WaterSMART Drought Response Program: Drought Resiliency Projects for Fiscal Year 2017

Building long-term resiliency to drought by employing riverbank filtration to improve water quality

Applicant:
Big Bend Water District
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Executive Summary

Date: February 14, 2017
Applicant: Big Bend Water District
Laughlin, Clark County, NV

All of the Big Bend Water District's (BBWD) drinking water comes from the Colorado River via an intake that draws river water into a direct filtration plant. Prolonged drought, climate change and other factors have negatively affected the river's water quality, including the production of high levels of trihalomethanes (THM), turbidity and algal growth. Although the BBWD water treatment plant has significant disinfection capabilities, its direct filtration process is being severely challenged by the river's variable water quality conditions.

In response, the BBWD proposes to employ riverbank filtration (RBF) as a pretreatment step before water enters the treatment facility. RBF is a natural process that has been used by public water supplies in the United States for half a century and has been successfully employed by Lake Havasu City, Arizona, located just downstream of Laughlin on the Colorado River. The proposed RBF project will require the construction of a well located adjacent to the Colorado River. Aquifer sediments will act as a natural filter removing various contaminants as the Colorado River recharges the groundwater. The RBF process has been proven to be effective in treating various constituents of concern, such as turbidity, pathogens, organic matter (i.e., THM precursors), algae, algal toxins, and trace organic contaminants. RBF will provide long-term resiliency for the BBWD water treatment system and thus avoid any future water quality crises that may otherwise occur.

The total estimated cost of the project is $1,308,317.36. The BBWD is requesting grant funding in the amount of $300,000 and is prepared to provide a matching contribution of $1,008,317.36. The Project is estimated to take approximately 14 months to complete. The estimated start date is September 1, 2017 with a tentative completion date of November 30, 2018.

The proposed project is not located on a Federal facility.

Task Area
This Project falls under Task A: *Increasing the Reliability of Water Supplies through Infrastructure Improvements* by constructing an emergency well to provide back-up water supplies and improved water quality to counteract the effects of drought.

Background Data
The Big Bend Water District (BBWD) is a publicly-owned water utility created by the Clark County Board of Commissioners in 1983 to supply water to Laughlin, Nevada. The Town of Laughlin is located approximately 90 miles south of Las Vegas, NV in the Mojave Desert, along the banks of the Colorado River (See Appendix A - Map).

The BBWD is governed by a Board of Trustees, which has jurisdiction over all its affairs and has the sole responsibility to establish rates, and set rules for the use, sale and distribution of water within its service area. The Las Vegas Valley Water District (LVVWD) is the operating agent for the BBWD through an agreement with the Big Bend Water District Board of Trustees. As part of that agreement, the LVVWD operates and maintains BBWD facilities. The BBWD is also one of the seven member agencies that comprise the Southern Nevada Water Authority (SNWA), a cooperative agency formed in 1991 to address Southern Nevada's unique water needs on a regional basis.

The BBWD serves approximately 9,000 residents and businesses. Its system maintains 2,111 service accounts (1,802 residential and 309 non-residential). The BBWD includes approximately 60 miles of service lines, close to 315 hydrants and four storage tanks. The BBWD water treatment facility can treat up to 15 million gallons of water per day (MGD), and the water-distribution system has a storage capacity of six million gallons.

The sole water source for the BBWD is the Colorado River. Through a delivery contract with the Department of the Interior, the BBWD has an annual Colorado River diversion right of 10,000 acre-feet. As a member agency of the SNWA, the BBWD also has a right to water under the SNWA's 1995 Cooperative Agreement, which allocates an additional 5,352 acre-feet per year to the BBWD for a total 15,352 acre-feet per year. Water is used primarily for domestic and municipal purposes. In addition to domestic water users, the BBWD supports a large number of visitors to the Laughlin resort and hotel industry. The current maximum day water demand is estimated at 19.8 acre-feet (6.46 MGD), the projected maximum day water demand including approved development is estimated at 20.7 acre-feet (6.74 MGD) and the projected maximum day water demand, including approved and proposed development, is estimated at 47.5 acre-feet (15.48 MGD).

The Bureau of Reclamation (Reclamation) awarded a $1 million WaterSMART Water and Energy Efficiency grant to the BBWD in September 2010 to support service line replacements, electrical upgrades and the replacement of pond lining at the water treatment facility. Also, Reclamation awarded a $300,000 WaterSMART Water and Efficiency grant to the BBWD in September 2011 to support leak detection and filter flow meters for the distribution system.

Project Description

The Colorado River, which is experiencing the worst drought on record and negative effects of climate change, provides the only potable water source for Laughlin, Nevada through an intake below Davis Dam. The BBWD water treatment facility has a treatment capacity of 15 million gallons per day (MGD) and can store up to 6 million gallons of water for later use. The BBWD treatment facility is a direct filtration plant with significant disinfection capabilities for removing pathogens. The treatment train follows the following order: ozone (0.25 mg/L), coagulation with ferric (0.8 mg/L), flocculation, filtration, ultraviolet disinfection (45 mJ/cm^2) and chlorination (1.5 mg/L at the finished water clearwell) (See Appendix B – Treatment Process).

The Colorado River has been experiencing variable water quality, especially during rain events that are linked to warmer temperatures caused by climate change. Normal levels of turbidity for the BBWD fall within the range of 1 - 2 nephelometric turbidity units (NTU). Rain events can cause the turbidity level to increase to the 5 - 10 NTU range, and intense storms can cause the turbidity to surge anywhere between 200 – 1000 NTUs. In 2015, turbidity levels spiked as high as 850 NTU, which is more than the BBWD's direct filtration plant was able to treat and resulted in a boil water notice issued to Laughlin residents and businesses.

Of additional concern, is the formation of THMs in the finished water produced by the BBWD water treatment facility. THMs are formed as the product of chlorine reacting with organic matter that is not removed by the direct filtration treatment process. The United States Environmental Protection Agency (EPA) sets a regulatory limit of 80 parts per billion (ppb) for total THMs. As a result of increased water temperature, bromide and organic matter in the source water, the BBWD's total THM level has reached up to 60 to 75 ppb – dangerously close to the EPA's regulatory limit. Extreme rain events have also led to higher levels of organic matter in the water and thus higher total THM levels.

It has been observed that drought conditions have decreased water flow and volume in Lake Mead, the Colorado River's largest reservoir, causing steady increases in water temperature, bromide, and total organic carbon (TOC) (Roefler et al., 2005; Veley and Moran, 2012). These water quality changes have the potential to be similar for BBWD intake water, since Lake Mead is its source (~65 miles upstream). Modeling performed for a Reclamation WaterSmart Grant (Flow Science, 2013) predicts Lake Mead surface water levels continue to drop due to sustained drought, increases in temperature, bromide, and TOC will most likely lead to an increased total THM levels and staying below the EPA's regulatory limit of 80 ppb will become increasingly difficult.

Algal blooms are also a concern as they have been observed near the BBWD intake and have the potential to produce algal toxins that are harmful to both humans (consumption via recreation or finished drinking water) and aquatic species. In March, 2015, Microcystis cyanobacteria and the toxin it produces (microcystin) were detected in Lake Mohave in the Colorado River just upstream of the BBWD water intake. Since that initial detection, Microcystis and microcystin have been measured repeatedly in Lake Mohave typically found near the surface of the water. Although ozone disinfection is a barrier against algal toxins, they present another water quality concern to monitor.

If the drought and climate change continue, it is expected that unwanted water quality changes will lead to harmful algal blooms, rising levels of regulated THMs in finished drinking water and more boil order notices for the Laughlin community, which has no other water source available to them.

A solution to this problem is river bank filtration (RBF), a natural process that has been used for public and industrial water supplies in Europe for more than a century and for half a century in the United States (Drewes et al. 2009). RBF would use a high capacity well adjacent to the Colorado River. RBF system would effectively utilize river water that has been naturally filtered by the geologic material located between the well and the river. The aquifer sediments act as a natural

filter removing various contaminants as river water recharges groundwater, either naturally or through inducement by pumping wells.

The process has been shown to be effective in moderating the peak concentrations of various constituents of concern [i.e., turbidity, pathogens, organic matter (i.e., THM precursors), algae, algal toxins, trace organic contaminants] present in river or lake water (Drewes et al. 2009). RBF will provide long-term resiliency for the BBWD and the avoidance of any future water quality crises that may occur (See Appendix C – Riverbank Filtration).

The performance of riverbank filtration systems depends upon well type and pumping rates, travel time of surface water between the river and the extraction wells, source water quality, site hydrogeology, biochemical reactions in sediments and aquifer. Lake Havasu City, Arizona, is approximately 50 miles downstream of Laughlin and successfully employs RBF as pretreatment for their drinking water treatment system. Lake Havasu City uses a horizontal collector well that is capable of producing 26 MGD as its primary source of drinking water. Their groundwater supply draws water from the Colorado River aquifer with an annual allocation of 28,581 acre-feet or 9.3 billion gallons of water a year. In Laughlin, a RBF system could be activated during short-term rainstorm events or algal blooms or, if background organic matter levels continue to rise, for the long-term like Lake Havasu City. This would allow for low-turbidity and Microcystis containing water and reduced organic matter levels to be delivered to the existing BBWD water treatment process.

In order to complete the proposed project, the following phases will be undertaken:

Scope Development/Site Assessment
The proposed location of the well has been identified as a site along the banks of the Colorado River near the current intake used by the BBWD water treatment facility (Figure 1). The study area is typical of the Basin and Range Province (Feneman, 1931) with north-south trending mountain ranges separated by basins in between. The basins are filled with alluvial material shed from the surrounding ranges. The study area is within Mohave Valley which is bounded to the north and west by the Newberry Mountains and to east by the Black Mountains. Geologic maps of the study area and vicinity have been published by the Nevada Bureau of Mines and Geology (Faulds et al., 2000; Faulds et al., 2004). The Faulds et al. (2004) publication is a preliminary geologic map that is similar to the earlier Faulds et al. (2000) publication, but includes the surficial geology on the Arizona side of the Colorado River as well. The geology of the study area is shown in Appendix D. The proposed well location and the city of Laughlin are located along the floodplain of the Colorado River and in an area of alluvial fan deposition. The floodplain was the active floodplain of the river prior to the construction of the upstream dams (Davis and Hoover) and has effectively been isolated from current river deposition by regulations of flows from the dams. The alluvial fans are comprised of easily erodible granitic material being shed from the Newberry Mountains. The alluvial fans interfinger with well-rounded gravels, sands, and silts, deposited by the Colorado River (Faulds, 2000). For the proposed well location the well may encounter Colorado River floodplain silts, sands, and gravels and/or decomposed granitic material shed from the Newberry Mountains to the west. While the available data may indicate a possibility

of encountering granitic bedrock at depth, it is believed that this would not be encountered at the shallow depths proposed for the vertical well.

Prior to the start of well construction, a search will be conducted for geotechnical borings that may have been installed within the area to support construction of the nearby bridge over the Colorado River. Deep borings in this area may provide valuable information as to the nature of the subsurface at this location prior to the commencement of drilling activities.

The available hydrogeologic data for the study area indicate a shallow depth to water at the proposed location. It is anticipated that the depth to water would be anywhere from 15 to 25 ft deep, and would correspond to the stage of the Colorado River.

Figure 1 Proposed project area and work site adjacent to the Colorado River.

Secure Permits

- Will obtain drilling and construction permits.

Well Design

- Develop and review specifications (including SCADA), installation drawings, and bid documents for the project.
- A vertical well with a capacity of 5,600 gpm will be designed. See Appendix E for proposed well specifications.

Bid Drilling Portion of Project

- During this phase the bid documents will be submitted and the bid will be awarded.

Drill and Test Bore-Hole

- The site will be prepared and geophysical testing will be performed.
- The well construction will begin with the drilling of a pilot borehole whereby additional geologic information may be acquired. The relatively low cost, pilot borehole may be abandoned if the hole looks unsuitable for use as a production well or reamed to a larger diameter to accommodate the construction of a production well.
- Drill the production borehole
- Install test pump assembly and test the borehole.
- Drilling and construction will be in accordance with all Federal, state, and local laws, regulations and codes.

Well Completion/Well Site Work

- Complete the construction of the well.

Pump, Motor, and MCC Order/ Pump Test the New Well

- Pump equipment will be ordered.
- Perform pump development and aquifer testing.

Install SCADA Communications

- Develop and test SCADA interface.

Evaluation of Treatment Performance

- The performance of the BBWD water treatment system will be assessed by monitoring turbidity and THM precursor (i.e., total organic carbon) levels before and after RBF is employed. The monitoring periods will likely capture treatment performance during rain events, as well.

Performance Measures

Riverbank filtration will provide treatment reliability so that all future water delivered by the BBWD will meet or surpasses all State of Nevada and Federal Safe Drinking Water Act standards, particularly for turbidity limits (i.e., pathogen control) and TTHM levels. In addition, RBF will

provide a redundant barrier (along with ozone) for the treatment of algal toxins that are yet to be regulated. RBF will provide additional side benefits for direct removal of pathogens and unregulated trace organic contaminants of concern, such as pharmaceuticals. To evaluate the RBF effectiveness, treatment performance for the BBWD water treatment system will be evaluated with and without the RBF, where targeted water quality analytes (i.e., turbidity, total organic carbon, THMs, algal toxins) will be measured after each process throughout the train of each scenario.

Evaluation Criteria

Criterion A – Project Benefits

Up to 40 points may be awarded based on the expected drought resiliency benefits of the proposed project. Proposals containing a well-supported and detailed description of both quantifiable and qualitative benefits will receive the most points under this criterion. For projects that do not make additional water supplies available, please describe how the project will improve water management. For projects that make additional water supplies available AND improve water management, please respond to all questions under this criterion.

Will the project make additional water supplies available? No.

- *How will the project build long-term resiliency to drought? How many years will the project continue to provide benefits?* RBF will provide long-term resiliency for the BBWD by acting as a pretreatment against high levels of THMs, turbidity and algal blooms. It will make water available to Laughlin water users during climate-induced rain events and allow the BBWD to avoid future water quality crises that may occur. The estimated lifespan of the RBF well is 25 years.

- *How will the project improve the management of water supplies? For example, will the project increase efficiency, increase operational flexibility, or facilitate water marketing (e.g., improve the ability to deliver water during drought or access other sources of supply)? If so, how will the project increase efficiency or operational flexibility?* The project will improve operational flexibility, providing safe drinking water to the BBWD even during times when the Colorado River's water is affected by climate change and drought.

- *Will the project make new information available to water managers? If so, what is the information and how will it improve water management?* This project will not make new information available to water managers.

- *Will the project have benefits to fish, wildlife, or the environment? If so, please describe those benefits.* This project will not benefit fish, wildlife or the environment.

- *Provide a brief qualitative description of the degree/significance of anticipated water management benefits.* The proposed project will improve Southern Nevada's drought resiliency by allowing the BBWD to treat seasonal and long-term deteriorating water

quality resulting from the Colorado River source water, such as turbidity spiking events and algal blooms in the Colorado River and continually rising THM levels within finished drinking water. Although the proposed project will not make any additional water supplies available, it will allow the BBWD to manage, use and treat Colorado River water that might otherwise be unsuitable for human consumption. Riverbank filtration will provide long-term treatment resiliency and thus avoid any future water quality crises that may otherwise occur.

- *What is the estimated capacity of the new well, and how was the estimate calculated?* A typical storm event could last for a couple of days and the production rates during the rainy season could be 8 MGD. This means that the well will need to produce up to 8.0 MGD (5,600 gpm). The flow requirements can be less [i.e., 5.8 MGD (4,000 gpm)], if need be, with public outreach and storage.

- *How much water do you plan to extract through the well?* Approximately up to 76 acre-feet would be extracted over a 3-day storm event. If the well is permanently placed online, approximately 8,943 acre-feet of water would be extracted per year.

- *Will the well be used as a primary supply or supplemental supply when there is a lack of surface supplies?* It will be used as a primary supply.

- *Please provide information documenting that the proposed well will not adversely impact the aquifer it will pump from. At a minimum, this should include aquifer description, information on existing or planned aquifer recharge facilities, a map of the well location and other nearby surface water supplies, and physical descriptions of the proposed well (depth, diameter, casing description, etc.). If available, information should be provided on nearby wells (sizes, capabilities, yields, etc.), aquifer test results, and if the area is currently experiencing aquifer overdraft or land subsidence.* The proposed new well is not expected to adversely impact the aquifer it will pump from, since it is under the direct influence of the Colorado River. Available well data were compiled for existing and abandoned wells near the location of the proposed Big Bend Water District well. Data were compiled from the United States Geological Survey's (USGS) National Water Information System database as well as the Nevada Division of Water Resources (NDWR) Well Driller's Reports (USGS, 2017; NDWR, 2017). Appendix F shows the location of the existing wells and Appendix G contains a summary of the available well construction information. The types of information collected for the wells includes approximate location, hole depth, casing size, perforation interval, and water levels. Water levels within the study area range from approximately 6 to 212 feet below ground surface (ft-bgs) and generally increase the further the well is located from the river. Water levels near the Colorado River tend to range from 12 to 24 ft-bgs (Appendix G). The well performance information found on Well Driller’s Reports within the study area is presented in Appendix H. There were 8 well logs within the study area that identified well performance characteristics including discharge, drawdown, and specific capacity. The majority of wells were tested at rates less than 200 gallons per minute and generally had fairly significant drawdowns for the minor discharge rates. Specific capacities for all

but one well were less than 5 gallons per minute per foot of drawdown (gpm/ft of drawdown). The one exception was Big Bend Well 2 Area 1 (Log No. 27137), which had a specific capacity of 77. It is expected the new proposed well will have comparable specific capacity as the existing Big Bend Well 2 Area 1 well, since both are expected to have similar lithology. This specific well is located at Site ID 18 along the riverbank approximately 0.8 miles south of where the current well is planned. According to the Well Driller's Report, the Big Bend Well 2 Area 1 well was constructed as a 24-inch borehole, drilled to a depth of 120 feet-bgs, and screened from 70 to 110 ft-bgs. The well encountered, from top to bottom, sands, sands and gravels, cobbles, cemented sands, and gravels, cobbles, and boulders. The well was pumped at a rate of 2,850 gpm and had a drawdown of 36 ft 10.5 in. after a period of 48 hours. This well is owned by BBWD, but the capacity is less than the target of 5,600 gpm. A diagram and specifications of the proposed new well is presented in Appendix E.

- *Please describe the groundwater monitoring plan that will be undertaken and the associated monitoring triggers for mitigation actions. Describe how the mitigation actions will respond to or help avoid any significant adverse impacts to third parties that occur due to groundwater pumping.* Since adverse impacts are not expected there will not be a monitoring plan.

Criterion B – Drought Planning and Preparedness

Up to 20 points may be awarded for a proposal based on the extent that the proposed drought resiliency project is supported by an existing drought plan. Such drought plans do not require Reclamation approval and may include plans prepared by someone other than the applicant.

For purposes of evaluating this criterion, please:

Attach a copy of the applicable drought plan, or sections of the plan, as an appendix to your application. Explain how the applicable plan addresses drought. Proposals that reference plans clearly intended to prepare for and address drought will receive more points under this criterion. The SNWA's 2015 Water Resource Plan provides a comprehensive overview of water resources and demands in Southern Nevada. It discusses factors that will influence resource availability and use over a 50-year planning horizon -- such as protracted drought. It serves as the drought planning document for the SNWA and its member agencies and is attached as Appendix I. The SNWA's 2015 Water Resource Plan also serves as a companion to other detailed planning documents, such as the SNWA's Water Conservation Plan (2014-2018). The Water Conservation Plan promotes more efficient water and addresses limited resource availability caused, in part, by drought conditions. The Conservation Plan is attached as Appendix J.

Explain whether the drought plan was developed with input from multiple stakeholders. Was the drought plan developed through a collaborative process? The SNWA's Water Resource Plan is reviewed annually by technical representatives from each of the SNWA's seven member agencies. Those representatives are invited to collaborate on the document by providing input and feedback to create a comprehensive document that considers the current and future water resource needs for all of Southern Nevada.

In addition, both the LVVWD and SNWA have established traditions of seeking public input on initiatives with community impacts, and often use advisory committees to seek recommendations to guide decision-making. Panels convened by both agencies have explored and deliberated over a wide range of issues, including the development of water resources to ensure Southern Nevada's future despite extended periods of drought and climate change.

By way of example, in 2012, the SNWA Board of Directors initiated an integrated resource planning process that included the formation of the Integrated Resource Planning Advisory Committee, comprised of diverse stakeholder groups throughout the Southern Nevada community. The 21-member committee was formed to provide recommendations on key organizational concerns, such as resources, drought, conservation, water quality and funding. The committee met between 2012 and 2014 and concluded, among other things, that "the risk of Lake Mead's elevation falling below 1,000 feet [due to drought and climate change] is not acceptable to the community due to the potential impacts on water delivery and resource availability." All of the committee recommendations were adopted by the SNWA's Board of Directors and integrated into the 2015 Water Resource Plan. Among those recommendations was the affirmation of projects intended to address the effects of long-term drought.

- *Does the drought plan include consideration of climate change impacts to water resources or drought?* Yes.

Describe how your proposed drought resiliency project is supported by an existing drought plan. Although the proposed drought resiliency project is not specifically mentioned in the 2015 Water Resource Plan, the plan does address the need to construct and/or expand facilities and infrastructure to meet the community's current and long-term water resource needs.

- *Does the drought plan identify the proposed project as a potential mitigation or response action?* No. The Drought Plan does not make specific reference to this project.

- *Does the proposed project implement a goal or need identified in the drought plan?* The 2015 Water Resource Plan discusses the potential impacts of continued drought and climate change on water resource availability, particularly for the Colorado River. It describes a flexible portfolio approach to water management that includes permanent, temporary and future resources and includes the need to construct additional infrastructure, when necessary.

- *Describe how the proposed project is prioritized in the referenced drought plan?* The construction and operation of water facilities and infrastructure is a high priority of the 2015 Water Resource Plan.

Criterion C – Severity of Actual or Potential Drought Impacts to be Addressed by the Project
Up to 20 points may be awarded based upon the severity of actual or potential drought impacts to be addressed by the project. Proposals that address more urgent needs and more severe drought

impacts will receive higher priority consideration on this criterion than proposals that address less significant needs and impacts.

Describe the severity of the impacts that will be addressed by the project:

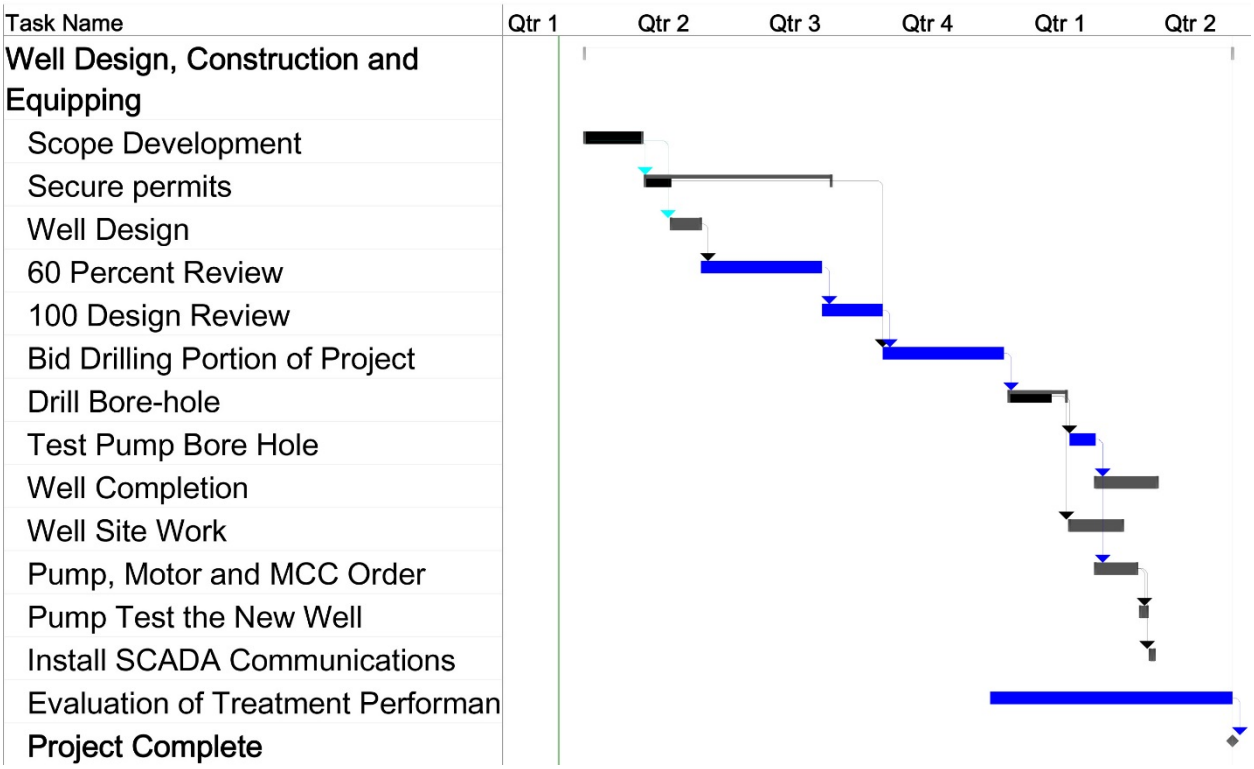
Beginning in 1999, the Colorado River Basin began experiencing record-setting drought conditions, which substantially reduced water levels in Lake Mead. In fact, as a result of the lowest 15-year period Colorado River inflows in over 100 years of record keeping (BOR 2016), Colorado River system reservoir content declined to 49 percent of capacity by the beginning of Calendar Year 2015 (BOR 2017). During the same period, Lake Mead's elevation declined by more than 125 feet and reached record lows.

The drought conditions and climatic changes have resulted in various water quality changes in Lake Mead and the Colorado River in Laughlin, Nevada. If the drought continues, it is expected that severe water quality will continue, such as increasing potential of harmful algal blooms and release of algal toxins (with established EPA health advisory levels), rising levels of regulated THMs in finished drinking in Laughlin (levels would likely exceed the maximum contaminant level allowable), and more frequent rainy events resulting in overloading of particles into the treatment facility potentially leading to more boil order notices for the community, as well as high THMs in finished drinking in Laughlin. This is the only potable water source for the city of Laughlin, therefore the community does not have another water source available to them if their water service is interrupted. Riverbank filtration will provide long-term resiliency for BBWD water treatment system and thus avoid any future water quality crises that may otherwise occur.

Criterion D – Project Implementation

Up to 10 points may be awarded based upon the extent to which the proposed project is capable of proceeding upon entering into a financial assistance agreement. Applicants that describe a detailed plan (e.g., estimated project schedule that shows the stages and duration of the proposed work, including major tasks, milestones, and dates) will receive the most points under this criterion.

Describe the implementation plan of the proposed project. Please include an estimated project schedule that shows the stages and duration of the proposed work, including major tasks, milestones, and dates. The BBWD is ready to begin project implementation if an Assistance Agreement is provided by Reclamation. The following graphic depicts proposed project scheduling:



From the date of award to the final project closeout, this project is expected to take 14 months to complete. Assuming a September 1, 2017 start date, the estimated date of completion is November 30, 2018.

Describe any permits that will be required, along with the process for obtaining such permits. A 1988 Nevada Attorney General Opinion concluded that there is no legal requirement for BBWD to obtain a State Engineer permit to appropriate Colorado River water. However, we will need to obtain a drilling permit and a construction permit.

Identify and describe any engineering or design work performed specifically in support of the proposed project. A vertical well with a capacity of 5,600 gpm will be designed. See Appendix E for proposed well specifications.

Describe any new policies or administrative actions required to implement the project. None.

Criterion E – Nexus to Reclamation

Up to 10 points may be awarded based on the extent that the proposal demonstrates a nexus between the proposed project and a Reclamation project or activity. Describe the nexus between the proposed project and a Reclamation project or activity, including:

How is the proposed project connected to a Reclamation project or activity? The BBWD is a member agency of SNWA and under the umbrella of SNWA's water management and conservation efforts. Reclamation is a critical partner of SNWA where SNWA diverts 90 percent of its water supply from the Reclamation managed Colorado River system. The SNWA receives delivery of Colorado River water from Reclamation under several contracts held by the SNWA or its member agencies, as listed below:

SNWA Contracts:

- Contract Number 2-07-30-W0266, Amendment Number 1, Amended and Restated Contract with the Southern Nevada Water Authority, for the Delivery of Colorado River Water
- Contract Number 7-07-30-W0004, Amendatory and Supplemental Contract between the United States and the State of Nevada for the Delivery of Water and Construction of Project Works

SNWA Member Agency Contracts:

- Contract Number 14-06-300-978, "Boulder Canyon Project Arizona-California-Nevada Contract for the Delivery of Water," City of Boulder City
- Contract Number 0-07-30-W0246, Contract for Delivery of Water to City of Henderson
- Contract Number 14-06-300-2130, "Boulder Canyon Project Contract for Delivery of Water to Las Vegas Valley Water District"
- Contract Number 2-07-30-W0269, "Boulder Canyon Project Contract with the Big Bend Water District, Nevada, for the Delivery of Colorado River Water"

Will the project help Reclamation meet trust responsibilities to any tribes? Not applicable.

Does the applicant receive Reclamation project water? Yes.

Is the project on Reclamation project lands or involving Reclamation facilities? The water delivered by the SNWA under the above-referenced contracts is diverted at Reclamation approved diversion points in the Colorado River at Lake Mead and below Hoover Dam. This includes delivery of water through the Robert B. Griffith Water Project (formerly the Southern Nevada Water Project) constructed by Reclamation, as authorized by an Act of the United States Congress.

Will the proposed work contribute water to a basin where a Reclamation project is located? Although the proposed project will not contribute water to any basins or make any additional water supplies available, it will allow the BBWD to manage, use and treat Colorado River water that might otherwise be unsuitable for human consumption.

Environmental and Cultural Resource Compliance

(1) Will the project impact the surrounding environment? No.

(2) Are there any species listed as a Federal threatened or endangered species, or designated critical habitat in the project area? If so, would they be affected by an activities associated with the proposed project? The Colorado River watershed contains a number of sensitive and protected species. Management of the river's resources is key to protecting these species and their habitats. Construction activities associated with this project will not harm or negatively impact any of Southern Nevada's threatened or endangered species. Construction will occur on BBWD facilities, which have been previously developed and disturbed.

(3) Are there wetlands or other surface waters inside the project boundaries that potentially fall under Clean Water Act (CWA) jurisdiction as "Waters of the United States?" If so, please describe and estimate any impacts the proposed project may have. The Colorado River falls under the CWA jurisdiction as "Waters of the United States," but no project-related impacts are anticipated.

(4) When was the water delivery system constructed? The Big Bend Water District was constructed in 1983.

(5) Modification to individual features of an irrigation system? This project will not modify individual features of an irrigation system.

(6) Are there any buildings, structures or features listed or eligible for listing on the National Register of Historic Areas? There are no buildings, structures or features eligible for listing on the National Register of Historic Places.

(7) Are there any known archaeological sites in the proposed project area? There are no known archeological sites in the proposed project area.

(8) Will the project have a disproportionally high and adverse effect on low income or minority populations? No.

(9) Will the project limit access to and ceremonial use of Indian sacred sites or result in other impacts on tribal lands? No.

(10) Will the project contribute to the introduction, continued existence or spread of noxious weeds or non-native invasive species known to occur in the area? No.

Existing Drought Contingency Plan
See response to Criterion B – Drought Planning and Preparedness.

Letters of Support – None.

Required Permits or Approvals – Drilling and construction permits.

Official Resolution
An official resolution authorizing the submission of this grant proposal will be approved by the Big Bend Board of Trustees on March 7, 2017, and will be sent to the BOR.

Project Budget
The total estimated cost of the project is $1,308,317.36. The BBWD is requesting grant funding in the amount of $300,000 and will provide a matching contribution of $1,008,317.36. The non-federal share of project costs will be provided through in-kind contributions (staff salary and fringe benefits) and the BBWD rates (FY 2017-2018 budget).

Engineer's Well Drilling Estimate (Contract Work):

24-Inch Diameter Production Well Construction Estimate for Big Bend (Using Colorado River Water)					
	Budget Item Description	Unit	Qty.	Price Per Unit	Total Price
1	Mobilization/Demobilization	ea.	1	$ 50,000	$ 50,000
2	Site Preparation	ea.	1	$ 81,250	$ 81,250
3	Geophysical Testing	ea.	1	$ 4,375	$ 4,375
4	Install and Remove Test Pump Assembly	ea.	1	$ 12,500	$ 12,500
5	Plumbness and Alignment	ea.	1	$ 4,375	$ 4,375
6	Conductor Casing	ft.	50	$ 625	$ 31,250
7	Pilot Borehole	ft.	200	$ 350	$ 70,000
8	Production Borehole	ft.	200	$ 156	$ 31,250
9	Well Screen	ft.	40	$ 781	$ 31,230
10	Well Casing	ft.	160	$ 342	$ 54,720
11	Transducer Pipe	ft.	200	$ 21	$ 4,250
12	Gravel Feed Pipe	ft.	160	$ 16	$ 2,600
13	Grout Seal	Cu. Yd.	1	$ 750	$ 750
14	Gravel Pack	Cu. Yd.	7.5	$ 1,000	$ 7,500
15	Gravel Pack Development	hrs.	20	$ 500	$ 10,000
16	Pump Development	hrs.	30	$ 313	$ 9,375
17	Aquifer Testing	hrs.	24	$ 313	$ 7,500
18	Disinfection	gals.	5	$ 31	$ 156
19	Standby Time	hrs.	12	$ 375	$ 4,500
	Total Engineer's Well Drilling Estimate				**$ 417,581**

Salaries and Wages
Reclamation funding will support contract work only. One hundred percent of SNWA internal labor costs (salaries and fringe benefits) will be provided by the SNWA as part of its matching contribution.

Fringe Benefits

Fringe Breakdown	
Pension Allocation	25.4%
OPEB	2.1%
Payroll Taxes	8.0%
Workers Comp	0.2%
Unemployment	0.1%
Health Insurance	13.7%
Disability	5.2%
Vacation	7.5%
Holiday	4.4%
Personal	0.7%
Service Recognition	2.5%
Vehicle Allowance	0.09%
Other	0.11%
	70.0%

Travel
Not applicable to this project.

Supplies and Materials
Not applicable to this project.

Other
Not applicable to this project.

Contractual
This Project will be under contract awarded to the apparent low bid. Contract costs are estimated at $1,258,081.

Regulatory and Environmental Compliance
Not applicable to this project.

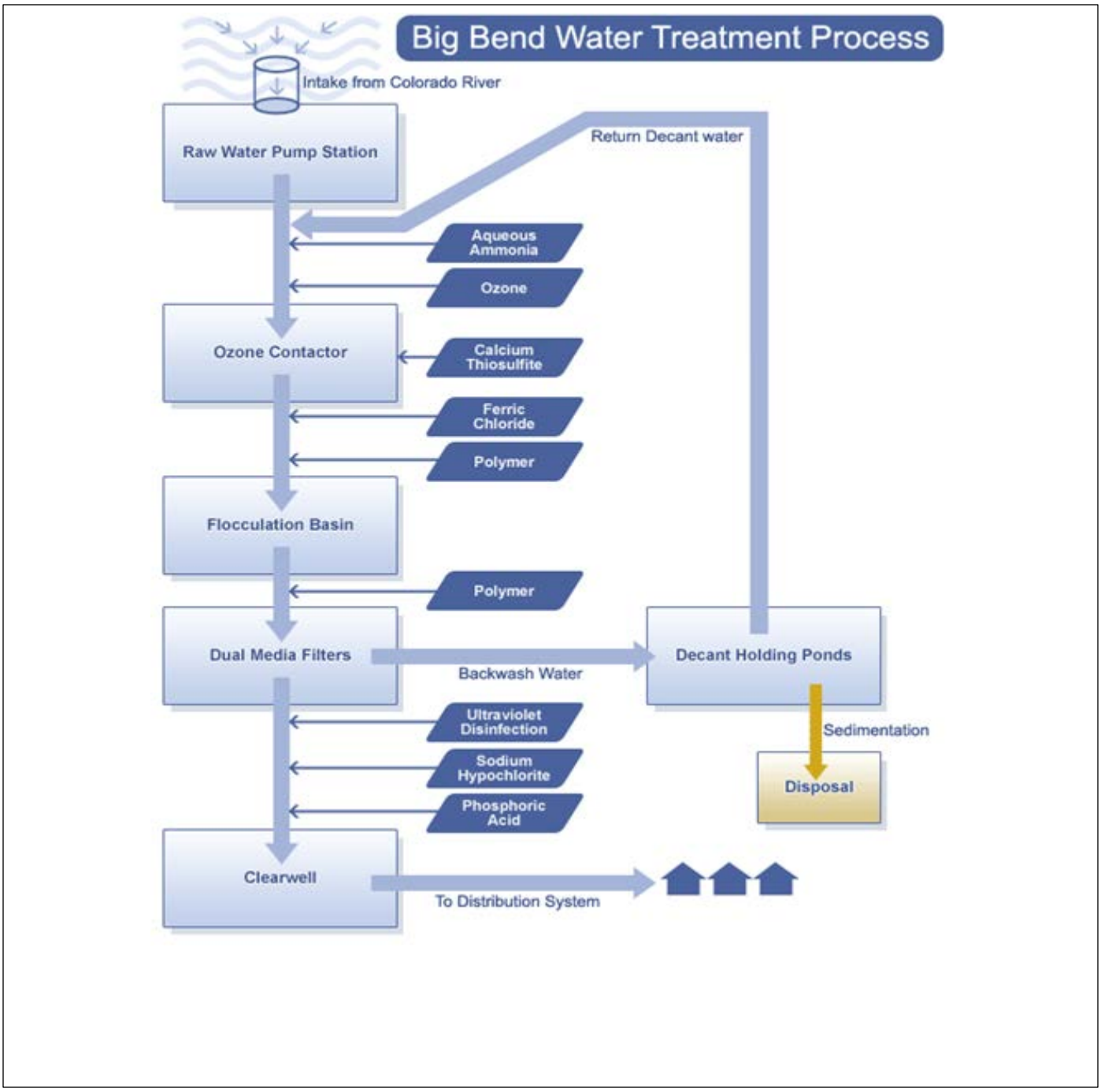
Total Direct Costs
All costs are direct and necessary for project implementation.

Indirect Costs
Not applicable to this project.

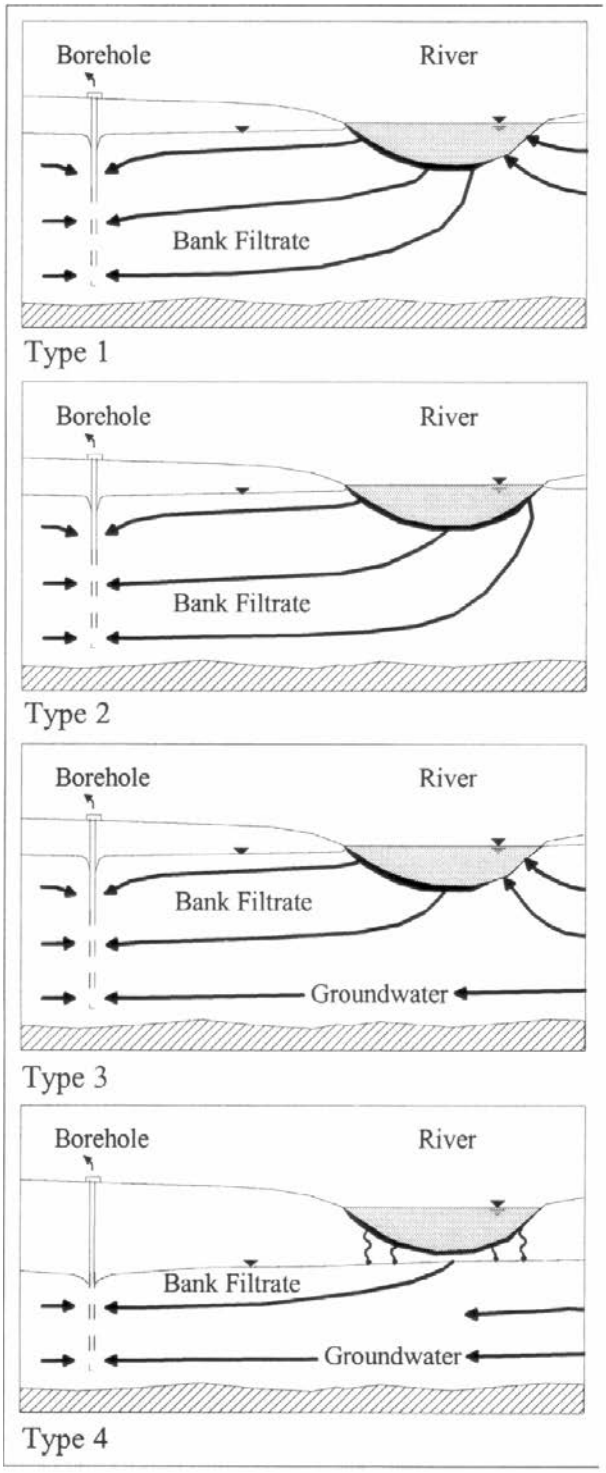
SF-424A Budget Form
SUBMITTED VIA GRANTS.GOV

APPENDIX A – MAP OF SOUTHERN NEVADA AND THE COLORADO RIVER

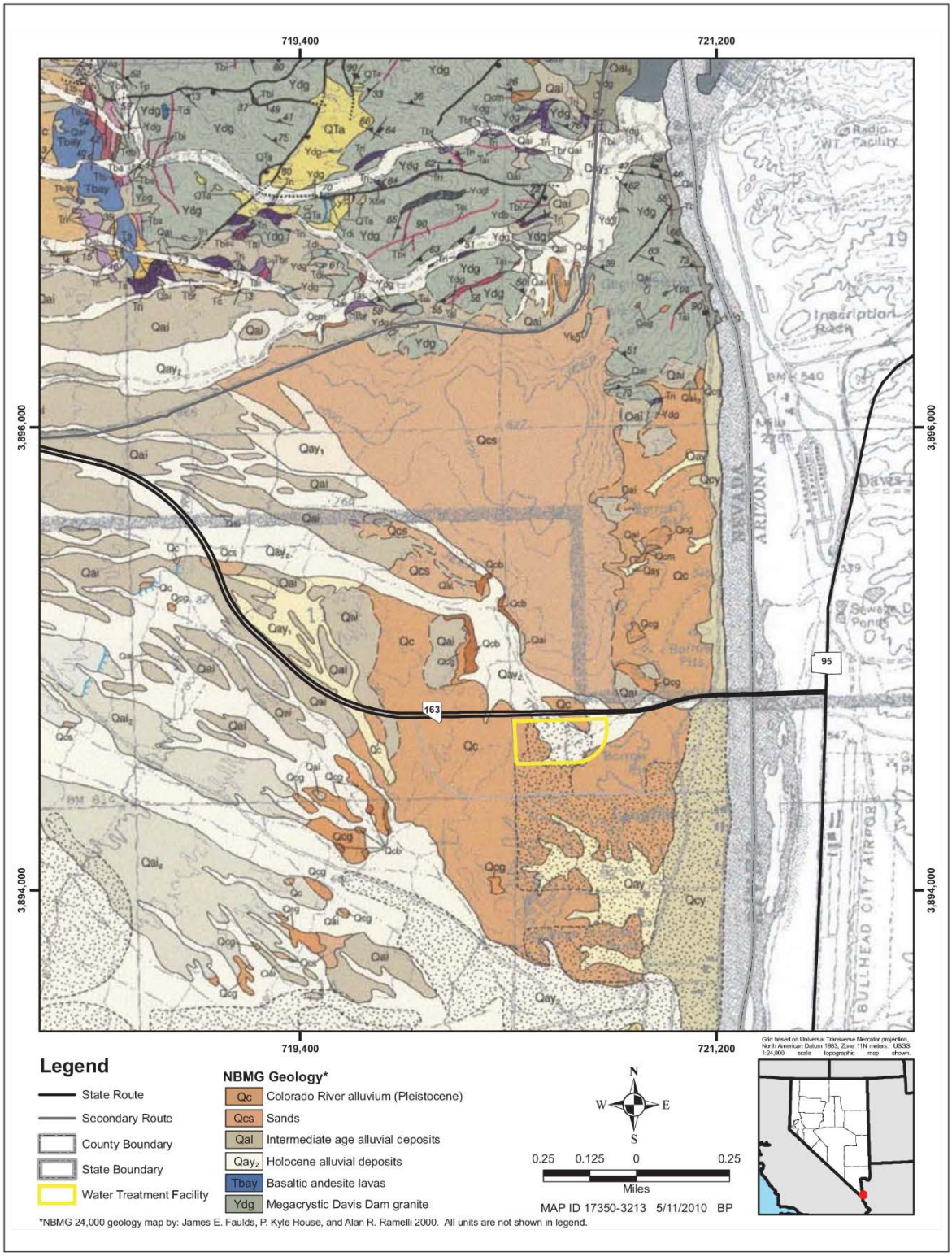
APPENDIX B – BBWD TREATMENT PROCESSES



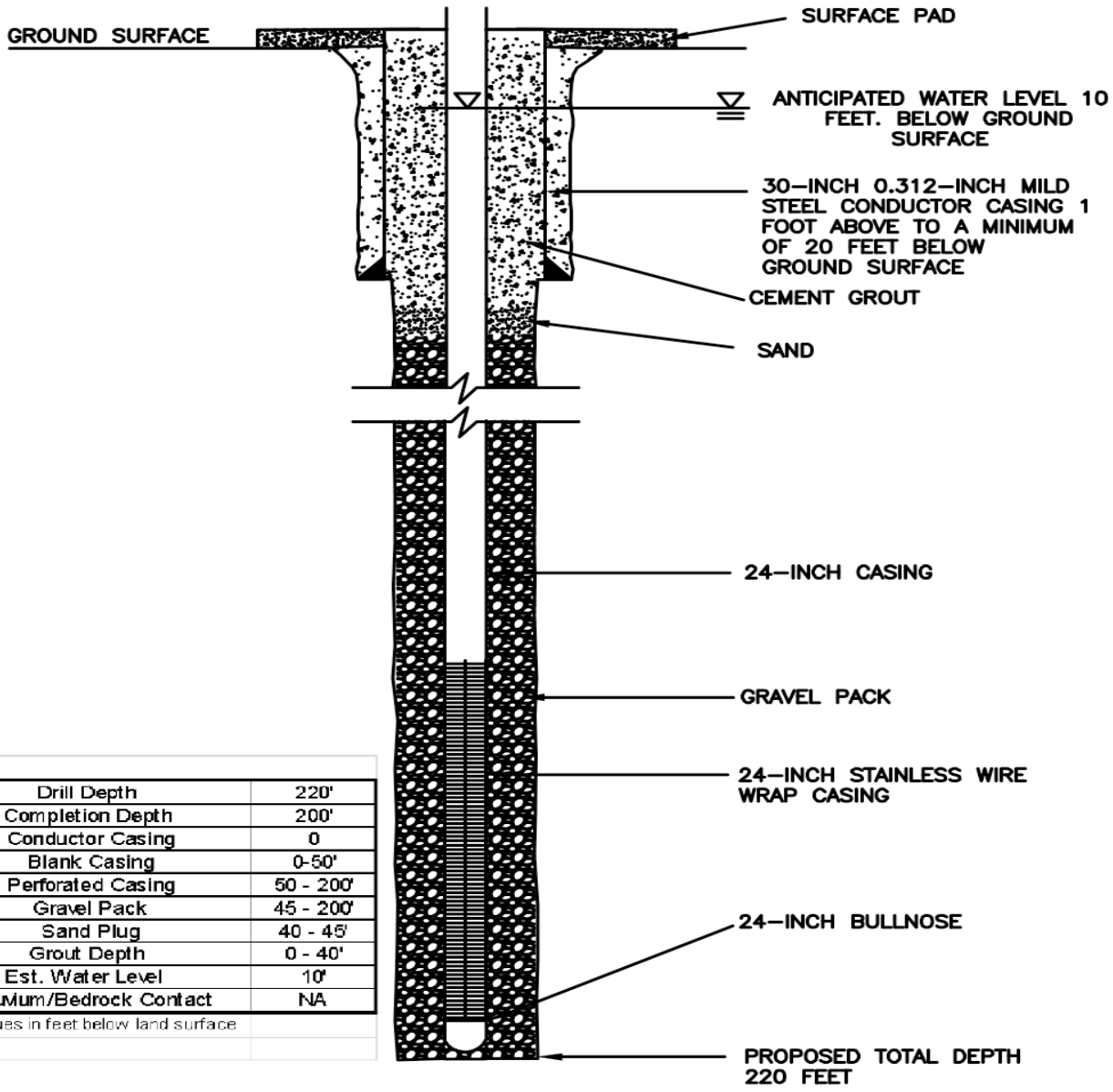
APPENDIX C – RIVERBANK FILTRATION



APPENDIX D – GEOLOGIC MAP OF THE AREA



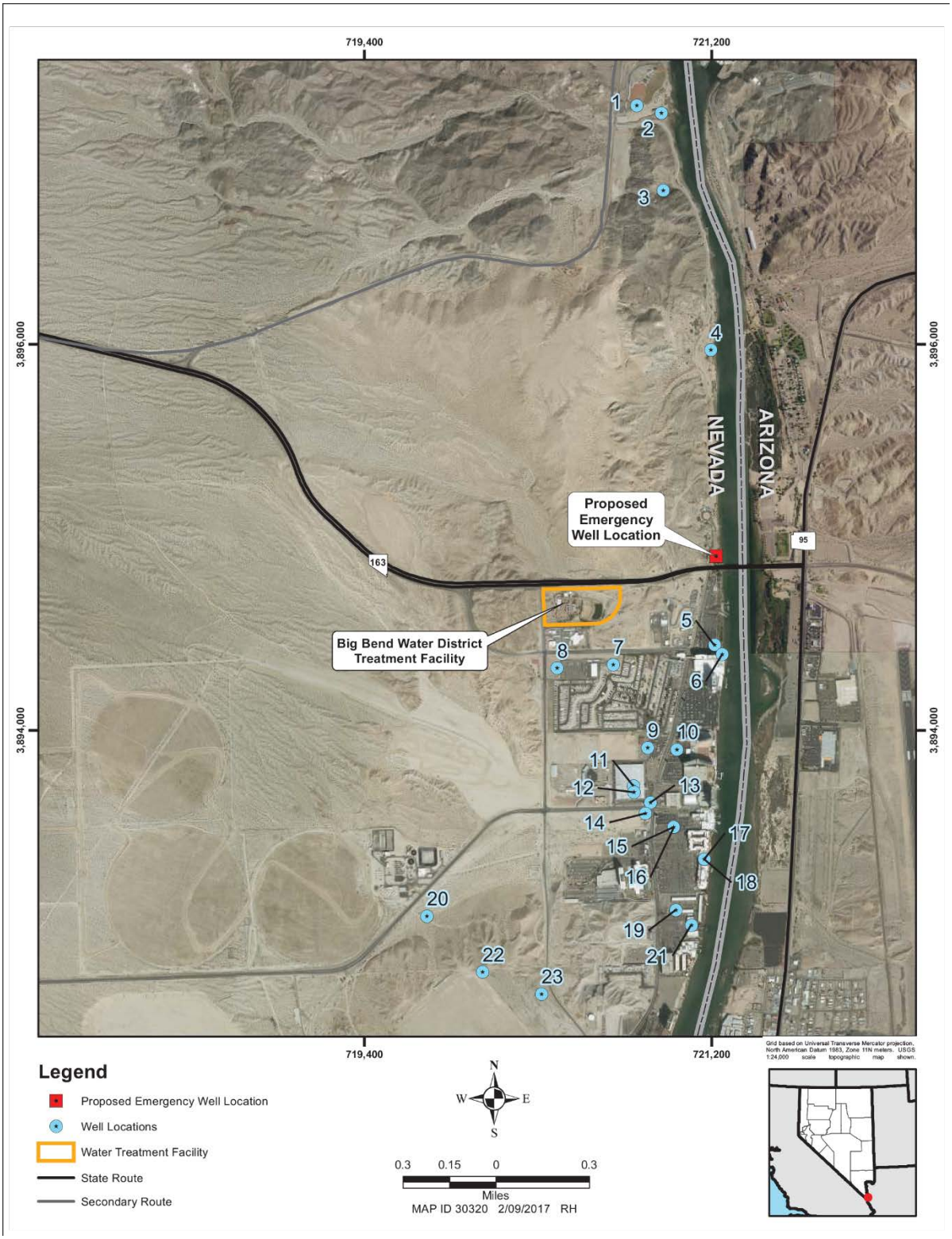
APPENDIX E – WELL DIAGRAM



Drill Depth	220'
Completion Depth	200'
Conductor Casing	0
Blank Casing	0-50'
Perforated Casing	50 - 200'
Gravel Pack	45 - 200'
Sand Plug	40 - 45'
Grout Depth	0 - 40'
Est. Water Level	10'
Alluvium/Bedrock Contact	NA

* All values in feet below land surface

APPENDIX F – EXISTING WELL LOCATIONS



APPENDIX G – SUMMARY INFORMATION FOR WELLS NEAR LAUGHLIN, NEVADA

ID	Well Owner Name	NDWR Drillers Log Number	UTM[a] Easting (m)	UTM[a] Northing (m)	Elevation[a] (ft-amsl)	Base Lithology[b]	Hole Depth (ft-bgs)	Smallest Casing Size (in)	Top of Perforations (ft-bgs)	Bottom of Performations (ft-bgs)	Water Level (ft-bgs)	Year of Water Level
1	Clark County	15624; 71747	720,812	3,897,237	541	Conglomerate	200	8.625	50	200	36	1976
2	The Mark Group	31547	720,937	3,897,198	522	Silty Sand	99	NA	NA	NA	31.2	1989
3	The Mark Group	31546	720,947	3,896,798	619	Decomposed Granite	58	NA	NA	NA	6	1989
4	y Dept. of Public Works	31544; 36150	721,195	3,895,971	525	Clayey Sand	99	NA	NA	NA	23.8	1989
5	y Dept. of Public Works	31545	721,214	3,894,442	529	Gravel and Sand	119	4	88	118	23.8	1989
6	Riverside Resort and Casino	11359	721,254	3,894,395	512	Granite and Clay	400	8.625	300	400	18	1970
7	Resort and Casino (Regency)	85619 and Many Others	720,689	3,894,341	604	Decomposed Granite	480	8.625	160	480	110	2002
8	Hotel and Casino (Shipkey)	20550; 24438	720,397	3,894,322	502	Decomposed Granite	498	5.6	152	498	100	1983
9	Conway, Hugh	11094	720,868	3,893,910	558.3	Decomposed Granite	63	8.625	40	63	31	1969
10	Riverside Resort and Casino	11121	721,018	3,893,901	544	Granite	92	6.625	84	89	21	1970
11	Planning Group	66822 and Many Others	720,795	3,893,711	560	Gravelly Sand	30	2	20	30	22	1992
12	Riverside Resort, Inc.	35524 to 35527	720,795	3,893,680	560	Gravelly Sand	30	4	15	30	21	1991
13	unty Sanitation District	25102	720,882	3,893,627	502	Gravel	111	12	69	111	12.4	1983
14	unty Sanitation District	108705 to 108708	720,856	3,893,569	558	Decomposed Granite	58	8	20	58	38	2008
15	Crystal Palace Gambling Hall	22501; 24733	721,002	3,893,500	544	Sand and Gravel	600	6.625	500	540	NA	NA
16	GEOFON (Cecil's Market)	66832 and Many Others	721,002	3,893,500	544	Sand	43	2.5	40	43	24	1995
17	Big Bend Well 1 Area 1	NA	721,161	3,893,332	520	NA	111	NA	NA	NA	24	1996
18	Big Bend Well 2 Area 1	27137	721,161	3,893,332	520	Gravels and Boulders	120	16	70	110	17.58	1984
19	Del Webb Nevada Club	Incorrect	721,013	3,893,069	544	NA	109	NA	NA	NA	23	NA
20	unty Sanitation District	66838 and Many Others	719,722	3,893,037	670	Sand and Gravel	300	6.625	260	300	117	1984
21	350220114341901	NA	721,093	3,892,991	520	NA	64	NA	NA	NA	21.16	1976
22	350913114350201	NA	720,010	3,892,749	705.95	NA	345	NA	NA	NA	208.1	1993
23	350909114345001	NA	720,317	3,892,633	675	NA	251	NA	NA	NA	211.9	1993

APPENDIX H – WELL PERFORMANCE IDENTIFIED ON DRILLER'S LOGS

ID	Driller's Log	Discharge (gpm)	Drawdown (ft)	Specific Capacity (gpm/ft drawdown)
1	15624	20	14	1.42
6	11359	300	360	0.83
8	20550	230	64	3.59
8	24438	200	80	2.5
9	11094	100	60	1.66
10	11121	40	60	0.67
18	27137	2,850	37	77.02
20	66838	100	21	4.76