4.0 WATER RESOURCES IN WRIA 53

No detailed evaluation of water resources has been completed in WRIA 53. Surface water information is almost exclusively located within the Columbia River. The watershed only contains one major tributary to the Columbia River, those drainages associated with the Hawk Creek watershed. Indian Creek and Cottonwood Creek flow to Hawk Creek, which enters the Columbia River (Lake Roosevelt) in the northeastern portion of the watershed.

4.1 SURFACE WATER RESOURCES

4.1.1 Introduction

This section contains a summary of existing information for WRIA 53 surface water studies. The Columbia River is the prominent surface water feature in the watershed, but is under the control of the federal agencies for storage in Lake Roosevelt for power generation and flood control. Numerous studies and assessments have been completed on the Columbia River, and it is currently under active management. For this assessment, the southern portion of the watershed was researched for existing data to assist with planning and management of the WRIA 53 watershed.

4.1.2 Existing Stream Flow Studies

The interpretation of the surface water resources in the southern half of WRIA 53 (Hawk Creek, Brody Creek South and Coulee Dam South Subbasins) was based on a review of information in the available literature and an analysis of the readily available streamflow data. A relatively limited number of documents were encountered relative to streamflow conditions within the WRIA. These documents were largely related to an adjudication that occurred on Hawk Creek in the 1930's (Superior Court of State of Washington Case No. 9972).

In addition, agencies were contacted to determine if any streamflow data was collected in conjunction with water quality monitoring efforts. Limited information was collected from the LCCD regarding stream flows in the Hawk Creek tributary. In conclusion, there are minimal stream flow studies which have been completed in WRIA 53, outside the main stem of the Columbia River.

4.1.3 Existing Stream Flow Gauging Data

Research was conducted to determine if any gauging stations were present in the WRIA 53 watershed. No gauges, temporary or permanent are currently present within WRIA 53. The only data referenced in the literature was within the Superior Court of State of Washington adjudication, Case No. 9972 (1932) and data collected by the Lincoln County Conservation District from six stations during 1995-1996.

Within the Superior Court adjudication Case No. 9972 document, three stream flows are referenced:

- On October 7, 1920: a flow of 5.4 cfs in Hawk Creek is referenced as "at a location above all diversions". The exact location of this measurements is unknown, but is thought to be approximately 8-miles upstream from the confluence with the Columbia River.

- On October 22, 1924: a flow of 2.1 cfs was recorded in Hawk Creek at Peach, Washington. This area has subsequently been inundated by Lake Roosevelt.
- On October 22, 1924: a flow of 1.21 cfs was recorded in Hawk Creek above the mouth of Indian Creek (T27N, R36E, Sec 32).

All these flows were collected prior to the construction of Grand Coulee Dam. The land use and water uses in the Hawk Creek drainage has changed since the collection of this data.

The Lincoln County Conservation District study conducted on Hawk Creek during 1995-1996 measured flows at six stations throughout the drainage. Flows were collected in January, June and October 1995, and March and September of 1996. Flows appear to have been collected with a hand held meter, and only measured when water quality samples were collected for the study. Flows in the headwaters of Hawk Creek (T25N, R36E, Sec 15) ranged from 2.0 cfs (10/17/95) to 36.7 cfs (3/12/96) with and average annual flow of 13.38 cfs. Flows near the outfall of Hawk Creek, measured at the Miles Creston Road (T27N, R36E, Sec. 30), ranged from 10.3 cfs (10/17/95) to 112.1 cfs (3/12/96) with an average annual flow of 42.12 cfs. No final report could be found for this study. A summary document prepared by the Lincoln County Conservation District is provided in Appendix H.

It appears there is no reliable long term stream flow gauging data in any of the tributary drainages in WRIA 53. Stream flow data for the main stem and lake levels for Lake Roosevelt can be found at:

- US Army Corp of Engineers and Grant County PUD web site: http://www.cbr.washington.edu/dart/river.html, or
- USGS web site: http://waterdata.usgs.gov/nwis/,

4.2 GROUNDWATER RESOURCES

4.2.1 Introduction

As noted in the overview of WRIA 53 hydrology (see section 2.5) the area is underlain by three basic aquifer systems: (1) a generally localized alluvial system with a high degree of hydrologic continuity with surface water, (2) the layered, generally widespread CRBG system, and (3) a low yield, joint and fracture controlled system found within the pre-basalt basement rocks. The following sections provide additional information about these three systems. The section describing suprabasalt sediments also provides some insights into vadose zone hydrology within these materials. The discussion is based largely on publically available regional information and insights, as little WRIA specific information was found to be available.

4.2.2 Alluvial Aquifer System

Within WRIA 53 the suprabasalt sediment, or alluvial, aquifer system comprises all saturated sediments that overlie the CRBG and pre-basalt basement. The base of the alluvial aquifer system is defined as the top of these underlying rocks, and it is hosted predominantly by Pleistocene Cataclysmic Flood deposits. The alluvial aquifer system is unconfined, although local semi-confined conditions may be encountered. The alluvial aquifer system water table can

lie as shallow as 1 ft (0.3 m) near surface water bodies, including Lake Roosevelt to over 100 feet (30 m) on the high alluvial benches found along the shores of Lake Roosevelt. Where the CRBG and pre-basalt basement is exposed at the Earth's surface and present above the unconfined water table, the alluvial aquifer system is absent.

The presence of bedrock highs acts to localize occurrences of the alluvial aquifer system. Consequently, the alluvial aquifer system generally consists of a number of small, isolated subs-systems that have no direct connection with each other. Existing geologic mapping for the WRIA (Waggoner, 1990) allows one to generally predict where these sub-systems may occur. However, a detailed evaluation of surface geology and well pumping records would be required to delineate the location, extent, and water resources associated with these local alluvial aquifer sub-systems.

Groundwater flow direction in the alluvial aquifer system is inferred to vary locally, depending on localized irrigation water application (if any), groundwater pumping, locations of surface-water bodies, suprabasalt sediment aquifer system and CRBG aquifer system hydrologic connection, and both buried and exposed bedrock highs. Natural recharge of the alluvial aquifer system is from rainfall and water infiltrating from streams along loosing reaches (Gephart and others, 1979; Drost and Whiteman, 1986; Gee, 1987; U.S. DOE, 1988), including bank storage from Lake Roosevelt. Discharge from the suprabasalt sediment aquifer system generally is down slope towards surface-water bodies and downward into the underlying CRBG aquifers and pre-basalt basement aquifer systems, if pathways through dense basalt flow interiors are available.

Generally, the Pleistocene Cataclysmic Flood deposits that host the most productive portions of the alluvial aquifer system consist of high permeability and high effective porosity sand facies and gravel facies. These strata typically are unconfined, and measured hydraulic conductivity for this unit ranges between 2,000 to 25,000 feet/day, with effective porosity greater than 10 percent (U.S. DOE, 1988). In many cases, water wells in these strata may sustain pumping rates in excess of 2000 gpm, especially where there is a significant degree of hydraulic continuity with surface water or the physical extent of the system great enough to store enough water. However, in areas where high permeability suprabasalt aquifer materials do not have a significant connection with surface water, or the surface water body is small, or the local sediment accumulations are small, it can be relatively easy to dewater the alluvial aquifer system.

<u>Alluvial Aquifer System Summary.</u> Some basic observations and inferences relative to the alluvial aquifer system are as follows:

1. The bulk of the system is hosted by coarse Pleistocene Cataclysmic Flood deposits and alluvial sediments.
2. The Flood deposits are found predominantly along Lake Roosevelt, probably display a fair amount of hydrologic connection with the Lake, and can be very productive.
3. Coarse strata not in connection with the Lake, or other surface water, may be productive, but limited recharge potential would limit potential pumping to recharge only available via limited infiltration from the small annual precipitation in this semi-arid climate.

4.2.3 CRBG Aquifer System

Numerous studies of CRBG aquifers have been conducted within the Columbia Basin to better understand their hydraulic characteristics and to develop a model of how various factors (e.g., physical characteristic/properties of CRBG flow, tectonic features/properties, erosional features, climate, etc.) interact to create and govern the CRBG groundwater system (e.g., Hogenson, 1964; Newcomb, 1961, 1969; Brown, 1978, 1979; Gephart et al., 1979; Oberlander and Miller, 1981; Livesay, 1986; Drost and Whiteman, 1986; Lite and Grondin, 1988; Davies-Smith et al., 1988; USDOE, 1988; Burt, 1989; Johnson et al., 1993; Hansen et al., 1994; Spane and Webber, 1995; Wozniak, 1995; Steinkampf and Hearn, 1996; Packard et al., 1996; Sabol and Downey, 1997; Bauer and Hansen, 2000). One of the most significant findings of these studies is the similarity of the hydrogeologic characteristics, properties, and behavior of the CRBG aquifers across the region. This similarity allows for the application of the knowledge of the general hydraulic characteristics and behavior of the CRBG aquifers to be applied to CRBG aquifers in other areas.

Groundwater in the CRBG generally occurs in a series of aquifers hosted by the interflow zones between the flow units comprising the upper three CRBG formations (Grande Ronde, Wanapum, and Saddle Mountains) and the interstratified Ellensburg Formation. CRBG aquifers have been characterized as generally semi-confined to confined. The major water-bearing and transmitting zones (aquifers) within the CRBG are variously identified as occurring in sedimentary interbeds of the Ellensburg Formation, between adjacent basalt flows (in the interflow zones), and in basalt flow tops (Gephart et al., 1979; Hansen et al., 1994; Packard et al., 1996; Sabol and Downey, 1997; USDOE, 1988). For the region it is generally accepted that lateral hydraulic gradients and groundwater flow directions in the CRBG aquifers are predominantly down structural dip (Drost and Whiteman, 1986; USDOE, 1988).

Hydraulic Characteristics of the CRBG

The physical characteristics and properties of individual CRBG flows affect their intrinsic hydraulic properties and influence potential distribution of groundwater within the CRBG. Interflow zones, in comparison to dense flow interiors, form the predominant water-transmitting zones (aquifers) within the CRBG (Newcomb, 1969; Oberlander and Miller, 1981; Lite and Grondin, 1988; USDOE, 1988; Davies-Smith et al., 1988; Wozniak, 1995; Bauer and Hansen, 2000; Tolan and Lindsey, 2000). Individual interflow zones are as laterally extensive as the sheet flows between which they occur. Given the extent and thickness (geometry) of individual interflow zones, this creates a series of relatively planar-tabular, stratiform layers that have the potential to host aquifers within the CRBG. Given the typical distribution and physical characteristics of CRBG intraflow structures, groundwater primarily resides within the interflow zones. The physical properties of undisturbed, laterally extensive, dense interiors of CRBG flows result in this portion of the flow having very low permeability (Newcomb, 1969; Oberlander and Miller, 1981; Lite and Grondin, 1988; USDOE, 1988; Davies-Smith et al., 1988; Lindberg, 1989; Wozniak, 1995). While the dense interior portion of a CRBG flow is replete with cooling joints, in their undisturbed state these joints have been found to be typically 77 to +99 percent filled with secondary minerals (clay, silica, zeolite). Void spaces that do occur are typically not interconnected (USDOE, 1988; Lindberg, 1989). The fact that CRBG dense flow interiors typically act as aquitards accounts for the confined behavior exhibited by most CRBG

aquifers. In many areas around the Columbia Plateau artesian (flowing) conditions and low pressure zones within the CRBG aquifer system have been encountered.

Field data and inferences based on modeling studies suggest that the hydraulic properties of CRBG aquifers are laterally and vertically complex (e.g., Drost and Whiteman 1986; USDOE, 1988; Whiteman et al., 1994; Hansen et al., 1994). Vertically averaged lateral hydraulic conductivities were estimated in Whiteman et al. (1994) to range from 7×10^{-3} to 1,892 feet/day for the Saddle Mountains, 7×10^{-3} to 5,244 feet/day for the Wanapum, and 5×10^{-3} to 2,522 feet/day for the Grande Ronde aquifers. Hydraulic conductivity of dense basalt flow interiors, where they can even be measured, have been estimated to be 5 orders of magnitude, or less, than flow tops (USDOE, 1988). The available data on hydraulic properties of the various CRBG aquifers, including permeability, porosity, and storativity, indicate that a large variability in local flow characteristics is expected.

The distribution, physical properties, and discontinuities found within the intraflow structures that comprise each CRBG flow unit form the primary stratigraphic control on groundwater flow direction and rate and recharge and discharge within the CRBG aquifer system. Groundwater flow within an individual CRBG interflow zone (adjacent flow tops and bottom, and, if present, a sediment interbed) is directly influenced by the intrinsic physical properties of that interflow zone. For example, thick flow top breccias, sand interbeds, and/or pillow lava complexes will have higher permeability than typical simple vesicular flow tops, claystone interbeds, and/or simple flow bottoms. In addition, the lateral persistence of dominant lithologies, or facies, will impact the lateral hydrologic properties inherent to any interflow zone (Figure 33). The lateral distribution of intraflow structures, particularly dense interiors, also influences the degree of hydrologic connection between successive interflow zones. Although quite widespread, individual CRBG units (and their associated interflow structures) do pinch out (Figure 34). Where pinch outs occur, the dense flow interior that typically separates successive interflow zones will be absent and these interflow zones will merge. Under such conditions, the groundwater seen in these zones can display some, to a high, degree of hydraulic continuity. On a regional scale, such continuity could be important to understanding groundwater recharge and flow. In more laterally restricted CRBG units the potential for significant hydraulic continuity would be greater than in the more voluminous and widespread units. In addition, the geographic and structural distribution of pinch outs could influence groundwater conditions. Beneath WRIA 53, based on GWMA subsurface mapping (GWMA, 2009b), it is clear that a number of flow unit pinchouts occur, especially as CRBG units pinchout near and beneath the WRIA. Under such circumstances, the potential for hydraulic continuity will be greater than in those areas where flow units are laterally continuous (e.g., undisturbed).

Secondary Controls on CRBG Hydraulic Characteristics

Natural processes and artificial features can modify the specific, and overall, hydraulic behavior of CRBG aquifers and aquitards. These include: (1) erosional windows, tectonic fracturing forming faults/tectonic joints, (2) folding, (3) secondary mineralization, (4) feeder dikes and, (5) construction of uncased water wells through multiple CRBG aquifers. The potential effects on CRBG groundwater systems can range from benign to profound.

Erosional windows

Incision into CRBG intraflow zones, and consequent formation of "erosional windows" into deeper CRBG aquifers, can create recharge/discharge areas into, and from, CRBG aquifers. Throughout the region, erosional windows potentially connecting CRBG aquifers are known to occur in the Channeled Scablands (Figure 35) and can be inferred from geologic mapping (see maps by Waggoner, 1990; Stoffel et al., 1991; Reidel and Fecht, 1994a, 1994b; Schuster et al., 1997). The most striking erosional window in WRIA 53 is the canyon of Hawk Creek.

Faults and Tectonic Joints

Faults and tectonic joints also have been found to impact groundwater movement within the CRBG in a number of ways (Newcomb 1959, 1961, 1969; Johnson et al., 1993) (Figure 36). Faults can form barriers to the lateral and vertical movement of groundwater; a series of faults can create hydrologically isolated areas. Faults and joints also can provide a vertical pathway (of varying length) for groundwater movement allowing otherwise confined CRBG aquifers to be in direct hydraulic communication. They can also expose interflow zones creating local opportunities for aquifer recharge and/or discharge.

Figure 33. This outcrop shows the lateral variation possible in a flow top breccia. Hydrologically, such thickening and thinning of a flow top breccia could have profound impact on well pumping performance and boundary conditions inferred from pumping tests.

Figure 34. Columbia River basalt flow layers are known to pinch out. These pinchouts essentially mark the lateral termination of individual basalt flow layers. Where layers pinchout, the impermeable flow interior is absent and potentially water-bearing flow tops and bottoms are in direct hydrologic connection. Flow margins create very limited (single flow) vertical connections.

Figure 35. Wilson Creek coulee, in western Lincoln County, Washington. This coulee, like dozens in the region cross-cut multiple CRBG flow units, offering abundant opportunity to influence groundwater flow, recharge, and discharge.

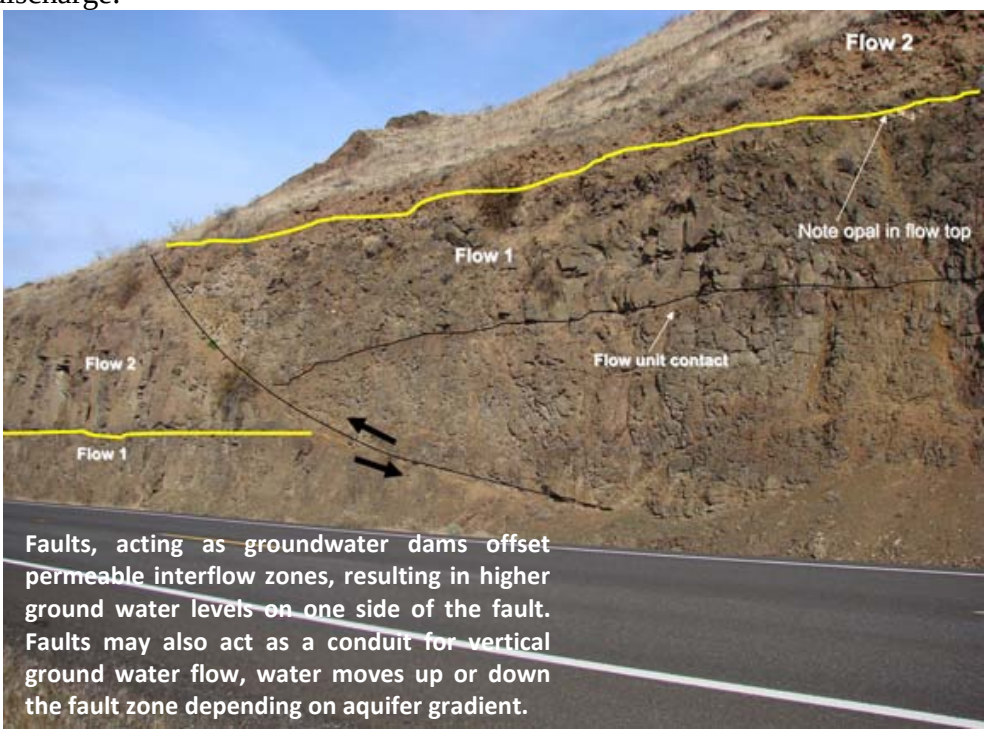


Figure 36. This photograph shows basic geologic relationships in a fault zone.

The ability of faults to affect CRBG groundwater systems in a variety of ways reflects the potential for both lateral and vertical heterogeneities in the physical characteristics of fault zones. For example, the degree of secondary alteration and mineralization along a fault zone may vary considerably. Complete alteration and/or mineralization of fault shatter breccias and gouge zones would "heal" these features and produce zones of very low permeability. Variations in the completeness of this process would produce hydrologic heterogeneities along the trace of the fault. Even if a fault zone is completely healed by secondary alteration and mineralization, renewed movement (displacement) on the fault could produce new permeable zones within the healed shatter breccia (e.g., USDOE, 1988; Johnson et al., 1993). No direct evidence from the WRIA was found for assessing the impacts of faults on the CRBG aquifer system in the area.

Folding

A number of groundwater investigations in the Columbia Plateau area have noted that folds (primarily anticlinal and monoclinal folds) affect the occurrence and movement of groundwater through CRBG aquifers (e.g., Newcomb 1961, 1969; Gephart et al., 1979; Oberlander and Miller, 1981; Lite and Grondin, 1988; USDOE, 1988; Burt, 1989; Hansen et. a., 1994; Packard et al., 1996; Bauer and Hansen, 2000). In many cases, folds have been identified as groundwater barriers or impediments that either block or restrict lateral groundwater movement through the CRBG aquifer system (e.g., Newcomb, 1969; Oberlander and Miller, 1981; USDOE, 1988; Hansen et. al., 1994). Because most of the folds in this region have genetically related faults, one would initially suspect that the observed impacts of folds on the CRBG groundwater system are caused by related faults. However, the process of folding CRBG can affect the hydraulic characteristics of interflow zones.

Low amplitude faults, such as the large anticline in the western portion of the WRIA, also might provide for enhanced vertical movement of ground water through dense basalt flow interiors. This would occur in a situation where the deformation has not progressed to the extent noted above. In such circumstances, the process of folding CRBG layers forms a extensional regime across the crest of the fold. This could open up vertical and subvertical cooling joints across the crest of the fold, providing a potential pathway for movement of water up or down (depending on local pressure gradient) through the open joints.

Secondary Alteration and Mineralization

<u>Paleosol Development</u>. If a sufficiently long hiatus occurs between emplacement of successive CRBG flows, weathering and chemical breakdown of the glassy vesicular flow top will lead to soil formation. This process will typically alter and destroy the original physical texture of a portion of the flow top as well as most of its original permeability. The extent of the flow top involved, and degree to which these paleosols are developed varies widely. Factors controlling paleosol development are thought to include length of time between successive flows, absence of sediment cover, and environmental conditions (e.g., climate, vegetation, paleogeography, etc.).

<u>Precipitation of Secondary Minerals</u>. After the emplacement and burial of CRBG flows, low-temperature water-rock interactions result in formation of secondary minerals (e.g., silica, cryptocrystalline quartz, zeolites, clay minerals, calcite, pyrite, etc.) which partially to

completely fill existing voids within interflow zones. Precipitation of secondary minerals depends on a number of variables including hydrochemistry, groundwater flow and mixing rates, residence times, and local geothermal regime (USDOE, 1988). The net effect of secondary mineralization on CRBG interflow zones is a reduction, ranging from slight to total, in the permeability of these zones. This process is also important in sealing cooling fractures within dense flow interiors (Lindberg, 1989).

Feeder Dikes

As noted earlier in this report, CRBG flows were emplaced by large volume volcanic eruptions. These eruptions generally occurred in elongated (linear vent systems that potentially extended many miles across the landscape). The subsurface manifestation of these vents are feeder dikes (Figure 37), which is the lava that solidified in the vent following flow unit emplacement. The hydrologic influence of feeder dikes cross-cutting the CRBG aquifer system is poorly understood. However, because these features consist of dense basalt that physical cross-cut and disrupt the lateral continuity of the interflow zones they cross-cut, it seems plausible that that CRBG feeder dikes will impede, if not at least locally block, lateral groundwater movement through the planar-tabular interflow zones which dominates the CRBG groundwater system.

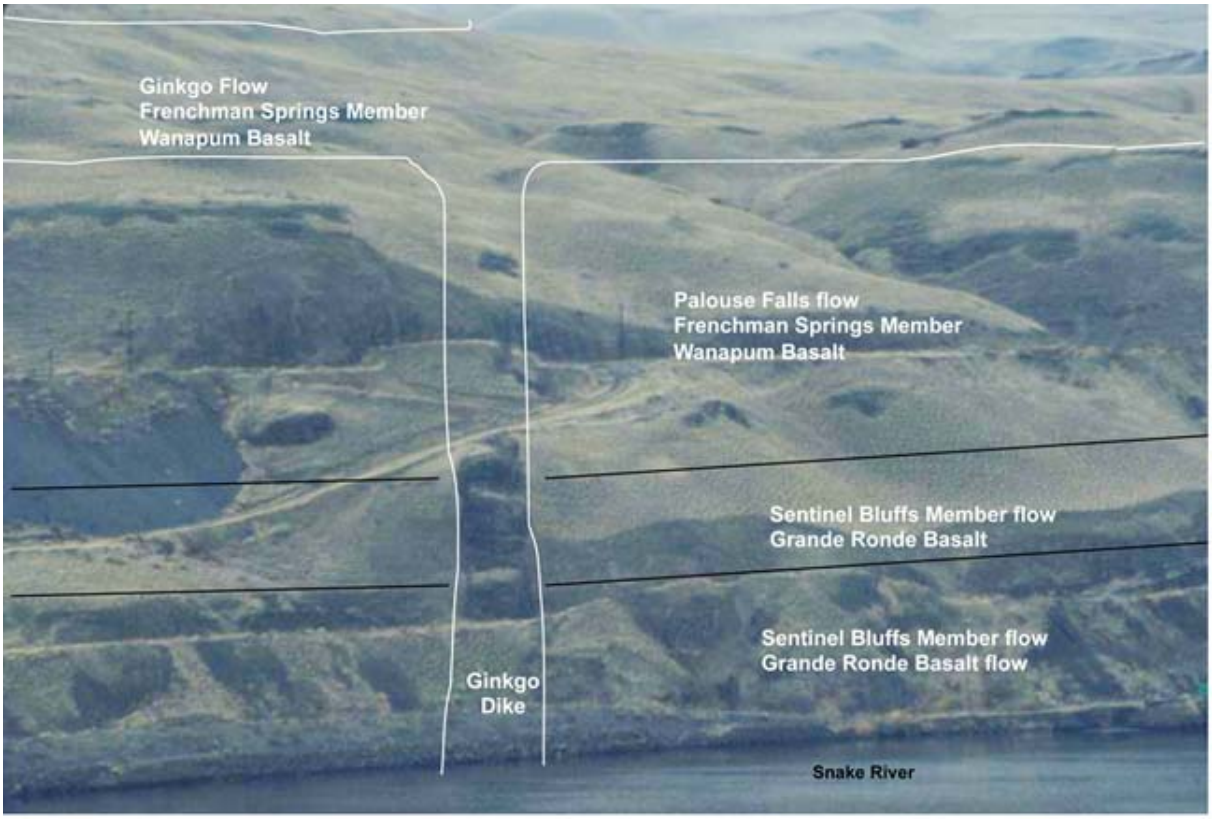


Figure 37. Feeder dikes, from which Columbia River basalt lava flows erupted millions of years ago, form long, nearly vertical subsurface features which probably form boundaries to groundwater flow.

Water Wells

Construction of water wells that are open to more than one CRBG interflow zone creates man-made, vertical pathways which allow groundwater to migrate between CRBG aquifers having different hydraulic heads (USDOE, 1988; Lite and Grondin, 1988; Wozniak, 1995). Historically, the construction of water wells open to multiple CRBG interflow zones (aquifers) has been the norm, rather than the exception. This is because the CRBG has generally been treated as a single aquifer instead of a multiple aquifer system. Therefore in regions where the CRBG groundwater is the primary source for domestic, agricultural, and/or industrial water use, local significant vertical connectivity within the CRBG groundwater system can exist due to water wells open to different aquifers. This is even more important in areas where the CRBG aquifers exhibit artesian conditions.

Water Level Data – Evidence for a Layered Aquifer System

Groundwater elevation measurements obtained during the same time period can be used as an indicator of possible hydraulic connection between groundwater and surface water and the extent of lateral and vertical connectivity within the basalt aquifer zones. Regular measurements taken over a number of years, particularly from non-pumping wells, provide a record of pumping and recharge to the zones monitored by the well. The water level measured in each well represents the water pressure in the interflow zone(s) open to the well. Similarities and differences in the levels and the trends between each well of a multi-well cluster define the relationship with interflow zones monitored in the cluster. If good vertical connection exists between interflow zones, we would expect the water levels in different zones to be very similar, and to react similarly over time. Conversely, differences in levels and/or trends indicate a degree of hydrologic separation between the monitored zones.

Review of historical groundwater levels from multi-level well clusters in the region suggest that there is limited vertical flow between the basalt interflow zones, and the aquifers comprised of these zones are separate and distinct. Figure 38a, which depicts water levels from a multi-well cluster west of Odessa, Washington shows that each zone has a distinctly different water level. While all three zones show declining water levels since the beginning of monitoring in 1973, each zone shows a different trend, and those differences are maintained over the entire record. The water levels in the multi-level well cluster shown in Figure 38a also show that each zone is vertically distinct and separate. The water levels in wells completed in Wanapum interflow zones are significantly higher than the well completed in the Grande Ronde and show rising water levels following the 1970s. Water levels in the Grande Ronde show decline throughout the period of record. This decline is interpreted to be the result of relatively heavy pumping impacts.

Figure 38b, which is from the Davenport multi-well cluster, shows historical water level trends in the southeastern portion of the WRIA. This well indicates that in this part of the WRIA, water levels in the shallower basalt are relatively stable. This suggests that demand on the shallow portion of the aquifer system in this area is not exceeding recharge to that portion of the system. The deeper water level shows a slightly different story. It appears that this portion of the CRBG aquifer system in this area experienced some declines through the 1970's and 1980's, suggesting pumping was exceeding recharge. More recently water levels have risen and the rate of decline,

if any, is less than previously. This suggests that at least in the area of Davenport, recharge to the deeper CRBG system is more or less balancing much of the pumping in recent years. However, as the other hydrograph shows for an area not that far away, the potential for pumping this aquifer system more than can be sustained by recharge is very high.

A review of the water usage from the City of Davenport was conducted in order to determine if there was any correlation between the City's pumping quantities and the elevated water levels observed in the wells in 1994 and 1996 in the deeper basalt aquifer (see Figure 38b). Records were reviewed for 1994 through 1998, of which only measurements were available for 1995, 1997 and 1998. The City withdrew approximately 19.2 million gallons in 1995, 18.6 million gallons in 1997, and 22.5 million gallons in 1998. It appears there has been a slight increase in withdrawal rates from the City of Davenport through the late 1990's. The data reviewed is not conclusive as to a direct correlation between the pumping rates and the groundwater levels. Fluctuations of the groundwater levels is probably more related to precipitation events which have a direct effect on the potentiometric heads of the confined/semi-confined basalt aquifers.

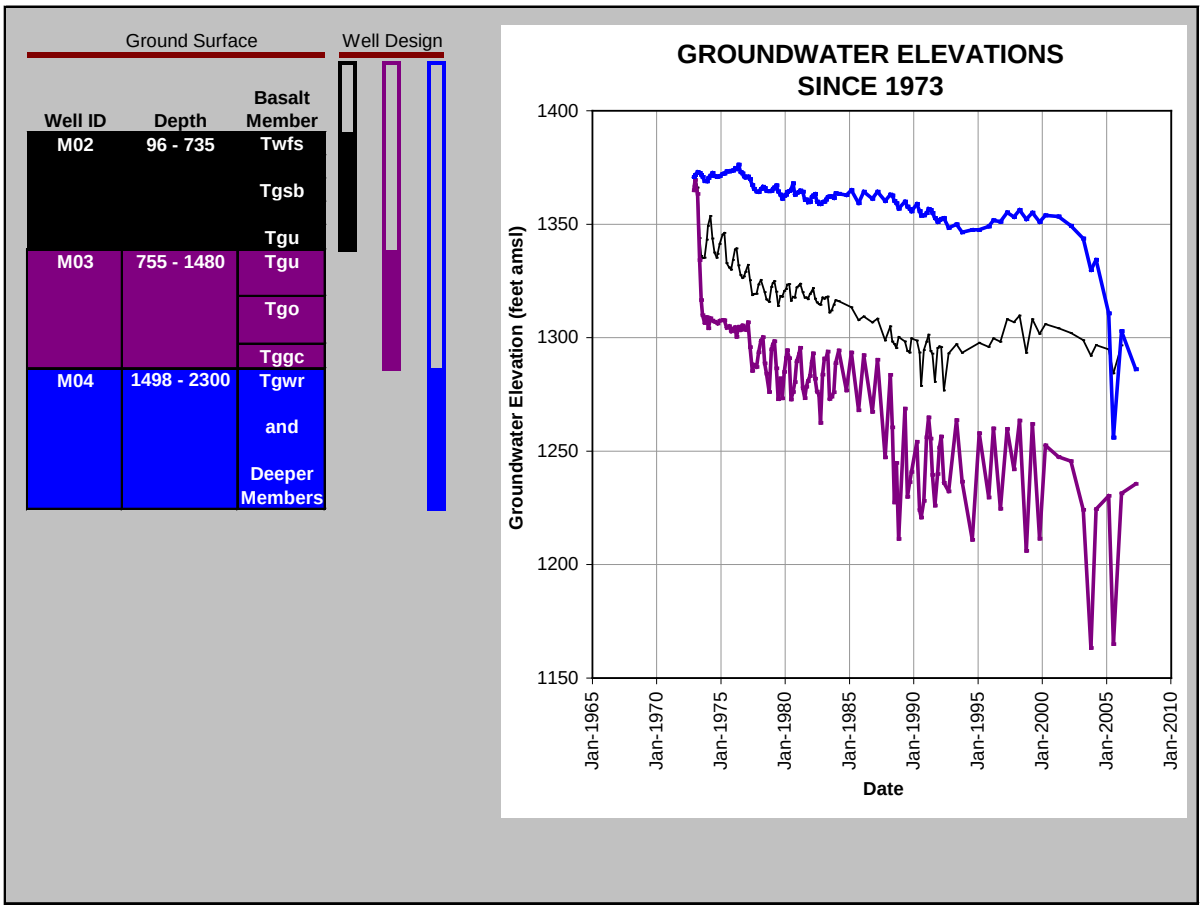


Figure 38a. Three hydrographs from a piezometer well in the north Columbia Plateau showing generally similar water level decline trends. Note however, the deepest measured interval has the highest water level through much of this record.

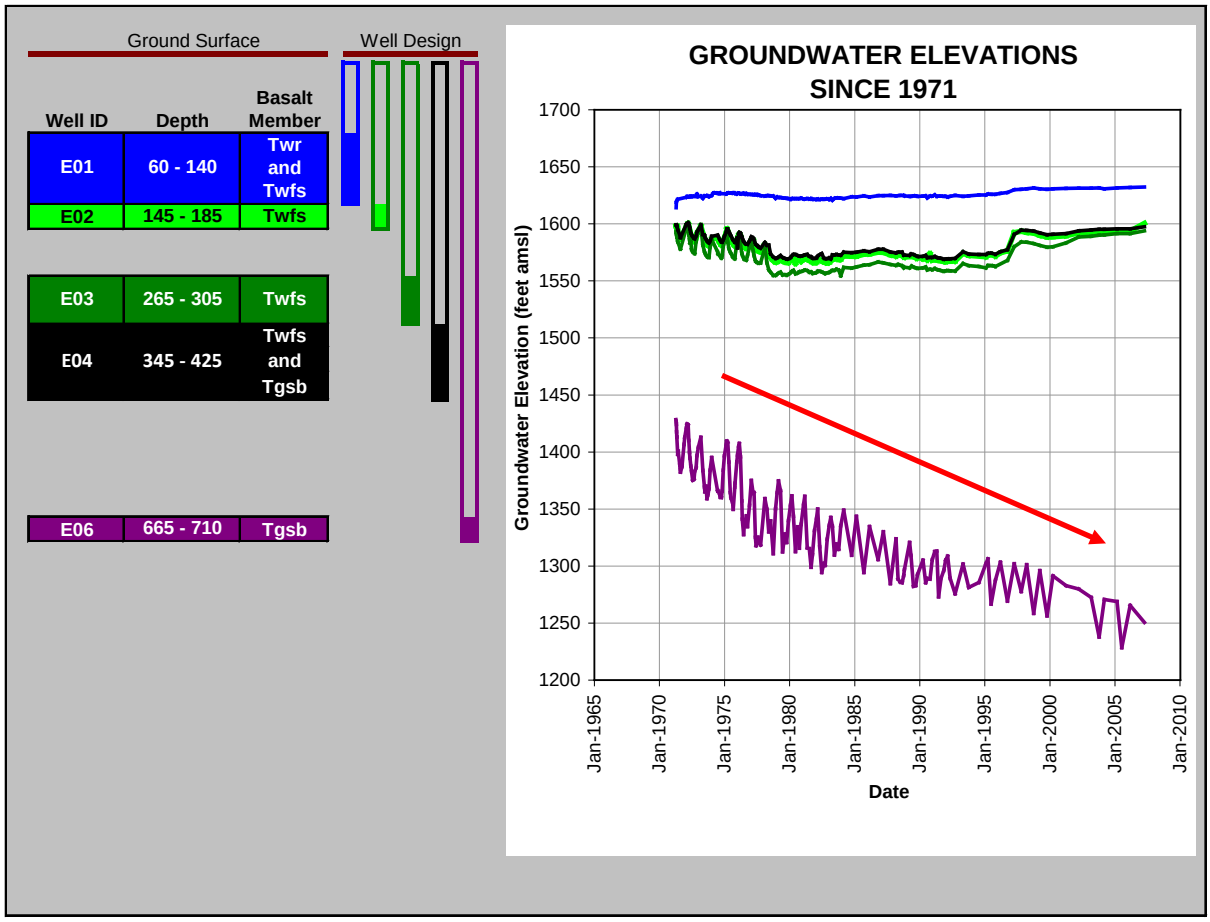


Figure 38b. Hydrographs for a piezometer well showing marked differences in water level trends between the shallower zones and the deepest zone.

Groundwater Geochemistry

Variations in the chemical and isotopic composition of groundwater in CRBG aquifers provide spatial information on the recharge sources, at present and during the past, a time-integrated record of water-rock interactions, and groundwater residence times. In particular, different recharge sources (ancient glacial melt water, irrigation waters, and recharge from present-day surface waters such as lakes, rivers, and canals) can be identified using geochemical tracers and groundwater dating methods. A brief summary of specific isotopic and chemical tracers (excerpted from GWMA 2009c) relevant to recharge and groundwater age considerations is presented here.

As part of recent investigations in the GWMA, selected irrigation, municipal and private supply wells, as well as surface water bodies representing potential recharge sources, were sampled and analyzed for a suite of geochemical and isotopic parameters including major and trace element concentrations, stable isotopes, dissolved gases and age tracers (radiocarbon, tritium, CFCs) in order to elucidate the origins and hydrochemical evolution of the groundwater and, in particular, to evaluate recharge mechanisms and timescales in the deeper basalt aquifer system. Tritium and

CFCs are used to identify and quantify recent recharge components (a few decades to a few years old), whereas radiocarbon is useful for identifying groundwater that is hundreds to tens of thousands of years old. By combining data for age tracers with different characteristic timescales, it is possible to estimate the time elapsed since the water entered the subsurface and also to identify mixtures of older and younger groundwater in production wells. This information is being used in conjunction with the geologic model discussed earlier to identify connections to current potential sources of recharge in the aquifer system.

As shown in Figures 39 and 40, relatively young groundwater recharge ages (i.e. less than 50 years) are generally found for shallow wells open to unconfined sediment aquifers, indicating direct connections to present day recharge sources (canals, seasonally water-filled coulees, creeks and lakes). In samples from some deeper municipal supply wells in basalt which are open over large vertical intervals, age tracers indicate the produced groundwater is a mixture of old (thousands of years) and young water entering from different flow zones with different connections to present day recharge. This data is being used in combination with static water level trends, to evaluate the sustainability of current groundwater use on a local and regional scale. Radiocarbon and stable isotope data and the absence of detectable tritium and CFCs, indicate that groundwater produced from deep irrigation wells in the Odessa area completed in the lower Grande Ronde basalt layers is pre-Holocene (more than 10,000 years old). This part of the aquifer system has not seen significant natural recharge since at least the late Pleistocene when conditions were wetter than present. A sample collected from two wells at Davenport, the Cemetery well and City Well #6 show younger water in the Cemetery well which is shallow and older water in City Well #6 which is deep.

<u>CRBG Aquifer System Summary</u>. The thick sequence of layered flood-basalt flows of the Columbia River basalt are prime sources of potable groundwater throughout the WRIA.

1. Aquifer horizons within the CRBG aquifer system generally are associated with intraflow structures at the top (e.g., vesicular flow-top, flow-top breccias) and bottom (e.g., flow-foot breccias, pillow lava/hyaloclastite complexes) of sheet flows.
2. The interiors of thick sheet flows (in their undisturbed state) generally have extremely low permeability and act as aquitards, typically creating a series of “stacked” confined aquifers within the Columbia River basalt aquifer system.
3. The dominant groundwater flow pathway within this aquifer system generally is stratiform, that is it is horizontal to sub-horizontal along individual, laterally extensive, stratified interflow zones.
4. Given the physical properties of the Columbia River basalt, outcrop observations, and interpretations of well hydraulics vertical groundwater movement through undisturbed basalt flow interiors is greatly restricted. However, vertical groundwater movement between layered CRBG aquifers is possible, but occurs predominantly under specific geologic and anthropogenic conditions where basalt flow interiors are disturbed (such as by folds or faults), truncated (such as by flow pinchouts, erosional windows), or where they are cross-connected by wells.

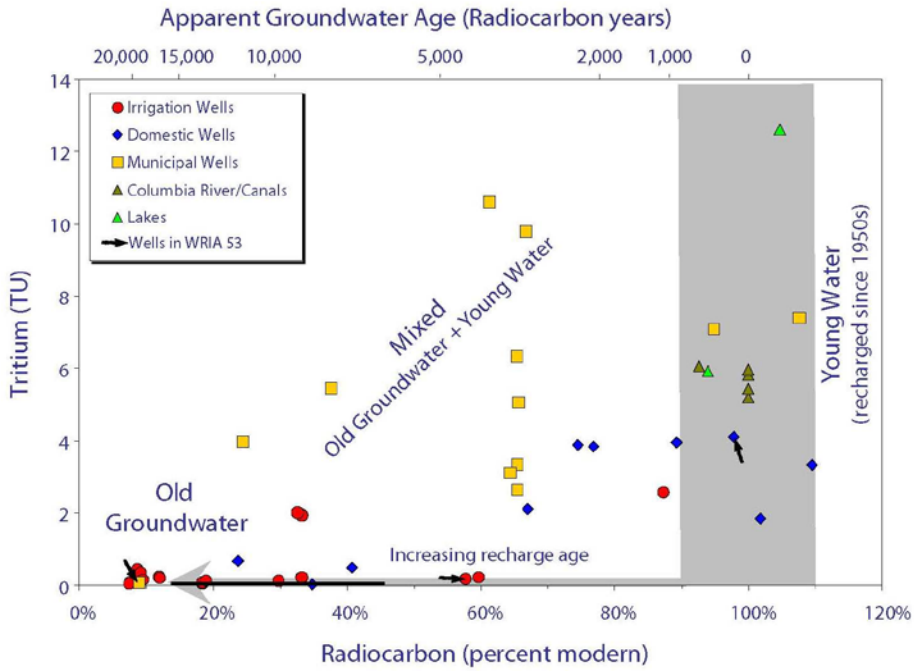


Figure 39. Radiocarbon and tritium contents in selected CRBG wells and local surface waters. Samples are collected from throughout the GWMA four county area. Samples identified with an arrow represent the five (5) samples collected within WRIA 53 boundaries.

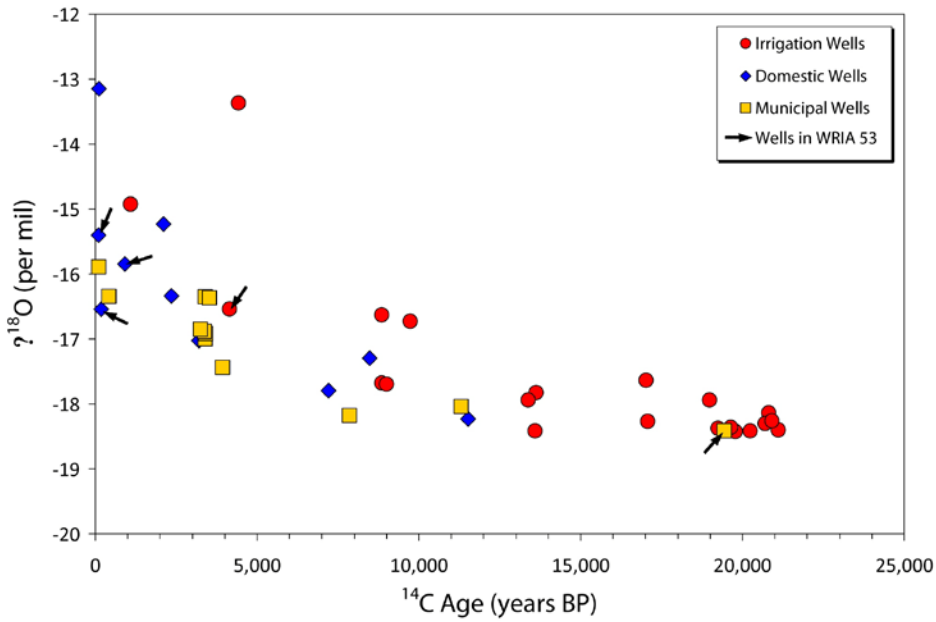


Figure 40. Stable oxygen isotope ratios of groundwater as a function of age. Samples with ages greater than 10,000 years (Pleistocene) are uniformly isotopically depleted relative to younger waters. Samples are collected from throughout the GWMA four county area. Samples identified with an arrow represent the five (5) samples collected within WRIA 53 boundaries.

4.3 WATER RIGHTS

The Washington State Department of Ecology manages the state's water resources, inclusive of the administration of water right claims, permits, and certificates. Washington State, like other U.S. jurisdictions, adopts the European notion that water is a natural resource held in common for the public good and as such, water in its natural flowing or seeping state is not susceptible to "ownership" (Gregoire and others, 2000). However, private parties do have the right to take this public resource and put it to a beneficial use. By utilizing the public waters for beneficial use, in sense, the party utilizing the water resource obtains an "exclusive right" of the quantity of water put to beneficial use, but as soon as it reenters the natural environment, the "ownership" reverts back to the public resource.

Allocation of water resources began in the late 1800's when settlers obtained water rights under two doctrines: the riparian doctrine and the prior appropriation doctrine. The riparian doctrine allowed persons with property next to a surface water source to divert or withdraw from that source. The riparian doctrine did not take into account the priority upon which a person established the use of water, but only where they were located in relevance to the water course. Prior appropriation allowed public waters to be used on land that was not adjacent to the surface water body and was established with the "first in time, first in right" for each of the water users.
In 1913, the Governor of Washington State formed a commission to study the issues which were already arising with the appropriation and use of water's within the State. This process led to the eventual development and passage of the Washington Water Code of 1917. The 1917 Water Code provided for the administration of water rights through the State, and as such, required individuals to file an application for a permit to establish appropriative water rights subject to any existing water rights. It also directed that public notice with a provision of protest if someone believed the new right may impair their senior water right. The 1917 Code did not affect existing water rights, but established future appropriations through a State permit system. Much of Washington State's current water law, practices, and uses are based upon this 1917 law (Ecology Publication #WR-98-152). Most water users at the time of the 1917 water code were diverting surface water for beneficial uses.

In the 1930's and 1940's, many water users were withdrawing groundwater as a source of water. In 1945, the Washington State legislature enacted the 1945 Groundwater Code, establishing the same permitting process used for surface water. The 1945 Groundwater Code does contain an exemption to the permitting requirement if:

- Providing water for a single home or groups of homes (limited to 5,000 gallons per day).
- Providing water for industrial purposes, including irrigation (limited to 5,000 gallons per day but no acre limit).
- Providing water for livestock (no gallon per day limit).
- Watering a non-commercial lawn or garden one-half acre in size or less (no gallon per day limit, however limited to reasonable use).

In the 1960's, the Washington State Legislature realized that records for water rights established before the 1917 surface water code and the 1945 groundwater code were incomplete. As a result, the state had an inadequate understanding of the amount being used (Ecology Publication #WR-98-152). In 1967, the Water Right Registration Act directed the Water Resources Department to record the amount and location of the pre-code water rights by authorizing the state to register water right claims. A water right claim does not establish a permitted or certificated water right, and is just a claim to water use prior to the adoption of the water codes in 1917 and 1945. Water right claims typically are certificated after a general water right adjudication. The 1967 Act also established that water must be used or after a period of time, the water user can lose their water right through relinquishment back to the state.

Filing of water right claims ended June 30th, 1974 under the initial statewide opening for filing instructed by the 1967 Act. The legislature has opened the Water Right Claim Registry three times since then, with the final claim registration opened from September 1st, 1997 through June 30th, 1998. To date, there are approximately 169,000 claims entered into the Washington State Claim Registry.

Other important legislation that guides water rights in Washington State includes:

- The Minimum Water Flows and Levels Act of 1967,
- The Water Resources Act of 1971,
- The 1971 Water Well Construction Act,
- The 1989 Water Use Efficiency Act,
- The Growth Management Acts (1990 and 1991), and
- The Watershed Management Act of 1998.

As with most legislation, case law also directs how the state is to manage water rights within Washington State. Numerous legal and policy issues affect the management of water in Washington. Some important court cases relevant to the administration of water rights in Washington State include:

- Rettkowski v. Department of Ecology (1993, commonly known as Sinking Creek): determined that Ecology may not attempt to resolve disputes among water users if one or more of them is based on an unadjudicated water right;
- Grimes v. Department of Ecology (1993): set down important case law regarding the obligations of water users to maintain efficient water delivery and use systems; and outlined important criteria related to beneficial use.
- PUD No.1 of Jefferson County v. Department of Ecology (1993, commonly known as the Elkhorn case): ruled that ecology could use instream flow conditions on a permit.
- Hubbard v. Department of Ecology (1994): ruled that the hydraulic continuity may exist even when the point of withdrawal is several miles away from the affected stream.

In summary, water users in Washington State are granted a conditional "ownership" of the water to be put to a defined beneficial use within a defined area and/or location. Water rights are quantified both with an instantaneous flow/discharge (Qi) and a quantified annual use (Qa). Quantities of flow and annual use are basically a "not to exceed" value, and actual quantities put to beneficial use, or "perfected" are the amounts available to the water users. All water user's have a responsibility in Washington State to use their water in a responsible manner, and if not used over a consecutive 5-year time period, forfeit that "ownership" of the water back to the State through relinquishment.

4.3.1 Introduction

The water rights analysis for WRIA 53 was conducted from the information stored in Ecology's Water Rights Application Tracking System (WRATS) database. Although the State of Washington has retained files for nearly every water right recorded, the scope and schedule of this analysis did not allow for a review of the hardcopy information.

A Public Records request was made of Ecology to provide the water rights documents contained in the WRATS database for WRIA 53. The WRATS spreadsheet information is in included in Appendix B. The WRATS report was run on November 14th, 2008. In addition, a request was made for all claim forms in order to try and estimate claim quantities for the assessment. The WRATS database was then linked to a GIS layer so the quantities recorded on the water right information could be totaled for each subbasin. After GIS review of the information, approximately 35,539 acre-feet of water is claimed and/or certificated for WRIA 53. Table 15 presents the results of the GIS analysis for each subbasin. A detailed graphical analysis of the water rights within the database is presented in Appendix C.

TABLE 15: SUMMARY OF GIS ANALYSIS ON WATER RIGHTS

Sub - Basin	Water Rights (annual acre feet)	Percentage
Brody S	2,913.85	8.20
Brody N	1,940.48	5.46
Coulee S	5,994.00	16.86
Coulee N	2,162.00	6.09
Hawk Creek	22,528.67	63.39
TOTAL	**35,539.00**	**100**

The water right analysis estimates the number of water rights and applications for WRIA 53 and each water right and document type. Although water rights are commonly measured and allocated on an annual total or instantaneous rate basis, this analysis described the annual total quantity allocated by water right and document type for WRIA 53. Since instantaneous rates (e.g. cubic feet per second or gallons per minute) are often short term or seasonal, the instantaneous quantities are assumed to be represented in the total annuals. In addition, the analysis identified the primary purpose by percentage in WRIA 53 for each water right type and annual total quantities associated with the primary purpose by document type.

As of November 14th, 2008, the WRATS database reviewed for WRIA 53 contained the basic information on file with the state of all known and recorded water rights in the watershed, be they claim, certificate or permit (776). Table 16 presents a summary of the active and inactive permits, applications and certificates in the Ecology files and Table 17 summarizes the information provided in the claims registry. Of this number 44 of the rights list Lake Roosevelt/Columbia River as the source (totaling 6,392.48 acre-feet of water) and for purposes of the watershed planning effort these are not be included in the analysis, leaving 732 rights for evaluation. This number was further reduced as a result of removing the inactive files (102) leaving 630 in the database for analysis. Some of the listed rights were duplicates in that there had been changes done on the right and both the original right and the change certificate were listed in the database so this further reduced the number of valid entries to 621.

TABLE 16: STATUS OF APPLICATIONS, PERMITS, AND CERTIFICATES WITHIN WRIA 53 – LOWER LAKE ROOSEVELT WATERSHED		
WATER RIGHTS STATUS & DISTRIBUTION	***ACTIVE***	***INACTIVE***
PERMITS	5	22
NEW APPLICATIONS	23	27
CHANGE APPLICATIONS	11	9
CERTIFICATES	78	2
TOTALS	117	60

TABLE 17: WATER RIGHT CLAIMS DISTRIBUTION		
CLAIMS	***ACTIVE***	***INACTIVE***
QUALIFIED PRIORITY DATE	219	1
UNQUALIFIED PRIORITY DATE	41	------
NO PRIORITY DATE LISTED	254	40
TOTALS	514	41

A further analysis of the data base determined there were 30 active surface water certificates and 48 active groundwater certificates (Table 18). Table 19 presents the distribution of instantaneous

diversion/withdrawal rates identified in the database and Table 20 presents the annual water allocations in acre-feet.

TABLE 18: WATER RIGHT DISTRIBUTION BY SOURCE				
WATER RIGHTS	***SURFACE WATER ACTIVE***	***SURFACE WATER INACTIVE***	***GROUND WATER ACTIVE***	***GROUND WATER INACTIVE***
PERMITS	0	7	5	15
NEW APPLICATIONS	6	17	17	10
CHANGE APPLICATIONS	0	2	11	8
CERTIFICATES	30	1	48	2
CLAIMS	292	35	221	5
TOTALS	328	62	302	40

TABLE 19: INSTANTANEOUS WATER RIGHT ALLOCATIONS				
WATER RIGHTS	***SURFACE WATER ACTIVE***	***SURFACE WATER INACTIVE***	***GROUND WATER ACTIVE***	***GROUND WATER INACTIVE***
PERMITS	0	1.19	5104	8045
NEW APPLICATIONS	0.85	15.52	6552	15925
CHANGE APPLICATIONS	0	233.07	2846	5650
CERTIFICATES	6.14	0.21	15199.5	100
CLAIMS	559.04	0	3625.03	0
TOTALS	***566.03 cfs***	***249.99 cfs***	***33,326.53 gpm***	***2,9720 gpm***

TABLE 20: ANNUAL WATER RIGHTS ALLOCATION (Acre-feet)				
WATER RIGHTS	***SURFACE WATER ACTIVE***	***SURFACE WATER INACTIVE***	***GROUND WATER ACTIVE***	***GROUND WATER INACTIVE***
PERMITS	0	89.75	2050	4004.2
NEW APPLICATIONS	0	5	184	0
CHANGE APPLICATIONS	0	58.55	1997.82	3355
CERTIFICATES	831.7	345	10446.3	54
CLAIMS	11181.84	0	2454.86	0
TOTALS	***12013.54***	***498.3***	***17132.98***	***7413.2***

4.3.2 Summary of Water Rights Certificates

The WRATS database contained records for 80 active individual water rights certificates for surface and ground water. Thirty (30) of these rights were for surface water and totaled 6.135 cfs and 831.7 acre-feet annually. The 50 ground water certificates totaled 15,665.5 gpm and 10,594.92 acre-feet per year.

The Surface water certificates had 6 different Purposes of Use identified while the Ground Water certificates identified 11 different purposes. In both cases irrigation was the most common purpose of use. Figure 41 and 42 are charts showing the distribution of use for both surface and ground water, respectively.

4.3.3 Summary of Water Right Permits

Within WRIA 53 there are only five (5) active permits, all for ground water withdrawals. The total amount authorized under the permits is 5604 gpm and 2050 acre-feet per year. These permits are authorized for municipal, multiple domestic and irrigation.

4.3.4 Summary of Water Rights Applications

Within WRIA 53 there are 23 active applications for water rights that do not specify the Columbia River as their source. These applications are broken out between surface and ground water as follows: 0.854 cfs and 6552 gpm respectively. Of the applications only two quantify the annual amount of water they are seeking so no significant data can be gleaned from this information. The applications are seeking to use the water for municipal, domestic supply, irrigation, stock watering and fire protection.

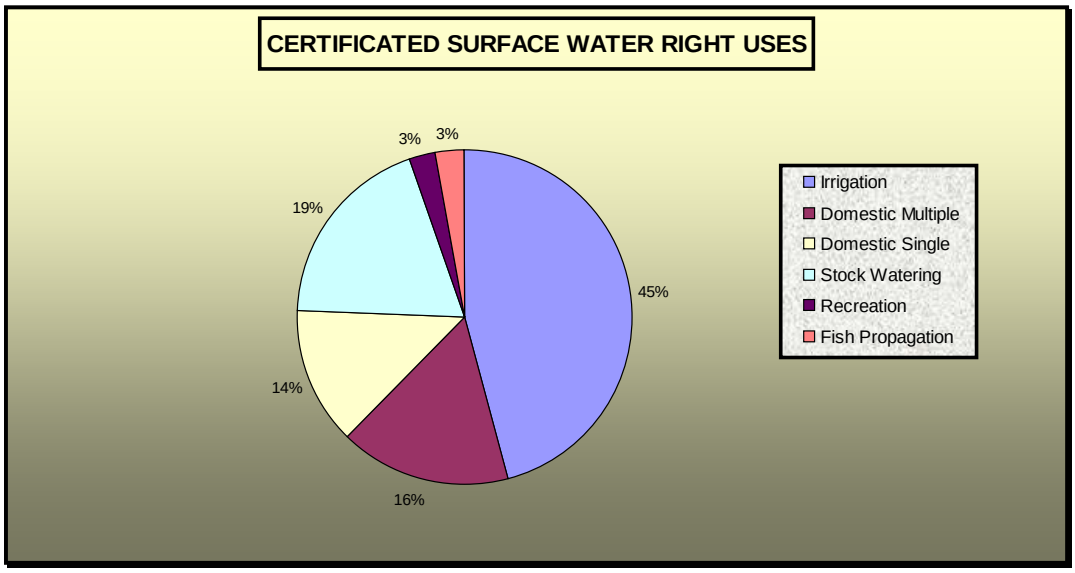


Figure 41: Distribution of use for surface water certificates in WRIA 53.

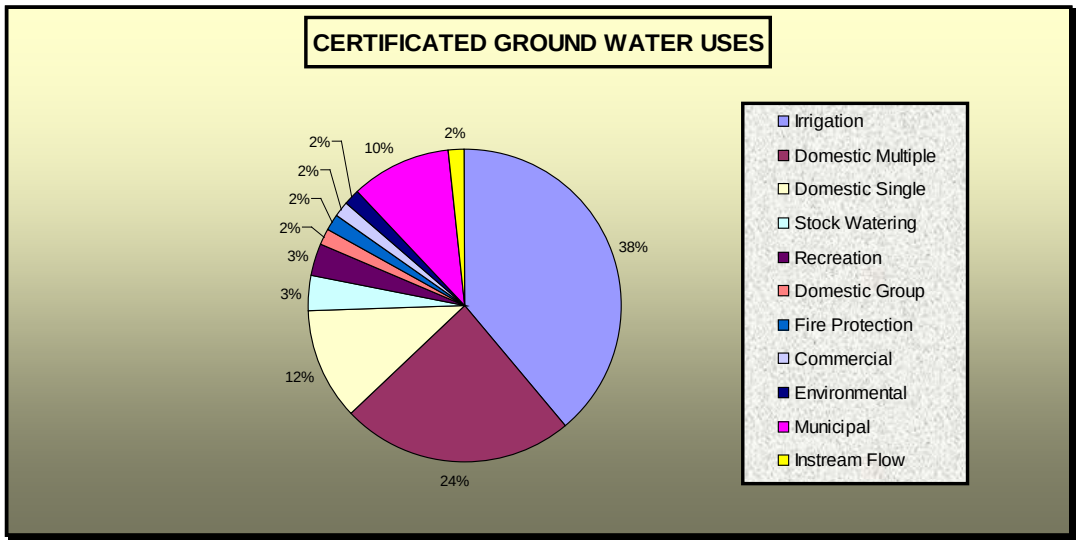


Figure 42: Distribution of use for groundwater certificates in WRIA 53.

4.3.5 Summary of Water Right Claims

There are a total of 513 active claims filed for water in WRIA 53 that are not using the Columbia River as their source. Of these 251 are short form claims and 262 are long form claims.

4.3.5.1 Short Form Claims

Short form claims are typically associated with single family residences or minor yard irrigation and stock usage. None of the short form claims in WRIA 53 listed either an instantaneous or annual quantity. A value of 800 gallons per day was assigned to each short form claim to represent an average daily use. Assuming use through the year this results in a total use instantaneous demand of 200,800 gpm and an annual amount of 225 acre feet per year.

The purpose of use designated in the short forms included group domestic, stock watering, wildlife, irrigation, forestry and natural resources.

4.3.5.2 Long Form Claims

The long form claims filed within WRIA 53 provide more information than do the short form claims but it is still limited. There are 262 long form claims with 193 of them being for surface water and 69 being for ground water. The 193 surface water claims are for 559.04 cfs and 11,181.84 acre-feet while the 69 ground water claims are for 3625.03 gpm and 2454.86 acre-feet. The purpose of use listed on the long form claims include stock water, irrigation, domestic supply, recreation, wildlife, and natural resources.

4.3.6 WRIA 53 Adjudications

Adjudications are an essential part of water management in Washington State and are currently the only definitive way to determine valid water rights within a watershed, subbasin, or a delineated geographic area. For the readers benefit, it should be noted that Washington has an administrative permitting and regulatory water management system; however, the adjudication procedure is judicial in nature (Washington Department of Ecology, December 2002). The Washington water rights system is designed to have superior courts conduct general adjudications to determine the water rights within the specific watersheds and geographic area.

The 1917 Water Code (Chapter 90.03 RCW) and the Superior Court Civil Rules govern the adjudication process (Washington Department of Ecology, December 2002). All pre-1952 adjudications addressed only surface water rights, and most adjudications were completed in the 1920's and 1930's. Only 26 adjudications have been completed in Washington State since 1952. Figure 43 presents a map of the status of water right adjudications in Washington State.

Washington State Attorney General records show that one adjudication has been initiated in WRIA 53 (Figure 44). This adjudication is identified as "g – Hawkes Creek" adjudication. This adjudication was conducted in 1932, and was never finalized. The Report of Referee is included in this document as Appendix E. A summary of the adjudication is provided in the Appendix F. Figure 44 shows a map of Lincoln County and the water right adjudications on file in the State of Washington. There have been six water right adjudications filed in Lincoln County. Table 21 presents a listing of the Lincoln County water right adjudications and when they were filed.

Table 21: Name and Date of Filed Water Adjudication Petitions in Lincoln County

Watercourse	Date Petition Filed	Map Code to Fig. 4.3a
Hawk Creek	3/28/1930	g
Duck and Lake Creek	11/16/1925	R
Wilson Creek	10/13/1960	JJ
Crab Creek	1962	LL
Clear Lake	04/04/1988	HHH
Sinking Creek	1994	NNN

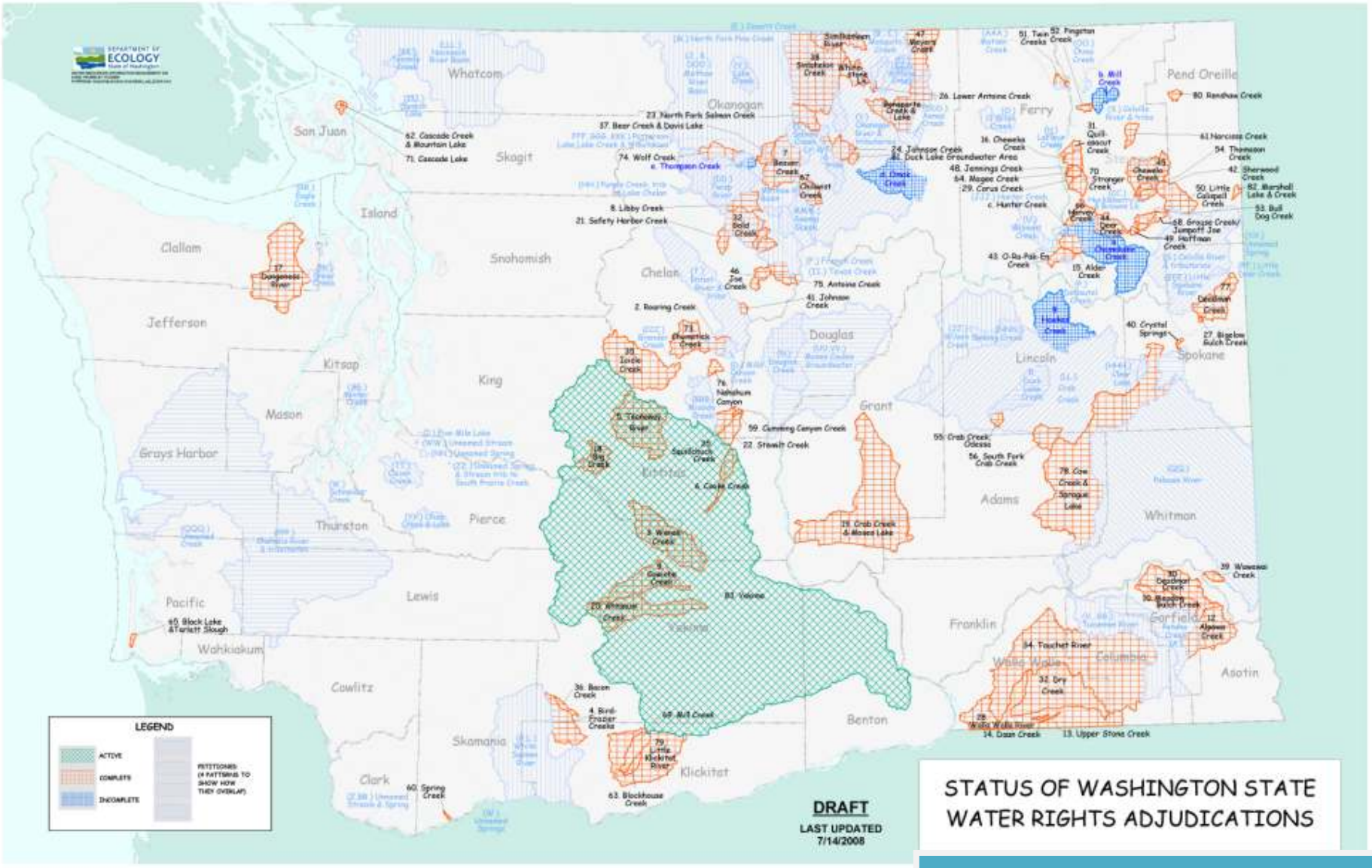


FIGURE 43

Generalized Map of Water Right Adjudications in the State of Washington

Prepared by: ENJS May 5, 2009

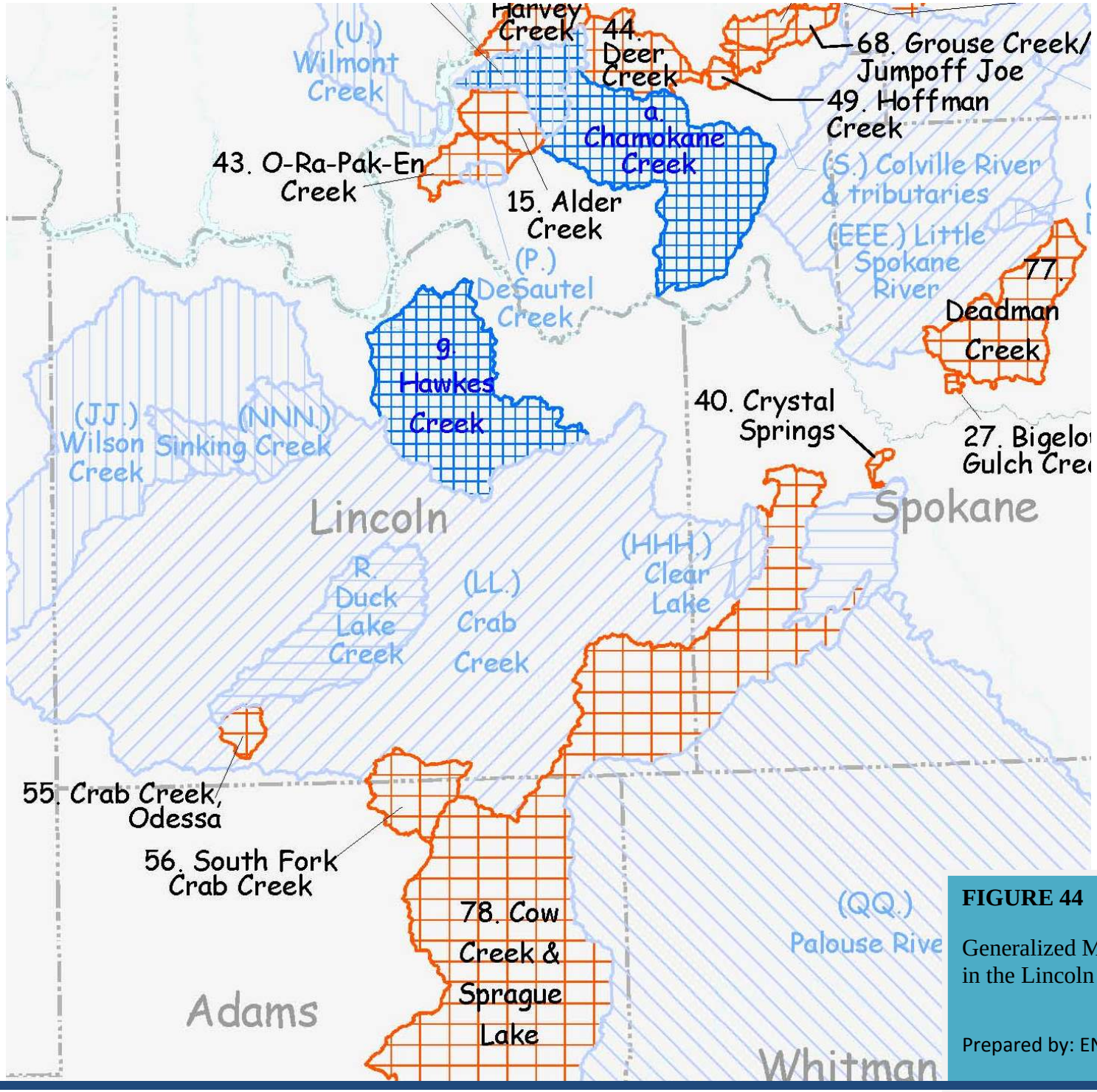


FIGURE 44

Generalized Map of Water Right Adjudications in the Lincoln County, Washington

Prepared by: ENJS May 5, 2009

The Hawk Creek adjudication was initiated in 1930 and encompassed the area outlined in Figure 45. The adjudication was conducted prior to the construction of Grand Coulee Dam and the subsequent formation of Lake Roosevelt. Much of the area discussed in the adjudication report of referee is now inundated from the formation of the reservoir. The Hawk Creek adjudication was not completed. However, the following facts were developed in the adjudication process.

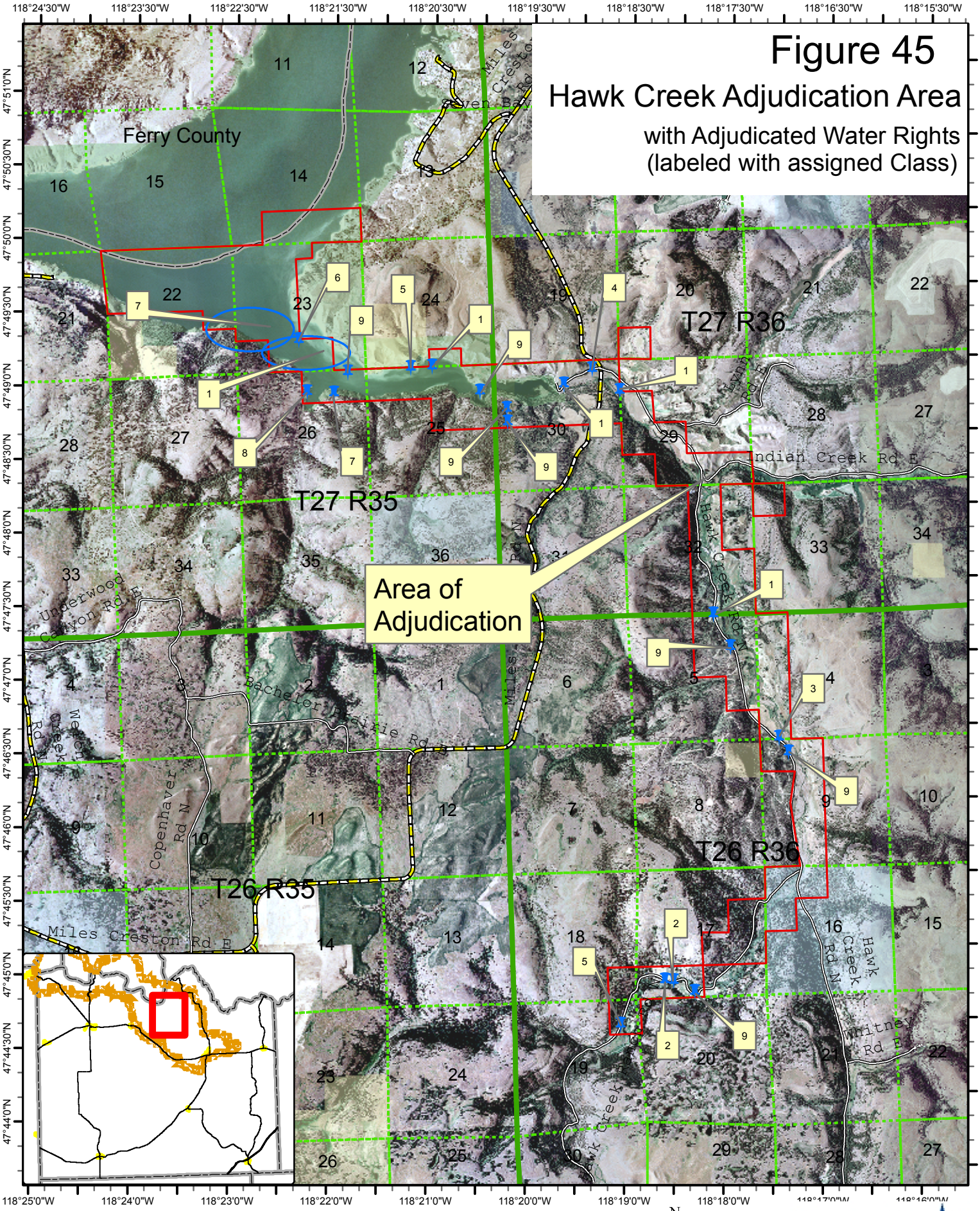
- The adjudication was started in the matter of: State of Washington (plaintiff) vs. W.M. Messinger and Grace F. Messinger (defendants);
- It was filed in the Superior Court of the State of Washington in and for the County of Lincoln;
- Hawk Creek Adjudication assigned Case No. 9972;
- The petition was filed in the Office of the State Supervisor of Hydraulics on March 28th, 1930 by petition of the China Ditch Company and others in the vicinity of Peach, Washington;
- The investigation on the adjudication:
    - stated that there were many long breaks in the flow of Hawk Creek, though it is fairly constant in the lower 8-miles, that portion focused on by the referee;
    - found that the only diversions are made on the lower section of the creek, and during the irrigation season there is no visible connection between the lower and upper creeks;
    - found that only the lower portion of the creek be adjudicated;
    - found the bulk of the land irrigated lies in the last mile of the valley and on the banks of the Columbia River;
    - determined that 11 ditches varying in length from a few hundred feet to 3-1/2 miles divert water from the creek;
    - determined there are 406 acres irrigated and 147 irrigable acres for which water is claimed (553 acres);
    - determined there is insufficient water in recent years to cover even the lands under the present ditch systems;
- All springs contributing flow to Hawk Creek were treated in the determination;
- The irrigation season for the area was determined to begin on May 1 and ends October 1 of each year;
- The duty of water was determined by the referee "that a quantity not greater than one cfs, net, for each fifty acres can be beneficially applied to the lands involved. This resulted in 14.4 acre inches per month or six acre feet per acre for the irrigation season;
- Nine classes were identified in the adjudication as outlined in Table 22. Figure 45. presents a map showing the location and the class ranking for the water rights addressed in the 1932 adjudication;

As stated previously, the Hawk Creek adjudication was never completed and is still listed as an open adjudication. The Planning Unit may wish to address this adjudication in future phases of planning.

TABLE 22: 1932 HAWK CREEK ADJUDICATION SUMMARY						
CLASS	**PRIORITY DATE**	**NAME**	**NUMBER OF ACRES**	**AMOUNT OF WATER (cfs)**	**LOCATION (T-R-SEC)**	**NOTES**
1	1883	Emma Joslin		0.010	26-36-05, 27-36-31,32	for stock and domestic use only and shall not be diverted from stream
1	1883	William Livingston		0.010	27-36-30	for stock and domestic use only and shall not be diverted from stream
1	1883	Vincent Moore		0.010	27-36-30	for stock and domestic use only and shall not be diverted from stream
1	1883	Gratt Slemp		0.010	27-35-24,25	for stock and domestic use only and shall not be diverted from stream
1	1883	Amelia Pierce	20.00	0.430	27-35-23	Allocated under China Ditch Rights
1	1883	Amelia Pierce	3.00	0.070	27-35-23	Allocated under China Ditch Rights
1	1883	Will Lynn	2.16	0.047	27-35-23	Allocated under China Ditch Rights
1	1883	Stephen Lynn	10.62	0.230	27-35-23	Allocated under China Ditch Rights
1	1883	Vincent Moore	6.00	0.132	27-35-23	Allocated under China Ditch Rights
1	1883	William Brannan	6.00	0.132	27-35-23	Allocated under China Ditch Rights
1	1883	William Messinger	15.00	0.358	27-35-23	Allocated under China Ditch Rights
1	1883	W.H. Jump	11.00	0.275	27-35-22	Allocated under China Ditch Rights
TOTAL CLASS 1 WATER RIGHTS			***73.78***	***1.714***		
2	1888	Peter Selde, Jr.	22.00	0.463	26-36-17	Due to fact that Hawk Creek sinks below this place, these rights are not subject to Class 1 rights of China Ditch claimants
2	1888	Peter Selde, Jr.		0.020	26-36-17	For stock and domestic use from a spring
TOTAL CLASS 2 WATER RIGHTS			***22.00***	***0.483***		

3	1890	Guy Lamb	40.00	0.914	26-36-04,05,09	Due to fact that Hawk Creek sinks near the lower end of property, this right when diverted from Lamb ditch is not subject to Class 1 rights of China Ditch claimants. If diverted north of south line of Sec. 4, then becomes subject to China Ditch rights.
TOTAL CLASS 3 WATER RIGHTS			***40.00***	***0.914***		
4	1896	Vincent Moore	30.00	0.632	27-36-30	
TOTAL CLASS 4 WATER RIGHTS			***30.00***	***0.632***		
5	1898	Gratt Slemp	17.00	0.377	27-35-24,25	
5	1898	Victor Lauritzen		0.020	26-36-19	Right is for stock and domestic use and is not subject to those of superior class
TOTAL CLASS 5 WATER RIGHTS			***17.00***	***0.397***		
6	1902	G.W. Timmons	2.45	0.049	27-35-23	
TOTAL CLASS 6 WATER RIGHTS			***2.45***	***0.049***		
7	1894	Creston State Bank	5.00	0.100	27-35-26	
7	1894	Orchard Valley Ditch Co.	206.00	5.316		
		John Lynn	7.00		27-35-23	Allocated under Orchard Valley Ditch Co.
		John / Mary Lynn	6.00		27-35-22	Allocated under Orchard Valley Ditch Co.
		Marcus Brannan	4.00		27-35-23	Allocated under Orchard Valley Ditch Co.
		Laura Nelson	7.83		27-35-23	Allocated under Orchard Valley Ditch Co.
		James Nelson	2.13		27-35-23	Allocated under Orchard Valley Ditch Co.
		W.H. Jump	18.96		27-35-22	Allocated under Orchard Valley Ditch Co.
		W.R. Jump Estate	12.00		27-35-23	Allocated under Orchard Valley Ditch Co.
		Homer / Alice Hill	9.00		27-35-23	Allocated under Orchard Valley Ditch Co.
		W.T. Hill	3.17		27-35-22	Allocated under Orchard Valley Ditch Co.
		Archer Pugh	15.50		27-35-23	Allocated under Orchard Valley Ditch Co.
		Guy Pugh	8.00		27-35-23	Allocated under Orchard Valley Ditch Co.
		John Bell	4.00		27-35-23	Allocated under Orchard Valley Ditch Co.
		F. Boyd Snook	22.00		27-35-22	Allocated under Orchard Valley Ditch Co.

		Thos Slemp	10.00		27-35-22	Allocated under Orchard Valley Ditch Co.
		Minnie Gabbert	10.00		27-35-22	Allocated under Orchard Valley Ditch Co.
		Creston State Bank	6.00		27-35-22	Allocated under Orchard Valley Ditch Co.
		J.B. Widener	8.50		27-35-22	Allocated under Orchard Valley Ditch Co.
		Emma Widener	14.00		27-35-22	Allocated under Orchard Valley Ditch Co.
		Chas Widener	8.00		27-35-22	Allocated under Orchard Valley Ditch Co.
		Emery Bayley	15.38		27-35-22	Allocated under Orchard Valley Ditch Co.
		J.M. Kirby	6.00		27-35-22	Allocated under Orchard Valley Ditch Co.
		Harry / Geo. H. Simons	8.00		27-35-22	Allocated under Orchard Valley Ditch Co.
TOTAL CLASS 7 WATER RIGHTS			***211.00***	***5.416***		
8	1915	Cornelius Dekker	10.00	0.210	27-35-26	This right is not subject to rights on Hawk Creek
TOTAL CLASS 8 WATER RIGHTS			***10.00***	***0.210***		
9		Peter Selde, Jr.	28.00	0.589	26-36-17	
9		Guy Lamb	40.00	0.914	26-36-04,05,09	When there is sufficient water in Hawk Creek to fill this Class 9 right, the conditions described in notes under rights of Peter Selde (Class 2) and Guy Lamb (Class 3) will not exist.
9		Emma Joslin	40.00	0.800	26-36-05, 27-36-31, 32	
9		William Livingston / Elzie Riddle	4.00	0.080	27-36-30	The lands under this right are entitled to the unrestricted use of a spring in the NW1/4 of SW1/4 Section 29, T27N, R36E.W.M.
9		Vincent Moore	10.00	0.210	27-36-30	
9		Gratt Slemp	10.00	0.222	27-35-25	
9		Creston State Bank	5.00	0.100	27-35-26	
TOTAL CLASS 9 WATER RIGHTS			***137.00***	***2.915***		
TOTAL ADJUDICATED WATER RIGHTS			***543.23***	***12.730***		



Actual relationships and distances between features may be different from those depicted on this map. Data was compiled from multiple sources. The data sources do not guarantee these data are accurate or complete. This map is for informational purposes only.

1 inch = 1 miles

USDA/NAIP Aerial Photo: 2006

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4.4 OTHER WATER RESOURCE DATA

Preliminary research on other readily available data for other optional planning elements was conducted for this assessment. Data specifically related to instream flow, water quality, water storage and habitat was searched. In general, there is minimal to no data and information related to instream flow and habitat for the WRIA 53 watershed. Water quality and water storage information is discussed briefly in this section.

4.4.1 Existing Water Quality Data

A request was made to Ecology to determine if any water quality data had been collected and recorded in the Ecology Environmental Assessment Program (EAP). No data was on record for the Lower Lake Roosevelt Watershed. However, at the time of the compilation of this assessment report, Ecology was initiating some water quality sampling at a new station located in Hawk Creek at Miles-Creston Road (station No. 53C070). Sampling is currently being conducted for: conductivity, fecal coliform, ammonia, nitrates, dissolved oxygen, pH, temperature, and total phosphorous.

The Washington State Department of Ecology under Section 303(d) of the Clean Water Act is required to identify and prioritize water bodies that do not meet state water quality standards. The identified water body list was updated in 1998 within Washington State and approved by the Environmental Protection Agency (EPA). An updated list for 2002/2004 was submitted and approved by the EPA in November 2005.

The US EPA requires the states to set priorities for cleaning up the 303(d) listed waters and to establish a Total Maximum Daily Load (TMDL) for each contaminant placed on the list. In 1998, Ecology signed a Memorandum of Agreement with the EPA and agreed to have TMDLs in place for the water quality parameters by 2013. Ecology will review the recently approved 303(d) list to determine which constituents should be evaluated for a TMDL. Ecology also has the option of adding parameters to monitor in the scoping process. It should be noted that TMDL's can be set per mile of stream reach.

Washington State's water quality assessment for 2004 was submitted to the EPA on June 2, 2005 as an integrated report for sections 305(b) and 303(d) of the Clean Water Act. The integrated report categorized impairments in a ranking from Category 1 through Category 5, with Category 5 polluted waters requiring a TMDL. Category 5 lists waterbody segments for which at least one characteristic or designated use is impaired and which does not already have a TMDL or other pollution control plan in place to address the impairment. Category 5 subsequently is the 303(d) listing for impairments and a TMDL is required for each waterbody segment. EPA approved Washington State's water quality assessment for Category 5 waterbodies on November 4, 2005. Washington State's integrated report listed 45 impairment notations for WRIA 43, with 6 notations under Category 5 (33 listings were under Category 1, 4 for Category 2, and 2 listings for Category 4a). A complete listing of the TMDL listings can be found at: http://apps.ecy.wa.gov/wats08/.

Table 23 summarizes the six impairments cited on the 303(d) list in 2008. There are currently no approved TMDLs in WRIA 53. In addition, no on-going TMDLs are occurring within the WRIA 53 watershed.

Six listings were identified in the 2008 Final Water Quality Assessment – Category 5 listings. Four of these listings were for dissolved oxygen and temperature within the Columbia River/Lake Roosevelt, and the remaining three were for dioxin, heptachlor, and PCB's for Buffalo Lake located on the Colville Indian Reservation in the Coulee Dam North Subbasin. Table 23 presents a summary of the 303(d) TMDL listings.

4.4.2 Hawk Creek Water Quality Study

During 1995 and 1996, the Lincoln County Conservation District conducted some limited water quality sampling within the Hawk Creek drainage. Six sampling sites were monitored in January 1995, June 1995, October 1995, March 1996, and September 1996 for:

- In the field monitoring of:
  - Dissolved Oxygen
  - pH
  - Conductivity
  - Temperature, and
  - Flow

- Laboratory Analysis
  - Ammonia-nitrogen
  - Nitrate plus nitrite-nitrogen
  - Total phosphorous
  - Total Suspended Solids
  - Turbidity, and
  - Fecal coliform

No final report was prepared for the sampling program, however, the Lincoln County Conservation District prepared a summary of this sampling program which is included in Appendix H. The following summary of testing was provided:

- The fecal coliform data are definitely affected by the small number of samples that were taken. A large sample population provides for a better estimate of actual conditions and also dampens out the affect of a single reading above the 100 colony per 100 milliliter level.
- Even at the maximum concentrations, the samples from Hawk Creek did not exceed 5% of the chronic criteria for the associated pH and temperature conditions. The source for making this comparison is the Environmental Protections Agency's (EPA) *Quality Criteria for Water 1986.*
- The nitrate-nitrite-nitrogen (NO3+NO2-N**)** results are higher than what we have found in the sampling we have conducted on other tributaries to Lake Roosevelt. A table in the

summary report provides a comparison of Hawk Creek data with data from the Colville River at Chewelah, WA and 10 tributaries to Lake Roosevelt/Columbia River in northern Stevens County.

- The total phosphorus readings for Hawk Creek are all in excess of the levels EPA recommends for surface waters flowing into a lake or reservoir; not more than 100 micrograms per liter is recommended for waters flowing into a lake or reservoir, not more than 50 micrograms per liter is recommended and for the lake itself, not more than 25 micrograms per liter.
- An evaluation for the loading data for both average and maximum conditions for each sampling station was conducted. In the case of ammonia, the maximum concentration at each site occurred during low flow periods and so the loading at this time is less than the loading calculated for the average conditions.

4.4.3 Groundwater Nitrate Sampling in WRIA 53

Between 1995 and 1999, some limited nitrate testing of domestic wells was done in the Hawk Creek watershed (David Lundgren, Lincoln County Conservation District, personal communication). The values ranged from less than 0.5 mg/L to as high as 70+ mg/L. A significant number of wells tested above the 10 mg/L State MCL. Elevated nitrates >10 mg/L are an issue of concern for some domestic wells in the southern half of WRIA 53, just as they are for some domestic wells in other WRIA's across Lincoln County. No report was prepared for this sampling program.

4.4.4 Lake Roosevelt Shoreline Management Plan

A Shoreline Management Plan is currently being completed for the Lake Roosevelt National Recreation Area (LARO). The Shoreline Management Plan is intended to determine whether to modify visitor access opportunities from the shoreline to the lake and from the lake to the shoreline. Alternatives in the Plan will make recommendations regarding future management of the shoreline to accommodate visitors and fluctuating lake levels, to better protect natural, cultural, and scenic resources, and to more effectively distribute visitors use. Information on the Lake Roosevelt Shoreline Management Plan can be found at http://www.nps.gov/laro.

TABLE 23: WRIA 303(d) LIST of IMPAIRMENTS in 2008.						
Water Name	**Contaminant**	**Media**	**Action**	**Listing ID #**	**T/R/S**	**Remarks**
Buffalo Lake	Dioxin	Tissue	TMDL	43197	30N/31E/S27	Data from fish tissue study in largemouth bass.
Buffalo Lake	Heptachlor	Tissue	TMDL	43205	30N/31E/S27	Data from fish tissue study in largemouth bass.
Buffalo Lake	Total PCB's	Tissue	TMDL	43215	30N/31E/S27	Data from fish tissue study in largemouth bass.
Columbia River	Temperature	Water	TMDL	40952	Grand Coulee Dam forebay	USBOR unpublished data shows 95 excursions beyond the criterion out of 359 days during 2001.
Franklin D. Roosevelt Lake	Dissolved Oxygen	Water	TMDL	43029	28N/33E/S08	3 excursions beyond criterion at Ecology monitoring station during 1991
Franklin D. Roosevelt Lake	Temperature	Water	TMDL	43028	28N/33E/S08	3 excursions beyond criterion at Ecology monitoring station during 1991