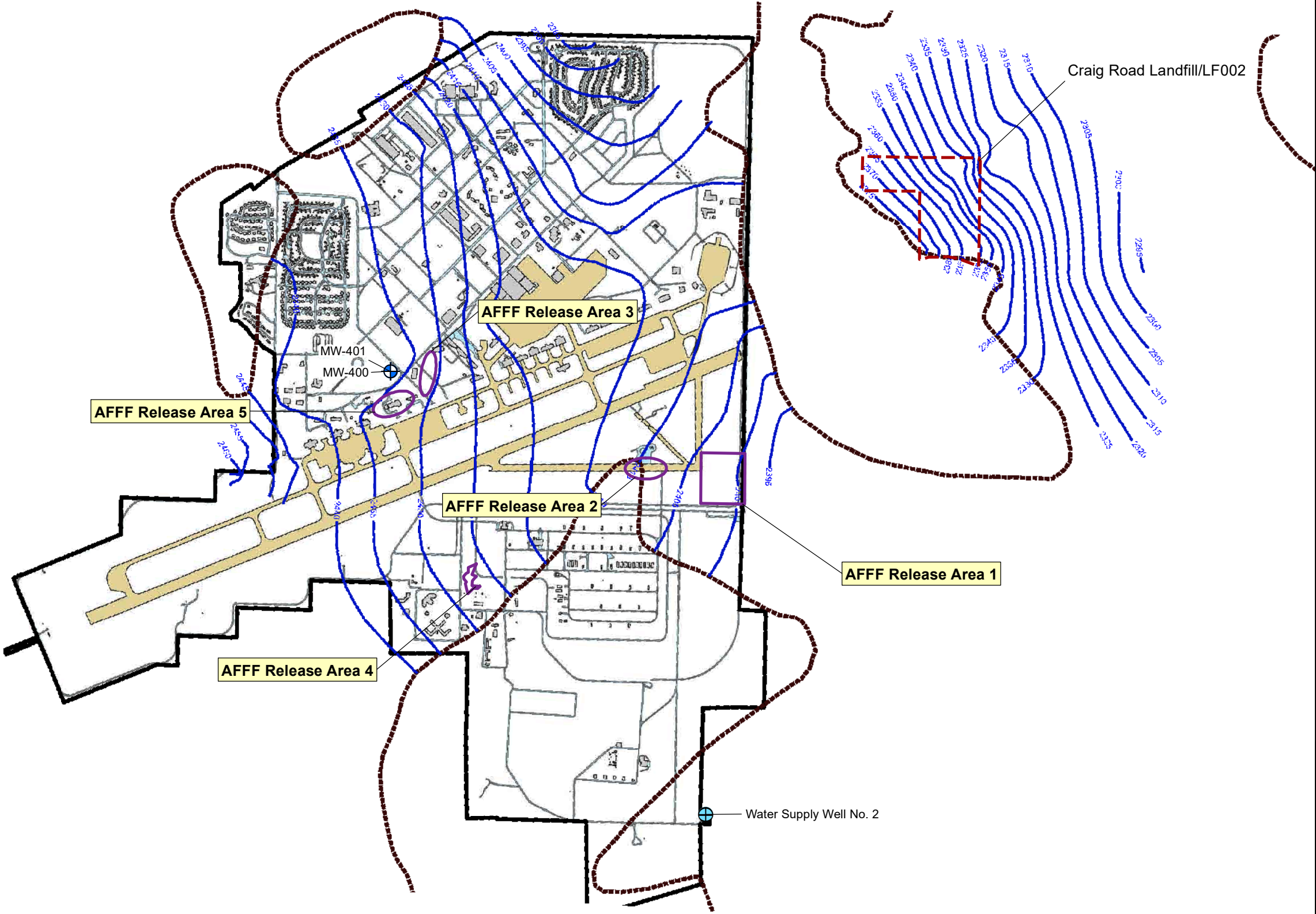
AFFF Release Area Locations

On-Base Groundwater Flow Directions Evaluation



DATE
06/21/2019

FIGURE
01



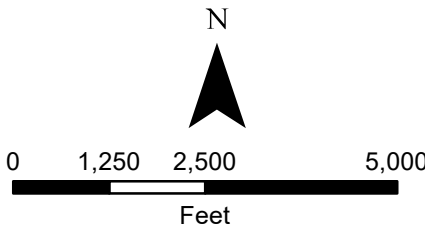
Legend

- Water Supply Well No. 2
- Monitoring Well
- Basalt-A Groundwater Contour (ft amsl)
- Basalt Outcrop
- AFFF Release Area
- Craig Road Landfill/LF002
- Fairchild Air Force Base

Notes:
Original image is from (see source below); AFFF Release Areas, Craig Road Landfill, and Water Supply Well No. 2 were added. Wells MW-400 and MW-401 added for comparison of water levels in the same area between the alluvium and Basalt A.

AFFF=aqueous film forming foam

Source: AECOM, 2012. Basewide Conceptual Site Model for Fairchild Air Force Base.



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Fairchild Air Force Base
Spokane, Washington

**Groundwater Contours for
Basalt A from
AECOM, 2012**
On-Base Groundwater Flow Directions Evaluation



DATE
06/24/2019

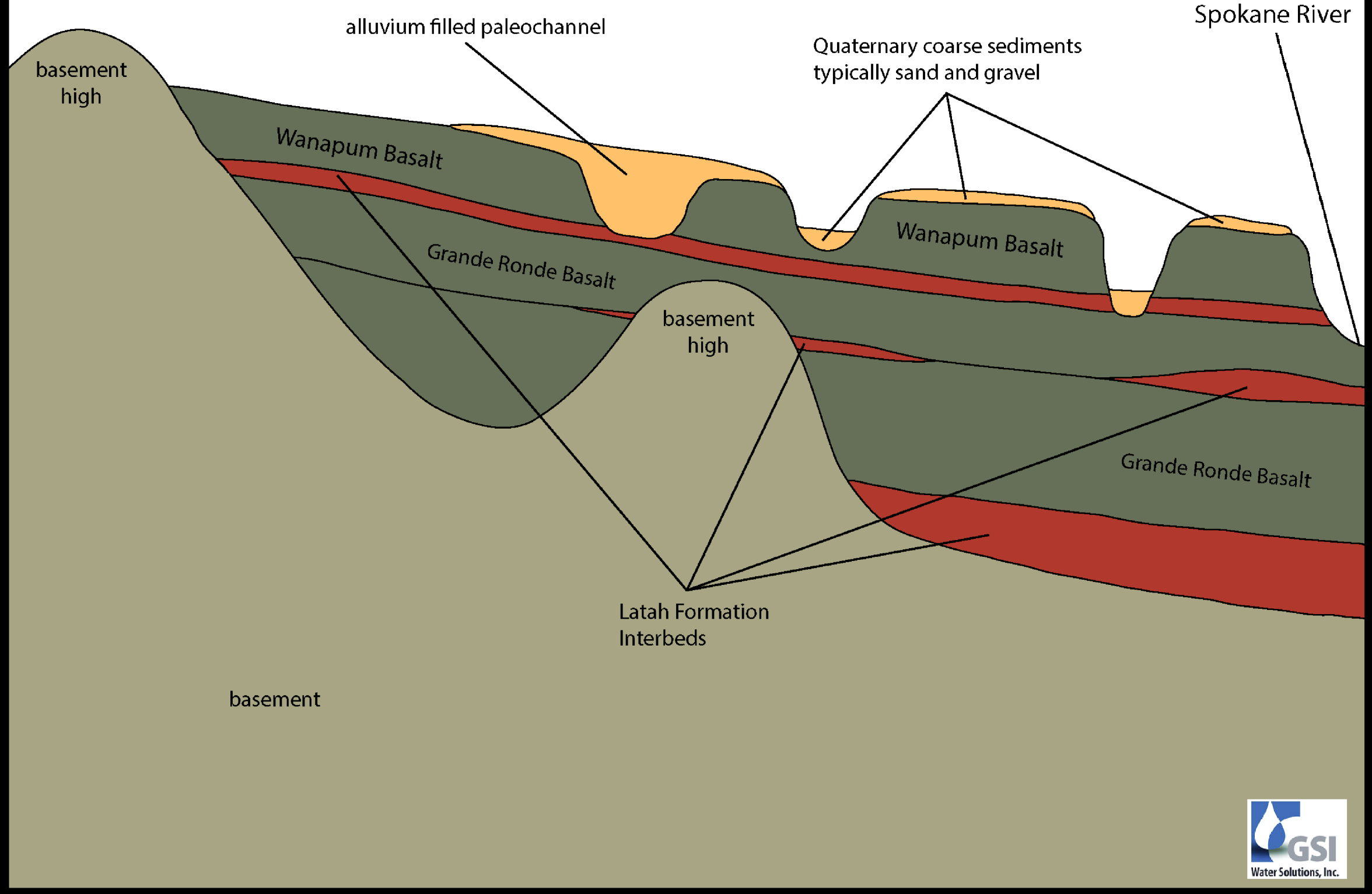
FIGURE
03

West

East

Legend

Note:
Figure from (source): GSI Water Solutions, Inc., INTERA, Inc., GeoEngineers, Inc., and Carlstad Consulting, 2015. Hydrogeologic Framework and Conceptual Groundwater Flow Model, Review of Groundwater Conditions in the West Plains Area, Spokane County, Washington. June. {No AR Number}



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Fairchild Air Force Base
Spokane, Washington

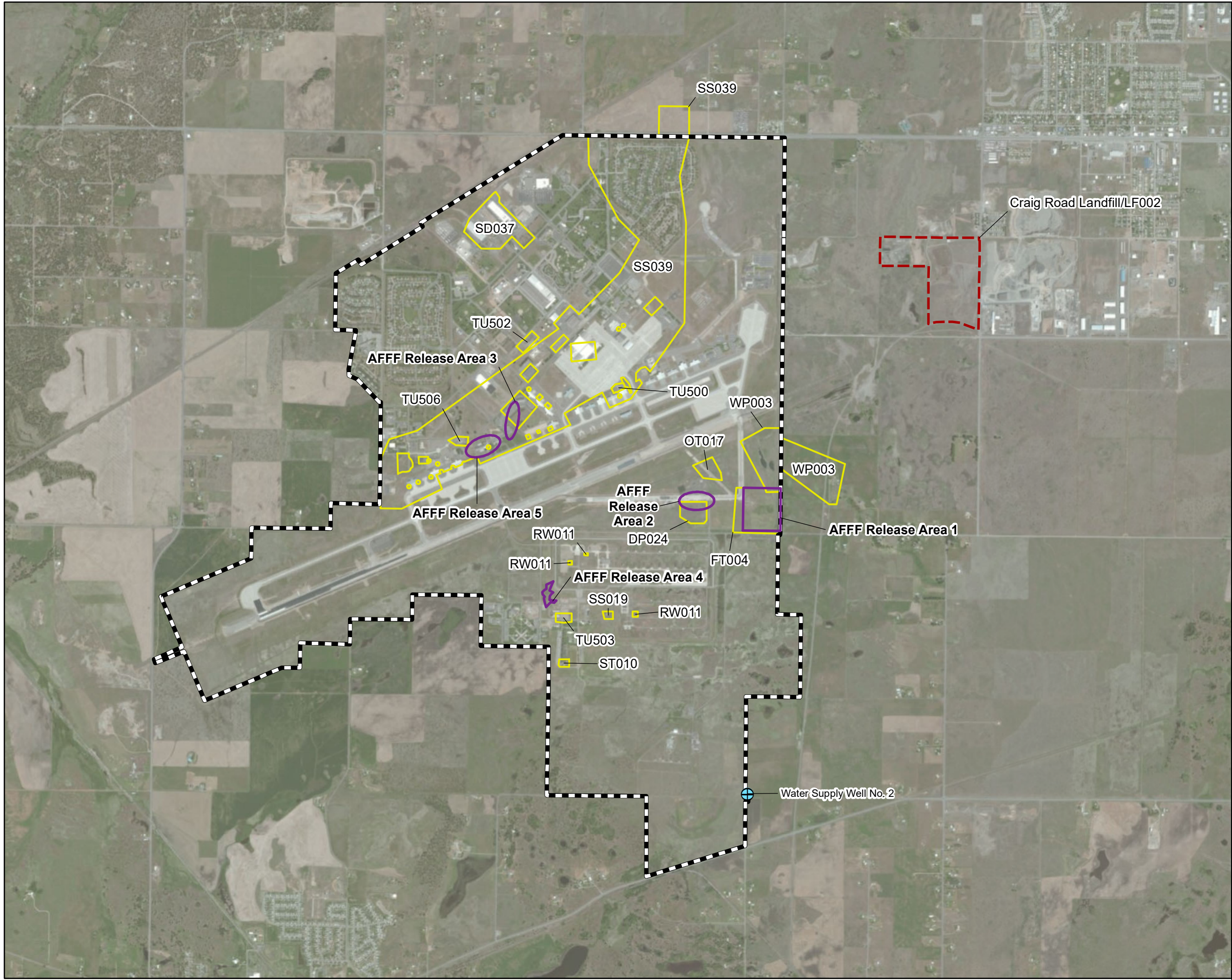
Conceptual Image of Geology at
Fairchild Air Force Base

On-Base Groundwater Flow Directions Evaluation



DATE
06/24/2019

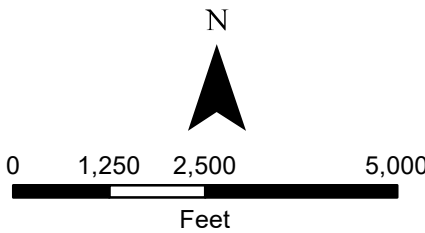
FIGURE
04



Legend

-  Water Supply Well No. 2
-  Site of Interest
-  AFFF Release Area
-  Craig Road Landfill/LF002
-  Fairchild Air Force Base

Note:
AFFF=aqueous film forming foam



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Fairchild Air Force Base
Spokane, Washington

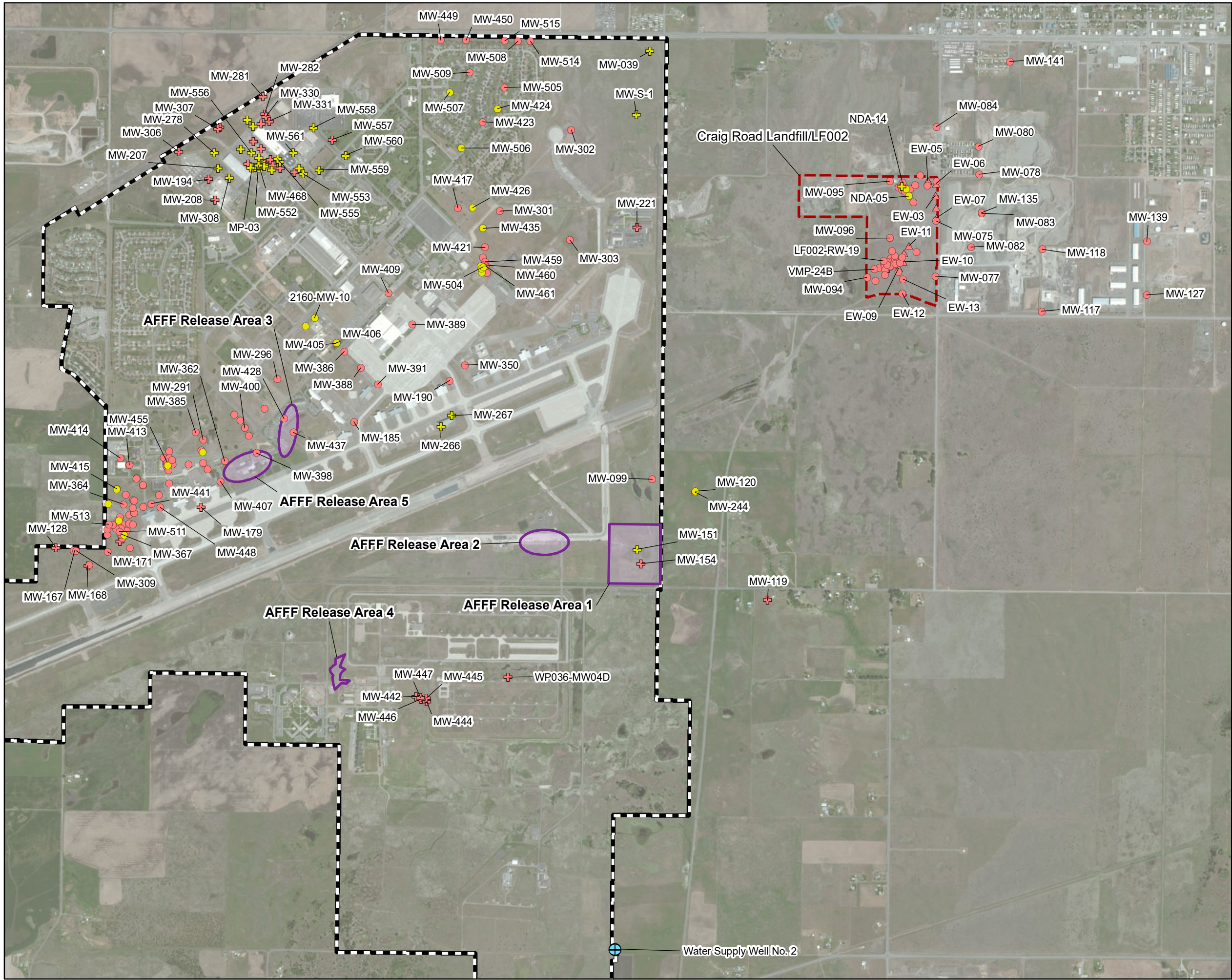
Sites of Interest at Fairchild AFB

On-Base Groundwater Flow Directions Evaluation



DATE
06/26/2019

FIGURE
05



Legend

- Basalt A Well
- Currently Sampling or Water Levels
 - ▲ Extraction Well (inactive or active)
 - + Not in Use

- Unconsolidated/Basalt A Well
- Currently Sampling or Water Levels
 - ▲ Extraction Well (inactive or active)
 - + Not in Use

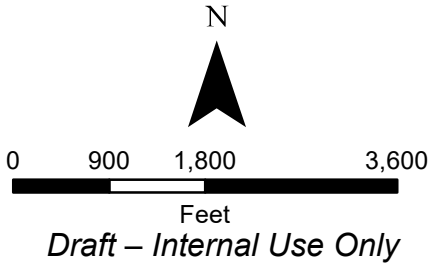
⊕ Water Supply Well

□ AFFF Release Area

▭ Craig Road Landfill/LF002

▭ Fairchild Air Force Base

Note:
AFFF=aqueous film forming foam



Fairchild Air Force Base
Spokane, Washington

**2018 Basewide Well Inventory:
Basalt A**
On-Base Groundwater Flow Directions Evaluation



DATE
06/26/2019

FIGURE
07

(b) (6)

Figure 8 provides information about the type and location of off-base private sampling sources. It contains personal privacy information that is not publicly releasable under the Freedom of Information Act, 5 U.S.C. § 552, and is maintained in a separate portion of the Administrative Record that is not accessible to the public.

Legend

Basalt B/Latah Formation Well

- Currently Sampling or Water Levels
- Not in Use
- Unknown or Damaged

Data Not Available/Unknown

- Currently Sampling or Water Levels
- Extraction Well (inactive or active)
- Not in Use
- Unknown or Damaged

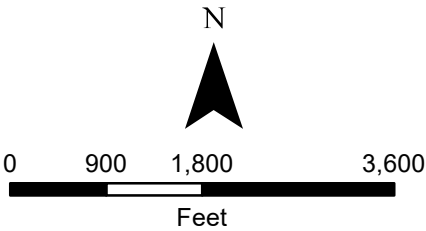
Water Supply Well

AFFF Release Area

Craig Road Landfill/LF002

Fairchild Air Force Base

Note:
AFFF=aqueous film forming foam



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Fairchild Air Force Base
Spokane, Washington

2018 Basewide Well Inventory:
Basalt B/Unknown
On-Base Groundwater Flow Directions Evaluation



DATE
06/26/2019

FIGURE
08

Appendix A

Previous Potentiometric Surface Maps and Groundwater Contours

Figure A-1: (AFFF Release Area 1) Groundwater Contours, FT004, September 2008

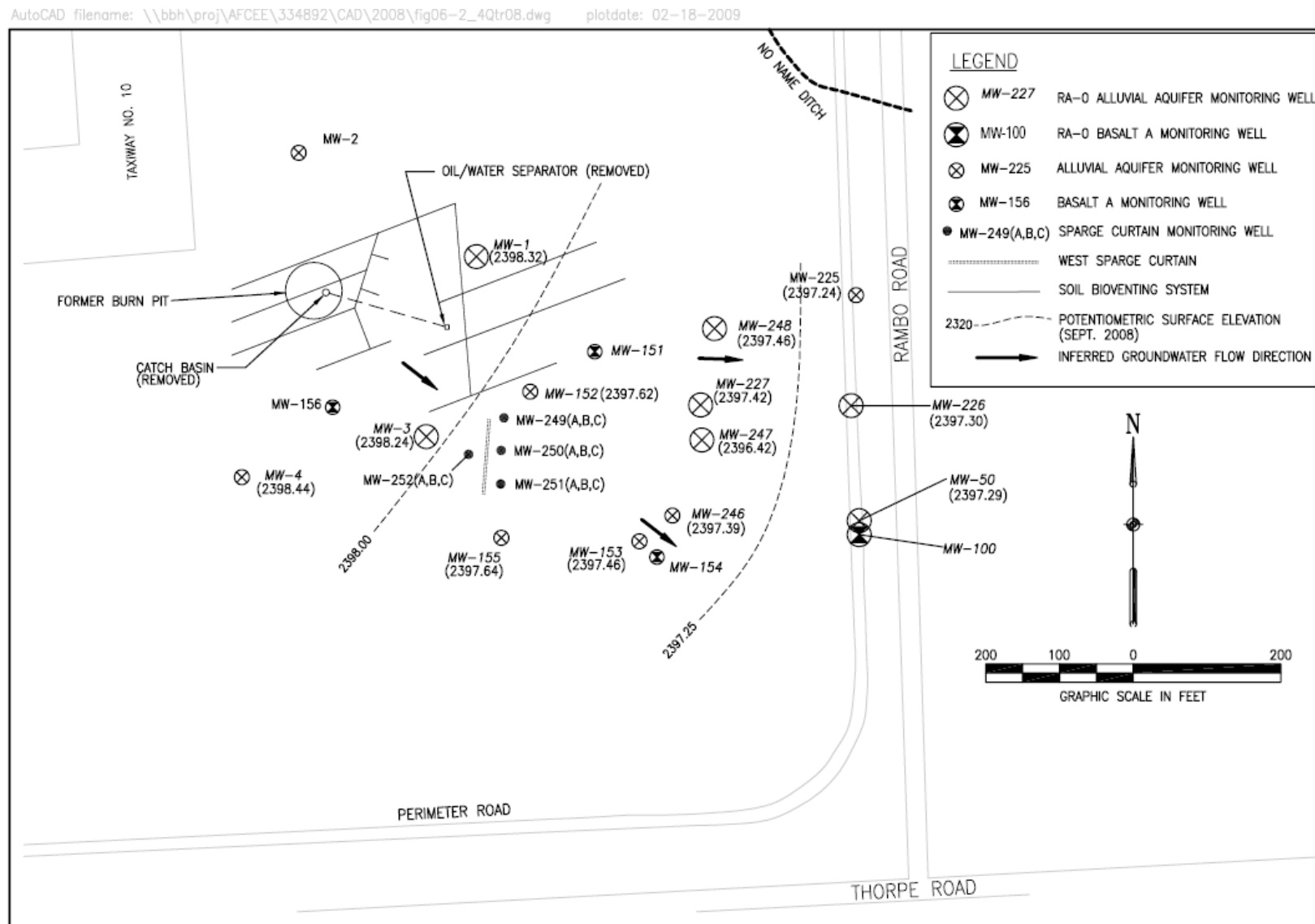
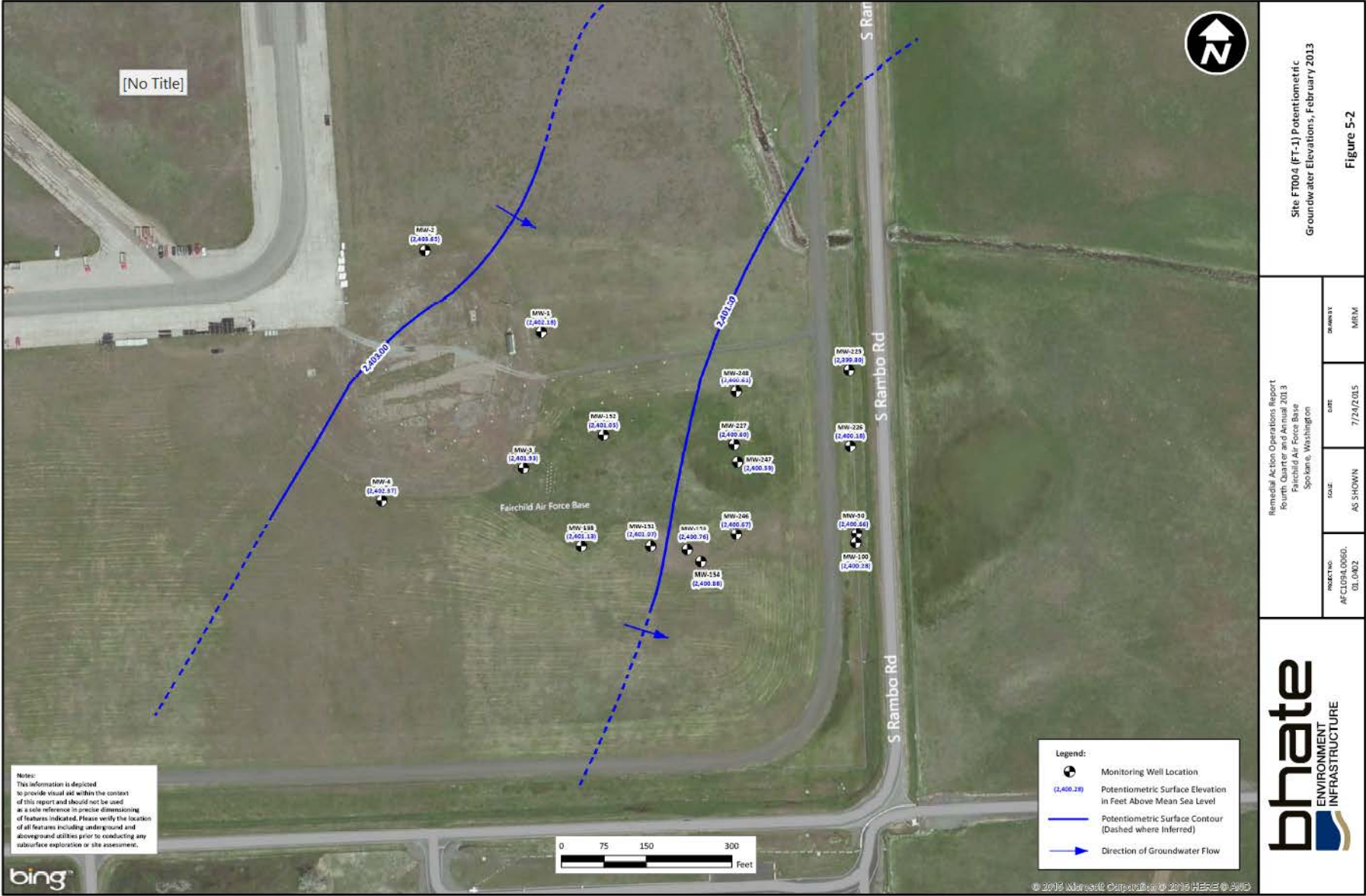


FIGURE 6-2: FT-1 POTENTIOMETRIC SURFACE MAP, SEPTEMBER 2008

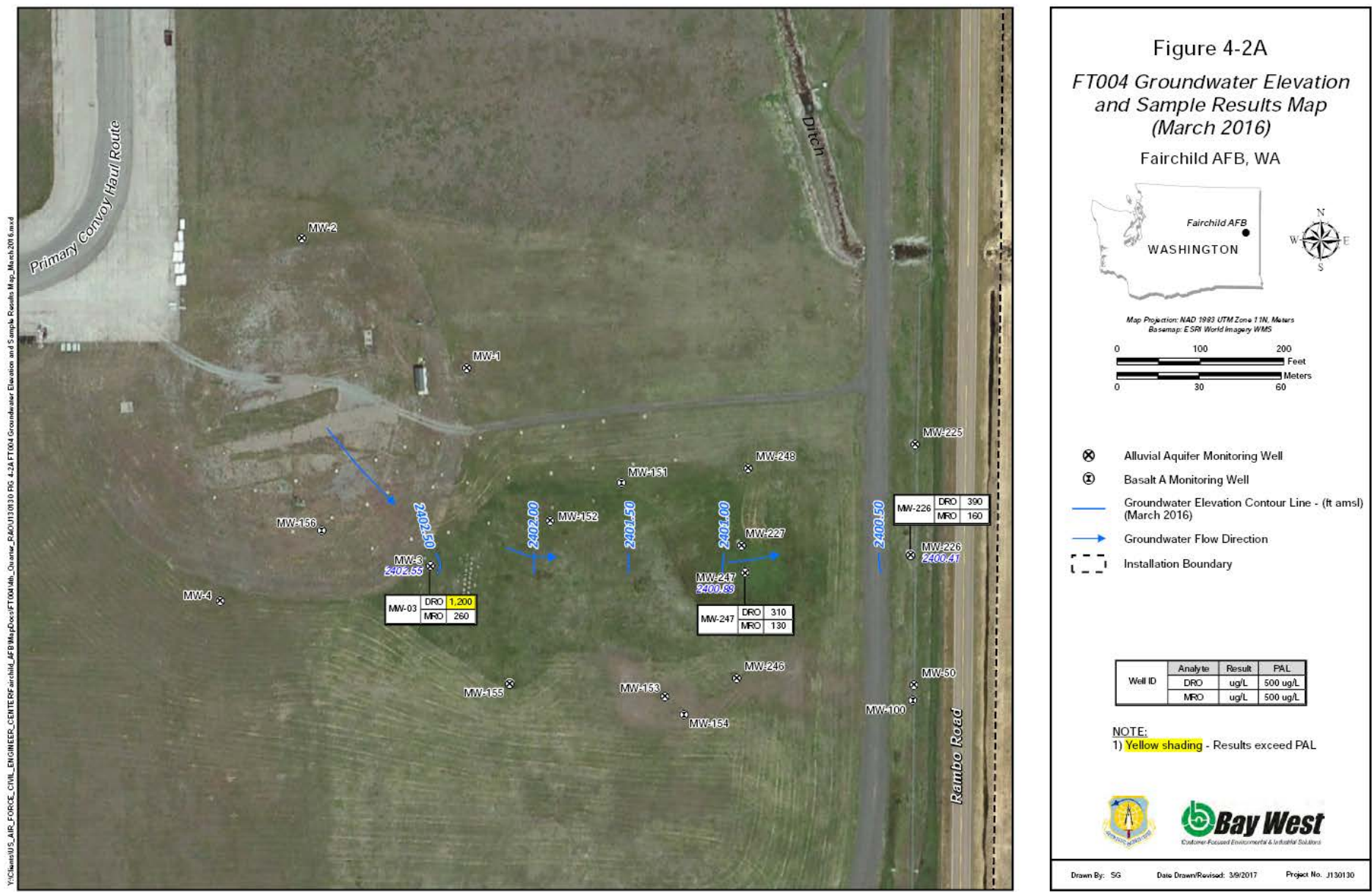
Source: CH2MHill, 2009

Figure A-2: (AFFF Release Area 1) Groundwater Contours, FT004, February 2013



Source: Bhate, 2015b

Figure A-3: (AFFF Release Area 1) Groundwater Contours, AFFF Release Area 1, March 2016



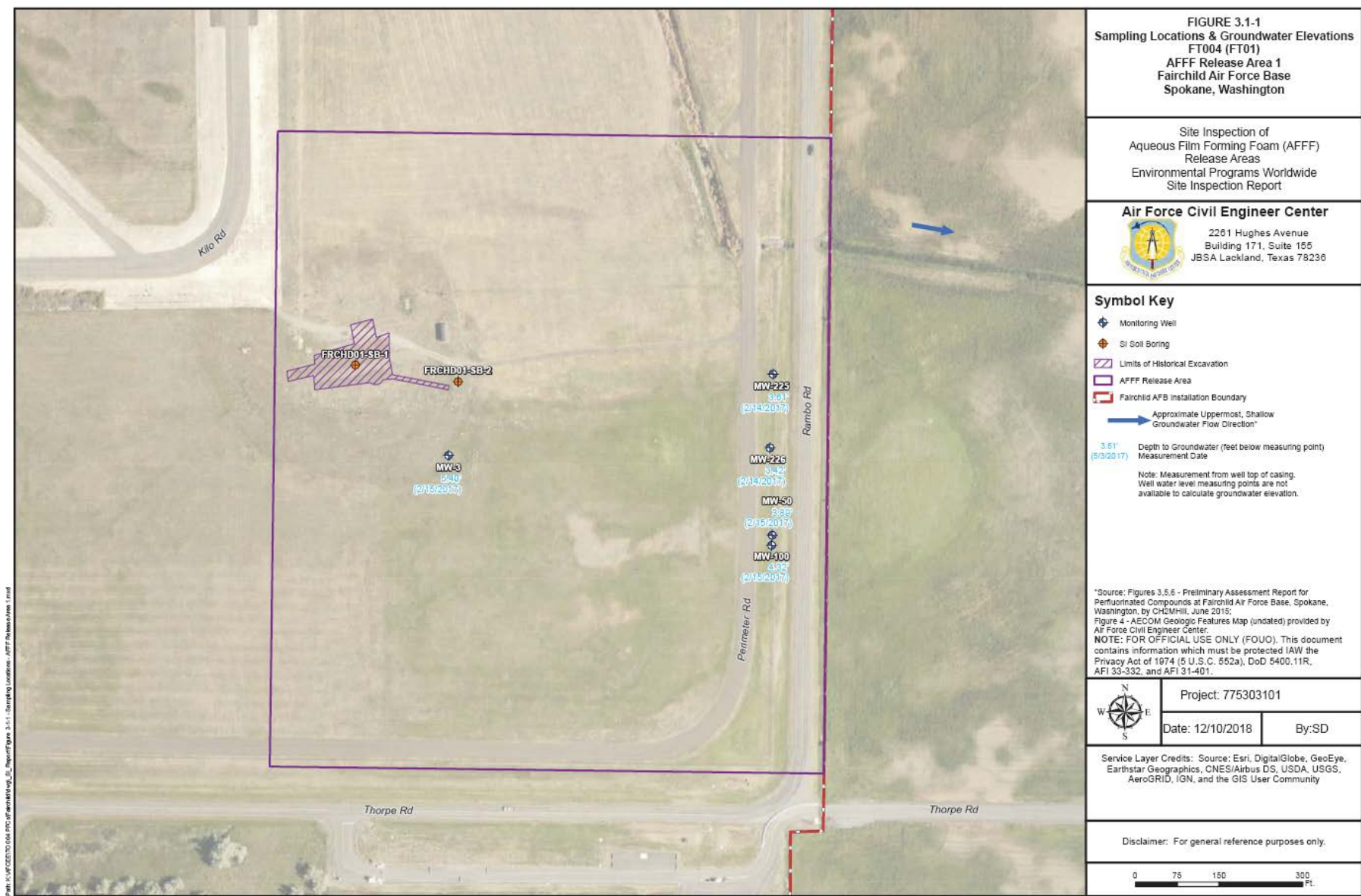
Source: Bay West, 2018h

Figure A-4: (AFFF Release Area 1) Groundwater Contours, AFFF Release Area 1, September 2016



Source: Bay West, 2018h

Figure A-5: (AFFF Release Area 1) Groundwater Contours, AFFF Release Area 1, February 2017



Source: AMEC, 2019

Figure A-6: (AFFF Release Area 1) Groundwater Contours, WP003, September 2008

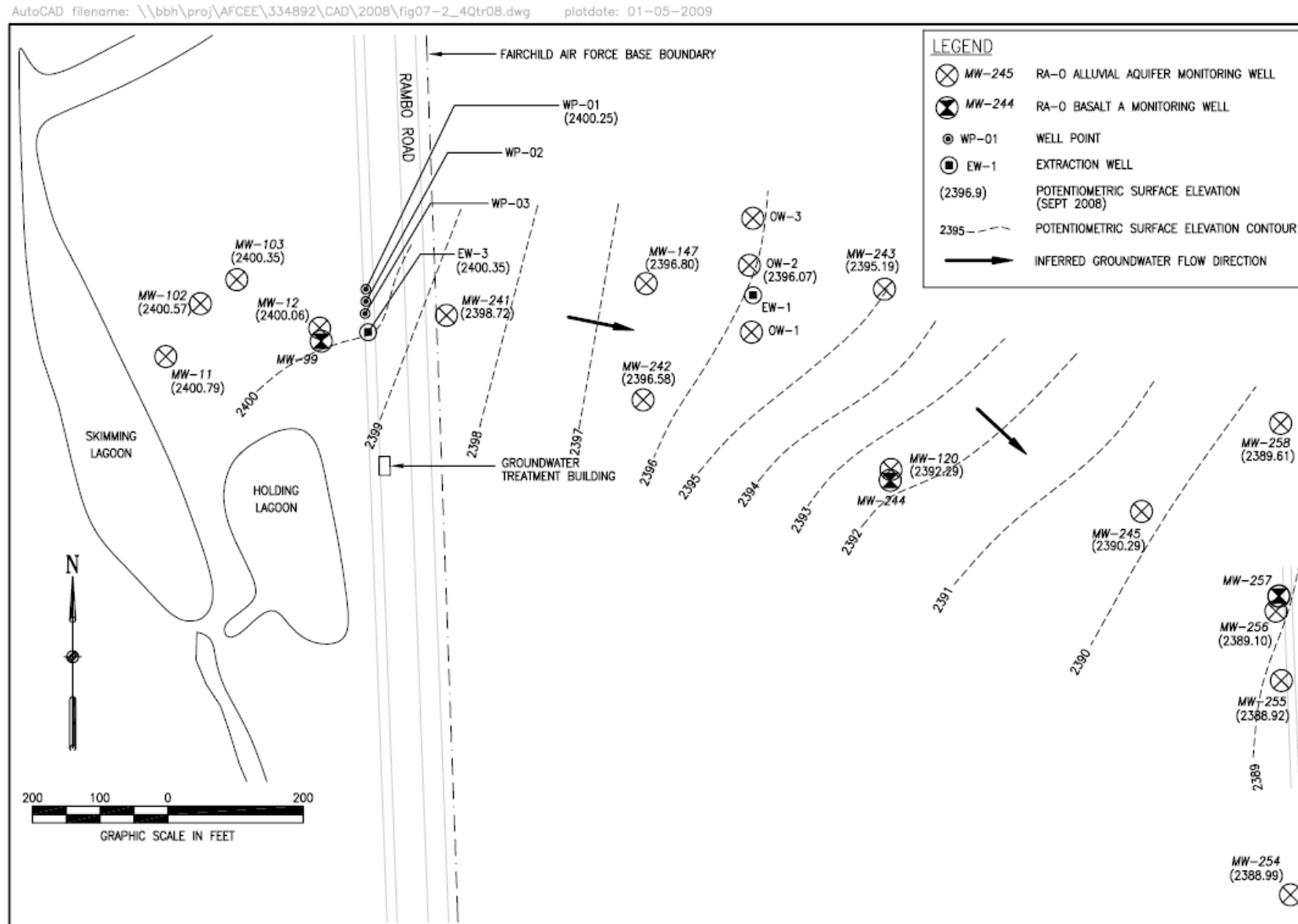
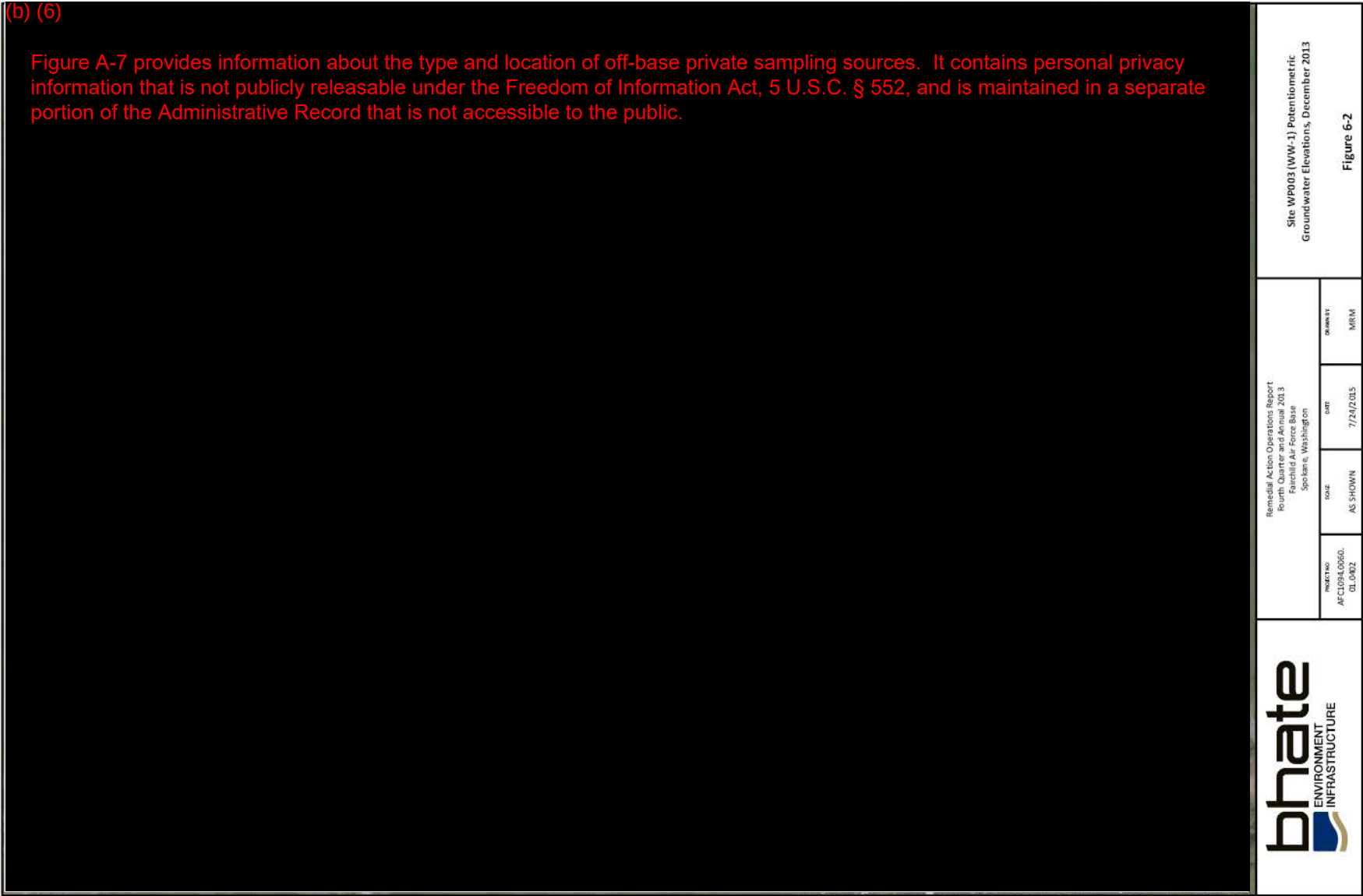


FIGURE 7-2: WW-1 POTENTIOMETRIC SURFACE MAP, SEPTEMBER 2008

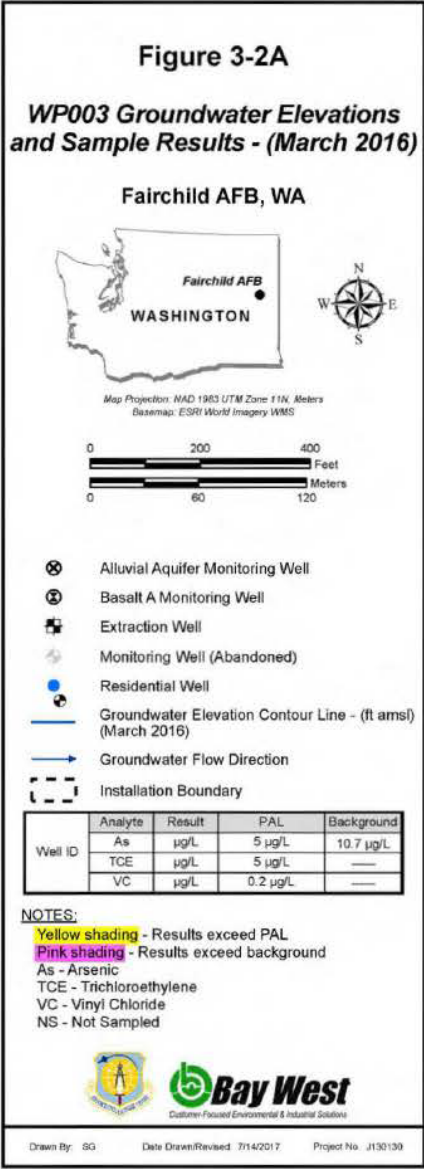
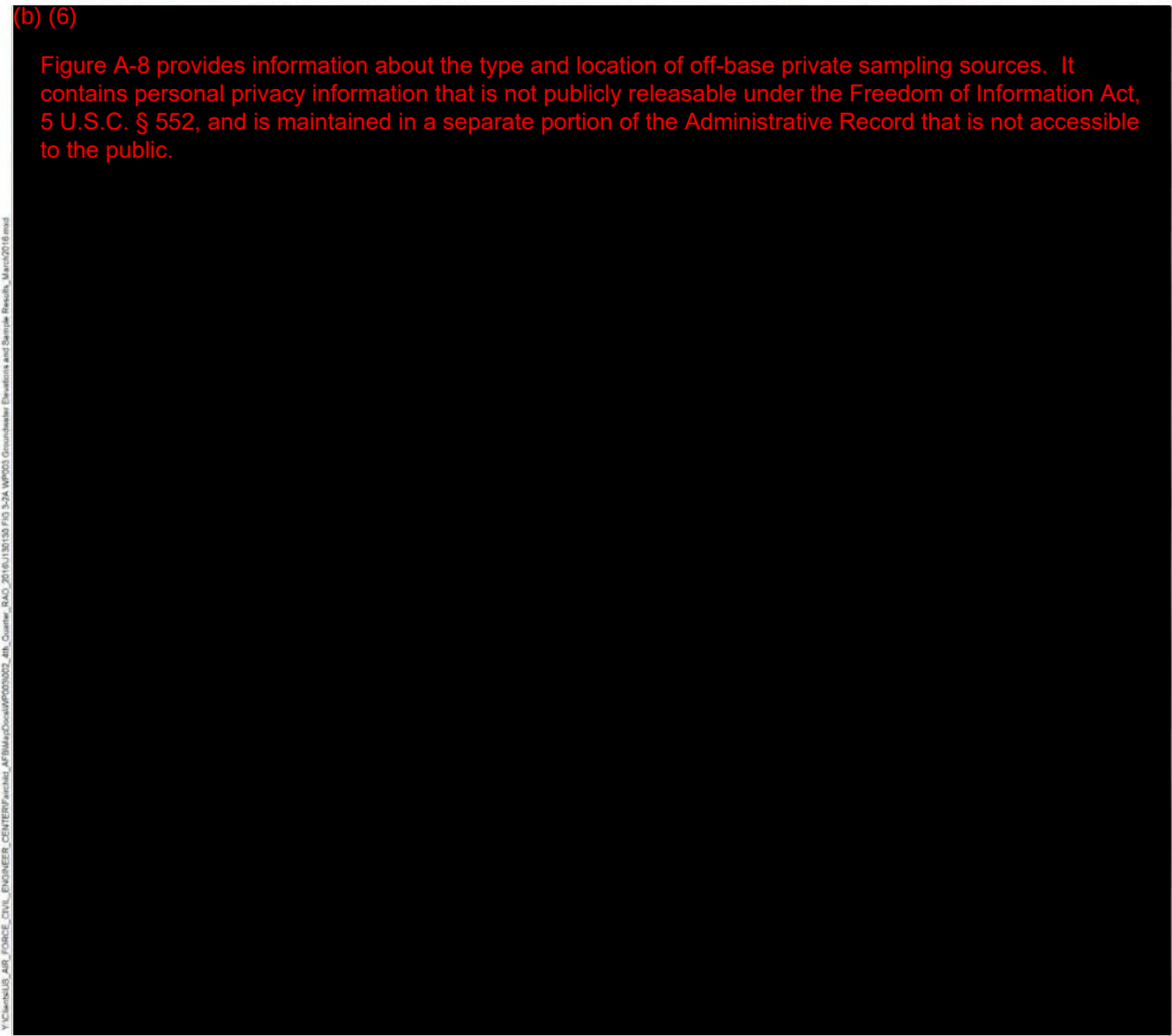
Source: CH2MHill, 2009

Figure A-7: (AFFF Release Area 1) Groundwater Contours, WP003, February 2013



Source: Bhate, 2015b

Figure A-8: (AFFF Release Area 1) WP003 Groundwater Contours, March 2016



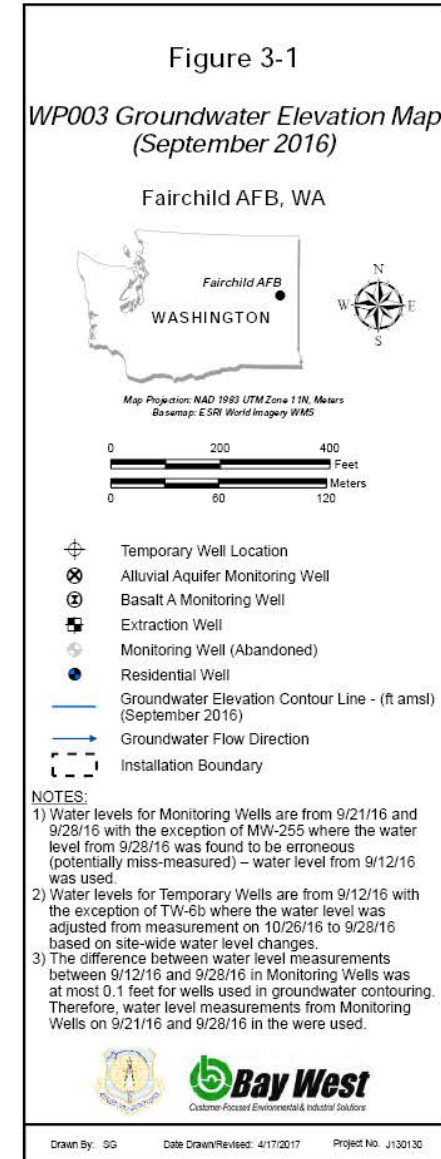
Source: Bay West, 2018h

Figure A-9: (AFFF Release Area 1) WP003 Groundwater Contours, September 2016

(b) (6)

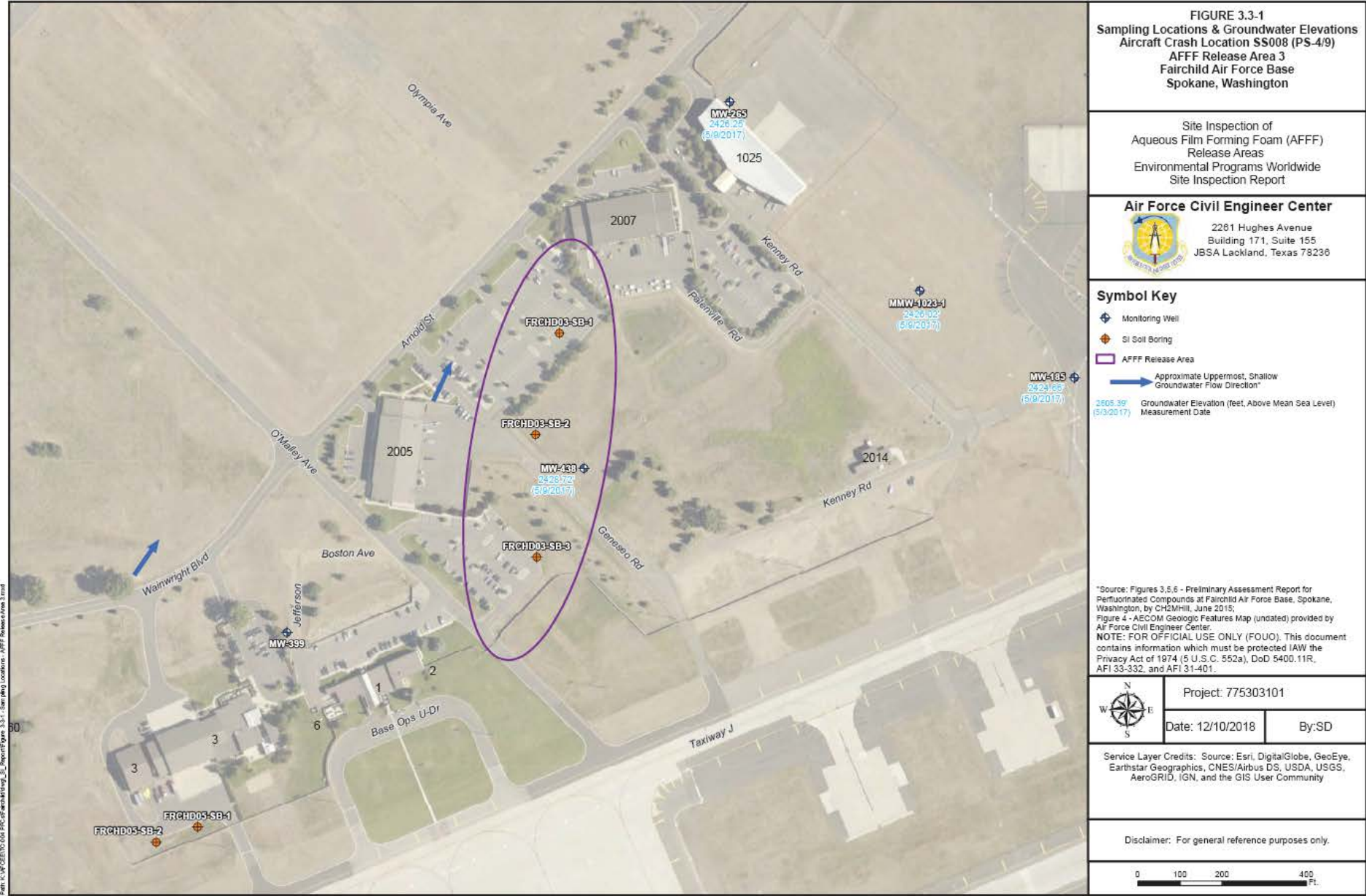
Figure A-9 provides information about the type and location of off-base private sampling sources. It contains personal privacy information that is not publicly releasable under the Freedom of Information Act, 5 U.S.C. § 552, and is maintained in a separate portion of the Administrative Record that is not accessible to the public.

Y:\CIB\US_AIR_FORCE_CIVIL_ENGINEER_CENTER\AFC\AFC\WP003\WP003_001_PDU\130 FIG 3-1 001 WP003 Groundwater Elevation Map_September 2016.mxd



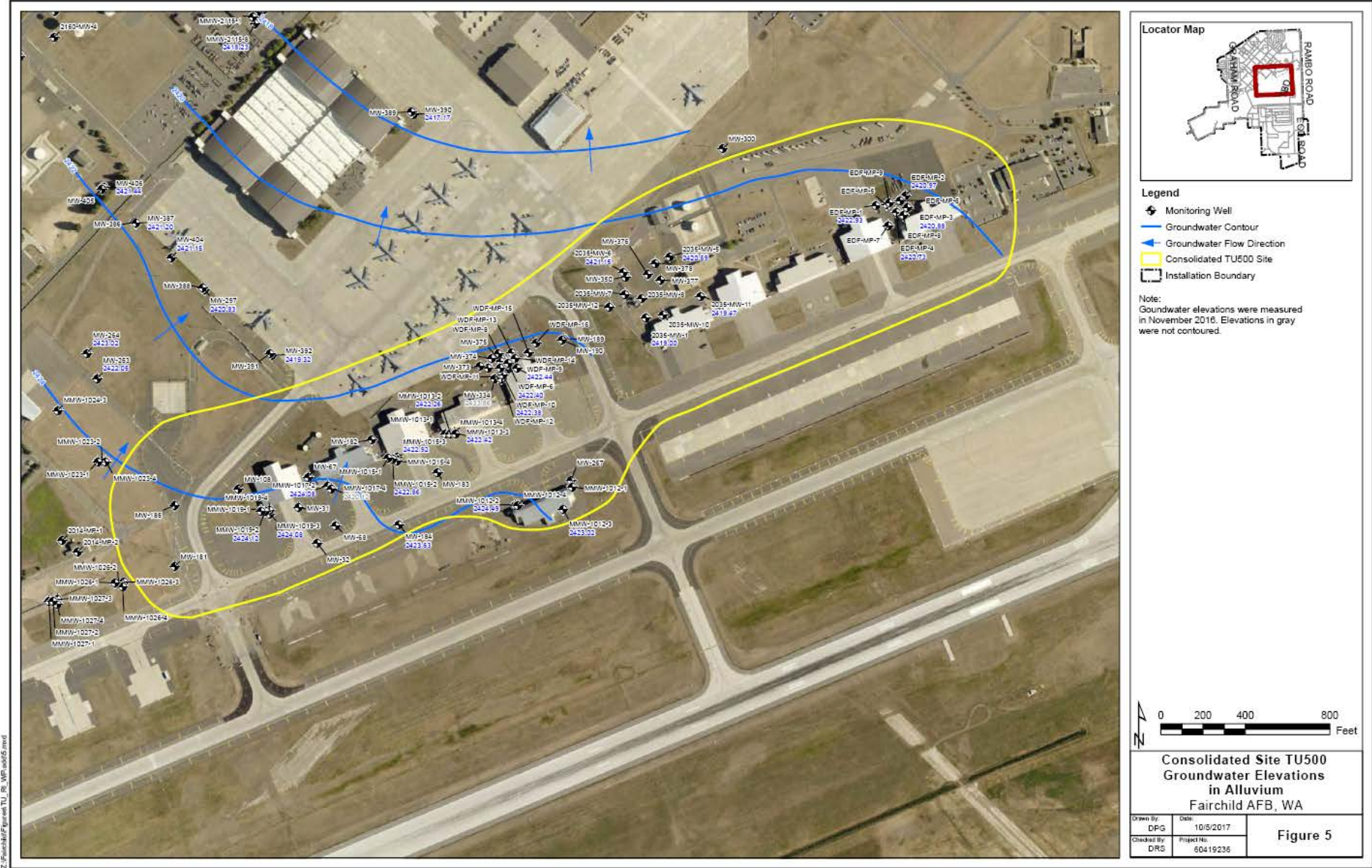
Source: Bay West, 2018h

Figure A-11: (AFFF Release Area 3) Groundwater Contours, May 2017



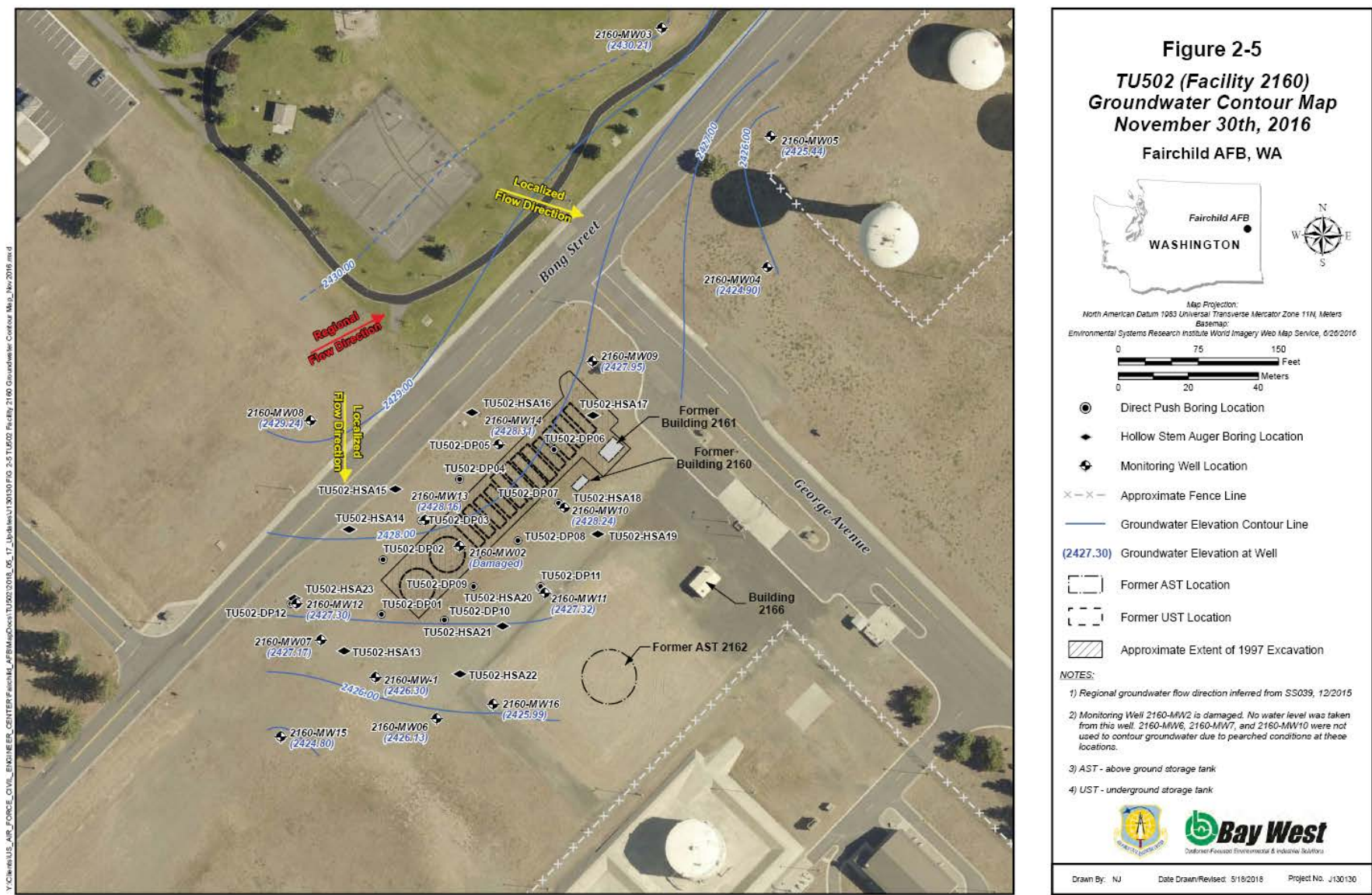
Source: AMEC, 2019

Figure A-12: (AFFF Release Area 3) Groundwater Contours (Alluvium), TU500, November 2016



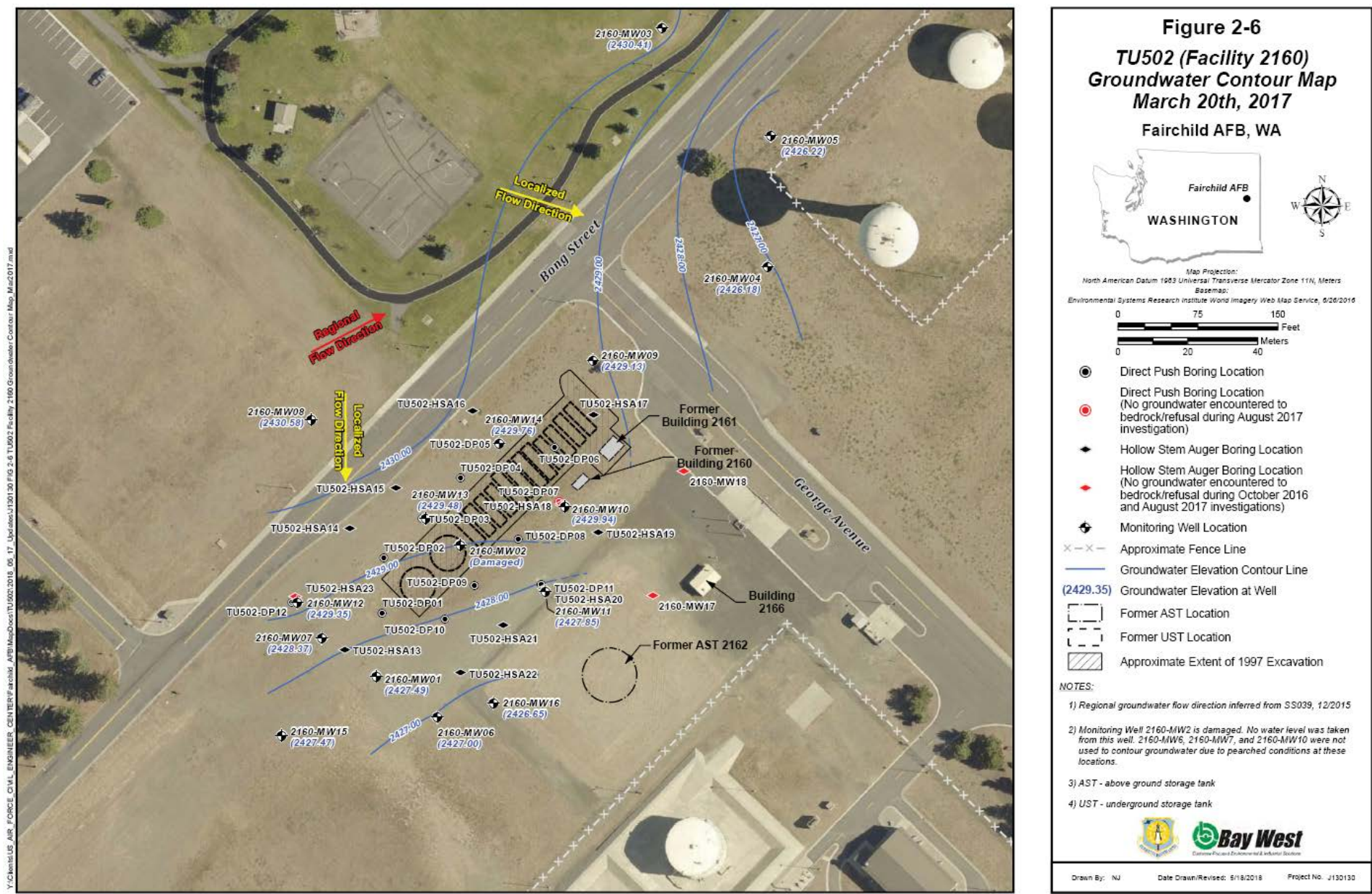
Source: Bay West, 2018c

Figure A-13: (AFFF Release Area 3) Groundwater Contours, TU502, November 2016



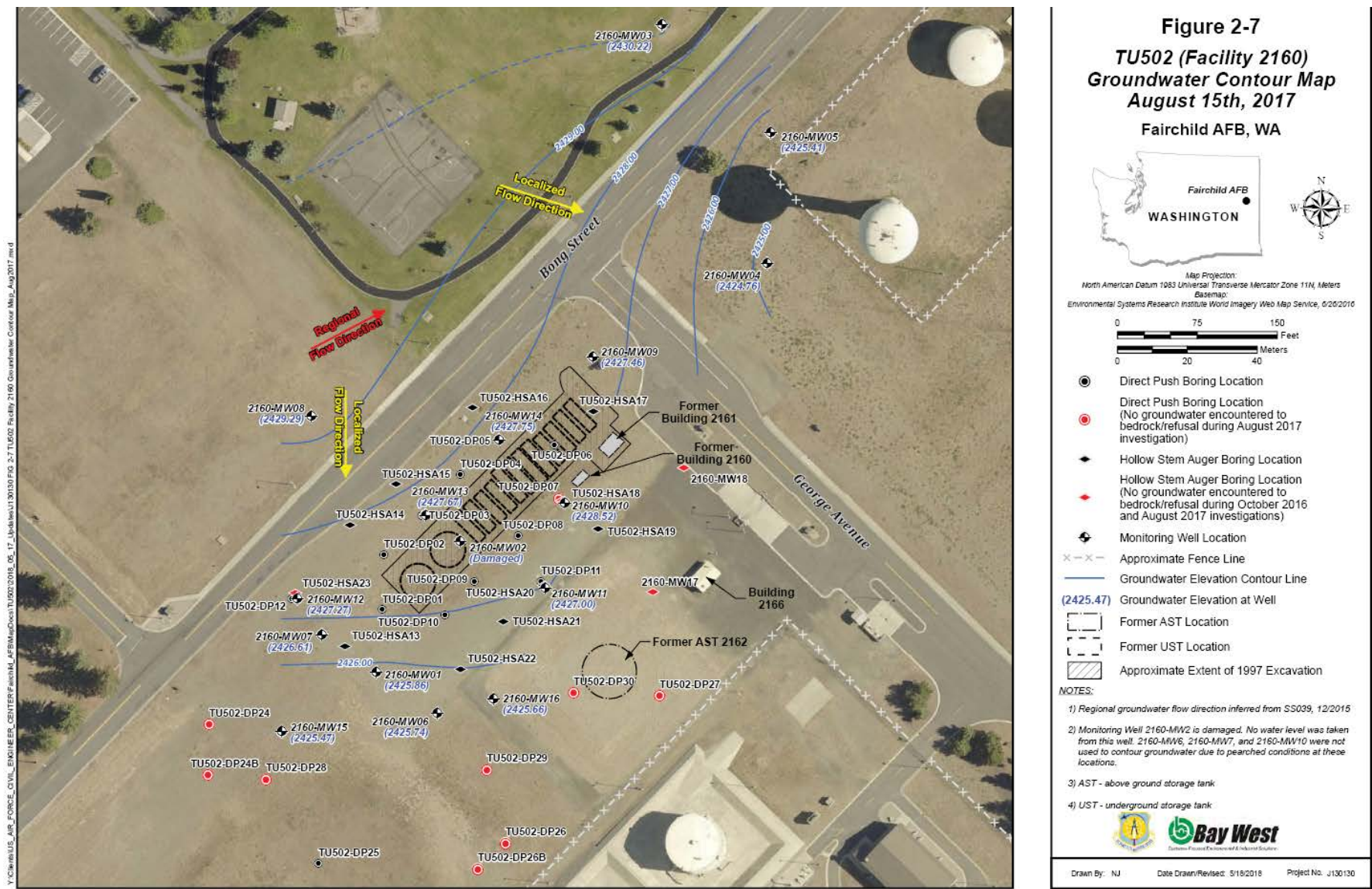
Source: Bay West, 2018h

Figure A-14: (AFFF Release Area 3) Groundwater Contours, TU502, March 2017



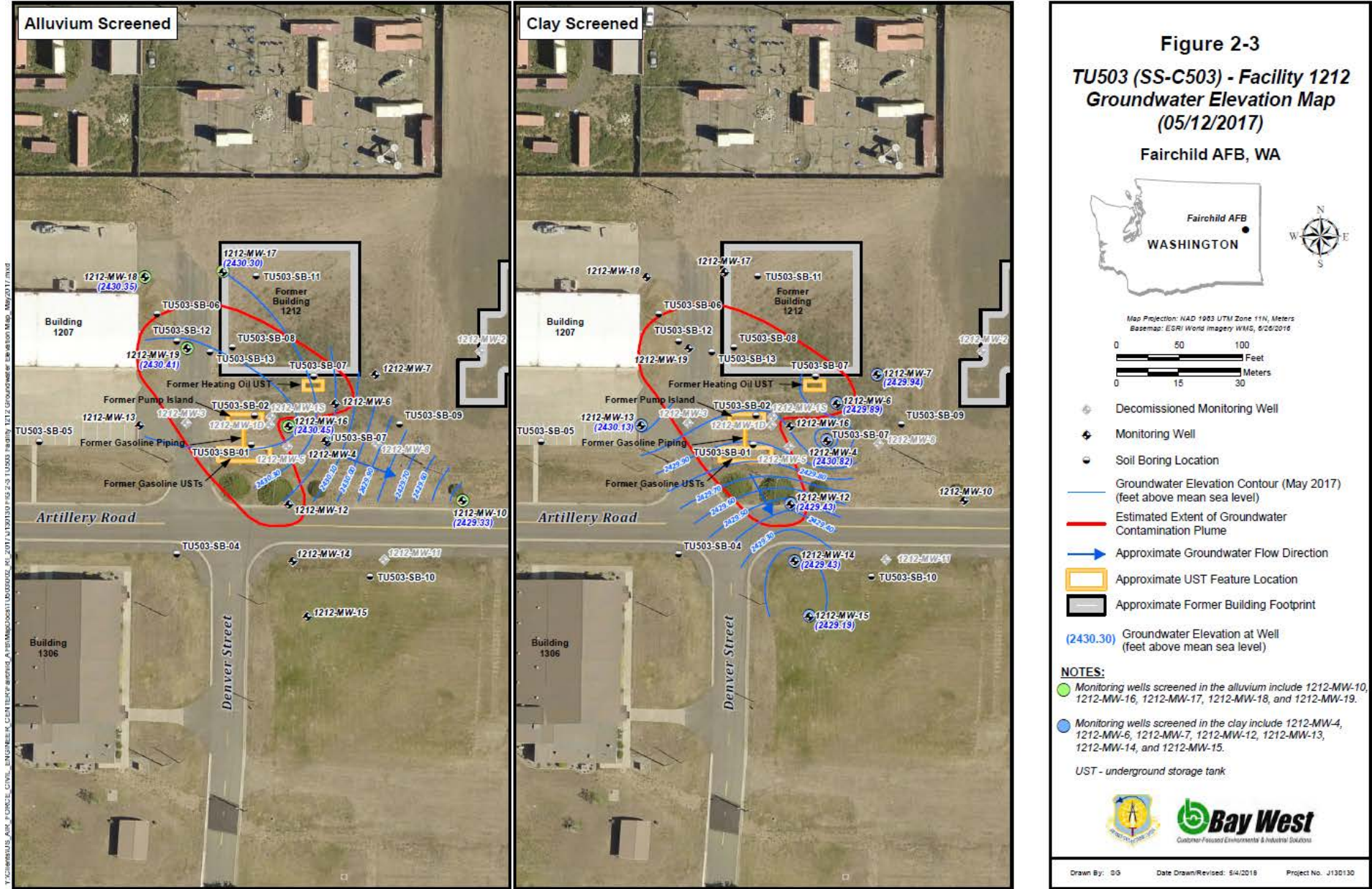
Source: Bay West, 2018g

Figure A-15: (AFFF Release Area 3) Groundwater Contours, TU502, August 2017



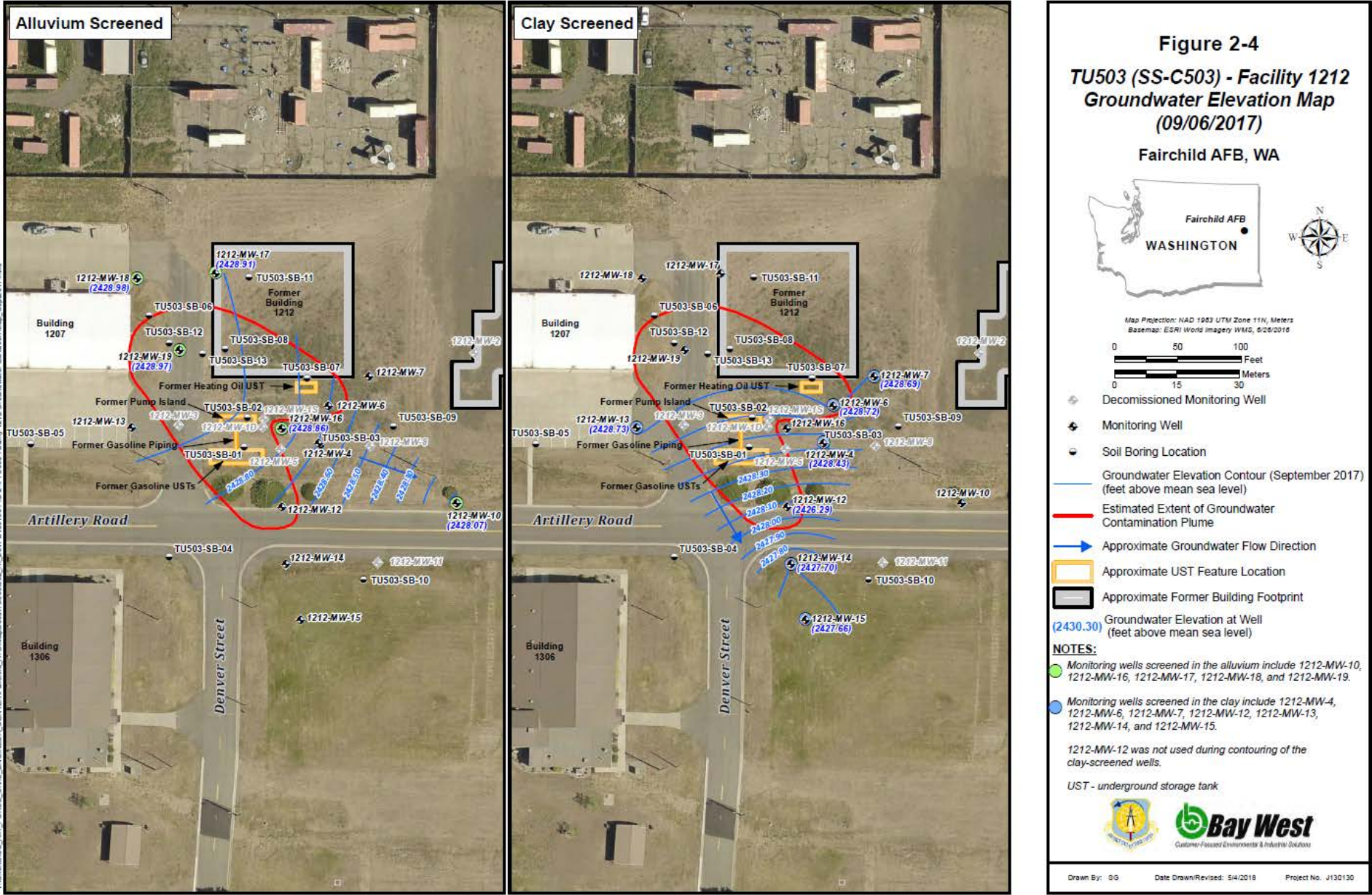
Source: Bay West, 2018g

Figure A-16: (AFFF Release Area 4) Groundwater Contours, TU503, May 2017



Source: Bay West, 2019d

Figure A-17: (AFFF Release Area 4) Groundwater Contours, TU503, September 2017



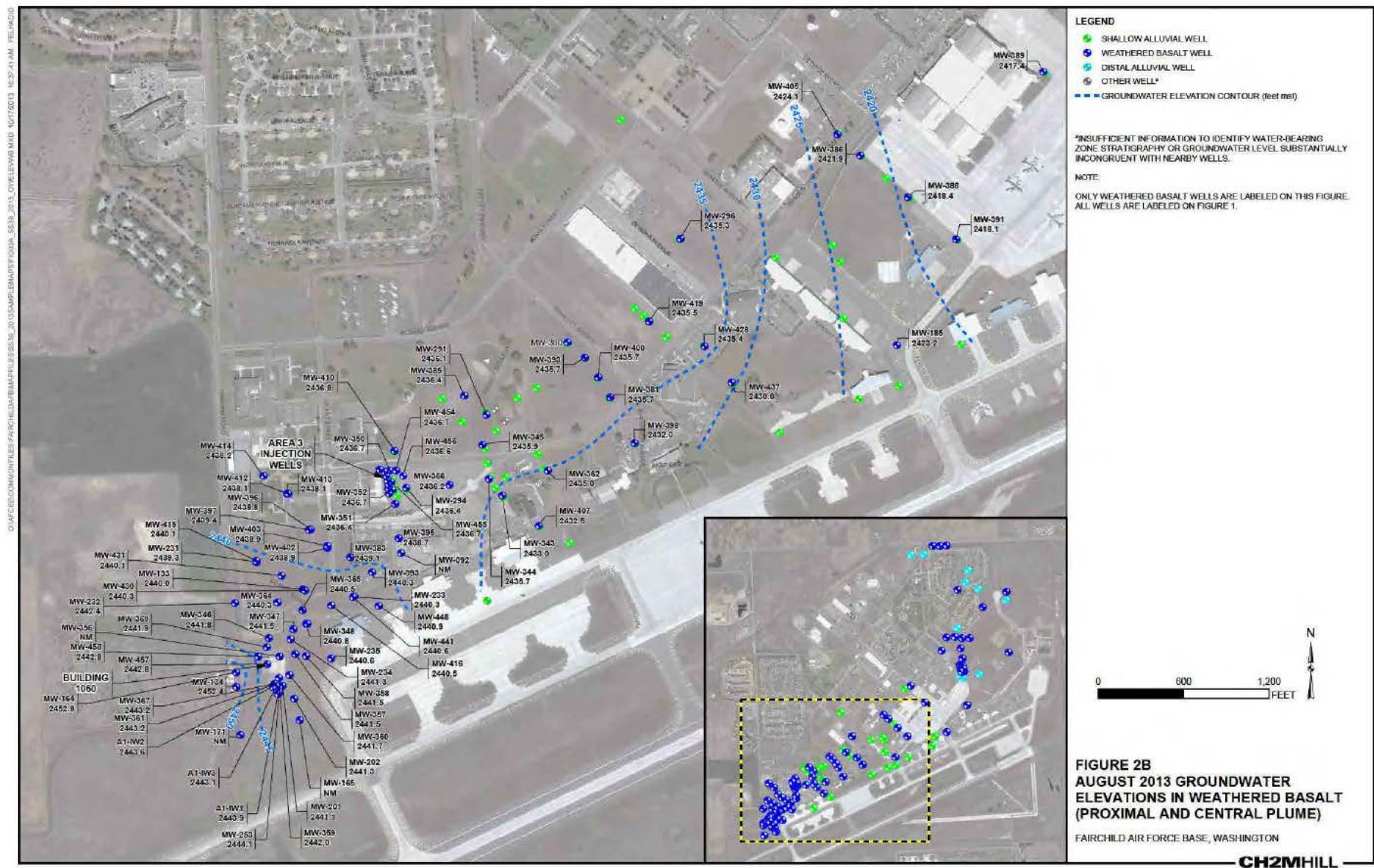
Source: Bay West, 2019d

Figure A-18: (AFFF Release Area 5) Groundwater Contours, TU506, November 2016



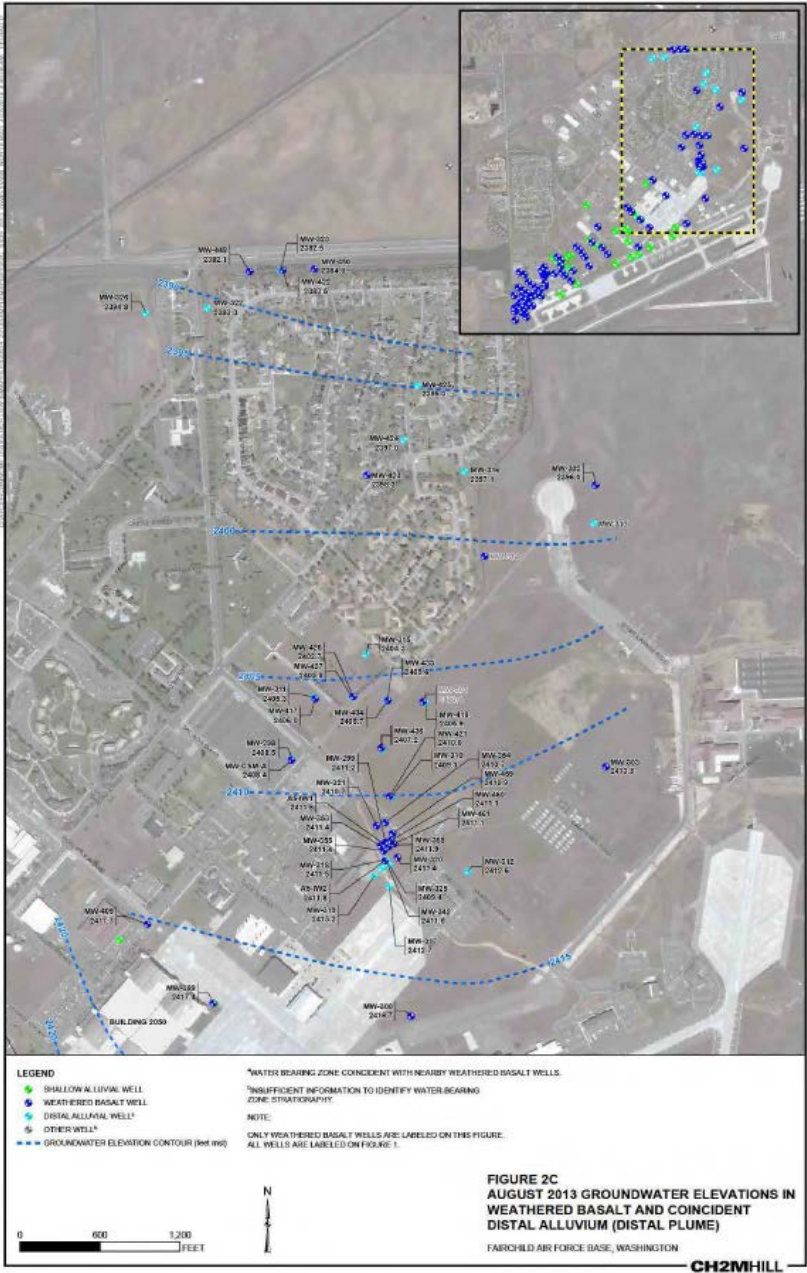
Source: Bay West, 2018f

Figure A-19: (SS039) Groundwater Contours in Weathered Basalt, August 2013



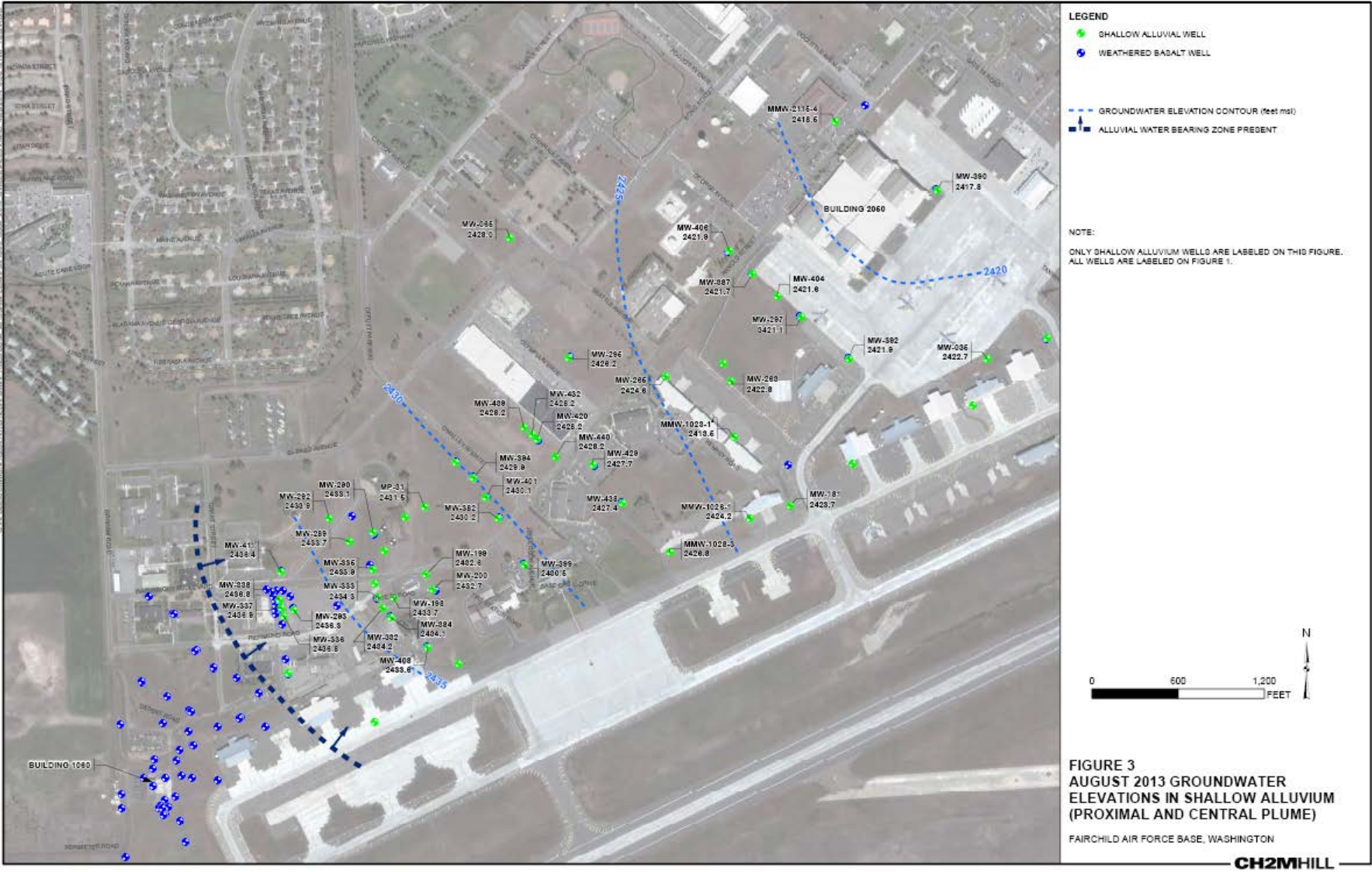
Source: CH2MHill, 2014

Figure A-20: (SS039) Groundwater Contours in Weathered Basalt & Alluvium, August 2013



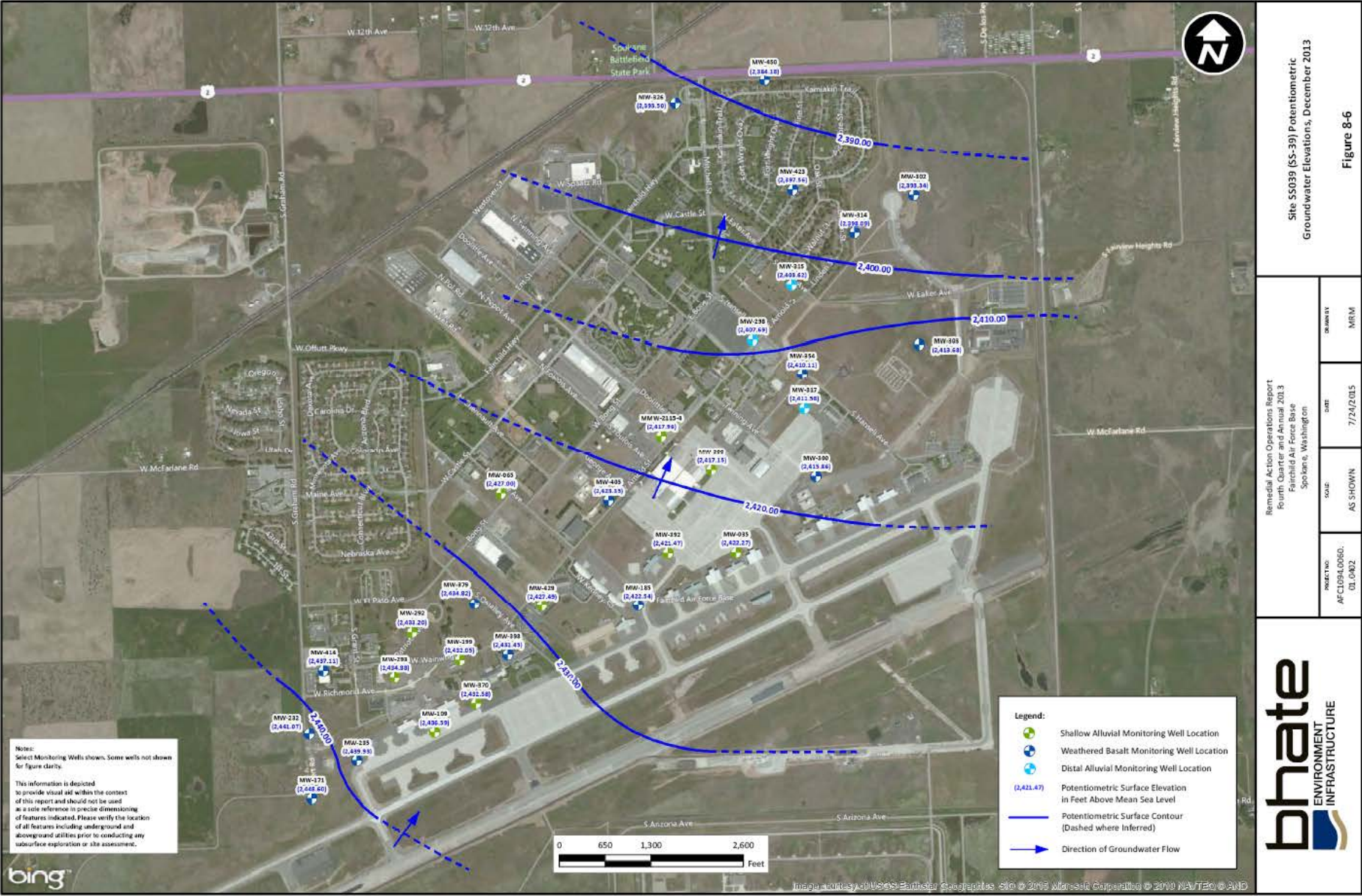
Source: CH2MHill, 2014

Figure A-21: (SS039) Groundwater Contours in Shallow Alluvium, August 2013



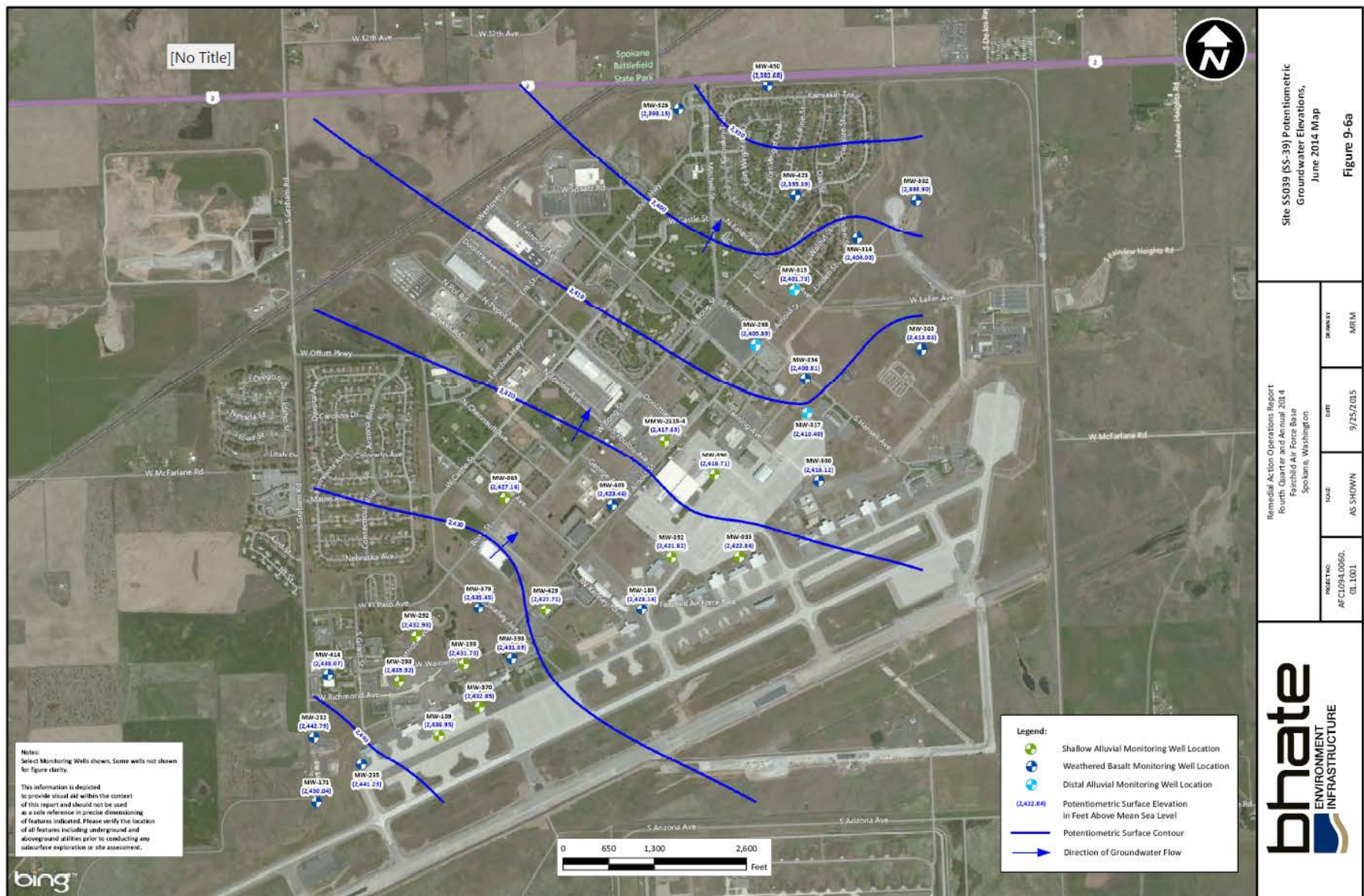
Source: CH2MHill, 2014

Figure A-22: (SS039) Groundwater Contours, December 2013



Source: Bhate, 2015b

Figure A-23: (SS039) Groundwater Contours, June 2014



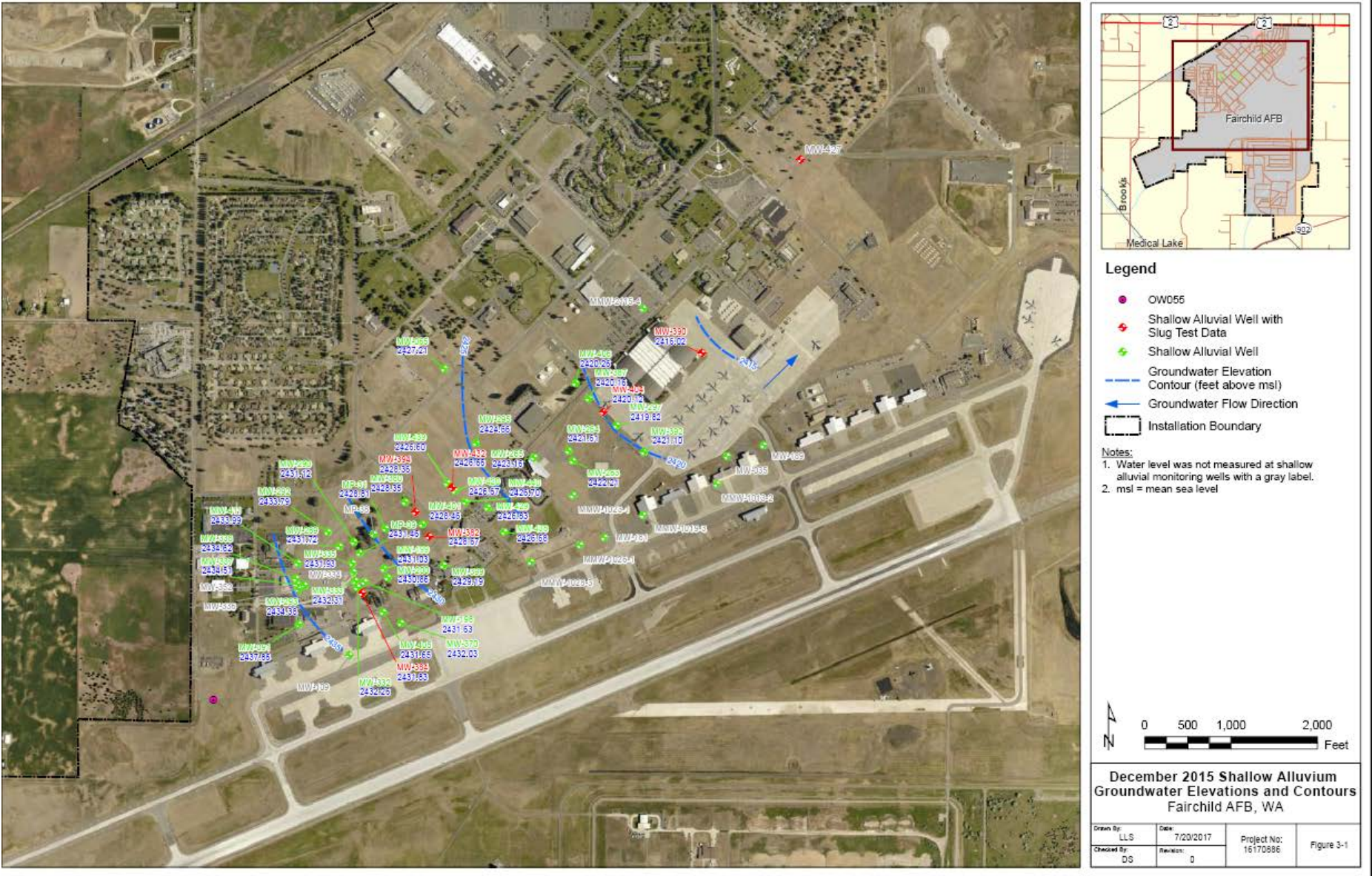
Source: Bhate, 2015a. Remedial Action Operations Report, Fourth Quarter and Annual 2014

Figure A-24: (SS039) Groundwater Contours, December 2014



Source: Bhate, 2015a. Remedial Action Operations Report, Fourth Quarter and Annual 2014

Figure A-25: (SS039) Groundwater Contours, OW055, December 2015



Source: Bay West, 2019b

Notes:
This information is depicted to provide visual aid within the context of this report and should not be used as a sole reference to precise dimensioning of features indicated. Please verify the location of all features including underground and aboveground utilities prior to conducting any subsurface exploration or site assessment.

Legend:
 Monitoring Well Location
 Shallow Alluvial Monitoring Well Location
 Weathered Basalt Monitoring Well Location
 Potentiometric Surface Elevation in Feet Above Mean Sea Level
 Not Measured
 Potentiometric Surface Contour
 Direction of Groundwater Flow

0 100 200 400 Feet

bing

Image courtesy of USGS Earthquake Geophysics 2010 © 2013 Microsoft Corporation © 2014 NAVIQA © ARD

Remedial Action Operations Report
Round Bay Air Force Base
Falconfield Air Force Base
Spokane, Washington

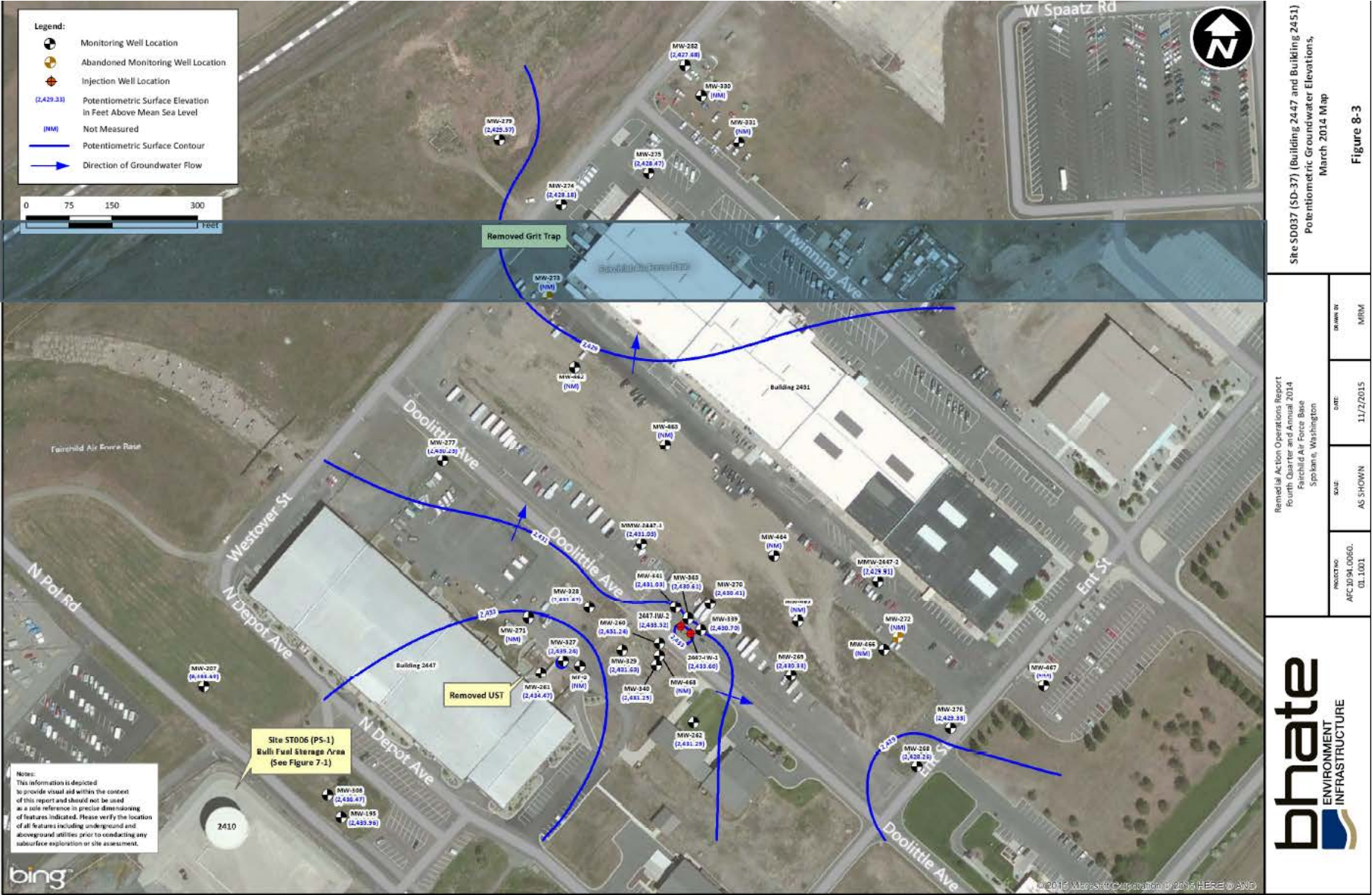
PROJECT NO: AEC1094.0060.01.0001
DATE: 9/25/2015
AS SHOWN
DRAWN BY: MRM

Figure 8-4

Site SD037 (SD-37) (Flightline Buildings)
Potentiometric Groundwater Elevation,
March 2014 Map

Source: Bhate, 2015c. Remedial Action Operations Report Fourth Quarter and Annual 2015, Fairchild Air Force Base, Spokane, Washington. November 2015.

Figure A-27: (SS037) March 2014



Source: Bhate, 2015c. Remedial Action Operations Report Fourth Quarter and Annual 2015, Fairchild Air Force Base, Spokane, Washington. November 2015.

Figure A-28: (SS037), August 2000

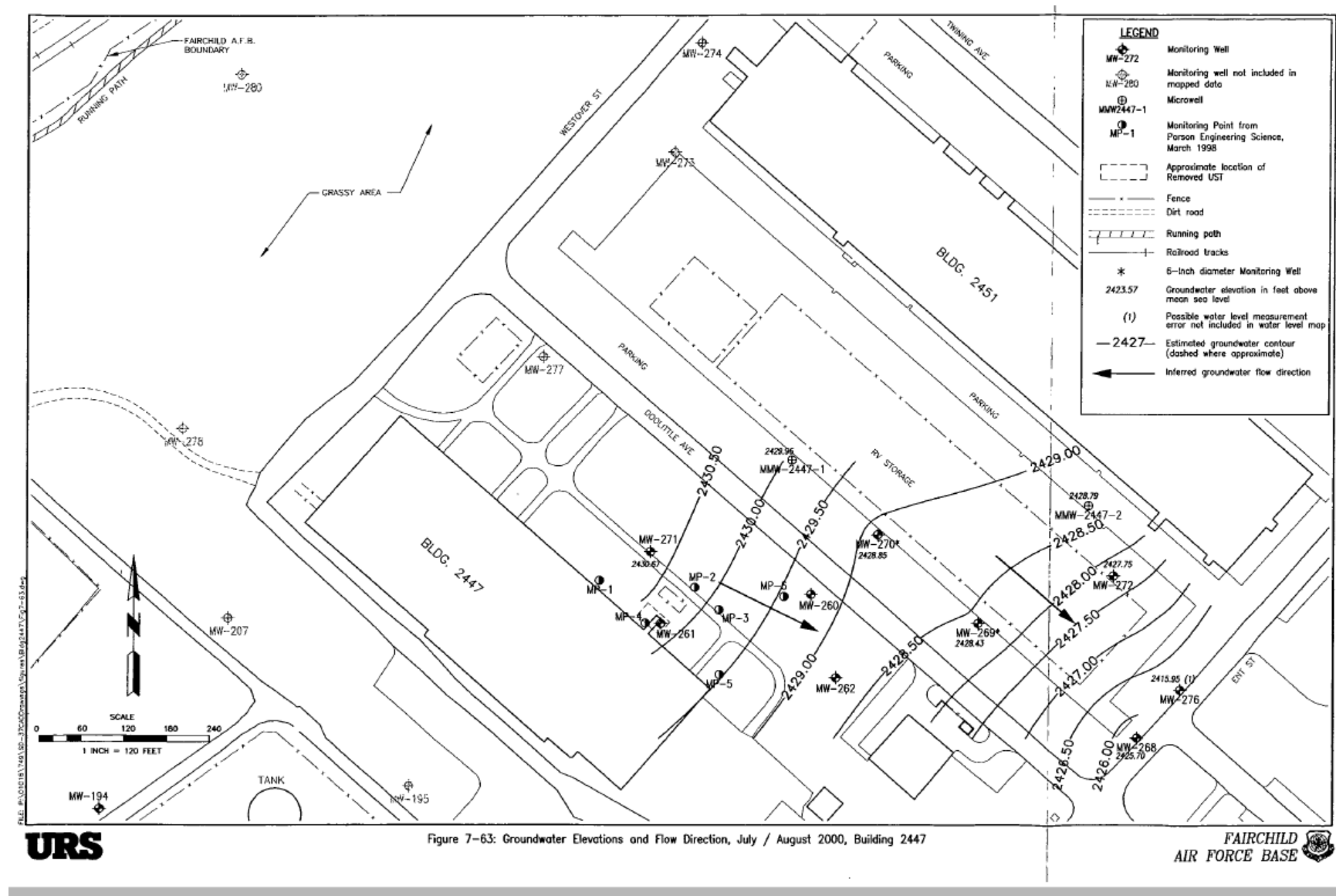
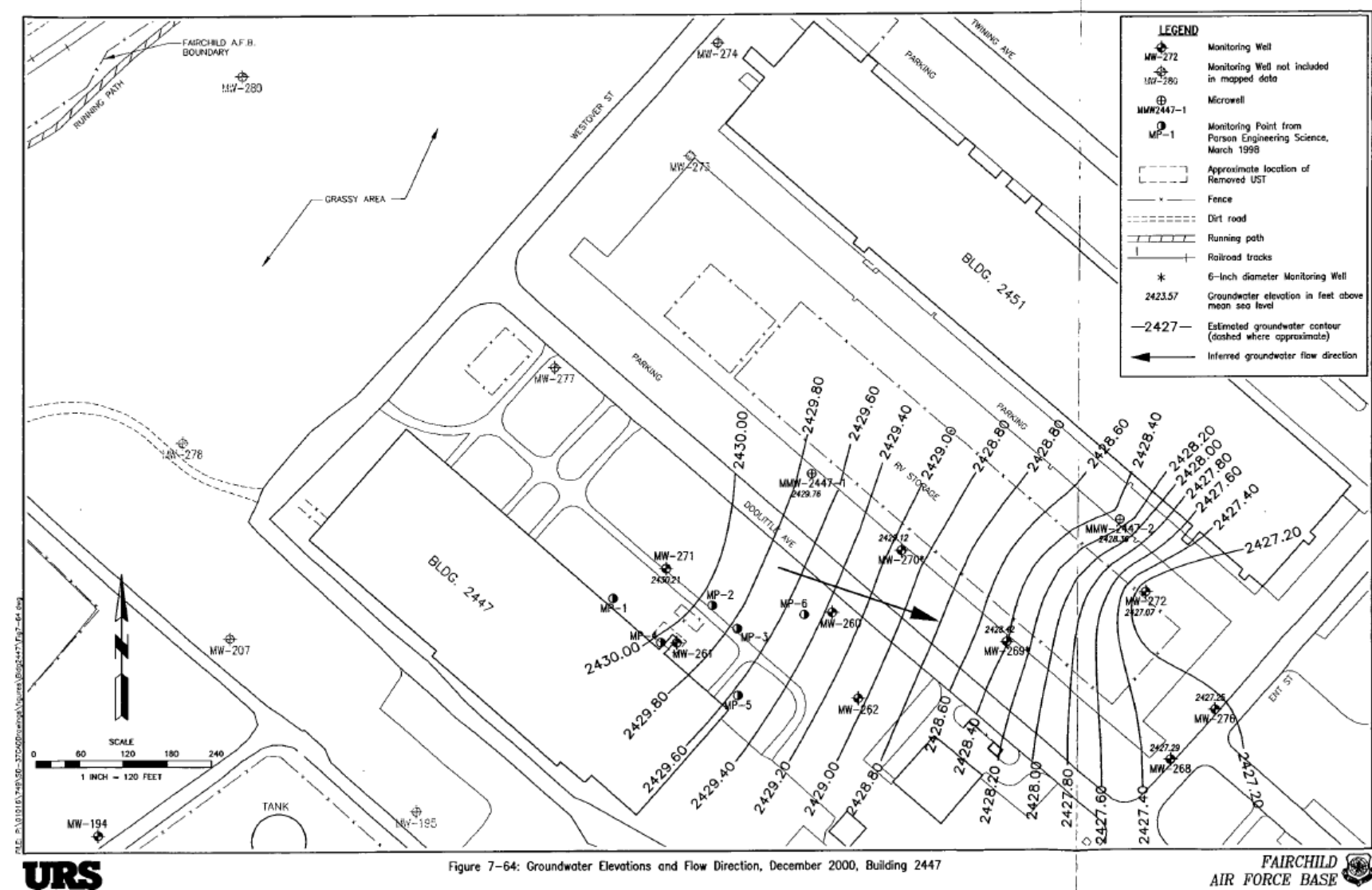
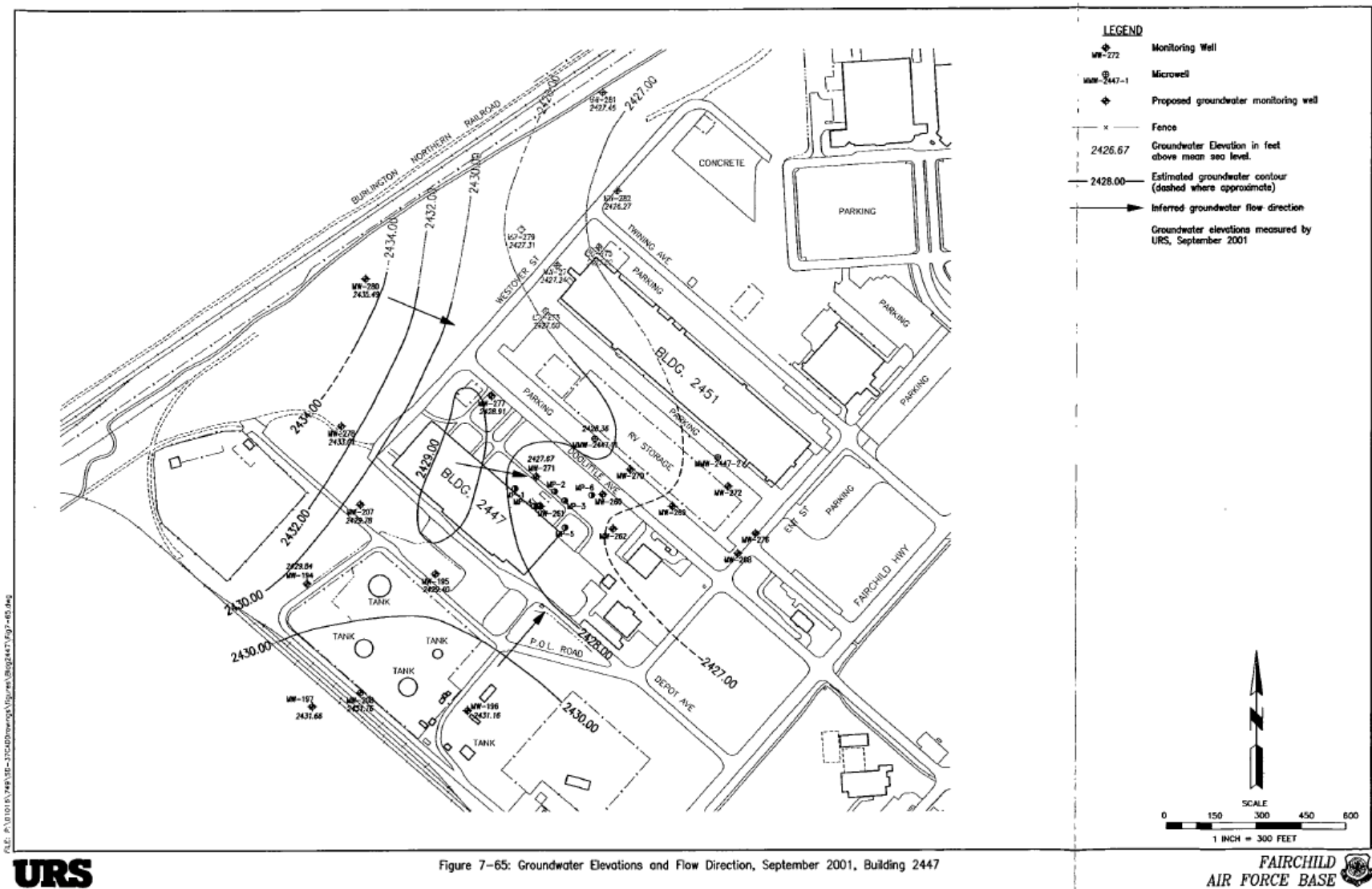


Figure A-29: (SS037) December 2000



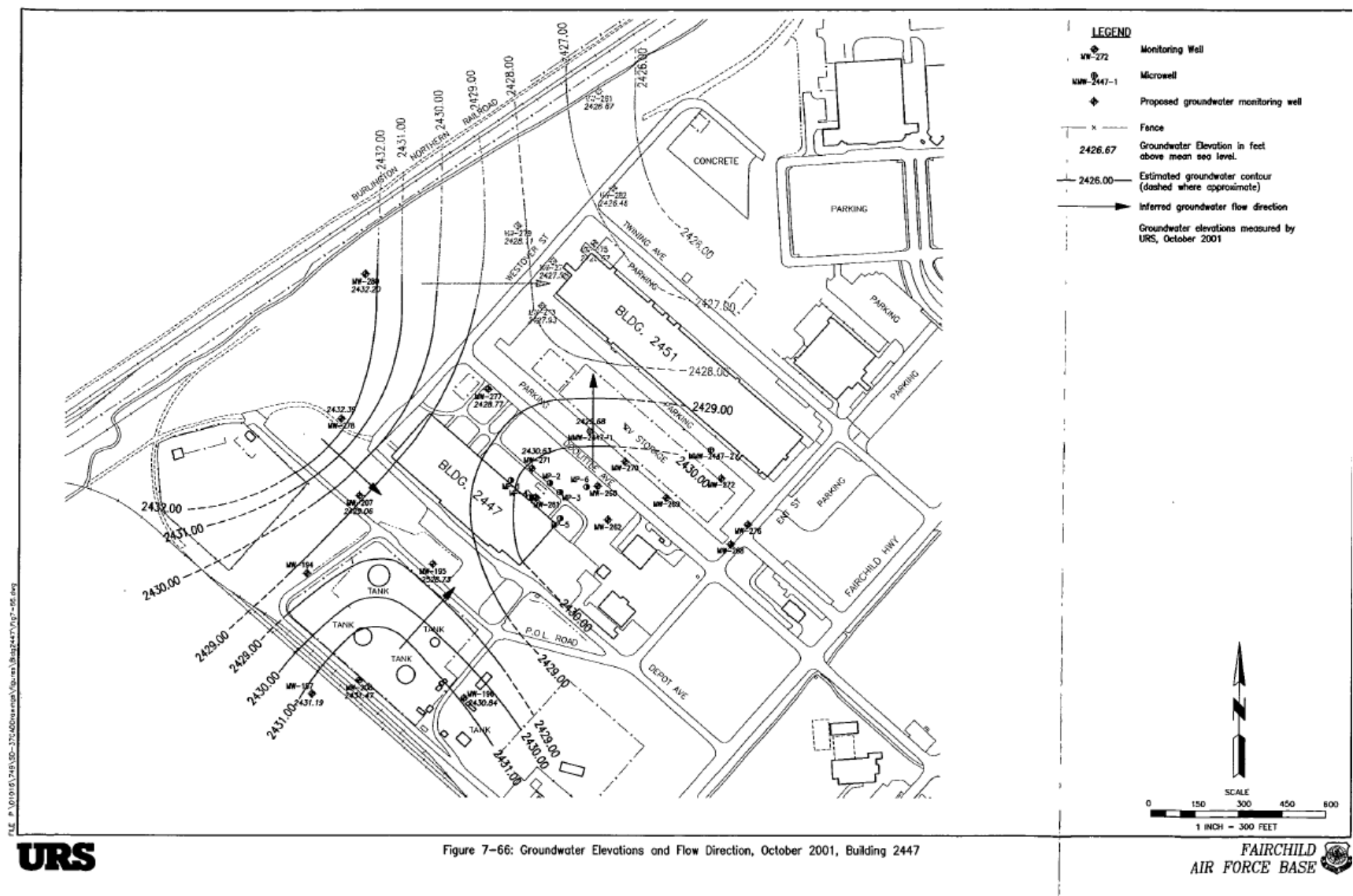
Source: URS, 2002. Final Remedial Investigation Report, Site SD-37, Volume 1. February 2002. AR#1873

Figure A-30: (SS037) September 2001



Source: URS, 2002. Final Remedial Investigation Report, Site SD-37, Volume 1. February 2002. AR#1873

Figure A-31: (SS037) October 2001



Source: URS, 2002. Final Remedial Investigation Report, Site SD-37, Volume 1. February 2002. AR#1873

Figure A-32: (SS037) November 2001

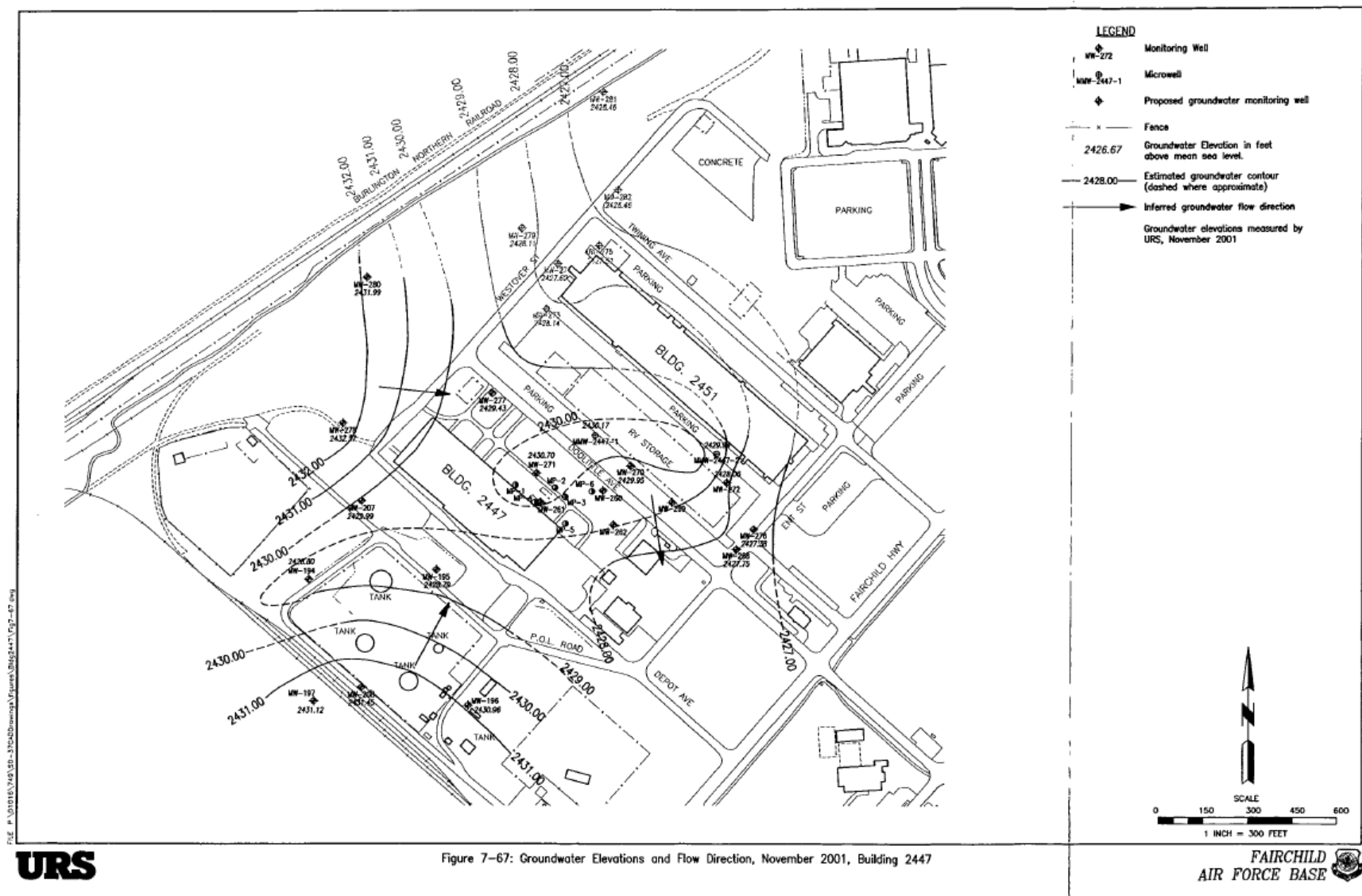


Figure A-33: (SS037), December 2001

