MEMORANDUM

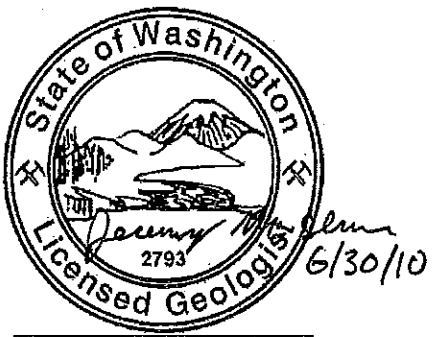
Project No.: 070024-12

June 30, 2010

To: Dave McClure, Klickitat County Department of Natural Resources

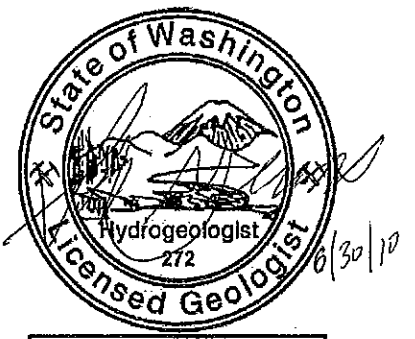
cc: WRIA 30 Planning and Advisory Committee

From:



Jeremy Michael Shaha

Jeremy M. Shaha, LG
Senior Staff Hydrogeologist



Steve J. Germiat

Steve J. Germiat, LHG, CGWP
Senior Associate Hydrogeologist

Re: **Little Klickitat Subbasin Water Level Monitoring Report, WRIA 30**

Project Objectives

In 2007, the Water Resource Planning and Advisory Committee (PAC) for Water Resource Inventory Area (WRIA) 30 received funding from the Washington State Department of Ecology (Ecology) to conduct a more detailed assessment of hydrologic and water use conditions in both the Swale Creek and Little Klickitat subbasins of WRIA 30 (Figure 1). The assessment provided additional information to help address data gaps regarding water availability on a subbasin scale, and thus support Ecology's processing of pending applications for new water rights in the subbasin (Aspect Consulting, 2007).

As part of the 2007 water availability study, water level monitoring networks were established for the two subbasins. Since June 2007, water level measurements have continued to be collected on a semi-annual basis in the well networks to begin assessment of long-term trends in groundwater levels, which helps determine sustainability of existing groundwater withdrawals and thus water availability. The semi-annual measurements have generally been collected corresponding to pre-irrigation (spring) and post-irrigation (autumn) conditions.

Subsequently, Ecology has provided additional funding (Grant No. G1000101) to expand the Little Klickitat subbasin monitoring network and provide annual water level monitoring data analysis and reporting. This memorandum provides a summary of the expansion of the Little Klickitat subbasin water level monitoring network and the water level measurements to date (since June 2007).

Setup of Expanded Well Monitoring Network

Klickitat County Department of Natural Resources (DNR) personnel conducted a field reconnaissance May 24-27, 2010, with the objective of identifying accessible existing wells to include in the expanded water level monitoring network for Little Klickitat subbasin. The setup of the water level monitoring network was conducted in accordance with the Quality Assurance Project Plan prepared for the project (Aspect Consulting, 2010). Prior to the field reconnaissance, both Klickitat County DNR and Aspect Consulting personnel contacted local well owners to request permission to include their well in the water level monitoring network and inform them of the study objectives.

Following completion of the field reconnaissance, 5 new wells were added to the Little Klickitat subbasin water level monitoring network, bringing the total number of wells to 10. Table 1 presents information regarding construction of the wells in the network, and their water level measurements to date. Figure 2 depicts the locations of the wells included in the current Little Klickitat subbasin water level monitoring network.

During the May 2010 water level measurements, permission was obtained from the well owners to contact them again for additional water level measurements in the future, dependent on continued funding. No wells will be measured without owner permission.

Field Procedures

Prior to the field reconnaissance for expanding the well network, addresses of prospective wells to be included in the water level monitoring network were compiled based on well locations from Ecology's well log database. Additional wells were added to the prospective water level monitoring network list based on personal contacts of local community members.

The prospective water level monitoring network wells were prioritized in order to (1) provide spatial coverage of the basin and (2) provide a representative number of wells completed in the various aquifers to allow for differentiation of water levels within the respective hydrostratigraphic units. Within Little Klickitat subbasin, the thin veneer of unconsolidated alluvium occurring locally is not considered to be an important water supply aquifer due to the limited number of wells completed within the respective unit; therefore, for the purposes of this assessment, the alluvium aquifer has not currently been included in the water level monitoring network.

Once the list of prospective wells was established, well owners were contacted to request permission to access their wells as part of the field reconnaissance. Only wells for which owner permission was granted were visited as part of the field reconnaissance. If permission was not granted for a well in an area of needed spatial coverage, the well owner of a lower priority prospective water level monitoring network well was contacted in its place. If a well owner granted permission to access their well, but wanted to be present during the measurements, personnel from Klickitat County DNR called and set up a time with the respective owner in which to do so.

During the field reconnaissance, each wellhead was examined in the field to determine whether an access port was available for the respective water level measurements. If suitable

access existed, the depth-to-water in the well was measured. Because most of the wells measured had pumps installed, care was taken to avoid getting the electric water level indicator, if used, caught on pump wiring or other items in the well. Only wells for which water levels could be readily measured were retained as part of the water level monitoring network. The location of the wells retained for the water level monitoring network were documented with field notes, photographs, and GPS-surveyed locations.

Well Survey

Wells included in the original well network were surveyed (x, y, z) by a licensed surveyor with Klickitat County Public Works, as described in Aspect Consulting (2007). There was insufficient time, prior to close of the contract for this work (ending June 30, 2010), to have the wells in the expanded network surveyed. However, these wells will be surveyed at a later date, and the data reported in the subsequent report. For this report, the locations of the expanded network wells are presented based on GPS locations collected by Klickitat County DNR personnel. This includes the City of Goldendale's Third Street and Dingmon wells, which were added to the water level monitoring network in November 2007. Table 1 only includes survey data for wells which were a part of the original (2007) water level monitoring network (Aspect Consulting, 2007).

Water Level Measurements

Depth-to-water measurements were conducted in all network wells using either an electric water level indicator (tape) or a sonic water level indicator (sounder)[1]. The former provides greater precision, but has the significant disadvantage of potentially becoming permanently caught on wiring or other appurtenances within the well casing. The latter has less precision but is much faster to use, and more importantly, does not have the risk of becoming caught in the well. The QAPP for this project provides a quality control (QC) comparability evaluation between the tape and sonic sounder based on measurements collected since 2007; the evaluation documents reliability of the sonic sounder for measuring depths-to-water less than about 250 feet (Aspect Consulting, 2010).

All depth-to-water measurements were made in accordance with the project-specific QAPP, and relative to the top of well casing or other defined measuring point at the wellhead. The selected measuring point for each well was marked in magic marker if possible, and was documented in the field form so that it can be reproduced during subsequent measurement rounds. Other pertinent information regarding the well or the measuring of water levels in it were also recorded in the field notes.

If a downhole water level indicator was used for the depth-to-water measurement, the lower couple of feet of tape was rinsed and wiped with a clean paper towel. Any rust or other visible material on the water level indicator after a measurement was also wiped off using a clean paper towel prior to the next measurement.

A table of static water level measurements from either the respective well logs or previous monitoring event was carried in the field. Measurements that varied greatly from past

[1] Global Water WL600 or equivalent instrument.

measurements in a given well (accounting for differences between spring and fall) were repeated for confirmation.

Description of Well Monitoring Network Aquifers

A generalized geologic history of the Little Klickitat subbasin is provided in the WRIA 30 Level 1 watershed assessment (WPN and Aspect Consulting, 2004). Water-bearing hydrostratigraphic units within the study area include (from youngest to oldest):

- Simcoe Mountains volcanic deposits;
- Wanapum basalt (Priest Rapids, Roza, and Frenchman Springs members); and
- Grand Ronde basalt.

The Wanapum and Grande Ronde basalts are formations within the Columbia River Basalt Group (CRBG). Groundwater in the CRBG primarily occurs in the top of the individual flows ("flow top"), which became vesicular (porous) as gas bubbles escaped the flows during cooling, and/or at the flow bottoms (sometimes referred to as "pillows"). Flow tops and bottoms – collectively referred to as interflow zones - are usually porous and permeable, and therefore transmit water more readily than the intervening massive portions of the basalt flow interior, which generally constitute flow barriers, except where fractured. For wells completed in the interflow zones between the various basalt units, water levels are considered to be representative of the underlying basalt aquifer. A permeable flow top is normally present for each flow, while permeable flow bottoms range from relatively thick units to completely absent. The lateral continuity of water-bearing interflow zones is highly variable. Within the Goldendale area of Little Klickitat subbasin, a majority of the wells completed in the CRBG are completed in the interflow zones of the Wanapum basalt aquifer (Priest Rapids, Roza, and Frenchman Springs members). The water level monitoring network includes no wells completed solely in the Grande Ronde basalt aquifer.

In addition, terrestrial sediments can be deposited between the underlying flow top and overlying flow bottom during time periods between basalt flows. These sediments are collectively considered part of the Ellensburg Formation and can be either relatively permeable or impermeable; depending on composition, thickness, and lateral extent. Both the lateral continuity and thickness of the water-bearing interflow zones are highly variable.

Simcoe Mountains Volcanic Aquifer

The Simcoe Mountains volcanic deposits are generally composed of basalt flows and volcanic cinder erupted from a series of low shield volcanoes and subsidiary cinder cones within the local area. Within Little Klickitat subbasin, particularly the Goldendale area, the Simcoe Mountains volcanic deposits are a prolific aquifer.

Of the 11 wells included in the Little Klickitat subbasin water level monitoring network, there are currently 2 wells completed in the Simcoe Mountains volcanic aquifer (T05/R14-R1 and T05/R15-19L1). Figure 2 provides the location of these wells. Additional wells completed in the Simcoe Mountains volcanic aquifer may need to be added in order to

improve spatial coverage of groundwater level monitoring in this aquifer. One well which could be included in a further expansion of the Little Klickitat subbasin water level monitoring network is the City of Goldendale's Chlorination Station well, located in Section 21 of T05/R16.

Wanapum Basalt Aquifer

Of the 11 wells included in the Little Klickitat subbasin water level monitoring network, there are currently 9 wells completed in the Wanapum basalt aquifer. Figure 2 provides the location of these wells.

Summary of Groundwater Level Measurements

Table 1 provides a summary of the groundwater level measurements from the Little Klickitat subbasin water level monitoring network to date. Evaluation of long-term trends in groundwater levels provides insight regarding aquifer response to precipitation patterns and sustainability of the existing level of groundwater withdrawal.

Long-Term Groundwater Level Trends

Long-term groundwater level trends can be evaluated for the 4 wells included in the water level monitoring network as part of the Hydrologic Information Report Supporting Water Availability Assessment, Swale Creek and Little Klickitat Subbasins, WRIA 30 (Aspect Consulting, 2007). Groundwater level measurements for these wells have been made on a semi-annual basis (pre-irrigation and post-irrigation) since June 2007. In addition, semi-annual water level measurements for the City of Goldendale's Third Street (T04/R16-16Q1) and Dingmon (T04/R16-28A1) wells have been collected since November 2007. Figure 3 provides long-term groundwater level hydrographs for these wells, all of which are completed in the Wanapum basalt aquifer. Since there is only one round of water level measurements (May 2010) for the wells included in the expansion of Little Klickitat subbasin water level monitoring network, long-term groundwater level trends will not be evaluated for these wells at this time. Therefore, there are currently no long-term hydrographs for wells completed in the Simcoe Mountains volcanic aquifer.

Wanapum Basalt Aquifer

Based on the hydrographs on Figure 3, none of the Wanapum basalt aquifer wells monitored showed any significant long-term decrease in groundwater levels during the period of monitoring (2007 - 2010). Seasonal changes of up to 10 feet were observed in several of the Wanapum basalt aquifer wells (T04/R15-26H1, T04/R16-16Q1, and T04/R16-28A1). For these wells, the lowest groundwater levels were consistently observed during the post-irrigation measurements (November) and the highest groundwater levels were consistently observed during pre-irrigation measurements (April - June). The seasonal declines in the water levels are primarily in response to pumping; however, the water levels have consistently recovered on an annual basis over the period of record. The available data indicate that the Wanapum basalt aquifer storage is not being depleted and that current and recent historical pumpage in Little Klickitat subbasin is sustainable on a regional scale.

In addition, the Wanapum basalt aquifer storage in Little Klickitat subbasin has not been depleted during a generally below-average period of precipitation. Figure 4 presents both the annual precipitation and the mean annual precipitation (upper portion of figure) and the cumulative departure from the mean annual precipitation (lower portion of figure) in Goldendale (NOAA Station #453222) and at Satus Pass (NOAA Station #457342) for the period of record (1931 - 2009)[2]. Note that individual months with more than 5 days of missing data were not used for monthly or annual precipitation statistics (so those years are not displayed on Figure 4).

With the exception of 1995-1998 (based on Goldendale data[3]) and 2006 (based on Satus Pass data), annual precipitation has been at or below the mean annual precipitation since 1984. However, the below-average precipitation has not appeared to affect groundwater levels in the Wanapum basalt aquifer, indicating that the aquifer may be able to handle additional withdrawals.

Recommendations

It is recommended that the expanded water level monitoring network continue to be monitored on at least a semi-annual basis (pre-irrigation and post-irrigation measurements), subject to availability of funding. Although an effort was made to expand the Little Klickitat subbasin water level monitoring network in 2010, only 5 additional wells were added based on permissions received from well owners. Therefore, it is recommended that, when possible, the Little Klickitat subbasin water level monitoring network be expanded to include additional wells, especially wells completed in the Simcoe Mountains volcanics aquifer in the northern portion of the subbasin.

Limitations

Work for this project was performed and this memorandum prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of Klickitat County for specific application to the referenced property. This memorandum does not represent a legal opinion. No other warranty, expressed or implied, is made.

[2] The cumulative departure plot is an effective way to illustrate longer-term trends in precipitation which influence groundwater levels regionally (e.g. extended wet or drought periods). The absolute values on the plot's y axis have little meaning since they depend on the year started. However, the scale of the y axis and shape of the curve are not dependent on year started.

[3] The 1995 and 1998 data points for Goldendale are not plotted because of gaps in the daily record; however, even with the missing data the annual precipitation is at or above average.

References

Aspect Consulting 2007, Hydrologic Information Report Supporting Water Availability Assessment, Swale Creek and Little Klickitat Subbasins, WRIA 30, Prepared for WRIA 30 Water Resource Planning & Advisory Committee, June 29, 2007.

Aspect Consulting 2010, Quality Assurance Project Plan for Water Level Monitoring – WRIA 30, April 9, 2010.

WPN and Aspect Consulting, 2004, WRIA 30 Level I Watershed Assessment, January 2005.

Attachments:

Table 1 – Water Level Monitoring Network Data for Little Klickitat Subbasin
Figure 1 – Little Klickitat Subbasin
Figure 2 – Little Klickitat Subbasin Water Level Monitoring Network
Figure 3 – Groundwater Hydrographs
Figure 4 – Long-term Precipitation Analysis

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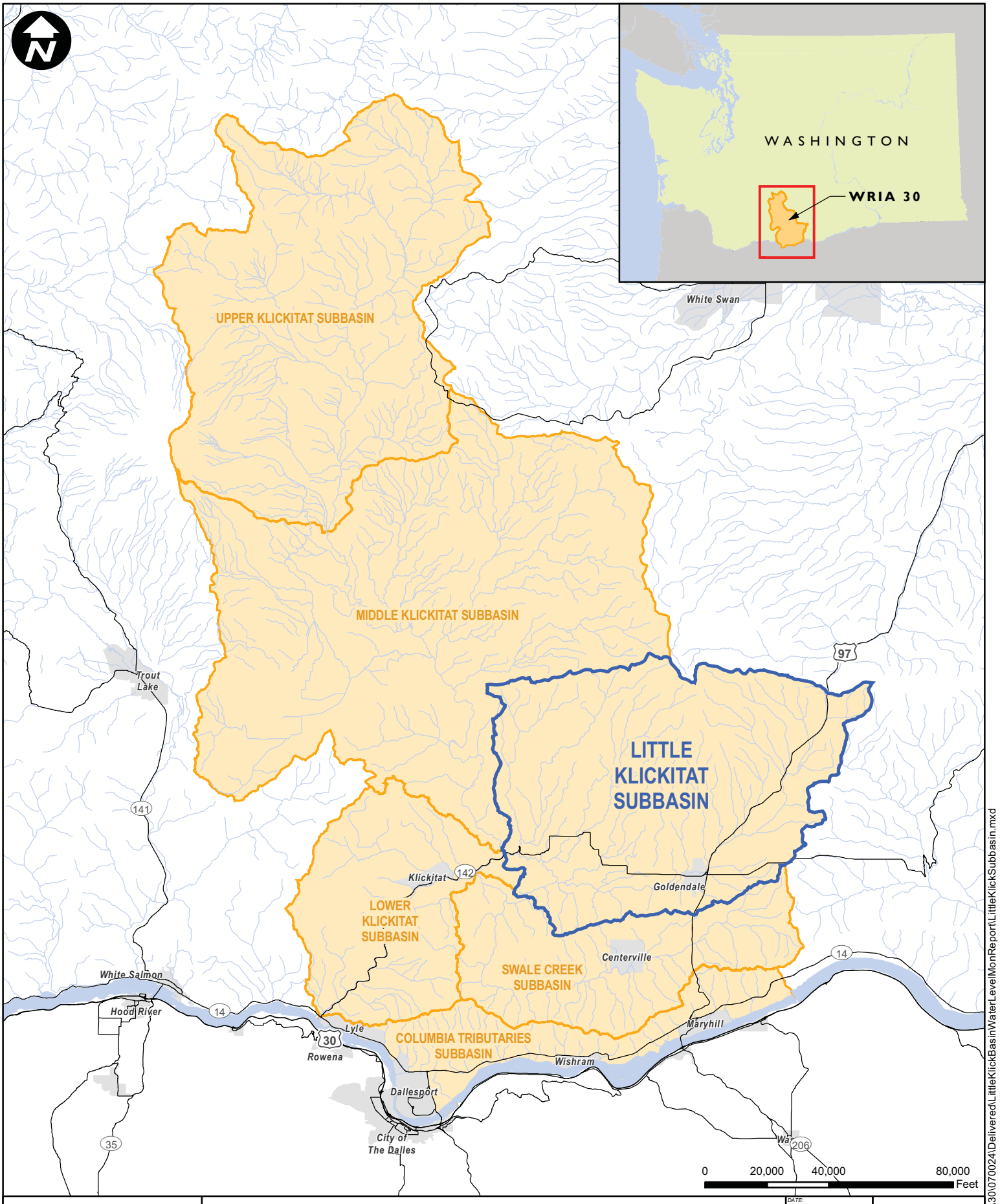
Table 1 - Water Level Monitoring Network Data

Little Klickitat Subbasin Annual Monitoring Report
WRIA 30, Washington

Contact Information		Ecology Well Log Data							GPS Coordinates		Well Survey Data				June 2007 Measurements			November 2007 Measurements			April 2008 Measurements			December 2008 Measurements			April 2009 Measurements			December 2009 Measurements			May 2010 Measurements		
Well Owner	Well Address/Name	Ecology Well Log ID	Well Log Name	TRS Label	Completion Date	Dia (in)	Depth (ft)	Aquifer	Northing[1] (SPS 83; ft)	Easting[1] (SPS 83; ft)	Northing[1] (SPS 83; ft)	Easting[1] (SPS 83; ft)	Wellhead Elevation[2] (ft MSL)	Casing Stick-up (ft)	Depth to Water (ft bTOC)	GW Elevation[2] (ft)	Comments	Depth to Water (ft bTOC)	GW Elevation[2] (ft)	Comments	Depth to Water (ft bTOC)	GW Elevation[2] (ft)	Comments	Depth to Water (ft bTOC)	GW Elevation[2] (ft)	Comments	Depth to Water (ft bTOC)	GW Elevation[2] (ft)	Comments	Depth to Water (ft bTOC)	GW Elevation[2] (ft)	Comments	Depth to Water (ft bTOC)	GW Elevation[2] (ft)	Comments
Stan & Josie Casswell	356 Largent Rd.	191874	JESSIE CASSWELL	T04/R15-26H1	5/25/99	6	395	Wanapum	-	-	172446.7	1541300.9	1567.9	1.5	34.4	1533.6	Rising water level	30.9	1537.0		22.5	1545.4	Rising water level	28.8	1539.1		20.7	1547.2		26.8	1541.1		21.2	1546.7	
Raymond Manning	Mustang Dr. & Morgan Ct.	417943	RAYMOND MANNING	T04/R15-29M1	7/25/05	6	500	Wanapum	-	-	171181.3	1521711.9	1689.3	2.29	294.9	1394.4		294.2	1395.1		294.6	1394.7		294.1	1395.2		292.8	1396.5		292.6	1396.7		295.5	1393.8	
Gary Burgess	Horseshoe Bend Rd.	302767	GARY BURGESS	T04/R15-29Q1	12/11/00	6	240	Wanapum	-	-	169640.1	1524932.9	1720.3	1.5	138.9	1581.4		138.4	1581.9		138.4	1581.9		138.3	1581.9		137.0	1583.3		138.0	1582.3		137.6	1582.7	
Dick Case	556 Pine Forest Rd.	138933	DICK CASE	T04/R15-2F1	2/17/78	10	495	-	-	-	-	-	-	-	-	-		-	-		-	-		-	-		-	-		-	-		-	-	No access port
Regan Eberhart	Appaloosa Court	521074	REGAN EBERHART	T04/R15-32F1	2/3/07	6	416	Wanapum	-	-	167372.0	1522129.5	1801.8	3.27	177.9	1624.0		177.4	1624.4		178.8	1623.1		-	-	No permission	-	-	No permission	-	-	No permission	-	-	No permission
City of Goldendale[3]	3rd Street	324536	CITY OF GOLDENDALE	T04/R16-16Q1	7/18/00	20	488	Wanapum	179799.65	1561298.18	-	-	-	-	-	-		15.6	-		11.9	-		15.8	-		12.2	-		14.9	-		13.1	-	
Fairgrounds - Klickitat County		139743	FAIRGROUNDS - KLICKITAT COUNTY	T04/R16-17P1	7/19/78	8	600	Wanapum	181936.85	1555219.18	-	-	-	1.8	-	-		-	-		-	-		-	-		-	-		-	-		39.2	-	
City of Goldendale[3]	Dingmon	205211	DWIGHT DINGMON	T04/R16-28A1	1/3/72	10	534	Wanapum	173729.91	1563257.17	-	-	-	-	-	-		89.6	-		83.6	-		89.5	-		84.2	-		90.5	-		85.5	-	
Terry Smith	729 Pine Forest Rd.	132923	TERRY SMITH	T05/R14-14R1 T05/R15-27A1	5/22/79	6	300	Simcoe Mountains	205011.39	1535993.79	-	-	-	2.6	-	-		-	-		-	-		-	-		-	-		-	-		310.2	-	
Vic Blandine	766 Thompson Rd.	191916/ 380146	VIC BLANDINE	T05/R15-19L1	5/14/04	6	320	Simcoe Mountains	208782.22	1517620.06	-	-	-	1.3	-	-		-	-		-	-		-	-		-	-		-	-		246.4	-	Well Tag AEG 169
Grady Bradley	381 Pothole Rd.	479802	GRADY BRADLEY	T05/R15-23B1	4/24/07	6	840	-	-	-	-	-	-	-	-	-		-	-		-	-		-	-		-	-		-	-		-	-	No access port
Paul Fasnacht	446 Austin Rd.	465677	PAUL FASNACHT	T05/R16-27M1	10/13/06	6	675	Wanapum	203032.38	1563796.83	-	-	-	0.7	-	-		-	-		-	-		-	-		-	-		-	-		416.7	-	
Brandon & Brooke Johnson	14 Just Another Rd.	588746	BRANDON & BROOKE JOHNSON	T05/R16-35H1	4/30/09	6	462	Wanapum	197284.54	1573553.31	-	-	-	1.8	-	-		-	-		-	-		-	-		-	-		-	-		209.5	-	

[1] Northing and Easting coordinates are in Washington South State Plane coordinate system (NAD 1983 datum).
[2] All elevations are in NAVD 1988 datum.
[3] Indicates wells included in the City of Goldendale's groundwater level monitoring program.



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Little Klickitat Subbasin

Little Klickitat Subbasin Annual Water Level Monitoring Report
WRIA 30, Washington

DATE: June 2010	PROJECT NO. 070024
DESIGNED BY: SJG	
DRAWN BY: PPW	FIGURE NO. 1
REVISED BY: -	

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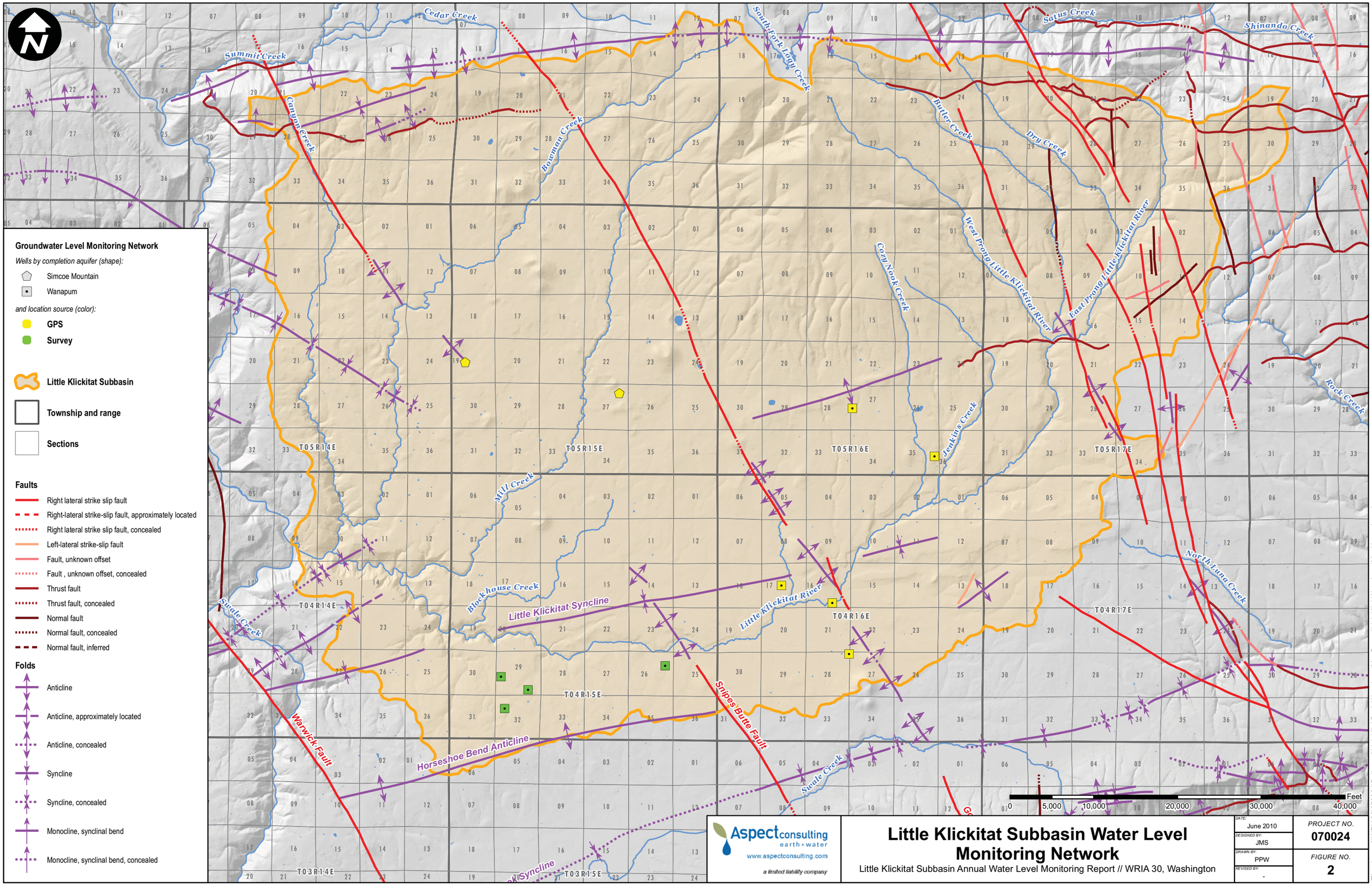

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Little Klickitat Subbasin Water Level Monitoring Network

Little Klickitat Subbasin Annual Water Level Monitoring Report // WRIA 30, Washington

DATE: June 2010	PROJECT NO. 070024
DESIGNED BY: JMS	
DRAWN BY: PPW	FIGURE NO. 2
REVISED BY: -	

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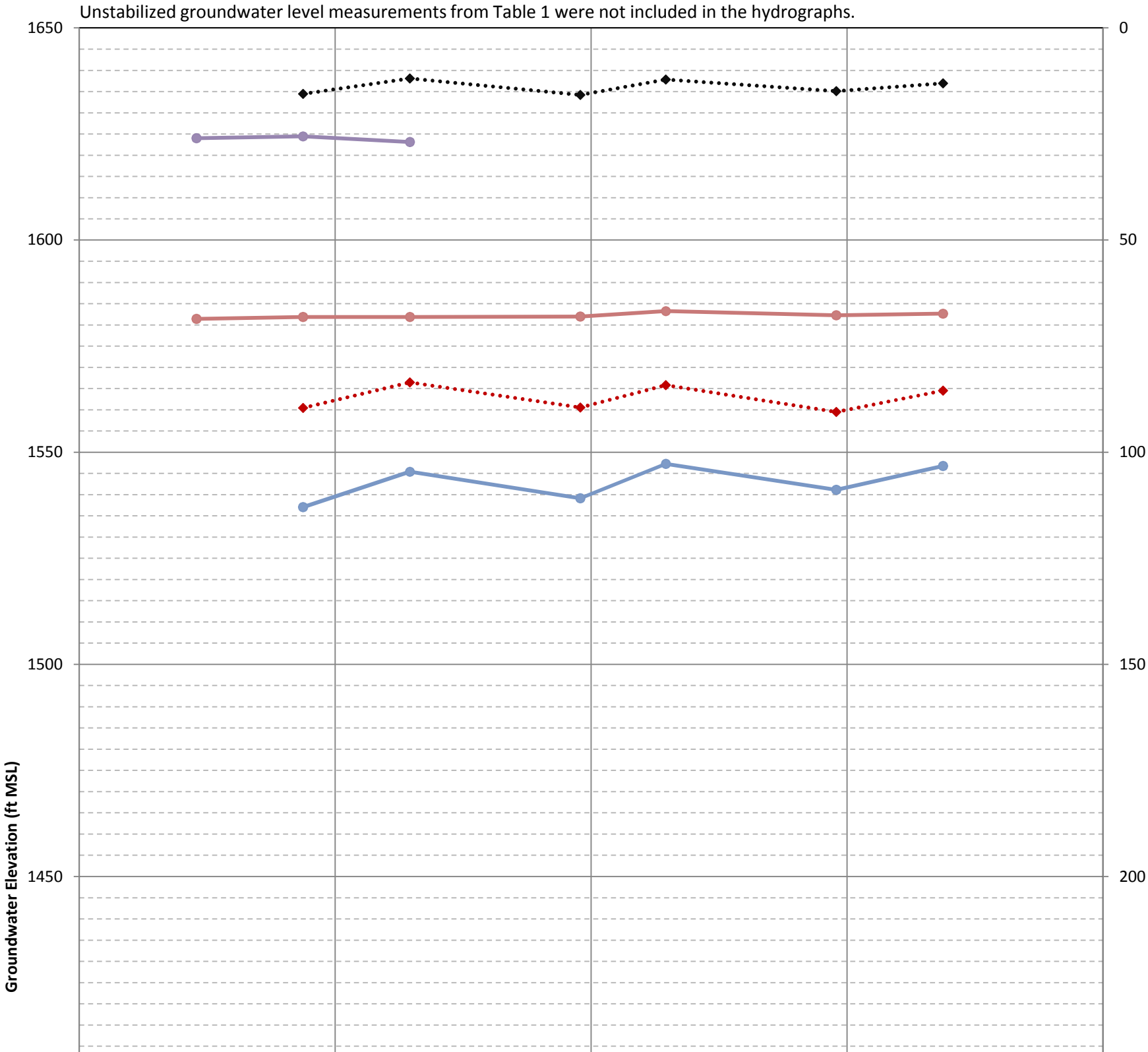
Notes:
Dotted hydrographs are presented as depth-to-water (secondary axis).
Unstabilized groundwater level measurements from Table 1 were not included in the hydrographs.



Aspect Consulting
6/30/10
V:\070024 WRIA 30 Phase 4\Deliverables\Water Level Monitoring Report\Table 1 Fig 3 - Groundwater Level Monitoring Data

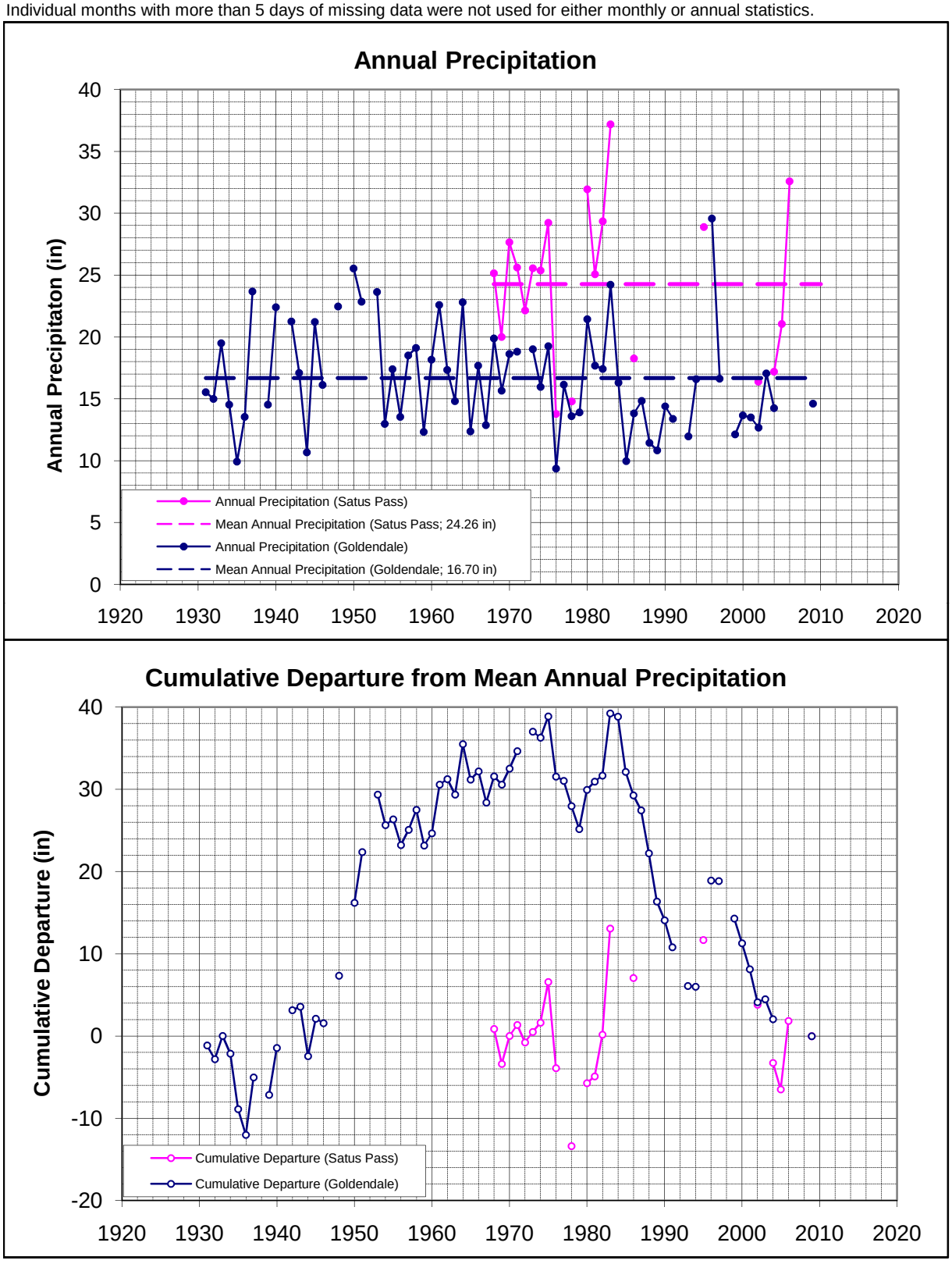
Figure 3 - Groundwater Hydrographs
Little Klickitat Subbasin Annual Monitoring Report
WRIA 30, Washington

Notes:

Goldendale annual precipitation data from Goldendale (NOAA #453222) and Goldendale 2E (NOAA #453226).

Satus Pass annual precipitation data from Satus Pass 2 SSW (NOAA #457342)

Individual months with more than 5 days of missing data were not used for either monthly or annual statistics.



Aspect Consulting

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V:\070024 WRIA 30 Phase 4\Deliverables\012 Water Availability\Little Klickitat Subbasin Monitoring\Fig 4 Precipitation Analysis

Figure 4 - Long-Term Precipitation Analysis

Little Klickitat Subbasin Annual Monitoring Report

WRIA 30, Washington