West Plains Hydrogeology

West Plains Groundwater Elevation Monitoring and Mapping

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Prepared by Spokane County Water Resources

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Introduction

This report describes the work completed for the *West Plains Groundwater Elevation Monitoring and Mapping Project* (project). The project was funded by a grant from the Washington Department of Ecology's (Ecology) Watershed Planning Program. The project scope was developed from recommendations included in the Water Resource Inventory Area (WRIA 54) Watershed Plan and WRIA 54 Detailed Implementation Plan (DIP). The WRIA 54 DIP includes the following recommendation:

Recommendation TI-1: West Plains Hydrogeology Study:

> *Basalt Aquifer Groundwater Study-The Columbia River Basalt Group aquifers that underlie the West Plains area are used for water supply. Groundwater levels have declined in some areas, indicating the groundwater resource is potentially strained. These aquifers are not well understood. Elsewhere in the Pacific Northwest, basalt aquifers are used extensively for water supply, indicating that a better understanding of the Columbia River Basalt Group aquifer in the West Plains area would be beneficial to understand how this resource can be used in a sustainable way. (Tetra Tech, 2010).*

Groundwater elevation data is essential to understanding a hydrogeologic system. As the USGS writes:

> *Groundwater systems are dynamic and adjust continually to short-term and long-term changes in climate, groundwater withdrawal, and land use. Water level measurements from observation wells are the principal source of information about the hydrologic stresses acting on aquifers and how these stresses affect groundwater recharge, storage, and dis-*

Figure 1—West Plains Groundwater Elevation Monitoring and Mapping Project Study Area

charge. Long term, systematic measurements of water levels provide essential data needed to evaluate changes in the resource over time, to develop ground water models and forecast trends, and to design, implement, and monitor the effectiveness of ground water management and protection programs. (Taylor, 2001)

The purpose of the project was two fold: 1) collect, document, and organize groundwater elevation data to be used in future hydrogeologic analysis of the study area and long term water level trend monitoring, and 2) Use groundwater elevation data to develop groundwater elevation contours and evaluate changes in water levels over various time scales. This report includes data collected for this project and data collected by other organizations, both current and historical.

Study Area Description

The identification of the geographic area the "West Plains" is used frequently in the region, yet the boundaries of this area are not well defined. It is often used to describe the area west of the Spokane River, south of Deep Creek, north of Interstate 90, and west of Lincoln County. The study area for this project, herein referred to as the West Plains, includes that area plus additional area to the north and south. The area was defined by outcrops of crystalline basement rock that appear to act as a barrier to ground water flow in the basalt aquifers of the West Plains. The boundaries of the basement outcrops have been shown on surficial geology maps in the past, but a more complete boundary has recently been mapped by McCollum and others and is included in the soon to be released paper entitled *Mesoproterozoic and Cambrian Geology of the Northeastern Columbia Plateau of Washington—A View from the Steptoes* (McCollum, 2013). Figure 1 shows the study area boundaries and the basement rock.

An understanding of the geologic setting of the West Plains is necessary to interpret the results described in latter sections of this report. The geology and hydrogeology of the Columbia River Basalt Group has been studied extensively and many studies on the West Plains specifically have been completed. The brief summary provided below provides information relevant to the discussion of results provided in latter sections of this report.

The West Plains is located in the northeast corner of the Columbia Plateau Regional Aquifer System (CRPAS). The geologic and hydrogeologic setting of the Columbia Plateau has been extensively studied and is well described in many publications. The USGS recently released two reports on the subject: *Hydrogeologic framework and hydrologic budget components of the Columbia Plateau Regional Aquifer System, Washington, Oregon and Idaho* (Kahle, 2011) and *Three-dimensional model of the geologic framework for the Columbia Plateau Regional Aquifer System, Idaho, Oregon, and Washington* (Burns, 2011). The following portion of the abstract from the first publication listed above provides a succinct description of the CPRAS:

> Conceptually, the system is a series of productive basalt aquifers consisting of permeable interflow zones separated by less permeable flow interiors; in places, sedimentary aquifers overly the basalts. The aquifer system of the Columbia Plateau Regional Aquifer System (CPRAS) includes seven hydrogeologic units—the overburden aquifer, three aquifer units in the permeable basalt rock, two confining units, and a basement confining unit. The overburden aquifer includes alluvial and colluvial valley-fill deposits; the three basalt units are the Saddle Mountains, Wanapum, and Grande Ronde Basalts and their intercalated sediments. The confining units are equivalent to the Saddle Mountains-Wanapum and Wanapum-Grande Ronde interbeds, referred to in this study as the Mabton and Vantage Interbeds, respectively. The basement confining unit, referred to as Older Bedrock, consists of pre-Columbia River Basalt Group (CRBG) rocks that generally have much lower permeabilities than the basalts and are considered the base of the regional flow system. (Kahle, 2011)

The West Plains is on the margin of the CPRAS and generally shares the same conceptual hydrogeology described above, but also has some characteristics that are distinct to the area The West Plains is in effect cut off from the larger CPRAS by steptoes of Pre-CRBG basement rocks, as shown in Figure 1. As a result the general groundwater flow direction is east/northeast as opposed to the west/southwest direction of much of the CPRAS. The West Plains hydrogeologic system has been described in several publications including *Hydrogeology of the West Plains Area of Spokane County, Washington* (Deobald and Buchanan, 1995), and *WRIA 54 Phase 2 Level 1 Data Compilation and Assessment* (Tetra Tech, 2007).

The Wanapum and Grande Ronde are the only basalt formations present in the West Plains. The Wanapum is the upper most formation and is found approximately between 2,300 ft and 2,450 ft above mean sea level (msl). It is not present in areas where basement rock extends above or where ground surface is below this elevation.

The Wanapum-Grande Ronde interbed varies in thickness occurrence, lithology, and lateral continuity. In some areas the interbed is comprised of material that acts as a groundwater barrier, such as clay, and in other areas it is comprised of material that can readily store and transmit groundwater, such as sand and gravel. (Deobald, 1995)

The Grande Ronde formation occurs beneath the Wanapum-Grande Ronde interbed and is found approximately between 2,300 and 1,700 ft. msl. The Grande Ronde is present in all portions of the study area except where basement rock extends above 2,300 ft. msl.

The surface of both basalt formations is incised and undulatory, creating a relatively complex distribution of overlying sediment (GeoEngineers, 2009), herein referred to as paleodrainage deposits. The paleodrainage deposits are incised into both the Wanapum and Grande Ronde formations in various areas of the West Plains. The paleodrainage deposits likely act as a conduit for water to move from the Wanapum to Grande Ronde formations, or for precipitation to move from the paleodrainage deposits directly to the Grande Ronde formation. (NLW, 2012).

Within each basalt formation are individual flows. Recent work has resulted in better resolution of two flows within the Grande Ronde formation found on the West Plains: 1) Sentinel Bluffs Member, and 2) Wapshilla Ridge Member (Pritchard, 2013). Prichard used whole rock geochemical analysis from basalt outcrops and well cuttings to identify the elevation of the top of each flow, and then evaluated driller descriptions from water well logs to assign elevations to additional locations. Identified and interpreted elevations of each Grande Ronde flow were used to develop contour maps for the top of each flow. The elevations of these individual flows of the Grande Ronde formation may explain the significant difference in water level elevation in wells completed in the Grande Ronde in the east and northeast portion of the West Plains in comparison to other areas of the West Plains.

Four hydrogeologic units are referred to in this report: 1) Wanapum Basalt, 2) Grande Ronde Basalt, 3) Unconsolidated, and 4) Basement. In many areas of the West Plains wells completed in one unit are in close proximity to wells completed in another unit. The Unconsolidated hydrogeologic unit includes the paleodrainage deposits and areas where unconsolidated material overlies a basalt formation, but is not incised like the paleodrainage deposits. The Basement hydrogeologic unit is largely found in the higher elevations of the West Plains in areas such as the step toes that form the western edge of the study area.

Many of the wells found within the study area are commingling wells. As described by the USGS: “Commingling is the term used to describe the condition that occurs when a well is constructed so water can move from one aquifer to another through the well bore. This can occur in wells that are open to multiple aquifers through screens or uncased intervals. If the aquifers have different heads, then water will move through the well bore from the aquifer(s) with the higher head to the aquifer(s) with the lower head” (Burns, 2012). The water level in a commingling well does not represent the head of either discreet aquifer, but a composite of the two (Figure 2). Additionally, the water level in a well that is constructed such that it represents one aquifer can be impacted by commingling wells in the surrounding area. The hydrogeologic unit of comingling wells or those that are likely impacted by comingling wells is identified as undetermined in this report.

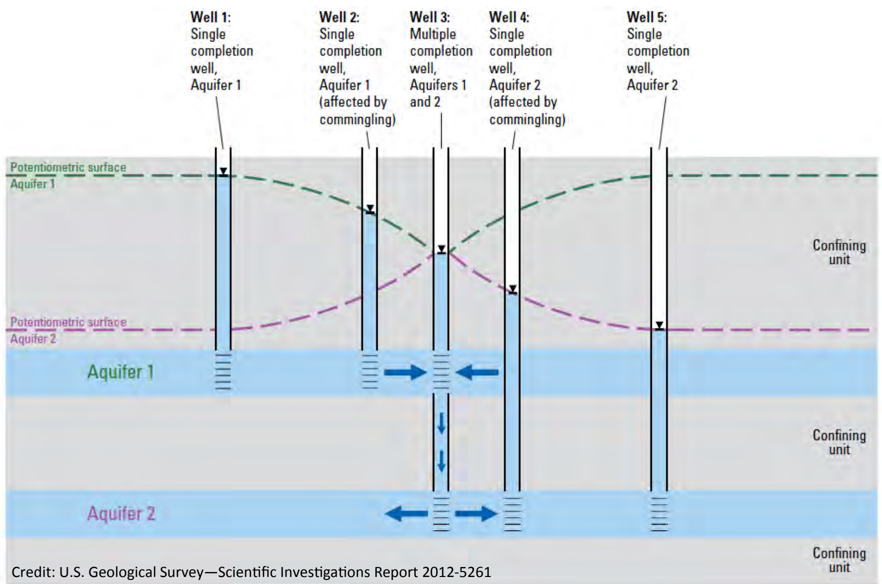


Figure 2—Impact of Commingling Wells on Water Level Measurements

Collection and Analysis of Groundwater Elevation Data

Data Collection

Three types of water level data were collected for this project: synoptic, monthly, and continuous.

Synoptic water-level measurements are a type of periodic measurement in which water levels in wells are measured within a relatively short period of time under specific hydrologic conditions. Synoptic measurements provide a “snapshot” of heads in an aquifer, and can be used for mapping the altitude of the water table or potentiometric surface, determining hydraulic gradients, and defining the physical boundaries of an aquifer (Taylor, 2001).

Monthly measurements are similar to the synoptic measurements, except that they provide additional information on seasonal water level fluctuations and response to recharge and withdrawal. Both of these types of measurements are collected with a manually operated water level meter.

Continuous water level measurements are collected by an automatic water level sensing and recording instrument that is programmed to make measurements at a specified frequency. Continuous water level data can be used to assess aquifer response to such things as rainfall, snowmelt, changes in surface water levels, and withdrawals. A quality assurance project plan (QAPP) was developed for data collection activities by Spokane County staff and approved by Ecology (Spokane County, 2011). The QAPP details measurement equipment, procedures, data quality objectives, etc.

In total approximately 600 well owners in the West Plains were invited to participate in the project and approximately 110 were willing. Twenty five wells, of the 110, were not measured due to scheduling conflicts, difficulty finding the well, difficulty removing the cap, or a blockage in the well that did not allow the probe to reach water.

Two synoptic measurements events were conducted for this project. The first event was done between October 17, 2011 and October 21, 2011, and included 85 wells. The second event was done between April 16, 2012 and May 1, 2012, and included 75 wells. Wells were selected based on well construction, location, the hydrogeologic unit in which the well was completed, and willingness of the well owner to participate in the project.

Monthly measurements were collected at 12 locations, and continuous data was collected at 10 locations. Several factors were considered in the selection of the monthly and continuous water level data collection locations including location, aquifer, well construction, type of well (i.e. domestic, municipal production, monitoring), and availability. Figure 3 shows the location and monitoring type of each well measured for this project. A listing of project wells including location, well construction, measurement type and interpreted hydrogeologic unit is provided in Table 1.

In addition to data collected for this project by Spokane County staff, data collected by other organizations is also included in this report. Data collected by other organizations includes both concurrent data and historical data, dating as far back as 1955. In this report these wells are referred to as supplemental wells. Locations of the supplemental wells are presented in Figure 4, and a listing of the supplemental wells including location, elevation, interpreted hydrogeologic unit, and organization that collected the water level data is presented in Table 2 and the supplemental water level data is presented in Tables 6.1 through 6.14.

Synoptic Water Level Measurements

Synoptic water level data is presented in Table 3 and is included in the electronic files that accompany this report. The October 2011 synoptic water level data is presented in Figures 5A & 5B, and the April/May 2012 synoptic water level data is presented in Figures 6A and 6B. The difference in water level elevation between the two measurements are shown in Figures 7 & 8.

Synoptic water level measurement data was used to develop contour maps of the potentiometric surface of aquifers in the Wanapum (Figure 9) and Grande Ronde units (Figure 10). The contours are principally based on the October 2012 synoptic water level measurement data. Inverse-distance-weighted spatial analysis of the fall water level data for each formation was done to generate a "first cut" of the contours. The first cut contours were then overlaid in GIS on the following data layers:

- surface contours of each stratigraphic unit;
- additional water level data points from the spring synoptic measurement;
- water level data reported on well driller logs;
- water level contours for the Grande Ronde Aquifer and Wanapum Aquifer from Deobald and Buchanan, 1995.

The first cut contours were then adjusted based on the data described above. The water level contours presented in Figures 9 and 10 are generalized; they do not represent the localized complexity that are the result of groundwater withdrawals, spatially varying aquifer hydraulic properties, variations in recharge, and topography.

The groundwater flow system of the Wanapum unit is compartmentalized. It can be separated into four distinct subareas of the study area: 1) north of Coulee Creek, 2) between Coulee Creek and Deep Creek, 3) between Deep Creek and Marshall Creek, and 4) south of Marshall Creek. Each of these creeks is incised into the Wanapum formation which interrupts the lateral continuity of the formation.

The surface and near surface basement structures also contribute to the compartmentalization of the Wanapum flow system. At the west edge of each subarea there are areas where the basement unit is at or near the surface. These areas serve as both a source of groundwater recharge and an impediment to groundwater flow from the western portion of the study area. The Basement unit generally has low hydraulic conductivity; as the unconsolidated material on the surface of the crystalline basement rock becomes saturated water can not infiltrate vertically at a sufficient rate, and therefore moves laterally, eventually encountering the contact between the Wanapum unit and Basement unit where it recharges the Wanapum unit. The surface and near surface basement area are also located on topographic highs that receive more precipitation.

The groundwater flow paths in the Wanapum formation generally originate at the bottom of each surface and near surface basement area and move east and north east. In the northern most subarea the groundwater flow paths appear to move east, west, and south, following the surface topography. Evidence of this flow pattern can be seen in the seeps and springs found along a draw that runs along Coulee Hite Rd. The draw is incised into Wanapum unit. Around the rim of the draw the water level in the Wanapum unit is above the surface elevation of the valley floor. The groundwater in the Wanapum unit is expressed on both sides of the draw as seeps and springs.

In addition to the basement structures and the incised valleys, the dip of the Wanapum formation and of the Wanapum-Grande Ronde interbed may impact the groundwater flow paths, because most groundwater occurs and moves in the interflow zones (Vaccaro, 2009). In areas where the surface topography and dip of the Wanapum formation is more subdued, such as the area south and southwest of the City of Airway Heights, the groundwater has a lower hydraulic gradient.

The Grande Ronde formation exhibits a more regional flow system than the Wanapum formation. While still impacted by the surface and near-surface basement structures, the Grande Ronde Formation extends below the creek valleys that are incised in the Wanapum formation; therefore there is more lateral continuity across the study area The potentiometric surface of the Grande Ronde aquifer is also below the surface elevation of the creek valleys, except in the lower portion of Deep Creek.

In much of the study area the Grande Ronde is buried below the Wanapum, Wanapum-Grande Ronde Interbed and Unconsolidated formations. In other areas with CRBG aquifers, such as the Yakima Basin, buried Grande Ronde formations water level contours are smoother and have less gradient because they are buried deeper, are thicker, and have a larger spatial extent than other CRBG formations. (Vaccaro, 2009) . This also holds for the West Plains.

The Grande Ronde flow system does not have the same pronounced groundwater highs near the surface and near surface basement structures as the Wanapum formation. While recharge likely occurs where the Grande Ronde unit meets the Basement unit, in many places this is buried and of larger spatial extent. This minimizes any localized groundwater highs as seen in the Wanapum unit. Also, the Grande Ronde unit receives recharge vertically from overlying formations, because the groundwater gradient throughout the study area is downward. This recharge mechanism is more significant in the Grande Ronde as there are more overlying formations. Since the Grande Ronde unit has recharge mechanisms that are more spatially distributed than the Wanapum unit there is little evidence of localized groundwater highs as seen in the Wanapum unit

In the northeast portion of the study area the groundwater level of the Grande Ronde unit is over 200 ft. below that of the groundwater level in the Grande Ronde Unit in the rest of the study area. This area may be hydraulically distinct from the rest of the Grande Ronde unit. As described in the introduction a Grande Ronde flow member is present, the Wapshilla Ridge, in this area that is not found, or is deeply buried in other portions of the study area. Grande Ronde wells in this area are completed in the Wapshilla Ridge flow while Grande Ronde wells in other portions of the study area are completed in the Sentinel Bluffs flow.

Table 4 Change in Water Level Fall to Spring in the Wanapum and Grande Ronde Units

Formation	Wanapum	Grande Ronde
total number of wells	**36**	**45**
average change	3.44 ft.	3.08 ft.
median change	2.65 ft.	1.57 ft.
% with less than 1 ft change	33%	33%
largest increase	17.5 ft.	20.14 ft.
largest decrease	-2.94 ft.	-14.92 ft.
number of wells with positive change	**28**	**30**
% wells with positve change	78%	67%
average positive change	4.03 ft.	2.9 ft.
median positive change	3.45 ft.	1.71 ft.
number of wells with negative change	**8**	**15**
%wells with negative change	22%	33%
average negative change	-1.39 ft.	-3.46 ft.
median negative change	-1.1 ft.	-1.15 ft.

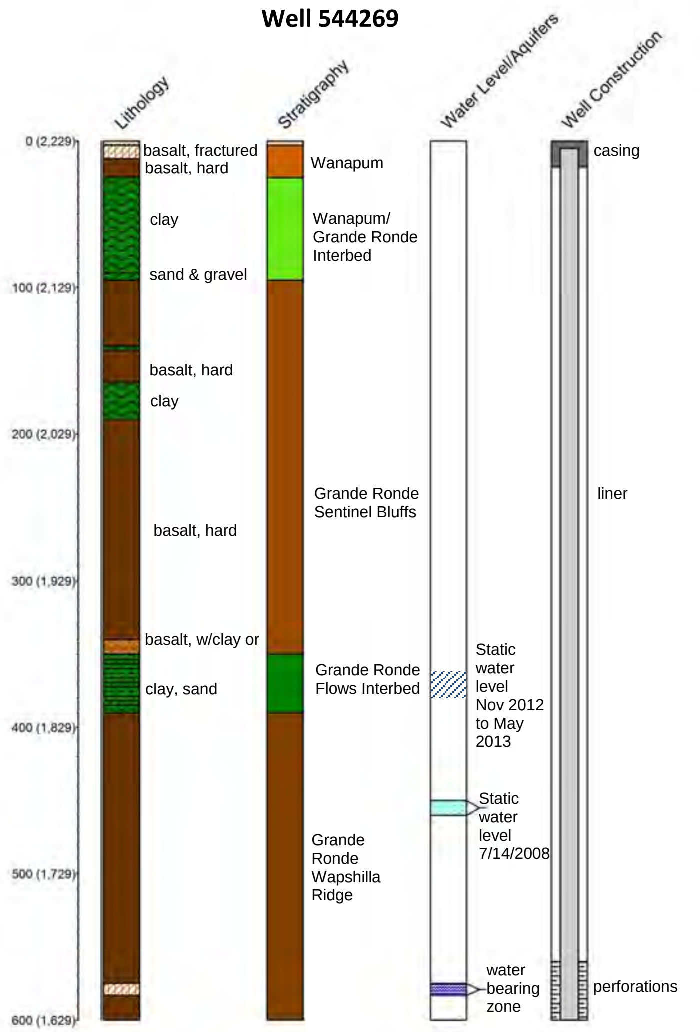
The synoptic water level measurements were conducted in the fall and spring which allows a comparison of the change in water level between Wanapum and Grande Ronde wells. Table 4 presents a comparison of the two units. The average absolute change (both positive and negative) was greater in the Wanapum unit. In the Wanapum unit the change in water level was more pronounced in wells that had a positive increase, which is in contrast to the Grande Ronde unit in which the change was more pronounced in wells that had a negative change in water level. There was a similar proportion of wells in each unit that had a change in water level less than one foot, either positive or negative.

A change in water level from fall to spring could be the result of groundwater recharge or recovery from summer withdrawals in the measured well or wells in the vicinity; likely in many cases it is some combination of the two. In general, between fall and spring the Wanapum unit has a greater magnitude of water level change than the Grande Ronde unit. Change in the Wanapum unit is more likely positive, and in the Grande Ronde unit it is more likely negative. Since the Wanapum unit is either at the surface or below a thin layer of unconsolidated material in many parts of the study area the impact of spring recharge is more pronounced in it in comparison to the Grande Ronde unit. It may be that the cycle of water level changes in the Grande Ronde Unit from groundwater withdrawals and recharge is delayed such that water level decreases were still occurring at the time of the spring measurement and an increase would occur in late spring/early summer. This pattern can be seen in Well 441147, which is a Grande Ronde well.

Monthly Water Level Measurements

Monthly data is presented in Tables 5.1 through 5.12 and is included in the electronic files that accompany this report. Below is a brief description, strip log, hydrograph of monthly measurements, and discussion of the water level data for each well. A map with the location of each well along with each hydrograph is presented in Figure 11.

<u>*Well 544269*</u>
Well 544269 is located in the northeast portion of the West Plains on a bluff overlooking Deep Creek. It is a domestic well, though no home has been built to date, and the well has not been used. The well yield reported on the well log is 30 gallons per minute (gpm). The well is 600 feet deep and penetrates the Wanapum, Wanapum/Grande Ronde interbed, Grande Ronde-Sentinel Bluff, Sentinel Bluff-Wapshilla Ridge interbed, and Grande Ronde-Wapshilla Ridge formations. The well is cased



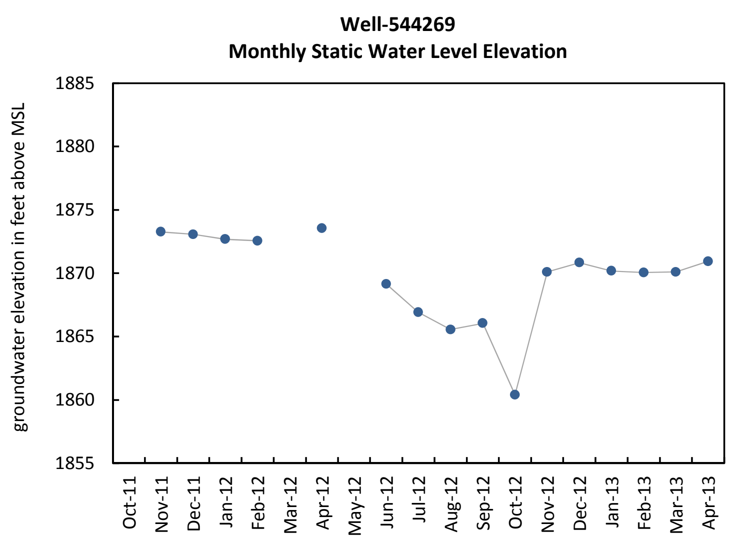


Figure 12: Well 544269 Strip Log & Hydrograph

to 18 ft below ground surface (bgs), and a PVC liner extends to the bottom of the well. Perforations in the liner are present from 560 ft to 600 ft. Figure 12 presents the lithology, stratigraphy water bearing zones, and well construction. While not noted on the well log, during field measurements it appeared that water was cascading from a water bearing zone above the static water level.

The static water elevation reported on the drillers log is 1778 ft. During the study the static water elevation ranged from 1866 to 1873 ft. msl. (Figure 12) The static water level elevations of Grande Ronde wells south of this well are clustered around an elevation of 2000 ft, and Grande Ronde wells north of this well are clustered around an elevation of 1750 ft. Wells to the south are completed in the Sentinel Bluffs flow and the wells to the north are completed in the Wapshilla Ridge flow. The perforations in this well are located in the Waspshilla Ridge flow, but water also may be cascading from the Sentinel Bluffs flow which would create a composite head of the hydraulically distinct Grande Ronde aquifers in the Wapshilla Ridge and Sentinel Bluffs flows.

This well is approximately 1,200 ft east of Deep Creek. At this location Deep Creek is at an approximate elevation of 1900 ft, 30-35 feet above the static water level of this well. This portion of Deep Creek loses water to the ground water system (Spokane County Water Resources, 2013).

During the study period the water level in this well declined over the summer months reaching a low during October 2012. The well recovered during winter and spring of 2012 and 2013, though it did not return to the level measured during April of 2012.

Well 174648

Well 174648 is located on the eastern edge of the study area, in the Palisades Park neighborhood. It is a domestic well that is currently in use; the pump, though, was not running during any of the measurements and the water level was stable during all measurements. A yield of 10 gpm is reported on the well drillers log.

The well is completed in the Grande Ronde unit in the Sentinel Bluffs flow, as shown in Figure 13. The water level in this well is consistent with measurements taken in other wells completed in the Grande Ronde unit in the vicinity. Water level elevations for this well are presented in Figure 13. Over the course of the project the water elevation changed very little in this well. This indicates that the Grande Ronde aquifer in this vicinity is not influenced by short term hydrologic stresses or events such as groundwater withdrawals or recharge.

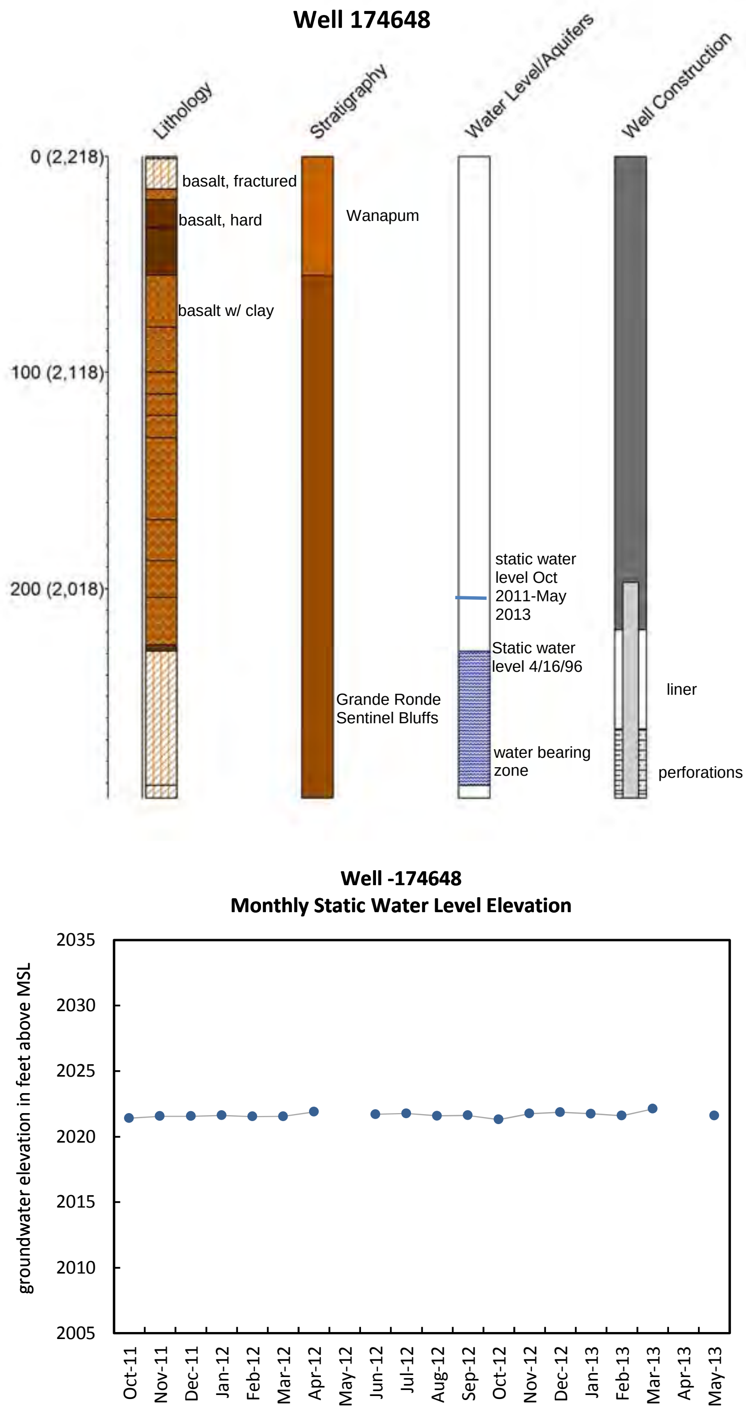


Figure 13: Well 174648 Strip Log & Hydrograph

Well Green

A well log is not available for this well, which is why it is not named by an Ecology Well Log ID like other wells in the study. The well is a domestic well located in the southern portion of the study area, one mile north of Marshall Creek. Based on well logs in the vicinity the well is located near a paleodrainage deposit that is incised into the Wanapum and Grande Ronde formations. Surface and near surface basement is located approximately 2 miles southwest of the well.

Water elevation measurements for this well are presented in Figure 14. Water level elevations ranged from 2255 to 2279, a range of 24 feet. Changes in water level followed a seasonal pattern, with increases occurring in February, March, and April and decreases throughout the summer and fall. This well appears to be influenced by annual recharge and water use patterns, i.e. snowmelt and summertime water use. Monthly data does not show a response to short term rainfall events.

The water level elevation of the Wanapum formation in the vicinity of this well is estimated to be between 2360 ft and 2320 ft and the water level elevation for the Grande Ronde Formation is estimated to be between 2120 ft and 2280 ft. The elevation range of the water level in this well is between the Wanapum and Grande Ronde formations. This is consistent with a well completed in multiple formations. A well located 900 feet south of this well (Ecology Well ID 315938) has a similar static water level elevation (2274) recorded on its well log. The log for this well shows that the well penetrates two water bearing zones, and that the well is completed such that both water bearing zones contribute to the well.

Figure 14

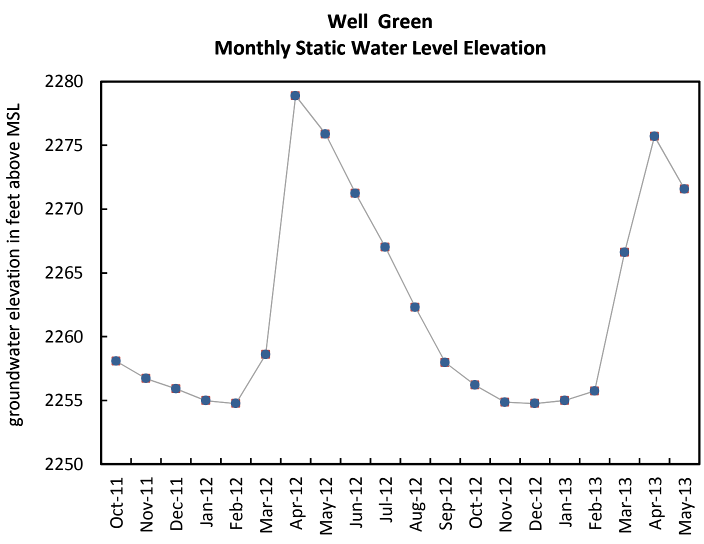
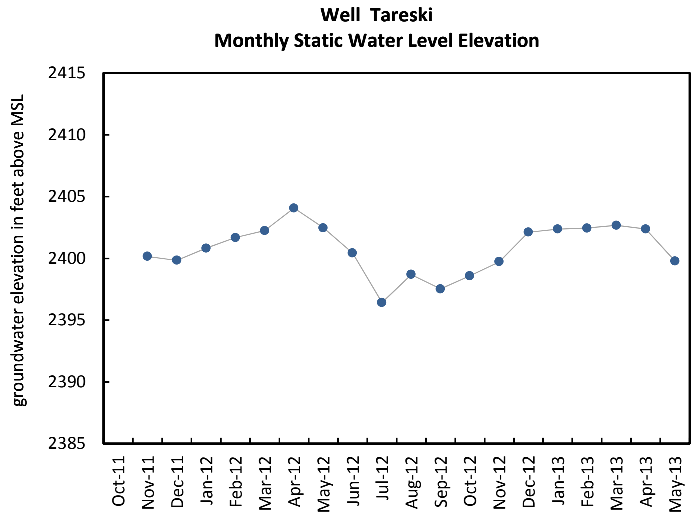


Figure 15



Well Tareski

A well log is not available for this well. The well is a domestic well located on the northeast side of Granite Lake. The well was not in use during any of the measurements, and the water level was stable. The well is located on the edge of an area mapped as surface and near surface basement rock. The water level in the well is relatively shallow, between 10 and 17 bgs. The static water level in the well is above the surface of Granite Lake indicating that ground water flows into the lake. Water levels, shown in Figure 15, show a seasonal pattern but also indicate a response to short term hydrologic events, as shown by the increase in water level in August 2012 above the July and September 2012 values.

Well 168759

Well 168759 is a domestic well located just west of Fairchild Air Force Base. The well was not in use during any of the measurements with the exception of August 2012, when the well was in use for lawn irrigation. The first 110 feet of the well is in the unconsolidated unit and the last 25 feet are in the Wanapum formation (Figure 16). The well is completed in the Wanapum and the water level elevation is consistent with other wells in the vicinity that are completed in the Wanapum. Over the course of the study the water level elevation changed very little, as shown in Figure 16.

The water level recorded on the drillers log on 4/4/1975 was 86.5 ft bgs, which is very similar to the water level elevations

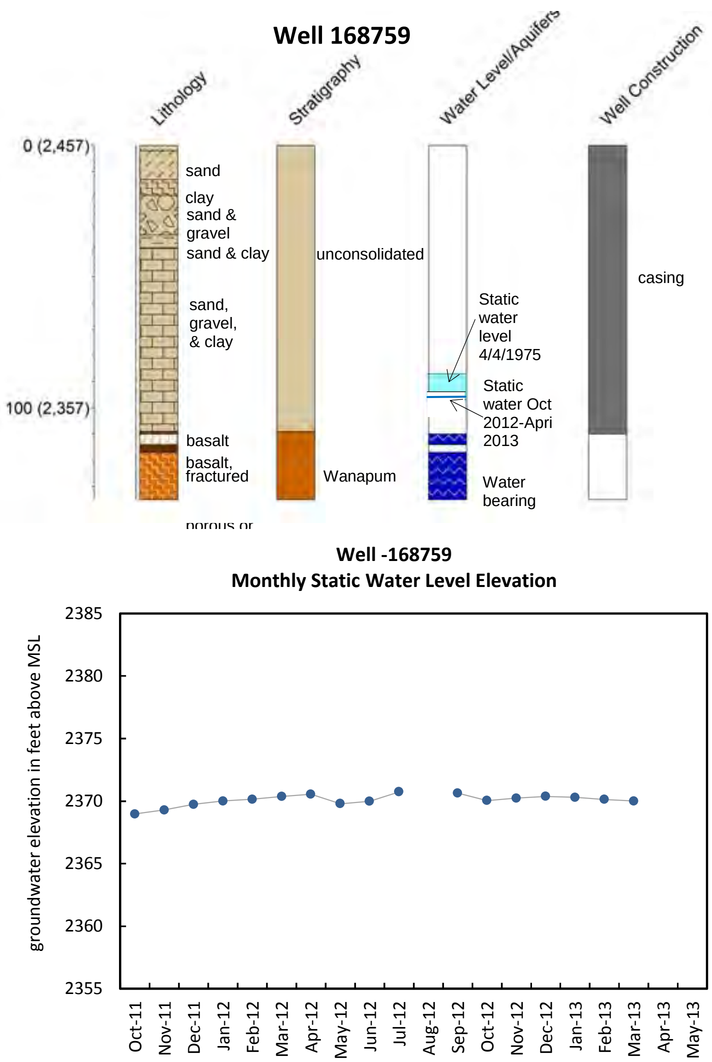


Figure 16: Well 168759 Strip Log & Hydrograph

measured during the study. This well does not appear to respond to short term hydrologic stresses or follow annual water level trends.

Well 171100

Well 171100 is a domestic well located on Indian Prairie between Deep Creek and Coulee Creek. The well was not in use during any of the measurements. Only five measurements were possible due to problems with the water level meter becoming stuck in the well during retrieval. The well penetrates the Wanapum, Wanapum/Grande Ronde Interbed, and Grande Ronde units. The well is completed such that it is open to all units but the water level is consistent with other wells completed in the Grande Ronde unit in the vicinity. During the measurement period the water level did not change significantly which is similar to other wells completed in the Grande Ronde formation

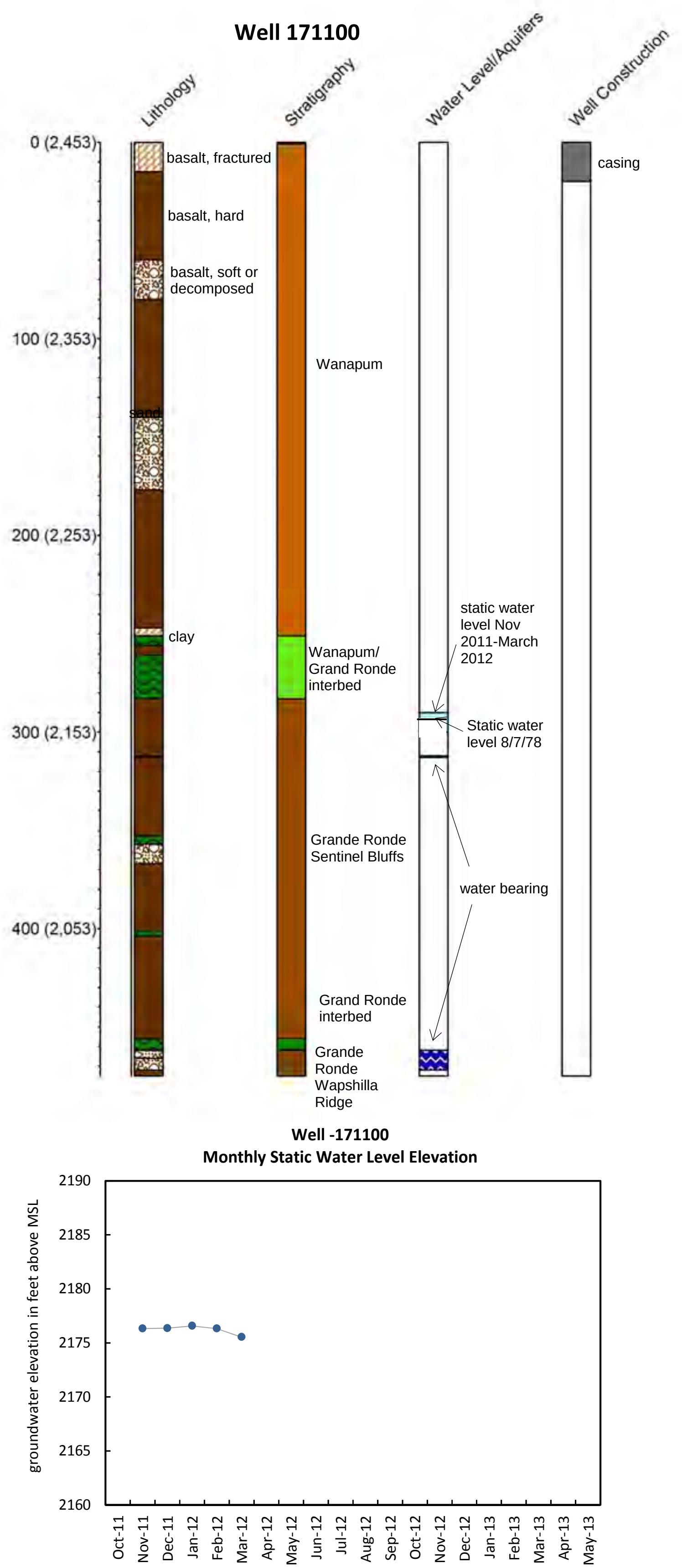


Figure 17: Well 171100 Strip Log & Hydrograph

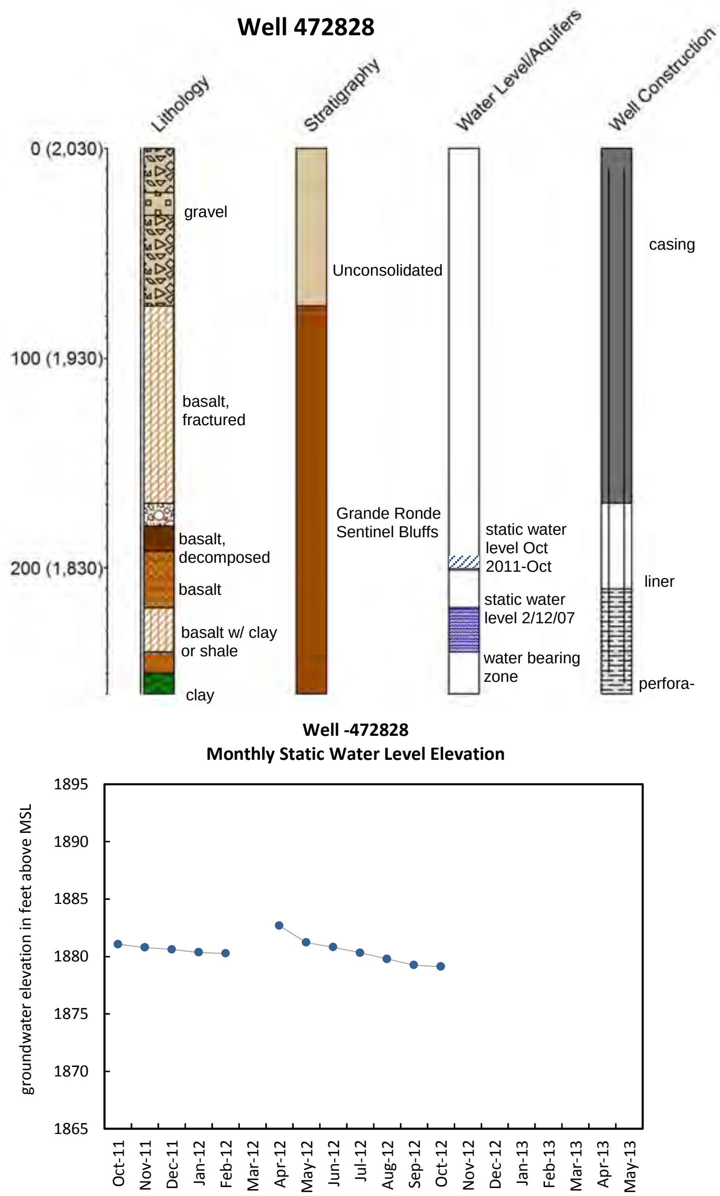


Figure 18 Well 472828 Strip Log and Hydrograph

that were measured during the study. The static water level recorded on the drillers log on 8/7/1978 was 2175, very similar to the levels measured during this study.

Well 472828

Well 472828 is a domestic well located outside of the study area to the north. The northern boundary of the study area was established because a basement ridge appears to exist extending east west across Four Mound Prairie. This well was monitored to evaluate differences between wells on either side of the basement ridge. Unfortunately no wells were located that could be measured on a monthly basis on the south side of the basement ridge.

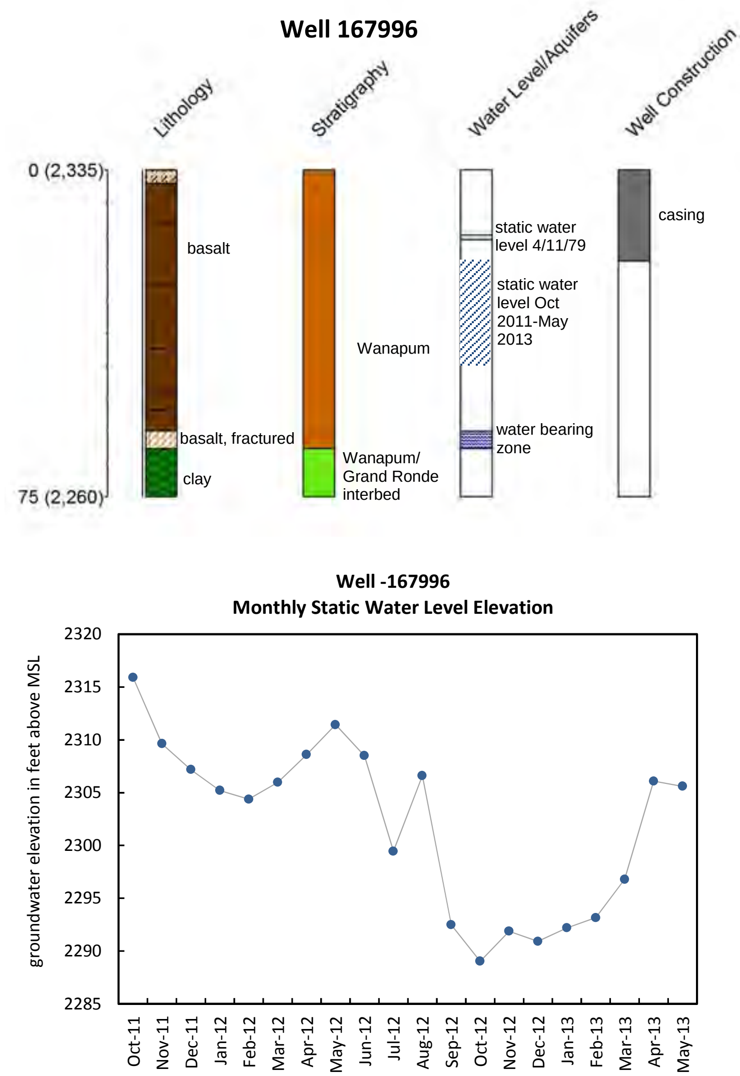


Figure 19 Well 167996 Strip Log & Hydrograph

Well 472828 demonstrates a typical seasonal pattern, and shows more variation than Grande Ronde wells located in other portions of the study area.

Well 167996

Well 167996 is a public supply well that provides water for the Indian Village Estates Water Association (IVEWA). This well is IVEWA's primary well during most of the year. In the summer a well that withdraws water from a deeper aquifer supplements this well. In some years during the late summer the water level drops below the pump intake and the well cannot be used. The well penetrates the Wanapum unit and the top of the Wanapum/Grande Ronde Interbed (Figure 19). The well shows a typical seasonal pattern and is responsive to both recharge pat-

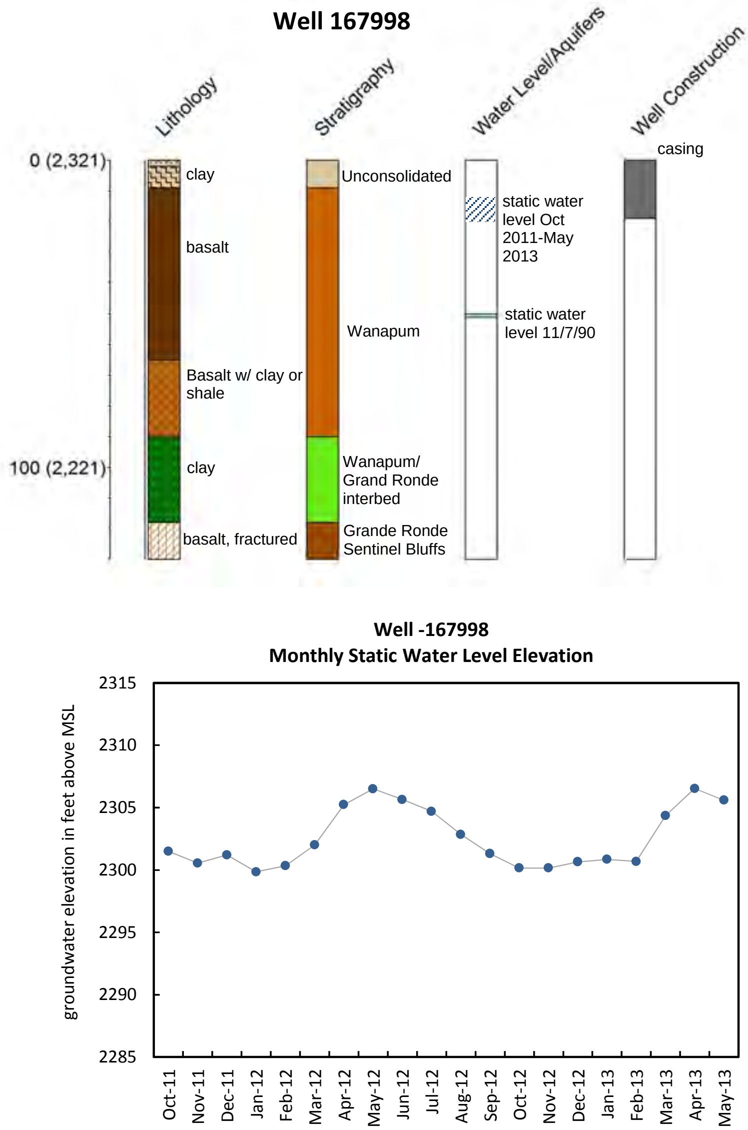


Figure 20 Well 167998 Strip Log & Hydrograph

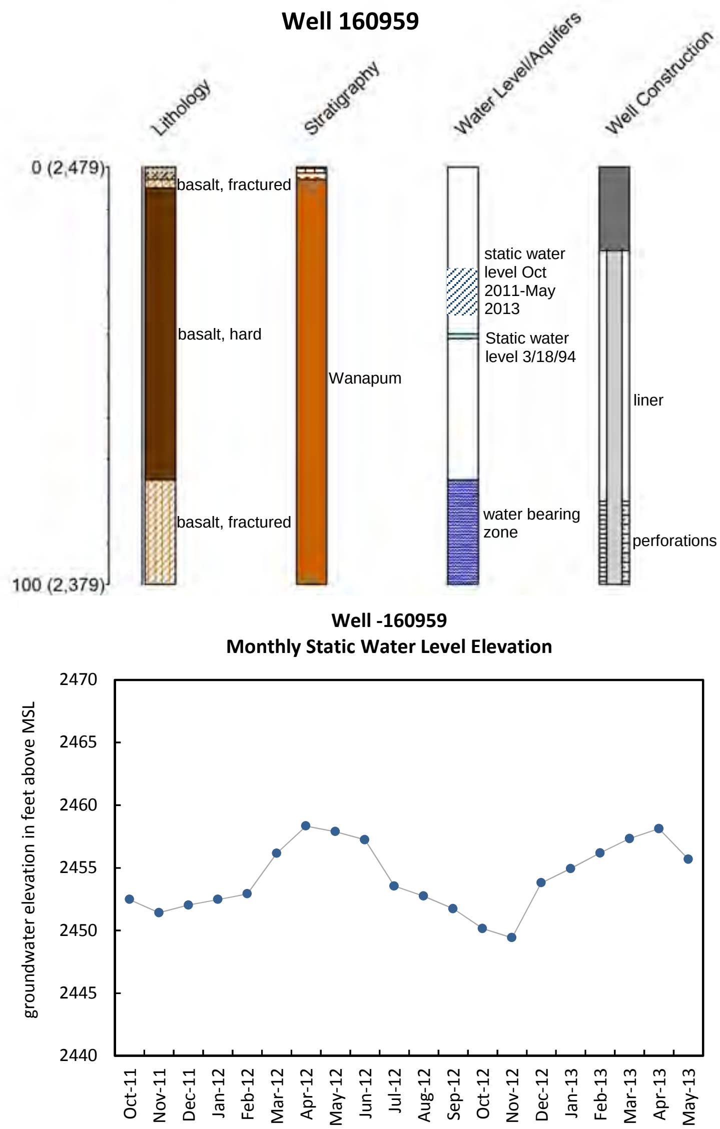


Figure 21 Well 160959 Strip Log & Hydrograph

terns and summertime withdrawals. Figure 19 presents the water level elevation of the static water level during the course of the study. Sharp declines in water levels occurred during the summer months.

Well 167998

Well 167998 is located approximately 0.5 miles southeast of well 167996. This well is not in use. It is completed in the same unit as well 167996 as shown in Figure 20, though it does extend beyond the Wanapum/Grande Ronde Interbed into the Grande Ronde formation. It does not extend into a water bearing zone within the Grande Ronde unit. Figure 22 presents the water level elevation measurements. This well is similar to Well 167996, but the changes are more subdued. The range of water level elevations in 167996 was 26.9 ft while in this well it was 6.7 ft. The well responds to both recharge patterns and summertime withdrawals.

Well 160959

Well 160959 is located in the northwest portion of the study area. It is a domestic well, though no home has been built to date, and the well has not been used. The well only penetrates the Wanapum unit, as shown in Figure 21. The well demonstrates a typical seasonal pattern, with elevated levels during the

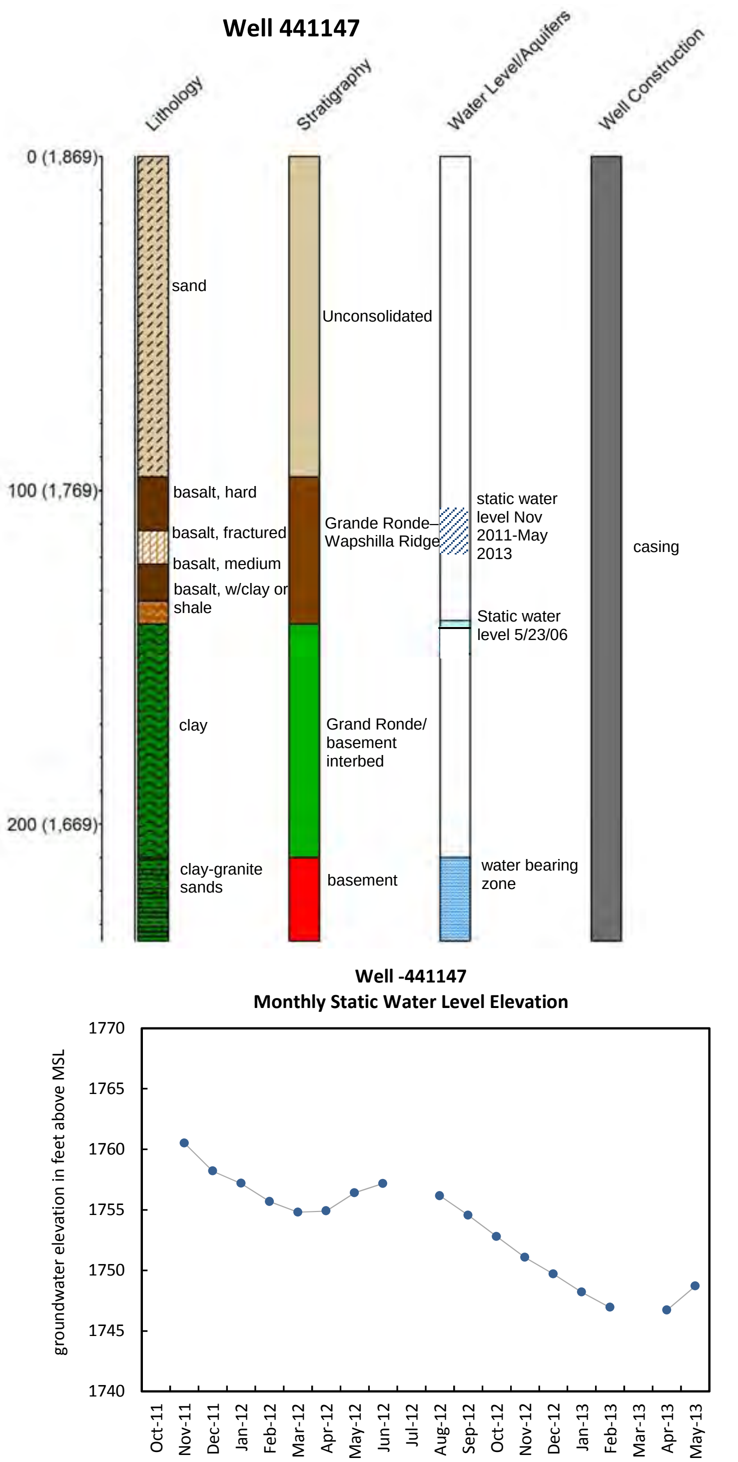


Figure 22 Well 441147 Strip Log & Hydrograph

early spring and lower levels in the late summer and fall. There are not many residences or other groundwater withdrawals in the vicinity of the well, so lower summer and fall water levels are not likely a result of groundwater withdrawals. The water level changes in this well are similar in magnitude and timing as seen in Well 167998.

Well 441147

Well 44147 is a domestic well located in the northeastern portion of the study area. The well provides water for a vacation home that is not in regular use. During most measurements the home was not occupied, with the exception of July 2012 when the well was in use to irrigate a small lawn. A measurement was not taken on that date.

The well is located 450 feet north of the portion of Coulee Creek that is intermittent most of the year.. The well is completed in an interval described as clay and granite sands on the well log. The description “granite sands” indicates that the well likely draws from a water bearing zone located between the Grande Ronde unit and basement unit.

Water levels measured in this well during the course of the study varied contrary to a regular seasonal pattern; the water levels declined through the spring and increased during the summer months. This is similar to the Lincoln-Garfield Rd well described in the continuous water level measurement portion of this report. The Lincoln-Garfield Rd Well is 0.5 miles south east of this well. It is possible that each of these wells are recharged, in part, from surface flows in Deep Creek and Coulee Creek that infiltrate into the ground above each well. Flow in each creek peak in the spring time, and it is possible that the influence of the creek is delayed in these well and is expressed during the summer months.

Well 172184

Well 172184 is located in the northeastern portion of the study area approximately 0.8 miles west of the Spokane River. The well provides water for the Riverside State Park Off Road Vehicle Area. During most visits no one was using the park facilities and the pump was not running. The water level was stable during all measurements.

The well is located in an unconsolidated sand and gravel aquifer, and shows similar water level elevation changes as wells located to the west such as the Lincoln-Garfield Rd. Well and Well 441147. The lowest water elevations occur in the spring and then increase to a yearly maximum in July. The pattern, though in this well is not as pronounced as in the other two wells mentioned above.

This well is located near the Spokane River. The water elevation in the well ranges between 1627 ft and 1633 ft. The elevation of the Spokane River is approximately 1600 ft; therefore groundwater is flowing from this location into the Spokane River.

Continuous Water Level Measurements

Continuous water level measurements were taken in 10 wells between fall 2011 and spring 2013. Figure 3 includes the location of each well. Continuous measurements, which include water level and temperature, were taken on an hourly basis with automatic data recording devices. Data is presented in Figures 33 through 46, and is included in the electronic files that accompany this report. The water level graphs are presented with the same scale on the x and y axis, so that comparisons of the scale of water level changes between the wells can be made. Below is a brief description of each well and discussion of the water level data collected during the study.

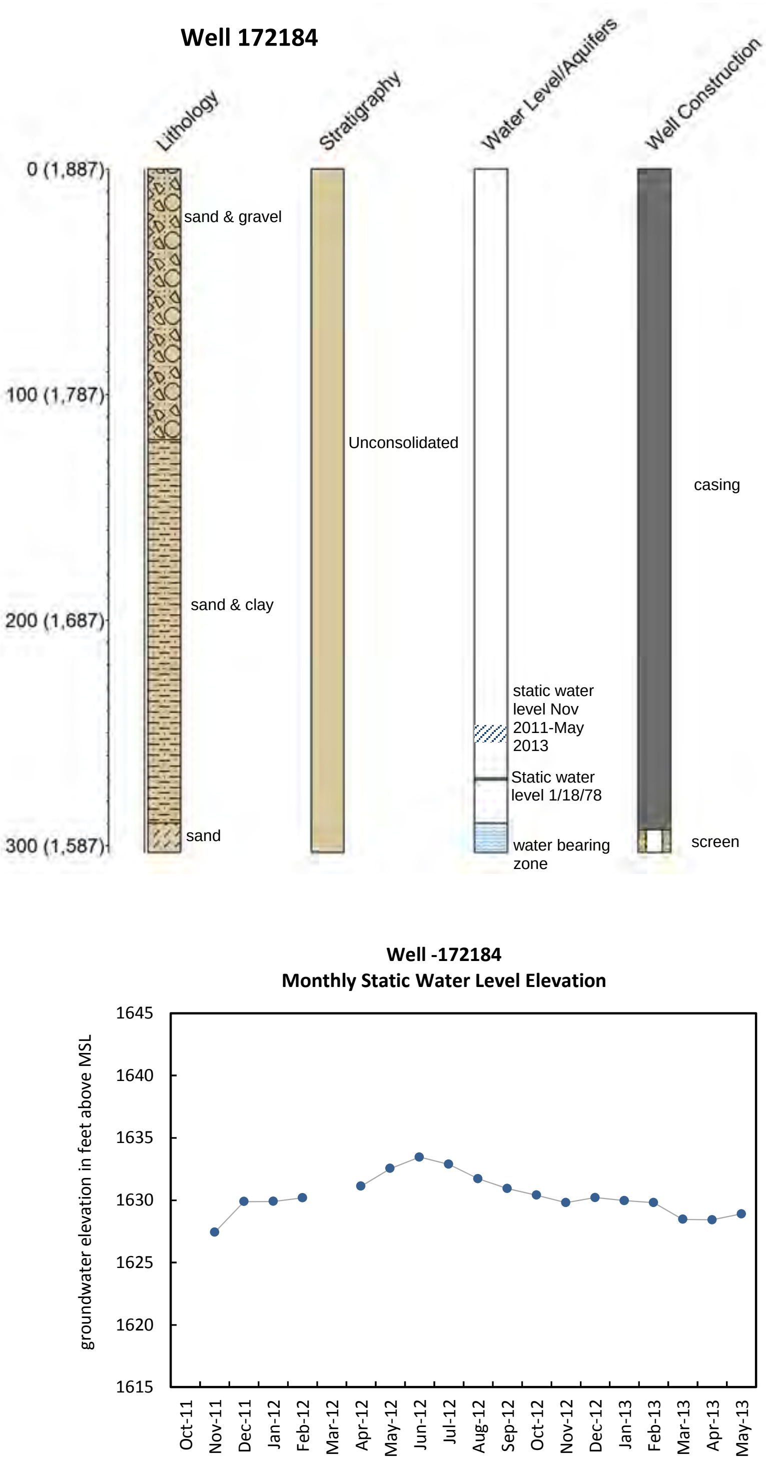


Figure 23: Well 172184 Strip Log & Hydrograph

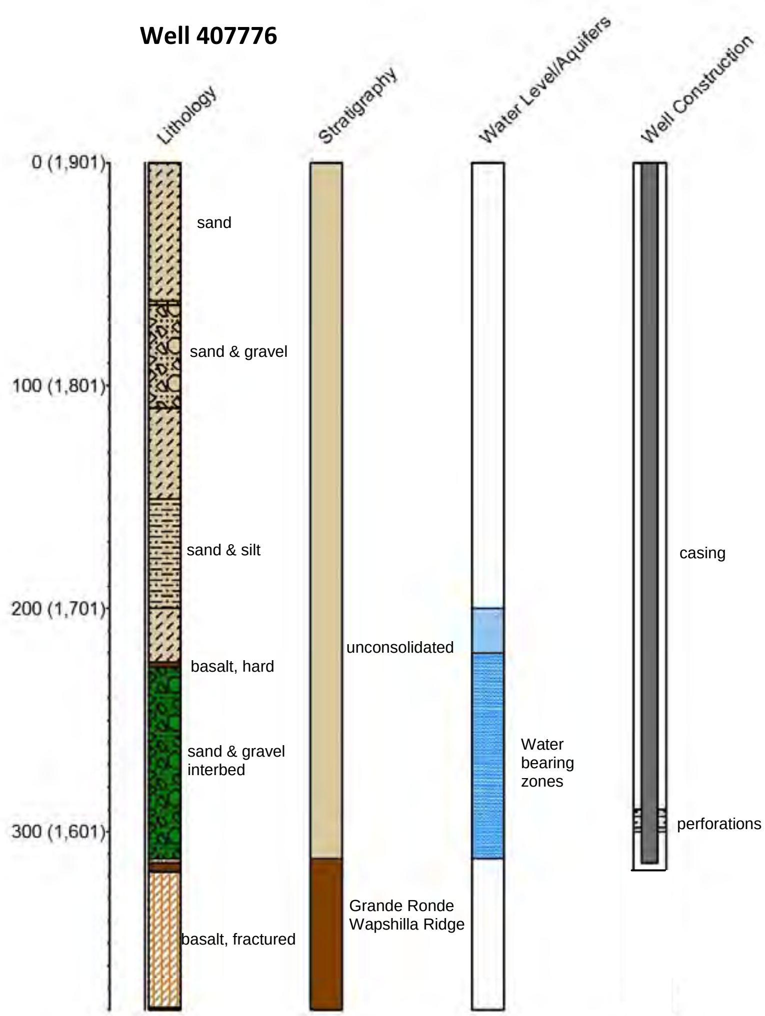


Figure 24: Well 407776 Strip Log

Lincoln-Garfield Rd. Well

A well log is not available for this well, though a well measured for the synoptic measurement that does have a well log (Well 407776) is located approximately 800 ft. southeast of the well. Even though this well does not have a well log it was chosen because it was not in use for all but the last two months of the study period. A strip log of well 407776 is shown in Figure 25. The well is located in the vicinity of Well 441147 and Well 172184, an area with a thick sequence of unconsolidated material underlain by the Wapshilla Ridge flow of the Grande Ronde formation. During the study period the water level elevation varied between 1,737 and 1,750 ft (Figure 33). The highest water level was recorded in September 2011 at the beginning of the study period and the lowest level was recorded in February 2013. The water level appears to follow an annual pattern with low levels occurring in late winter/early spring and increasing to an annual high during late spring/early summer. The water level changes are nearly sinusoidal in nature and do not exhibit any irregular patterns that indicate a response to short term climatic events, such as precipitation. In 2013 the low water level is 6 feet lower than it was in 2012. To date it has not recovered to the same level as 2012. This well was not in use until May of 2013, when it was put in use for domestic purposes. The groundwater temperature was relatively constant throughout the study period; temperature changes began to occur when the well was put in use and are likely due to pump operation rather than changes in groundwater temperature.

Well 172968

Well 172968 is located in the northern portion of the study area and is completed in the Wanapum formation. The well provides domestic water for a volunteer fire station. Use of the well is limited. There are no resident personnel and administrative staff are present on a limited basis. There is no outdoor irrigation. Water level elevation varied between 2,390 and 2,394 ft. during the study period (Figure 34) and follows a seasonal pattern. In contrast to the Lincoln-Garfield Rd. well, this well appears to respond to short term climactic events. Figure 35 shows water level changes over the study period with the 7 day rolling average of precipitation. (*note: the scale of the water level changes is different on Figure 35 so that changes are more apparent).* The 7 day rolling average of precipitation was used instead of daily precipitation so that several days of moderate precipitation would be as evident as one day of significant precipitation.

The water level in this well is impacted by both the amount of precipitation and the time of year. During the winter of 2011/2012 there are precipitation events with little response in water level because the ground is frozen and the precipitation is often snow rather than rain. During the spring of 2012 water level increases are preceded by rainfall events. The water level response to the precipitation events is on the order of days and weeks. During the late spring/and early summer there are rainfall events of similar magnitude to events that produced water level increases in the early spring that do not produce increases in water level. This is due to the evapotranspiration that occurs during the late spring and summer. In the late spring and summer the precipitation is evaporated or used by plants (transpired) before it infiltrates beyond the root zone, while during the early spring the precipitation does move beyond the root zone before it is evaporated or transpired.

The annual high water level occurred at approximately the same time, within a few weeks, in both 2012 and 2013. The high water level was approximately the same both years.

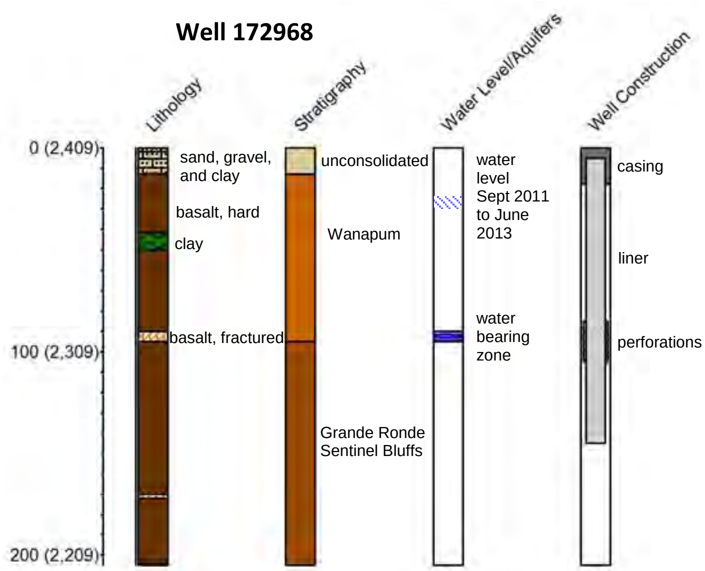


Figure 25: Well 172968 Strip Log

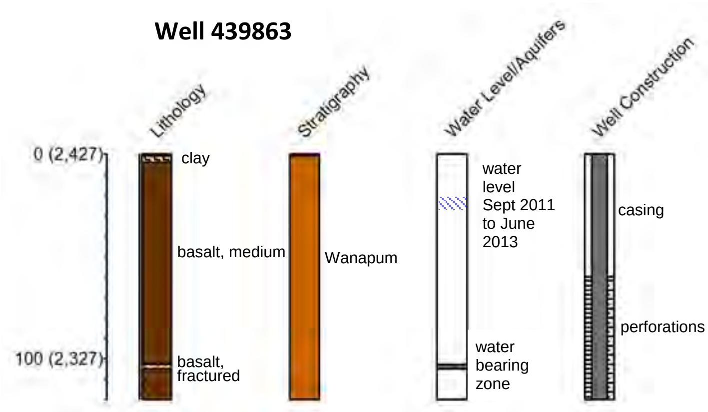


Figure 26: Well 439863 Strip Log

Well 439863

Well 439863 is located approximately 4.7 miles southwest of Well 172968. It is completed in the Wanapum formation. The well was drilled for domestic use, but has not been used to date. Water level elevation varied between 2,401 and 2,406 ft. during the study period (Figure 36). The water level trends in this well are very similar to those in Well 172968 described above.

Figure 37 shows the water level changes and 7 day rolling average of precipitation. The response to precipitation is similar to Well 172968, though it does show more daily variability, which may indicate a more immediate response to precipitation. Also the high water level in 2013 is 1 ft. higher than in 2012. This is in contrast to the Lincoln-Garfield Rd. Well where it is the opposite, 2013 is lower than 2012.

Four Lakes Water District—School Well

A well log is not available for this well, but based on well logs of wells in the vicinity the well is completed in the basement unit. The well is a backup well for the Four Lakes Water District and is rarely used. Water level elevation varied between 2,382 and 2,384 during the study period (Figure 38). The water level appears to follow an annual trend with the highest water level occurring in late March/early April and the low water level occurring during October or November. The change in water level was similar for 2012 and 2013.

Well 411175

Well 411175 is located on the eastern edge of the study area approximately 1,800 feet west of the Spokane River. It is located just outside the boundary of the Spokane Valley Rathdrum Prairie Aquifer as mapped by the USGS (Kahle, 2007). The elevation of the Spokane River in the vicinity of the well is approximately between 1,700 and 1,725 depending on river flow. Water level elevation in the well varied between 1,691 and 1,700 ft. during the study period (Figure 39). Figure 40 shows the water level elevation in the well and the elevation of the Spokane River measured at the USGS River Gage 12422500 Spokane River at Spokane, WA. Between the gage and the location of the river due east of the well there is an approximate elevation drop of 20 ft.

The water level changes in the well correspond with changes in the stage of the Spokane River. Increases in water level elevation in the well are preceded by approximately 1 to 2 weeks by increases in river stage. This suggests that the aquifer found between the Grande Ronde unit and Basement unit at the edge of the study area and the Spokane River/Spokane Valley Rathdrum Prairie Aquifer system are connected.

Well 164270

Well 164270 was drilled by the Town of Reardan to serve as a municipal supply well, but the production was not adequate to meet their needs. Another well was drilled approximately 150 ft. east of Well 164270, which did meet their needs and is now used as a municipal supply well. Well 164270 is completed in the Grande Ronde unit. The water level elevation varied between

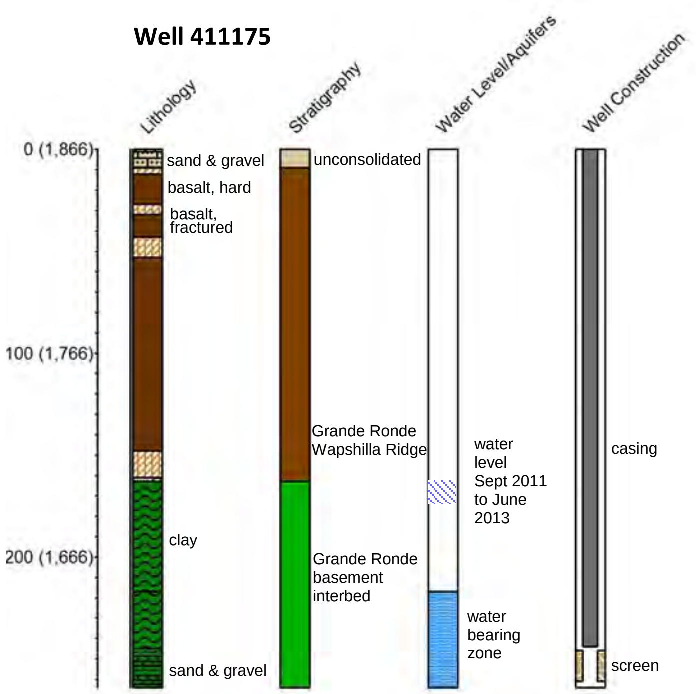


Figure 27: Well 411175 Strip Log

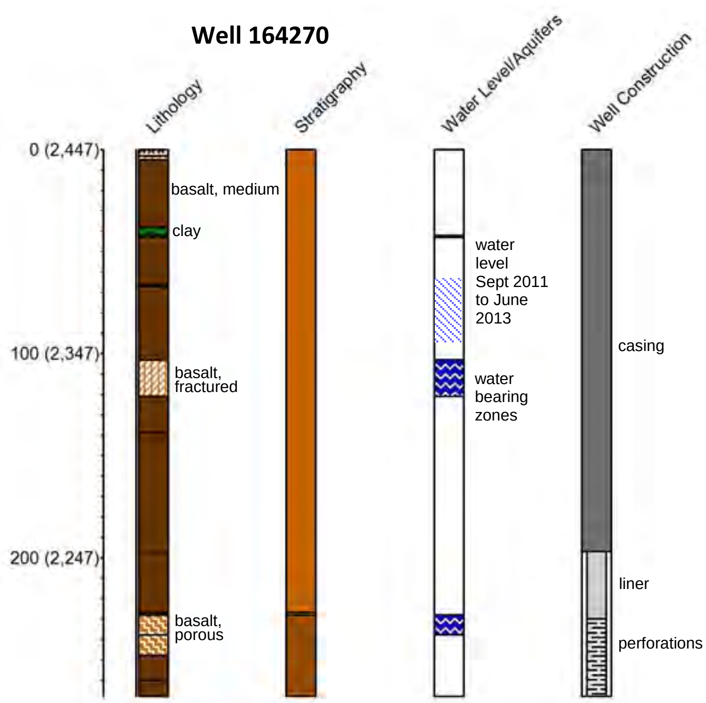


Figure 28: Well 164270 Strip Log

2,351 and 2,381 during the study period (Figure 41)

During the months of August, September, and October of 2012 the water level dropped below the level of the datalogger, and the water level was not measured. This occurred because during the Fall of 2011 it became apparent that the winter water level increase would go above the rated water level range of the data logger, so it was redeployed at a higher elevation. The redeployed data logger captured the water level highs but did miss the water level low in the summer and fall of 2012.

The water level changes in well 164270 show the influence of the nearby municipal supply well, and annual recharge patterns. Water levels decrease between late April/early May and September, which corresponds with increased municipal water use. October through late April the water levels increase as they recover from the increased summer pumping and receive more recharge from precipitation and snow melt. This well is located in the western portion of the study area near the surface and near surface basement, where recharge is likely occurring.

Well 295341

Well 295341 is located in the southern portion of the study area. It is located approximately 600 ft. west of the outlet of Queen Lucas Lake into Minnie Creek. The well is a monitoring well that was drilled for the Marshall Landfill Groundwater Investigation. The well is located approximately 500 ft. south of an area mapped as surface and near surface basement. Water level elevation varied between 2,122 and 2,144 ft. during the study period (Figure 42) The water level followed an annual pattern with water level highs in May and lows in February. The water level high in the spring of 2013 was about 3.5 ft. lower than the water level high in 2012.

The elevation of Queen Lucas Lake is approximately 2,130, though it does vary some during the year. The water level elevation in Well 295341 is both above an below the elevation of Queen Lucas Lake depending on time of year. Also, Minnie Creek, the outlet of Queen Lucas Lake, runs seasonally. Aerial photos taken during spring show that Minnie Creek has water, but those taken during the summer show no water in Minnie Creek. The relative elevations of Well 295341, Queen Lucas Lake, and Minnie Creek and the seasonal nature of the groundwater elevation and flow in Minnie Creek suggest a connection between the ground and surface water.

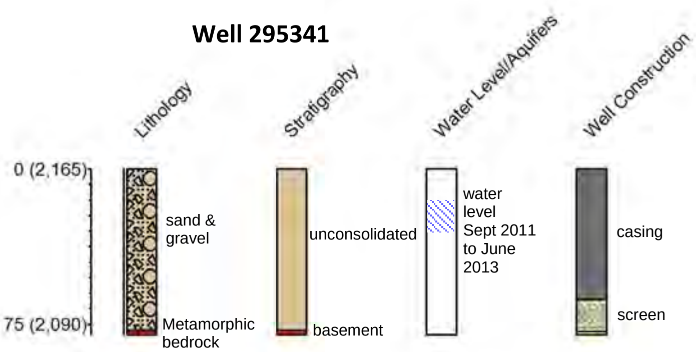


Figure 29: Well 295341 Strip Log

Well 472535

Well 472535 is located in what is often called the "Airport or Polo Grounds Paleodrainage." A paleodrainage, which is also called a paleochannel, is a channel that was incised into the basalt formations and then filled with unconsolidated materials, often sands and gravels. This well is a monitoring well. The water level elevation in this well varied between 2,115, and 2,126 ft. during the study period (Figure 43).

This well showed a similar pattern to the two other wells completed in the unconsolidated unit (Lincoln-Garfield Well, Well 295341); water level highs during the late spring/early summer and water level lows during the late winter. This pattern is the result of precipitation occurring during the winter months as snow onto frozen ground and then thawing during the spring and recharging the aquifer. Also during early spring there is limited evapotranspiration which allows the water to move through the soil to below the root zone. During the summer months precipitation is transpired or evaporated before it travels beyond the root zone. In addition to annual trends this well responded to both individual precipitation events and accumulated precipitation events, as shown in Figure 44.

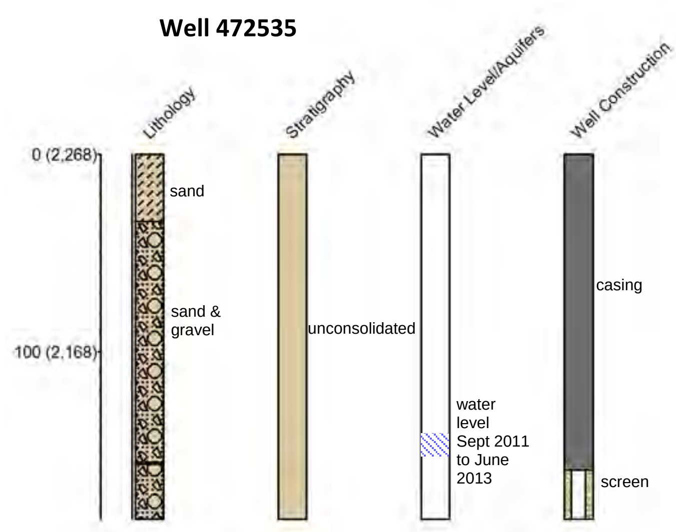


Figure 30: Well 472535 Strip Log

During the period between March 20, 2013 and April 17, 2013 there was a water level drop of approximately 4 ft. The drop is immediate, as is the return, and does not fit the data collected during the other parts of the study. Nothing out of the ordinary was encountered at any of the field visits, so it is unknown what caused the drop, but no conclusions were made based on the data during that period.

Well 617922

Well 617922 is a monitoring well completed in the Grande Ronde unit, though the water level elevation suggests that the well represents a composite of the potentiometric surface of both the Wanapum and Grande Ronde Units. It may be that the well construction allows water from both units to be expressed in this well, or that wells in the vicinity are creating the composite water level. This well is located in the central portion of the study area, approximately 1 mile northeast of a cluster of municipal supply wells that provide water for the City of Medical Lake, the City of Airway Heights, and Four Lakes Water District.

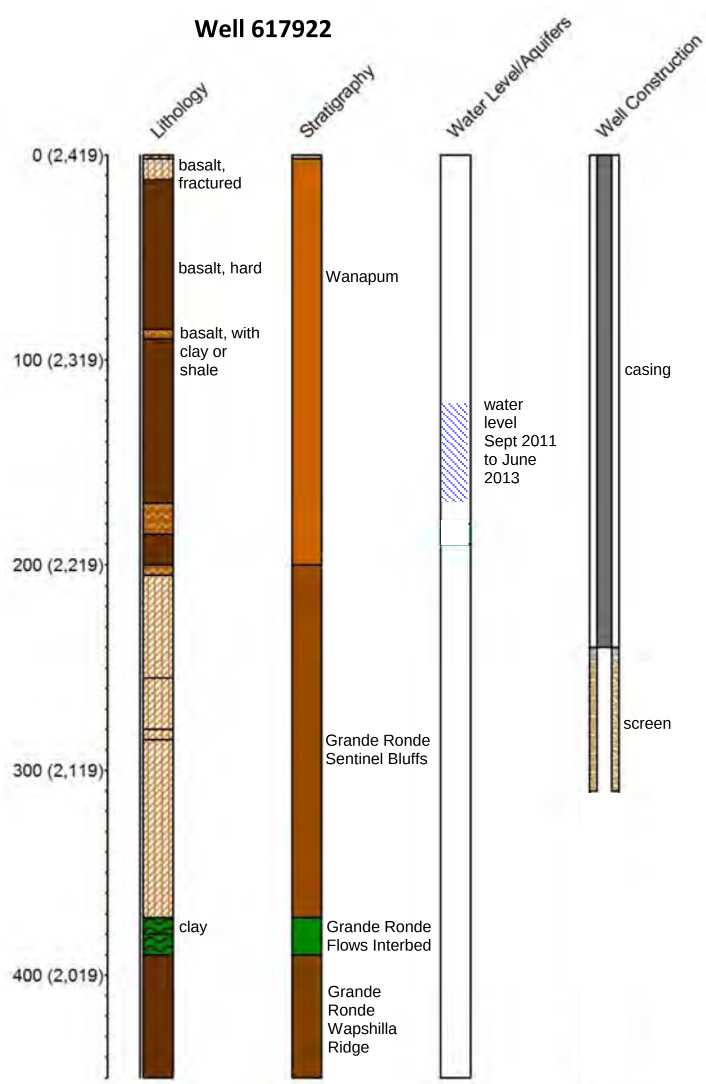


Figure 31: Well 617922 Strip Log

In recent years this area has been experiencing declining water levels, most notably in the Four Lakes Water District well along Craig Rd. As a result of the declining water levels an agreement was reached whereby the City of Airway Heights would reduce and eventually eliminate the use of their well located in this vicinity.

The water level elevation in this well varied from 2,251 to 2,297 during the study period (Figure 45). The water level appears to follow seasonal fluctuations, though it is not consistent between 2012 and 2013. In 2012 the water level high occurred at the end of June and in 2013 the trend indicates that the water level high was at the beginning of March. The water level lows in 2011 and 2012 occurred at the end of September. The water level elevation trend is likely a result of the municipal withdrawals in the vicinity, but it is difficult to determine the relationship since the data does not show a consistent year to year pattern and municipal withdrawals are changing as a result of Airway Heights reducing and eliminating their water withdrawals from their well in the vicinity.

Well 167912

Well 167912 is located in the central portion of the study area, and is completed in the Wanapum unit. It is 0.5 miles north of Well 617922. The well was drilled for domestic purposes but has not been used to date and no pump is installed. This well was originally drilled to 98 feet in July 1973, and deepened to 185 feet in May 1979.

The water level elevation varied between 2,337 and 2,344 during the study period (Figure 46). The water level appears to fluctuate sea-

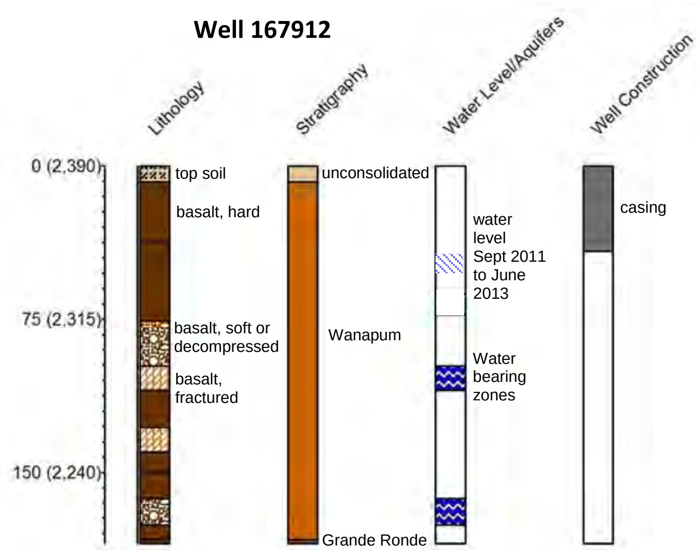


Figure 32: Well 167912 Strip Log

sonally, though not the same each year. In 2012 the water level high was in late July, while in 2013 it appears that the water level high may be in May. The pattern of water level fluctuations is similar in nature to Well 617922, though the range of fluctuation in Well 617922 is 44 ft. while in Well 167912 it is just 6 ft.

Summary and Conclusions

A groundwater elevation monitoring and mapping project was completed for the West Plains area of Spokane County, Washington. The project included groundwater elevation measurements from 124 wells at various frequencies including synoptic, monthly, and continuous between September 2011 and June 2013. The wells included public supply wells, domestic wells, and monitoring wells.

The purpose of the project was two fold: 1) collect, document, and organize groundwater elevation data to be used in future hydrogeologic analysis of the study area and long term water level trend monitoring, and 2) Use groundwater elevation data to develop groundwater elevation contours and evaluate changes in water levels over various time scales.

Key findings of the project include:

- The Wanapum aquifer is compartmentalized by incised creek valleys and surface and near-surface basement rock. Localized groundwater highs are created by recharge from the surface and near-surface basement rock .
- The Wanapum aquifer discharges to Deep Creek, Coulee Creek and seeps and springs within the study area.
- The Wanapum aquifer responds on a time scale of days and weeks to precipitation events during the early spring, but during late spring and summer precipitation is largely lost to evapotranspiration and does impact groundwater levels.
- The Grande Ronde aquifer is not impacted by the incised creek valleys and exhibits more lateral continuity throughout the study area. Recharge most likely occurs at the surface and near-surface basement structures but also comes from the overlying Wanapum and Unconsolidated units.
- The Grande Ronde aquifer on the east edge of the study area is in contact with the SVRP Aquifer-Spokane River system, and based on water level elevation is likely receiving water from the river and aquifer.
- Aquifers located in the unconsolidated and paleodrainage units are recharged from both precipitation and surface water features depending on their location. Those that are recharged from precipitation show a relatively quick response to precipitation events, while those that are recharged by infiltration from surface water features have a more constant increase and decrease in water level.
- There are many wells within the study area that are completed in multiple water bearing formations. This complicates the interpretation of groundwater elevation data because a well that is completed in multiple water bearing formations can represent a composite of the potentiometric surface of each aquifer it receives water from.

Figure 33
Lincoln-Garfield Rd. Well
Groundwater Elevation & Temperature September 2011 - June 2013

Figure 34
Well 172968
Groundwater Elevation & Temperature September 2011 - June 2013

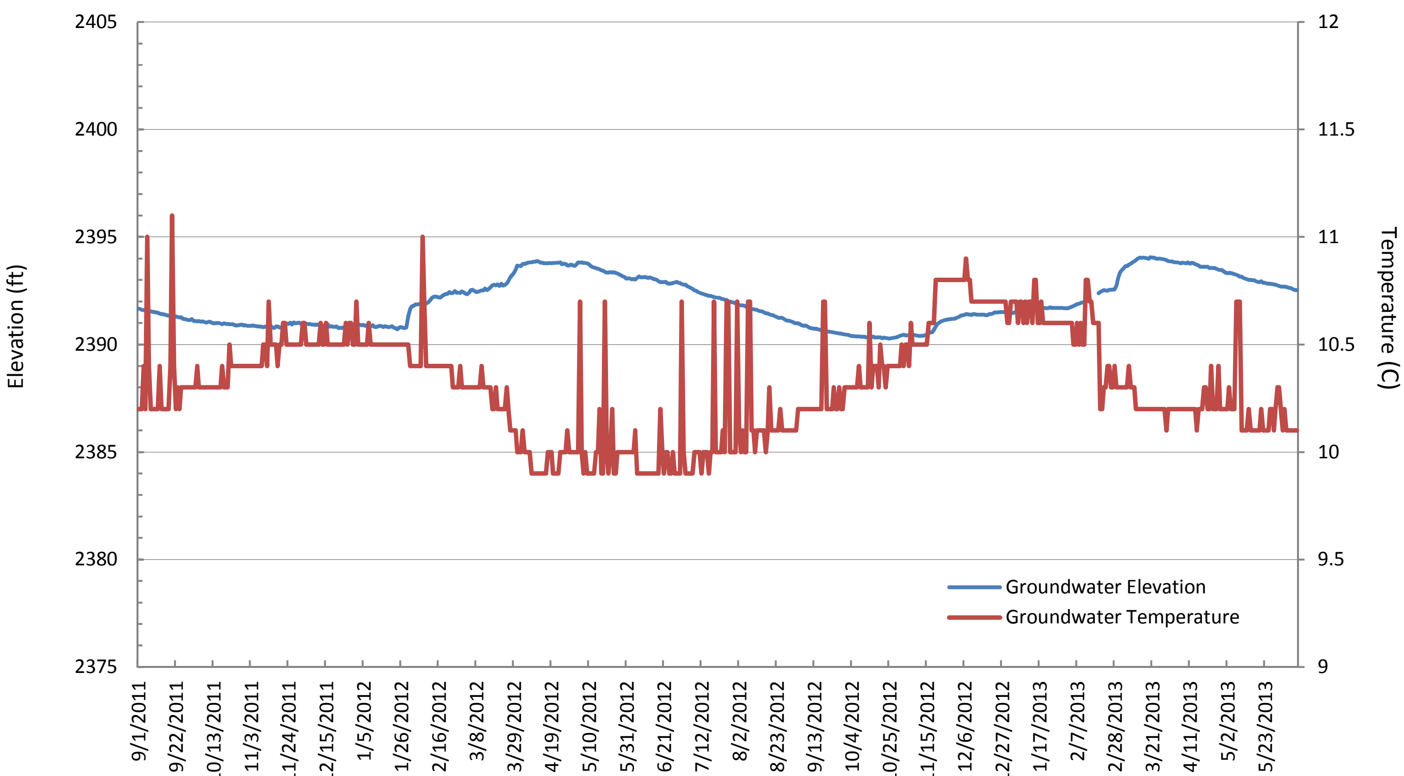


Figure 35

Well 172968

Groundwater Elevation & 7 day average precipitation 2011 - June 2013

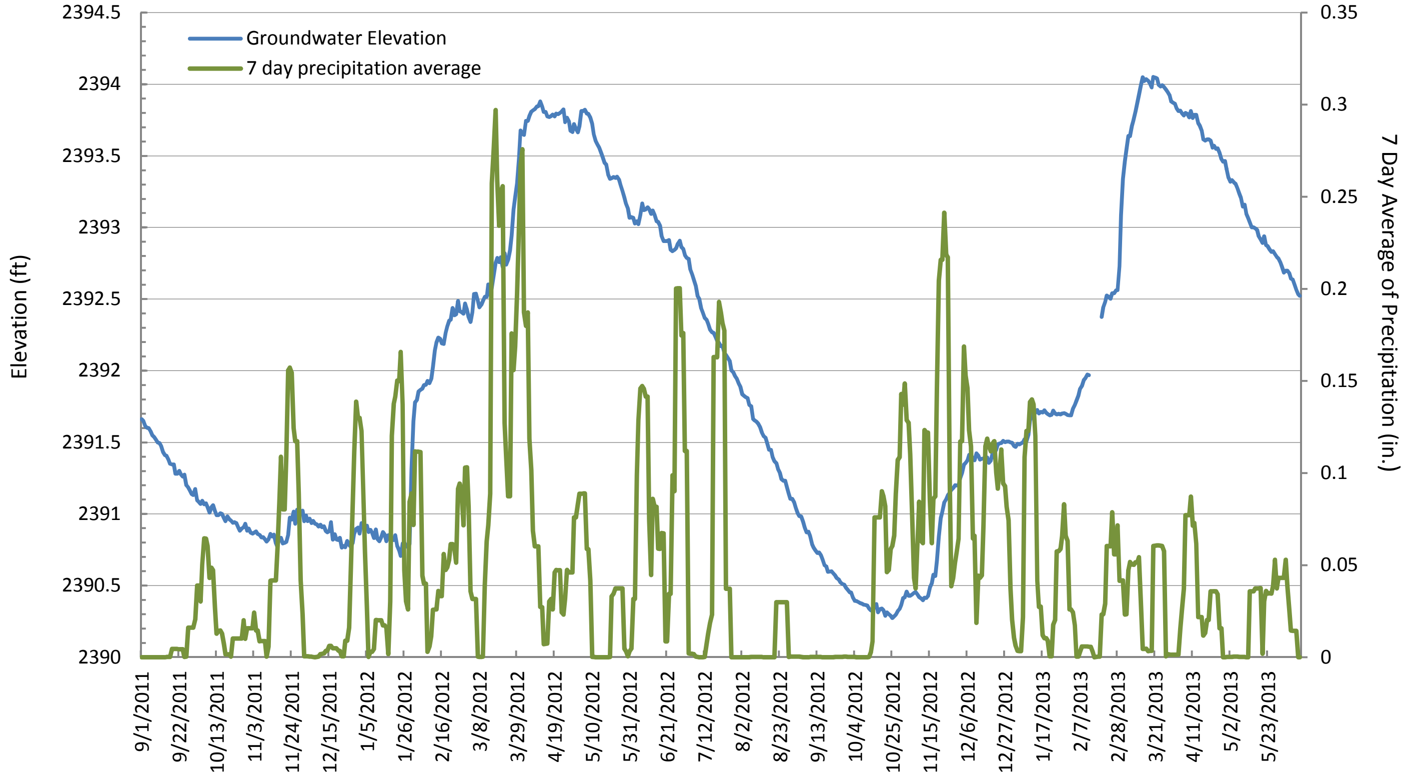


Figure 36

Well 439863

Groundwater Elevation & Temperature September 2011 - June 2013

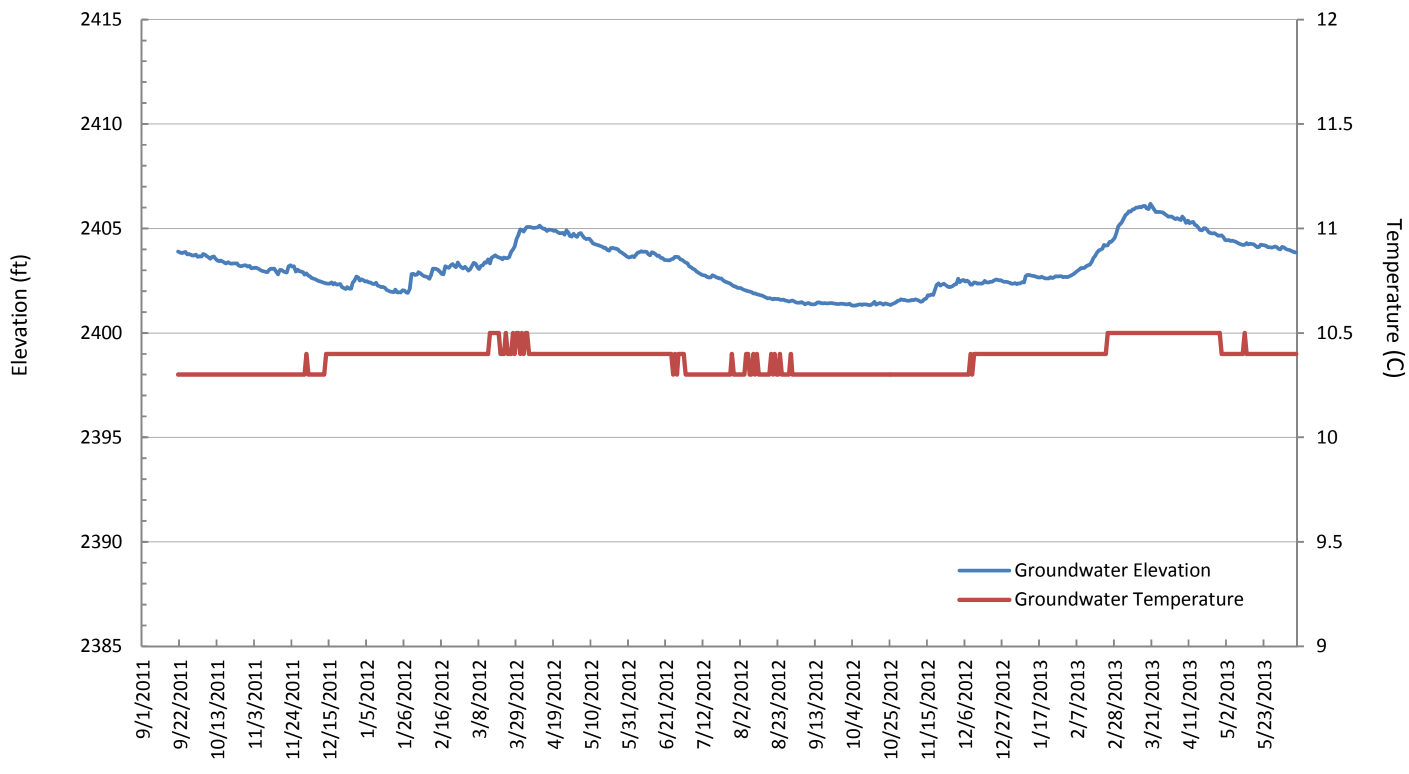


Figure 37

Well 439863

Groundwater Elevation & 7 day average precipitation 2011 - June 2013

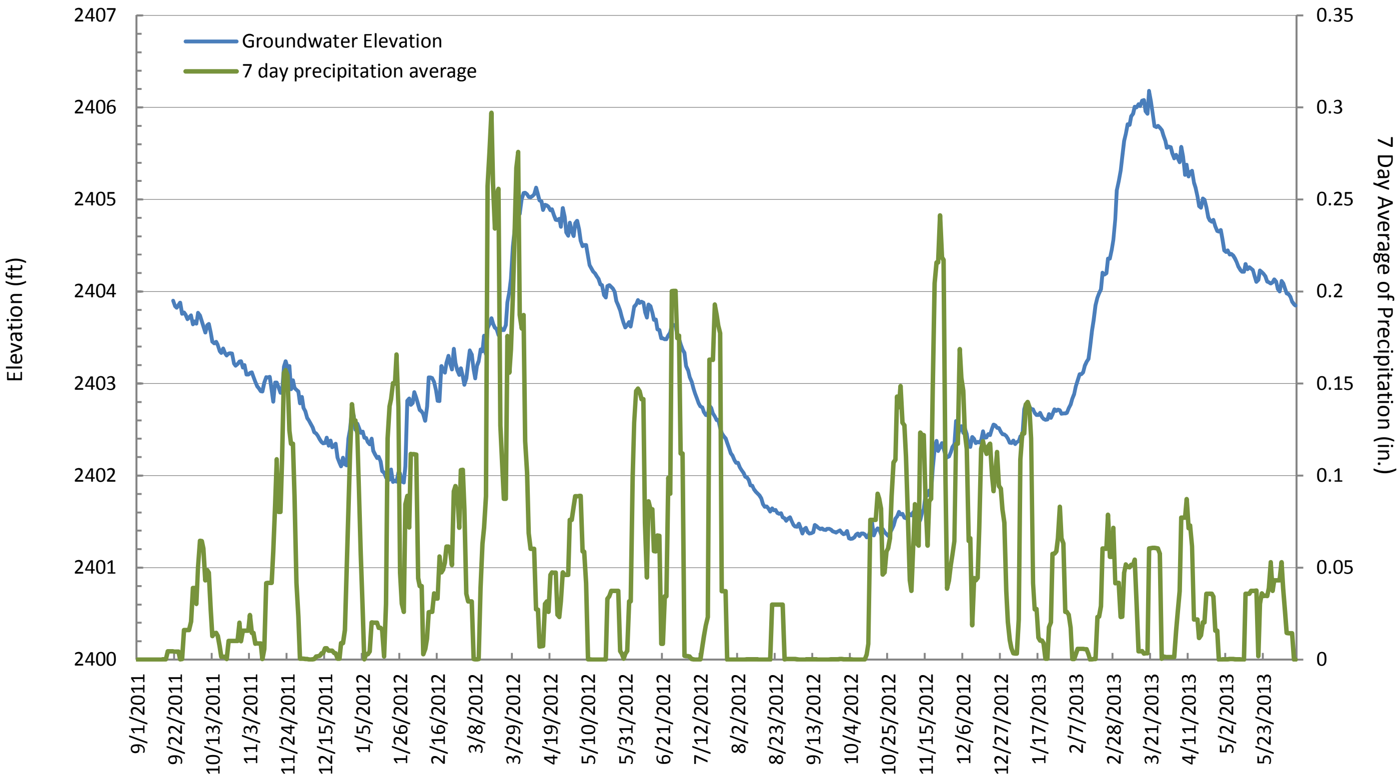


Figure 38

Four Lakes Water District - School Well

Groundwater Elevation & Temperature September 2011 - June 2013

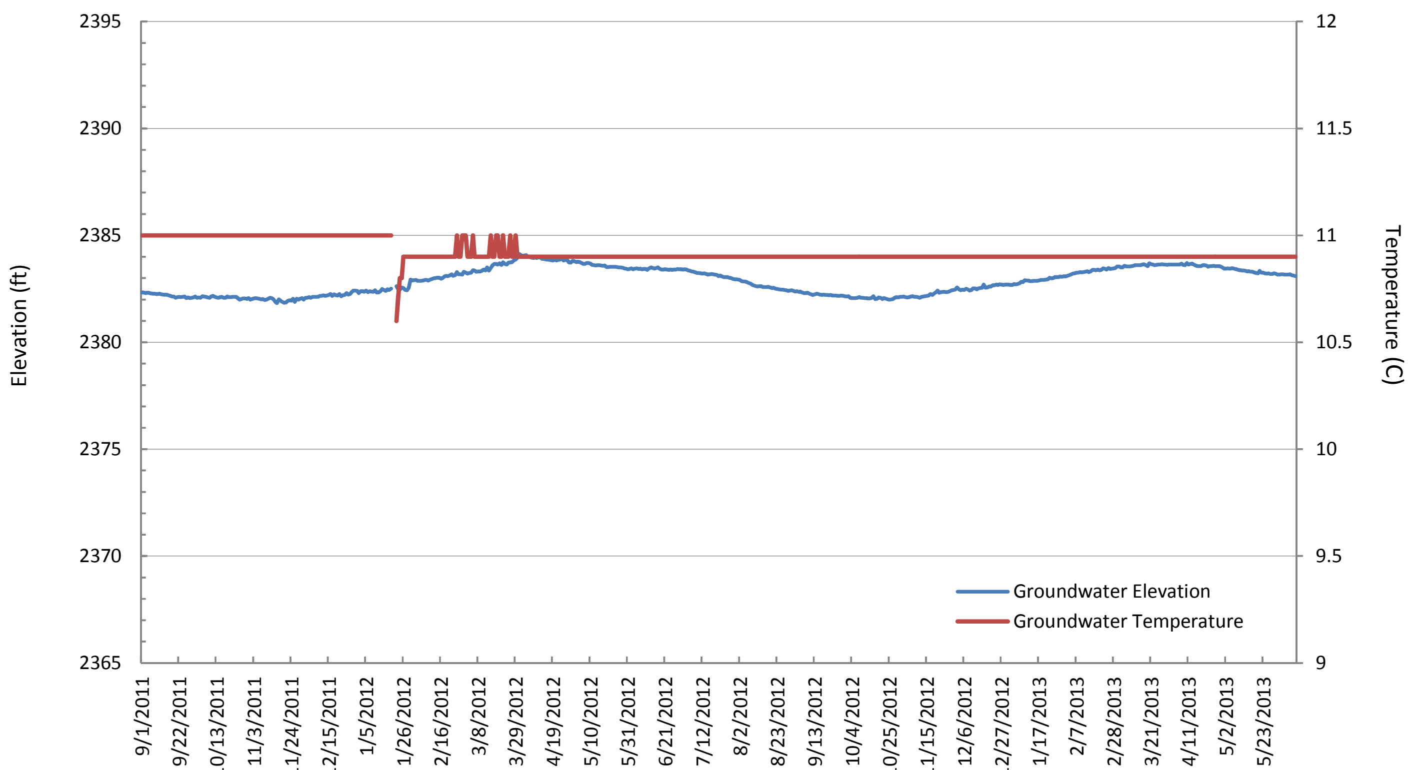


Figure 39
Well 411175
Groundwater Elevation & Temperature September 2011 - June 2013

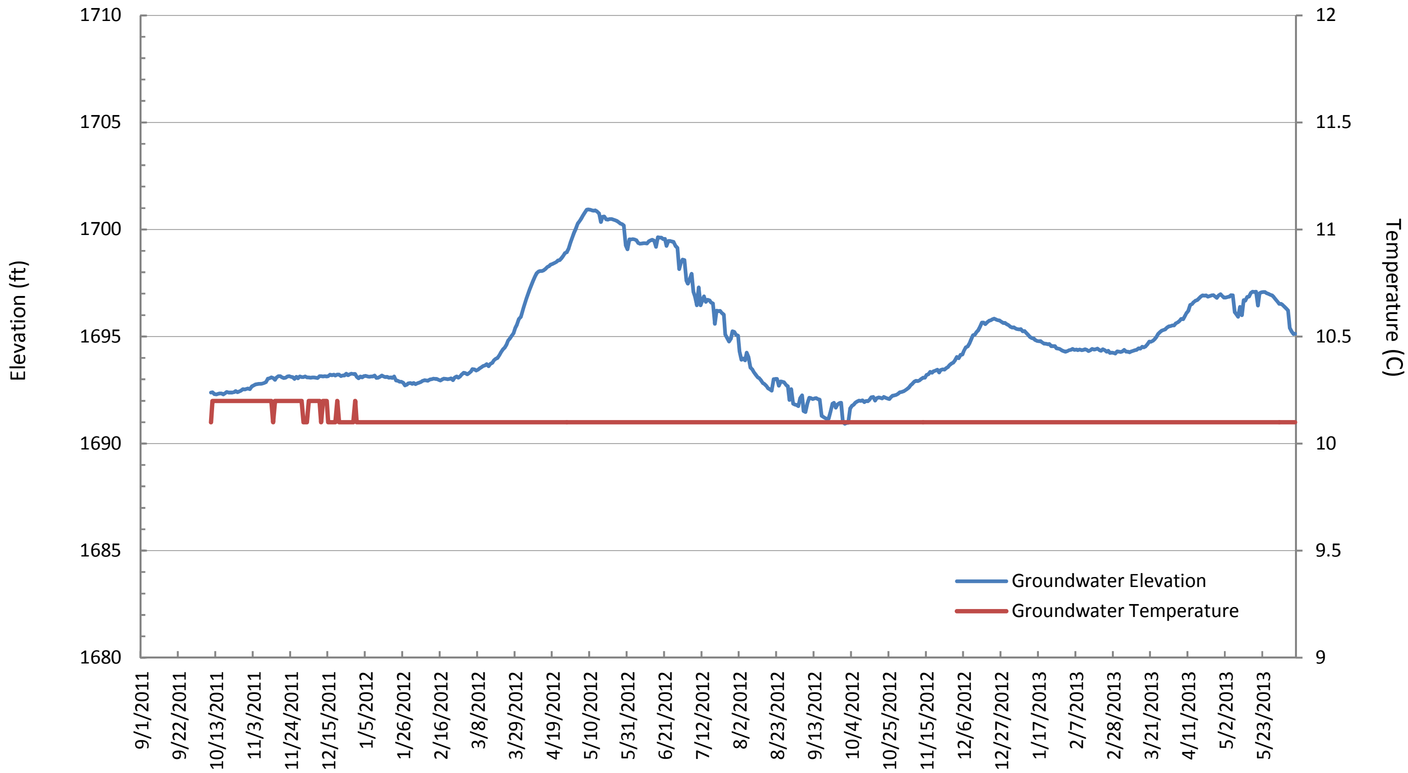


Figure 40
Well 411175
Spokane River Elevation and Groundwater Elevation September 2011 - June 2013

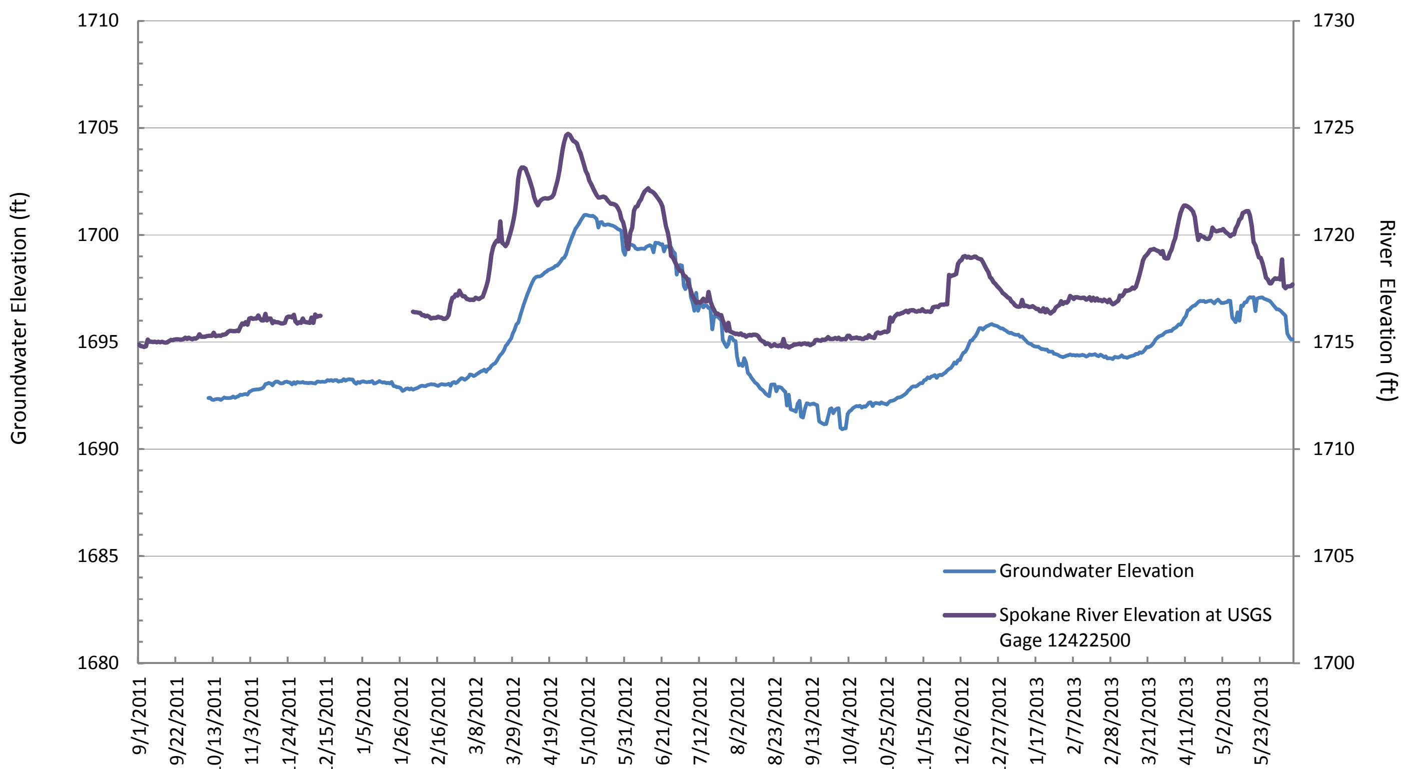


Figure 41
Well 164270
Groundwater Elevation & Temperature September 2011 - June 2013

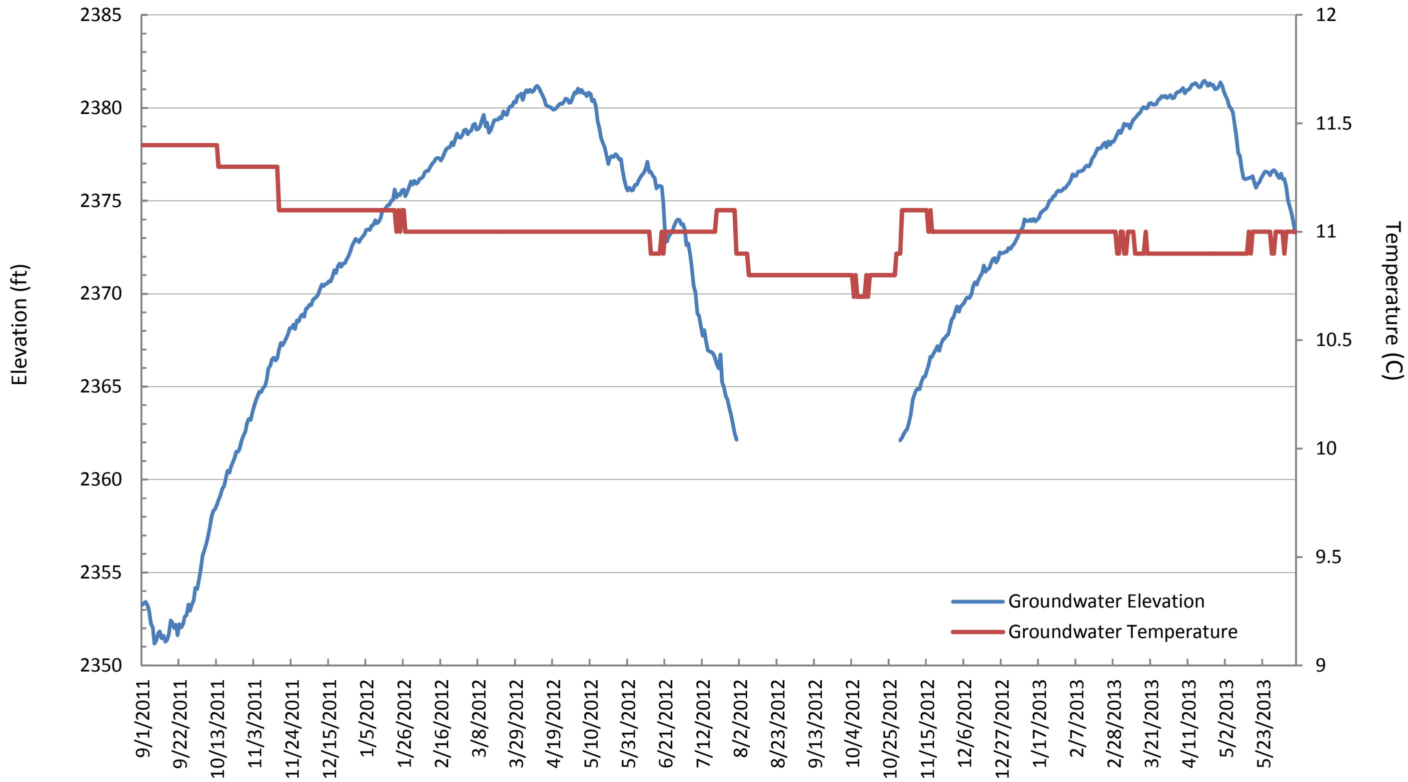


Figure 42
Well 295341
Groundwater Elevation & Temperature September 2011 - June 2013

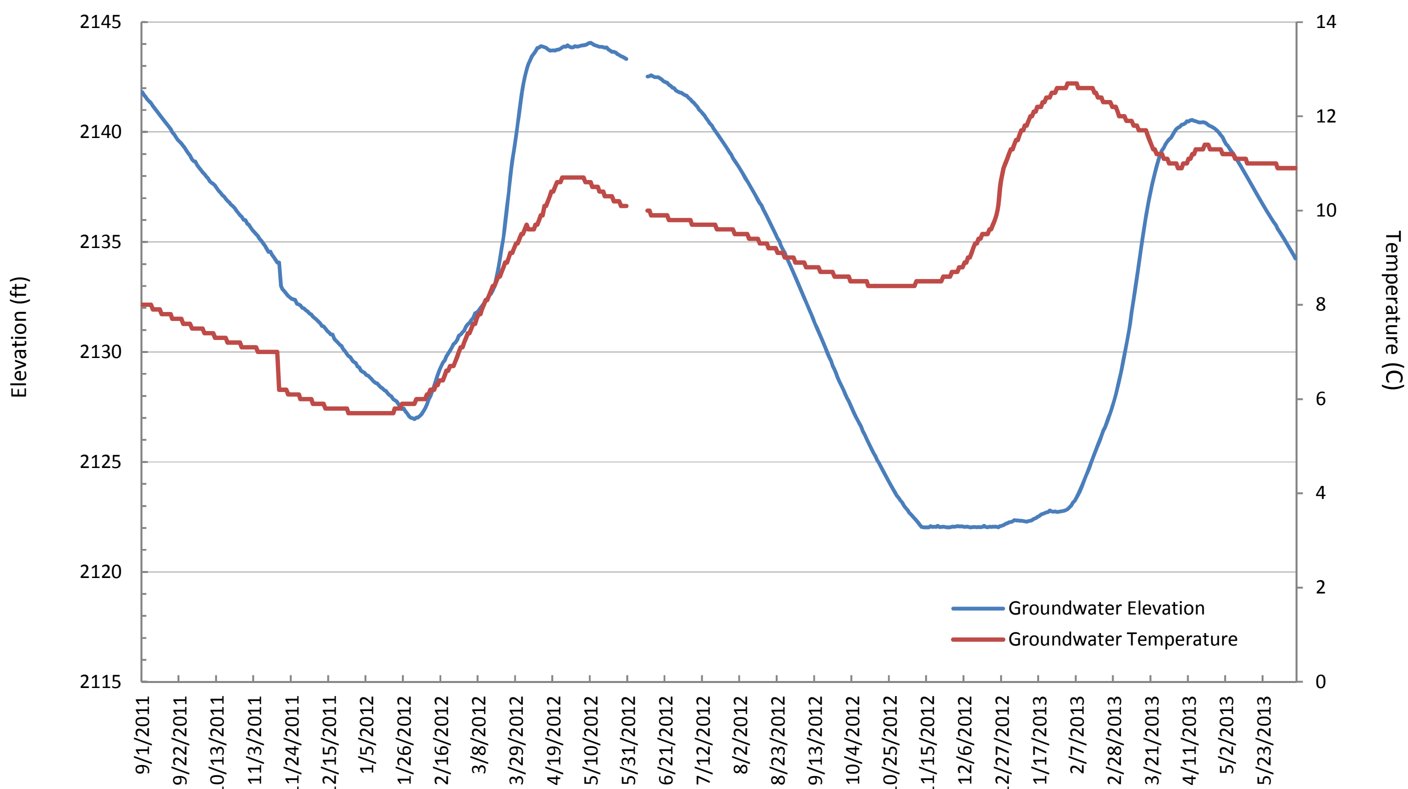


Figure 43
Well 472535
Groundwater Elevation & Temperature September 2011 - June 2013

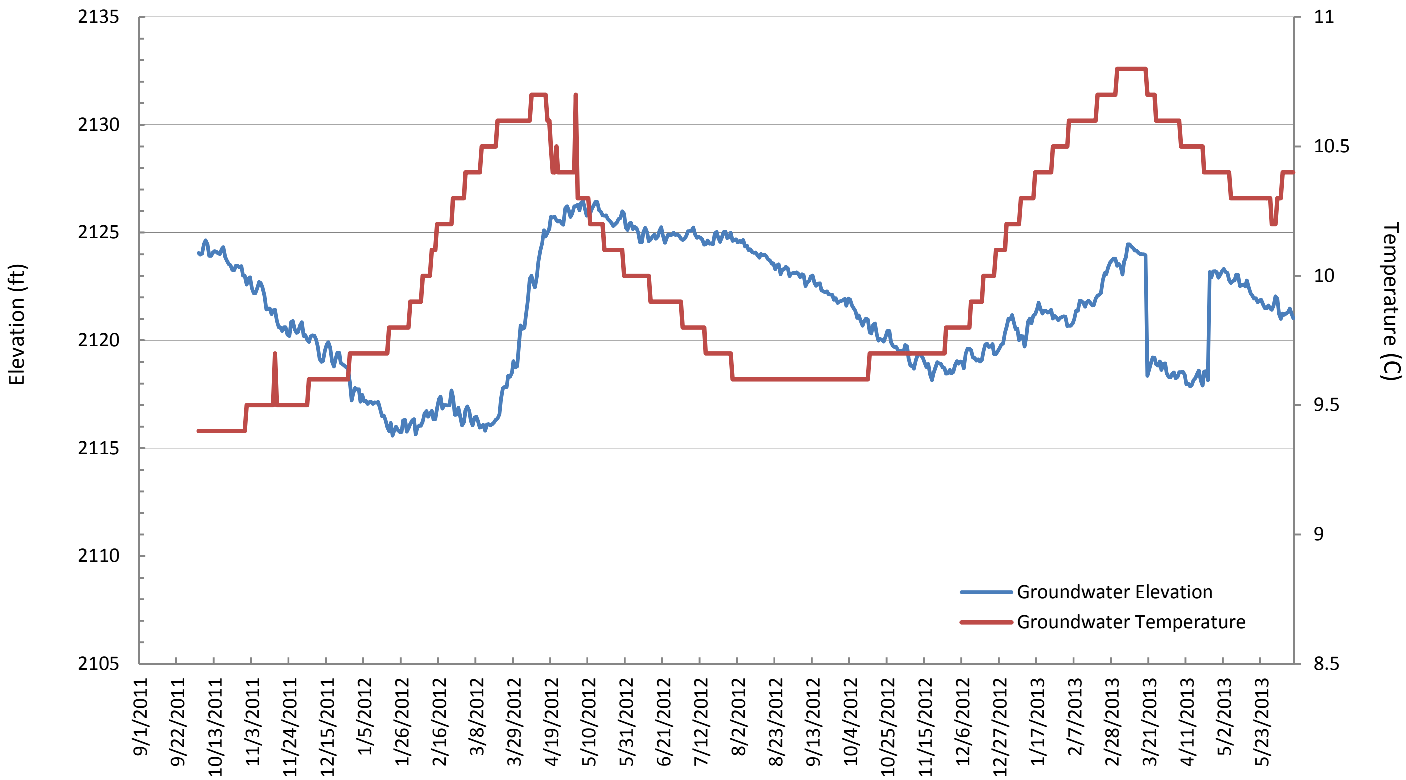


Figure 44
Well 472535
Groundwater Elevation & 7 day average precipitation 2011 - June 2013

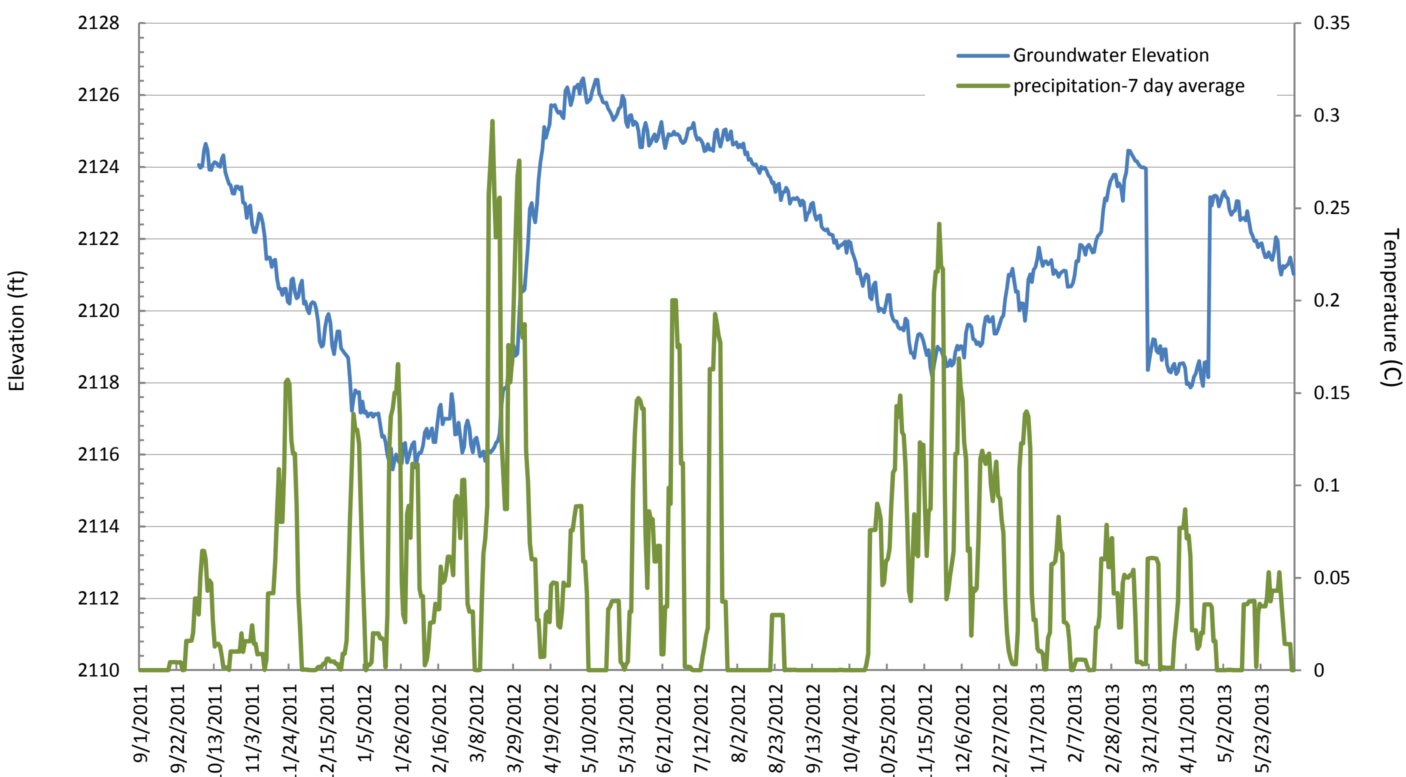


Figure 45

Well 617922

Groundwater Elevation & Temperature September 2011 - June 2013

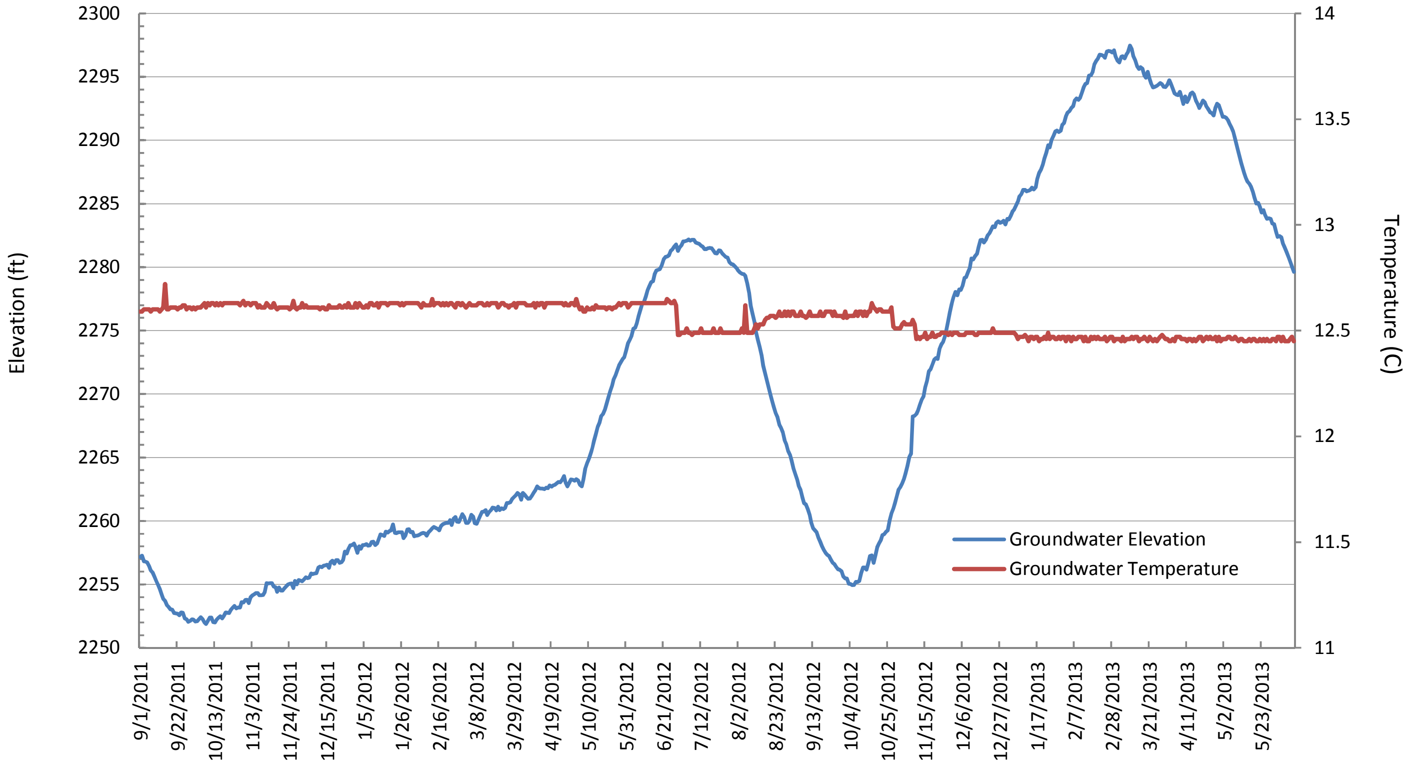
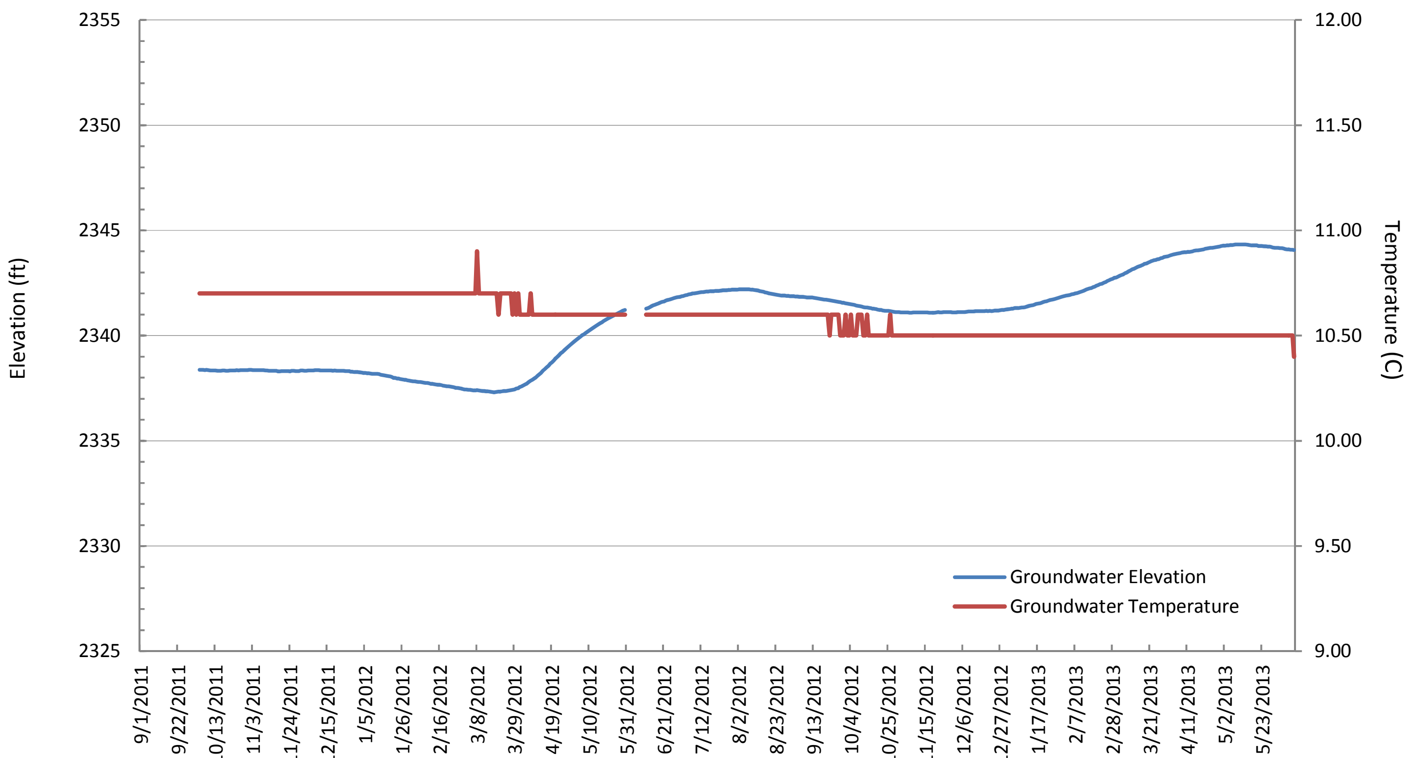


Figure 46

Well 167912 (165941)

Groundwater Elevation & Temperature September 2011 - June 2013



References

Burns, E.R., Morgan, D.S., Peavler, R.S., and Kahle, S.C., 2011, Three-dimensional model of the geologic framework for the Columbia Plateau Regional Aquifer System, Idaho, Oregon, and Washington: U.S. Geological Survey Scientific Investigations Report 2010-5246, 44 p.

Burns, E.R, Snyder, D.T, Haynes, J.V., and Waibel, M.S., 2012, Groundwater status and trends for the Columbia Plateau Regional Aquifer System, Washington, Oregon, and Idaho: U.S. Geological Survey Scientific Investigations Report 2012-5261, 52 p.

Deobald, W.B. and Buchanan, J.P., 1995, Hydrogeology of the West Plains Area of Spokane County, Washington: Report Prepared for the Spokane County Water Quality Management Program, 111 p.

GeoEngineers, 2009, Quality Assurance Project Plan for the Paleochannel Water Quality Monitoring Study Water Resource Inventory Area (WRIA) 54 , 35 p.

Kahle, S.C., and Bartolino, J., 2007, Hydrogeologic framework and water budget of the Spokane Valley-Rathdrum Prairie Aquifer, Spokane County, Washington and Bonner and Kootenai Counties, Idaho: U.S. Geological Survey Scientific Investigations Report 2007-5041, 48 p

Kahle, S.C., Morgan, D.S., Welch, W.B., Ely, D.M., Hinkle, S.R., Vaccaro, J.J., and Orzol, L.L., 2011, Hydrogeologic framework and hydrologic budget components of the Columbia Plateau Regional Aquifer System, Washington, Oregon, and Idaho: U.S. Geological Survey Scientific Investigations Report 2011-5124, 66 p.

McCollum, L.B., McCollum, M.B., Hamilton, M.M., and Pritchard, C.J. 2013. Mesoproterozoic and Cambrian Geology of the Northeastern Columbia Plateau of Washington—A View from the Steptoes. (in press)

Northwest Land and Water, 2012, West Plains (WRIA 54) & Lower Hangman Creek Watershed (WRIA 56) Hydrogeologic Characterization & Monitoring Well Drilling Final Report. 20 p.

Northwest Land and Water, 2013, Letter Memorandum to Rick Noll, Spokane Conservation District Re: Addendum to June 2012 West Plains and L. Hangman Ck Hydrogeologic Study, variously paginated.

Pritchard, C.J., 2013, Subsurface Projection of the Stratigraphy of the Columbia River Basalt Group and Paleodrainages in the West Plains Area, variously paginated

Spokane County Water Resources, 2011, Quality Assurance Project Plan for West Plains Groundwater Elevation Study, 26 p.

Spokane County Water Resources, 2013, West Plains Hydrogeology: Deep Creek and Coulee Creek Groundwater/Surface Water Interaction, 8 p.

Taylor, C.J., Alley, W.M., 2001, Ground-water-level monitoring and the importance of long-term water-level data: U.S. Geological Survey Circular 1217, 67 p.

Tetra Tech, 2007, Water Resource Inventory Area 54 (Lower Spokane) Watershed Plan Phase 2, Level 1 Data Compilation and Technical Assessment, variously paginated.

Tetra Tech, 2010, WRIA 54-Lower Spokane Watershed Detailed Implementation Plan, variously paginated.

Vaccaro, J.J., Jones, M.A., Ely, D.M., Keys, M.E., Olsen, T.D., Welch, W.B., and Cox, S.E., 2009, Hydrogeologic framework of the Yakima River basin aquifer system, Washington: U.S. Geological Survey Scientific Investigations Report 2009–5152, 106 p.

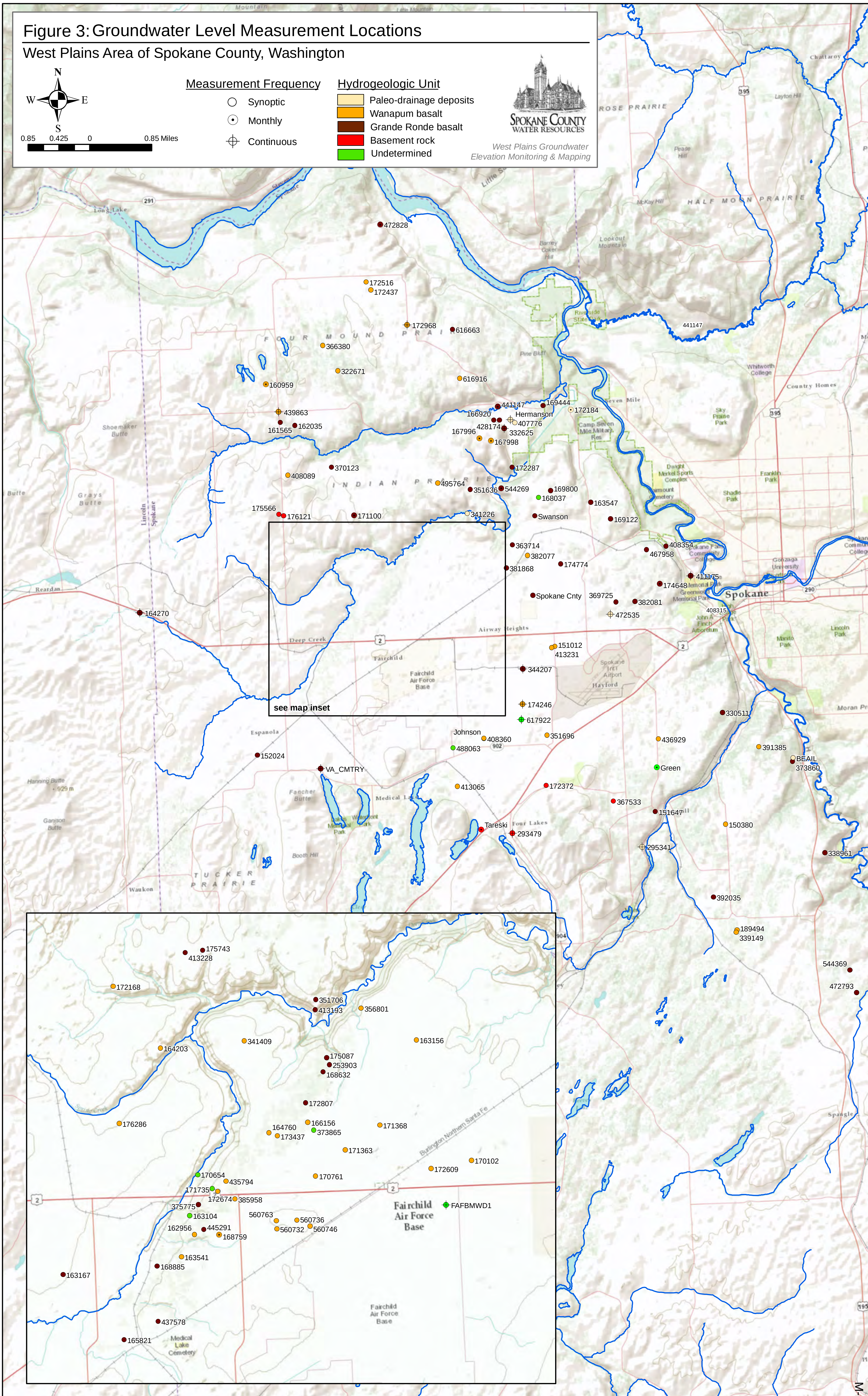


Figure 3: Groundwater Level Measurement Locations
West Plains Area of Spokane County, Washington
N
W
E
S
0.85
0.425
0
0.85 Miles
Measurement Frequency
Synoptic
Monthly
Continuous
Hydrogeologic Unit
Paleo-drainage deposits
Wanapum basalt
Grande Ronde basalt
Basement rock
Undetermined
SPOKANE COUNTY
WATER RESOURCES
West Plains Groundwater
Elevation Monitoring & Mapping
472828
172516
172437
172968
616663
366380
322671
160959
616916
439863
161565
162035
441147
169444
166920
Hermanson
172184
407776
428174
167996
332625
167998
370123
408089
172287
495764
351636
544269
169800
168037
163547
175566
176121
171100
341226
Swanson
169122
363714
382077
381868
174774
408354
467958
411175
174648
Spokane Cnty
369725
382081
472535
164270
151012
413231
344207
174246
617922
Johnson
408360
488063
351696
330511
436929
391385
152024
VA_CMTRY
Green
BEAIL
373860
413065
172372
367533
151647
Tareski
293479
150380
295341
338961
392035
189494
339149
544369
472793
see map inset
Spokane
175743
413228
172168
351706
413193
356801
341409
163156
164203
175087
253903
168632
172807
176286
164760
166156
373865
173437
171368
171363
170654
435794
170761
172609
170102
171735
172674
385958
375775
163104
560763
560736
560732
560746
FAFBMWD1
162956
445291
168759
163541
168885
163167
437578
165821
Fairchild Air Force Base

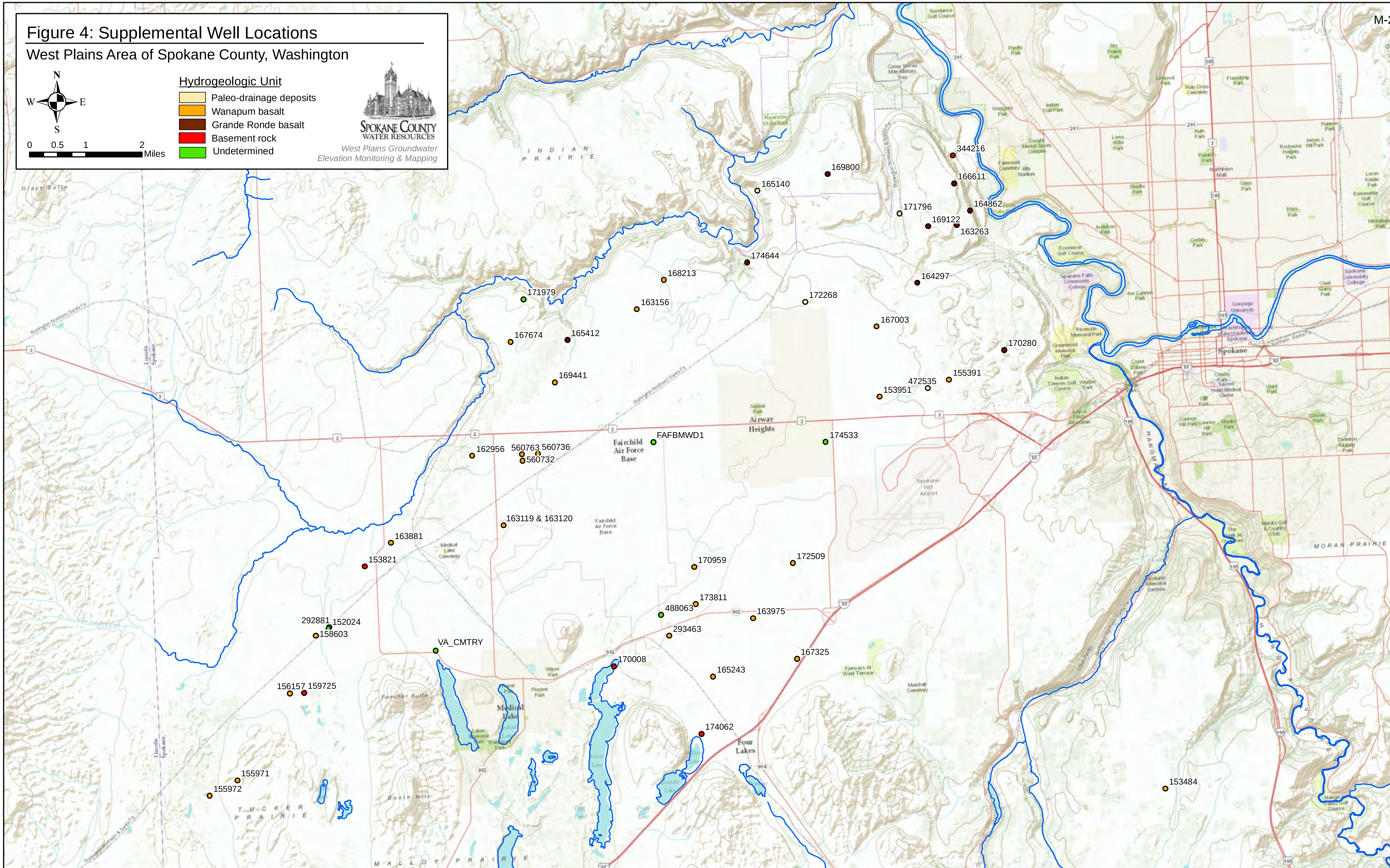
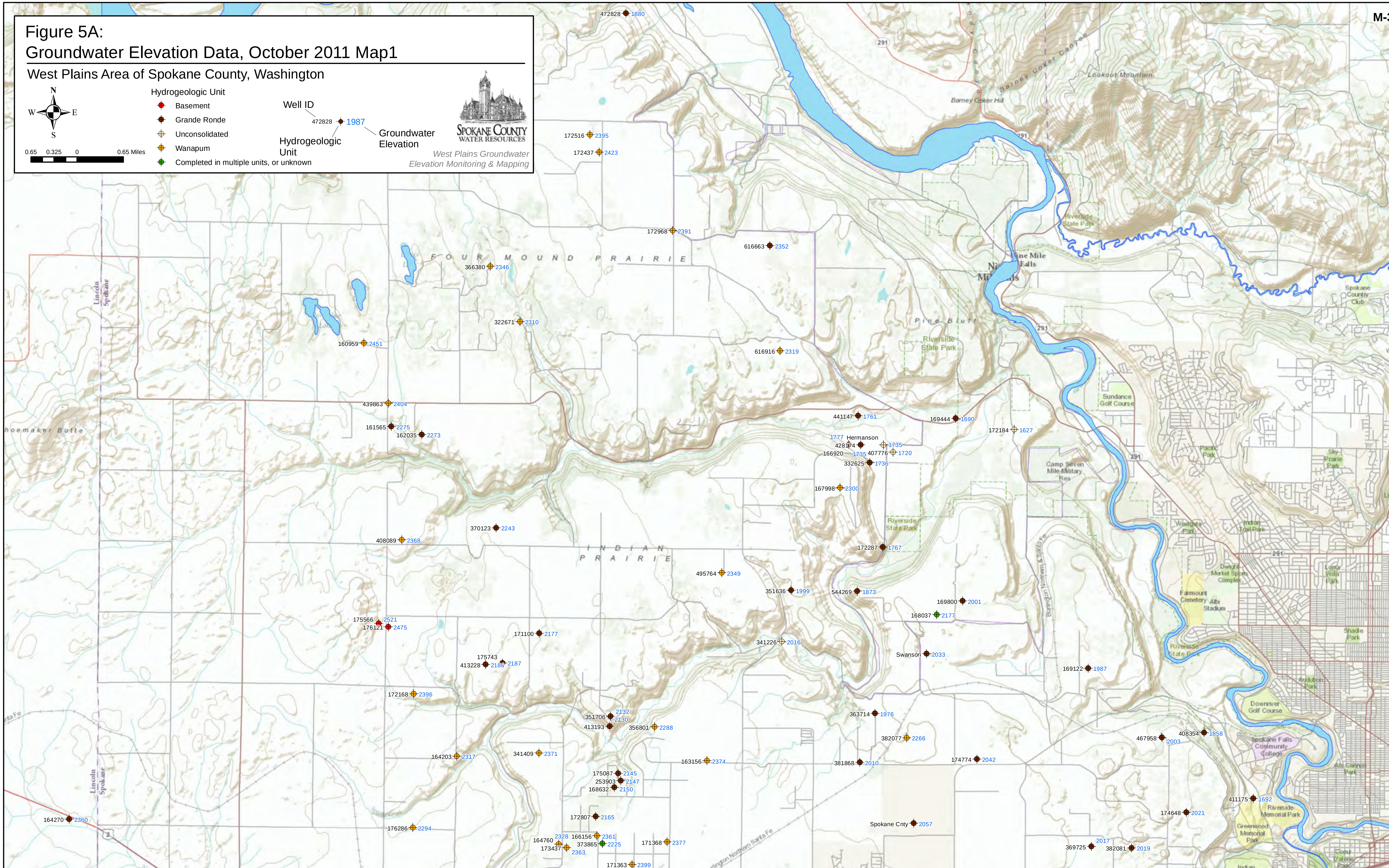
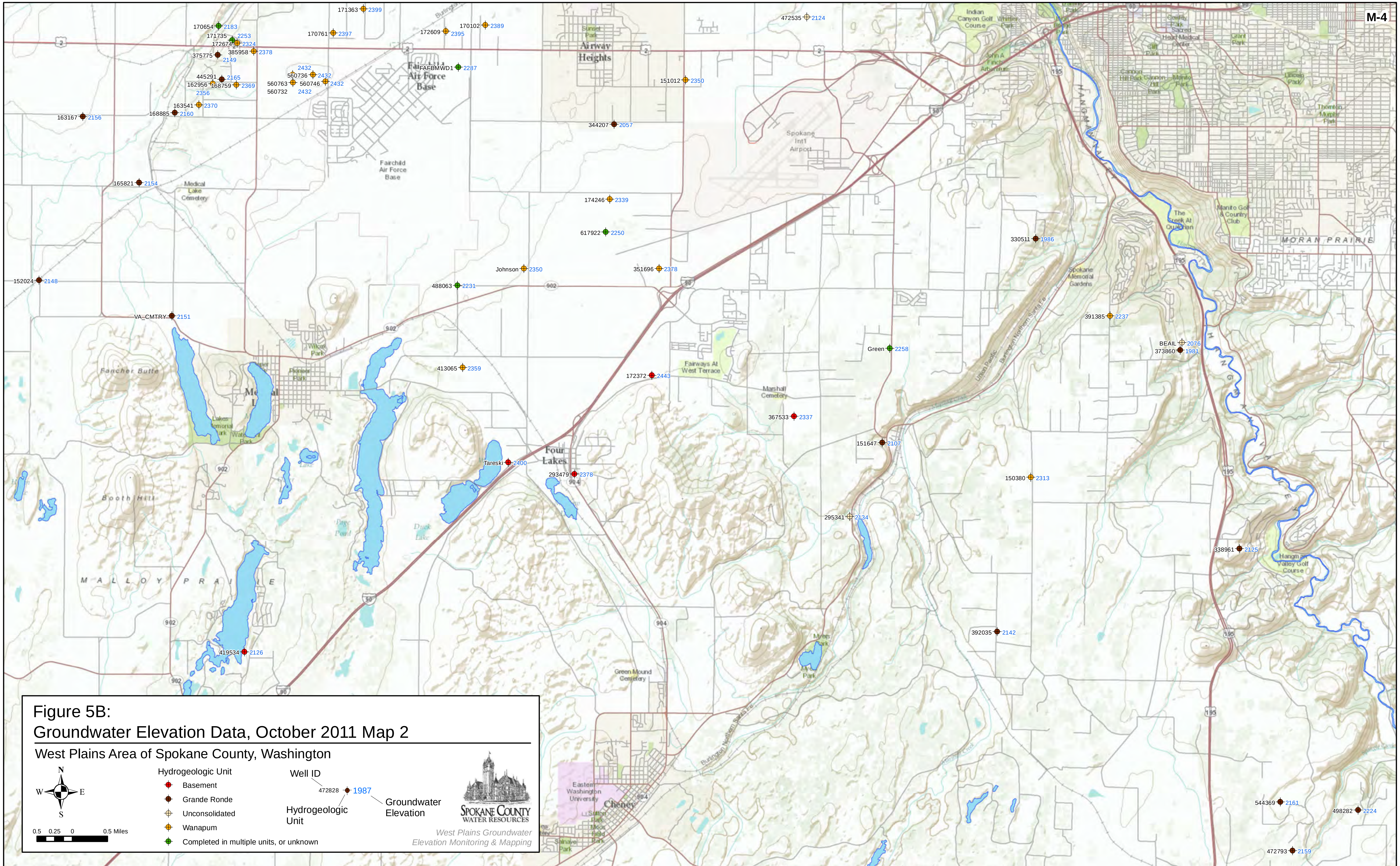


Figure 4: Supplemental Well Locations
West Plains Area of Spokane County, Washington
N
W
E
S
0 0.5 1 2 Miles
Hydrogeologic Unit
Paleo-drainage deposits
Wanapum basalt
Grande Ronde basalt
Basement rock
Undetermined
SPOKANE COUNTY
WATER RESOURCES
West Plains Groundwater
Elevation Monitoring & Mapping
344216
169800
166611
165140
171796
164862
169122
163263
174644
168213
164297
172268
171979
163156
167003
167674
165412
170280
169441
155391
472535
153951
FAFBMWD1
174533
162956
560763
560736
560732
163119 & 163120
163881
153821
170959
172509
173811
488063
163975
292881
152024
158603
293463
VA_CMTRY
167325
170008
165243
156157
159725
174062
155971
155972
153484
Airway Heights
Fairchild Air Force Base
Spokane
Medical Lake
Four Lakes
INDIAN PRAIRIE
TUCKER PRAIRIE
MALLOY PRAIRIE
MORAN PRAIRIE



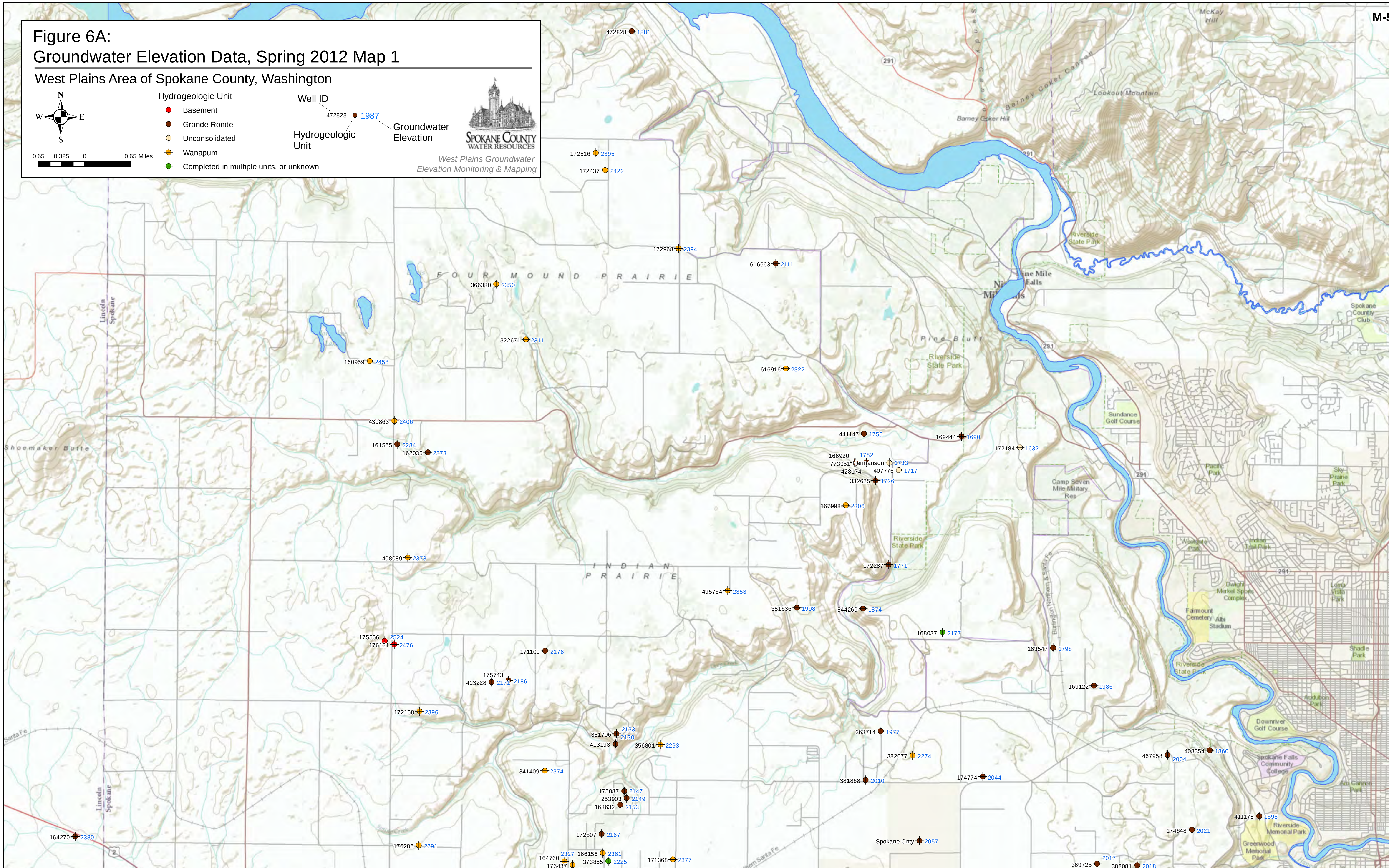
M-3
Figure 5A:
Groundwater Elevation Data, October 2011 Map1
West Plains Area of Spokane County, Washington
Hydrogeologic Unit
Basement
Grande Ronde
Unconsolidated
Wanapum
Completed in multiple units, or unknown
Well ID
472828 1987
Groundwater Elevation
Hydrogeologic Unit
0.65 0.325 0 0.65 Miles
N
S
E
W
SPOKANE COUNTY WATER RESOURCES
West Plains Groundwater Elevation Monitoring & Mapping
FOUR MOUND PRAIRIE
INDIAN PRAIRIE
Shoemaker Butte
Lincoln Spokane
Nine Mile Falls
Riverside State Park
Pine Bluff
Sundance Golf Course
Camp Seven Mile Military Res
Hermanson
Swanson
Spokane Cnty
Lookout Mountain
Barney Coker Hill
Spokane Country Club
Downriver Golf Course
Spokane Falls Community College
Riverside Memorial Park
Greenwood Memorial Park
Fairmount Cemetery
Albi Stadium
Indian Trail Park
Burlington Northern Santa Fe
472828 1880
172516 2395
172437 2423
172968 2391
616663 2352
366380 2346
322671 2310
160959 2451
616916 2319
439863 2404
161565 2275
162035 2273
441147 1761
169444 1690
172184 1627
1777
428174
166920 1735
407776 1720
1735
332625 1736
167998 2300
370123 2243
408089 2368
172287 1767
495764 2349
351636 1999
544269 1873
169800 2001
168037 2177
175566 2521
176121 2475
171100 2177
341226 2016
175743 2187
413228 2186
Swanson 2033
169122 1987
172168 2396
351706 2132
2130
413193
356801 2288
363714 1976
382077 2266
408354 1858
467958 2003
164203 2317
341409 2371
163156 2374
381868 2010
174774 2042
175087 2145
253903 2147
168632 2150
411175 1692
174648 2021
164270 2360
176286 2294
172807 2165
Spokane Cnty 2057
164760 2328
166156 2361
373865 2225
173437 2363
171368 2377
369725 2017
382081 2019
171363 2399
472535 2124

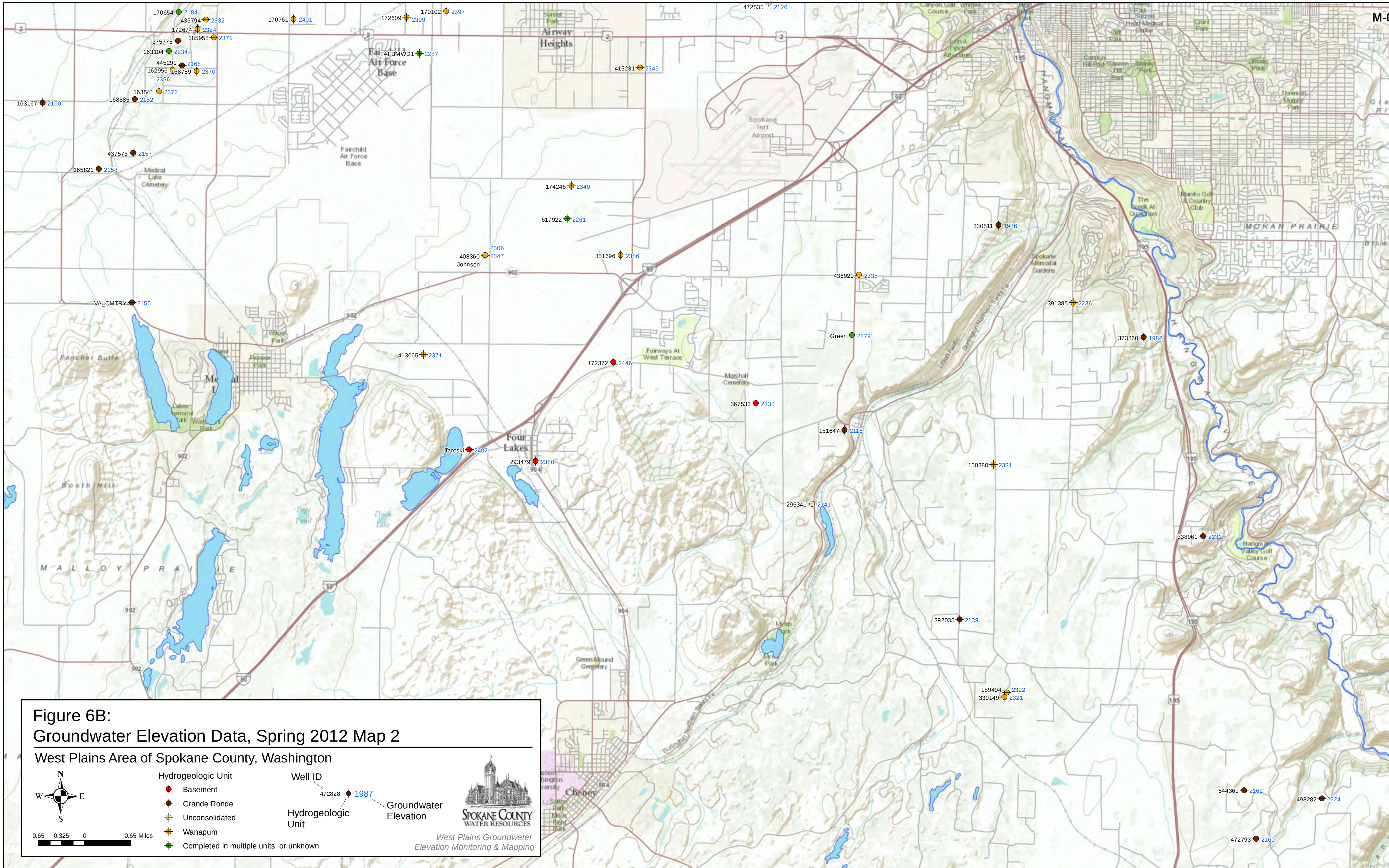

M-4
Figure 5B:
Groundwater Elevation Data, October 2011 Map 2
West Plains Area of Spokane County, Washington
Hydrogeologic Unit
Basement
Grande Ronde
Unconsolidated
Wanapum
Completed in multiple units, or unknown
Well ID
472828
1987
Hydrogeologic Unit
Groundwater Elevation
0.5 0.25 0 0.5 Miles
Spokane County Water Resources
West Plains Groundwater Elevation Monitoring & Mapping

M-5

Figure 6A:
Groundwater Elevation Data, Spring 2012 Map 1

West Plains Area of Spokane County, Washington




M-6
Figure 6B:
Groundwater Elevation Data, Spring 2012 Map 2
West Plains Area of Spokane County, Washington
Hydrogeologic Unit
Basement
Grande Ronde
Unconsolidated
Wanapum
Completed in multiple units, or unknown
Well ID
472828
1987
Groundwater Elevation
Hydrogeologic Unit
0.65 0.325 0 0.65 Miles
Spokane County Water Resources
West Plains Groundwater Elevation Monitoring & Mapping

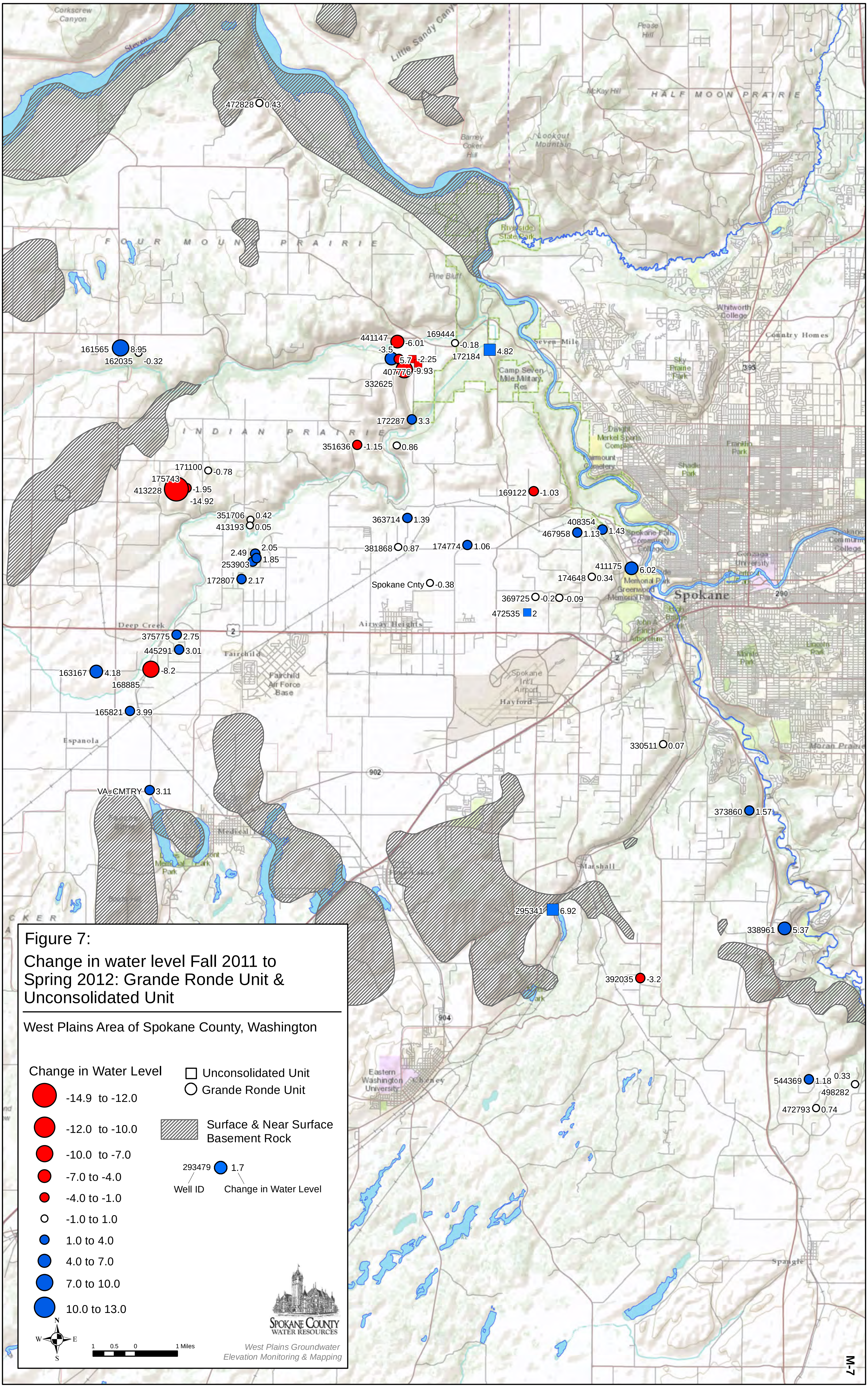


Figure 7:
Change in water level Fall 2011 to Spring 2012: Grande Ronde Unit & Unconsolidated Unit
West Plains Area of Spokane County, Washington
Change in Water Level
-14.9 to -12.0
-12.0 to -10.0
-10.0 to -7.0
-7.0 to -4.0
-4.0 to -1.0
-1.0 to 1.0
1.0 to 4.0
4.0 to 7.0
7.0 to 10.0
10.0 to 13.0
Unconsolidated Unit
Grande Ronde Unit
Surface & Near Surface Basement Rock
293479 1.7
Well ID
Change in Water Level
Spokane County Water Resources
West Plains Groundwater Elevation Monitoring & Mapping
M-7

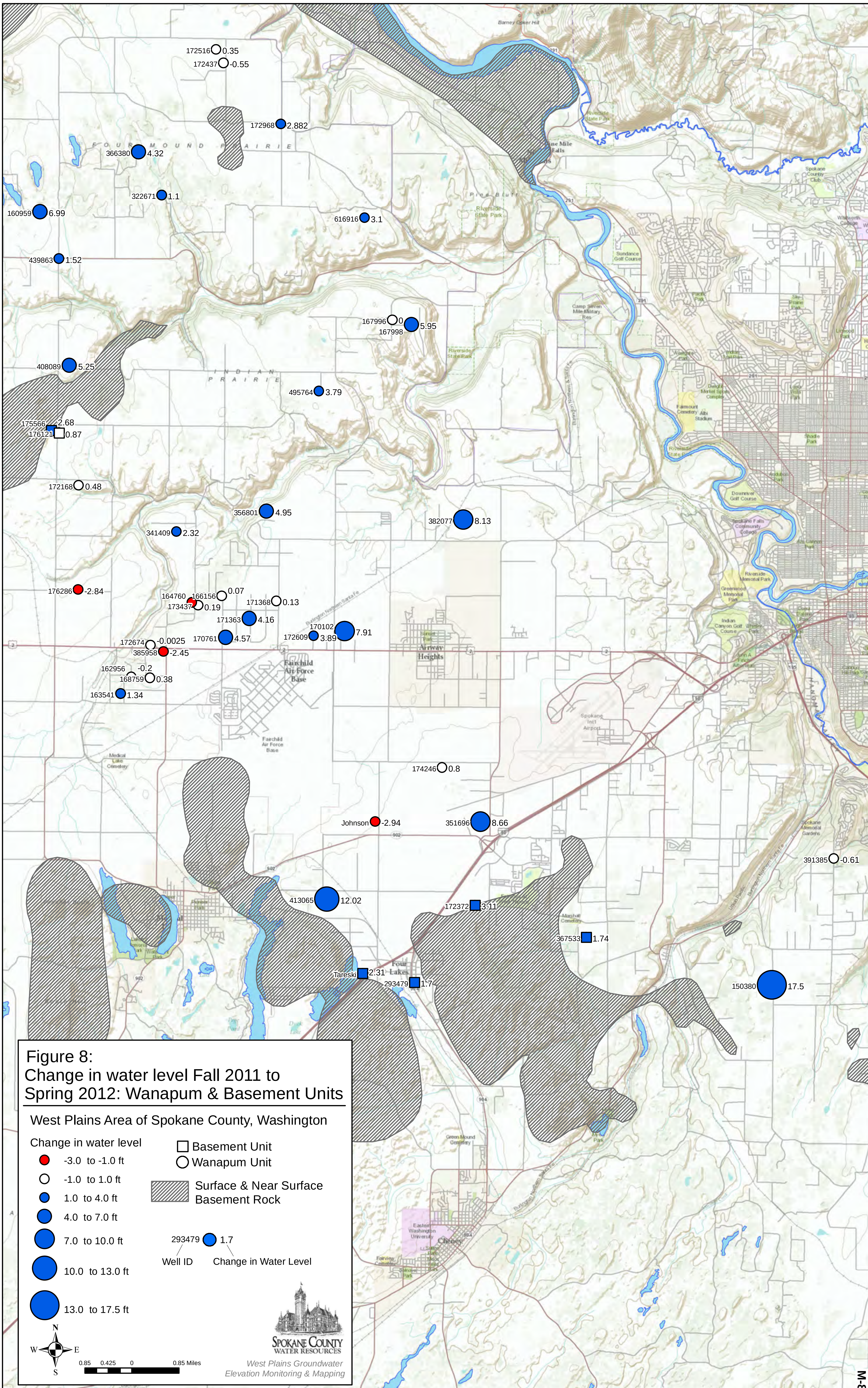
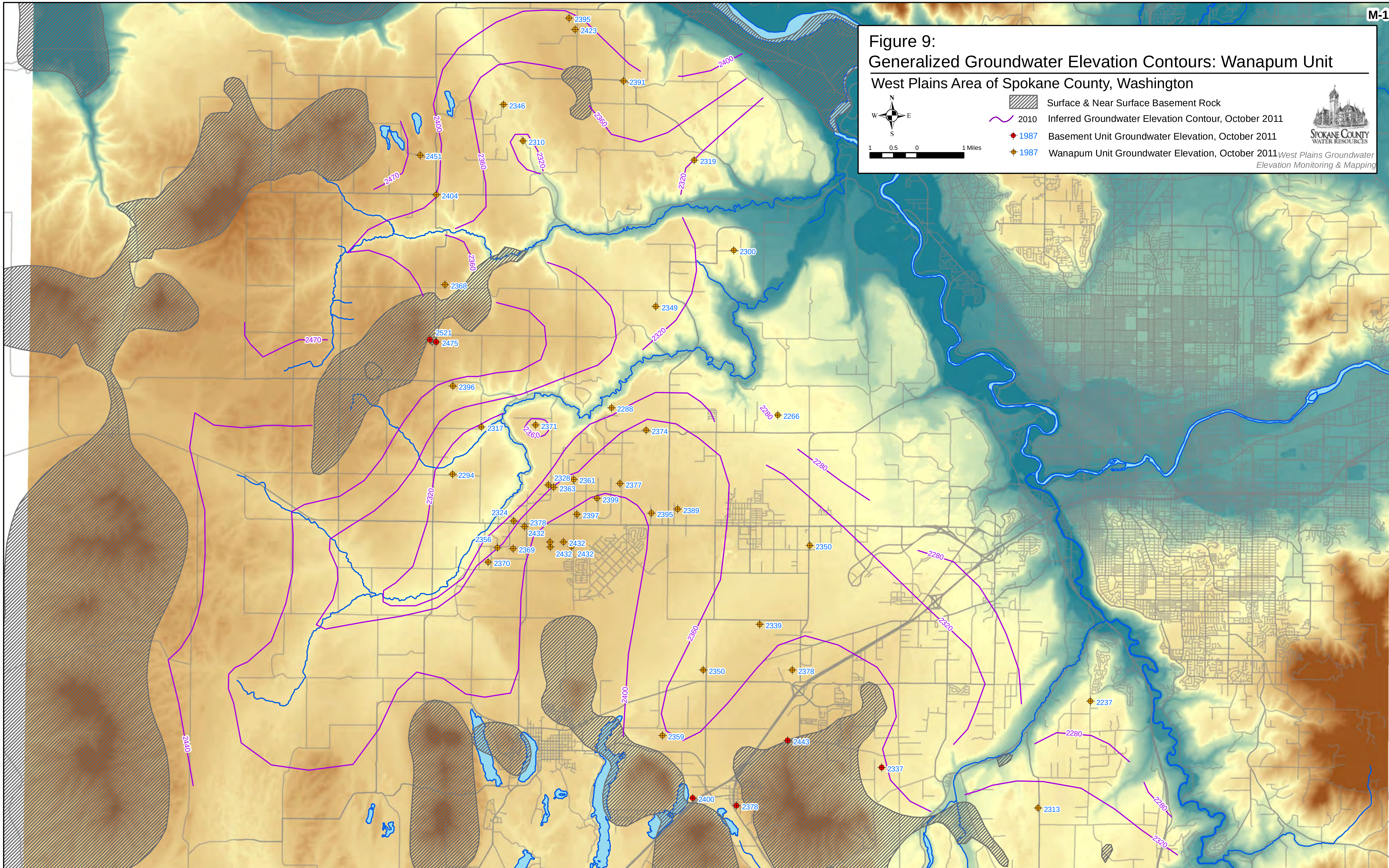
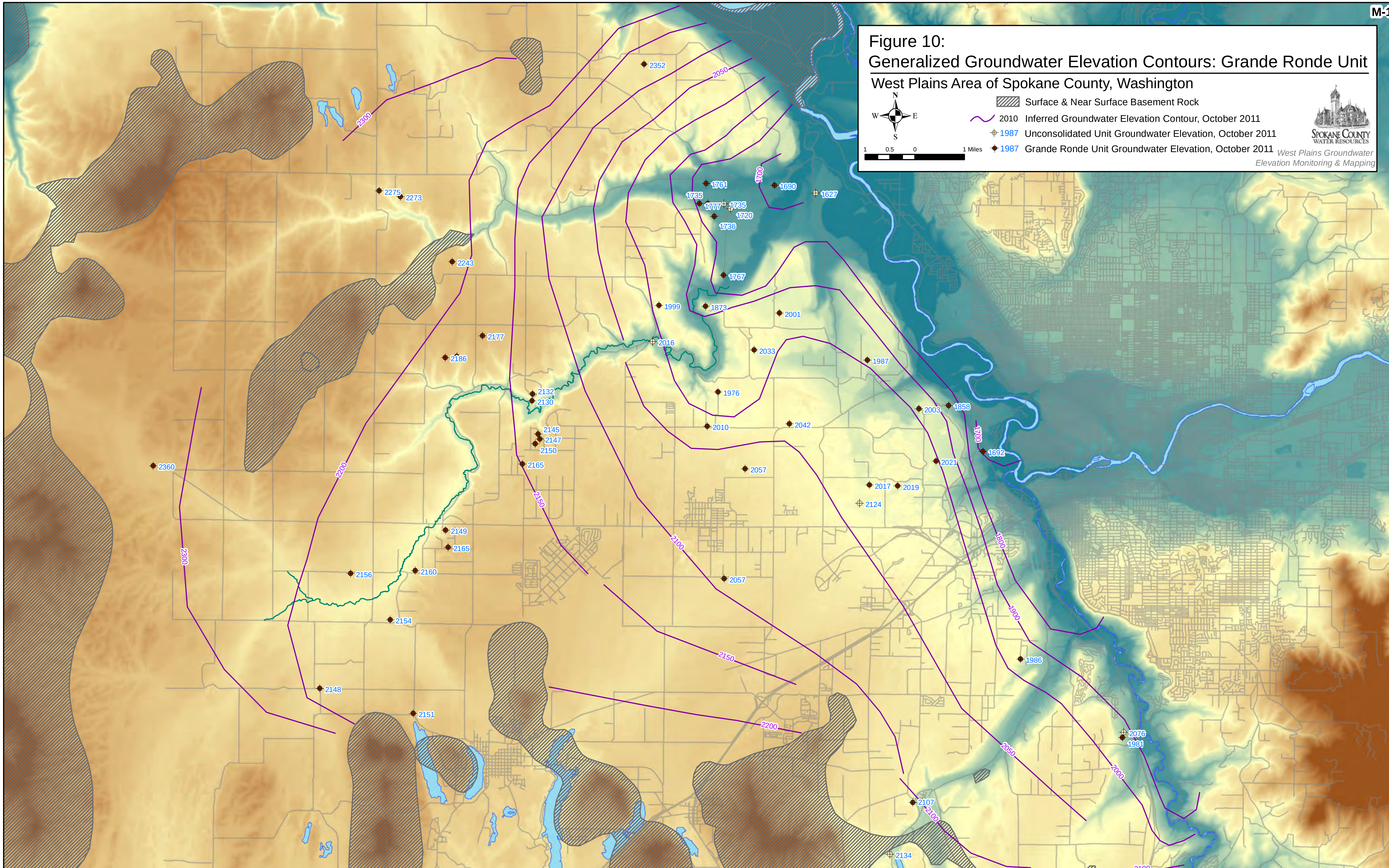


Figure 8:
Change in water level Fall 2011 to Spring 2012: Wanapum & Basement Units


M-10
Figure 9:
Generalized Groundwater Elevation Contours: Wanapum Unit
West Plains Area of Spokane County, Washington
Surface & Near Surface Basement Rock
2010 Inferred Groundwater Elevation Contour, October 2011
1987 Basement Unit Groundwater Elevation, October 2011
1987 Wanapum Unit Groundwater Elevation, October 2011
1 0.5 0 1 Miles
N
S
E
W
SPOKANE COUNTY WATER RESOURCES
West Plains Groundwater Elevation Monitoring & Mapping


M-11
Figure 10:
Generalized Groundwater Elevation Contours: Grande Ronde Unit
West Plains Area of Spokane County, Washington
Surface & Near Surface Basement Rock
2010 Inferred Groundwater Elevation Contour, October 2011
1987 Unconsolidated Unit Groundwater Elevation, October 2011
1987 Grande Ronde Unit Groundwater Elevation, October 2011
N
W
E
S
1 0.5 0 1 Miles
SPOKANE COUNTY WATER RESOURCES
West Plains Groundwater Elevation Monitoring & Mapping

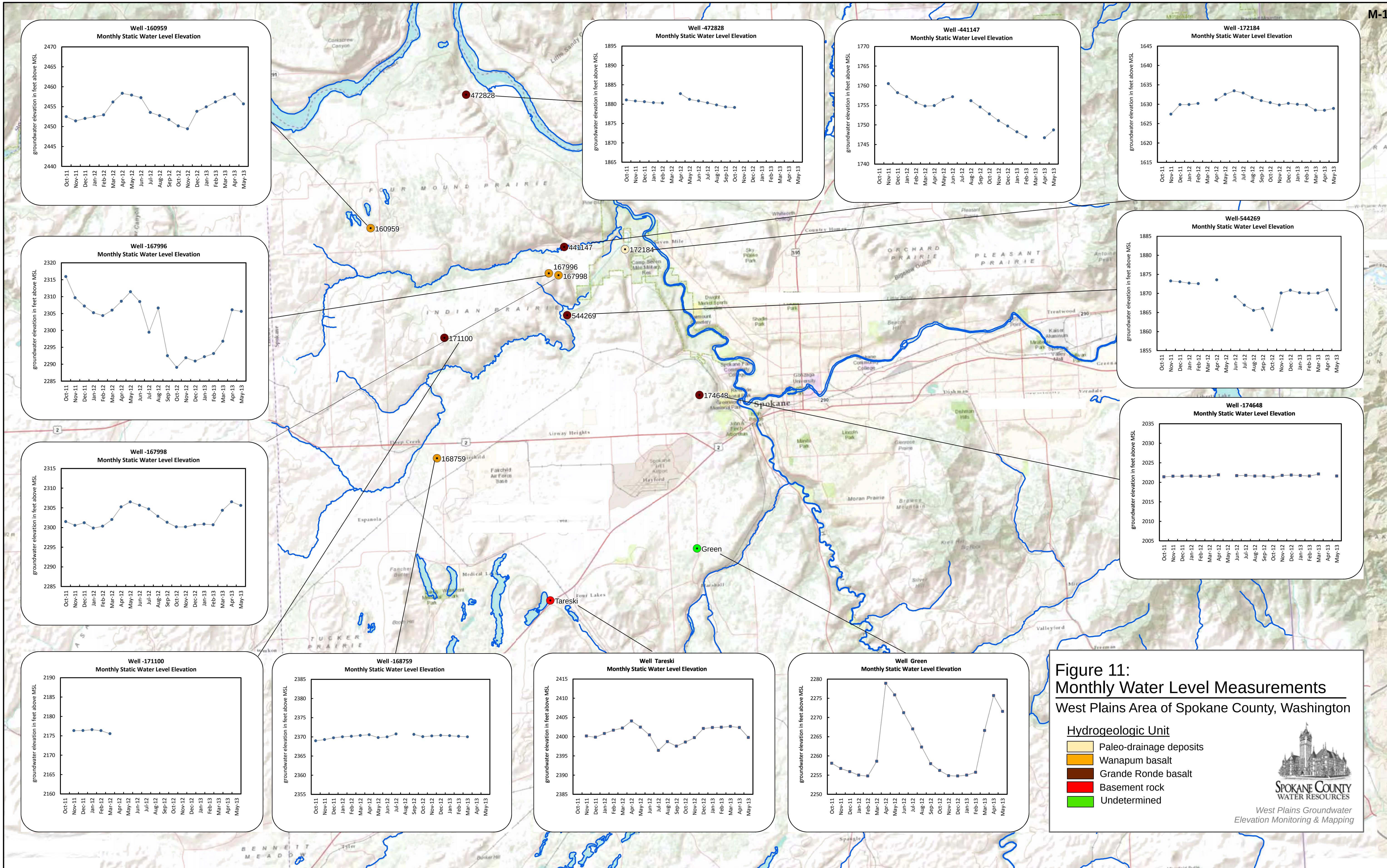


Figure 11:
Monthly Water Level Measurements
West Plains Area of Spokane County, Washington

Table 1 Project Wells

Well ID-primary well identifier used in project (where possible Ecology Well Log Id used);**Well Tag**-Ecology Well Tag ID; **Elevation**-Elevation in ft. above MSL derived from USGS DEM;**Open Interval**-depth below ground surface (bgs) of top and bottom of interval open to formation;**Hydrogeologic Unit** - interpreted hydrogeologic formation which the well draws water from;**Static Water Level**-static water level recorded on well drillers log, often at the time of construction; **Yield** - well yield in gallons per minute recorded on well drillers log;**Measurement Frequency** - frequency of measurment of well during project

Well ID	Well Tag	Elevation	Latitude	Longitude	Date of Well Construction	Total Depth	Open Interval		Well Type	Hydrogeologic Unit	Static Water Level	Yield	Measurement Frequency
							Top	Bottom					
151647	-	2261	47.5630	-117.5001	5/11/1992	320	159	320	Domestic	grande ronde	110	40	Continuous
164270	-	2447	47.6593	-117.8283	8/12/1991	268	230	260	Monitoring	grande ronde	38	187	Continuous
Thorpe Rd	-	2396	47.6125	-117.5830	5/10/1979	185	22	268	Domestic	wanapum	63	40	Continuous
172968	-	2409	47.7805	-117.6476	2/22/1993	205	35	105	Domestic	wanapum	25	10	Continuous
293479	-	2447	47.5562	-117.5931	10/19/1965	200	183	200	Public	basement	70	50	Continuous
295341	-	2166	47.5479	-117.5097	10/4/1990	80	63	78	Monitoring	unconsolidated	74.5	-	Continuous
332625	ABR634	1924	47.7335	-117.5874	5/8/1991	320	314	320	Public	grande ronde	234	45	Continuous
344207	AGG478	2372	47.6279	-117.5819	7/11/1994	440	380	440	Public	grande ronde	340	100	Continuous
411175	AKA146	1870	47.6655	-117.4707	6/23/2005	264	246	261	Domestic	grande ronde	180	50	Continuous
439863	ALR844	2428	47.7448	-117.7331	2/15/2006	120	60	120	Domestic	wanapum	38	35	Continuous
472535	-	2268	47.6501	-117.5238	3/23/2002	185	160	185	Monitoring	unconsolidated	159	-	Continuous
617922	APC141	2424	47.6058	-117.5842	6/30/2009	450	240	310	Monitoring	undetermined	180	-	Continuous
Hermanson	-	1897	47.7371	-117.5832	-	-	-	-	Domestic	unconsolidated	-	-	Continuous
152024	AHC093	2383	47.5950	-117.7557	1/16/1961	440	129	440	Public	grande ronde	160	700	Monthly
160959	ABI141	2484	47.7570	-117.7407	3/18/1994	100	80	100	Domestic	wanapum	40	50	Monthly
167998	-	2321	47.7283	-117.5963	11/7/1990	130	20	130	Public	wanapum	50	10	Monthly
168759	-	2461	47.6353	-117.6964	4/9/1975	135	110	135	Domestic	wanapum	87	24	Monthly
171100	-	2465	47.6981	-117.6869	8/4/1978	475	20	475	Domestic	grande ronde	290	25	Monthly
172184	ABR836	1880	47.7404	-117.5437	1/18/1978	303	293	303	Domestic	unconsolidated	270	20	Monthly
174648	AAJ814	2218	47.6626	-117.4910	4/16/1996	297	265	295	Domestic	grande ronde	229	10	Monthly
419534	AKA181	2376	47.5192	-117.6924	7/15/2005	440	260	440	Public	basement	24.1	10	Monthly
441147	ALR168	1869	47.7430	-117.5910	5/31/2006	235	205	225	Domestic	grande ronde	139	35	Monthly
472828	APC990	2063	47.8248	-117.6622	2/12/2007	260	210	260	Domestic	grande ronde	200	12	Monthly
544269	APC133	2240	47.7072	-117.5909	7/18/2008	600	560	600	Domestic	grande ronde	450	30	Monthly
Green	-	2344	47.5824	-117.4980					Domestic	undetermined	-	-	Monthly
Tareski	-	2414	47.5585	-117.6132					Domestic	basement	-	-	Monthly

Table 1 Project Wells

Well ID-primary well identifier used in project (where possible Ecology Well Log Id used);**Well Tag**-Ecology Well Tag ID; **Elevation**-Elevation in ft. above MSL derived from USGS DEM;**Open Interval**-depth below ground surface (bgs) of top and bottom of interval open to formation;**Hydrogeologic Unit** - interpreted hydrogeologic formation which the well draws water from;**Static Water Level**-static water level recorded on well drillers log, often at the time of construction; **Yield** - well yield in gallons per minute recorded on well drillers log;**Measurement Frequency** - frequency of measurment of well during project

Well ID	Well Tag	Elevation	Latitude	Longitude	Date of Well Construction	Total Depth	Open Interval		Well Type	Hydrogeologic Unit	Static Water Level	Yield	Measurement Frequency
							Top	Bottom					
150380	-	2354	47.5562	-117.4551	8/6/1991	140	120	140	Domestic	wanapum	40	20	Synoptic
151012	-	2360	47.6371	-117.5604	4/4/1979	220	37	220	Domestic	wanapum	18	100	Synoptic
161565	ABZ989	2380	47.7400	-117.7321	6/7/1996	100			Domestic	grande ronde	30	5	Synoptic
162035	ACN080	2407	47.7384	-117.7229	11/13/1996	180	140	180	Domestic	grande ronde	80	15	Synoptic
162956	-	2434	47.6355	-117.7036	9/18/1990	140	89	140	Domestic	wanapum	60	12	Synoptic
163156	-	2392	47.6724	-117.6359	7/9/1993	100	80	100	Domestic	wanapum	16	13	Synoptic
163167	-	2386	47.6285	-117.7429	7/15/1992	325			Domestic	grande ronde	210	50	Synoptic
163541	-	2404	47.6311	-117.7077	2/27/1991	120	37	120	Domestic	wanapum	35	30	Synoptic
164203	-	2339	47.6729	-117.7114	8/29/1978	50	40	50	Domestic	wanapum	20	15	Synoptic
164760	-	2412	47.6551	-117.6804	3/23/1988	160			Domestic	wanapum	90	30	Synoptic
165821	-	2363	47.6151	-117.7256	3/27/1980	230	170	230	Domestic	grande ronde	70	25	Synoptic
166156	-	2426	47.6569	-117.6689	10/16/1975	108	78	108	Domestic	wanapum	67	20	Synoptic
166920	-	1928	47.7371	-117.5938	3/10/1993	323	312	323	Domestic	grande ronde	154	90	Synoptic
168037	-	2277	47.7026	-117.5668	12/15/1981	125	113	118	Domestic	undetermined	100	4	Synoptic
168632	-	2431	47.6668	-117.6638	4/30/1990	340	320	340	Domestic	grande ronde	275	18	Synoptic
168885	-	2352	47.6295	-117.7150	3/18/1974	198	98	198	Domestic	grande ronde	149	60	Synoptic
169122	-	2225	47.6919	-117.5209	8/31/1989	527	431	527	Domestic	grande ronde	120	5	Synoptic
169444	-	1864	47.7426	-117.5615	11/4/1993	275	149	275	Domestic	grande ronde	200	30	Synoptic
169800	-	2258	47.7054	-117.5590	7/6/1990	302	260	302	Domestic	grande ronde	-	15	Synoptic
170102	-	2436	47.6480	-117.6212	6/6/1994	94	44	93	Domestic	wanapum	40	5	Synoptic
170654	-	2242	47.6473	-117.7019	7/18/1985	100	37	160	Domestic	grande ronde	50	30	Synoptic
170761	-	2424	47.6461	-117.6672	3/3/1978	105	65	105	Domestic	wanapum	30	25	Synoptic
171363	-	2416	47.6511	-117.6582	1/3/1992	105			Domestic	wanapum	25	60	Synoptic
171368	-	2418	47.6558	-117.6477	5/23/1986	160	44	160	Domestic	wanapum	40	100	Synoptic
171735	-	2391	47.6445	-117.6978	2/24/1986	300	103	300	Domestic	undetermined	210	50	Synoptic
172168	-	2459	47.6855	-117.7246	5/14/1991	150			Domestic	wanapum	58	15	Synoptic
172287	-	1983	47.7163	-117.5832	7/19/1993	300	290	300	Domestic	grande ronde	265	8	Synoptic
172372	-	2449	47.5765	-117.5699	2/19/1977	260	100	260	Domestic	basement	15	15	Synoptic
172437	-	2464	47.7964	-117.6700	5/10/1977	90	19	90	Domestic	wanapum	30	20	Synoptic

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Well ID	Well Tag	Elevation	Latitude	Longitude	Date of Well Construction	Total Depth	Open Interval		Well Type	Hydrogeologic Unit	Static Water Level	Yield	Measurement Frequency
							Top	Bottom					
172516	-	2449	47.7999	-117.6729	5/29/1976	123	67	123	Domestic	wanapum	55	30	Synoptic
172609	-	2420	47.6467	-117.6331	8/18/1995	120			Domestic	wanapum	20	10	Synoptic
172674	-	2406	47.6439	-117.6963	5/13/1978	175	94	175	Domestic	wanapum	-	40	Synoptic
172807	-	2415	47.6608	-117.6693	7/1/1993	345	260	345	Domestic	grande ronde	240	20	Synoptic
173437	-	2414	47.6544	-117.6780	1/13/1981	140	74	140	Domestic	wanapum	40	45	Synoptic
174774	AAL205	2309	47.6732	-117.5543	10/8/1997	320	240	320	Domestic	grande ronde	200	20	Synoptic
175087	ABI250	2425	47.6696	-117.6626	5/13/1994	345	290	330	Domestic	grande ronde	258	15	Synoptic
175566	ABW156	2528	47.6998	-117.7354	12/6/1995	320	230	310	Domestic	basement	50	5	Synoptic
175743	ABZ994	2440	47.6920	-117.6978	5/7/1996	340	300	340	Domestic	grande ronde	250	15	Synoptic
176121	-	2491	47.6991	-117.7325	10/17/1996	300	98	300	Domestic	basement	-	1	Synoptic
176286	ACP517	2383	47.6582	-117.7245	9/10/1997	140	100	140	Domestic	wanapum	70	40	Synoptic
253903	AEH324	2419	47.6682	-117.6618	5/23/2000	355	295	355	Domestic	grande ronde	270	30	Synoptic
322671	AGC271	2322	47.7617	-117.6935	2/4/2002	120	100	120	Domestic	wanapum	65	15	Synoptic
330511	AGG672	2267	47.6051	-117.4540	4/4/2002	364	362	364	Domestic	grande ronde	300	10	Synoptic
338961	AHC336	2307	47.5418	-117.3918	7/25/2002	280	0	280	Domestic	grande ronde	190	60	Synoptic
341226	AAK721	2055	47.6968	-117.6135	6/3/1994	123	114	123	Domestic	unconsolidated	47	55	Synoptic
341409	AFO087	2395	47.6737	-117.6866	5/15/2002	50	35	50	Domestic	wanapum	25	25	Synoptic
351636	AHS149	2305	47.7073	-117.6109	1/15/2003	370	330	365	Domestic	grande ronde	290	10	Synoptic
351696	AHG910	2406	47.5984	-117.5680	10/22/2002	140	120	140	Domestic	wanapum	80	50	Synoptic
351706	AHF917	2364	47.6813	-117.6651	11/29/2002	365	314	334	Domestic	grande ronde	145	9	Synoptic
356801	AHF929	2378	47.6792	-117.6518	3/11/2003	160	135	155	Domestic	undetermined	90	17	Synoptic
363714	AFQ103	2274	47.6823	-117.5852	6/10/2003	385	300	340	Domestic	grande ronde	295	10	Synoptic
366380	AHJ220	2370	47.7729	-117.7026	5/14/2003	140			Domestic	wanapum	17	20	Synoptic
367533	AHJ211	2373	47.5684	-117.5268	4/4/2003	400			Domestic	basement	36	10	Synoptic
369725	AHJ092	2249	47.6555	-117.5196	7/23/2003	300			Domestic	grande ronde	225	15	Synoptic
370123	AHC624	2452	47.7195	-117.7002	9/11/2003	330			Domestic	grande ronde	223	40	Synoptic
373860	AHJ414	2125	47.5824	-117.4100	11/22/2003	320	240	320	Domestic	grande ronde	145	24	Synoptic
373865	AHJ743	2434	47.6553	-117.6672	11/18/2003	320			Domestic	mixed	100	50	Synoptic

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Well ID	Well Tag	Elevation	Latitude	Longitude	Date of Well Construction	Total Depth	Open Interval		Well Type	Hydrogeologic Unit	Static Water Level	Yield	Measurement Frequency
							Top	Bottom					
375775	AHS537	2386	47.6414	-117.7021	11/6/2003	260	240	260	Domestic	grande ronde	236	20	Synoptic
381868	ABZ938	2334	47.6723	-117.5897	8/1/1996	480			Domestic	grande ronde	400	15	Synoptic
382077	AKT919	2292	47.6774	-117.5755	4/14/2004	128	55	60	Domestic	undetermined	50	10	Synoptic
382081	AKT916	2267	47.6553	-117.5074	4/6/2004	360	320	340	Domestic	grande ronde	300	20	Synoptic
385958	AHJ563	2443	47.6422	-117.6913	6/18/2004	150			Domestic	wanapum	70	15	Synoptic
391385	AHJ107	2319	47.5893	-117.4313	10/6/2004	180	120	175	Domestic	undetermined	120	6	Synoptic
392035	AHJ586	2323	47.5245	-117.4650	9/2/2004	240	0	240	Domestic	grande ronde	200	5	Synoptic
407776	AEK209	1906	47.7356	-117.5803	2/4/2005	314	290	300	Domestic	unconsolidated	220	12	Synoptic
408089	AKO852	2484	47.7169	-117.7287	3/4/2005	220	140	220	Domestic	wanapum	112	12	Synoptic
408354	AKM084	2001	47.6788	-117.4857	12/20/2004	320	200	320	Domestic	grande ronde	125	30	Synoptic
408360	AKO858	2378	47.5981	-117.6089	11/18/2004	180	120	180	Domestic	undetermined	100	30	Synoptic
413065	ALR955	2406	47.5778	-117.6272	6/13/2005	160			Domestic	wanapum	60	22	Synoptic
413193	AKY024	2294	47.6793	-117.6654	7/22/2005	295	255	295	Domestic	grande ronde	180	20	Synoptic
413228	AKA192	2453	47.6916	-117.7030	6/16/2005	300	260	300	Domestic	grande ronde	75	3	Synoptic
428174	AKL353	1907	47.7371	-117.5901	10/7/2005	346	262	272	Domestic	grande ronde	215	12	Synoptic
616916	APN344	2331	47.7561	-117.6147	2/1/2006	80	18	80	Domestic	wanapum	25	30	Synoptic
437578	APP804	2424	47.6185	-117.7153	5/25/2006	420	380	420	Domestic	grande ronde	260	15	Synoptic
445291	APP840	2445	47.6364	-117.7008	5/30/2006	335	295	335	Domestic	grande ronde	190	20	Synoptic
467958	APP874	2212	47.6778	-117.4985	10/4/2006	346	339	346	Domestic	grande ronde	225	10	Synoptic
472793	APC449	2403	47.4800	-117.3753	3/8/2007	420	360	420	Domestic	grande ronde	150	50	Synoptic
495764	BAC719	2373	47.7107	-117.6319	8/28/2007	180	150	180	Domestic	wanapum	90	17	Synoptic
498282	-	2403	47.4884	-117.3556	12/14/1994	265			Domestic	grande ronde	90	50	Synoptic
544369	BAS080	2366	47.4900	-117.3790	5/2/2008	340	280	340	Domestic	grande ronde	120	40	Synoptic
616663	ALT367	2364	47.7776	-117.6181	9/23/2009	525	485	525	Domestic	grande ronde	208	18	Synoptic
BEAIL	-	2098	47.5839	-117.4096	-	-	-	-	Domestic	unconsolidated	-	-	Synoptic
Spokane Cnty	-	2345	47.6600	-117.5733	-	-	-	-	Monitoring	grande ronde	-	-	Synoptic
Swanson	-	2285	47.6946	-117.5698	-	-	-	-	Domestic		-	-	Synoptic
Johnson	-	2378	47.5982	-117.6089	-	-	-	-	Domestic	wanapum	-	-	Synoptic
560746	-	2456	47.6362	-117.6695	10/10/1992	111	99	111	Monitoring	Wanapum	-	-	Synoptic

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Well ID	Well Tag	Elevation	Latitude	Longitude	Date of Well Construction	Total Depth	Open Interval		Well Type	Hydrogeologic Unit	Static Water Level	Yield	Measurement Frequency
							Top	Bottom					
560732	-	2458	47.6359	-117.6793	10/4/1992	95	85	95	Monitoring	Wanapum	-	-	Synoptic
560763	-	2468	47.6375	-117.6794	10/6/1992	106	96	106	Monitoring	Wanapum	-	-	Synoptic
560736	-	2465	47.6375	-117.6733	10/12/1992	112	102	112	Monitoring	wanapum	-	-	Synoptic
163104	AGG131	2358	47.6393	-117.7048	7/1/1992	320	283	320	Domestic	undetermined	70	30	Synoptic
163547	-	2096	47.6995	-117.5333	6/5/1993	395	240	395	Domestic	grande ronde	300	20	Synoptic
189494	AHC681	2339	47.5097	-117.4507	11/7/1998	45	25	45	Domestic	wanapum	12	10	Synoptic
339149	AEC076	2332	47.5087	-117.4514	7/19/2002	320	20	320	Domestic	wanapum	215	30	Synoptic
413231	AKA184	2360	47.6367	-117.5625	5/10/2005	200	140	192	Domestic	wanapum	60	40	Synoptic
435794	AKL321	2404	47.6458	-117.6937	4/13/2006	220	180	220	Domestic	wanapum	80	15	Synoptic
436929	APM879	2343	47.5947	-117.4960	4/17/2006	130	50	130	Domestic	wanapum	6	25	Synoptic
167996	AEH155	2335	47.7295	-117.6037	4/11/1979	75	18	75	Public	wanapum	15	150	Monthly
773951	BCE358	1928	47.7370	-117.5934	12/21/2011	237	-	-	Domestic	grande ronde	157	30	Synoptic

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Static Water Level-static water level recorded on well drillers log, often at the time of construction;**Yield** - well yield in gallons per minute recorded on well drillers log;**Organization** - organization that collected the data

Well ID	Well Tag	Elevation	Latitude	Longitude	Date of Well Construction	Total Depth	Open Interval		Well Type	Hydrogeologic Unit	Static Water Level	Yield	Organization
							Top	Bottom					
488063	BAC801	2375	47.5947	-117.6290	5/20/1959	320	205/380	215/400	Public	mixed	145	725	Fairchild AFB
419534	AKA181	2376	47.5192	-117.6924	7/15/2005	440	260	440	Public	basement	24.1	10	Fairchild AFB
VA_CMTRY	-	2438	47.5879	-117.7153	4/1/1955	343	-	-	Monitoring	mixed	177	50	Ecology
FAFBMWD1	-	2426	47.6393	-117.6292	-	-	-	-	Monitoring	mixed	137.5	-	Ecology
153484	-	2322	47.5444	-117.4401	7/10/1964	122	25	122	Irrigation	wanapum	26	400	USGS
292881	AHC094	2383	47.5950	-117.7555	10/29/1957	440	73.5	440	Public	mixed	160	1000	USGS
152024	AHC093	2383	47.5946	-117.7558	1/16/1961	440	129	440	Public	mixed	160	700+	USGS
153821	-	2367	47.6103	-117.7411	5/1/1969	335	-	-	Irrigation	basement??	116	-	USGS
560746	-	2456	47.6362	-117.6695	10/10/1992	111	99	111	Monitoring	wanapum		-	Waste Mangement
560732	-	2458	47.6359	-117.6793	10/4/1992	95	85	95	Monitoring	wanapum		-	Waste Mangement
560763	-	2468	47.6375	-117.6794	10/6/1992	106	96	106	Monitoring	wanapum		-	Waste Mangement
560736	-	2465	47.6375	-117.6733	10/12/1992	112	102	112	Monitoring	wanapum		-	Waste Mangement
472535	-	2268	47.6501	-117.5238	3/23/2002	185	160	185	Monitoring	unconsolidated	159	-	Spokane County
152024	AHC093	2380	47.593003	-117.75536	1/16/1961	440	129	440	Public	Grande Ronde	160	700+	EWU
152942	-	2350	47.523778	-117.70057	4/22/1994	100	39	100	Domestic	Wanapum	20	120	EWU
153951	-	2305	47.648513	-117.54234	2/25/1977	100	19	100	Domestic	Wanapum	10	60	EWU
155391	-	2275	47.652111	-117.51562	4/4/1975	148	23	148	Domestic	Wanapum	35	40	EWU
155971	-	2490	47.556505	-117.79281	8/10/1977	95	47	95	Domestic	Wanapum	65	40	EWU
155972	-	2430	47.552835	-117.80351	9/21/1977	80	18	80	Domestic	Wanapum	30	10	EWU
156157	-	2425	47.578388	-117.77147	6/10/1985	75	19	75	Domestic	Wanapum	12	75	EWU
158603	-	2385	47.592982	-117.76073	1/20/1984	62	19	62	Domestic	Wanapum	artesian	25	EWU
159725	AHC092	2425	47.578402	-117.76608	1/12/1978	964	380/836	400/964	Public	Basement	52	2500	EWU
162956	-	2430	47.637637	-117.69838	9/18/1990	140	89	140	Domestic	Wanapum	60	12	EWU
163156	-	2390	47.673681	-117.63336	7/9/1993	100	18	100	Domestic	Wanapum	16	13	EWU
163263	-	2150	47.691795	-117.51015	2/4/1988	203	18	203	Domestic	Grande Ronde	160	8	EWU
163881	-	2360	47.616105	-117.7307	11/3/1992	182	30	182	Domestic	Wanapum	60	60+	EWU
163975	-	2420	47.59285	-117.59408	8/7/1973	180	31	180	Domestic	Wanapum	100	20	EWU
164297	-	2165	47.677421	-117.52605	4/26/1993	400	18	400	Domestic	Grande Ronde	345	25	EWU
164862	-	2160	47.695398	-117.5048	10/25/1988	540	298	540	Domestic	Grande Ronde	360	5	EWU
165140	-	1995	47.702864	-117.58549	-	175	48	175	Domestic	Overburden	115	50+	EWU
165243	-	2410	47.578262	-117.61023	8/28/1992	100	39	100	Domestic	Wanapum	30	24	EWU

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Well ID	Well Tag	Elevation	Latitude	Longitude	Date of Well Construction	Total Depth	Open Interval		Well Type	Hydrogeologic Unit	Static Water Level	Yield	Organization
							Top	Bottom					
167674	-	2370	47.666596	-117.682	4/10/1976	60	26	60	Domestic	Wanapum	15	20	EWU
168213	-	2380	47.680939	-117.62263	10/20/1984	225	0	30	Domestic	Wanapum	30	70+	EWU
169122	-	2220	47.691821	-117.52099	8/31/1989	527	431	527	Domestic	Grande Ronde	120	5	EWU
169441	-	2420	47.655726	-117.66577	3/24/1977	150	77	150	Domestic	Wanapum	56	20	EWU
169800	-	2250	47.706407	-117.55854	7/6/1990	302	260	302	Domestic	Grande Ronde	250	15	EWU
170008	-	2360	47.581984	-117.64774	9/21/1987	140	43	140	Domestic	Basement	10	150	EWU
170280	-	2255	47.659145	-117.49403	5/8/1989	302	200	302	Domestic	Grande Ronde	243	17	EWU
170959	-	2375	47.60669	-117.61561	3/22/1978	225	20	225	Domestic	Wanapum	21	20	EWU
171796	-	2140	47.695435	-117.53175	8/6/1979	370	357	367	Domestic	Overburden	356	3.5	EWU
171979	-	2370	47.677439	-117.6765	12/29/1982	150	19	150	Domestic	undetermined	45	50	EWU
172268	-	2310	47.673722	-117.56914	8/7/1979	283	282	283	Domestic	Overburden	240	15	EWU
172509	-	2410	47.606628	-117.57796	12/2/1983	60	19	60	Domestic	Wanapum	23	25	EWU
173811	-	2380	47.597096	-117.61566	10/25/1985	171	31	170	Domestic	Wanapum	29	100	EWU
174062	-	2405	47.563649	-117.61557	4/21/1977	153	50	153	Domestic	Basement	50	15	EWU
174533	-	2360	47.637446	-117.56356	11/19/1988	242	76	242	Domestic	undetermined	53	15	EWU
174644	-	2265	47.684518	-117.59056	12/3/1993	225	341	358	Domestic	Grande Ronde	311	15	EWU
293463	-	2370	47.589214	-117.62629	2/24/1988	125	18	125	Domestic	Wanapum	12	20	EWU
344216	AAJ804	2180	47.709826	-117.51037	6/20/1994	782	767	781	Domestic	Basement	550	20	EWU
163119 & 163120		2460	47.619421	-117.68752	11/20/1984	200	60	200	Domestic	Wanapum	150	12+	EWU

Table 3 Synoptic Water Level Measurment Data

Depth to water-feet bgs to water surface; **Ground Water Elevation**-ground surface elevation less depth to water

Well ID	Fall Measurment			Spring Measurment		
	Date	Depth to Water	Ground Water Elevation	Date	Depth to Water	Ground Water Elevation
151647	11/2/2011	154.21	2107	5/1/2012	144.35	2116
164270	10/20/2011	87.10	2360	4/18/2012	66.96	2380
Thorpe Rd	10/20/2011	56.60	2339	4/18/2012	55.80	2340
172968	10/20/2011	17.60	2391	4/18/2012	14.72	2394
293479	10/20/2011	68.52	2378	4/18/2012	66.82	2380
295341	10/20/2011	31.27	2134	4/18/2012	24.35	2141
332625	11/1/2011	187.96	1736	4/18/2012	197.89	1726
344207	10/20/2011	315.92	2057	-	-	-
411175	10/20/2011	177.65	1692	4/18/2012	171.63	1698
439863	10/20/2011	23.71	2404	3/9/2012	22.19	2406
472535	10/20/2011	144.40	2124	5/2/2012	142.40	2126
617922	10/20/2011	173.86	2250	5/2/2012	163.43	2261
Lincoln-Garfield Rd.	10/20/2011	161.98	1735	4/4/2012	164.23	1733
VA_CMTRY	10/20/2011	286.58	2151	4/18/2012	283.47	2155
FAFBMWD1	10/20/2011	139.23	2287	4/18/2012	139.11	2287
152024	10/19/2011	235.40	2148	-	-	-
160959	11/2/2011	32.92	2451	4/18/2012	25.93	2458
167998	11/1/2011	20.45	2300	5/1/2012	14.50	2306
168759	10/20/2011	91.59	2369	5/1/2012	91.21	2370
171100	11/2/2011	288.18	2177	3/9/2012	288.96	2176
172184	11/2/2011	252.91	1627	5/1/2012	248.09	1632
174648	11/2/2011	197.45	2021	4/4/2012	197.11	2021
419534	12/6/2011	250.00	2126	-	-	-
441147	10/19/2011	107.90	1761	4/18/2012	113.91	1755
472828	11/2/2011	182.22	1880	5/1/2012	181.79	1881
488063	10/13/2011	144.00	2231	-	-	-
544269	10/18/2011	367.15	1873	4/17/2012	366.29	1874
Green	10/17/2011	85.92	2258	4/16/2012	65.12	2279
Tareski	11/2/2011	13.85	2400	5/1/2012	11.54	2402
150380	10/17/2011	40.93	2313	4/16/2012	23.43	2331
151012	10/18/2011	10.30	2350	-	-	-
161565	10/19/2011	105.11	2275	4/18/2012	96.16	2284
162035	10/19/2011	133.51	2273	4/18/2012	133.83	2273
162956	10/21/2011	78.45	2356	4/23/2012	78.65	2356
163156	10/21/2011	17.46	2374	-	-	-9999
163167	10/20/2011	230.23	2156	4/20/2012	226.05	2160
163541	10/20/2011	33.19	2370	4/20/2012	31.85	2372
164203	11/17/2011	21.85	2317	-	-	-9999
164760	10/20/2011	83.65	2328	4/19/2012	85.24	2327
165821	10/17/2011	209.19	2154	5/1/2012	205.20	2158
166156	10/20/2011	65.39	2361	4/19/2012	65.32	2361
166920	10/23/2011	151.20	1777	4/18/2012	145.50	1782
168037	10/18/2011	100.15	2177	4/17/2012	100.15	2177
168632	10/21/2011	281.37	2150	4/23/2012	278.88	2153
168885	10/20/2011	192.38	2160	4/20/2012	200.58	2152
169122	11/2/2011	237.95	1987	5/2/2012	238.98	1986

Table 3 Synoptic Water Level Measurment Data

Depth to water-feet bgs to water surface; **Ground Water Elevation**-ground surface elevation less depth to water

Well ID	Fall Measurment			Spring Measurment		
	Date	Depth to Water	Ground Water Elevation	Date	Depth to Water	Ground Water Elevation
169444	10/19/2011	173.19	1690	4/18/2012	173.37	1690
169800	10/21/2011	256.57	2001	-	-	-
170102	10/20/2011	46.46	2389	4/20/2012	38.55	2397
170654	10/20/2011	58.83	2183	4/20/2012	58.24	2184
170761	10/20/2011	27.33	2397	5/1/2012	22.76	2401
171363	10/21/2011	16.66	2399	4/23/2012	12.50	2403
171368	10/20/2011	41.26	2377	4/19/2012	41.13	2377
171735	10/21/2011	138.44	2253	-	-	-
172168	10/21/2011	63.03	2396	4/23/2012	62.55	2396
172287	10/19/2011	215.73	1767	4/18/2012	212.43	1771
172372	11/2/2011	6.24	2443	4/16/2012	3.13	2446
172437	10/19/2011	40.90	2423	4/18/2012	41.45	2422
172516	10/19/2011	54.10	2395	4/18/2012	53.75	2395
172609	11/2/2011	25.02	2395	4/20/2012	21.13	2399
172674	10/21/2011	82.19	2324	4/23/2012	82.19	2324
172807	10/21/2011	249.93	2165	4/23/2012	247.76	2167
173437	10/20/2011	51.01	2363	4/19/2012	50.82	2364
174774	10/18/2011	266.37	2042	4/17/2012	265.31	2044
175087	10/20/2011	280.12	2145	4/19/2012	278.07	2147
175566	10/20/2011	7.50	2521	4/19/2012	4.82	2524
175743	10/20/2011	252.45	2187	4/19/2012	254.40	2186
176121	10/21/2011	16.08	2475	4/23/2012	15.21	2476
176286	10/20/2011	88.73	2294	4/20/2012	91.57	2291
253903	10/20/2011	278.04	2141	4/19/2012	276.19	2143
322671	10/20/2011	11.52	2310	4/19/2012	10.42	2311
330511	10/17/2011	280.72	1986	4/16/2012	280.65	1986
338961	10/17/2011	181.66	2125	4/16/2002	176.29	2131
341226	10/18/2011	39.40	2016	-	-	-
341409	10/20/2011	23.19	2371	4/19/2012	20.87	2374
351636	10/18/2011	305.80	1999	4/17/2012	306.95	1998
351696	10/17/2011	28.22	2378	4/16/2012	19.56	2386
351706	10/20/2011	231.19	2132	4/19/2012	230.77	2133
356801	10/20/2011	90.80	2288	4/19/2020	85.85	2293
363714	10/18/2011	297.46	1976	4/17/2012	296.07	1977
366380	10/19/2011	23.55	2346	4/18/2012	19.23	2350
367533	10/21/2011	36.18	2337	5/1/2012	34.44	2338
369725	10/18/2011	231.56	2017	4/17/2012	231.76	2017
370123	10/20/2011	208.49	2243	-	-	-9999
373860	10/17/2011	144.43	1981	4/17/2012	142.86	1982
373865	10/20/2011	208.29	2225	4/19/2012	208.11	2225
375775	10/20/2011	237.50	2149	4/20/2012	234.75	2152
381868	10/18/2011	324.50	2010	4/17/2012	323.63	2010
382077	10/18/2011	26.20	2266	4/19/2012	18.07	2274
382081	10/18/2011	248.53	2019	4/17/2012	248.62	2018
385958	10/20/2011	65.17	2378	4/23/2012	67.62	2375
391385	10/17/2011	81.48	2237	4/16/2012	82.09	2236

Table 3 Synoptic Water Level Measurment Data

Depth to water-feet bgs to water surface; **Ground Water Elevation**-ground surface elevation less depth to water

Well ID	Fall Measurment			Spring Measurment		
	Date	Depth to Water	Ground Water Elevation	Date	Depth to Water	Ground Water Elevation
392035	10/17/2011	180.66	2142	4/16/2012	183.86	2139
407776	10/19/2011	186.28	1720	4/18/2012	188.61	1717
408089	10/20/2011	116.30	2368	4/19/2012	111.05	2373
408354	10/18/2011	143.06	1858	4/17/2012	141.63	1860
408360	-	-	-	4/16/2012	71.73	2306
413065	10/17/2011	47.33	2359	4/16/2012	35.31	2371
413193	10/20/2011	164.52	2130	4/19/2012	164.47	2130
413228	10/20/2011	267.25	2186	5/1/2012	282.17	2171
428174	10/19/2011	171.65	1735	4/18/2012	175.15	1732
616916	10/19/2011	12.29	2319	4/18/2012	9.19	2322
437578	10/17/2011	290.10	2134	4/16/2012	267.30	2157
445291	10/20/2011	279.70	2165	4/18/2012	276.69	2168
467958	10/21/2011	209.92	2003	5/1/2012	208.79	2004
472793	10/17/2011	243.96	2159	4/16/2012	243.22	2160
495764	10/19/2011	24.21	2349	4/18/2012	20.42	2353
498282	10/17/2011	179.41	2224	4/23/2012	179.08	2224
544369	10/17/2011	205.13	2161	4/16/2012	203.95	2162
616663	10/19/2011	12.00	2352	5/1/2012	252.95	2111
BEAIL	10/17/2011	22.11	2076	-	-	-
Spokane Cnty	10/12/2011	288.38	2057	2/7/2012	289.73	2055
Swanson	10/19/2011	252.35	2033	-	-	-
Johnson	10/17/2011	27.61	2350	4/16/2012	30.55	2347
560746	11/29/2011	24.74	2432	-	-	-
560732	11/29/2011	26.53	2432	-	-	-
560763	11/29/2011	35.91	2432	-	-	-
560736	11/29/2011	32.62	2432	-	-	-
163104	-	-	-	4/20/2012	123.65	2234
163547	-	-	-	4/17/2012	297.53	1798
189494	-	-	-	4/16/2012	17.16	2322
339149	-	-	-	4/16/2012	10.62	2321
413231	-	-	-	4/17/2012	15.16	2345
435794	-	-	-	4/20/2012	72.43	2332
436929	-	-	-	4/16/2012	0.00	2343
773951	-	-	-	4/18/2012	145.19	1783

Table 5 Monthly Water Level Data

Table 5.1 Well 544269
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
11/2/2011	366.74	1873.26
12/8/2011	366.93	1873.07
1/6/2012	367.32	1872.68
2/3/2012	367.45	1872.55
4/17/2012	366.46	1873.54
6/11/2012	370.85	1869.15
7/9/2012	373.09	1866.91
8/3/2012	374.45	1865.55
9/6/2012	373.95	1866.05
10/3/2012	379.60	1860.40
11/7/2012	369.90	1870.10
12/7/2012	369.17	1870.83
1/4/2013	369.82	1870.18
2/1/2013	369.95	1870.05
3/6/2013	369.90	1870.10
4/3/2013	369.07	1870.93
5/10/2013	375.80	1865.70

Table 5.2 Well 174648
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
10/6/2011	198.10	2021.40
11/2/2011	197.95	2021.55
12/8/2011	197.95	2021.55
1/6/2012	197.88	2021.62
2/3/2012	197.97	2021.53
3/9/2012	197.96	2021.54
4/4/2012	197.61	2021.89
6/12/2012	197.80	2021.70
7/9/2012	197.74	2021.76
8/3/2012	197.91	2021.59
9/6/2012	197.88	2021.62
10/3/2012	198.20	2021.30
11/9/2012	197.75	2021.75
12/7/2012	197.64	2021.86
1/4/2013	197.76	2021.74
2/1/2013	197.90	2021.60
3/6/2013	197.39	2022.11
5/10/2013	197.90	2021.60

Table 5.3 Well Green
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
10/6/2011	87.42	2258.08
11/2/2011	88.78	2256.72
12/8/2011	89.59	2255.91
1/6/2012	90.52	2254.98
2/3/2012	90.75	2254.75
3/9/2012	86.90	2258.60
4/17/2012	66.62	2278.88
5/1/2012	69.62	2275.88
6/11/2012	74.27	2271.23
7/9/2012	78.50	2267.00
8/3/2012	83.20	2262.30
9/6/2012	87.53	2257.97
10/3/2012	89.30	2256.20
11/7/2012	90.65	2254.85
12/7/2012	90.75	2254.75
1/4/2013	90.51	2254.99
2/1/2013	89.77	2255.73
3/6/2013	78.90	2266.60
4/3/2013	69.80	2275.70
5/10/2013	73.93	2271.57

Table 5.4 Well Tareski
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
11/2/2011	13.85	2400.15
12/8/2011	14.16	2399.84
1/6/2012	13.18	2400.82
2/3/2012	12.32	2401.68
3/9/2012	11.76	2402.24
4/4/2012	9.93	2404.07
5/1/2012	11.54	2402.46
6/11/2012	13.58	2400.42
7/9/2012	17.58	2396.42
8/3/2012	15.31	2398.69
9/6/2012	16.48	2397.52
10/3/2012	15.42	2398.58
11/9/2012	14.28	2399.72
12/7/2012	11.89	2402.11
1/4/2013	11.64	2402.36
2/1/2013	11.56	2402.44
3/6/2013	11.33	2402.67
4/3/2013	11.62	2402.38
5/10/2013	14.62	2399.78

Table 5.5 Well 168759
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
10/6/2011	92.03	2368.97
11/2/2011	91.72	2369.28
12/8/2011	91.26	2369.74
1/6/2012	90.99	2370.01
2/3/2012	90.86	2370.14
3/9/2012	90.63	2370.37
4/4/2012	90.45	2370.55
5/1/2012	91.21	2369.79
6/11/2012	91.02	2369.98
7/9/2012	90.26	2370.74
9/6/2012	90.36	2370.64
10/3/2012	90.96	2370.04
11/9/2012	90.77	2370.23
12/7/2012	90.62	2370.38
1/4/2013	90.7	2370.3
2/1/2013	90.87	2370.13
3/6/2013	90.99	2370.01

Table 5.6 Well 160959
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
10/6/2011	32.36	2452.47
11/2/2011	33.42	2451.41
12/8/2011	32.80	2452.03
1/6/2012	32.36	2452.47
2/3/2012	31.92	2452.91
3/9/2012	28.68	2456.15
4/4/2012	26.50	2458.33
5/1/2012	26.95	2457.88
6/12/2012	27.59	2457.24
7/9/2012	31.29	2453.54
8/3/2012	32.10	2452.73
9/6/2012	33.10	2451.73
10/3/2012	34.68	2450.15
11/7/2012	35.41	2449.42
12/7/2012	31.03	2453.80
1/4/2013	29.90	2454.93
2/1/2013	28.66	2456.17
3/6/2013	27.50	2457.33
4/3/2013	26.71	2458.12
5/10/2013	29.15	2455.68

Table 5 Monthly Water Level Data

Table 5.7 Well 472828
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
10/6/2011	181.93	1881.07
11/2/2011	182.22	1880.78
12/8/2011	182.38	1880.62
1/6/2012	182.65	1880.35
2/3/2012	182.74	1880.26
4/4/2012	180.32	1882.68
5/1/2012	181.79	1881.21
6/12/2012	182.19	1880.81
7/9/2012	182.68	1880.32
8/3/2012	183.22	1879.78
9/6/2012	183.75	1879.25
10/3/2012	183.88	1879.12

Table 5.8 Well 172184
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
11/2/2011	253.41	1627.42
12/8/2011	250.95	1629.88
1/6/2012	250.93	1629.90
2/3/2012	250.65	1630.18
4/4/2012	249.71	1631.12
5/1/2012	248.29	1632.54
6/12/2012	247.38	1633.45
7/9/2012	247.95	1632.88
8/3/2012	249.11	1631.72
9/6/2012	249.90	1630.93
10/3/2012	250.43	1630.40
11/9/2012	251.03	1629.80
12/7/2012	250.63	1630.20
1/4/2013	250.87	1629.96
2/1/2013	251.03	1629.80
3/6/2013	252.37	1628.46
4/3/2013	252.41	1628.42
5/10/2013	251.93	1628.90

Table 5.9 Well 171100
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
11/2/2011	288.68	2176.32
12/8/2011	288.64	2176.36
1/6/2012	288.43	2176.57
2/3/2012	288.68	2176.32
3/9/2012	289.46	2175.54

Table 5.10 Well 441147
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
11/2/2011	110.49	1760.51
12/8/2011	112.80	1758.20
1/6/2012	113.82	1757.18
2/3/2012	115.32	1755.68
3/9/2012	116.20	1754.80
4/4/2012	116.10	1754.90
5/1/2012	114.59	1756.41
6/12/2012	113.83	1757.17
8/3/2012	114.84	1756.16
9/6/2012	116.45	1754.55
10/3/2012	118.20	1752.80
11/9/2012	119.93	1751.07
12/7/2012	121.30	1749.70
1/4/2013	122.80	1748.20
2/1/2013	124.06	1746.94
4/3/2013	124.28	1746.72
5/10/2013	122.30	1748.70

Table 5.11 Well 167998
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
10/3/2011	19.5	2301.5
11/1/2011	20.45	2300.55
12/5/2011	19.8	2301.2
1/3/2012	21.15	2299.85
2/2/2012	20.67	2300.33
3/1/2012	19	2302
4/2/2012	15.77	2305.23
5/1/2012	14.5	2306.5
6/1/2012	15.35	2305.65
7/1/2012	16.3	2304.7
8/1/2012	18.15	2302.85
9/4/2012	19.7	2301.3
10/1/2012	20.85	2300.15
11/2/2012	20.85	2300.15
12/2/2012	20.35	2300.65
1/2/2013	20.15	2300.85
2/1/2013	20.32	2300.68
3/1/2013	16.65	2304.35
4/8/2013	14.47	2306.53
5/1/2013	15.41	2305.59

Table 5.12 Well 167996
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
9/1/2011	19.80	2,315.20
10/3/2011	19.10	2,315.90
11/1/2011	25.37	2,309.63
12/5/2011	27.82	2,307.18
1/3/2012	29.80	2,305.20
2/2/2012	30.62	2,304.38
3/1/2012	29.03	2,305.97
4/2/2012	26.40	2,308.60
5/1/2012	23.57	2,311.43
6/1/2012	26.50	2,308.50
7/1/2012	35.55	2,299.45
8/1/2012	28.40	2,306.60
9/4/2012	42.51	2,292.49
10/1/2012	45.95	2,289.05
11/2/2012	43.11	2,291.89
12/2/2012	44.08	2,290.92
1/2/2013	42.80	2,292.20
2/1/2013	41.84	2,293.16
3/1/2013	38.21	2,296.79
4/8/2013	28.91	2,306.09
5/1/2013	29.40	2305.60

Table 6 Supplmental Well Water Level Data

Table 6.1 Well 488063
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
1/21/2003	100	2275
1/29/2003	115	2260
2/7/2003	105	2270
3/15/2003	115	2260
4/17/2003	130	2245
4/23/2003	132	2243
5/6/2003	113	2262
5/13/2003	116	2259
5/27/2003	114	2261
6/11/2003	115	2260
6/30/2003	125	2250
7/15/2003	130	2245
9/17/2003	154	2221
9/23/2003	160	2215
10/7/2003	146	2229
10/16/2003	170	2205
12/10/2003	145	2230
12/28/2003	160	2215
1/10/2004	115	2260
1/30/2004	127	2248
3/29/2004	150	2225
1/25/2005	160	2215
2/11/2005	155	2220
3/16/2005	170	2205
4/12/2005	150	2225
5/25/2005	160	2215
6/29/2005	125	2250
7/16/2005	124	2251
9/28/2005	124	2251
10/11/2005	160	2215
11/8/2005	160	2215
12/5/2005	160	2215
1/3/2006	160	2215
1/30/2006	160	2215
2/14/2006	160	2215
3/7/2006	160	2215
3/21/2006	162	2213
4/11/2006	160	2215
4/25/2006	162	2213
5/10/2006	157	2218
5/31/2006	118	2257
6/14/2006	160	2215
6/26/2006	160	2215

Table 6.1 Well 488063
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
7/10/2006	160	2215
7/26/2006	160	2215
8/10/2006	160	2215
9/9/2006	140	2235
9/25/2006	150	2225
10/10/2006	150	2225
12/28/2006	160	2215
1/10/2007	160	2215
2/13/2007	155	2220
3/10/2007	160	2215
3/25/2007	170	2205
4/10/2007	142	2233
4/26/2007	145	2230
5/10/2007	135	2240
5/28/2007	145	2230
6/5/2007	133	2242
6/27/2007	152	2223
7/10/2007	133	2242
7/25/2007	145	2230
8/10/2007	145	2230
8/25/2007	150	2225
9/11/2007	106	2269
9/25/2007	107	2268
10/10/2007	105	2270
10/24/2007	100	2275
11/9/2007	100	2275
11/25/2007	100	2275
12/8/2007	95	2280
12/25/2007	93	2282
1/10/2008	80	2295
1/26/2008	80	2295
2/10/2008	95	2280
2/26/2008	129	2246
3/10/2008	156	2219
3/25/2008	122	2253
4/10/2008	120	2255
4/25/2008	80	2295
5/10/2008	105	2270
5/25/2008	124	2251
6/11/2008	120	2255
6/24/2008	120	2255
7/10/2008	120	2255
7/25/2008	115	2260

Table 6.1 Well 488063
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
8/10/2008	120	2255
8/25/2008	118	2257
9/10/2008	120	2255
9/25/2008	125	2250
10/10/2008	170	2205
10/25/2008	117	2258
11/10/2008	145	2230
11/25/2008	140	2235
12/10/2008	140	2235
12/28/2008	140	2235
1/11/2009	143	2232
1/25/2009	144	2231
2/10/2009	135	2240
2/25/2009	135	2240
3/10/2009	135	2240
3/25/2009	135	2240
4/6/2009	210	2165
4/24/2009	215	2160
5/10/2009	192	2183
5/25/2009	175	2200
6/10/2009	160	2215
6/25/2009	130	2245
7/10/2009	160	2215
7/25/2009	152	2223
8/10/2009	160	2215
8/26/2009	155	2220
9/10/2009	160	2215
9/25/2009	155	2220
10/10/2009	153	2222
10/26/2009	150	2225
11/10/2009	150	2225
11/25/2009	145	2230
12/11/2009	145	2230
12/25/2009	150	2225
1/11/2010	145	2230
1/19/2010	150	2225
2/10/2010	143	2232
2/25/2010	148	2227
3/10/2010	147	2228
4/10/2010	145	2230
4/25/2010	145	2230
5/10/2010	145	2230
5/27/2010	152	2223

Table 6 Supplmental Well Water Level Data

Table 6.1 Well 488063
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
6/10/2010	154	2221
6/25/2010	175	2200
7/10/2010	158	2217
8/10/2010	163	2212
8/25/2010	156	2219
9/10/2010	160	2215
9/25/2010	156	2219
10/11/2010	160	2215
10/26/2010	153	2222
11/9/2010	153	2222
11/25/2010	154	2221
12/10/2010	157	2218
1/10/2011	152	2223
1/25/2011	157	2218
2/10/2011	154	2221
2/25/2011	147	2228
3/10/2011	140	2235
3/25/2011	154	2221
4/10/2011	155	2220
4/25/2011	150	2225
5/15/2011	128	2247
5/25/2011	125	2250
6/10/2011	128	2247
6/25/2011	128	2247
7/10/2011	152	2223
7/25/2011	130	2245
8/10/2011	135	2240
8/26/2011	135	2240
9/10/2011	135	2240
9/25/2011	136	2239
10/13/2011	144	2231
10/25/2011	150	2225
11/18/2011	148	2227
11/25/2011	137	2238
12/10/2011	132	2243
12/25/2011	140	2235
1/10/2012	130	2245
1/25/2012	140	2235
2/10/2012	132	2243
2/25/2012	153	2222
3/10/2012	143	2232
3/25/2012	149	2226
4/10/2012	130	2245
4/25/2012	138	2237
5/1/2012	150	2225

Table 6.1 Well 488063
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
6/10/2012	135	2240
7/11/2012	128	2247
7/25/2012	130	2245
8/25/2012	150	2225
9/10/2012	138	2237
9/25/2012	157	2218
10/10/2012	160	2215
10/25/2012	145	2230
11/10/2012	175	2200
11/25/2012	147	2228
12/10/2012	147	2228
12/25/2012	147	2228
1/10/2013	114	2261
1/25/2013	155	2220
2/10/2013	155	2220
2/27/2013	117	2258
3/12/2013	157	2218
3/27/2013	115	2260
4/10/2013	127	2248
4/29/2013	137	2238

Table 6.2 Well 419534
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
1/10/2010	245	2131
9/25/2010	302	2074
2/1/2011	246	2130
3/12/2011	250	2126
6/25/2011	242	2134
12/6/2011	250	2126
12/10/2011	250	2126
2/11/2012	258	2118
7/5/2012	310	2066

Table 6 Supplmental Well Water Level Data

Table 6.3 Well VA_CMTRY
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
4/1/1955	177	2261
4/20/2007	282.05	2155.95
4/23/2007	282.60	2155.40
7/18/2007	288.00	2150.00
6/4/2008	284.75	2153.25
10/4/2010	288.91	2149.09
6/28/2012	286.59	2151.41

Table 6.4 Well FAFBMWD1
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
10/4/2010	141.58	2284.42
6/28/2012	140.94	2285.06

Table 6.5 Well 152024
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
1/16/1961	160	2223
12/15/1992	213	2170
4/1/1993	221	2162
9/15/1993	209	2174
12/15/1993	210	2173
6/15/1994	219	2164

Table 6.6 Well 292881
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
9/1/1957	160	2223
5/12/1966	165	2218
1/10/1967	162	2221
2/22/1967	166	2217
3/22/1967	161	2222
5/8/1967	159	2224
7/7/1967	168	2215
9/7/1967	165	2218
10/19/1967	169	2214
1/2/1968	168	2215
2/26/1968	166	2217
4/22/1968	168	2215
6/26/1968	168	2215
8/27/1968	164	2219
10/22/1968	164	2219
4/21/1969	167	2216
7/3/1969	166	2217
8/28/1969	172	2211
10/28/1969	166	2217
1/23/1976	174	2209
2/17/1977	179	2204

Table 6.7 Well 153821
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
4/11/1975	165	2202
1/23/1976	162	2205
2/17/1977	168	2199
4/26/1977	165	2202
2/15/1978	171	2196
10/10/1979	179	2188
3/21/1980	175.7	2191.3
12/4/1980	180.9	2186.1
3/24/1981	177.4	2189.6
5/27/1981	185	2182
10/23/1981	185.5	2181.5
3/26/1982	176.7	2190.3
10/15/1982	183.2	2183.8
3/29/1983	179.5	2187.5
10/6/1983	191.3	2175.7
4/6/1984	180	2187
11/7/1984	185.5	2181.5
4/25/1985	182	2185
10/14/1985	192.5	2174.5
4/17/1986	186.5	2180.5
10/21/1986	192.5	2174.5
4/28/1987	186.5	2180.5
10/21/1987	192.5	2174.5
4/21/1988	187.8	2179.2
5/9/1988	178	2189
10/11/1988	195.9	2171.1
5/1/1989	191.3	2175.7
10/4/1989	193.6	2173.4

Table 6 Supplmental Well Water Level Data

Table 6.8 Well 560746
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
10/10/1992	30.21	2426.23
3/17/1993	24.50	2431.94
4/1/1993	22.85	2433.59
4/12/1993	22.72	2433.72
6/29/1993	24.07	2432.37
10/8/1993	26.53	2429.91
2/24/1994	27.95	2428.49
5/12/1994	28.30	2428.14
9/8/1994	28.63	2427.81
12/19/1994	28.38	2428.06
3/31/1995	20.47	2435.97
7/17/1995	23.49	2432.95
10/9/1995	25.50	2430.94
12/18/1995	24.18	2432.26
3/18/1996	19.68	2436.76
6/19/1996	22.19	2434.16
8/19/1996	24.35	2432.00
9/20/1996	25.06	2431.29
10/18/1996	26.18	2430.17
10/22/1996	25.87	2430.48
11/26/1996	24.37	2431.98
12/19/1996	21.23	2435.12
1/16/1997	18.72	2437.64
2/24/1997	18.06	2438.30
3/18/1997	17.73	2438.63
7/15/1997	22.02	2434.34
10/14/1997	25.10	2431.26
1/5/1998	25.21	2431.15
5/5/1998	22.96	2433.40
7/22/1998	23.80	2432.56
10/14/1998	25.52	2430.84
1/18/1999	23.43	2432.93
4/27/1999	20.79	2435.57
8/4/1999	23.38	2432.98
12/3/1999	25.36	2431.00
2/25/2000	21.20	2435.16
5/23/2000	21.04	2435.32
7/11/2000	22.28	2434.08
8/21/2000	23.44	2432.92
11/6/2000	25.52	2430.84
2/20/2001	27.40	2428.96
5/15/2001	24.15	2432.21

Table 6.8 Well 560746
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
37117.00	24.82	2431.54
37179.00	26.48	2429.88
37298.00	22.88	2433.48
37382.00	21.68	2434.68
37480.00	23.60	2432.76
37578.00	26.31	2430.05
37690.00	22.78	2433.58
37775.00	22.52	2433.84
37872.00	23.90	2432.46
37956.00	25.72	2430.64
37956.00	25.72	2430.64
38033.00	23.59	2432.77
38124.00	22.92	2433.44
38181.00	20.29	2436.07
38320.00	26.54	2429.82
38404.00	25.41	2430.95
38489.00	24.50	2431.86
38588.00	24.40	2431.96
38691.00	26.64	2429.72
38776.00	20.17	2436.19
38873.00	20.99	2435.37
38951.00	19.12	2437.24
39063.00	24.65	2431.71
39118.00	23.82	2432.54
39237.00	22.45	2433.91
39384.00	25.62	2430.74
39622.00	22.13	2434.23
39770.00	26.00	2430.36
39972.00	22.13	2434.23
40126.00	25.13	2431.23
40350.00	22.85	2433.51
40437.00	24.52	2431.84
40518.00	25.27	2431.09
40612.00	19.67	2436.69
40700.00	19.91	2436.45
40779.00	22.51	2433.85
40876.00	24.74	2431.62

Table 6.9 Well 560732
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
10/10/1992	34.76	2423.49
3/17/1993	26.46	2431.79
4/1/1993	25.14	2433.11
4/12/1993	24.81	2433.44
6/30/1993	25.44	2432.81
10/8/1993	27.40	2430.85
2/24/1994	29.16	2429.09
5/12/1994	29.49	2428.76
9/8/1994	31.36	2426.89
12/19/1994	29.65	2428.60
3/31/1995	22.40	2435.85
7/17/1995	24.75	2433.50
10/9/1995	26.66	2431.59
12/18/1995	25.83	2432.42
3/18/1996	21.60	2436.65
6/19/1996	23.61	2434.70
8/19/1996	25.48	2432.83
9/20/1996	26.26	2432.05
10/18/1996	27.49	2430.82
10/23/1996	27.05	2431.26
11/26/1996	25.95	2432.36
12/19/1996	23.33	2434.98
1/16/1997	20.49	2437.60
2/5/1997	20.15	2437.94
2/6/1997	20.13	2437.96
2/10/1997	20.28	2437.81
2/14/1997	20.39	2437.70
2/24/1997	19.87	2438.22
2/25/1997	19.67	2438.42
2/26/1997	19.50	2438.59
3/18/1997	19.66	2438.43
7/15/1997	23.56	2434.53
10/14/1997	26.33	2431.76
1/5/1998	26.59	2431.50
5/5/1998	24.63	2433.46
7/22/1998	25.16	2432.93
10/14/1998	26.79	2431.30
1/18/1999	24.96	2433.13
4/27/1999	22.42	2435.67
8/4/1999	24.88	2433.21
12/3/1999	26.82	2431.27
2/25/2000	23.30	2434.79

Table 6 Supplmental Well Water Level Data

Table 6.9 Well 560732
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
5/23/2000	22.92	2435.17
7/11/2000	23.94	2434.15
8/21/2000	24.95	2433.14
11/6/2000	26.90	2431.19
2/20/2001	28.70	2429.39
5/15/2001	25.71	2432.38
8/13/2001	26.33	2431.76
10/15/2001	27.75	2430.34
2/11/2002	24.85	2433.24
5/6/2002	23.54	2434.55
8/12/2002	25.14	2432.95
11/18/2002	27.69	2430.40
3/10/2003	24.68	2433.41
6/3/2003	24.47	2433.62
9/8/2003	25.56	2432.53
12/1/2003	27.16	2430.93
2/16/2004	25.49	2432.60
5/17/2004	24.70	2433.39
7/13/2004	25.06	2433.03
11/29/2004	27.96	2430.13
2/21/2005	27.03	2431.06
5/17/2005	25.90	2432.19
8/23/2005	26.00	2432.09
12/5/2005	28.15	2429.94
2/28/2006	22.40	2435.69
6/5/2006	23.35	2434.74
8/22/2006	21.47	2436.62
12/12/2006	26.37	2431.72
2/5/2007	25.61	2432.48
6/4/2007	24.44	2433.65
10/29/2007	27.29	2430.80
6/23/2008	24.18	2433.91
11/18/2008	27.69	2430.40
6/8/2009	24.22	2433.87
11/9/2009	26.92	2431.17
6/21/2010	24.94	2433.15
9/16/2010	26.53	2431.56
12/6/2010	27.08	2431.01
3/10/2011	22.14	2435.95
6/7/2011	22.17	2435.92
8/24/2011	24.59	2433.50
11/29/2011	26.53	2431.56

Table 6.10 Well 560763
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
10/10/1992	40.06	2427.66
3/17/1993	36.02	2431.70
4/1/1993	34.63	2433.09
4/12/1993	34.24	2433.48
7/1/1993	34.76	2432.96
10/8/1993	36.75	2430.97
2/24/1994	38.49	2429.23
5/13/1994	39.00	2428.72
9/8/1994	39.32	2428.40
12/19/1994	39.15	2428.57
3/31/1995	31.73	2435.99
7/17/1995	34.07	2433.65
10/9/1995	36.00	2431.72
12/18/1995	35.22	2432.50
3/18/1996	30.94	2436.78
6/19/1996	32.98	2434.85
8/19/1996	34.80	2433.03
9/20/1996	35.58	2432.25
10/18/1996	36.76	2431.07
11/26/1996	35.36	2432.47
12/19/1996	32.78	2435.05
1/16/1997	29.74	2437.87
2/5/1997	29.45	2438.16
2/6/1997	29.45	2438.16
2/10/1997	29.57	2438.04
2/14/1997	29.66	2437.95
2/24/1997	29.18	2438.43
2/25/1997	28.97	2438.64
2/26/1997	28.79	2438.82
3/18/1997	29.01	2438.60
7/15/1997	32.90	2434.71
10/14/1997	35.65	2431.96
1/5/1998	35.93	2431.68
5/5/1998	34.05	2433.56
7/22/1998	34.65	2432.96
10/14/1998	36.13	2431.48
1/18/1999	34.20	2433.41
4/27/1999	31.75	2435.86
8/4/1999	34.24	2433.37
12/3/1999	36.16	2431.45
2/25/2000	33.70	2433.91
5/23/2000	32.26	2435.35

Table 6.10 Well 560763
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
7/11/2000	33.25	2434.36
8/21/2000	34.25	2433.36
11/6/2000	36.23	2431.38
2/20/2001	38.11	2429.50
5/15/2001	35.09	2432.52
8/13/2001	35.73	2431.88
10/15/2001	37.13	2430.48
2/11/2002	34.25	2433.36
5/6/2002	32.89	2434.72
8/12/2002	34.51	2433.10
11/18/2002	37.04	2430.57
3/10/2003	34.11	2433.50
6/3/2003	33.88	2433.73
9/8/2003	35.02	2432.59
12/1/2003	36.51	2431.10
2/16/2004	34.92	2432.69
5/17/2004	34.11	2433.50
7/13/2004	34.43	2433.18
11/29/2004	37.31	2430.30
2/21/2005	36.40	2431.21
5/17/2005	35.78	2431.83
8/23/2005	35.36	2432.25
12/5/2005	37.44	2430.17
2/28/2006	31.85	2435.76
6/5/2006	32.74	2434.87
8/22/2006	30.71	2436.90
12/12/2006	35.72	2431.89
2/5/2007	34.99	2432.62
6/4/2007	33.84	2433.77
10/29/2007	36.70	2430.91
6/23/2008	33.60	2434.01
11/18/2008	37.05	2430.56
6/8/2009	33.63	2433.98
11/9/2009	36.28	2431.33
6/21/2010	34.41	2433.20
9/16/2010	35.91	2431.70
12/6/2010	36.50	2431.11
3/10/2011	31.69	2435.92
6/7/2011	31.67	2435.94
8/24/2011	33.96	2433.65
11/29/2011	35.91	2431.70

Table 6 Supplmental Well Water Level Data

Table 6.11 Well 560736
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
10/10/1992	41.46	2427.77
3/17/1993	36.69	2432.54
4/1/1993	35.28	2433.95
4/12/1993	35.08	2434.15
7/1/1993	36.06	2433.17
10/8/1993	39.10	2430.13
2/24/1994	40.37	2428.86
5/13/1994	40.66	2428.57
9/8/1994	40.70	2428.53
12/19/1994	40.35	2428.88
3/31/1995	32.79	2436.44
7/17/1995	35.55	2433.68
10/9/1995	37.52	2431.71
12/18/1995	36.36	2432.87
3/18/1996	32.14	2437.12
6/19/1996	34.37	2435.00
8/19/1996	36.34	2433.03
9/20/1996	37.15	2432.22
10/18/1996	38.44	2430.93
11/26/1996	36.65	2432.72
12/19/1996	33.68	2435.69
1/16/1997	31.18	2438.10
2/10/1997	31.03	2438.25
2/14/1997	31.15	2438.13
2/18/1997	30.69	2438.59
2/19/1997	30.31	2438.97
2/20/1997	30.44	2438.84
2/24/1997	30.52	2438.76
2/25/1997	30.34	2438.94
2/26/1997	30.16	2439.12
3/18/1997	30.24	2439.04
7/15/1997	34.31	2434.97
10/14/1997	37.28	2432.00
1/5/1998	37.35	2431.93
5/5/1998	40.67	2428.61
7/22/1998	35.96	2433.32
10/14/1998	37.77	2431.51
1/18/1999	35.55	2433.73
4/27/1999	33.03	2436.25
8/4/1999	35.52	2433.76
12/3/1999	37.53	2431.75
2/25/2000	33.70	2435.58

Table 6.11 Well 560736
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
5/23/2000	33.46	2435.82
7/11/2000	34.50	2434.78
8/21/2000	35.57	2433.71
11/6/2000	37.68	2431.60
2/20/2001	39.56	2429.72
5/15/2001	36.36	2432.92
8/13/2001	36.97	2432.31
10/15/2001	38.56	2430.72
2/11/2002	35.32	2433.96
5/6/2002	34.07	2435.21
8/12/2002	35.78	2433.50
11/18/2002	38.50	2430.78
3/10/2003	35.19	2434.09
6/3/2003	34.90	2434.38
9/8/2003	36.13	2433.15
12/1/2003	37.93	2431.35
2/16/2004	35.98	2433.30
5/17/2004	35.27	2434.01
7/13/2004	35.36	2433.92
11/29/2004	38.77	2430.51
2/21/2005	37.70	2431.58
5/17/2005	36.91	2432.37
8/23/2005	36.58	2432.70
12/5/2005	38.93	2430.35
2/28/2006	32.82	2436.46
6/5/2006	33.91	2435.37
8/22/2006	31.87	2437.41
12/12/2006	37.01	2432.27
2/5/2007	36.19	2433.09
6/4/2007	34.89	2434.39
10/29/2007	37.98	2431.30
6/23/2008	34.65	2434.63
11/18/2008	33.82	2430.99
6/8/2009	30.10	2434.71
11/9/2009	32.81	2432.00
6/21/2010	30.65	2434.16
9/16/2010	32.36	2432.45
12/6/2010	33.05	2431.76
3/10/2011	27.74	2437.07
6/7/2011	27.87	2436.94
8/24/2011	30.46	2434.35
11/29/2011	32.62	2432.19

Table 6.12 Well 472535
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
4/11/2002	159.05	2124.35
5/6/2002	157.18	2126.22
5/21/2002	157.10	2126.30
6/11/2002	157.35	2126.05
6/25/2002	157.60	2125.80
7/11/2002	157.90	2125.50
7/25/2002	158.45	2124.95
8/6/2002	158.92	2124.48
8/20/2002	159.45	2123.95
9/5/2002	160.00	2123.40
9/19/2002	160.78	2122.62
10/1/2002	160.75	2122.65
10/15/2002	161.00	2122.40
10/31/2002	161.51	2121.89
11/14/2002	162.00	2121.40
11/26/2002	162.50	2120.90
12/12/2002	163.10	2120.30
12/26/2002	163.75	2119.65
1/9/2003	164.14	2119.26
1/23/2003	163.35	2120.05
2/6/2003	162.08	2121.32
2/19/2003	158.50	2124.90
3/6/2003	157.16	2126.24
3/17/2003	156.90	2126.50
4/1/2003	156.40	2127.00
4/17/2003	155.25	2128.15
4/29/2003	154.74	2128.66
5/15/2003	154.55	2128.85
5/27/2003	154.70	2128.70
6/10/2003	154.70	2128.70
6/26/2003	154.90	2128.50
7/8/2003	155.35	2128.05
7/24/2003	156.05	2127.35
12/4/2003	162.40	2121.00
1/21/2004	163.50	2119.90
2/23/2004	162.80	2120.60
3/30/2004	157.40	2126.00
5/19/2004	157.30	2126.10
6/22/2004	156.30	2127.10
7/26/2004	157.50	2125.90
8/25/2004	158.50	2124.90
9/22/2004	159.20	2124.20

Table 6 Supplmental Well Water Level Data

Table 6.12 Well 472535
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
10/20/2004	160.10	2123.30
11/23/2004	160.90	2122.50
12/21/2004	163.00	2120.40
1/26/2005	163.60	2119.8
2/15/2005	163.60	2119.8
3/30/2005	163.60	2119.8
4/29/2005	166.10	2117.3
5/25/2005	164.10	2119.3
6/27/2005	163.30	2120.1
8/4/2005	163.60	2119.8
8/30/2005	164.40	2119
9/30/2005	165.40	2118
10/28/2005	166.80	2116.6
11/28/2005	166.20	2117.2
12/29/2005	168.40	2115
1/31/2006	168.10	2115.3
3/1/2006	166.70	2116.7
4/20/2006	149.50	2133.9
5/25/2006	149.40	2134
6/28/2006	149.40	2134
8/9/2006	151.30	2132.1
9/29/2006	154.40	2129
10/31/2006	155.10	2128.3
12/19/2006	157.20	2126.2
1/24/2007	157.70	2125.7
3/5/2007	156.30	2127.1
4/26/2007	148.70	2134.7
5/31/2007	150.40	2133
6/22/2007	151.50	2131.9
7/27/2007	152.10	2131.3
8/24/2007	154.30	2129.1
10/26/2007	158.60	2124.8
6/9/2008	149.90	2133.5
7/14/2008	143.60	2139.8
8/26/2008	153.10	2130.3
9/26/2008	155.20	2128.2
10/28/2008	156.70	2126.7
11/21/2008	158.30	2125.1
4/20/2009	146.90	2136.5
5/29/2009	147.00	2136.4
6/18/2009	147.80	2135.6
7/29/2009	148.70	2134.7

Table 6.12 Well 472535
Water Level Measurments

Date	Depth to Water	Ground Water Elevation
8/21/2009	151.40	2132.0
9/29/2009	152.20	2131.2
10/28/2009	153.70	2129.7
11/30/2009	155.30	2128.1
5/28/2010	154.60	2128.8
6/29/2010	153.90	2129.5
7/29/2010	154.60	2128.8
8/25/2010	155.20	2128.2
9/29/2010	155.60	2127.8
11/5/2010	155.00	2128.4
3/29/2011	147.50	2135.9
4/29/2011	146.90	2136.5
6/1/2011	139.00	2144.4
6/30/2011	140.50	2142.9
7/22/2011	142.40	2141.0
8/17/2011	143.40	2140.0
9/28/2010	145.60	2137.8
11/3/2011	148.20	2135.2
1/4/2012	153.40	2130.0

Table 6 Supplmental Well Water Level Data

Table 6.13 Water Level Data from Deobald & Buchanan, 1995

Well ID	Spring Measurment			Fall Measurment		
	Date	Depth to Water	Ground Water Elevation	Date	Depth to Water	Ground Water Elevation
152024	5/1/94	210	2170	9/1/94	219	2161
152942	-	-	-	10/18/94	13	2337
153951	5/16/94	9	2296	10/14/94	10	2295
155391	5/10/94	53	2222	10/14/94	58	2217
155971	5/2/94	59	2431	10/12/94	62	2428
155972	5/9/94	48	2382	10/12/94	50	2380
156157	5/2/94	16	2409	10/12/94	25	2400
158603	5/2/94	2	2383	10/12/94	7	2378
159725	-	-	-	12/1/94	125	2300
162956	5/9/94	87	2343	10/12/94	89	2341
163156	5/9/94	19	2371	10/12/94	21	2369
163263	5/10/94	162	1988	10/18/94	163	1987
163881	5/9/94	61	2299	10/12/94	59	2301
163975	5/2/94	41	2379	-	-	-
164297	5/17/94	283	1882	10/14/94	296	1869
164862	-	-	-	9/22/94	365	1795
165140	5/31/94	103	1892	10/18/94	104	1891
165243	5/3/94	27	2383	10/12/94	31	2379
165412	5/10/94	274	2146	-	-	-
166611	-	-	-	9/22/94	438	1722
167003	5/16/94	30	2280	10/14/94	32	2278
167325	5/9/94	17	2403	10/12/94	20	2400
167674	5/9/94	18	2352	10/12/94	26	2344
168213	5/3/94	41	2339	10/12/94	53	2327
169122	5/10/94	243	1977	10/18/94	238	1982
169441	5/9/94	51	2369	-	-	-
169800	5/15/94	258	1992	10/21/94	258	1992
170008	5/2/94	8	2352	10/12/94	10	2350
170280	5/17/94	243	2012	10/14/94	244	2011
170959	5/3/94	34	2341	10/12/94	27	2348
171796	5/23/94	337	1803	10/18/94	337	1803
171979	5/9/94	60	2310	10/12/94	71	2299
172268	5/24/94	259	2051	10/18/94	261	2049
172509	5/2/94	18	2392	10/12/94	22	2388
173811	5/3/94	32	2348	10/12/94	35	2345
174062	5/3/94	18	2387	10/12/94	21	2384
174533	5/10/94	64	2296	10/20/94	98	2262
174644	5/15/94	312	1953	10/14/94	313	1952
293463	5/3/94	9	2361	10/12/94	15	2355
344216	9/22/94	555	1625			
163119 & 16312	5/16/94	63	2397			