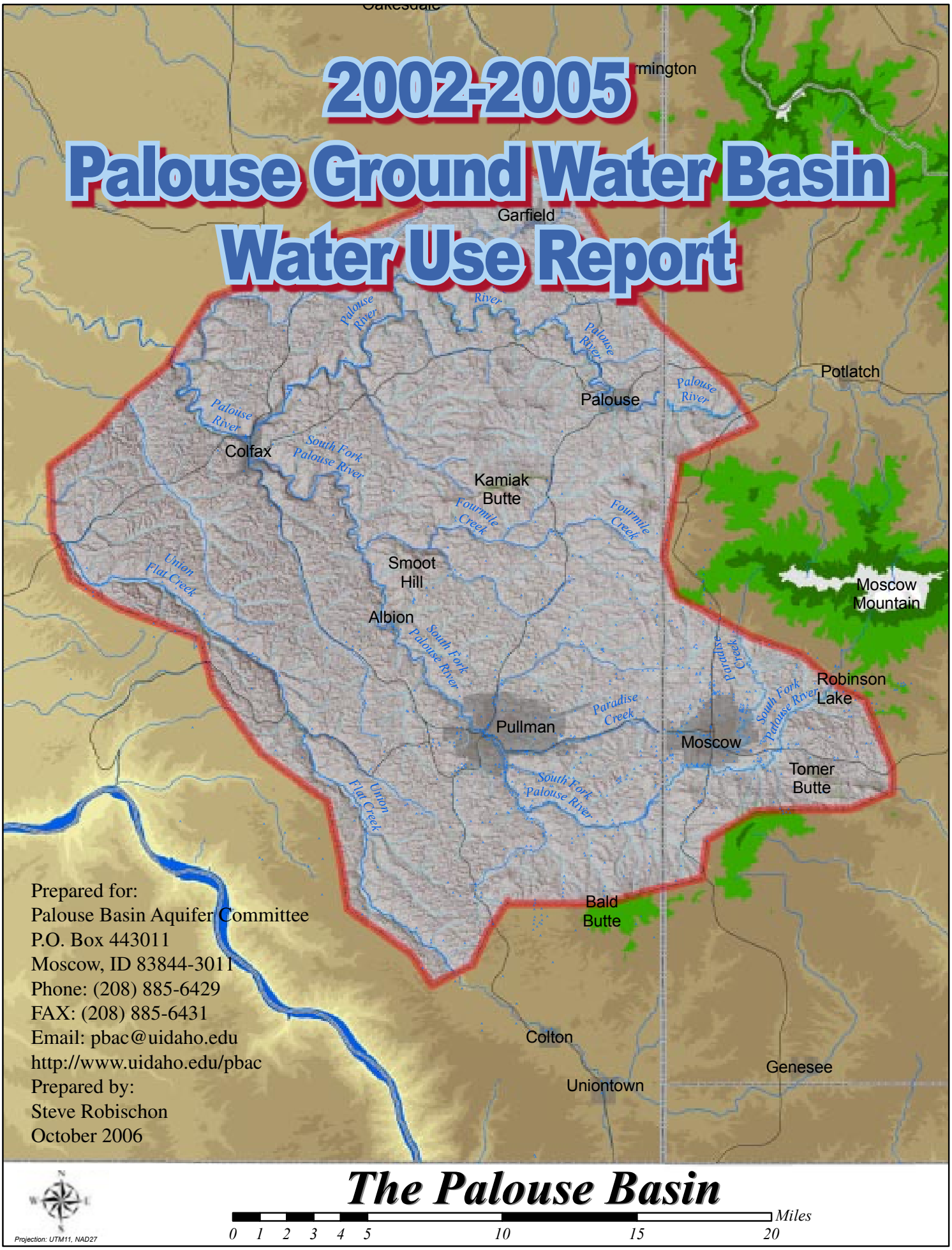
2002-2005
Palouse Ground Water Basin
Water Use Report
Garfield
Palouse
Potlatch
Colfax
Kamiak Butte
Smoot Hill
Albion
Pullman
Moscow
Moscow Mountain
Robinson Lake
Tomer Butte
Bald Butte
Colton
Uniontown
Genesee
Palouse River
South Fork Palouse River
Fourmile Creek
Union Flat Creek
Paradise Creek
Prepared for:
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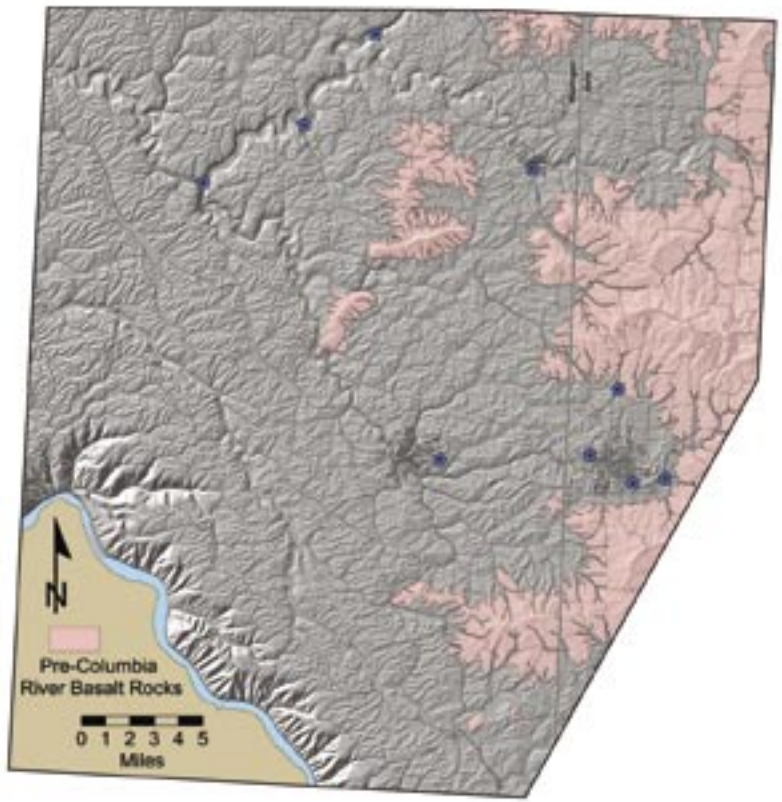
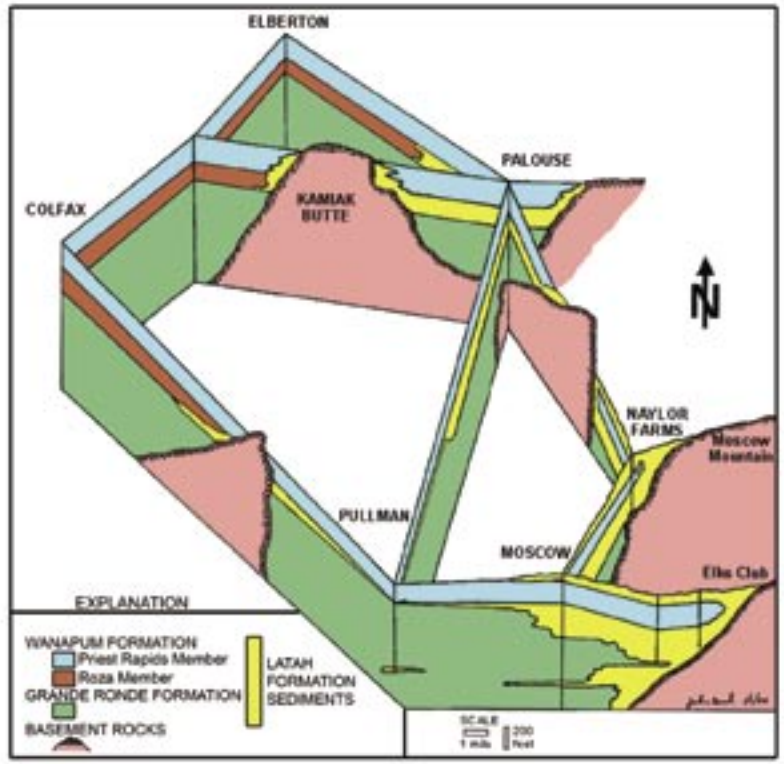
Prepared by:
Steve Robischon
October 2006
The Palouse Basin
Miles
0 1 2 3 4 5 10 15 20
Projection: UTM11, NAD27

Panel Diagram for Wanapum and Grande Ronde Formations, Latah and Whitman Counties (Bush and Garwood)





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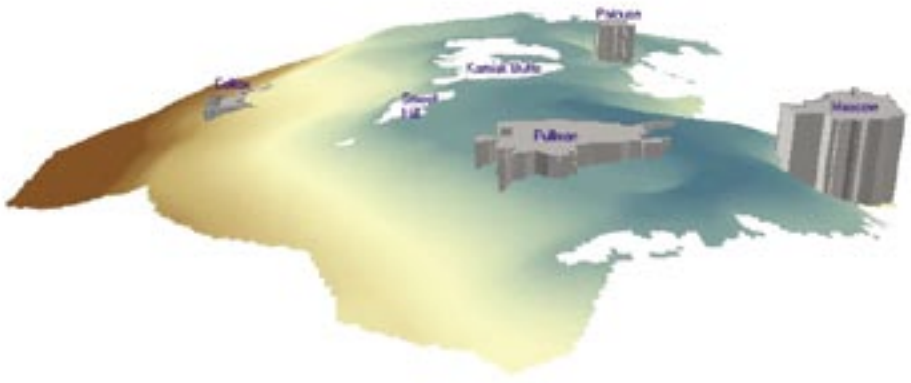


A 3-dimensional depiction of the upper surface of the Grande Ronde (vertical scale highly exaggerated). The upper surface of each of the cities represents its approximate land surface elevation

The South Fork of the Palouse River looking toward Tomer Butte

Executive Summary

Ground water is the sole drinking water supply for the communities, rural residents and industries in Whitman County in Washington and Latah County in Idaho.

The Palouse Basin Aquifer Committee (PBAC) is a voluntary, cooperative, multijurisdictional group with representatives from the cities, counties and universities in the Palouse Ground Water Basin (the Basin). PBAC is charged with ensuring a long-term, quality water supply for the Palouse Basin region. This task is to be accomplished through the implementation of the Ground Water Management Plan, first enacted in 1992.

The Ground Water Management Plan and an associated Intergovernmental Agreement include requirements to report accomplishments, pumpage and water level information. The purpose of this report is to review ground water pumpage and aquifer water levels and summarize research accomplishments during the period between 2002 and 2005.

The total combined ground water pumpage by the four cities and two universities for the year 2005 was 2.77 billion gallons. **(see figure 1 below)** Pumping for 2005 was approximately 10 percent less than in 1992, the first year the Ground Water Management Plan took effect.

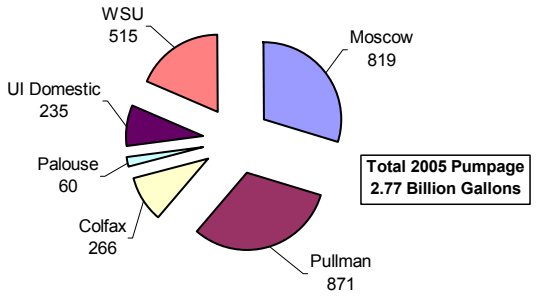


Figure 1: Combined Gound Water Pumpage

Water level data for the period reveal no consistent trend, with some wells experiencing a decline in static water level, others remaining relatively stable, and yet others indicating a possible increase in static water level.

In the three years between 2002 and 2005, PBAC sponsored research projects totaling over a quarter million dollars. Activities included shallow and deep aquifer monitoring and testing projects, a geophysical study, a geologic mapping project, and a compilation of existing data and publications related to the Palouse Basin Aquifer system.

The foundation of the 1992 Ground Water Management Plan consists of a set of goals. As of 2006, PBAC's primary goal is to develop and implement a balanced, basin-wide, water supply and use program by the year 2020. In order to accomplish this goal, PBAC has committed to the creation of an action plan for aquifer system enhancement and alternate water supply development by 2010.

Annual Water Use Report

The report that follows includes water use and water level information covering the period between 1992 and 2005. In an attempt to provide as up to date information as possible, in some instances data are included for portions of 2006. Water use reports for the 1999 through 2001 period can be viewed at the PBAC web site (http://www.uidaho.edu/pbac)

The Palouse Basin Aquifer Committee

Ground water is pumped in the Basin by four major water suppliers (Pullman, Moscow, Washington State University and the University of Idaho), several smaller cities and towns, and many businesses and rural residents residing in the unincorporated areas of Whitman County, Washington and Latah County, Idaho. Ground water levels in the deep aquifer system have been declining since the turn of the 20th century. Growth in the area following World War II led to increased pumping from the aquifer system, and by the late 1960's a serious decline in the water levels was being recognized by the cities, state institutions and regulatory agencies. A recommendation made at a meeting of the Regents of the University of Idaho led to the 1967 formation of a committee, known then as the Pullman Moscow Water Resource Committee (PMWRC), to study the problem and make recommendations to the administrative and elected representatives of the major pumping entities. As time progressed, membership in the committee was expanded to include Whitman and Latah counties and then Colfax, Washington. In 1998, to reflect its expanded membership, the committee name was changed to the Palouse Basin Aquifer Committee (PBAC).

The Ground Water Management Plan

In 1992, the PMWRC, with the support of Washington and Idaho state regulators, drafted and signed a Ground Water Management Plan for the Basin. The Plan is authorized by an Intergovernmental Agreement between the (now 7) primary pumping entities and an Interagency Agreement between the Washington Department of Ecology and the Idaho Department of Water Resources. The plan details the governance structure of the committee and lays out specific goals for the pumping entities. Since 1992, the goals have been periodically reviewed and updated by PBAC.

Basin Description

The precise boundaries of the Basin have not been delineated, but a working boundary appears as shown in figure 2. Ground water in the basin is pumped primarily from two aquifer systems: the shallower Wanapum and the deeper Grande Ronde. The Wanapum and Grande Ronde Formations are part of the Columbia River Basalt Group, which consists of thousands of feet of lava flows that covered much of eastern Washington and northeastern Oregon during eruptions between 17 and 6 million years ago.

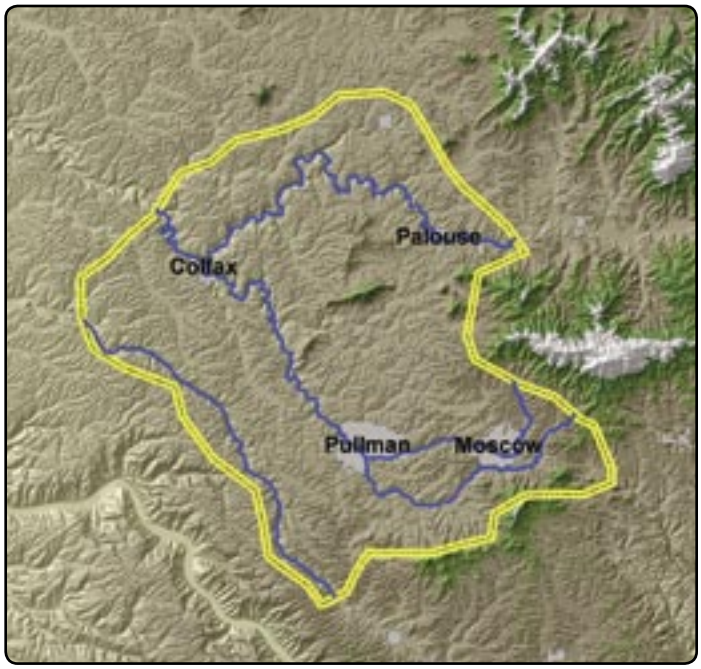


Figure 2: Working boundary for the Palouse Ground Water Basin

The nature of the emplacement of the basalts over time resulted in significant differences in geology from west to east across the basin. The eastern end of the basin is characterized by thick sedimentary interbeds that thin west of Moscow. The Grande Ronde basalts are thicker beneath Pullman. An exaggerated schematic cross section of the Basin is shown in figure 3, and one focusing on the eastern end of the Basin in figure 4.

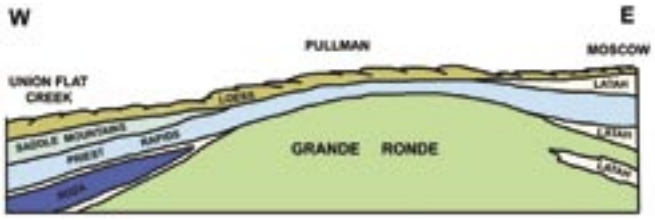


Figure 3: E-W Schematic Cross Section (Bush, Garwood)

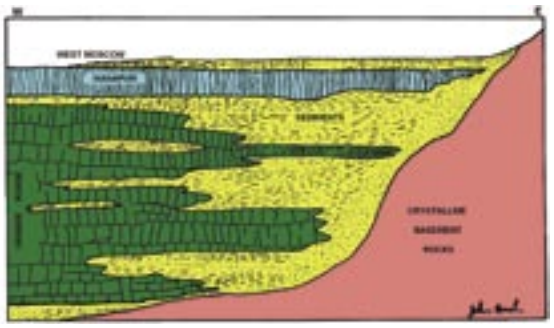
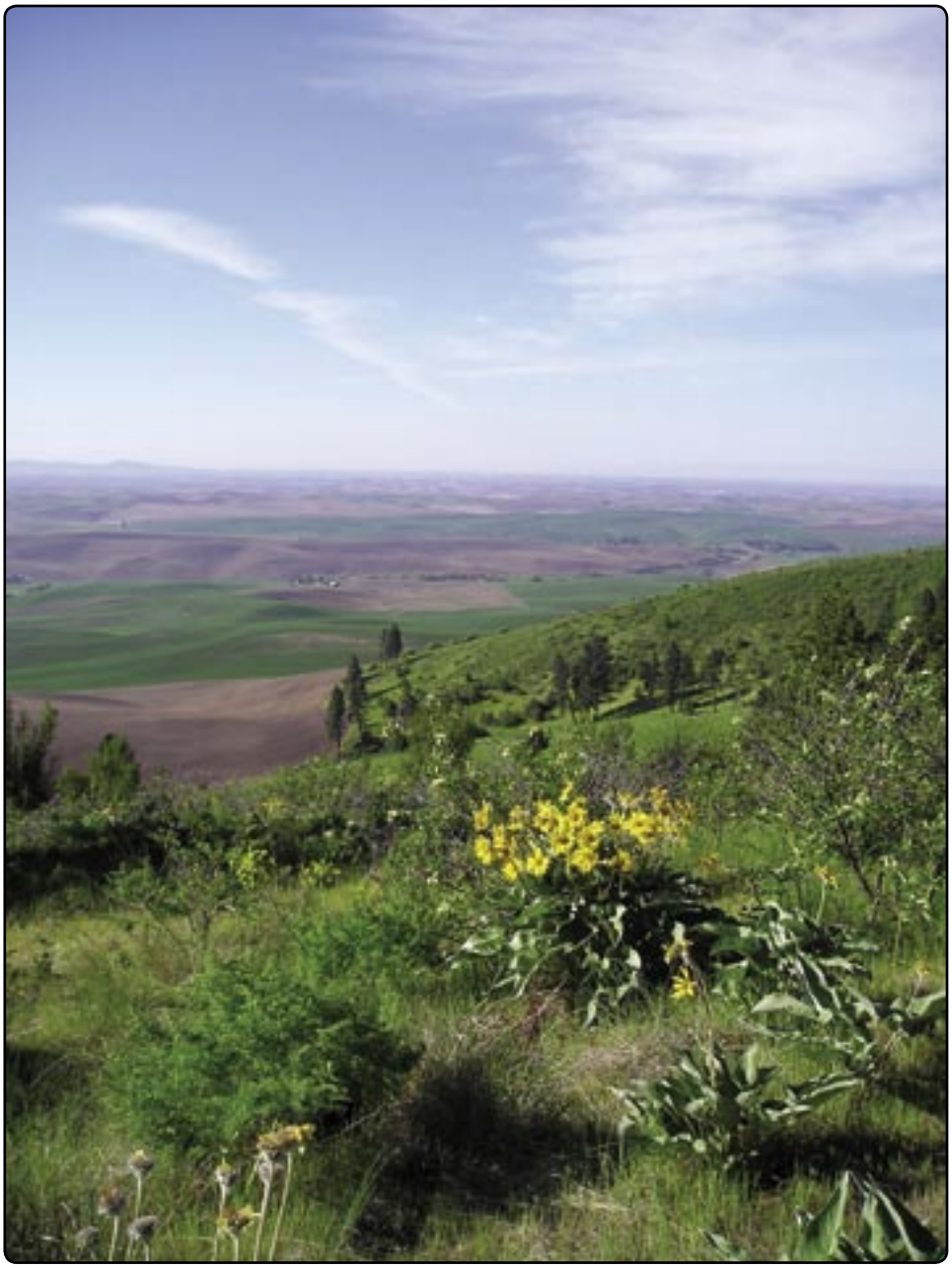


Figure 4: East End Schematic Cross Section (Bush, Garwood)

The primary municipal drinking water source in the Basin is the Grande Ronde aquifer system. In Pullman, all of the municipal and most of the rural residents obtain their drinking water from the Grande Ronde. In Moscow, nearly 30% of the supply is from the Wanapum, and many of the rural residents in Latah County also tap the shallower aquifer. In general, the Grande Ronde wells are more productive and contain higher quality water than those in the Wanapum.

Water levels in the Grande Ronde have historically declined at a rate of 1 to 2 feet per year for 70 or more years (**see figure 5 below**). Water levels in the Wanapum dropped drastically in the 1950's and early 60's, but recovered in the 1970's and 80's when much of the pumping switched to the deeper Grand Ronde. Although absolute values are still uncertain, it is thought that there is limited recharge to the Wanapum and very little recharge to the Grande Ronde.



Kamiak Butte looking generally south

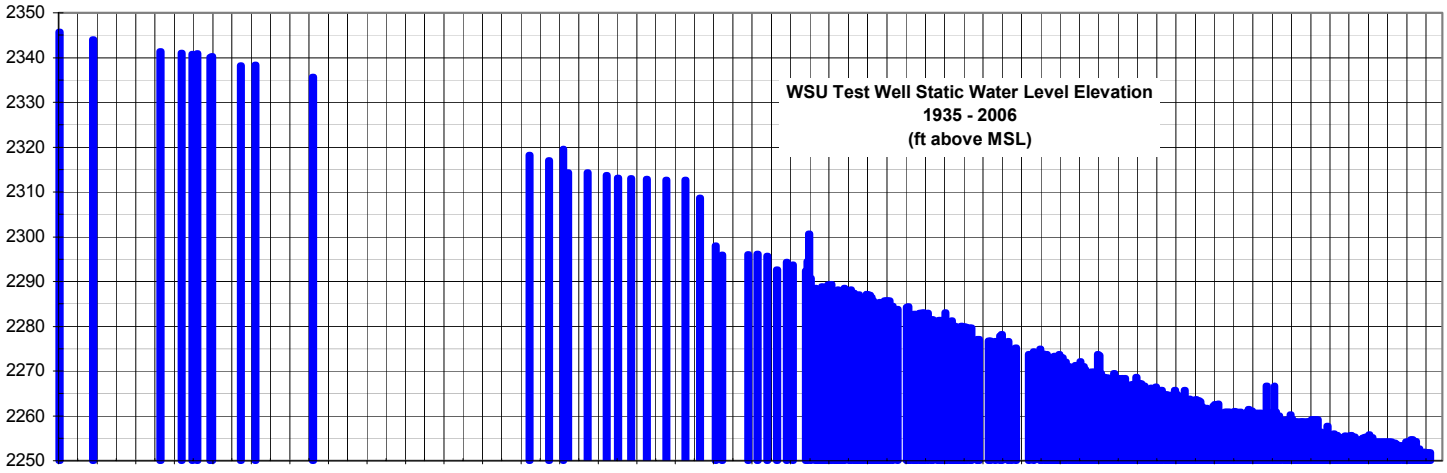


Figure 5: Static water level, WSU Test Well, 1935-2006

Ground Water Pumpage and Water Levels

The total combined ground water pumpage for the four cities and two universities for the year 2005 was 2.77 billion gallons (**figure 6**). This was approximately 1.7 percent more than was pumped in 2004 (2.72 billion gallons), but 10.4 percent less than was pumped in 1992 (3.09 billion gallons), the first year the Ground Water Management Plan took effect. Annual pumping figures for each of the four cities and two universities for the period between 1992 and 2005 are shown in figures 12-17 (pp 13,14). Available monthly pumping figures for the period between 2002 and early 2006 are illustrated in figures 18-24 (pp 15,16).

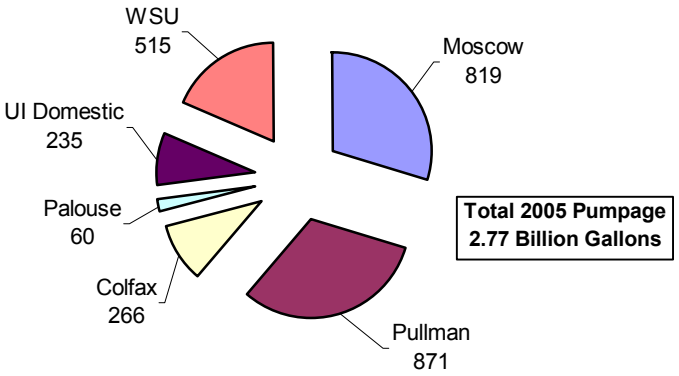


Figure 6: 2005 Combined Gound Water Pumpage

In 2005, Moscow and Pullman each accounted for roughly one third each (29.6% and 31.5% respectively) of the total pumping, followed by WSU at just under one fifth (18.6%) of the total. Colfax and UI pumped 9.6 and 8.5 percent, respectively, and Palouse pumped just over 2 percent of the combined pumping total **(see figure 7 below)**.

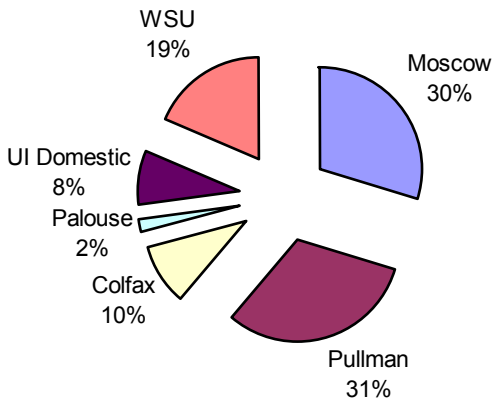


Figure 7: 2005 Pumpage - Percentage of Combined Total

Steptoe Butte looking South and East

Nearly 91 percent of the total combined pumping by the six reporting major pumping entities in the Basin is from the Grande Ronde aquifer system. Moscow pumped nearly 32 percent (261 million gallons) of its water from the Wanapum aquifer system in 2005; the other pumping entities all pump almost entirely from the Grande Ronde. Of the combined pumping total, the Moscow Wanapum contribution amounts to approximately 9.4 percent.

Pumping increases significantly in the summer months, primarily due to increased irrigation needs. An estimate of the baseline pumping can be calculated as the average of the pumping levels for the months of November, December, January and February. Pumping above this average level can then be considered non-baseline usage. In 2005, as a percentage of total pumping, the non-baseline usage for the four major pumping entities ranges from 21.5% for UI to 30.8% for Pullman (**figure 8**).

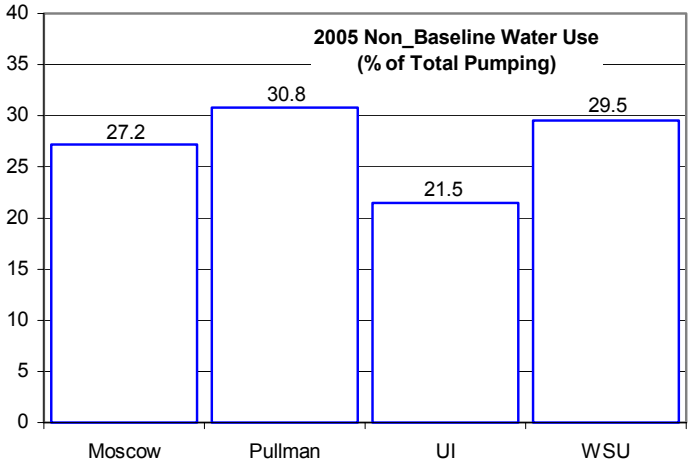


Figure 8: Non-baseline Water Use

As part of the Ground Water Management Plan, each pumping entity has agreed to voluntary pumping targets. Each entity is to attempt to limit annual pumping increases, based upon a 5-year moving average, to 1% of the 1986-1990 average pumping level. In addition, each entity is to keep its total pumping below 125% of the 1981-1985 average pumping level. The 1% and 125% targets for each entity are illustrated in figures 25-32 (pp17,18). An aggregation of the pumping targets for the four signatory entities is shown in figures 9 and 10 below. Note that no figures are shown for Colfax and Palouse, as they were not original signatories to the Ground Water Management Plan, and as such are not subject to the pumping targets.

Water level data for the period show no consistent trend, with some wells experiencing a decline in static water level, others remaining relatively stable, and yet others indicating a possible increase in static water level. Measurement of static water levels in pumping wells is problematic, and there have been additional complications associated with the instrumentation and protocols utilized to make the measurements during the period. The combination of these factors makes it difficult to provide any generalized conclusions as to the aquifer water level trends at this time.

Figures 33-45 (pp19-22) illustrate monthly pumping and static water level data for Basin wells covering the period from 2002 to early 2006.

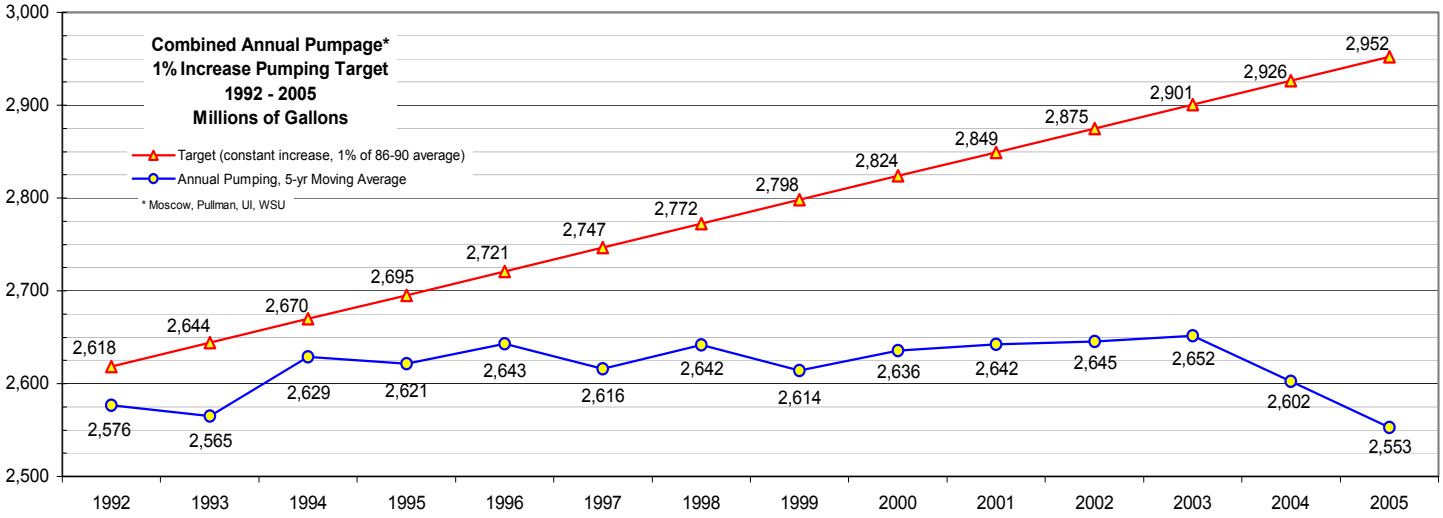


Figure 9: Voluntary 1% Annual Pumping Increase Target - All Entities Combined

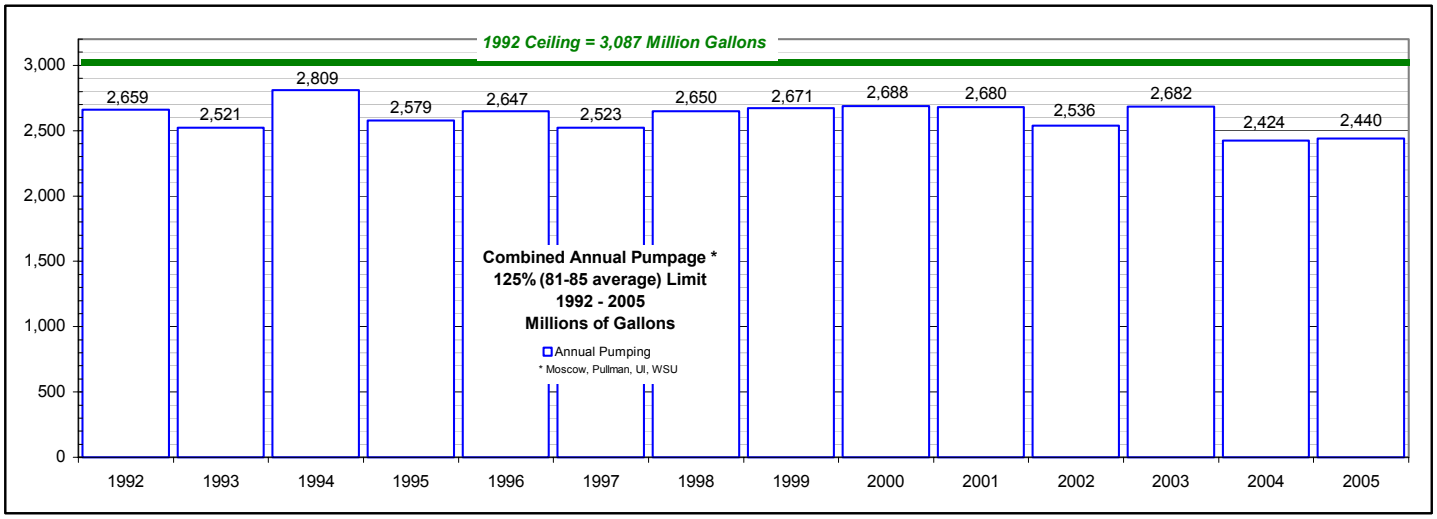


Figure 10: Voluntary 125% (of 1981-85) Pumping Ceiling - All Entities Combined

Research Accomplishments 2002 – 2005

The following are summaries of presentations made at PBAC meetings during the period covered. Note that not all reported findings can be directly attributed to the individual researchers listed, as what is reported herein comes primarily from third party reports of presentation contents. Note also that findings reported earlier in the period may have been superceded by more recent research.

2002

A project begun in 1999 by Professors Kent Keller of WSU and Jim Osiensky of UI continued during 2002. Findings included:

- Interpretation of geologic data together with ground water level and water isotope chemistry data suggests that Moscow and Pullman may be located in separate ground water sub-basins.
- A north-south trending ground water/geologic divide may be present approximately half way between Pullman and Moscow.
- Geologically, Palouse appears to be isolated from the Moscow and Pullman pumping centers by rock barriers. However, the Grande Ronde aquifer systems in Palouse, like those in the Moscow area, are sediment dominated, suggesting concurrent deposition and possible hydraulic connection.
- Hydraulic testing of the (then) new Pullman well suggests distinct horizontal anisotropy within the Pullman area, with the cone of depression formed by the Pullman pumping center growing preferentially to the west.
- The new Palouse well, the DOE well, and several Moscow wells respond together, at least seasonally, although magnitudes of fluctuation differ by more than a factor of 10. Fluctuations of Pullman wells span a similar range but exhibit a different response to summertime irrigation stress.
- One well physically located in the Pullman area appears to exhibit the pattern characteristic of the Moscow wells, possibly suggesting that the sub-basins are physically distinct, but that the boundary between them may be more complex than previously thought.

John Bush (UI professor emeritus) continued his geologic research in the Basin. Findings he reported include:

- Horizontal basalt flows in the Columbia Basin are rare. It is likely that the basalts in the Palouse Basin are folded.
- On the Idaho side of the state line there are Miocene sediments above the Wanapum basalt that range from up to 250 feet thick in the east to 15 to 20 feet near the Palouse Mall in the west. Much of this sediment is clay that is quite impermeable.
- Union Flat Creek and the Snake River are in a syncline southwest of Pullman. Colfax and Glenwood Canyon may be in a syncline. The west edge of Pullman is on an anticline.
- It appears that ground water to the west of Pullman is moving NW from the Palouse Basin following a slight plunge in the syncline and anticline sequence.
- A fold between Pullman and Moscow may be blocking any direct connection between the Moscow and the Pullman ground water areas.
- It appears the basalts and sediments thicken and thin depending on where they are in the axes of the synclines and anticlines rather than proximity to the Moscow Mt. Range.
- The Rosa flow is 200 feet thick in the Colfax area. It pinches out at Pullman. This basalt flowed up against a high that developed between Pullman and Moscow.
- There is no indication of deep aquifer water from the Moscow-Pullman area aquifers making it to the Snake River. The small amount of ground water that does make it from the Palouse Basin to the Snake River appears to be shallow aquifer and even perched aquifer waters. Evidence supporting this thesis, in the form of water geochemistry, has been obtained by Kent Keller.

Tobin O'Geen reported on the results of his PhD dissertation:

- The precipitation gradient across the Palouse Basin from west to east, from low precipitation, 450 mm, to higher, 800 mm, significantly impacts the area soils and the rate that water moves vertically through them.
- The rate of vertical water movement through western and central soils in the basin is much more rapid than through eastern soils because the western soils are weakly developed and, therefore, more permeable.
- In the eastern portion of the Palouse Basin study area the soils are well developed, macropores are clogged and/or compacted by wetting and drying cycles. As a result the vertical permeability of these soils is very low to water. Once the water reaches the densified fragipan layer(s), almost all movement is horizontal or downslope parallel to the surface.
- Results indicate that recharge is less than 3 mm yr^{-1} in 33% of the loess-covered Basin where precipitation is greatest, and regolith is heterogeneous. Recharge is 10 mm yr^{-1} in 37% of the Basin where loessal regolith is homogeneous. Due to the fragipan which blocks essentially all downward movement of water, downward migration of water is in thousands of years, if at all in soils similar to the eastern catchment soils.
- Pore water samples taken from below the fragipan layer were essentially stagnated and 1000s of years old.

Professor Joan Wu of WSU reported that:

- Long-term hydrographs compiled from water level records of more than 20 wells (dating back to 1923 for the Wanapum and 1965 for the Grande Ronde) exhibit a bimodal (Wanapum and Grande Ronde) trend. The data suggest that the stratification of water levels has existed back to the beginning of development, and that there has always been natural discharge "draining" the Grande Ronde.

2003

Additional findings were reported from the Keller/ Osiensky project:

- Isotopes, streamflow, and basin-scale water level data support the idea that the Grande Ronde in the Pullman-Moscow area is hydraulically isolated from the Wanapum above, and possibly the Grande Ronde in the vicinity of the Snake River canyon.
- Uncorrected ages of ground waters in the Grande Ronde are 10,000 years old and greater. Samples collected to date from the Wanapum basalts away from the creeks range in age from 8,820 to 14,190 years. Ground water samples from the Grande Ronde basalts range in age from 12,630 to 23,070 years.
- Aquifer test data suggest there is an apparent barrier to aquifer test drawdowns between Pullman and Moscow, and there is an apparent (but unconfirmed) hydraulic connection roughly north-south between Moscow and Palouse.
- Aquifer test data show that within hours to days, the effects of Moscow pumping extend westward to at least the WDOE well and possibly north to Palouse. The effects of Pullman pumping at the same time scale do not evidently extend eastward to the WDOE well, northwestward to Colfax, or north to Palouse.
- Water level data suggest that a hydraulic boundary may exist near the cluster of Pullman wells (3, 4, 5, 6, and the WSU test well).
- An emerging conceptual model suggests the Palouse Basin system consists of at least two lithologically and possibly structurally defined sub-basins. In the short term, these basins appear hydrologically distinct. In the long term (monthly or greater) the sub-basins exhibit similar water level trends and apparent hydraulic connection. The steady, basin-wide decadal Grande Ronde water level declines may represent an average, net response to cumulative pumping stresses throughout the entire Palouse Basin.

- Preliminary aquifer test data do not suggest short term hydraulic connection exists between Pullman and Colfax. However, limited water level data do suggest possible long term hydraulic connection exists between Colfax and the rest of the Palouse Basin. Long term water level declines and ground water ages may indicate that long term recharge to the Grande Ronde is presently less than discharge over the basin as a whole.

Dennis Owsley presented information from his graduate research on the characterization of the Grande Ronde aquifer system. He concluded that:

- There are at least three separate subbasins in the Grande Ronde Formation which are so poorly connected that short-term pumping effects do not transmit from one to the next.
- Both a Pullman area subbasin and a Moscow area subbasin that are at about the same depth extend to the City of Palouse where impacts of pumping from both were observed in Palouse Well #2.
- The third aquifer appears to exist only under the Moscow side of the basin including the WDOE test well but it does not extend to the Palouse area.
- Grande Ronde basalt flows observed in Pullman are observed in Palouse but they are some 200 feet higher in elevation. The overlying flows in the Pullman area have pinched out before getting to the Palouse area. (Note: Another researcher has noted that the pinching out hypothesis is only one possible explanation of this phenomenon, not yet verified by additional research. What is known is that the top of the Grande Ronde is higher in Pullman than it is in Palouse)
- No connection between Grande Ronde pumping and Wanapum water levels was ever observed.

2004

John Bush and Dean Garwood reported further findings from their research:

- In general the upper Grande Ronde surface west of Pullman slopes to the west and northwest. From Pullman to the Snake River there are several low amplitude NW plunging folds. With depth the contacts between flows increase in the amount of dip.
- Pullman is located both on an anticline and in a deformation zone.
- A number of small dikes have been observed in Pullman indicating secondary intrusions which could be acting as barriers to water movement within and between aquifers.
- The upper Grande Ronde surface in Pullman is commonly weathered to a saprolite and it slopes away from Pullman to the west and east.
- In Moscow, the Wanapum is "wrapped" in all directions by Latah sediments.
- In Moscow, the Wanapum and upper Grande Ronde surfaces dip eastward.
- Geophysical, emplacement modeling, surface mapping, stratigraphic maps, and stratigraphic correlations all indicate a N-S component to the basin at least for the upper Grande Ronde. This basin dips slightly northward towards Palouse.
- The city of Palouse is located on a syncline and the Palouse River trends northwest from Palouse down the axis of the syncline.
- The Priest Rapids Basalt and Vantage Member of the Latah Formation are over 400 feet thick in the Moscow area.
- The Rosa Basalt of the Wanapum underlays the Priest Rapids to the west of Albion, so the Wanapum Formation is 400 feet thick in the vicinity of Colfax. In Pullman the Wanapum is generally less than 150 feet thick and consists primarily of Priest Rapids Basalt.

Alyssa Douglas (UI graduate student) reported on the results of her research involving radiocarbon dating:

- The oldest water samples measured were from the Moscow and Palouse areas.
- Samples nearly as old were taken in the Pullman and Colfax areas.
- The youngest samples were from the relatively shallow Grande Ronde wells approximately half way between Moscow and Pullman (close to an anticlinal axis), which may indicate a fracture zone that is allowing water to naturally flow from the shallow aquifer system down to the deeper aquifer system.
- With one exception, samples from the shallow aquifer wells were younger than those collected from deep aquifer wells.
- A study of the possible sources of added carbon in the basalts concluded that no correction was needed to the C14 dating equation utilized to age date the water samples.

Derek Holom (UI graduate student) provided some interim information related to his geophysical research in the Basin. Derek reported that data suggests there is not a basement formation ridge under "D" Street in Moscow. (Note: This finding is supported by earlier work by Bush et al illustrated by geologic maps published by the Idaho Geologic Survey)

2005

Nicole Badon (UI graduate student) reported on the results of a February 14, 2005 pump test. The results indicate a short-term hydraulic connection between Moscow #2 and the Bond well (approx 3000 feet to the south) and Moscow #3, no (or slight) impact on Moscow 6, 8 or 9 (Grande Ronde), or area private wells.

Derek Holom reported that preliminary findings from a gravity survey in the Kamiak Gap indicate the presence of a V-shaped boundary condition between Kamiak Butte and Angel Butte (**see figure 11**). Additional data in the vicinity of the purported D Street ridge support earlier conclusion that the ridge is likely not present.

John Bush wrapped up his work producing geologic maps of the Basin. Begun in 1995, John, with the assistance of several contributors, first produced five bedrock geologic maps of 7.5 minute quadrangles for the eastern end of Palouse basin. His latest work includes five more quads in Whitman County, geologic cross sections, panel diagrams, a fold map, and a structural contour map of the upper Grande Ronde in the Palouse Basin region.

Farida Leek, a WSU graduate student, initiated efforts to compile and analyze existing information pertinent to the hydrogeology of the Palouse Basin aquifer system. The project will gather and format in digital form all available information that can be utilized as a foundation for improved characterization of the Basin's ground water resource. Elements of the compilation will include a GIS database, research reference citations, hydrogeologic cross sections, ground water contour maps, and a variety of supporting data. The goal of the project is to provide baseline information that can be utilized in the creation and verification of improved 3-dimensional ground water flow models.

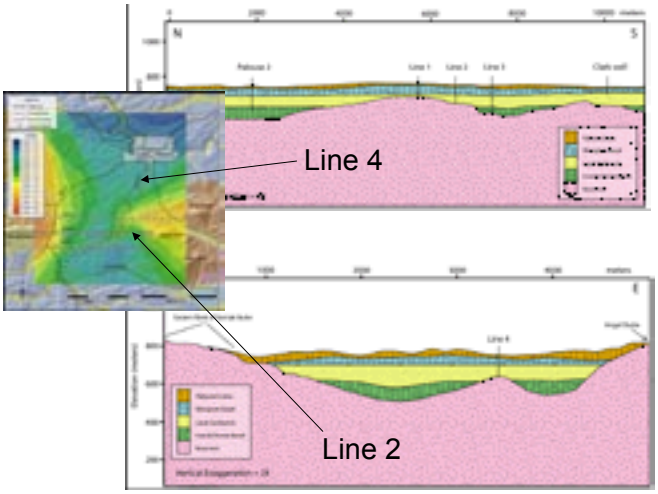


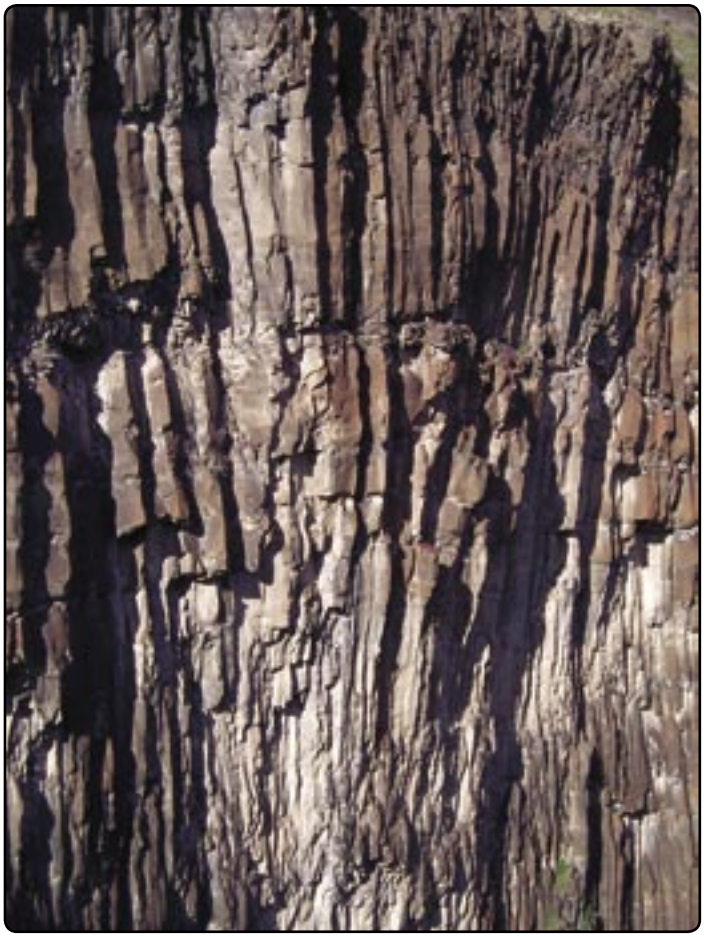
Figure 11: Kamiak Gap - Cross sections derived from geophysical modeling.

Goals, Plans and Ongoing Efforts of the Committee

The foundation of the Ground Water Management Plan consists of a set of goals. Each member entity crafts its water resource management plan(s) to support the goals. The goals are periodically reviewed and updated by PBAC.

The goals were revised in 2006, and the primary goal of PBAC is now to develop and implement a balanced basin-wide water supply and use program by the year 2020. An interim goal requires that an action plan for the program be developed by 2010.

In order to meet the current goals, research will be required to better characterize those components of the Basin water balance that currently lack high levels of certainty. As part of the characterization effort, PBAC in 2006 will continue to fund ongoing shallow and deep aquifer monitoring and testing projects, as well as a project to study a standby well on the UI campus in which water from the Priest Rapids (Wanapum) Basalt is flowing into the well and down into the Vantage Formation interbed.



The University of Idaho Arboretum is irrigated using reclaimed water.

In late 2005 and early 2006 a new interdisciplinary graduate water resources program called Waters of the West (WoW) was proposed and funded at the University of Idaho. A portion of the program includes an interdisciplinary water resource case study of the Palouse Basin area. PBAC looks forward to working with WoW in 2006 to identify, fund and implement research projects that will enable better-informed decision making aimed at ensuring a sustainable, high quality water supply for the region.

In 2005, PBAC formed a Citizens Advisory Group (CAG), aimed at ensuring dialogue among a broader range of interested parties. The CAG has been charged with the development of recommendations for consideration by PBAC involving management, research, conservation and public participation. The CAG presented its first recommendation to PBAC in early 2006, and is currently working on additional recommendations.

Also in 2005, PBAC participated in the Palouse Water Summit. The Summit brought together water resource professionals from around the country to discuss management strategies that have been employed in several large and small communities. PBAC will support and participate in a follow-up to the Summit, scheduled for October 2006. The 2006 Water Summit will feature a more local focus and be targeted at laying a foundation for a long-range plan for sustainable water use on the Palouse.

Annual Pumping Totals 2002-2005

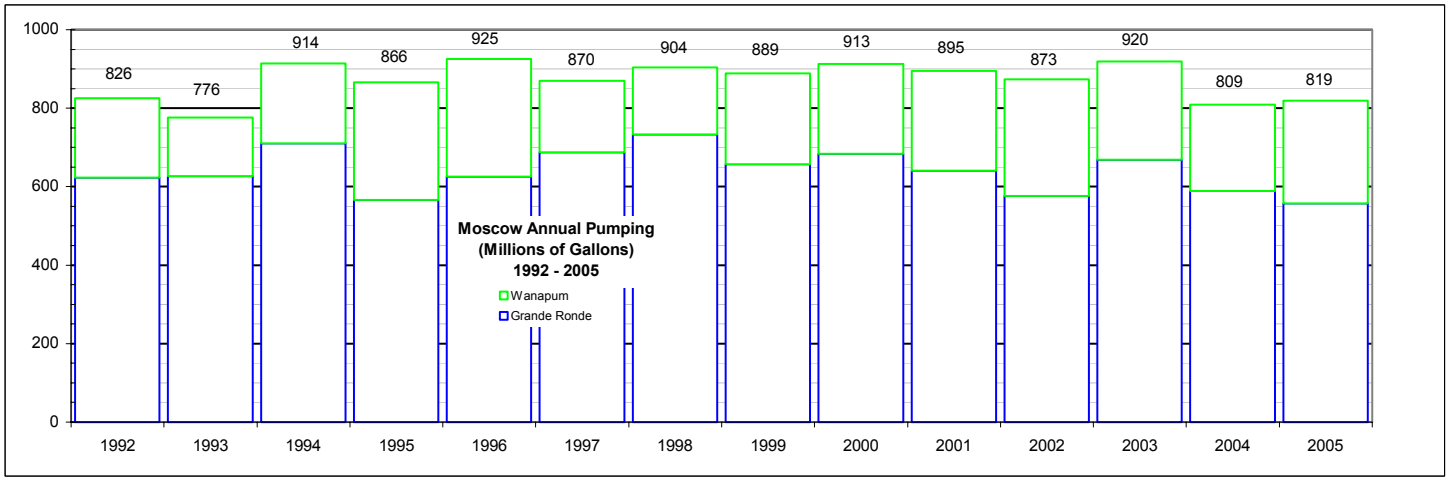


Figure 12: Moscow

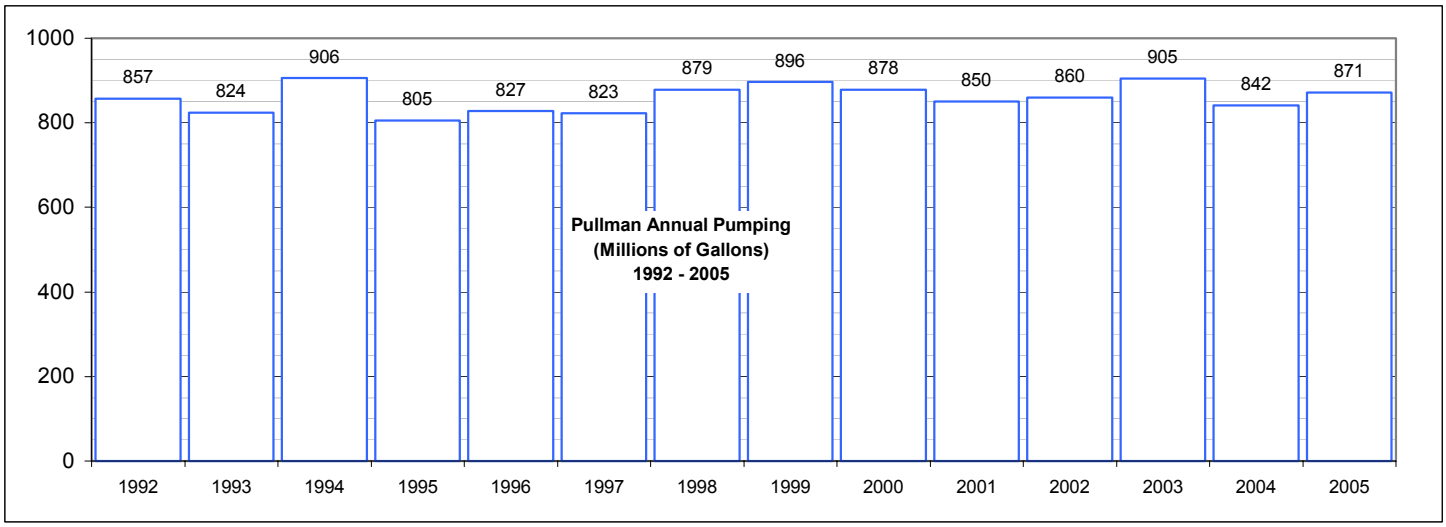


Figure 13: Pullman

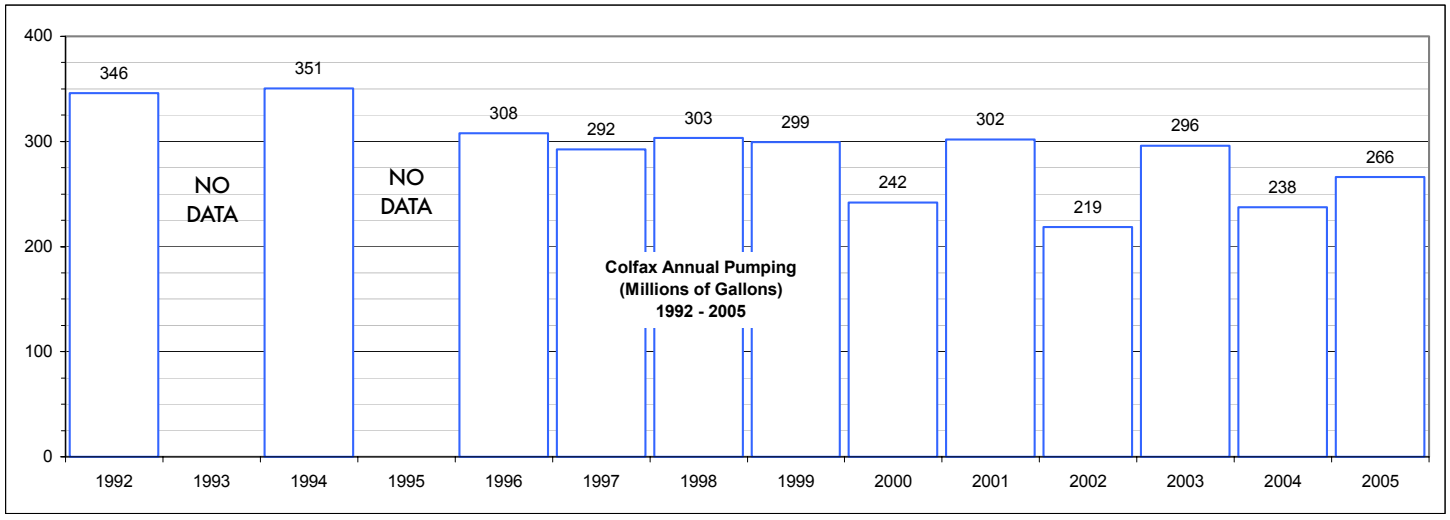


Figure 14: Colfax

Annual Pumping Totals 2002-2005

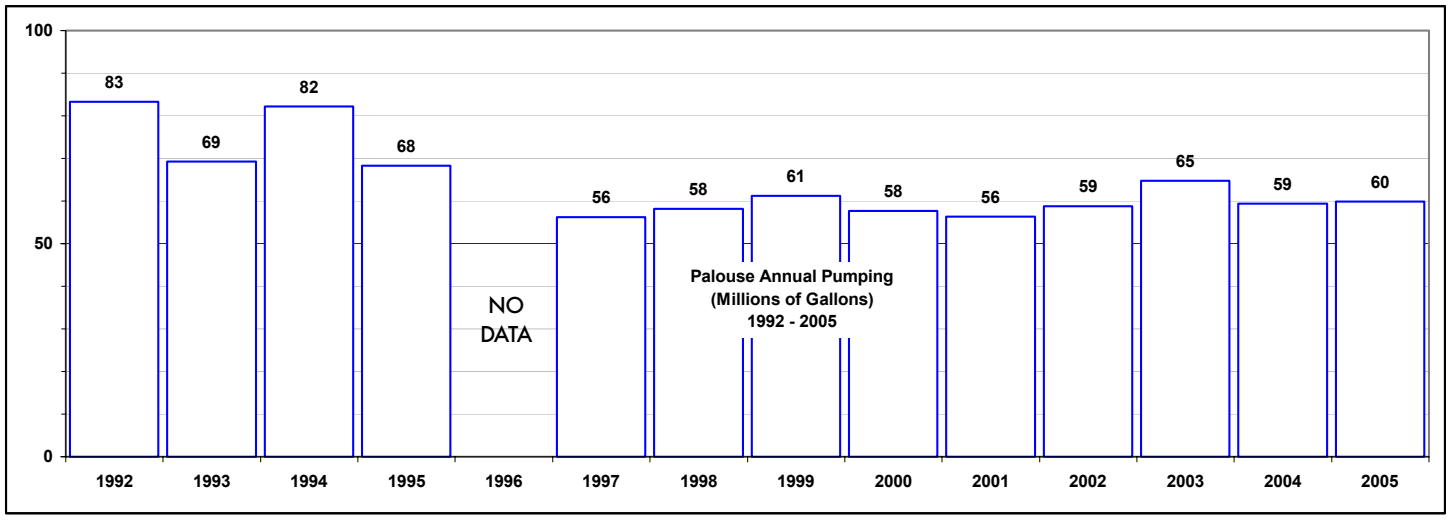


Figure 14: Palouse

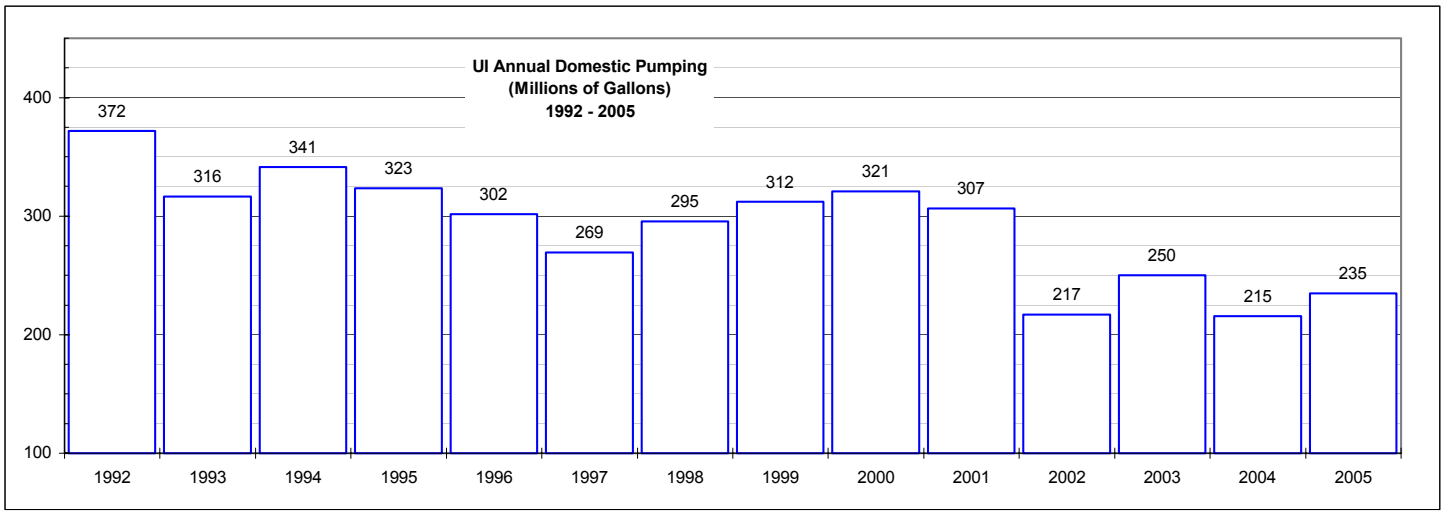


Figure 16: UI Domestic

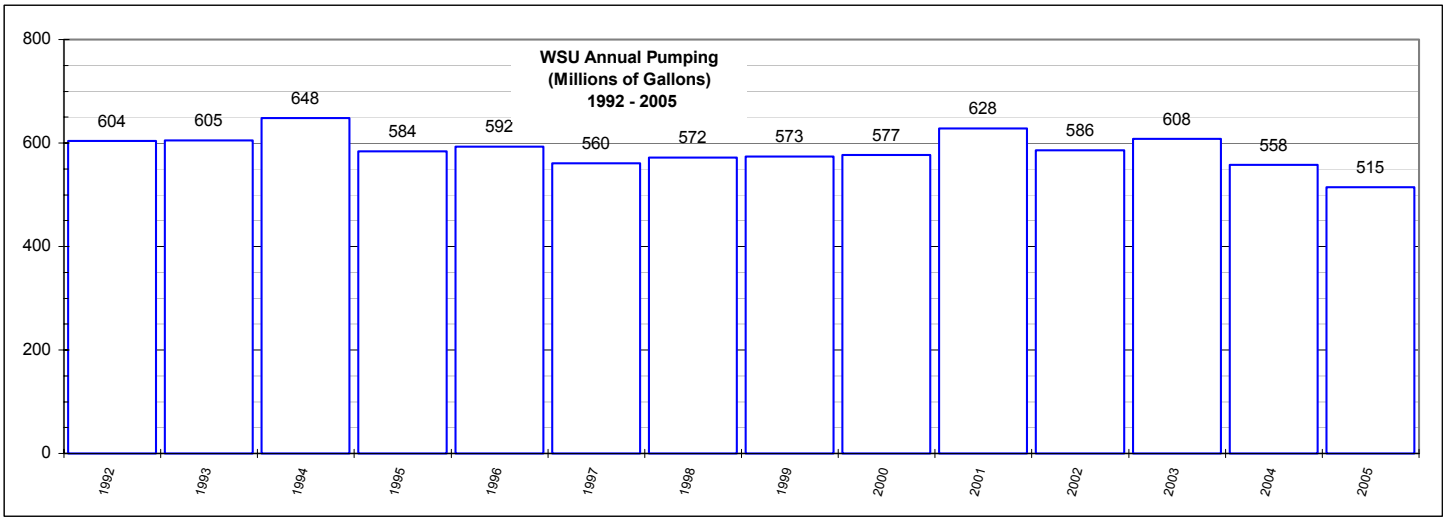


Figure 15: WSU

Monthly Pumping Totals 2002-2006

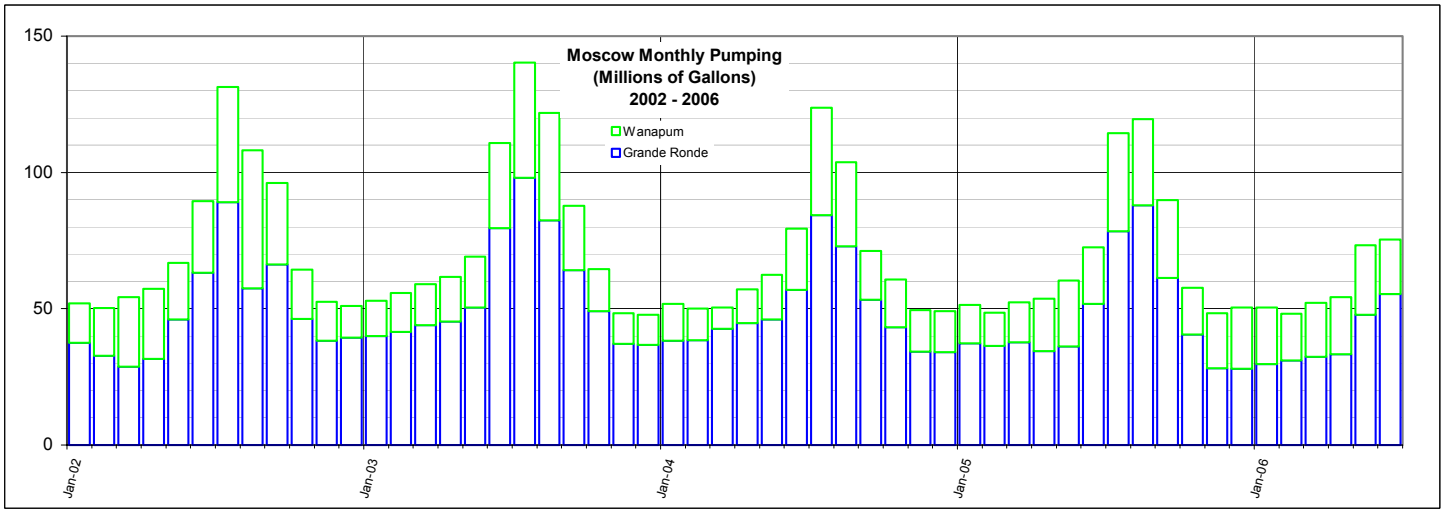


Figure 18: Moscow

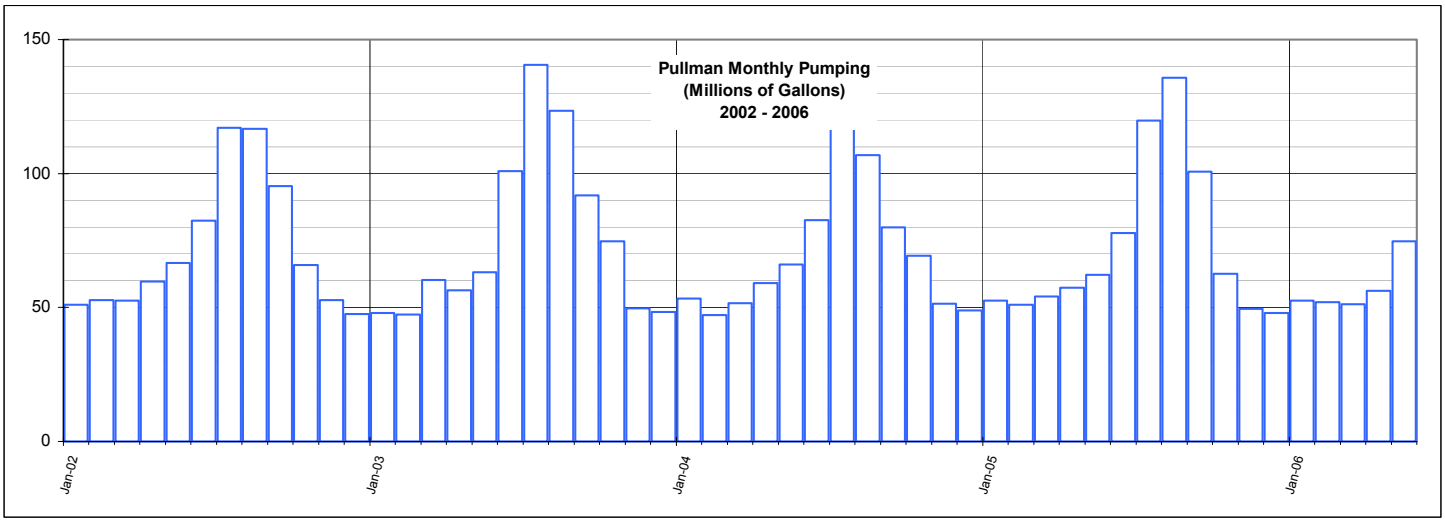


Figure 19: Pullman

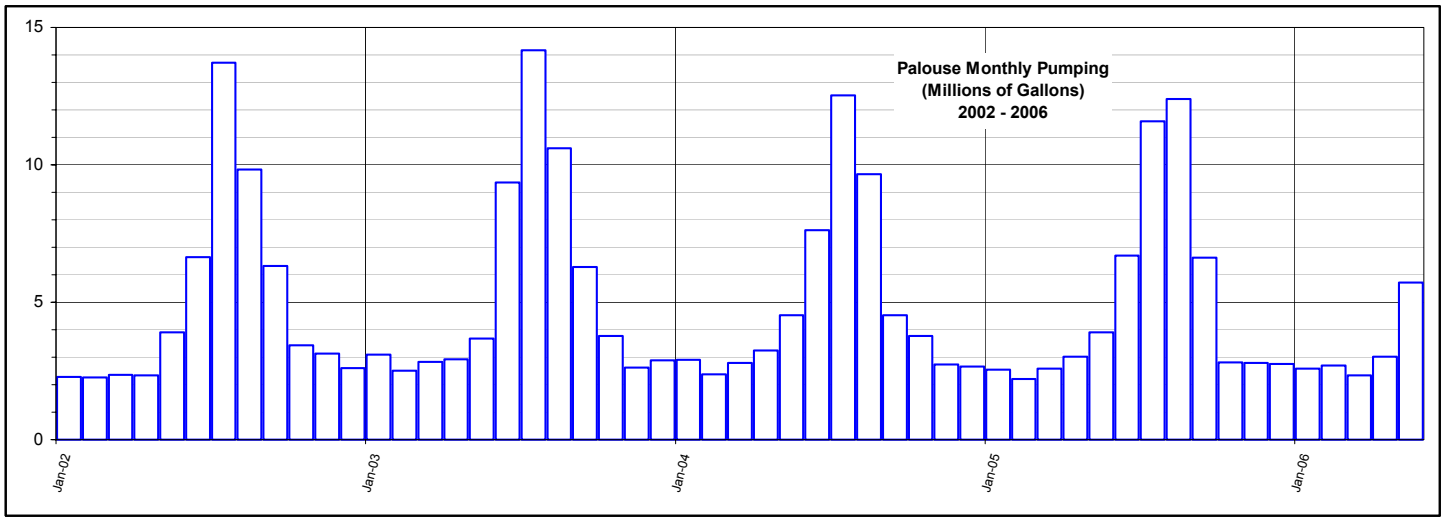


Figure 20: Palouse

Monthly Pumping Totals 2002-2006

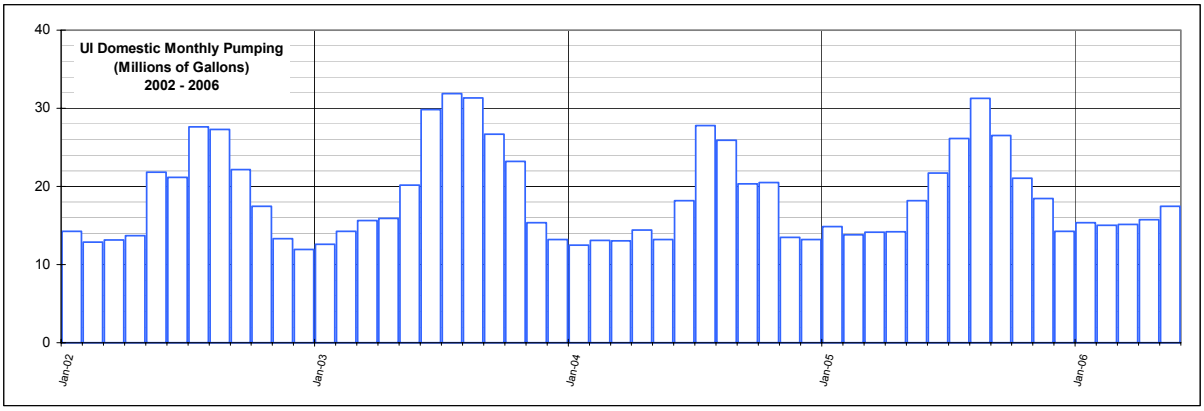


Figure 21: UI Domestic

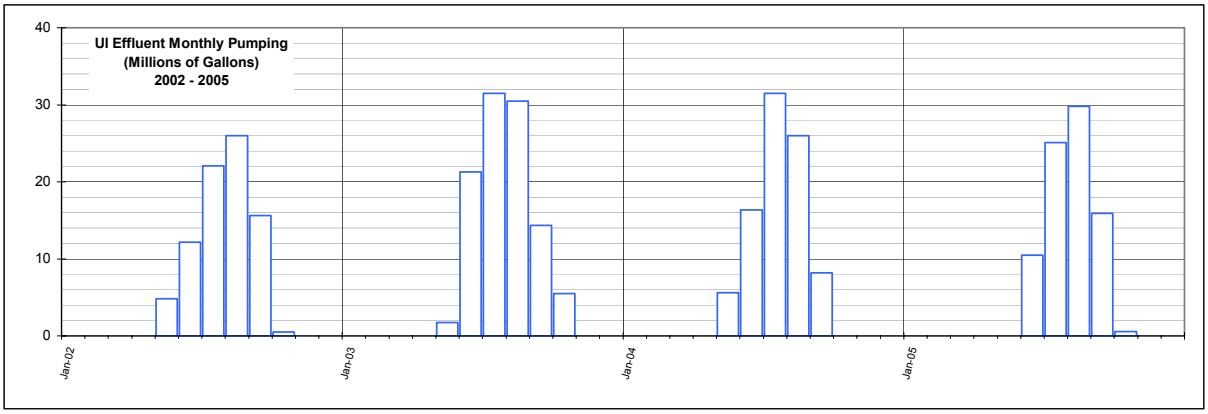


Figure 22: UI Efficient

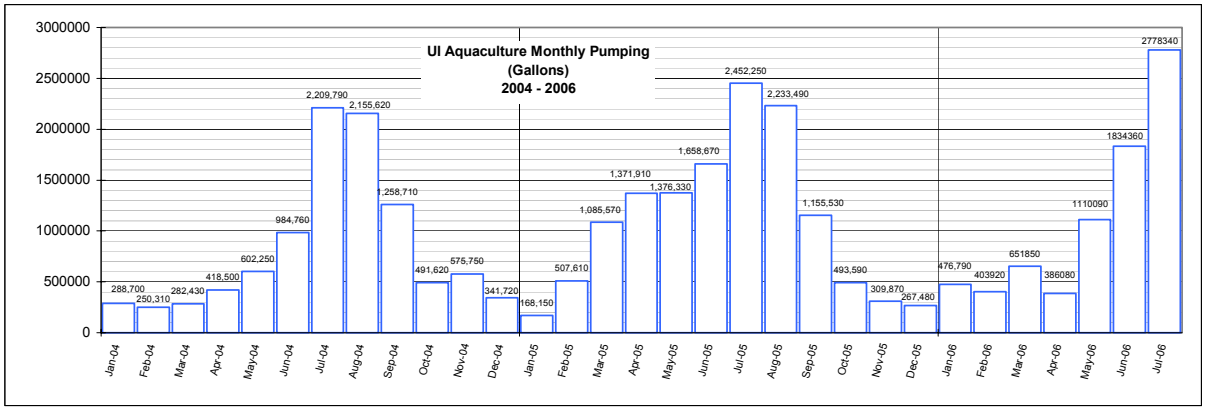


Figure 23: UI Aquaculture

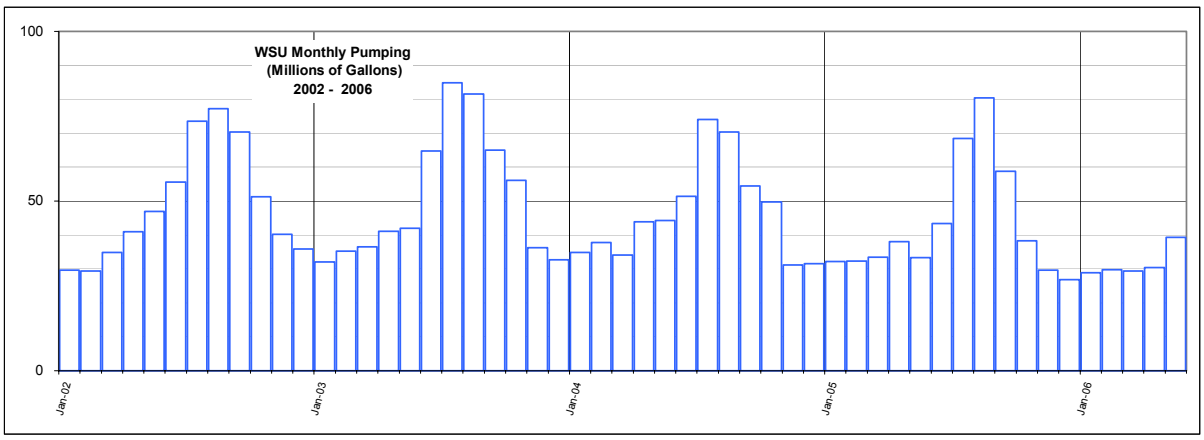


Figure 24: WSU

Voluntary 1% (of 1986-90 average) Annual Pumping Increase Targets 1992-2005

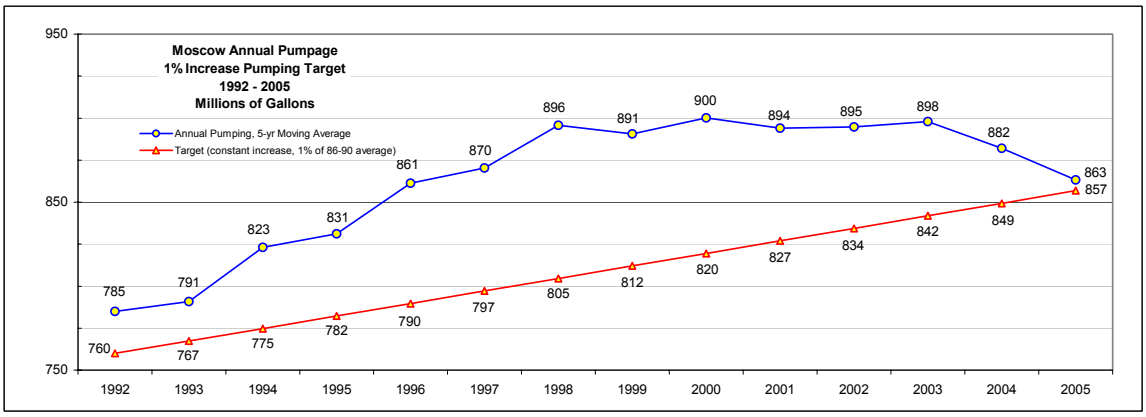


Figure 25: Moscow

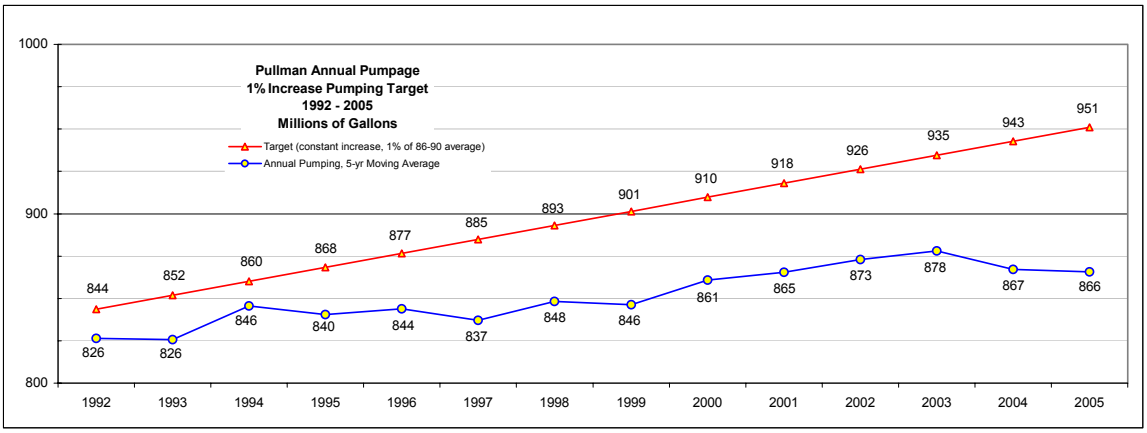


Figure 26: Pullman

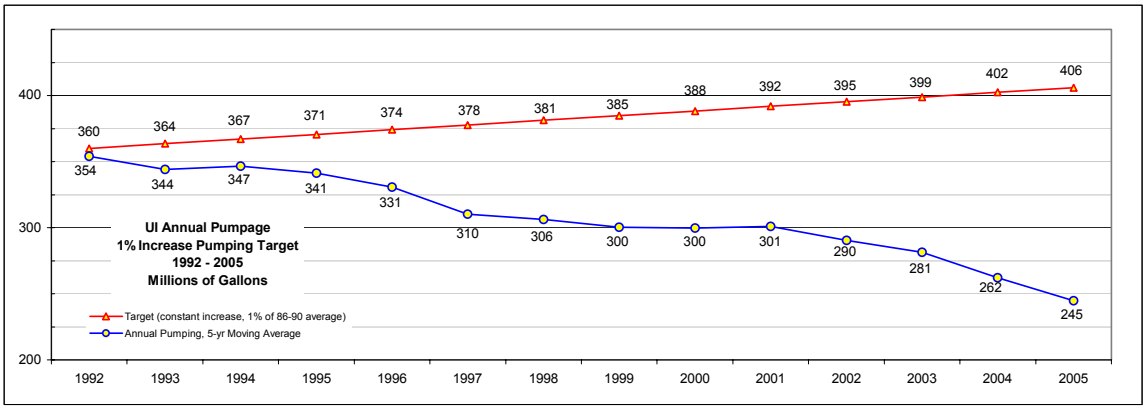


Figure 27: UI

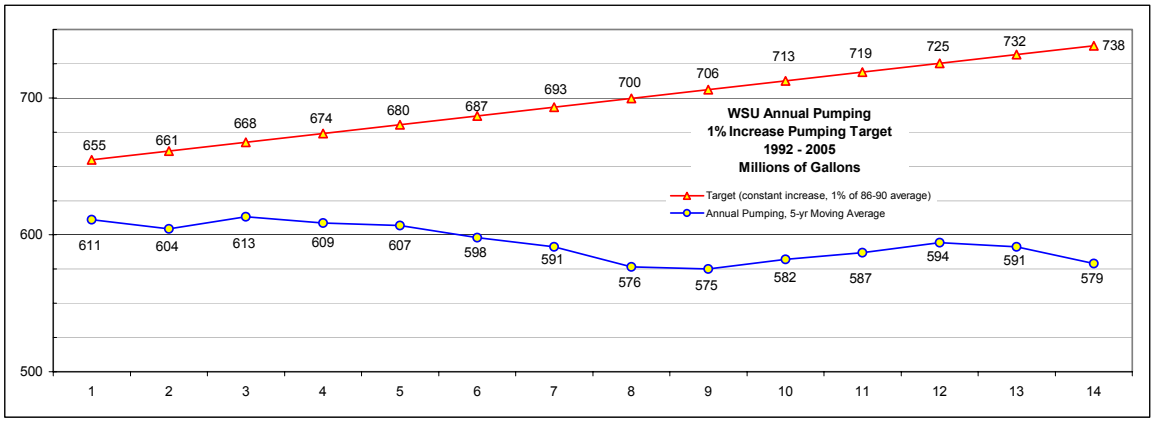


Figure 28: WSU

Voluntary 125% (of 1981-85 average) Pumping Ceiling 1992-2005

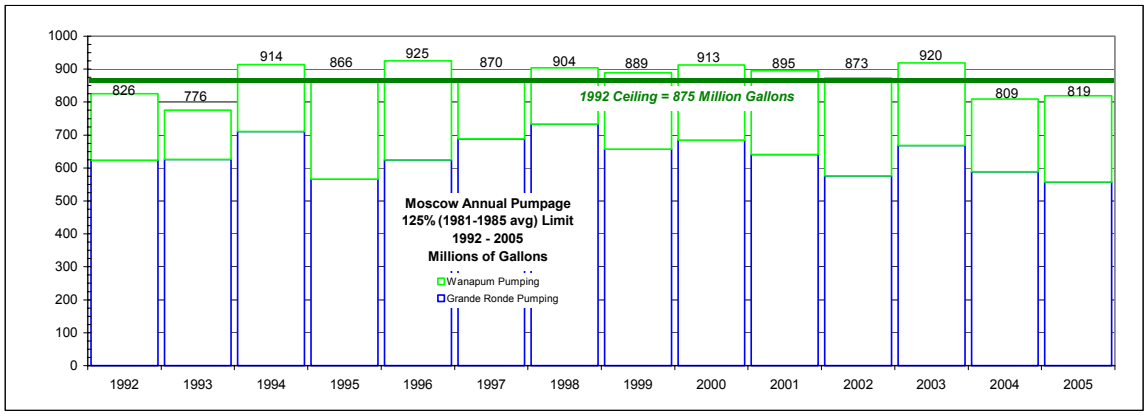


Figure 29: Moscow

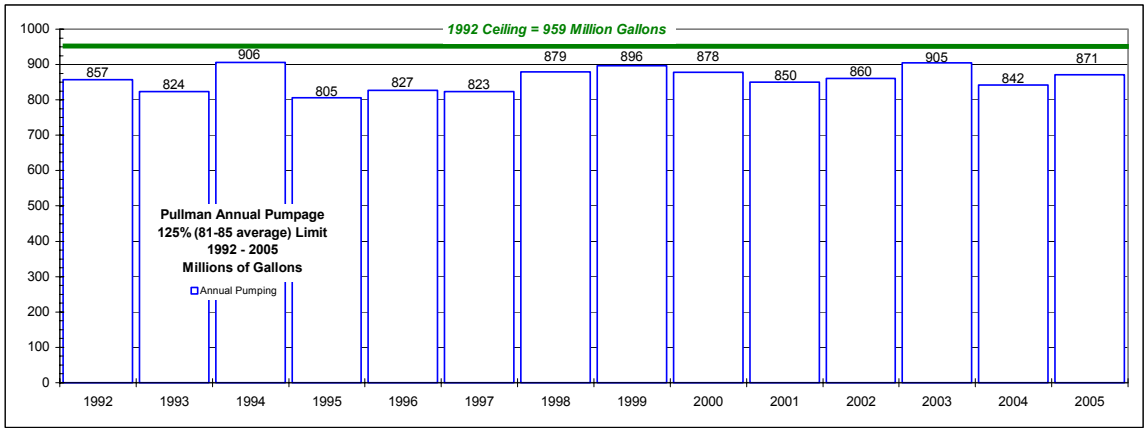


Figure 30: Pullman

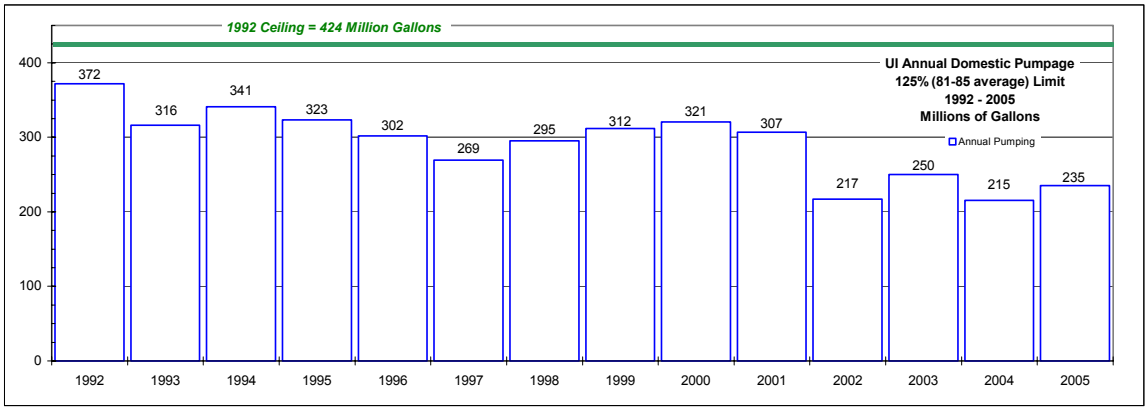


Figure 31: UI

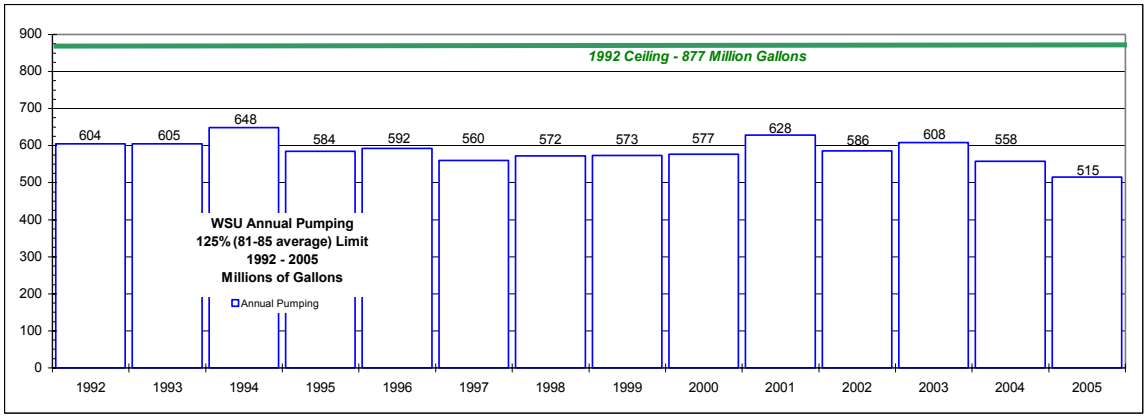


Figure 32: WSU

Water Levels 2002-2006

Note: Left axis is monthly pumpage in millions of gallons, right axis is static water level in feet above mean sea level.

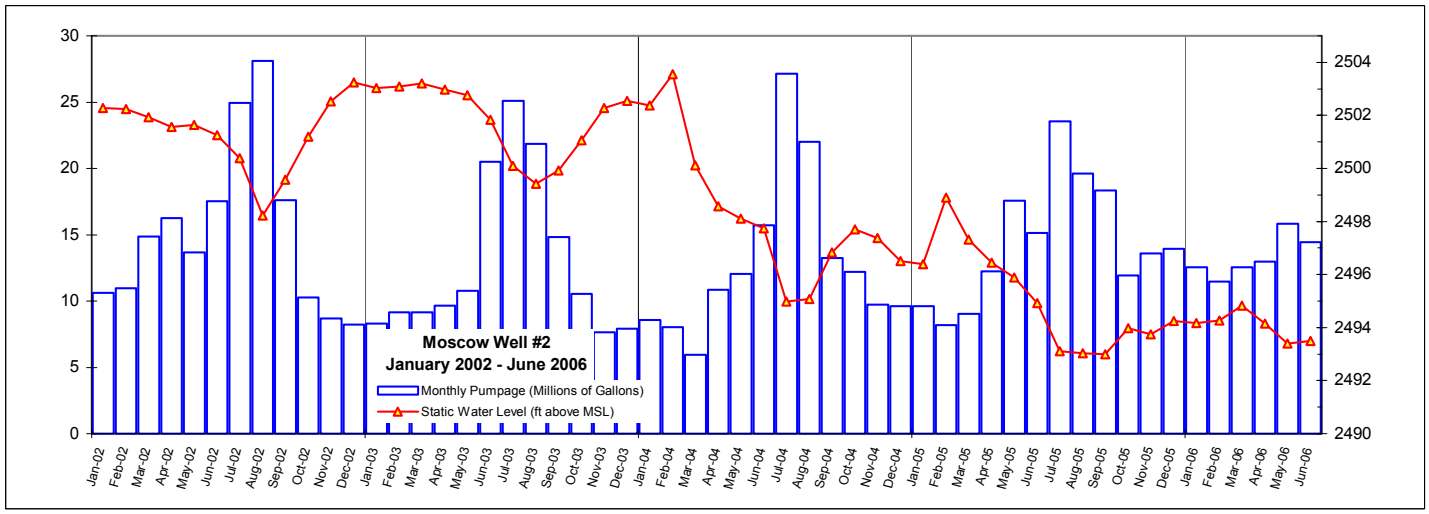


Figure 33: Moscow #2 (Wanapum)

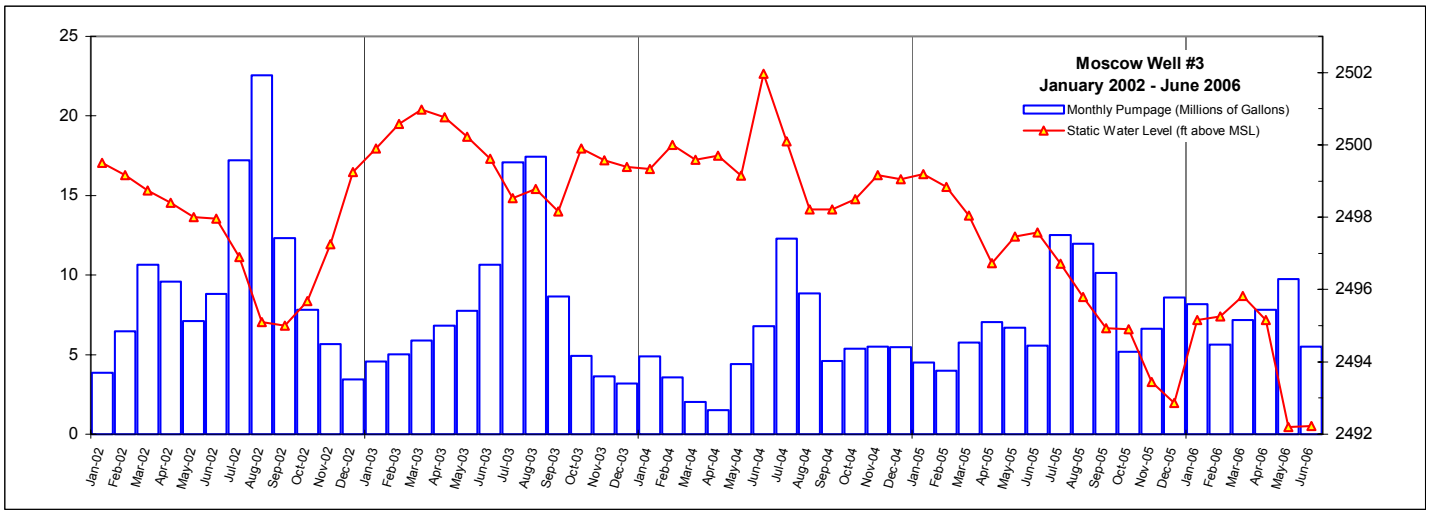


Figure 34: Moscow #3 (Wanapum)

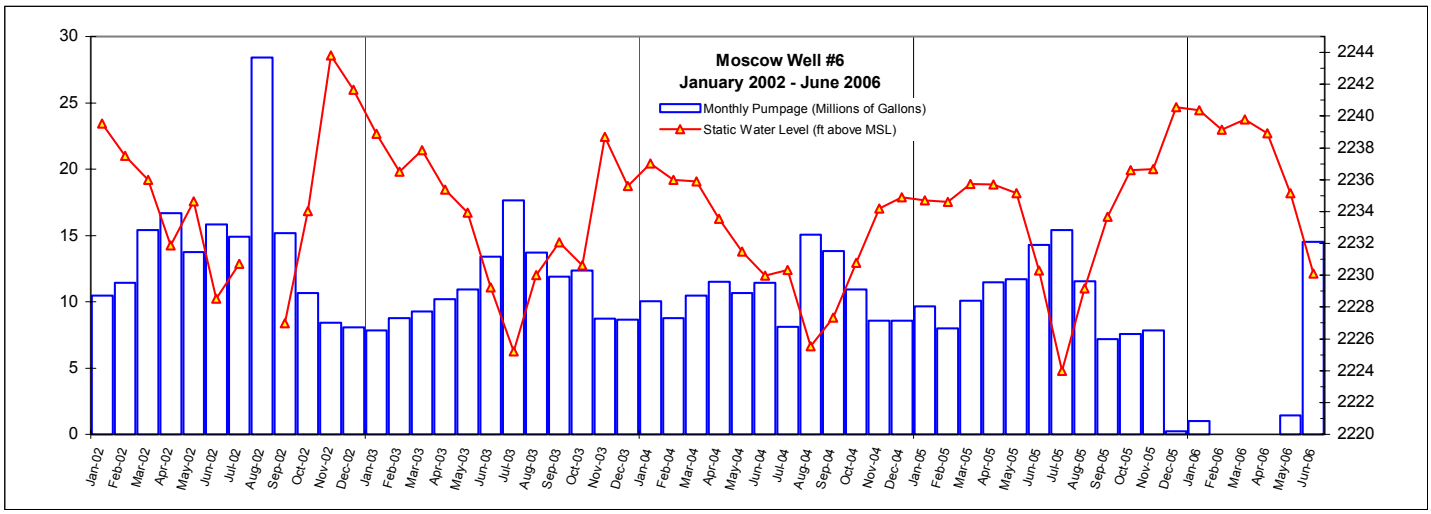


Figure 35: Moscow #6 (Grande Ronde)

Water Levels 2002-2006

Note: Left axis is monthly pumpage in millions of gallons, right axis is static water level in feet above mean sea level.

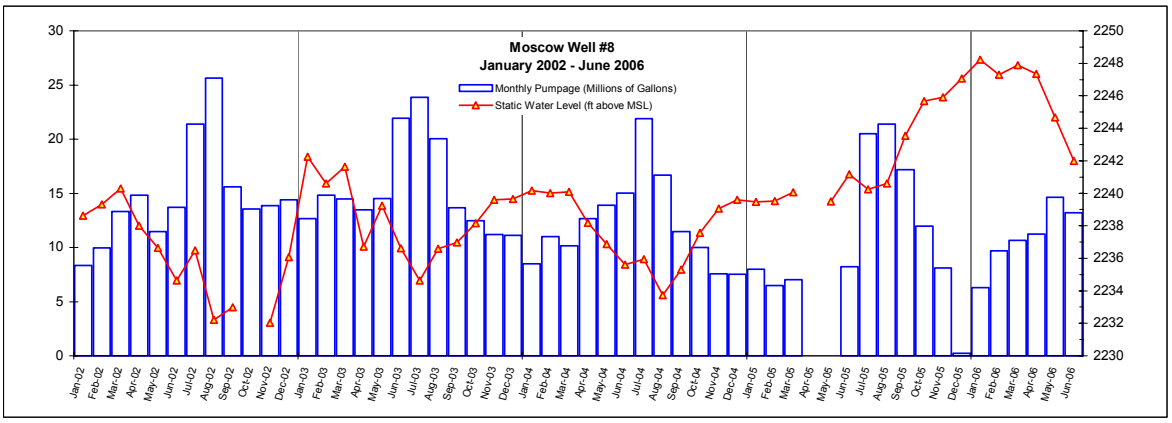


Figure 36: Moscow #8 (Grande Ronde)

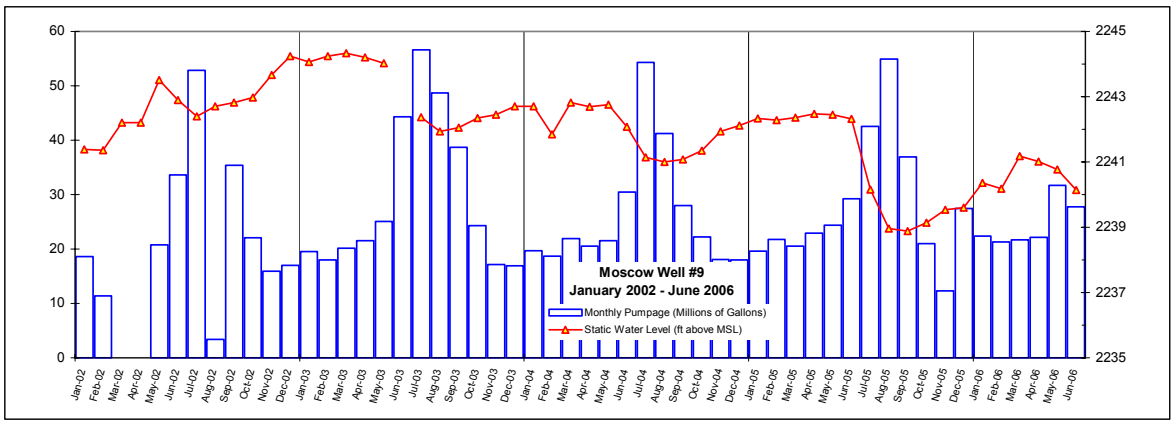


Figure 37: Moscow #9 (Grande Ronde)

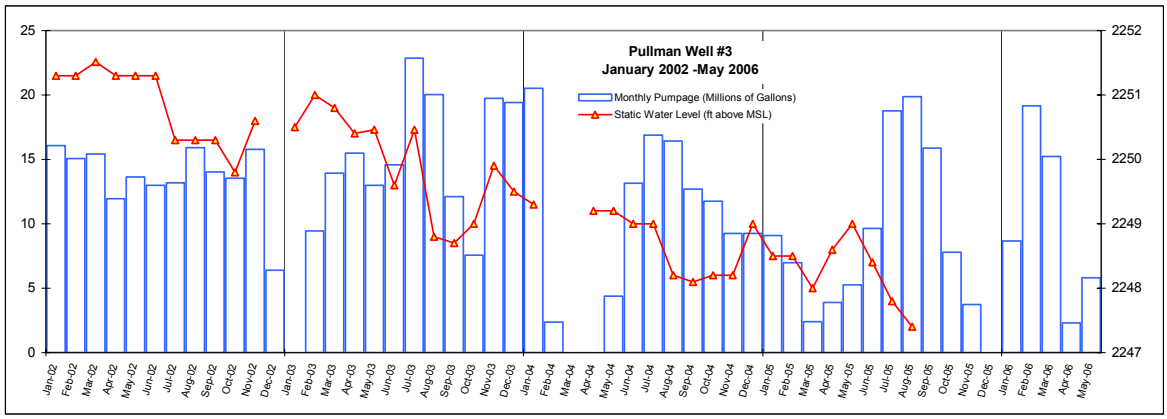


Figure 38: Pullman #3 (Grande Ronde)

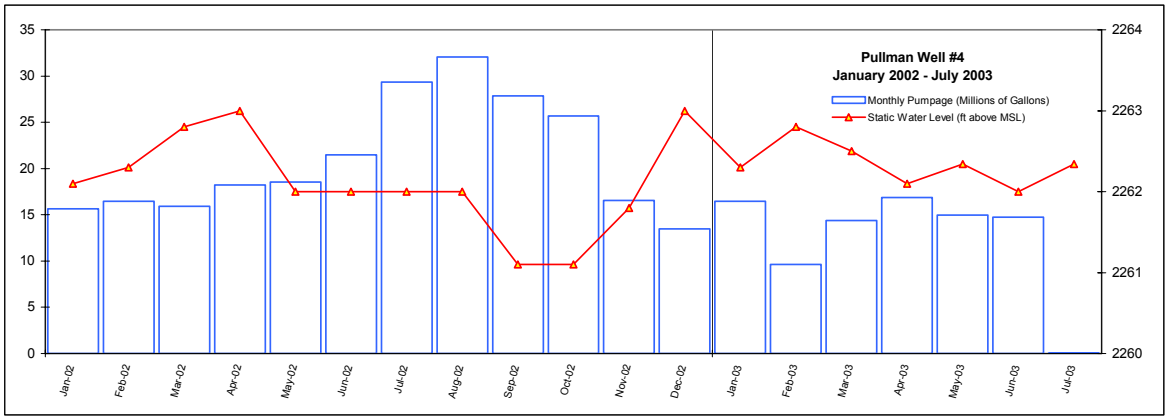


Figure 39: Pullman #4 (Grande Ronde)

Water Levels 2002-2006

Note: Left axis is monthly pumpage in millions of gallons, right axis is static water level in feet above mean sea level.

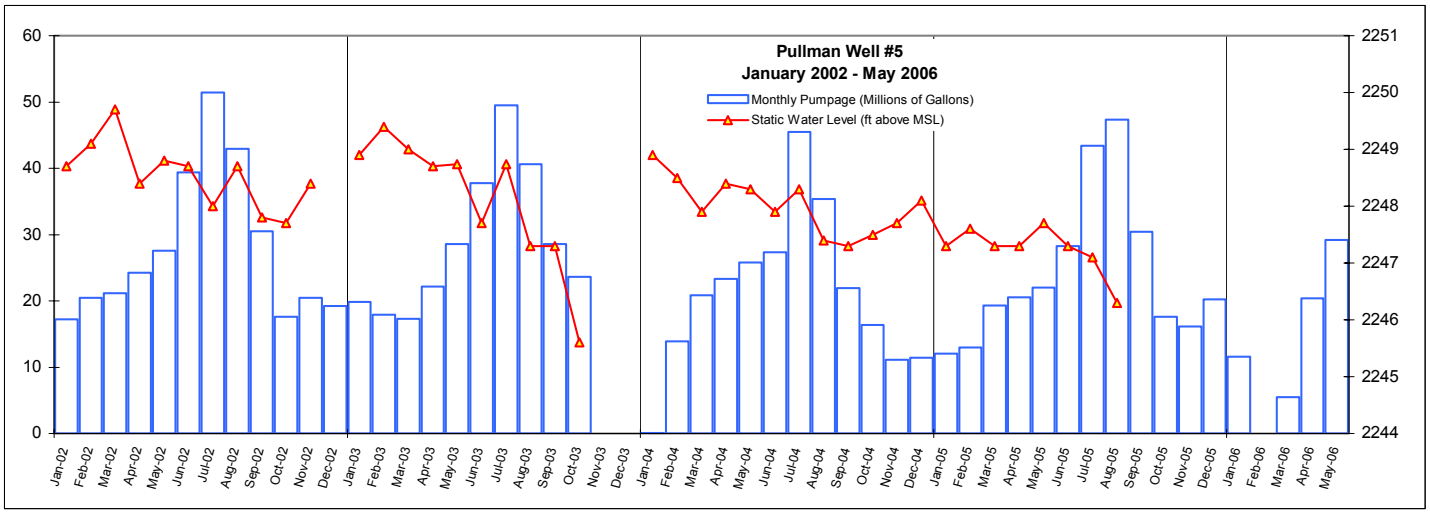


Figure 40: Pullman #5 (Grande Ronde)

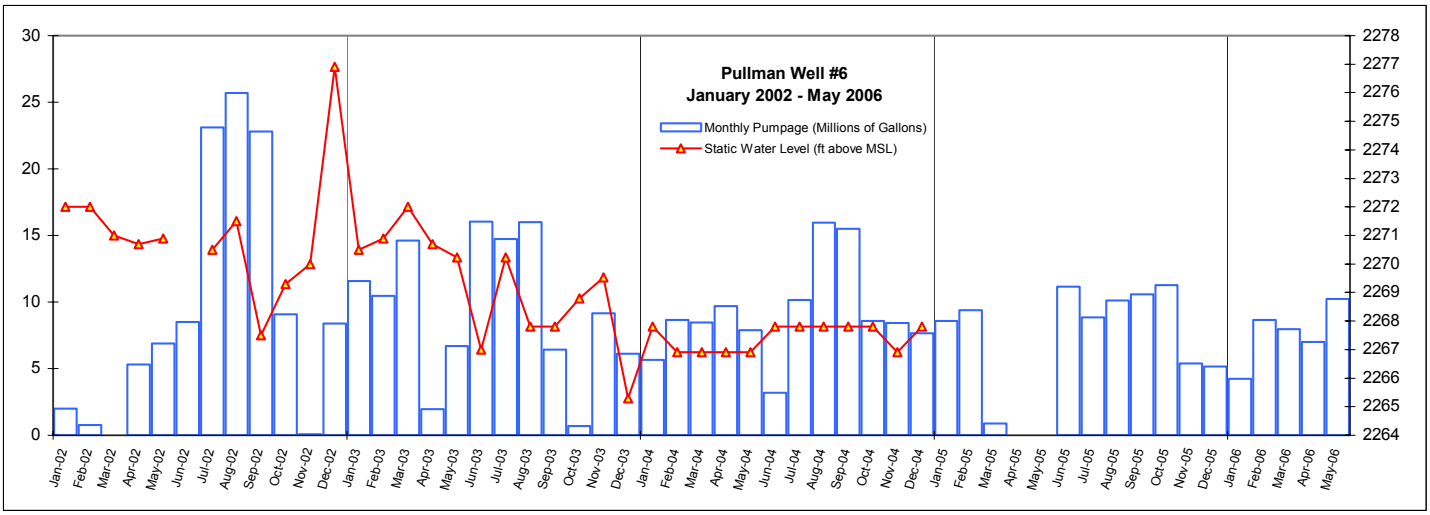


Figure 36: Pullman #6 (Grande Ronde)

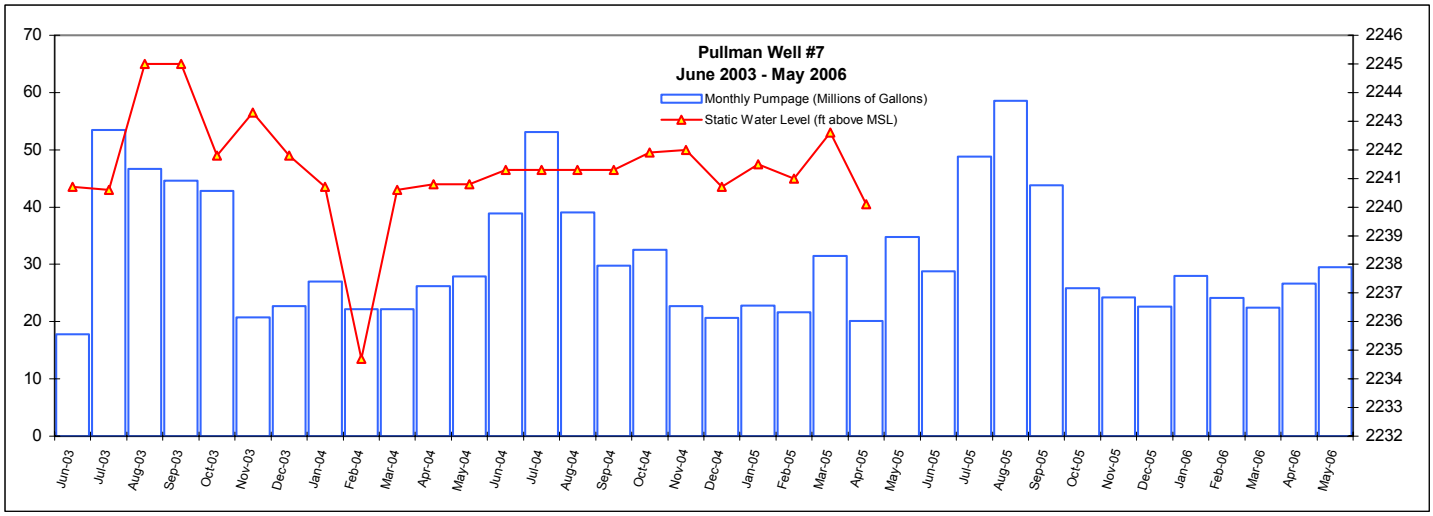


Figure 36: Pullman #7 (Grande Ronde)

Note: Left axis is monthly pumpage in millions of gallons, right axis is static water level in feet above mean sea level.

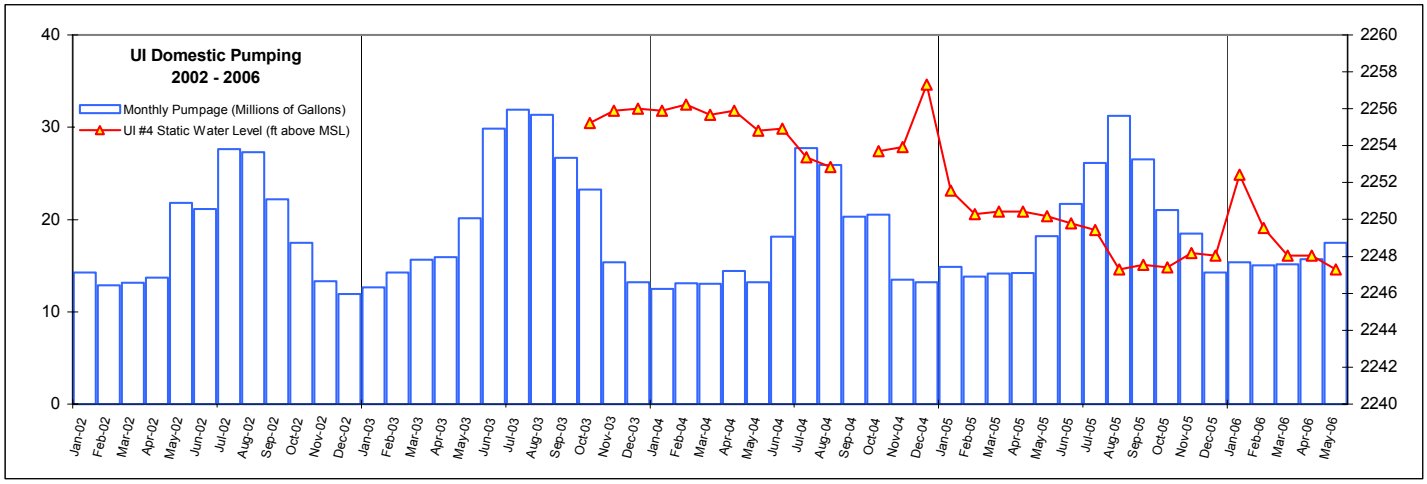


Figure 43: UI Domestic (Grande Ronde) - pumpage includes aquaculture (Wanapum)

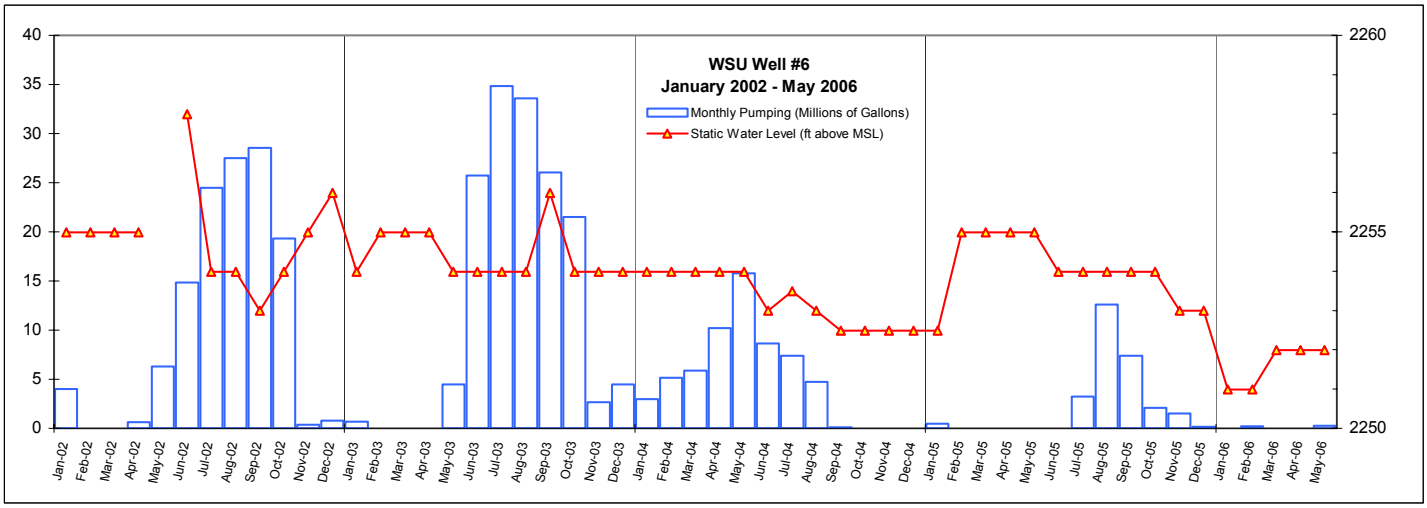


Figure 44: WSU #6 (Grande Ronde)

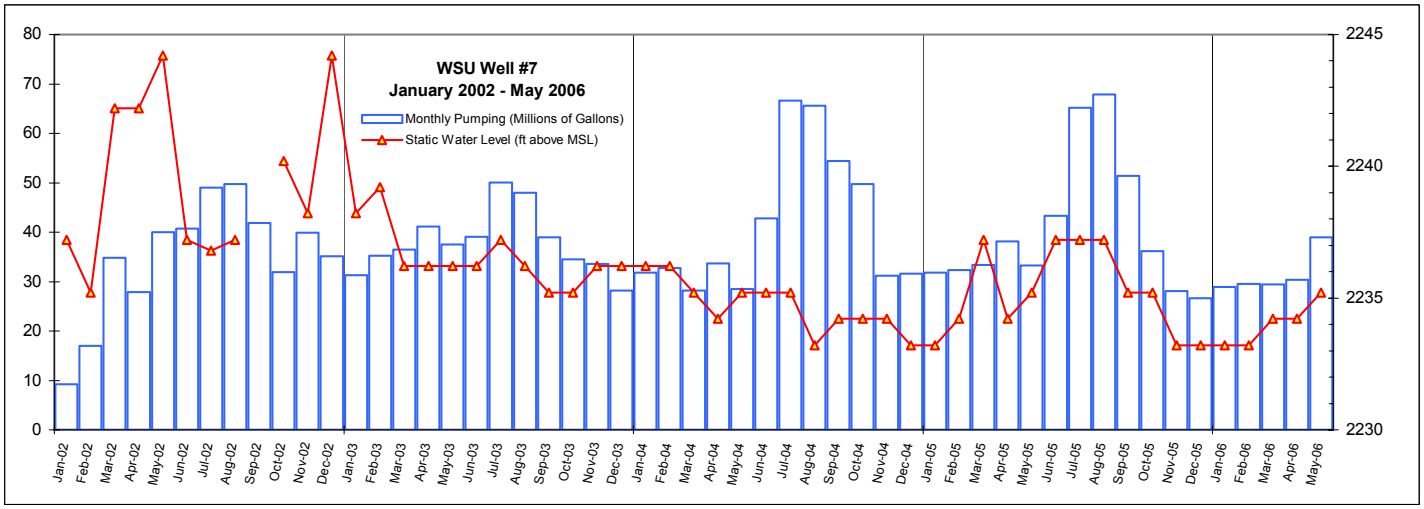


Figure 45: WSU #7 (Grande Ronde)

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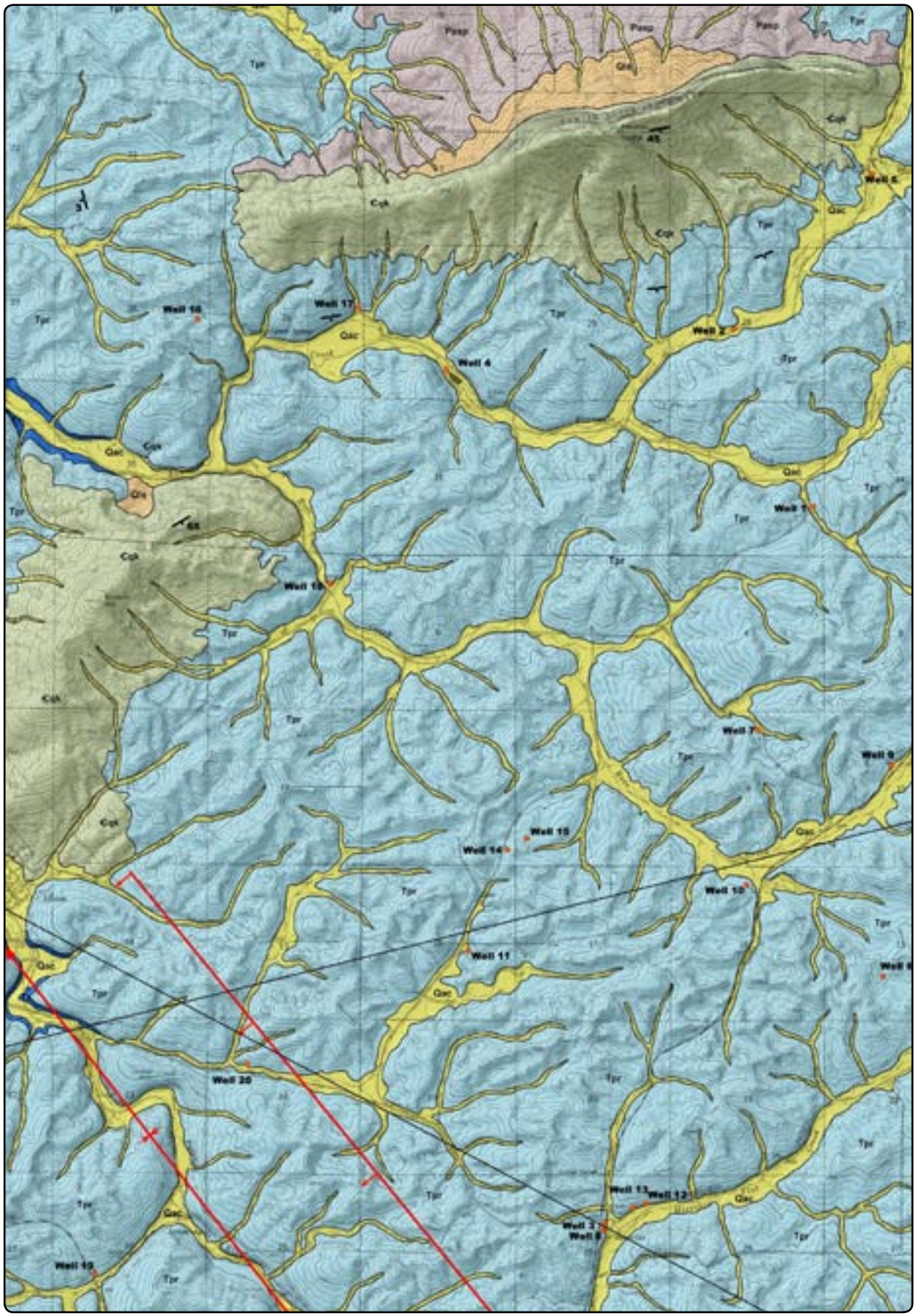
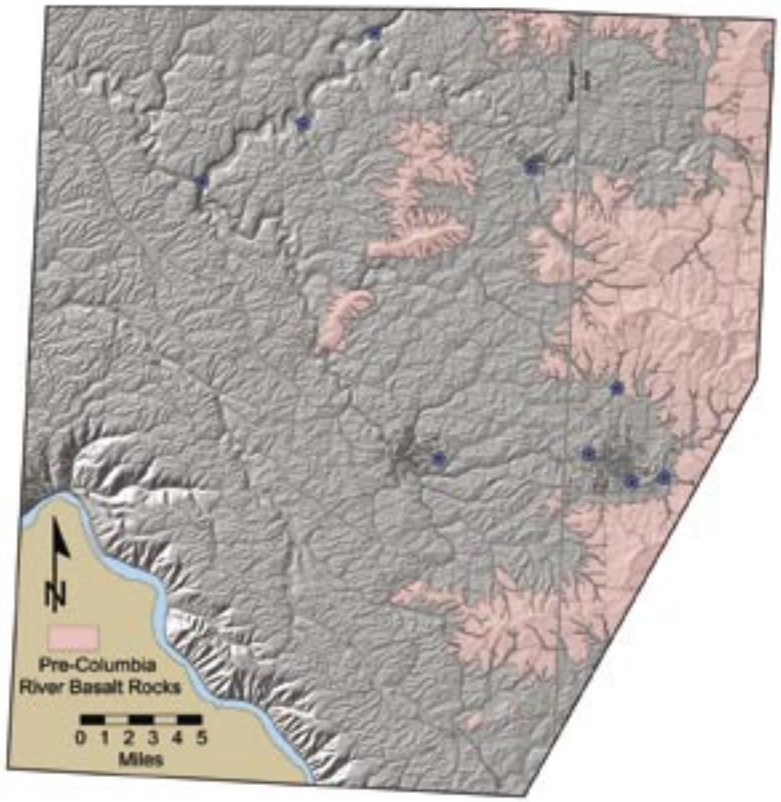
PBAC Mission

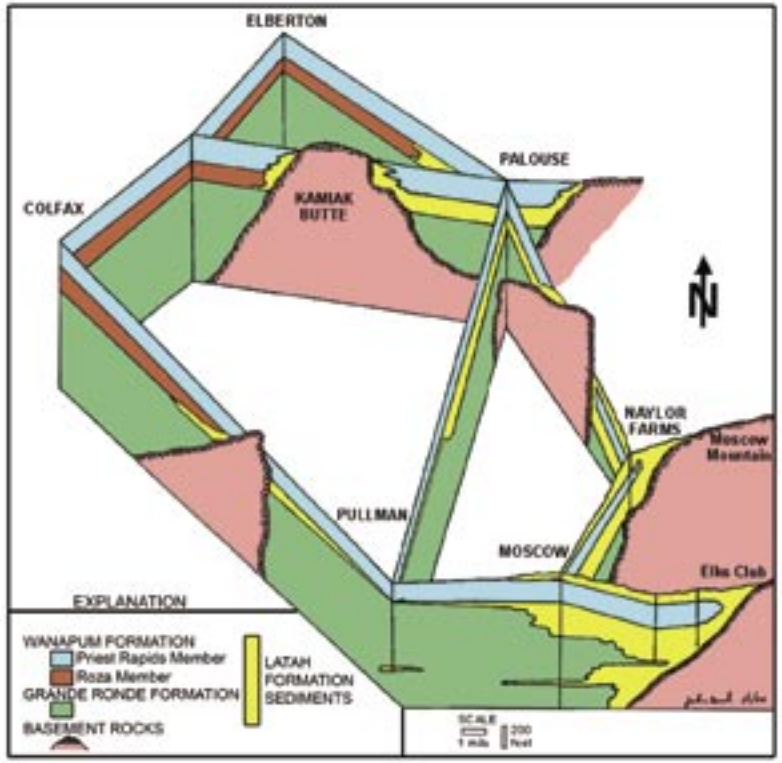
To ensure a long-term, quality water supply for the Palouse Basin region.

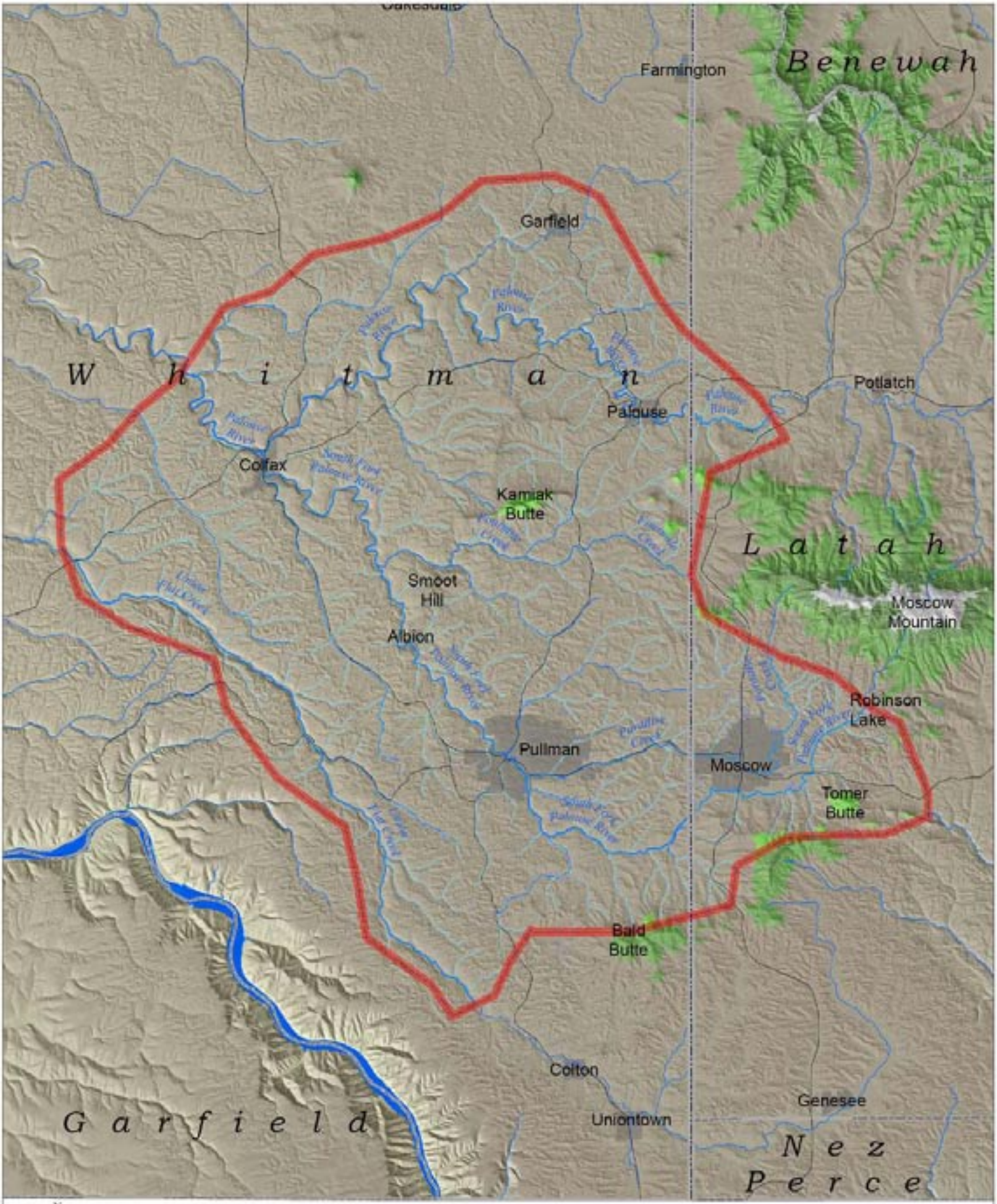


Bedrock Geologic Map of the Albion 7.5 Minute Qudrangle Washington (Bush, Garwood)

Panel Diagram for Wanapum and Grande Ronde Formations, Latah and Whitman Counties (Bush and Garwood)







The Palouse Basin