columbia basin sustainable water coalition

PRELIMINARY WATERSHED MANAGEMENT PLAN

Mid-Columbia Basin, Washington

December 21, 2023

Prepared for

Columbia Basin Sustainable Water Coalition
Mid-Columbia Basin, Washington

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LIST OF ABBREVIATIONS AND ACRONYMS

acre-ft	acre-feet
ASGW	artificially stored groundwater
ASR	aquifer storage and recovery
bgs	below ground surface
Bureau	US Bureau of Reclamation
CBP	Columbia Basin Irrigation Project
CBGWMA	Columbia Basin Groundwater Management Area
CBSWC	Columbia Basin Sustainable Water Coalition
CRBG	Columbia River Basalt Group
ECBID	East Columbia Basin Irrigation District
Ecology	Washington State Department of Ecology
EIS	Environmental Information System
EPA	US Environmental Protection Agency
ERO	Ecology’s Eastern Regional Office
ESA	Endangered Species Act
FLAG Counties	Franklin, Lincoln, Adams, and Grant Counties
ft	foot/feet
LCCD	Lincoln County Conservation District
M&I	Municipal and Industrial
NMFS	National Marine Fisheries Service
OGWRP	Odessa Groundwater Replacement Program
Pasco subarea	Pasco groundwater subarea (previously 508-14 Area)
PFAS	per- and polyfluoroalkyl substances
pMCL	proposed maximum contaminant level
project area	FLAG Counties
QCBID	Quincy-Columbia Basin Irrigation District
Quincy subarea	Quincy groundwater subarea
RCW	Revised Code of Washington
SCID	South Columbia Irrigation District
SOC	synthetic organic compounds
USGS	US Geological Survey
VOC	volatile organic compounds
WAC	Washington Administrative Code
WDOH	Washington Department of Health
WSU	Washington State University
YBIP	Yakima Basin Integrated Plan

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INTRODUCTION

The Columbia Basin Sustainable Water Coalition (CBSWC) is a non-profit entity formed by municipalities and other drinking water purveyors (referred to herein generally as municipalities) within the Mid-Columbia Basin to promote a sustainable source of potable drinking water for the municipalities and communities within Franklin, Lincoln, Adams, and Grant Counties (FLAG Counties), Washington (project area). The mission of the CBSWC is to: "Address potable groundwater supply issues by creating locally driven recommendations that influence water management and policy that will direct resources to create sustainable water solutions." This preliminary watershed management plan, prepared by Landau Associates, Inc. with support from GeoEngineers, Inc., provides an initial assessment of the groundwater supply challenges faced by CBSWC municipality and other water purveyor members and recommendations regarding water resource management project, tool, and planning alternatives for implementation to support long-term sustainable water solutions within the project area. The project area, along with the FLAG County boundaries and select municipalities within the project area, are shown on Figure 1.

Primary Challenge

For municipalities and water purveyors within the project area, deep groundwater in the basalt aquifers has been the primary supply of reliable and safe potable water. Declining water levels in those aquifers threatens the long-term sustainability of that supply. Water levels have been declining for several decades and doing nothing is not a long-term option for these communities. In the meantime:

- Some municipalities have resorted to drilling new and deeper wells or deepening existing wells (a temporary solution that is not sustainable in the long-term);
- Some have looked to shallow groundwater sources (though shallow groundwater in portions of the project area can be negatively impacted by agricultural-related contamination, such as nitrate, and therefore typically requires additional treatment);
- Others are considering aquifer storage and recovery (ASR) to bolster seasonal supplies (for those who have access to another source of water, which they can store);
- And still others do not have the natural or financial resources to adapt (many of the municipalities and other water purveyors confronted with water supply challenges in the project area are considered disadvantaged communities, in accordance with the Biden administration's Interim Implementation Guidance for the Justice40 Initiative [Executive Office of the President 2021]).

The CBSWC is providing a venue for coordinated regional solutions to the challenges faced by many municipalities within the project area.

Groundwater Use in the Project Area

Groundwater is withdrawn and used in the project area primarily for municipal and commercial irrigation uses.

There are approximately 137 municipal and other Group A water systems providing potable water to approximately 90,000 residents throughout the project area (Washington Department of Commerce 2019). These municipalities use groundwater as their primary source of supply. Groundwater levels within large portions of the project area have experienced significant and ongoing declines, which threaten the long-term viability of groundwater as a source of supply for these municipalities.

Agriculture is an important economic and social element within the project area. Most irrigation water for commercial agriculture is sourced from surface water, supplied by the federal US Bureau of Reclamation (Bureau) Columbia Basin Irrigation Project (CBP), which is America's largest federal reclamation project. However, some agricultural lands within the project area do not have access to CBP surface water and instead use groundwater for irrigation. The groundwater level declines observed within the project area are thought to be most significantly related to groundwater pumping for large-scale irrigated agriculture.

Columbia Basin Project and Groundwater Irrigation

The CBP provides surface water from the Columbia River to approximately 680,000 acres of irrigated crop land via three federally recognized irrigation districts that operate within the project area: East Columbia Basin Irrigation District (ECBID), Quincy-Columbia Basin Irrigation District (QCBID), and South Columbia Irrigation District (SCID). The primary CBP infrastructure includes: the Grand Coulee Dam, which impounds water in the Columbia River to form the Lake Roosevelt reservoir; the John W. Keys III pump station, which pumps water from Lake Roosevelt up into Banks Lake, which in turn is an artificial reservoir impounded by the Dry Falls and North Dams; a Main Canal which delivers surface water south from the southern end of Banks Lake; a canal bifurcation that splits the Main Canal into the West Canal and the East Low Canal; a series of lateral canals, ditches, and wasteways of the West and East Low Canals that provide water to lands within the QCBID and ECBID service areas, respectively; Potholes Reservoir (impounded by O'Sullivan Dam) which collects drainage water and excess flows from the West and East Low Canals and laterals/wasteways for delivery further south, where it is delivered via additional lateral canals and wasteways to the SCID service area before drainage water is finally collected and conveyed to the Columbia River near Pasco, Washington. The primary components of the CBP infrastructure, relative to the project area, are shown on Figure 2.

As originally authorized by the U.S. Congress in the Rivers and Harbors Act of 1935 and the Columbia Basin Project Act of 1943, the CBP was intended to serve 1,029,000 acres of irrigated crop land. Therefore, the actual irrigated acreage of the CBP (680,000 acres) is currently 349,000 acres less than authorized. The primary limitations to the number of acres served by the CBP are the water rights held by the Bureau for the CBP and the existing CBP infrastructure. The Bureau holds reservoir permits (R3-00013C, R3-21869CWRIS, and R3-22472C) that allow for the storage of 6,400,000 acre-feet (acre-ft) of water in Lake Roosevelt and Banks Lake, and multiple secondary use permits or certificates (S3-01622C, S3-28586P, S3-30486P, and S4-33091P) that authorize a total of 720,000 acres of seasonal irrigation. As originally planned—and if sufficient water rights and Congressional funding were secured—the CBP would be completed (i.e., the full 1,029,000 acres of crop land would be served with surface water deliveries) by the construction of a third major canal off the Main Canal—the East High Canal—that would convey water to the eastern portion of the CBP area.

Starting in the 1960s and continuing into the 1990s, the Washington State Department of Ecology (Ecology) issued temporary groundwater permits, largely for irrigated agriculture, in the area that was to be served by the East High Canal of the CBP (which roughly correlates to the Odessa groundwater management area, or the Odessa subarea). There are an estimated 100,000 to 200,000 acres of agricultural cropland that have been irrigated by temporary groundwater permits within the Odessa subarea (LCCD et al. 2011). The temporary permits were intended to provide groundwater use authorization for a relatively short term until surface water deliveries from the CBP system became available. To this day, the East High Canal has not been completed and large-scale groundwater withdrawals for irrigated agriculture have largely continued, resulting in severe and long-term declining groundwater levels, particularly in the deep basalt aquifers. The declining water level issue is perhaps most pronounced in the Odessa subarea, but it extends throughout much of the project area. The Bureau, Ecology, and the East Columbia Basin Irrigation District are in the process of implementing the Odessa Groundwater Replacement Program (OGWRP), which is intended to replace deep groundwater withdrawals for irrigated agriculture in a portion of the Odessa subarea—the Odessa subarea Special Study Area—with surface water deliveries through CBP infrastructure. The OGWRP is intended to replace 87,700 acres of groundwater irrigation with surface water irrigation (as authorized by secondary use permits S3-30486P and S4-33091P as well as the Coordinated Conservation program). The Odessa subarea and the Odessa subarea Special Study Area are shown relative to the project area on Figure 3.

Hydrogeologic Setting

The hydrogeologic setting of the project area is described extensively by others, notably by the US Geological Survey (USGS) (WRI 87-4238 [USGS 1990]; WRI 96-4106 [USGS 2000]; SIR 2010-5246 [USGS 2011b]; SIR 2011-5124 [USGS 2011a]; SIR 2014-5127 [USGS 2015]; and SIR 2018-5162 [USGS 2018]) and the now-defunct Columbia Basin Groundwater Management Area (CBGWMA; CBGWMA 2009, CBGWMA 2010). At its most basic level, the project area hydrogeologic setting is made up of four primary aquifers, from shallowest to deepest:

- Shallow unconsolidated to semi-consolidated sedimentary deposits (referred to generally as overburden material) ranging from Miocene to Holocene in age. The thickness of the overburden material ranges from 0 to 1,300 ft, with a median thickness of 47 ft. Significant among the overburden material is sand and gravel deposited during the Pleistocene-age (< 2 million years) Missoula Floods and Miocene-Pliocene-age (7.5 to 3.5 million years) semi-consolidated weakly indurated clay, silt, sand, and gravel of the Ringold Formation. These strata most commonly host groundwater in the Quincy Basin, Royal Slope, Pasco Basin, and some of the coulees eroded by the Missoula Floods.
- Miocene-age (17 million to 6 million years before present) Columbia River Basalt Group (CRBG), including:
  - Saddle Mountains Basalt, which is up to 990 ft thick (median thickness of 280 ft) and consists of numerous individual basalt flow members, including (but not limited to): Ice

Harbor, Elephant Mountain, Pomona, and Umatilla Members. The Saddle Mountains Basalt generally hosts shallow groundwater south of Highway 26 and is absent to the north.

- Wanapum Basalt, which is up to 1,200 ft thick (median thickness of 330 ft) and consists of numerous individual basalt flow members, including (but not limited to): Priest Rapids, Roza, and Frenchman Springs Members. The Wanapum Basalt commonly hosts shallow groundwater north of Highway 26 while hosting deeper groundwater to the south.
- Grande Ronde Basalt, the thickness of which is not well-defined but can be up to 14,000 ft thick and consists of numerous individual basalt flow members, with the uppermost one being the Sentinel Bluffs Member. The upper Grande Ronde Basalt hosts groundwater throughout the project area while becoming progressively deeper from north to south.

Within the CRBG aquifer system, groundwater can occur and flow in appreciable volumes, most notably through typically lateral “interflow zones” consisting of the tops and bottoms of individual flow members where the basaltic lava cooled more quickly (relative to the flow interiors) and became cracked and vesiculated as a result. During and following emplacement 17 to 6 million years ago, other geologic processes (e.g., faults, folds, outburst flooding, etc.) have modified the basalt formations resulting in slanted interflow zones, cracks connecting multiple interflow zones, and erosion of coulees through multiple flow members and interflow zones. As such, the groundwater occurrence and flow patterns within the project area can be complex.

For the purposes of describing general groundwater availability at various depths, the various water-bearing zones can be grouped into three categories: shallow, intermediate, and deep aquifers, described as follows:

- Shallow aquifers generally are hosted by the overburden/alluvial strata across the region and the upper Saddle Mountains Basalt in Franklin County and southern Grant and Adams Counties, and upper Wanapum Basalt to the north. These aquifers usually encompass the upper 300 to 500 ft of the CRBG, though thickening to the south.
- Intermediate aquifers generally are hosted by the lower Saddle Mountains Basalt and upper Wanapum Basalt in Franklin County and southern Grant and Adams Counties, and the lower Wanapum Basalt to the north. These aquifers usually encompass the CRBG from the bottom of the shallow aquifer to depths of 600 to 1,200 feet (deepening to the south).
- Deep aquifers generally are hosted by the Grande Ronde Basalt, Sentinel Bluffs Member and deeper units across the region. The top of this system deepens to the south, from around 600 to about 1,200 feet below the surface.

Site-specific conditions may deviate from these general conceptual depth zones.

Beneath the CRBG, it is generally understood that low permeability granitic bedrock (in the eastern and northern portions of the project area) or thick Eocene-age low permeability sediment (in the west and southwest portions of the project area), form a basement layer to the groundwater flow system of the project area. However, from the potable groundwater perspective, poor groundwater quality (including, but not limited to, high temperatures and dissolved solids) at depths below about 2,000 feet generally precludes potable use of deep CRBG groundwater without significant treatment. Select excerpts illustrating the conceptual hydrogeologic setting of the project area are included in Attachment 1.

From a conceptual perspective, the basic groundwater flow pattern of the project area includes recharge areas in the north and east and groundwater flow directions toward the south and west toward discharge to the Columbia River. Prior to the onset of large-scale irrigation, natural aquifer recharge was fairly limited and slow – most naturally occurring deep Wanapum and Grande Ronde groundwater in the project area is thousands of years old (CBGWMA 2009a, 2009b). With the onset of irrigation, widespread artificial recharge has occurred in the irrigated portions of the project area via seepage from irrigated fields and ponds, ditches, canals, and wasteways. The artificial groundwater recharge percolates downward and increases groundwater occurrence (i.e., mixes with naturally occurring groundwater), particularly in the shallow unconsolidated (and semi-consolidated) overburden and shallow Saddle Mountain and Wanapum Basalt aquifers. Specific examples of this artificial recharge or "artificially stored groundwater" (ASGW; as opposed to naturally occurring groundwater) are within the Quincy groundwater subarea (Quincy subarea) and the Pasco groundwater subarea (Pasco subarea, previously referred to as the "508-14 Area"). In the Quincy and Pasco subareas, the ASGW has been (in the case of the Quincy subarea) or will soon be (in the case of the Pasco subarea) leveraged by the Bureau and Ecology for permitted withdrawal and use, primarily for increased irrigated agricultural production.

Therefore, the current primary water sources for project area municipalities are:

- deep groundwater from the CRBG aquifers (the current primary source for most municipalities);
- shallow groundwater, particularly ASGW from CBP return flows, where it exists; and
- Columbia River surface water delivered through CBP infrastructure and contracted by the Bureau through Municipal and Industrial (M&I) contracts.

Additional sources may include food industry process water (e.g., potato wash water) treated for re-use, and potentially direct diversions from the Columbia River. All options to augment project area municipal water supplies would require a range of permitting (e.g., water rights or contracting) and water quality (e.g., treatment) considerations. These considerations are explored further in the next few pages.

Water Right Permitting Considerations

Water use in Washington State is managed by Ecology through a prior appropriation (i.e., first in time, first in right) water right permitting system, most notably under Revised Code of Washington (RCW) 90.03 (surface water) and 90.44 (groundwater) and regulatory rule in Washington Administrative Code (WAC). Water supply availability in many watersheds (and groundwater management areas) is addressed by regulatory rule (the WAC), and in recent years by federal Endangered Species Act (ESA) considerations. In most areas of the State, the water supply (both surface water and groundwater) has been fully appropriated.

Surface Water Permitting

Water right permitting for surface waters can be constrained by instream flow rules, which are regulatory rules that can establish flow targets for rivers and streams—often seasonally varying—that must be met before additional water rights can be issued and satisfied. ESA-related requirements can impose additional limitations on further surface water diversions. Both instream flow rule-related and ESA-related requirements, when applicable, must be followed for new water right permitting. While the majority of the Bureau's secondary use surface water rights for the CBP allow for diversions during the irrigation season, the secondary use permit obtained by the Bureau more recently to support the OGWRP (S4-33091P) is provisioned in accordance with a 2013 Biological Opinion developed by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) in accordance with the ESA. The 2013 Biological Opinion provision limits diversions under S4-33091P to occur during October and then provisionally from November through March (depending on chum salmon returns at Bonneville Dam), requiring significant storage for use of that water during the summer months. Any future surface water rights—including secondary use water rights for the full CBP build-out—would likely be provisioned similarly.

Groundwater Permitting

Water right permitting for groundwater withdrawals is sometimes explicitly limited by specific WAC rules. For example:

- In the Quincy subarea, governed by Chapters 173-124 and 173-134A WAC, state groundwater rights are fully allocated (except for small-scale withdrawals for domestic and group domestic uses and other small-scale uses allowed under the permit exemption of RCW 90.44.050) and permits for ASGW are limited to a specified total quantity.
- In the Odessa subarea, governed by Chapters 173-128A and 173-130A WAC, Ecology is to manage groundwater resources to maintain the rate of groundwater level declines below a total of 30 ft over three consecutive years and to keep the overall groundwater table within a maximum decline of 300 ft from the level it existed in the spring of 1967. Because of declining groundwater levels, new groundwater withdrawals are generally not allowed in the Odessa subarea (except for small-scale withdrawals allowed under the permit exemption of RCW 90.44.050).
- In the Pasco subarea, currently governed by Chapter 508-14 WAC, there is significant ASGW (from CBP return flows) commingled with naturally occurring groundwater. Ecology is able to issue temporary permits—but not certificates—in cases where public (i.e., naturally occurring) groundwater availability is apparent until a more definitive determination of the occurrence of public groundwater is developed. Ecology is currently in process of rulemaking, to develop a future Chapter 173-135 WAC, for the management of groundwater within the Pasco Basin with a quantified determination of public groundwater and ASGW. It is anticipated that Chapter 173-135 WAC will be modeled after Chapter 173-134A WAC (Quincy subarea management rule), with some modifications.

The Quincy, Odessa, and Pasco subareas are shown relative to the project area on Figure 3.

Water Quality Considerations

Water quality concerns vary across the project area. Where there are challenges, they range from shallow groundwater, for which surface activities (e.g., agricultural and/or industrial) can result in impacts, to deeper groundwater, where naturally occurring water quality impacts may exist.

Some shallow groundwater quality issues, such as nitrate, show seasonal fluctuations and can be relatively widespread, depending on the intensity of surface activities acting as the contaminant source, proximity to clean water sources (like leaky CBP canals), and waste management activities (CBGWMA 2008, 2009a, 2009b). Other shallow groundwater quality issues, such as volatile organic compounds (VOCs) and synthetic organic compounds (SOCs) are known to occur, though tend to be more local and in areas of past or current industrial activity or in some agricultural areas. Additionally, the group of emerging contaminants known as per- and polyfluoroalkyl substances (PFAS), which are manufactured chemicals used in a wide range of commercial and industrial products (notably firefighting foam) and are thought to be essentially ubiquitous in the environment, have been identified in some project area wells but have not been fully characterized in the region.

Natural water quality concerns can also occur in both shallow and deep aquifers—though can be more significant in deeper aquifers due to longer groundwater residence time leading to greater dissolution of minerals from the basalt into the groundwater (USGS 1995)—and include such things as elevated fluoride, temperature, and dissolved mineral salts. For example, water quality data and summaries reported by the USGS (2012), CBGWMA (2009a, 2009b), and the Washington Potato Commission (GSI 2021) indicate that the following notable examples of natural water quality constituents have been observed to be elevated in some wells installed in the CRBG aquifers:

- Temperature tends to increase with depth (and age) of groundwater (CBGWMA 2009b). For example, groundwater pumped from the Town of Lind’s Well No. 8 (a 2,034 foot well completed in the Grande Ronde Basalt) exhibits temperatures exceeding 84 degrees Fahrenheit.
- Sodium, potassium, bicarbonate, silica, fluoride, manganese, iron, and hydrogen sulfide (as well as total dissolved solids in general) typically become more elevated with greater depths of groundwater; the pH of deeper Grande Ronde Basalt groundwater can also be elevated (i.e., in the 8.0 to 10.0 range; CBGWMA 2009a, 2009b; GSI 2021)
- Radon, a radionuclide, occurs in a significant percentage of wells above the U.S. Environmental Protection Agency (EPA) proposed maximum contaminant level (pMCL) of 300 picoCuries per liter (USGS 2012).

In all cases, these shallow and deep groundwater quality considerations vary in degree and location based on local conditions. However, water quality considerations are an important factor for the CBSWC and member municipalities when planning for future sustainable water supplies.

GROUNDWATER LEVEL MONITORING

Because the primary water supply challenge within the project area is water quantity-related (i.e., declining groundwater levels), collecting reliable water level data from relevant aquifer units is an important tool for understanding the magnitude of the challenge in various areas. This section describes water level data from the project area collected by the CBSWC, a select number of individual water purveyors, and other separate entities.

CBSWC Monitoring

Using existing wells, the CBSWC established an initial network of four wells to monitor groundwater levels over time. The criteria used in selecting the wells for the CBSWC monitoring network included:

- Wells are open to the CRBG aquifer system, have a well log available to verify well construction, and can be identified to be completed in a specific CRBG unit (or units).
- Wells are not currently monitored by—or in the immediate vicinity of wells monitored by—other groundwater monitoring programs, to avoid redundancy.
- Wells are accessible for water level monitoring equipment (e.g., electronic water level indicator) installation or that are outfitted with a reliable airline for measuring water levels.
- Wells are not regularly pumped, in order to obtain background static water level data with minimal effects from individual well pumping.

An initial list of 45 prospective monitoring wells were reviewed against the well selection criteria and an effort was made to contact 17 individual well owners (i.e., municipalities; some with multiple wells under consideration) for well construction and access details and for permission for inclusion into the CBSWC monitoring network. Based on the results of well selection criteria review and outreach, the following four wells were selected for on-going monitoring.[1]

- City of Connell Well #5, a 990-ft-deep well with a perforated and/or open hole interval between 420 and 990 ft below ground surface (bgs), which at this location relates to being completed in the bottom of the Wanapum Basalt and top of the Grande Ronde Basalt. Connell #5 could be considered a deeper intermediate to deep aquifer well.
- City of Mattawa Well #2, a 993-ft-deep well with an open hole interval from 526 to 993 ft bgs, which is within the bottom of the Saddle Mountains Basalt and the top of the Wanapum Basalt at this location. Given the thickness of the overburden sediments and aquifer at this location (over 500 feet), Mattawa #2 could be considered an intermediate aquifer well.
- City of Quincy Well #6, a 241-ft-deep well with a perforated and/or open hole interval from 110 to 241 ft bgs, which is fully within the Wanapum Basalt at this location. This well should be considered a shallow aquifer well.

[1] Two additional wells were identified as good candidates for monitoring, but current access restrictions limit the CBSWC's ability to collect reliable groundwater level data from them. These wells are considered prospective CBSWC monitoring wells and may be re-evaluated at a later time for inclusion into the CBSWC monitoring network.

- City of Quincy ASR Well, a 786-ft-deep well with an open hole interval from 615 to 786 ft bgs, which is fully within the Grande Ronde Basalt at this location. This well could be considered a deep aquifer well.

The locations of the selected CBSWC monitoring wells are shown on Figure 4. Select well construction parameters and results of initial water level monitoring in the selected CBSWC monitoring wells are summarized in Table 1. Well logs are provided in Attachment 2.

The CBSWC intends to continue collecting water level data in its monitoring well network to document water level conditions in various locations throughout the project area, and also plans to expand its monitoring network to include additional wells, as funding allows.

In addition, as a result of CBSWC outreach during the monitoring well identification effort, several other wells for which the water system operators were collecting water level data were identified. The wells from which the purveyors are supplying the CBSWC with data are discussed in the following section.

Water Purveyor Monitoring

Four wells for which the water operators are collecting water level data are included in the CBSWC's effort. Water level data were obtained from those wells and converted into hydrograph timeseries format (i.e., water level elevation plots) for better visualization of groundwater level trends over time. Trends in water levels over time were assessed visually.[2] Only data from wells without pumping (or data from wells with pumps that were off) were used for this analysis. The wells for which water level data was provided by individual municipalities and formatted by CBSWC included:

- City of Moses Lake Well #28, a 750-ft-deep well completed within the Wanapum and Grande Ronde Basalts, with municipality-collected water level data going back to 2010. The Moses Lake Well #28 exhibits a declining water level trend of approximately 1.5 ft per year. This well could be considered an intermediate aquifer well.
- City of Othello Well #8, an 853-ft-deep well completed within the Saddle Mountains and Wanapum Basalts, with municipality-collected water level data going back to 2012. The Othello Well #8 exhibited an increasing water level trend of approximately 7.2 ft per year from 2012 to around 2017 and then began exhibiting a declining water level trend of approximately 15 ft per year from 2017 through 2020. According to well pumping data (totalized flow and pump motor hour readings) provided by the City engineer of Othello, the increasing trend observed from 2012 to 2017 may be attributable to decreases in annual pumped volumes from this well (related to well performance issues) over the same general timeframe. From 2016 to 2020, conversely, pumping from Well #8 gradually increased up to annual pumped volumes similar to those of 2012, correlating to the decreasing water level trend during the same period. It may also be possible that changes in groundwater pumping from other wells in the vicinity of Othello has had an effect on water levels observed in Well #8. Based on these observations, analysis of the water level trends in Othello Well #8 for the purposes of regional water level trend analysis requires consideration of local effects within and in the vicinity of the well. This well could be considered a shallow to intermediate aquifer well.

[2] Statistical trend analysis was not employed in order to avoid confounding effects from some apparent anomalous readings or seasonal fluctuations that resulted in trend lines that did not appear representative.

- Town of Lind Well #8, a 2,034-ft-deep well completed within the Grande Ronde Basalt, with municipality-collected water level data going back to 2003. The Lind Well #8 exhibits a declining water level trend of approximately 2.7 ft per year. This well could be considered a deep aquifer well.
- City of Soap Lake Well #2, a 435-ft-deep well completed within the Grande Ronde Basalt, with water level data going back to 2020. The Soap Lake Well #2 exhibits a significant seasonal fluctuation in water levels on the order of 15 ft due to regional groundwater extraction in the area (presumably for agricultural irrigation) but shows a potentially declining water level trend in wintertime (i.e., non-irrigation season) water levels of approximately 0.6 ft per year. Although this is a Grande Ronde well, local conditions suggest it could be considered an intermediate aquifer well.

Water level hydrographs with visual trend lines for the municipality-monitored wells are provided separately on Figures 5 through 8 and together on Figure 9. Well logs are included in Attachment 2.

Other Entity Monitoring

Several other entities have active groundwater level monitoring programs that at least partially overlap with the CBSWC project area. The monitoring programs coordinated by other entities include:

- Ecology's Eastern Regional Office (ERO) monitors approximately 100 wells throughout eastern Washington. ERO's monitoring data is accessible from Ecology's Environmental Information Management (EIM) database under the ERO GWDB project identification number. Many of the wells monitored as part of ERO's program are fitted with airlines for water level measurements. Occasionally, individual well airlines are modified (e.g., replaced or deepened) without input or control from Ecology. Therefore, some apparent "jumps" in the water level data over time exist in the ERO dataset for some wells. Ecology staff report that these jumps are not corrected if new airline depth data is not provided but the data can still be useful for assessing groundwater level trends (if not actual water level elevations).
- Lincoln County Conservation District (LCCD) monitors approximately 80 wells throughout Lincoln County for the purpose of assessing on-going groundwater supply resources.
- The Black Sands Irrigation District (BSID) monitors approximately 5 wells located within the Quincy subarea. The BSID wells are used as agricultural supply wells permitted to withdraw shallow ASGW from the unconsolidated sands, semi-consolidated Ringold Formation, or the shallow Wanapum Basalt in the Quincy subarea. BSID is monitoring these wells to assess long-term sustainability of the ASGW in its area.
- Researchers at Washington State University (WSU) are monitoring approximately 30 wells throughout eastern Washington. The WSU monitoring program is focused on agricultural and industrial supply wells.

Select groundwater level hydrographs from wells monitored by these other entities are included in Attachment 3.

In addition, there are several historical groundwater monitoring programs (or portions of currently active monitoring programs) that are no longer actively monitored. For example, the Ecology ERO and LCCD monitoring programs both had previously included a larger network of monitoring wells. This historical data, combined with more current data, can be leveraged for a more holistic and long-term perspective of groundwater supplies within the project area. The locations of wells monitored by other entities—both currently and historically—are shown, along with the CBSWC monitoring wells, on Figure 4.

Groundwater Level Monitoring Discussion

Generally, the groundwater level data collected by CBSWC, individual municipalities, and other entities confirm declining groundwater levels (typical or common rates of decline of approximately 1 to 5 ft per year) throughout the project area, though there are some locations that appear to show relatively stable water level conditions and some that show steeper declines. Where and when groundwater is extracted at a greater rate than it is replenished, the groundwater system (i.e., aquifer) is considered to be “mined.” Mining an aquifer can occur for relatively short periods without detrimental impact but is not sustainable in the long term. Based on the physical hydrogeologic setting (i.e., aquifer depths and thicknesses) and water quality constraints within the project area, there is a practical limit for how far the groundwater levels can decline and still provide water for both irrigation and municipal uses. Generally speaking, when static (non-pumping) water levels fall below approximately 800 to 900 ft bgs, high electricity costs and physical wear on pump components (e.g., high pressures on the pump impellers) make groundwater withdrawals economically impractical for most uses. In addition, warmer groundwater temperatures, often also associated with higher dissolved mineral content (as encountered at greater depths in the project area), are typically not suitable (or favored by customers) for potable water supplies. It is not fully understood how far away from those practical limitations each municipality within the project area is, though continued groundwater monitoring and potentially numerical modeling may help provide insight. However, at the most basic level, it is apparent that the current groundwater withdrawal practices and management throughout much of the project area is not sustainable.

SUSTAINABLE WATER MANAGEMENT ALTERNATIVES

To address the general trend of declining groundwater levels throughout the project area, in accordance with its mission, the CBSWC has identified a number of projects, tools, and planning alternatives for sustainable water management in the project area. This section provides a high-level conceptual description of each of the identified projects, tools, and planning alternatives; a set of ranking criteria used to prioritize individual alternatives; and a summary of the CBSWC recommendations for preferred alternatives for implementation. The alternatives rankings are intended to provide a general statement regarding CBSWC's relative preferences based on the CBSWC member municipality perspective, considering current information and potential funding mechanisms. The rankings are not meant to imply that the lower-ranked alternatives have less or no merit. The lower-ranked alternatives are as valid as the higher-ranked alternatives, and because they may be important from the perspective of other regional stakeholders, which the CBSWC supports they should also be considered.

The primary opportunities and challenges of each alternative are discussed herein and are also summarized in Table 2. In addition, simple illustrative graphics providing visual context for each alternative are included for reference in Attachment 4. The CBSWC acknowledges that actual implementation of the preferred alternatives may need to be completed by others, and not necessarily by CBSWC itself.

Water Resource Project Alternatives

Project alternatives include capital and operational projects that are generally intended to bolster physical water supplies. For the purposes of this plan, project alternatives are separated into local and regional groupings. While the CBSWC encourages each individual municipality and purveyor to consider all available options for their individual water supply management and planning strategy, the local project alternatives identified herein do not advance the mission of the CBSWC and are not the focus of the CBSWC's regional alternative assessment and recommendations and are therefore not discussed in terms of priority or ranking.

Local Water Resource Project Alternatives

Local project alternatives that may provide bolstered water supplies for individual municipalities or purveyors—on a temporary or sometimes long-term basis—include, but are not limited to:

- Well modifications: including well deepening, well rehabilitation, pump lowering, and other infrastructure modifications made to existing supply wells. The typical intention of existing well modification is to increase—or maintain—the yield from an existing well.
- New wells: either to replace or supplement existing wells, typically to increase—or maintain—the overall supply quantities for a water system.
- Storage: typically an above-ground constructed tank (e.g., water tower or steel/concrete reservoir) or excavated storage pond. Local water storage facilities are most commonly used for relatively short-term peak flow rates in a water system and are usually not large enough to provide longer-term seasonal supplies.

- Local Aquifer Storage and Recovery (ASR): involving the injection of water (typically surface water) into the ground during times or seasons of water availability and reduced water demand (e.g., during the winter wet season) and retrieving that water (or a portion of that water) during times or seasons of higher demand (e.g., during the dry summer season). ASR is typically accomplished using high-capacity injection/extraction wells that are either constructed specifically for that purpose or are converted from other uses (e.g., groundwater supply well), access to a source of water for storage, and water treatment and conveyance infrastructure.
- New source treatment and local distribution: including developing an alternative source of supply (e.g., shallow groundwater, CBP canal surface water, food-processing effluent, etc.), treating it to Washington Department of Health (WDOH) drinking water standards, and blending it with the purveyor's existing local water distribution system. This local project alternative would typically be available only for those purveyors located adjacent to an alternative source and would require investment in appropriate water treatment infrastructure.

Regional Water Resource Project Alternatives

The CBSWC's focus is on sustainable water supply solutions to the regionally declining groundwater level challenges in the project area. As such, the CBSWC recommendations regarding capital and operational projects are regional. This section provides a high-level conceptual summary of the regional project alternatives (Alternatives Group A) considered by the CBSWC.

A1. Odessa Groundwater Replacement Program

As summarized above, the OGWRP is intended to replace groundwater extraction for the irrigation of up to 87,700 acres with surface water deliveries through CBP infrastructure. The OGWRP includes the expansion of the existing East Low Canal and the construction of lateral pump stations and distribution piping off the East Low Canal to deliver water to irrigated fields within the Odessa Special Study Area. To be eligible for OGWRP water deliveries, an irrigator must own (or purchase) and retire an Odessa Groundwater Subarea groundwater right for irrigation of a field or fields in the direct vicinity of one of the planned lateral distribution pipes. The OGWRP has been planned and permitted and is currently in incremental final design and construction stages. The East Low Canal expansion has largely been completed and work is starting on the lateral pump stations. The OGWRP projects are being completed by the Bureau, Ecology, and ECBID with support from other groups.

When completed, the OGWRP is expected to reduce the mining of the aquifer but likely will not eliminate it (i.e., the 80,000 acres under the OGWRP will not fully replace the estimated 100,000 to 200,000 acres irrigated by groundwater within the Odessa subarea). The OGWRP also requires numerous pumping stations to push water from the East Low Canal uphill (i.e., against gravity) and is limited in areal extent to within the Odessa Subarea Special Study area, in the western portion of the Odessa subarea. The OGWRP is considered by some as a temporary stop-gap measure until the full CBP completion is implemented. The OGWRP went through extensive environmental review, including an Environmental Impact Statement, as part of its permitting process (USBR 2012b). Additional details regarding the OGWRP are in the Odessa Subarea Special Study Final Feasibility-Level Special Study Report (USBR 2012a).

A2. Full Columbia Basin Project Completion

Completion of the full CBP, as originally authorized, would likely include the construction of the East High Canal with a small number of pump stations and then gravity flow to provide surface water for irrigation of up to 349,000 additional acres than are currently irrigated under the CBP. Full CBP completion would likely replace groundwater for more than 100,000 acres of land currently/previously irrigated by groundwater (i.e., it would alleviate groundwater mining more than the OGWRP). One concept of the original full CBP completion reportedly included pump stations and lateral conveyance piping to bring water for irrigation and communities eastward as far away as Ritzville, Washington.

Challenges for full CBP completion include its high cost (likely multiple billions of dollars), its need for additional secondary use water rights from Ecology (which would trigger additional environmental review and an Environmental Impact Statement), and its long timeframe for implementation.

A3. Water Conservation

Water conservation, completed at the local level (i.e., within individual municipalities' distribution systems, at individual residences, and on individual farms) can stretch existing water resources. Water conservation done at the local level can have limited impact on regional water supplies; however, conservation done in a coordinated regional effort—by both municipalities and farms—can have a more significant regional impact. Examples of conservation opportunities include reduction of irrigated turf lawns in parks and residential communities (and replacement with xeriscaping, or drought-tolerant landscaping), fixing leaking pipes, and using modern water-efficient irrigation technologies.

All public water systems in Washington State are required to implement a water use efficiency program as part of their WDOH permitting. Coupling this individual requirement with a multi-stakeholder coordinated regional conservation effort could be a significant source of conserved water, stretching irrigation and municipal water supplies. Such coordination may also help individuals and groups of stakeholders secure funding for water conservation improvements. Water conservation measures can be implemented in the short term.

Challenges for water conservation are primarily related to the difficulty of implementation with respect to public perception (i.e., reducing water use – including for outdoor lawn watering – is typically unpopular) and the fact that conservation may be only a partial measure to stretch existing supplies but not provide additional supplies for future growth. In addition, there is currently no regional mechanism to promote and encourage widespread and large-scale water use conservation across different sectors (i.e., municipalities and agriculture).

A4. Aquifer Recharge by Passive Rehydration

Aquifer recharge is a potential project concept that would rely on delivering water (when available) to surface or shallow subsurface facilities and/or or natural features for percolating downward to augment groundwater supplies within the aquifer system of the project area. If infiltrated water could replenish the aquifer system in meaningful quantities and on a relevant timeframe, down-gradient municipalities would likely be able to continue to use their existing hydrologically connected infrastructure (i.e., wells, pumps, and piping) to access that water, as it would be comingled with the naturally occurring groundwater. Infiltration could occur when water is available (i.e., in the winter wet season). Infiltration areas would likely need to be located in natural recharge areas for the aquifer system, such as along the northern and eastern margins of the project area and/or in deeper coulees. Surface (or near surface) infiltration of water would likely entail relatively minimal water quality treatment requirements.

The primary challenges for aquifer recharge by passive rehydration include a potentially long timeframe (i.e., decades or hundreds of years) for project benefits to reach municipalities; significantly less than full recovery of infiltrated water (i.e., a large portion of the infiltrated water to recharge the aquifer system would likely not be captured for groundwater withdrawal and use, though this could be seen as a positive attribute from a natural resources and aquifer augmentation perspective since the unrecovered water would replace historically depleted native groundwater); and it would require a significant source of water (both from a physical and permitting/contracting perspective) that has not yet been defined. Passive rehydration in Lincoln County has been assessed at a pre-feasibility study level and found to be potentially feasible though at high cost and with technical and permitting difficulty (LCCD et al. 2011). A full feasibility study would be required to assess the technical and regulatory feasibility of implementing this project alternative.

A5. Aquifer Recharge by Deep Well Injection Network

A similar project to Alternative A4 is aquifer recharge by a network of deep injection wells, or regional aquifer storage and recovery (ASR). With this project concept, water would be injected directly into the aquifers that have been experiencing declining water levels potentially by using existing (and retired) large-scale irrigation wells throughout (or strategically selected throughout) the project area. In essence, water would be injected directly to where it has been depleted. This project would have similar opportunities as the passive rehydration of Alternative A4, namely that injection could occur when water is available and municipalities could continue to use their existing well, pump, and piping infrastructure. In contrast to the passive rehydration alternative, however, aquifer recharge by deep well injection could potentially provide benefits on a much shorter timeframe (i.e., years to decades).

Otherwise, similar challenges would be posed for aquifer recharge by deep well injection as for passive rehydration. For instance, depending on the configuration of the injection well/recovery well system and aquifer properties, there may be significantly less than full recovery of injected water. For example, a large portion of the injected water might not be recovered for use because of limited hydraulic connection. Though again, this could be seen as a positive attribute from a natural resources and aquifer augmentation perspective as unrecovered water would replace historically depleted native groundwater. In addition, it would require a significant source of water that has not yet been defined and infrastructure to deliver that water to an injection well network. The water quality treatment requirements for a deep well injection project also would likely be difficult under the current regulatory framework in Washington State. If ASR source water is taken from surface water, WDOH requires treatment of that water to a surface water standard prior to injection. The surface water treatment standard is more stringent than the groundwater treatment standard most project area municipalities are used to. Also, the permitting framework for a regional aquifer recharge project by deep well injections—related to both Ecology and WDOH permitting—is uncertain, since no similar project has been completed previously in Washington State. A feasibility study would be required to assess the technical and regulatory feasibility of implementing this project alternative.

A6. New Source Treatment and Regional Distribution

This project, in concept, would involve the development of a new source of water, treatment of that water to drinking water standards, and delivery to multiple municipalities using new conveyance piping and pumping infrastructure. It would be similar to the local new source treatment and distribution project concept described above in the Local Water Resource Project Alternatives section but would be intended to serve multiple municipalities through a network of conveyance piping. Potential source water options may include: Columbia River (or Lake Roosevelt or Banks Lake) surface water, shallow groundwater, CBP canal surface water, or food-processing effluent. Water quality treatment of surface water to drinking water standards would be required (treatment may also be required for shallow groundwater, especially if impacted by poor water quality). Once delivered to the municipalities, the treated new source water could likely be connected directly to the municipality's existing water distribution system, assuming geochemical compatibility with the municipality's other source water and physical piping and other facility infrastructure. Variations on the scale and layout of this project alternative are possible. For example, it could consist of one or two large, centralized treatment plants located at significant source areas (e.g., on Lake Roosevelt or Banks Lake) and long (i.e., hundreds of miles) piping networks delivering treated water to municipalities throughout the project area. Alternatively, it could consist of numerous smaller treatment facilities located at numerous source areas throughout the project area (e.g., CBP canals, shallow groundwater, food-processing effluent, etc.) and distribution through smaller networks of conveyance piping to municipalities in the more direct vicinity of each source. Additionally, treatment could be either centralized (i.e., located at each source, upstream of the distribution network) or dispersed (i.e., located at each endpoint municipality destination). Benefits of this project concept include: a high level of efficiency (i.e., nearly 100 percent) in terms of source water being available for use by participating municipalities; at least some water sources are currently available (e.g., food processing re-use water, M&I contracts from the Bureau for CBP canal water, etc.); and the technical and permitting pathway for the treatment and use of surface waters for municipal supply are already well understood.

The primary challenges associated with this project include the potentially large cost for new treatment and conveyance piping infrastructure and the potential difficulty of providing a benefit to municipalities and purveyors located far from potential new water sources, especially if hundreds of miles of new distribution piping would be required to reach them and securing access to a pipeline right-of-way across a region dominated by private land ownership. A feasibility study would be required to assess the technical and regulatory feasibility of implementing this project alternative.

Water Resource Management Tool Alternatives

Water resource management tools provide information to help policy makers make decisions regarding current use and future planning related to the resource. A regional water resource management tool is essential for effective and sustainable water management within the project area. This section provides a high-level conceptual summary of the regional groundwater management tools alternatives (Alternatives Group B) considered by the CBSWC.

B1. Groundwater Level Monitoring

Groundwater level monitoring, in conjunction with a solid conceptual understanding of the hydrogeologic setting, provides direct measurements of current groundwater supplies in an aquifer. Groundwater monitoring over time can provide information on the trends in those groundwater supplies; it is exactly what has enabled water resource managers to understand the currently observed declining groundwater supplies in portions of the project area, as described above. Groundwater level data can help decision-makers prioritize limited resources in developing capital improvements to support water resource management strategies. Finally, groundwater level monitoring is an essential tool to use in measuring the effects of any action on the groundwater system. Groundwater monitoring is relatively straight-forward and inexpensive to implement (especially if leveraging existing wells), requiring minimal equipment (e.g., water level indicator, pressure transducer/datalogger, etc.).

The primary challenges related to groundwater level monitoring are related to identifying suitable monitoring wells and correctly collecting, managing and interpreting the data, both of which are relatively easy to overcome with appropriate technical expertise. In addition, identifying long-term stable funding sources to continue a groundwater monitoring program once initiated is a common challenge for implementation of this type of tool.

B2. Groundwater Modeling

Numerical groundwater modeling (e.g., with MODFLOW or similar), when properly constructed and calibrated, can help water resource managers better understand a hydrogeologic system and even plan for future conditions. For example, a numerical model can help predict the impact on groundwater supplies from projected future conditions like climate change scenarios, increased/decreased groundwater pumping, and/or increased/modified groundwater recharge (e.g., from aquifer recharge or percolation of irrigation runoff from the OGWRP or full CBP completion). The USGS has completed a numerical model of the Columbia Plateau Regional Aquifer System, including the hydrogeologic system within the project area (USGS 2015), and the CBGWMA developed its own numerical model encompassing the project area (CBGWMA 2010), either of which could be leveraged to address specific groundwater management objectives within the project area.

The cost for groundwater modeling can vary and would depend on the degree of model construction or modification but would likely cost more than groundwater monitoring. A primary challenge of groundwater modeling would be the inherent uncertainties related to modeling in general, defining both spatial and time scales that provide meaningful input to groundwater managers, and in attempting to predict future conditions.

Water Resource Planning Alternatives

Water resource planning is an important component in managing the resource. Planning provides a venue for coordination among multiple stakeholders and allows for the development of explicit objectives and recommendations. Multiple water resource planning options are available for groundwater management within the project area. This section provides a high-level conceptual summary of the regional water resource planning alternatives (Alternatives Group C) considered by the CBSWC.

C1. Coordinated Water System Planning

Coordinated water system planning is a framework for water resource management mostly related to WDOH-focused water system planning. It can provide a regulatory mechanism to limit additional groundwater withdrawals within its applicable area (i.e., it can help reduce the number of straws drawing from the aquifer system), but it is not intended as a mechanism for project implementation to bolster water supplies. Grant County developed a coordinated water system plan in 2001 and its primary function has reportedly been to limit additional groundwater withdrawals in certain areas.

C2. Groundwater Management Planning

Groundwater (or aquifer) management planning typically involves a grassroots effort led by groundwater-dependent stakeholders to study, maintain, or even augment groundwater supplies on a regional or sub-regional basis. Groundwater management planning is often technically focused and geared toward project implementation to achieve clean and/or sustainable groundwater supplies. While groundwater management planning can bring multiple groundwater-related stakeholders to the table to recommend (and implement) important regional water supply projects, it can sometimes overlook other important stakeholders (e.g., surface water users, recreational groups, etc.) that are important for a holistic watershed management effort.

C3. Integrated Planning and Project Implementation

Integrated planning and project implementation is a resource management planning structure that brings together the efforts of a diverse group of agencies, tribes, and other stakeholders around a complex water supply issue and takes action to implement projects. It provides a space for a diverse group of stakeholders to discuss different water management perspectives, identify shared goals and objectives, and work together to implement projects and programs to reach shared goals and objectives. Integrated planning is a stakeholder-driven process, where decisions are made based on stakeholder consensus. Several integrated planning efforts are underway in Washington State, with the most notable—and successful—example being the Yakima Basin Integrated Plan (YBIP). One of the tenets of the YBIP is that all stakeholders will get some of what they need but not everything that they want.

Integrated planning in the project area may provide an opportunity to coordinate with the myriad water resource stakeholders in the region—including the CBSWC (and its member municipalities), the Bureau of Reclamation, irrigation districts, Tribes, environmental advocacy groups, recreational advocacy groups, and others—to identify perspectives, objectives, and strategies for holistic water supply management in the project area (and potentially beyond) and to implement projects. For example, there may be an opportunity through integrated planning to find a pathway forward for sustainable water supply for municipalities (i.e., implementation of one or more of the project alternatives identified in this document), full CBP completion for the Bureau and irrigation districts, secure water right authorizations for the Confederated Tribes of the Colville Reservation (who are currently seeking a water right adjudication for the Lake Roosevelt and middle tributaries of the Columbia River), and maintenance of or improved environmental and/or recreational features for advocacy groups.

Integrated planning would require legislative funding for state agency (e.g., Ecology) involvement and facilitation and would require significant coordination with various stakeholders who may be accustomed to being at odds with each other.

C4. US Bureau of Reclamation Basin Study

The Bureau provides for regional water resource management planning through its WaterSMART Basin Study program. With a Basin Study, the Bureau (or its contractor) would collaborate with a non-federal entity (e.g., a state agency, like Ecology) to complete a feasibility study level assessment of a basin- (or watershed)-wide water supply issue. There is a 50 percent matching requirement from the non-federal entity to complete a Basin Study. The Bureau describes the Basin Study program as a stakeholder-driven, collaborative process to help Reclamation identify future issues related to current water supplies and potential future climate change, and their impacts on future water supplies. A Basin Study would likely be similar in extent and concept to integrated planning (described above) but would be driven primarily by the Bureau, with collaborative input from the non-federal entity partner and other stakeholders, including the CBSWC. A Basin Study, however, would be primarily a planning effort, with less emphasis (compared to integrated planning) on project implementation, at least initially.

Given the number of water resource stakeholders and the importance of the Bureau in water supply management within the project area, a Basin Study may be a potentially viable regional planning venue, and one in which the CBSWC can play an active role.

Alternatives Scoring Criteria and Ranking

The alternatives described above were scored for relative preference for implementation to provide solutions for sustainable water supplies in the project area. The scoring was conducted considering eight criteria categories, described below. Each alternative was assigned a score within each criteria category. In addition, each criteria category was assigned a weighting factor to represent the level of priority (high, medium, low) of that criteria category for the CBSWC. Total weight-factored scores for each Alternative were then calculated to identify the relative preference of each alternative. The highest scores in each alternative group (i.e., projects, tools, planning) were identified as the most preferred. This section describes the criteria category and system of scoring and weighting used to determine the relative order of preferred alternatives.

Criteria Categories

Each alternative was assessed relative to the following criteria categories: extent of benefit, type of benefit, timing of benefit, certainty of benefit, sustainability of benefit, technical implementability, regulatory implementability, and cost.

Extent of Benefit

The extent-of-benefit criteria category addresses the anticipated geographic extent of the benefit of an alternative. Since the CBSWC is focused on regional solutions, alternatives that are anticipated to provide regional benefit score higher while alternatives that are more local in nature score lower.

Type of Benefit

The type-of-benefit criteria category addresses the nature of the anticipated benefit of an alternative. Generally, alternatives that are anticipated to provide tangible or physical benefits (e.g., augmented water supplies) score higher while alternatives that are anticipated to provide more conceptual benefits (e.g., paperwork) score lower.

Timing of Benefit

The timing-of-benefit criteria category addresses the anticipated relative timeframe of the benefit of an alternative to materialize. Alternatives that are anticipated to provide benefits relatively soon score higher while alternatives that are anticipated to take longer to show benefits score lower.

Certainty of Benefit

The certainty-of-benefit criteria category addresses the degree of certainty of an alternative in providing an actual benefit to CBSWC objectives. Alternatives that are currently well understood with a high degree of certainty to provide benefits, if implemented, score higher while alternatives that have less certainty in providing benefits score lower. For example, a previously completed feasibility study for a project may provide more certainty of benefit compared to a project that is only in concept and requiring a feasibility study to determine anticipated benefits.

Sustainability of Benefit

The sustainability-of-benefit criteria category addresses the anticipated longevity and sustainability of the alternative to provide benefit. Alternatives that are anticipated to be self-sustaining (or implementable in the long-term with on-going management) score higher while alternatives that are anticipated to provide only short-term benefits score lower.

Technical Implementability

The technical implementability criteria category addresses the anticipated technical feasibility (e.g., from an engineering design standpoint) of an alternative to be implemented. Alternatives that are understood to be technically feasible via a known technical process score higher while alternatives that are anticipated to encounter significant technical challenges during implementation score lower.

Regulatory Implementability

The regulatory implementability criteria category addresses the anticipated regulatory feasibility (e.g., from permitting standpoint) of an alternative to be implemented. Alternatives that follow a known regulatory process score higher while alternatives that are likely to encounter regulatory challenges (or require a novel regulatory pathway) during implementation score lower.

Cost (relative order of magnitude)

The cost criteria category addresses the anticipated financial cost of an alternative to be implemented. Alternatives that are anticipated to be relatively low cost score higher while alternatives that are anticipated to be relatively high cost score lower.

Scoring and Weighting Factors

Each alternative within the project, tool, and planning categories was assigned a relative score on a scale of 1 through 5, with the following scale relative to the likelihood of each alternative achieving the CBSWC's objectives of a regional sustainable water supply solution:

- Score = 1: Poor; Does not achieve CBSWC's objectives
- Score = 2: Fair; Only achieves a small part of CBSWC's objectives
- Score = 3: Good; Achieves some of the CBSWC's objectives
- Score = 4: Very Good; Achieves most of CBSWC's objectives
- Score = 5: Excellent; Achieves all of CBSWC's objectives.

In addition, each criteria category (i.e., Extent of Benefit, Timing of Benefit, Cost, etc.) was assigned a weighting factor between 1 and 3 to signify the CBSWC's perspective on the level of importance for that criteria category, with 1 relating to a lower importance, 2 relating to a moderate importance, and 3 relating to a higher importance. The initial (1 through 5) score for each project/tool/planning alternative in each criteria category was then multiplied by the weighting factor (1 through 3) for that criteria category to determine the project/tool/planning score for each criteria category. All project/tool/planning scores from all criteria categories were then added up to obtain the total score for each project/tool/planning alternative. The most preferred alternatives, therefore, are those ranked with the highest scores in each of the projects, tools, and planning groups.

The alternatives scoring system and project scores within each criteria category are summarized in Table 3.

PREFERRED ALTERNATIVES

This section summarizes the results of the alternatives scoring assessment and CBSWC's current perspective regarding relative priority for alternative implementation. The alternative rankings summarized below are based on the CBSWC's understanding of current technical, regulatory, and external funding opportunity conditions. The CBSWC understands that the relative rankings of the alternatives may evolve over time as additional information is obtained or external conditions change.

Preferred Project Alternatives

Based on the results of the alternatives scoring and ranking process described above, the project alternatives are ranked in the following order with respect to CBSWC preference for implementation:

1. OGRWP (Project Alternative A1)
2. New Source Treatment and Regional Distribution (Project Alternative A6)
3. Water Conservation (Project Alternative A3)
4. CBP Completion (Project Alternative A2)
5. Aquifer Recharge by Deep Well Injection (Project Alternative A5)
6. Aquifer Recharge by Passive Rehydration (Project Alternative A4).

Preferred Water Resource Management Tool Alternatives

Based on the results of the alternatives scoring and ranking process described above, the water resource management tool alternatives are ranked in the following order with respect to CBSWC preference for implementation:

1. Groundwater Level Monitoring (Tool Alternative B1)
2. Numerical Groundwater Modeling (Tool Alternative B2).

Preferred Water Resource Planning Alternatives

Based on the results of the alternatives scoring and ranking process described above, the water resource planning alternatives are ranked in the following order with respect to CBSWC preference for implementation:

1. Integrated Planning and Project Implementation (Planning Alternative C3)
2. Groundwater Management Planning (Planning Alternative C2)
3. Bureau of Reclamation Basin Study (Planning Alternative C4)
4. Coordinated Water System Planning (Planning Alternative C1).

SUMMARY AND DISCUSSION

Groundwater levels throughout portions of Franklin, Lincoln, Adams, and Grant Counties (project area) are experiencing long-term declining trends on the order of 1 to 5 ft per year (in some cases more), particularly in the deep aquifer system. The water level declines are thought to be due to groundwater pumping exceeding aquifer recharge, related to an over-allocation of groundwater rights, and limited natural and artificial recharge to the deep aquifers. Groundwater rights have been issued by the Washington State Department of Ecology for a range of uses in the project area, including irrigation, industrial, and food-processing in addition to municipal. A significant number of those groundwater rights, especially for irrigation, industrial, and food-processing uses within the Odessa subarea, were intended to be temporary until the federal Bureau of Reclamation Columbia Basin Project (CBP) was to be completed. While the Bureau, Ecology, and the East Columbia Basin Irrigation District are actively working to implement the Odessa Groundwater Replacement Program, the full CBP completion is not currently permitted or scheduled for construction. Therefore, many large-scale temporary groundwater withdrawals will likely continue, resulting in continued stresses on the groundwater supplies for project area municipalities and other drinking water purveyors. The Columbia Basin Sustainable Water Coalition (CBSWC) is a non-profit entity formed by municipalities and other drinking water purveyors within the project area to promote a sustainable source of water for potable drinking water for municipalities and communities. The mission of the CBSWC is to: “Address potable groundwater supply issues by creating locally driven recommendations that influence water management and policy that will direct resources to create sustainable water solutions.”

The CBSWC has established an initial groundwater monitoring network in the project area by leveraging existing wells and water level data from member municipalities. The CBSWC network complements existing monitoring programs managed by other entities. The groundwater level data collected through these monitoring programs help to document —and confirm—the declining water level trends in the project area and to identify areas of particular concern so that resources to implement regional solutions can be focused where they will have the most impact.

This Preliminary Watershed Management Plan provides documentation of CBSWC’s recommendations regarding creating sustainable water solutions within the project area. The CBSWC has identified six project alternatives, two water resource management tool alternatives, and four water resource planning alternatives and ranked those alternatives in order of their anticipated potential for achieving the CBSWC’s goal of sustainable water use within the project area. The CBSWC recommends implementation of the alternatives in order of priority reflected in the preference ranking summarized herein. As external political and financial conditions change, the CBSWC may revisit the relative preferences for project, tool, and planning alternative implementation.

REFERENCES

CBGWMA.2008. Analysis of Nitrate (NO_3-N) Concentration Trends in the Suprabasalt Sediment Aquifer, Pasco and Quincy Basins, Washington, 2006-2007: Columbia Basin Ground Water Management Area of Adams, Franklin, Grant, and Lincoln Counties. Columbia Basin Ground Water Management Area. June.

CBGWMA. 2009a. A Summary of Columbia River Basalt Group Physical Geology and its Influence on the Hydrogeology of the Columbia River Basalt Aquifer System: Columbia Basin Ground Water Management Area of Adams, Franklin, Grant, and Lincoln Counties. Columbia Basin Ground Water Management Area. June.

CBGWMA., 2009b. Mulitple Tracer Study of Recharge Mechanisms and the Age of Groundwater in the Columbia River Basalt Group Aquifer System: Columbia Basin Ground Water Management Area of Adams, Franklin, Grant, and Lincoln Counties. Columbia Basin Ground Water Management Area. July. CBGWMA. 2010. Summary Report: Groundwater Model Development Process for the Columbia Basin Ground Water Management Area of Adams, Franklin, Grant, and Lincoln Counties, Washington; Progress Report of the Groundwater Hydrologic Modeling Project. Columbia Basin Ground Water Management Area of Adams, Franklin, Grant, and Lincoln Counties. September.

Executive Office of the President. 2021. Memorandum for the Heads of Departments and Agencies: Interim Implementation Guideance for the Justice40 Initiatiative. Office of Management and Budget, Washington, D.C. July 20.

GSI. 2021. Report: Groundwater Conditions in the Odessa Subarea, Washington, 2020 Update. Prepared for Washington State Potato Commission and Washington Department of Ecology by GSI Water Solutions, Inc. December.

LCCD, Inc. GSI Water Solutions, Inc. HDR Engineering, and Inc. WNR Group. 2011. Prefeasibility Assessment Report: Lincoln County Passive Rehydration Project. Lincoln County Conservation District. April.

USBR. 2012a. Final Feasibility-Level Special Study Report Odessa Subarea Special Study, Columbia Basin Project, Washington. United State Bureau of Reclamation. September.

USBR. 2012b. Report: Odessa Subarea Special Study Final Environmental Impact Statement Executive Summary, Columbia Basin Project, Washington. United State Bureau of Reclamation. August.

USGS. 1990. Report: Geologic Framework of the Columbia Plateau Aquifer System; Washington, Oregon, and Idaho. Water Resources Investigations Report 87-4238*.* United States Geological Survey.

USGS.1996. Report: Ground-Water Geochemistry of the Columbia Plateau Aquifer System, Washington, Oregon, and Idaho. Open-File report 95-467. United State Geological Survey.

USGS. 2000. Report: Hydrology of the Columbia Plateau Regional Aquifer System, Washington, Oregon, and Idaho. Water Resources Investigations Report 96-4106. United States Geological Survey.

USGS. 2011a. Report: Hydrogeologic Framework and Hydrologic Budget Components of the Columbia Plateau Regional Aquifer System, Washington, Oregon, and Idaho. Scientific Investigations Report 2011–5124. United States Geological Survey.

USGS. 2011b. Report: Three-Dimensional Model of the Geologic Framework for the Columbia Plateau Regional Aquifer System, Idaho, Oregon, and Washington. Scientific Investigations Report 2010-5246 ed. U.S. Department of the Interior, U.S. Geological Survey. February 25.

USGS.2012. Groundwater Quality in the Columbia Plateau, Snake River Plain, and Oahu Basaltic-Rock and Basin-Fill Aquifers in the Northwestern United States and Hawaii, 1992-2010. Scientific Investigations Report 2012-5123. United States Geological Survey.

USGS. 2015. Report: Numerical Simulation of Groundwater Flow in the Columbia Plateau Regional Aquifer System, Idaho, Oregon, and Washington. Scientific Investigations Report 2014-5127. United States Geological Survey. January.

USGS. 2018. Report: Simulation of Groundwater Storage Changes in the Quincy Basin, Washington. Scientific Investigations Report 2018-5162. United States Geological Survey. December 18.

Washington Department of Commerce. 2019. Mid-Columbia Resiliency Coordination: Final Report. Washington State Department of Commerce. August 30.

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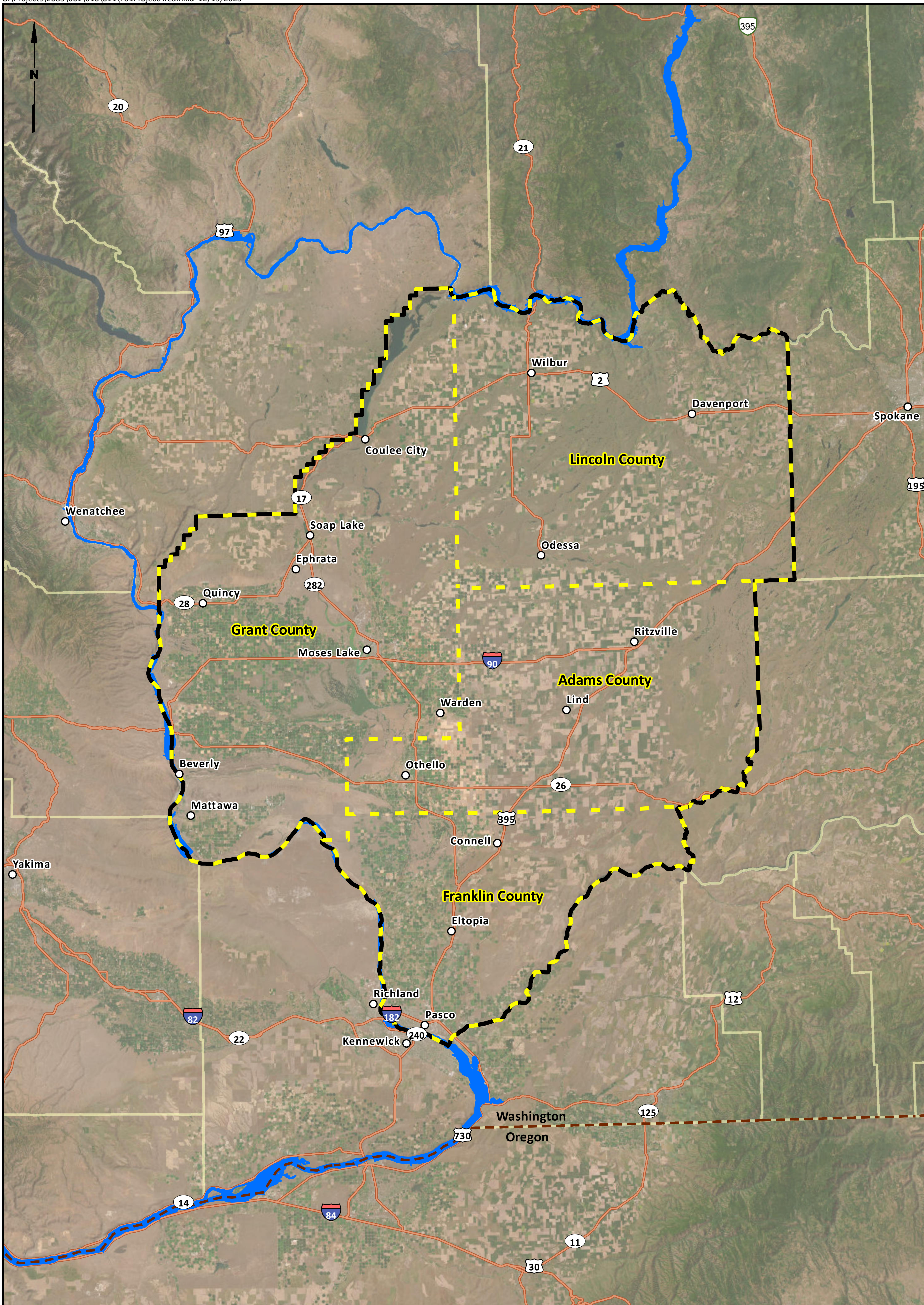


Legend

- Project Area
- Project Area Counties
- Other Counties
- Columbia River

0 15 30

Miles

Note

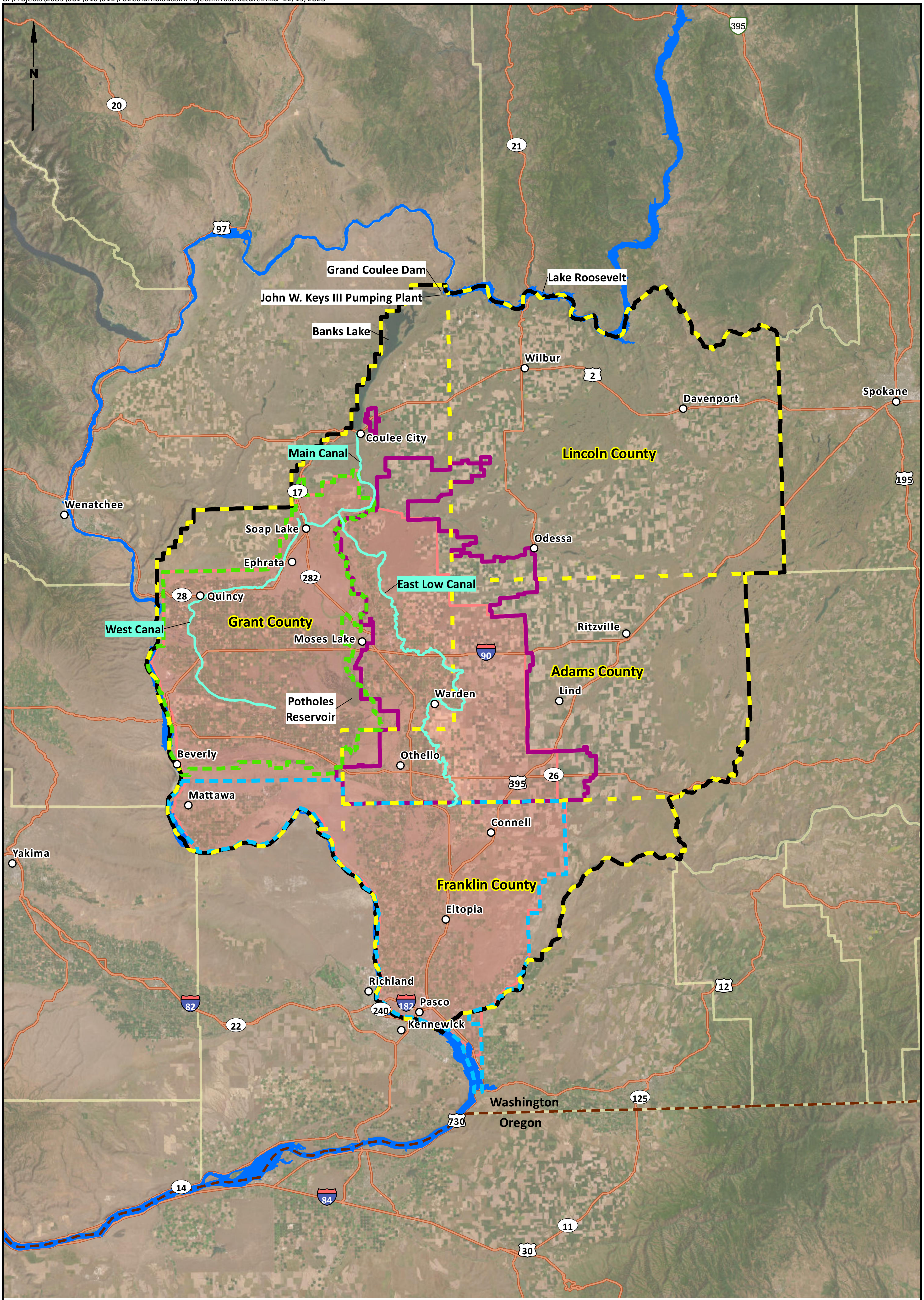
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Sources: WADNR; Esri World Imagery.

LANDAU ASSOCIATES

Columbia Basin Sustainable Water Coalition Mid-Columbia Basin, Washington	**Project Area**	Figure 1

G:\Projects\2085\001\010\011\F02ColumbiaBasinProjectInfrastructure.mxd 12/15/2023



Legend

- Project Area
- Project Area Counties
- Other Counties
- Columbia River
- Columbia Basin Project Area
- East Columbia Basin Irrigation District
- Quincy Columbia Basin Irrigation District
- South Columbia Basin Irrigation District

0 15 30

Miles

Data Sources: WADNR; Esri World Imagery.

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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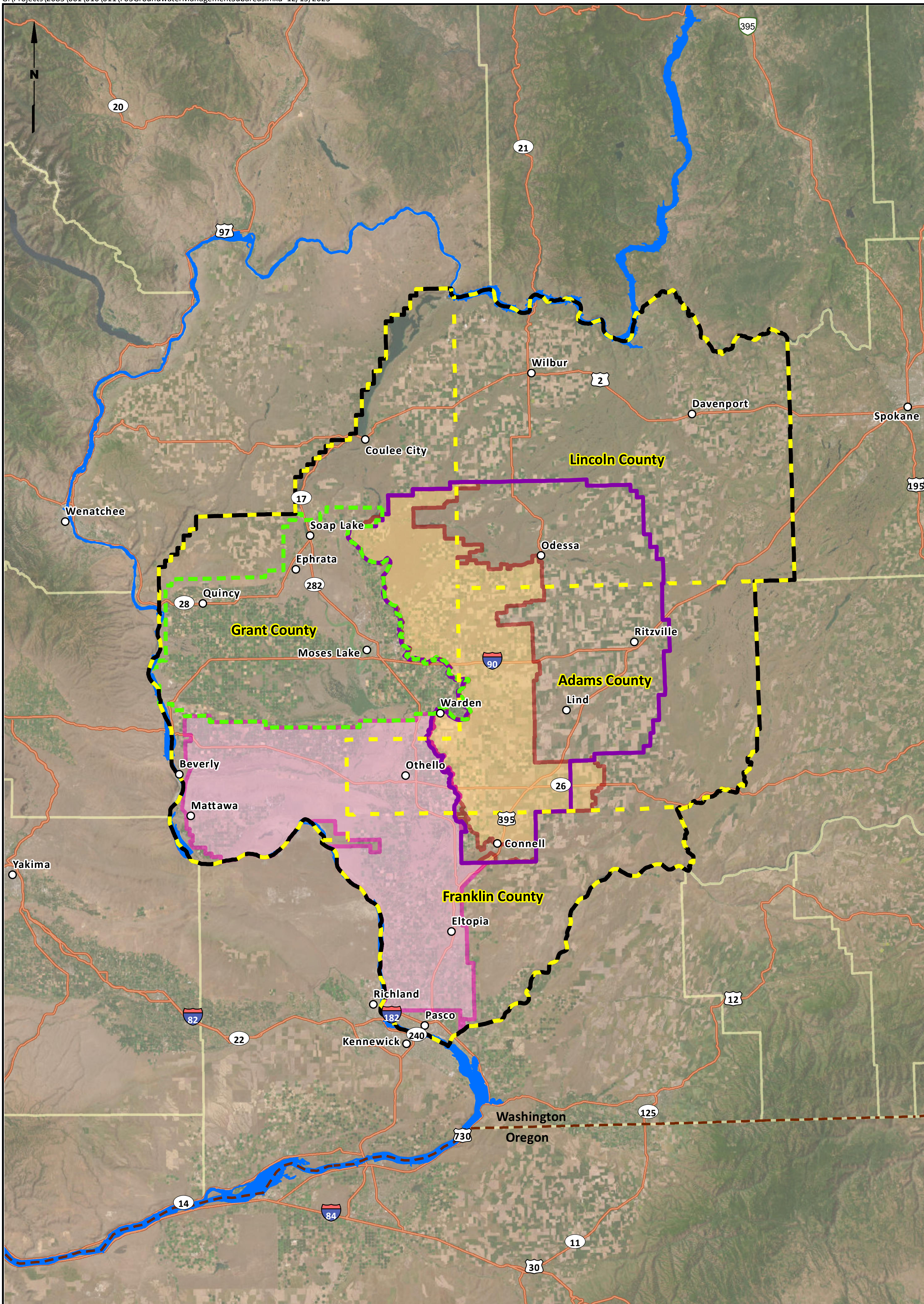
Columbia Basin Sustainable Water Coalition Mid-Columbia Basin, Washington	Columbia Basin Project Infrastructure	Figure 2

G:\Projects\2085\001\010\011\F03GroundwaterManagementSubareas.mxd 12/15/2023



Legend

- Project Area
- Project Area Counties
- Other Counties
- Columbia River
- Odessa Special Study Area
- Odessa Subarea
- Pasco Subarea
- Quincy Groundwater Subarea

0 15 30

Miles

Note

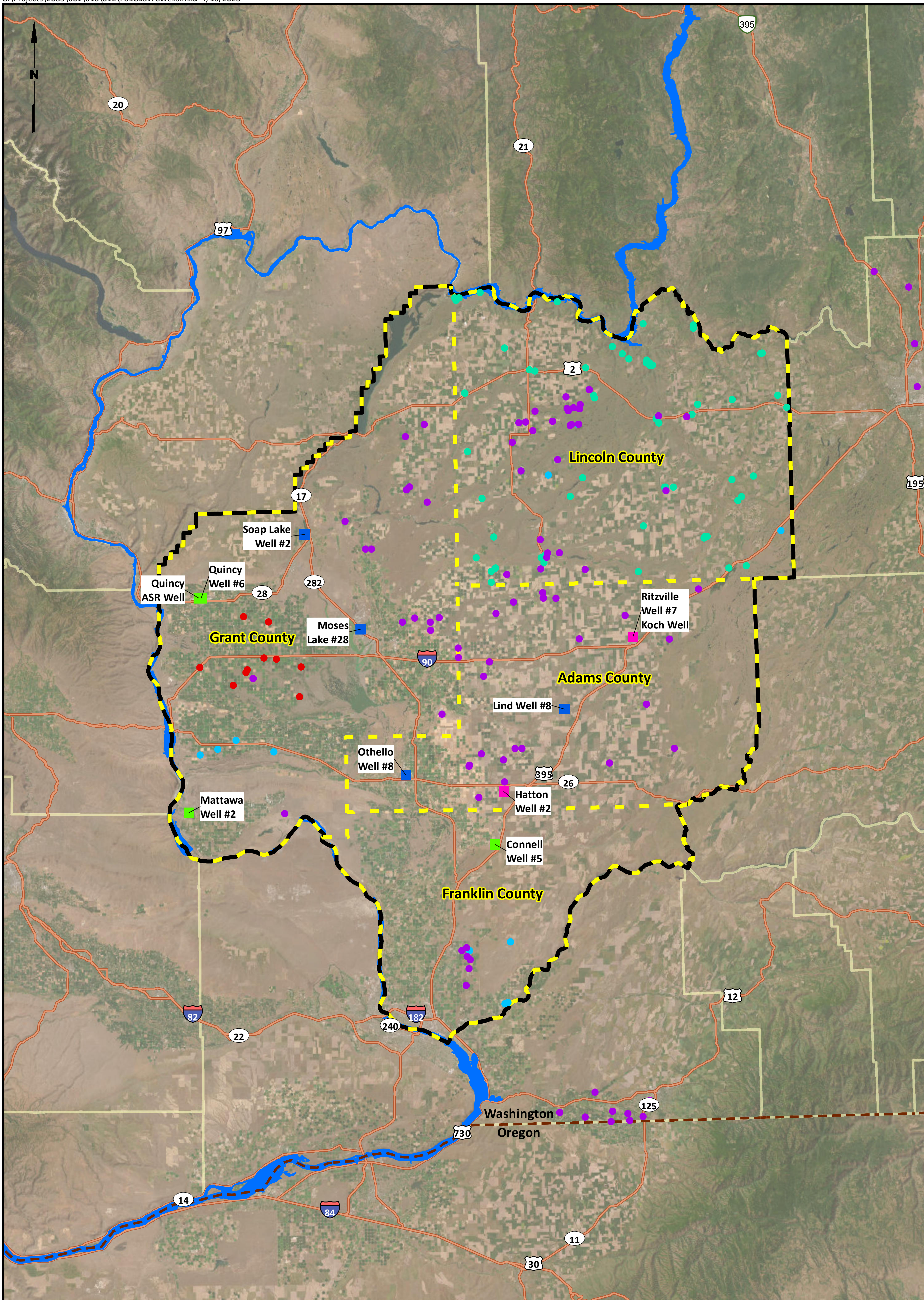
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Sources: WADNR; Esri World Imagery.

LANDAU ASSOCIATES

Columbia Basin Sustainable Water Coalition Mid-Columbia Basin, Washington	**Groundwater Management Subareas**	Figure 3

G:\Projects\2085\001\010\012\F01CBSWCWells.mxd 4/10/2023



Legend

- CBSWC Well Network
- Municipal Monitored Wells
- Prospective CBSWC Wells
- BSID (Current)
- Ecology-ERO (Current)
- LCCD (Current)
- WSU (Current/Planned)
- Project Area
- Project Area Counties
- Other Counties
- Columbia River

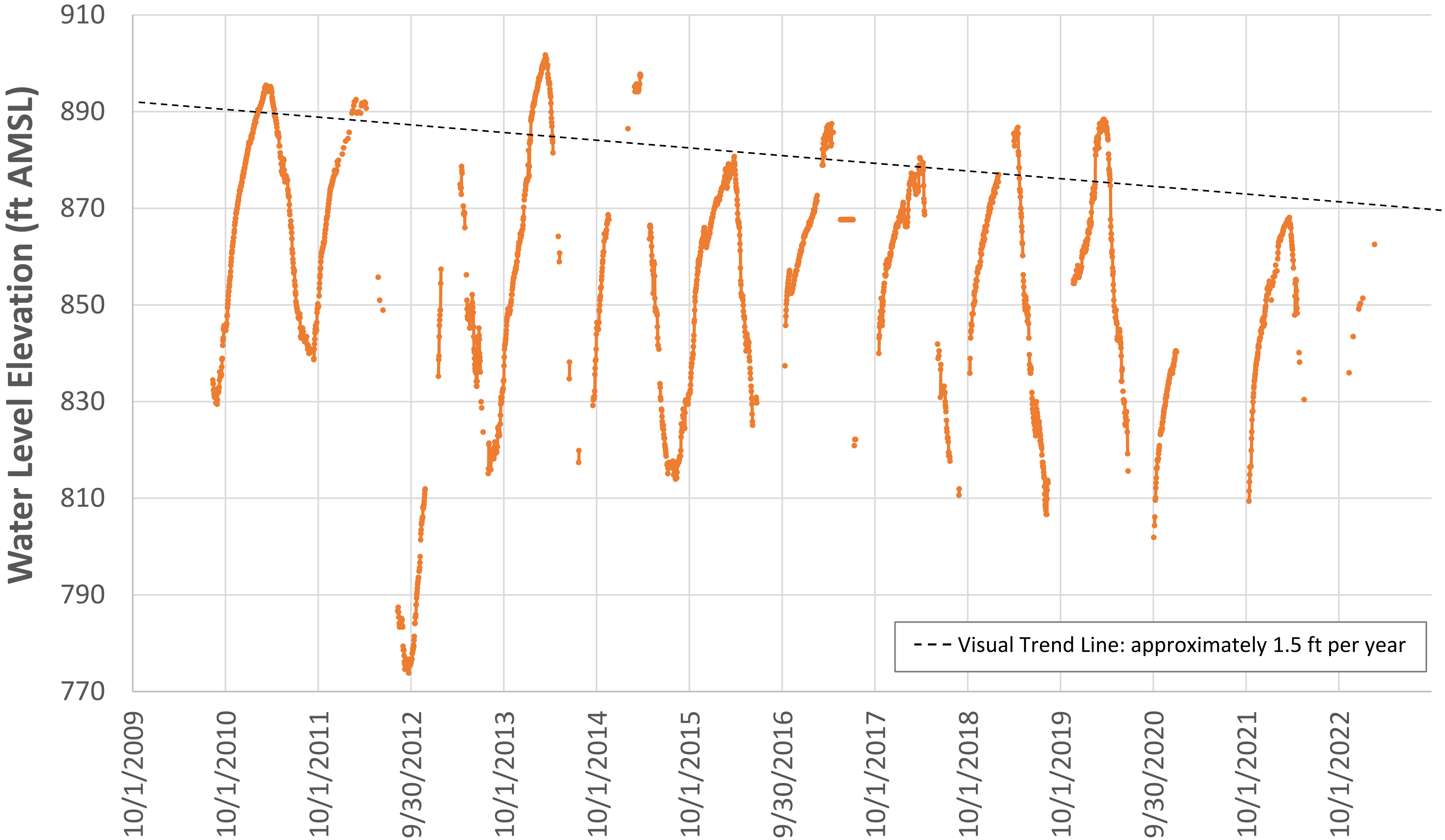
0 15 30
Miles

Note
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Sources: WADNR; Esri World Imagery.

LANDAU ASSOCIATES

Columbia Basin Sustainable Water Coalition Mid-Columbia Basin, Washington	**Columbia Basin Sustainable Water Coalition and Other Entity Monitoring Wells**	Figure 4



Notes

1) This plot includes water level elevation data recorded only while the pump was off and is therefore representative of background aquifer water levels.

2) A visual trend line was used to assess the approximate trend in off-season (i.e., winter, non-irrigation pumping season) peak water levels over time.

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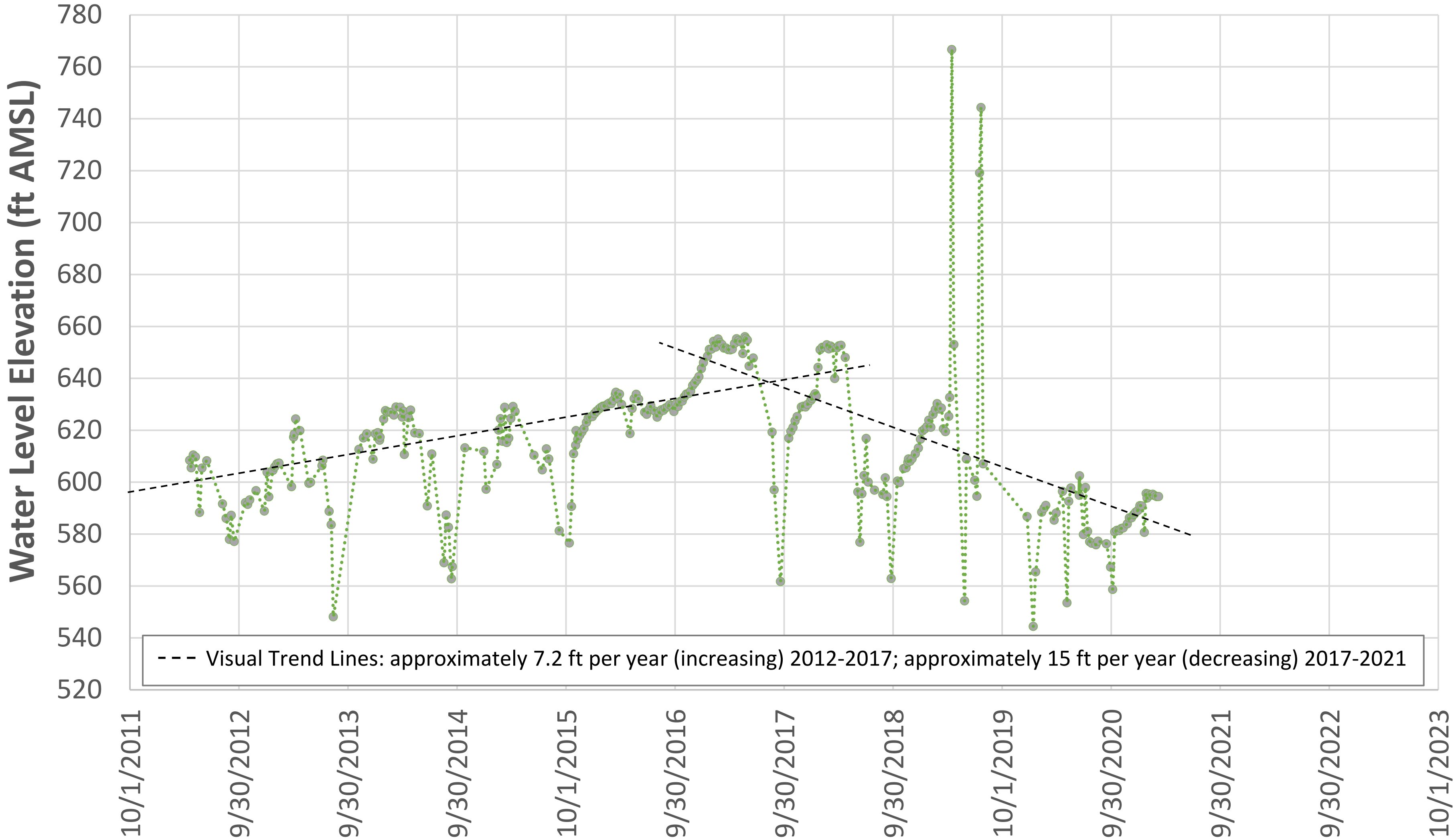
Columbia Basin Sustainable Water Coalition
Mid-Columbia Basin, Washington

City of Moses Lake Well #28 Hydrograph

Figure 5



Notes

1) This plot includes water level elevation data recorded only while the pump was off and is therefore representative of background aquifer water levels.

2) A visual trend line was used to assess the approximate trend in off-season (i.e., winter, non-irrigation pumping season) peak water levels over time.

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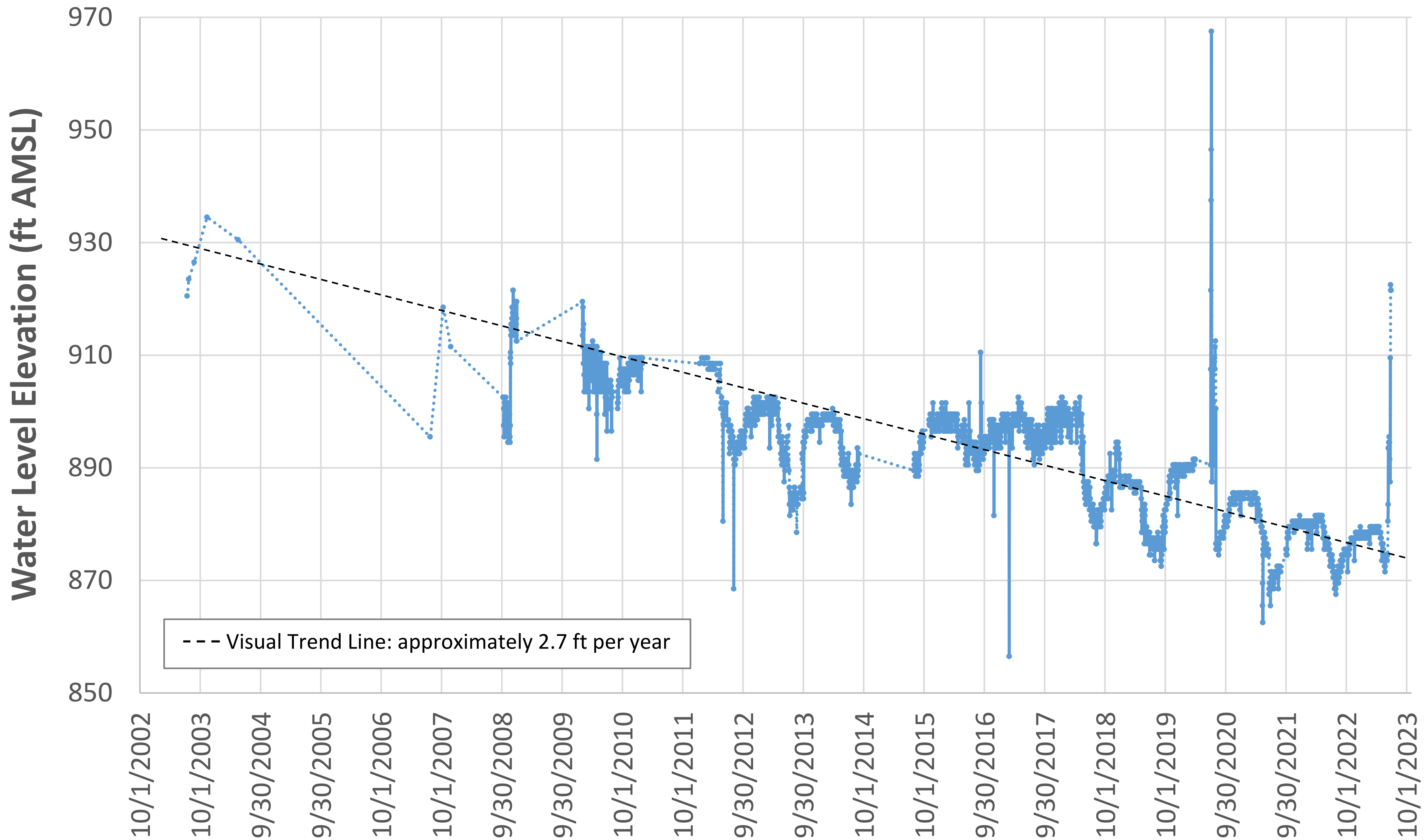
Columbia Basin Sustainable Water Coalition Mid-Columbia Basin, Washington	**City of Othello Well #8 Hydrograph**	Figure 6



Notes

1) This plot includes water level elevation data recorded only while the pump was off and is therefore representative of background aquifer water levels.

2) A visual trend line was used to assess the approximate trend in off-season (i.e., winter, non-irrigation pumping season) peak water levels over time.

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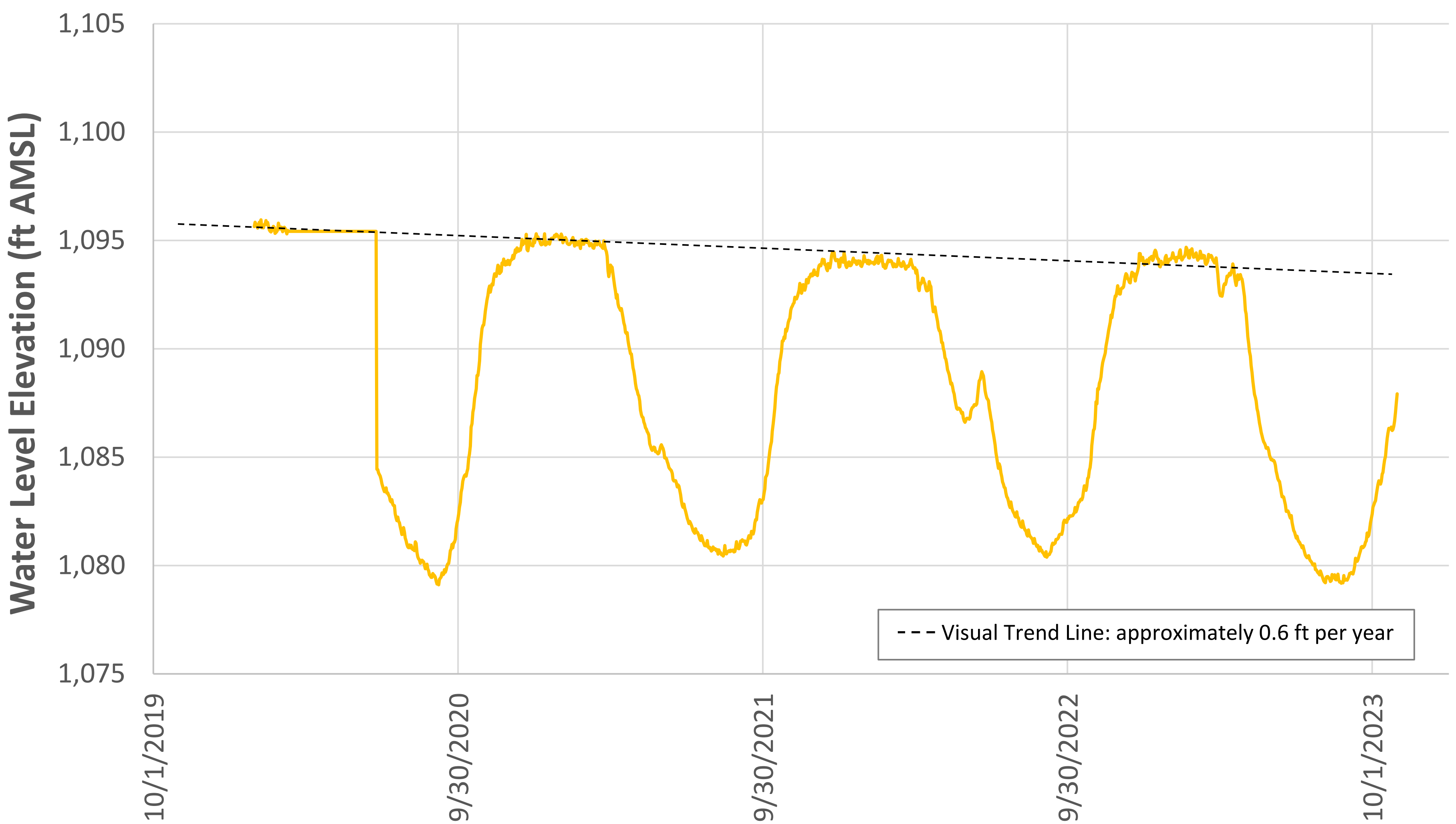
Columbia Basin Sustainable Water Coalition
Mid-Columbia Basin, Washington

Town of Lind Well #8 Hydrograph

Figure 7



Notes
1) This well is not fitted with a pump; therefore, the water level elevation data recorded is representative of background aquifer water levels.
2) A visual trend line was used to assess the approximate trend in off-season (i.e., winter, non-irrigation pumping season) peak water levels over time.

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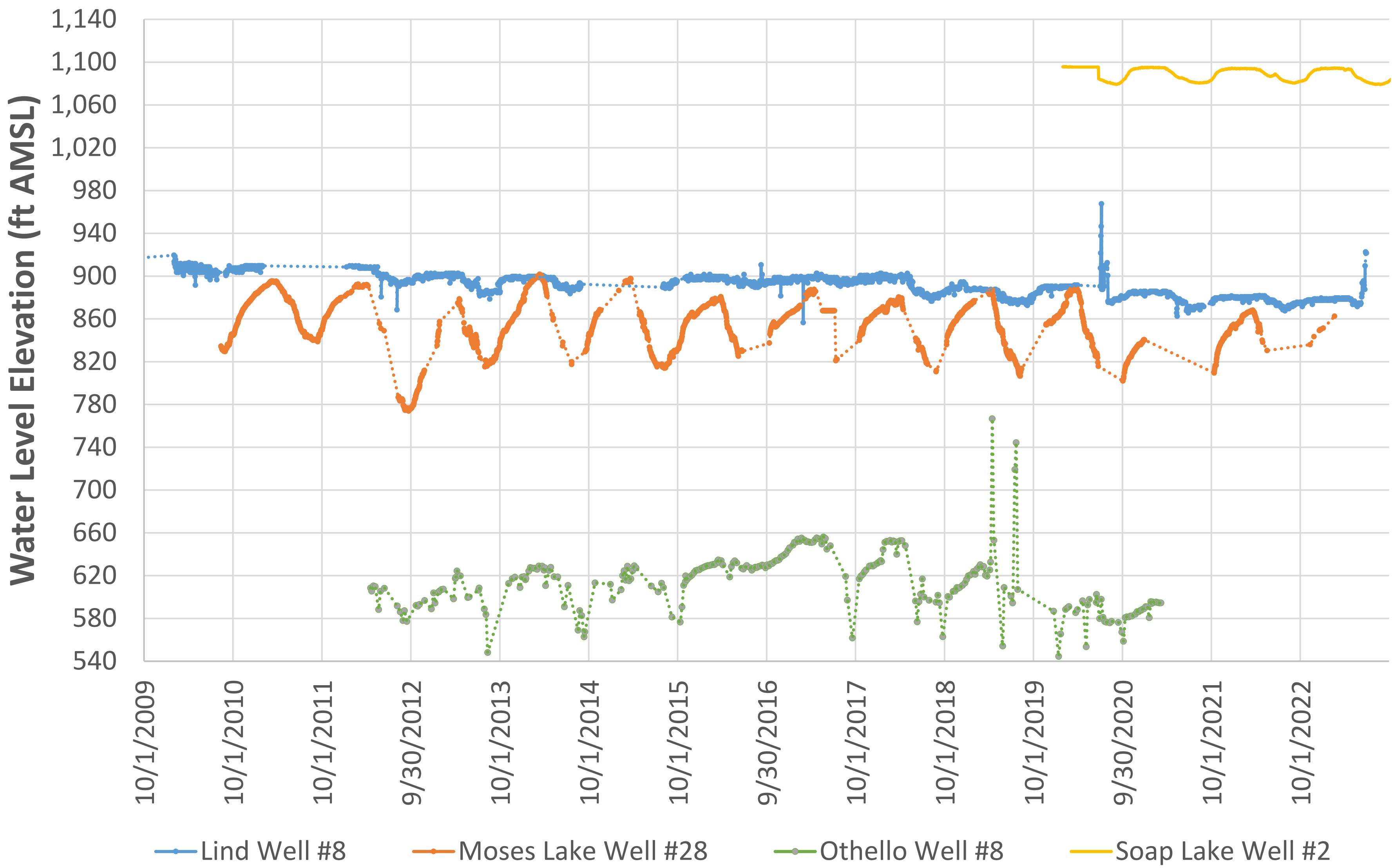
Columbia Basin Sustainable Water Coalition
Mid-Columbia Basin, Washington

Soap Lake Well #2 Hydrograph

Figure 8



Note: Graph excludes water level elevations recorded while respective pumps are on (Lind Well #8, Moses Lake Well #28, and Othello Well #8. The Soap Lake Well #2 does not have a pump installed).

LANDAU ASSOCIATES

Columbia Basin Sustainable Water Coalition Mid-Columbia Basin, Washington	**Combined Hydrographs**	Figure 9

Table 1
Columbia Basin Sustainable Water Coalition Monitoring Wells Summary
Preliminary Watershed Management Plan
Mid-Columbia Basin, Washington

Well Name	Approximate Ground Surface Elevation (ft AMSL) (a)	Depth of Perforated/Open Interval (ft bgs)		Elevation of Perforated/Open Interval (ft AMSL) (a)		Hydrogeologic Unit of Perforated/Open Interval (b)	Water Level Measurements		
		Top	Bottom	Top	Bottom		Date	Water Level Depth (ft bgs) (c)	Water Level Elevation (ft AMSL) (a) (d)
Connell Well #5	865	420	990	445	-125	Wanapum/Grande Ronde	3/9/2023	401.9	463.1
							5/4/2023	408.0	457.0
							11/17/2023	407.7	457.3
Mattawa Well #2	750	526	993	224	-243	Saddle Mt./Wanapum	3/15/2023	263.7	486.3
							11/17/2023	265.6	484.4
Quincy Well #6	1,322	110	241	1,212	1,081	Wanapum	3/15/2023	34.4	1,287.6
							5/4/2023	36.0	1,286.0
							11/17/2023	33.0	1,289.0
Quincy ASR Well	1,324	615	786	709	538	Grande Ronde	3/15/2023	506.0	818.0
							5/4/2023	506.4	817.6
							11/30/2023	515.9	808.1
Moses Lake Well #28	1,185	259	750	927	435	Wanapum/Grande Ronde	See Figure 5 Hydrograph		
Lind Well #8	1,351	720	2,034	631	-683	Grande Ronde	See Figure 6 Hydrograph		
Othello Well #8	1,076	204	853	873	223	Saddle Mt./Wanapum	See Figure 7 Hydrograph		
Soap Lake Well #2	1,159	95	435	1,064	724	Grande Ronde	See Figure 8 Hydrograph		

Notes:

a) The elevation datum used is from Google Earth (WGS84 EGM96) and is referred to generally and approximately as "above mean sea level" (ASML).

b) Hydrogeologic units to which each well is open (or perforated) were inferred based on a review of geologic structure contour maps from USGS SIR 2010-5246 (USGS 2011b), USGS WRI 87-4238 (USGS 1990), and CBGWMA (2009).

c) Depth to water measurements are taken in the field relative to the top of casing of each well. The well casing typically sticks up above ground (0.8 ft for Connell Well #5; 1.0 ft for Mattawa Well #2; 1.5 ft for Quincy Well #6; 4.4 ft for Quincy ASR Well). Depth to water measurements summarized here are converted to be relative to ground surface based on casingn stick-up height.

d) Water level elevations were based on depth to water readings taken by: E-tape measurements (Connell Well #5, Mattawa Well #2, Quincy Well #6), sonic meter measurements (Quincy ASR Well), aireline measurements (Lind Well #8), or pressure transducer (Moses Lake Well #28, Othello Well #8, Soap Lake Well #2) and converted to elevations based on Google Earth ground surface elevations of the well locations.

Abbreviations and Acronyms:

AMSL = above mean sea level
bgs = below ground surface
CBGWMA = Columbia Basin Groundwater Management Area
ft = feet
USGS = US Geological Survey

Table 2
Alternatives—Summary of Opportunies and Challenges
Preliminary Watershed Management Plan
Mid-Columbia Basin, Washington

ALTERNATIVES - PROJECTS	OPPORTUNITIES	CHALLENGES	COMMENTS
1. Odessa Groundwater Replacement Program (OGWRP)	-Reduces some pressure on aquifer (approximately 80,000 acres) -Secondary Use Permits (water rights) are approved -Permitted, designed, ready to implement -Funding for construction has momentum now	-Does not eliminate all pressure on aquifer (does not reach east) -Requires numerous pumping stations (against gravity) -Considered temporary stop-gap measure	-Will not be funded by CBSWC but is conceptually supported
2. Full Columbia Basin Project (CBP) Completion	-Reduces more pressure on aquifer (i.e., more groundwater replacement acreage than OGWRP) -Primarily gravity flow system (after main pumps) -Would add approximately 349,000 irrigated acres to CBP -Potential to serve communities to east (requires new conveyance)	-Does not eliminate pressure on aquifer (does not reach east) -Longer timeframe for implementation -Large cost -Requires additional Secondary Use Permits (water rights)	-Will not be funded by CBSWC but is conceptually supported
3. Water Conservation	-Can stretch existing supplies	-Difficult to implement (public perception) -Limited benefit	-Communities can do their part to stretch existing supplies for sustainable use
4. Aquifer Recharge by Passive Rehydration	-Adds water to system to recharge aquifers -Would allow use of existing municipal infrastructure -Would likely not require treatment	-Long timeframe for benefits (decades or hundreds of years) -Likely not 100 percent recovery of water (inefficient) -Would require a new/purchased water right authorization	-2012 pre-feasibility study showed that this is technically feasible, though challenging -May require legislative action for permitting
5. Aquifer Recharge by Deep Well Injection Network	-Adds water to system to recharge aquifers -Would allow use of existing municipal infrastructure -Could leverage existing wells (e.g., retired irrigation wells) for injection	-Moderate timeframe for benefits (decades) -Likely not 100 percent recovery of water (inefficient) -Would require a new/purchased water right authorization -Would require treatment prior to injection (under current regulations) -Would require new treatment and piping infrastructure -Difficult under current regulations	-May only make more sense compared to Alternate 5 IF the distribution piping network could be significantly smaller AND regulatory treatment requirements are lessened -May require legislative action for permitting
6. New SourceTreatment and Regional Distribution (Municipal and Industrial [M&I], Columbia River, Re-Use/Shallow groundwater)	-Brings in additional water -Near 100 percent efficiency -Water sources are currently available (Municipal and Industrial; Re-use) -Permitting pathway already well understood	-Would require new treatment and piping infrastructure -May be difficult to benefit communities far from canals/river/processors/shallow groundwater	-Multiple concepts are possible: Single (or small number of) large treatment plants and regional distribution system from one (or small number of) water source(s) OR multiple localized treatment and distribution systems from multiple water sources spaced throughout region; centralized treatment at/near source(s) or dispersed treatment at/near water systems -New sources may include: Direct Columbia River diversions; M&I water from CBP canals; food-processing re-use water; shallow artifically stored groundwater
ALTERNATIVES - TOOLS	**OPPORTUNITIES**	**CHALLENGES**	**COMMENTS**
1. Groundwater Monitoring	-Easy to implement -Relatively low cost (approximately $50,000 per year) -Provides solid data to support decision-making and public engagement	-Long-term funding for operational monitoring is challenging to secure	
2. Numerical Groundwater Modeling	-Could simulate future conditions scenarios	-Moderate cost (approximately $100,000 to $200,000) -Inherent uncertainties	-Numerical modeling usually comes with model uncertainties/error -Scale issues for specific questions (existing regional models have large grid cell sizes)
ALTERNATIVES - PLANNING	**OPPORTUNITIES**	**CHALLENGES**	**COMMENTS**
1. Coordinated Water System Planning	-Tool for limiting additional groundwater withdrawals	-Not well-geared toward project implementation	-This is more Washington Department of Health water system planning related
2. Groundwater Management Planning	-Geared toward project implementation -Technically-focused	-Not necessarily focused on multiple stakeholders (focused on groundwater stakeholders)	-This is potentially locally-driven effort (requiring targeted outreach for agency funding), with stakeholders being limited to groundwater users
3. Integrated Planning and Project Implementation	-Stakeholder engagement -Geared toward regional solutions for multiple parties -Focused on project implementation	-Potentially long timeframe for project implementations -Requires legislative funding for agency involvement and facilitation	-This is potentially more Washington State Department of Ecology (Ecology)-driven, opening up pathways for Ecology/Office of Columbia River or legislative funding
4. US Bureau of Reclamation (USBR) Basin Study	-Stakeholder engagement -Geared toward regional solutions for multiple parties	-USBR-driven (potentially limiting local control) -Focused on planning (less on project implementation)	-This is more USBR-driven, potentially limiting local control on results

Table 3
Alternatives—Scoring and Ranking
Preliminary Watershed Management Plan
Mid-Columbia Basin, Washington

	CRITERIA CATEGORIES											
	Extent of Benefit			**Type of Benefit**			**Timing of Benefit**			**Certainty of Benefit**		
Notes:	**Regional benefit is preferred over local benefit**			**Physical/tangible benefit is preferred over conceptual benefit**			**Near-term benefit is preferred over delayed benefit**			**Currently known/expected benefit is preferred over need for additional study to determine benefit**		
Alternatives - Projects	Scoring Criteria (1 to 5)	Weighting Multiplier (1 to 3)	Project Score (criteria X multiplier)	Scoring Criteria (1 to 5)	Weighting Multiplier (1 to 3)	Project Score (criteria X multiplier)	Scoring Criteria (1 to 5)	Weighting Multiplier (1 to 3)	Project Score (criteria X multiplier)	Scoring Criteria (1 to 5)	Weighting Multiplier (1 to 3)	Project Score (criteria X multiplier)
1. Odessa Groundwater Replacement Program (OGWRP)	4		12	4		12	4		8	5		10
2. Full Columbia Basin Project (CBP) Completion	5		15	5		15	1		2	5		10
3. Water Conservation	4		12	3		9	5		10	5		10
4. Aquifer Recharge by Passive Rehydration	4		12	4		12	1		2	3		6
5. Aquifer Recharge by Deep Well Injection Network	5		15	4		12	2		4	3		6
6. New Source Treatment and Regional Distribution	5		15	5		15	3		6	5		10
Alternatives - Tools	Scoring Criteria (1 to 5)		Tool Score (criteria X multiplier)	Scoring Criteria (1 to 5)		Tool Score (criteria X multiplier)	Scoring Criteria (1 to 5)		Tool Score (criteria X multiplier)	Scoring Criteria (1 to 5)		Tool Score (criteria X multiplier)
1. Groundwater Monitoring	4	3	12	3	3	9	5	2	10	4	2	8
2. Numerical Groundwater Modeling	5		15	2		6	3		6	3		6
Alternatives - Planning	Scoring Criteria (1 to 5)		Planning Score (criteria X multiplier)	Scoring Criteria (1 to 5)		Planning Score (criteria X multiplier)	Scoring Criteria (1 to 5)		Planning Score (criteria X multiplier)	Scoring Criteria (1 to 5)		Planning Score (criteria X multiplier)
1. Coordinated Water System Planning	4		12	1		3	3		6	2		4
2. Groundwater Management Planning	4		12	2		6	3		6	3		6
3. Integrated Planning and Project Implementation	5		15	2		6	2		4	4		8
4. USBR Basin Study	5		15	1		3	2		4	3		6

Table 3
Alternatives—Scoring and Ranking
Preliminary Watershed Management Plan
Mid-Columbia Basin, Washington

	CRITERIA CATEGORIES													
	Sustainability of Benefit			**Technical Implementability**			**Regulatory Implementability**			**Cost**				
Notes:	**Benefit that is sustainable over the long-term is preferred over benefit that is only short-term**			**Benefit that is easy to implement, from a construction and/or contracting perspective, is preferred over benefit that is difficult to implement**			**Benefit that is easy to permit or has a known permitting pathway is preferred over benefit that is difficult to permit or would require a novel permitting pathway**			**Lower cost is preferred over higher cost**				
Alternatives - Projects	Scoring Criteria (1 to 5)	Weighting Multiplier (1 to 3)	Project Score (criteria X multiplier)	Scoring Criteria (1 to 5)	Weighting Multiplier (1 to 3)	Project Score (criteria X multiplier)	Scoring Criteria (1 to 5)	Weighting Multiplier (1 to 3)	Project Score (criteria X multiplier)	Scoring Criteria (1 to 5)	Weighting Multiplier (1 to 3)	Project Score (criteria X multiplier)	**Total Project Alternative Score**	**Project Alternative Rank**
1. Odessa Groundwater Replacement Program (OGWRP)	5		15	3		6	5		5	2		2	**70**	**1**
2. Full Columbia Basin Project (CBP) Completion	5		15	2		4	1		1	1		1	**63**	**4**
3. Water Conservation	3		9	5		10	4		4	4		4	**68**	**3**
4. Aquifer Recharge by Passive Rehydration	3		9	2		4	3		3	2		2	**50**	**6**
5. Aquifer Recharge by Deep Well Injection Network	3		9	2		4	2		2	2		2	**54**	**5**
6. New Source Treatment and Regional Distribution	4		12	3		6	3		3	2		2	**69**	**2**
Alternatives - Tools	Scoring Criteria (1 to 5)		Tool Score (criteria X multiplier)	Scoring Criteria (1 to 5)		Tool Score (criteria X multiplier)	Scoring Criteria (1 to 5)		Tool Score (criteria X multiplier)	Scoring Criteria (1 to 5)		Tool Score (criteria X multiplier)	**Total Tool Alternative Score**	**Tool Alternative Rank**
1. Groundwater Monitoring	4	3	12	4	2	8	5	1	5	4	1	4	**68**	**1**
2. Numerical Groundwater Modeling	3		9	4		8	5		5	3		3	**58**	**2**
Alternatives - Planning	Scoring Criteria (1 to 5)		Planning Score (criteria X multiplier)	Scoring Criteria (1 to 5)		Planning Score (criteria X multiplier)	Scoring Criteria (1 to 5)		Planning Score (criteria X multiplier)	Scoring Criteria (1 to 5)		Planning Score (criteria X multiplier)	**Total Planning Alternative Score**	**Planning Alternative Rank**
1. Coordinated Water System Planning	4		12	3		6	3		3	3		3	**49**	**4**
2. Groundwater Management Planning	4		12	3		6	3		3	3		3	**54**	**2**
3. Integrated Planning and Project Implementation	5		15	2		4	3		3	2		2	**57**	**1**
4. USBR Basin Study	4		12	3		6	3		3	2		2	**51**	**3**

Scoring Criteria for each Alternative, if implemented:
1: Poor; Does not achieve any of CBSWC's Objectives
2: Fair; Only achieves a small part of CBSWC's Objectives
3: Good; Achieves Some of CBSWC's Objectives
4: Very Good; Achieves Most of CBSWC's Objectives
5: Excellent; Achieves All of CBSWC's Objectives

Weighting Multiplier for Criteria Category Relative Importance
1: Low Priority
2: Moderate Priority
3: High Priority