SOURCE WATER PROTECTION PLAN

For

Big Mesa MDWCA

PWS #NM 3573725

March 29, 2021

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Big Mesa MDWCA

Source Water Protection Plan

Prepared for: Big Mesa MDWCA

PWS # NM 3573725

Prepared by New Mexico Rural Water Association

March 29, 2021

Approved by:

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<NAME,TITLE>
Big Mesa MDWCA Date

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Martha Graham, Source Water Protection Specialist Date
NMRWA Source Water Protection Program

Date Reviewed	Reviewed By	Comments

This Source Water Protection Plan is a planning document and there is no legal requirement to implement the recommendations here. Actions on public lands will be subject to federal, state, and county policies and procedures. Action on private land may require compliance with federal, state, or county land use codes, building codes, local covenants, and permission from the landowner.

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Acronyms and Glossary

BMP	Best Management Practices
Critical Stream Segment	Defined by NMED as the reach of the watercourse beginning 500 feet below a public water system intake and extending ten miles upstream
CWA	Clean Water Act
CWPP	Community Wildfire Protection Plan
DWB	Drinking Water Bureau
EPA	Environmental Protection Agency
Groundwater vulnerability	The likelihood that a contaminant will reach a specified position – such as the water table or the depths used for public-water supply – in a groundwater-flow system (National Research Council 1993). groundwater vulnerability is a function not only of the properties of the groundwater flow system (intrinsic susceptibility) but also of the proximity of contaminant sources, relative location of wells, and the fate and transport of the contaminant(s).
Intrinsic susceptibility	The ease with which water and contaminants can travel to and through an aquifer.
Intrinsic vulnerability	A type of groundwater where contamination is general, and non-specific.
NM WARN	New Mexico Water / Wastewater Agency Response Network
NMED	New Mexico Environment Department
NMRWA	New Mexico Rural Water Association
NPS	Nonpoint source pollution: any source of water pollution that does not meet the legal definition of 'point source' in Section 502(14) of the Clean Water Act.
Point Source	Point source pollution: any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged.
PSOC	Potential Source of Contamination
SDWA	Safe Drinking Water Act
Specific vulnerability	A type of groundwater vulnerability where the contaminant is specific.

SWP	Source Water Protection

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Executive Summary

Access to clean, safe drinking water is a key component of a healthy and viable community. Protecting the sources of drinking water from contamination and depletion is essential for a healthy community. It also saves is costs of water treatment or avoids the need to find an alternative water source.

The Big Mesa Mutual Domestic Water Consumers Association (MDWCA) and New Mexico Rural Water Association (NMRWA) collaborated to develop the Big Mesa MDWCA Source Water Protection (SWP) Plan. This plan delineates SWP Areas and establishes SWP Zones within those areas. It identifies potential sources of contamination (PSOCs) within the SWP Zones and other issues of concern for the water system. It gives Best Management Practices (BMPs) to address the potential for contamination from various sources. Finally, it outlines the next steps in implementing the SWP Plan, which includes contingency planning and setting priorities for addressing PSOCs.

The Big Mesa MDWCA gets its drinking water from an intake on Conchas Lake. Big Mesa MDWCA has one of three intakes for drinking water in Conchas Lake. Building alliances with the US Army Corps of Engineers (ACE) and Conchas Lake State Park (CLSP) to protect the lake as a drinking water source is a vital way to protect these communities' water. Old septic systems and environmental factors that could worsen with climate change pose the greatest potential threats of contamination to the Big Mesa MDWCA's intake. Recreational boating accidents and the indiscriminate or inadvertent application of pesticides and herbicides are other possible threats. While any potential threat of contamination is closest near the intake on Conchas Lake, these potential threats extend to the tops of the watersheds that feed Conchas Lake, particularly if they occur within the Conchas or Canadian Rivers. It is important to note that the Big Mesa MDWCA SWP Plan identifies *potential* sources of contamination. Planning and implementing BMPs go a long way towards preventing contamination from occurring.

SWP Plans are living documents, meant to be used when making planning decisions and as resources for information on potential contaminants and how to prevent or mitigate impacts to the water system. The Big Mesa MDWCA SWP Plan not only identifies PSOCs but also provides BMPs to help prevent contamination from occurring.

Finally, this SWP Plan provides the opportunity to build relationships with the State and Federal agencies that manage Conchas Lake and the ranchers and other landowners around Conchas Lake. Working together, Big Mesa MDWCA and its neighbors can provide safe drinking water to their communities while offering a relaxing haven and water wonderland.

1 Introduction

Access to clean, safe drinking water is a key component of a healthy and viable community. Protecting sources of drinking water from contamination and depletion can prevent consequences to economy, ecology, and human health. Source Water Protection is a voluntary program, created by Congress in the 1996 amendments to the Safe Drinking Water Act (SDWA). The program encourages partnerships between public water systems and their neighbors to safeguard sources of drinking water. The U.S. Department of Agriculture provides funding to the New Mexico Rural Water Association (NMRWA) to partner with public water systems to protect water sources from contamination and depletion, and to develop contingency plans if water sources dry up or become contaminated.

Big Mesa is an unincorporated community at Conchas Lake in San Miguel County, in northeastern New Mexico (Figure 1). Principal activities in this part of the county are ranching and farming. Big Mesa has both part- and full-time residents, many of whom are drawn by the recreational opportunities of Conchas Lake, including boating, fishing, and other water sports. Other recreational activities in the area include hunting, camping, and hiking. In addition to its residential community Big Mesa has several services.

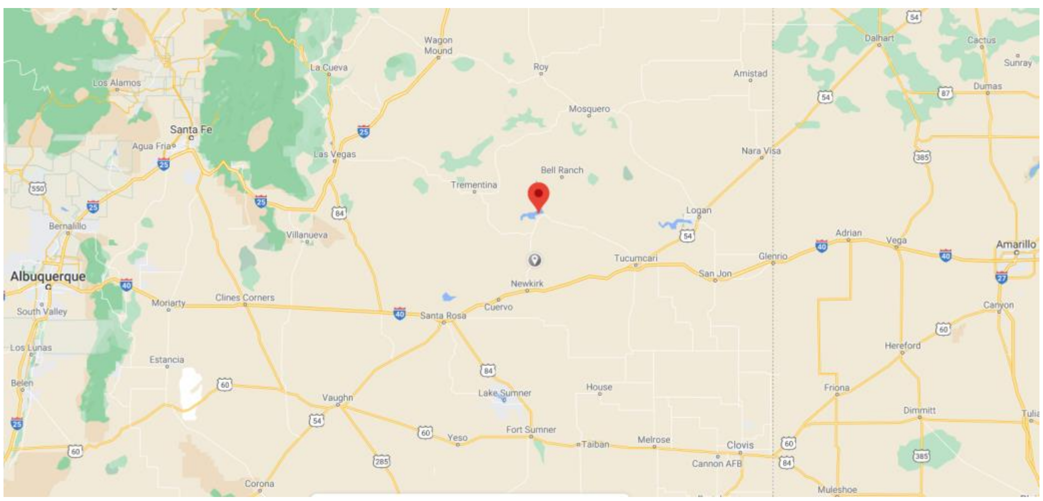

Figure 1. Location of Conchas Lake, San Miguel County, Northeastern New Mexico.

The Big Mesa Mutual Domestic Water Consumers Association (Big Mesa MDWCA) and the New Mexico Rural Water Association (NMRWA) collaborated to develop this Big Mesa MDWCA Source Water Protection Plan (SWP Plan). The Big Mesa MDWCA SWP Plan identifies potential sources of contamination and other issues of concern within established Source Water Protection Areas (SWP Areas) for the MDWCA's intake. This SWP Plan sets up measures to monitor and protect the community's drinking water source and assembles information into a document that can serve as a valuable reference in the future.

An intake in Conchas Lake provides Big Mesa MDWCA with its only source of drinking water. The residential community shares this drinking water source with the Army Corps of Engineers (ACE) and Conchas Lake State Park (Conchas Lake SP), each of which also has its own intake in the reservoir. While this SWP Plan focuses primarily on Big Mesa, the SWP Area is generally the same for all three entities. The Big Mesa MDWCA, Conchas Lake SP, and ACE should work together on safeguarding Conchas Lake and the surrounding area as a drinking water resource for their respective communities in addition to being a recreational destination. The SWP Team sees moving forward with this coordination as an important step in implementing the SWP Plan.

1.1 Source Water Protection Background

Source Water Protection is part of a multi-barrier approach by which a public water system can actively protect its valuable drinking water resources and the capital investment used to develop these water resources. The multi-barrier approach protects current and future drinking water sources through prevention, standards and treatment, an effective distribution system, and encouraging an engaged public. Because there is no single approach to water safety, the best way to protect drinking water is through the effective management of the drinking water treatment and distribution systems, and source water protection. This plan focuses on the third approach.

The Environmental Protection Agency (EPA) defines *source water* as "untreated water from streams, rivers, lakes, or underground aquifers that is used to supply private wells and public drinking water." The Source Water Protection Program, which Congress authorized in the 1996 Amendments to the SDWA, outlines a comprehensive plan to achieve maximum public health protection.

The purpose of developing a SWP Plan is to establish SWP Areas and take the necessary measures to safeguard them against potential sources of contamination (PSOCs) and other issues of concern, thereby protecting the community's water resources. A *SWP Area* is "the surface and subsurface area surrounding [an intake,] water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield" (42 U.S.C. §300h—7(e)). Source water protection focused first on wells and groundwater systems and then expanded to its current definition. Current guidance retains some of the terminology, such as "wellhead protection."

Protecting and restoring the places that supply water can be a cost-effective alternative to expensive water treatments. In some cases, it can even mean preventing the loss of the water as a drinking water source. Not only can source water protection offset additional water treatment, for example, the investment in source water protection also can be an opportunity to enhance water security.

The goal of NMRWA's Source Water Protection Program is to protect drinking water resources through the implementation of a community based SWP Plan. NMRWA helps in the development of this plan by providing onsite technical assistance to water systems in the development and implementation of the SWP Plan. NMRWA facilitates communication and collaboration among the water utility, community, and coordinating government agencies in the development and implementation of the SWP Plan. It can supply outreach, educational materials, and training related to source water protection issues.

NMRWA's SWP planning process follows the 5-step process set up by the EPA and the National Rural Water Association. These steps are:

1. Form a community planning team (SWP Team)
2. Delineate SWP Areas
3. Identify PSOCs and other issues of concern
4. Manage the SWP Areas
5. Contingency planning

Each of next five sections of this SWP Plan address one of these steps.

2 Source Water Protection Planning Team

The first step in the Source Water Protection process is to form a community planning, or Source Water Protection, Team. The role of the SWP Team is to assemble relevant technical information and draft the SWP Plan. It defines SWP Areas and surveys them to find and assess contaminant sources that have the potential to pollute water sources. It gathers information through members' knowledge of the community and experience with this and other water systems, public documents, internet research, and through discussions with other knowledgeable individuals. The SWP Team then uses this information to develops strategies to protect the source water. The most important duty of the planning team is to help ensure the SWP Plan's implementation. Once the SWP Plan is in place NMRWA is available to give continued support and technical help with its components. The Big Mesa MDWCA SWP Team consists of Dana Romero (Business Office Manager, Big Mesa MDWCA), and Martha Graham (SWP Specialist, NMRWA).

3 Defining the Big Mesa MDWCA Source Water Protection Area

The SWP Area delineation process establishes the physical area around a drinking water source that will become the focal point of the drinking water protection process. The localized and regional hydrogeology of the SWP Area gives valuable information about the water resources.

3.1 Hydrogeologic Setting

Conchas Lake is a 25-mi-long water body with a surface area of about 6,419 acres and average storage of 61,532 acre-feet (acre-ft) (Daniel B. Stephens & Associates, Inc. 2005). The Canadian River and one of its tributaries, the Conchas River, feed the lake.

Originating in Colorado's Sangre de Cristo Mountains, the Canadian River supplies most of Conchas Lake's water. It enters the northern border of San Miguel County and flows towards the south through the Canadian River canyon to Conchas Lake. Below Conchas Lake it continues to the eastern county line. The river "carves a one-thousand-foot gorge in the Las Vegas Plateau before spilling onto the Pecos-Canadian Plain in northeastern New Mexico. Northwest of the river stand the red wall of the Canadian Escarpment. To the east sprawls the Great Plains. Passing through New Mexico, the Canadian River cuts through Texas to Oklahoma, where it runs into the Arkansas River. The Canadian River is the largest tributary of the Arkansas River" (New Mexico Museum of Art 2010)., *The Conchas Dam Project*, http://online.nmartmuseum.org/nmhistory/people-places-and-politics/water/history-water.html).

Average daily streamflow for a stream gage along the river, approximately 15 miles north of the Lake, is 250 cubic feet per second and the average gage height is 2.1 feet (Conchas Lake SP Draft Management Plan 2018). The peak streamflow recorded at the site was 145,000 cubic feet per second on June 18th, 1965, with a gage height of 36.6 feet (Conchas Lake SP Draft Management Plan 2018).

"Most of the rocks, including the bedrock at Conchas Dam, belong to the Upper Triassic Chinle Group. The group is a sedimentary rock that was created by sediment deposits from a river that flowed from central Texas to central Nevada, 220 million years ago. This sandstone is typically reddish-brown, maroon, gray, or yellowish. The red color in some of the rocks is caused by the oxidation of iron, which is common in arid environments that existed at the time the Chinle Group was deposited. Loose, or unconsolidated, material found in the area is a result of glaciers wearing away at the Sangre de Cristo Mountains during the last ice age" (Conchas Lake SP Draft Management Plan 2018).

Groundwater for domestic wells and livestock in this area primarily comes from the Chinle Group (Daniel B. Stephens & Associates, Inc 2005). One well near Conchas Lake yielded groundwater of poor quality but adequate quantity for domestic use at a depth of about 1,800 ft below the ground surface (Matherne and Stewart 2012).

3.2 Conchas Dam and Reservoir

Conchas Dam was built as a multiple-purpose project under the control of the Army Corps of Engineers between 1935 and 1943. It is a "...grey ... Art Deco-style concrete mammoth" constructed of 27 steel-reinforced monoliths and spanning the entire river canyon (New Mexico Museum of Art 2010). It is 235 ft high and 1,250 feet long, and cost $12 million to build.

The dam spans the South Canadian River, a quarter mile below its confluence with the Conchas River. Placed under the jurisdiction of the War Department, the dam is the oldest, and one of the largest, water projects that the Army Corps of Engineers (ACE) has undertaken in New Mexico. In addition to the ACE, the Works Relief Program (WPA), Civilian Conservation Corps (CCC), and Public Works Administration (PWA) all worked on the project. The project was the successful culmination of 40 years of working to develop large-scale irrigation in the region.

The Conchas Dam Project was part of the Emergency Relief Appropriation Act of 1935, which President Franklin D. Roosevelt signed into law on July 29, 1935. The Emergency Relive Appropriate Act was for the purpose of "water conservation, trans-mountain water diversion and irrigation, and reclamation." (74th Congress, H.J. 117. Pub. Res. No. 11, Statutes At Large 1935). Congress authorized funding for the project in the Flood Control Act of 1936. Under the 1936 Flood Control Act, the project was "for flood control, irrigation, want water supply benefits in New Mexico" (74th Congress, H.R. 8455, Pub No. 7388, Statutes at Large, 1936)

The logistics of building Conchas Dam went beyond the complex construction of the dam itself. Because of the site's isolation, workers at Conchas Dam required housing, meals, schools for their children and a hospital for their healthcare. This meant that the federal government also had to build an entire town – of over 1,800 at its height – essentially in the middle of nowhere (Conchas Dam Historic District 2005).

Construction of the construction camp, Conchas City, extended from the winter of 1935 through the summer of 1936, during which over 2,500 relief workers were involved at a cost of 1.5 million dollars. Fifty adobe buildings, 29 stone buildings, and 1 adobe and stone building supplied dormitory quarters for 1,320 men and apartment residences for 141 families (Conchas Dam Historic District 2005).

Roads, gas and power lines, a sewage system and power plant were also in place by August 1936. The town also had "a mess hall capable of feeding 1,500 employees; an administration building; a 24-bed modern hospital; a filling station; a business building, which housed a drug store, a restaurant, a dry cleaning and tailor shop, a barber shop, a pool hall, a grocery store, and a beauty parlor; a town hall which also contained the post office, a service building; a guest house; and a concrete and soils laboratory. Following the major construction effort, a movie theater capable of seating 700 patrons; three 8-car garages; nine single houses; one quadruplex apartment; and a Catholic church were added" (Conchas Dam Historic District 2005).

The groundwater in the area has a high saline content, so "four water storage tanks, each with a capacity of 2,200,000 [sic] gallons, and a complete water purification plant were constructed" (Conchas Dam Historic District 2005).

After Conchas Dam was completed, the town was dismantled. In 1939 the CCC used the material to create the offices, workshops, and permanent housing for Army Corps' employees. The duplexes served as housing for Corps of Engineers employees stationed at the dam, until 1999, after which the Corps turned their management over to a private concessionaire (Lockyear 2011). Until recently these duplexes, known as the Adobe Belle, were available as vacation rental. In 2019, the ACE invited public comment on whether to rehabilitate or raze the structures.

The reservoir created by Conchas Dam is 25 miles long water body with a surface area of about 6,419 acres and average storage of 61,532 acre-feet (Daniel B. Stephens & Associates, Inc, 2005). Fed by the Canadian and Conchas Rivers, the reservoir's drainage area is approximately 7,400 square miles. It can store up to 671,179-acre feet of water, and at capacity the surface area is 16,033 acres. A minimum pool level is set at an elevation of 4,155 feet with a capacity of 61,532-acre feet and a surface are of 2,694 acres. At its deepest point, the lake is around 158 feet deep. (Conchas Lake State Park Draft Management Plan 2018).

The reservoir supplies appropriated water to irrigated lands around Tucumcari, about 35 mi to the southeast. Congress authorized the Bureau of Reclamation to build the Arch Hurley project in 1939 (Public Law 477, 75th Congress) (Arch Hurley Irrigation District 2021). Over one hundred miles of irrigation canals extend the project southeast across the surface of the land. Underground are over six miles of tunnels and three miles of siphons. For more information see the Arch Hurley Irrigation District (http://www.archhurley.com/, accessed March 4, 2021).

3.3 Public Water Systems in Conchas Lake

Three public water systems use Conchas Lake as their source of drinking water. All three have intakes in the lake (Figure 2). Big Mesa MDWCA (NM #3573725) and Conchas Dam State Park Northside (NM #3593225) (CLSP) are both listed as public water systems by the New Mexico Environment Department (NMED). The Army Corps of Engineers has its own intake, located at the dam.

3.3.1 Big Mesa (NM #3573725)

The Big Mesa MDWCA is a *community water system*. A *community water system* serves at least 15 service connections used by year-round residents or regularly serves 25 year-round residents. In addition to serving its year-round and seasonal residents in the community, Big Mesa supplies water to the South Recreation Area at Conchas Lake.

The system gets its drinking water from its Intake #1, in the Conchas Lake (Reservoir). The intake is on a floating barge in the cove east of Hooverville and north of the building that houses the mutual domestic's office and water treatment facilities.

Water is pumped into a treatment plant consisting of filtration galleries, cartridge filters, and chlorination treatment (Figure 3). The treated water is pumped to a 325,000-gallon tank on a hill to the east of the community and gravity fed back to residences. Big Mesa MDWCA has 604 service connections and serves about 265 people at the height of summer and vacation times. The average daily production is about 9,200 gallons. Table 1 lists the characteristics of Big Mesa MDWCA's water source and infrastructure (NMED 2004).

Table 1. Characteristics of Big Mesa MDWCA Water Source and Infrastructure (from NMED 2004)

Water Source	Conchas Lake
Annual average surface area of reservoir (acres)	3,000 – 6,000
Typical reservoir depth or range in depth (ft)	40
Average annual stream flow (ft3/sec)	N/A
Type	Floating barge
Construction material	Steel
Depth of intake or range of inlet depth (ft below ground or ft above mean sea level)	8 – 12" below lake surface
Site security	In lake
Typical duration of use (hours/day)	2-5
Method of discharge (pump or gravity flow)	Pump
Year installed or constructed	60 (estimated)

Figure 2. Conchas Lake showing intakes, water treatment plants, and storage tanks for Big Mesa MDWCA, Conchas Lake State Park, and US Army Corps of Engineers

Figure 3. Big Mesa Water Treatment Facility

3.3.2 Conchas Lake State Park

Conchas Lake State Park (Conchas Dam State Park Northside [NM3593225]) is a *transient non-community* water system. A *transient non-community* public water system regularly serves at least 25 non-residential individuals (transient) during 60 or more days per year. According to the NMED Drinking Water Watch (https://dww.water.net.env.nm.gov/NMDWW/index.jsp the State Park's water system serves a population of 450 through 137 connections. From the Park's intake, water is pumped one quarter mile to a treatment plant, where it is chlorinated and stored in a 75,000-gallon tank (Conchas Lake State Park 2018) (Figure 2). The Park distributes this drinking water to the North Recreation Area. No drinking water is provided to the Central Recreation Area, and Big Mesa MDWCA supplies the drinking water to the South Recreation Area.

The New Mexico State Parks Division leases Conchas Lake State Park from the ACE, which owns the property and controls the dam. The Park offers camping, fishing, and boating opportunities. Fish species are both wild and stocked by the New Mexico Department of Game & Fish. The North Campground has high water boat ramps. Cove Campground has boat ramps usable at more variable water levels. In January 2021, the Park closed all boat ramps because the water level in the lake was so low.

There are four distinct camping areas with a total of 104 campsites (Figure 4). The Bell Point Campground, North Campground and Cove Campground are all part of the North Recreation Area. Bell Point and North Campgrounds have water and electric hookups. The Central Recreation Area has one campground and 30 sites. Primitive camping is allowed along the shore in the Cove and Central campgrounds.

The Park's intake is between Bell Point and the marina area (Figure 2). "Water is pumped 1/4 of a mile to the water treatment plant where it is filtered, chlorinated and stored in a 78,000-gallon storage tank. Drinking water is then distributed to the facilities in the North Recreation Area. No drinking water is provided at the Central Recreation Area" (Conchas Lake State Park 2018).

3.3.3 Army Corps of Engineers

"USACE has an intake and uses water for operations functions, such as water for the visitor center, office, and landscape irrigation" (Wastrell 2020, included as Appendix B of this SWP Plan). Figure 2 shows the approximate location of the intake, based on Plate 16 of the 1976 Master Plan (Farrell 1990). A water treatment plant and water tower with an 80,000-gallon storage tank are north of the ACE Administrative complex. According to the Conchas Dam Historic District nomination (2005), the water tower and tank were installed between 1939 and 1940 and are a contributing element to the Historic District.

Currently, the Big Mesa SWP Team does not have specific information on the number of people served by ACE's intake and drinking water infrastructure. However, it appears that it is used at the Administrative complex and recreation facilities next to the complex. The recreation facilities consist of a day use area with picnic table, playground, group shelter and recreational facilities of a disc golf course, volleyball court, and a Visitor Center (Figure 5).

While the ACE manages the facilities in the South Recreation Area, Big Mesa MDWCA supplies the water. The South Recreation Area consists of a boat ramp, paved parking area, dock, bathroom, day use area, and a 20-site campground. The campground is only open during the summer.

3.4 Establishing the Source Water Protection Area

Big Mesa MDWCA's intake in the Conchas Reservoir is fed by two HUC 8 watersheds, the Upper Canadian (HUC 11080003) and Conchas (HUC 11080005). The NMED Drinking Water Bureau (DWB) completed the *Source Water Assessment & Protection Program Report of Big Mesa Mutual Domestic Water Consumers Association Water Utility, Public Water System # 73725* (NMED 2004a , also included in Appendix A of this SWP Plan). Source water assessments follow a similar process to that of source water protection planning but are not as rigorous or comprehensive. Source water assessments do not involve a community planning team or develop management plan to protect the delineated source water protection areas. They also lack the contingency planning recommendations.

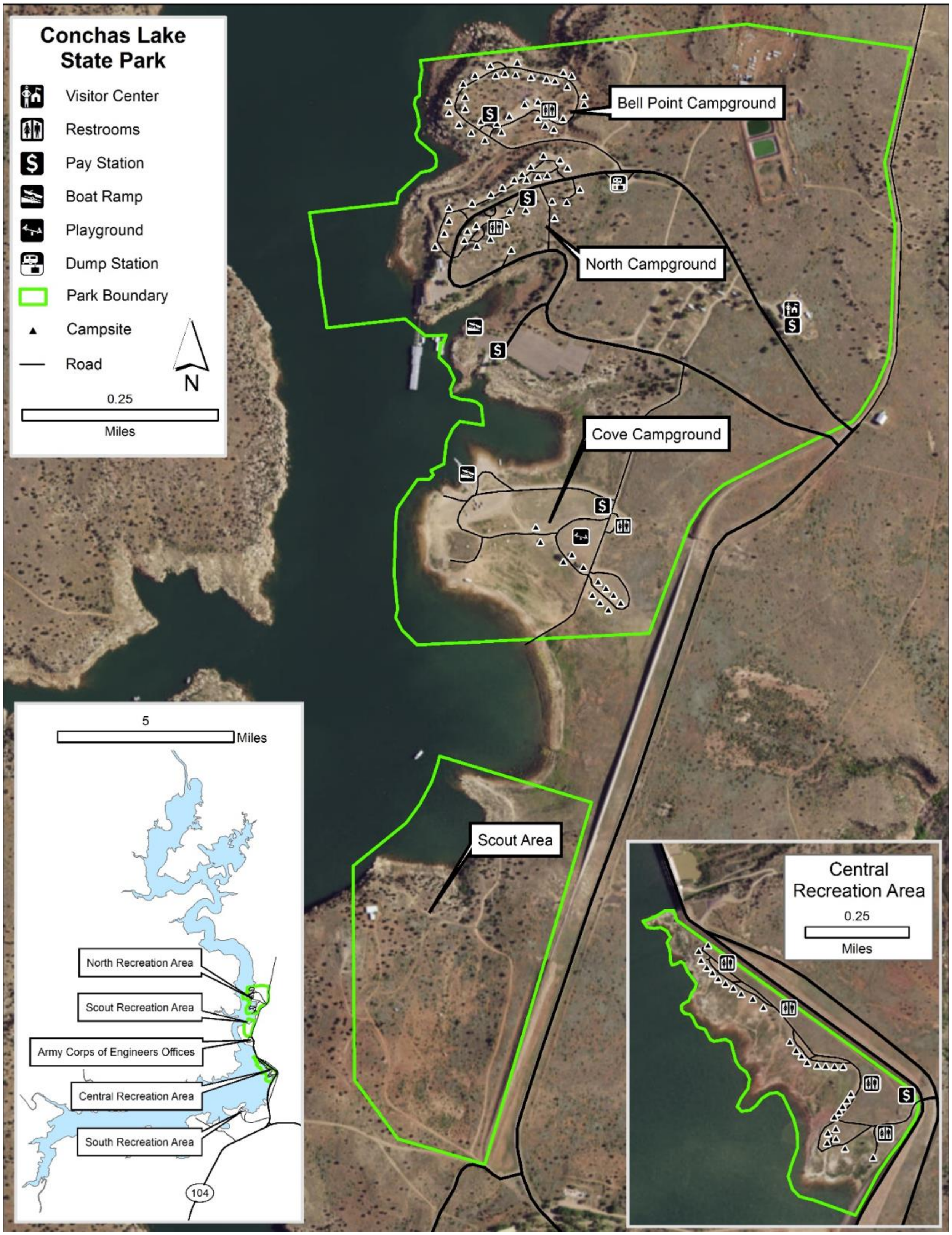

Figure 4. CLSP Recreation Areas (from Conchas Lake State Park 2018).

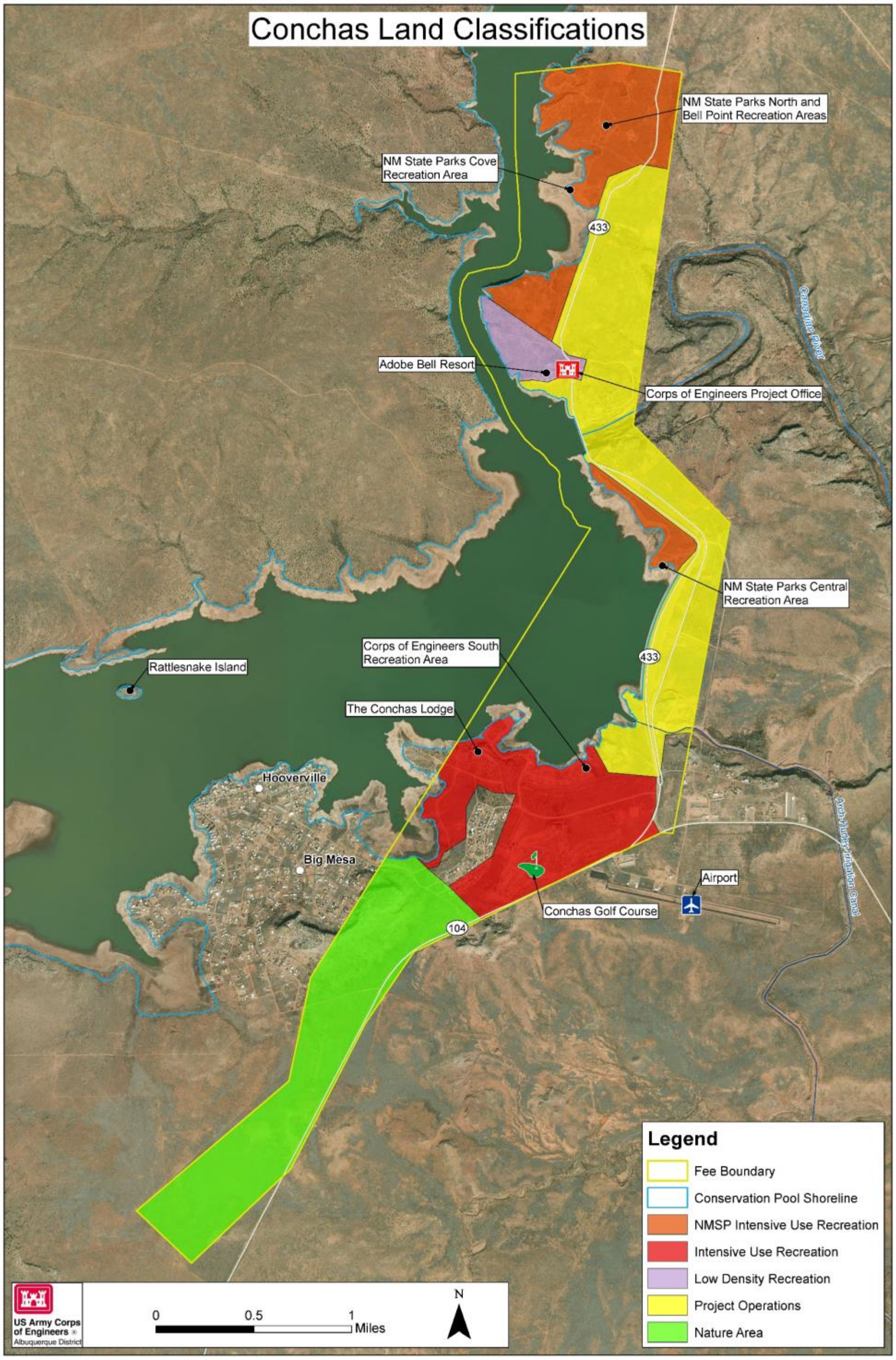

Figure 5. ACE Conchas Reservoir Land Use Map (https://www.spa.usace.army.mil/Missions/Civil-Works/Recreation/Conchas-Lake/Master-Plan/).

NMED also completed the *Source Water Assessment & Protection Program Report of Conchas Dam State Park Water Utility Public Water System # 93225* (NMED 2004b) using the same approach. It is unlikely that the ACE's water system received similar treatment since it does not appear as a public water system in NMED's Drinking Water Watch.

The Big Mesa MDWCA is a *Type B Watershed* – that is, a watershed with an area greater than 30 square miles. NMED guidelines for a Type B Watershed SWP Area are: Zones A, B, and C parallel to the banks of the reservoir at intervals of 0-200 ft, 200-500 ft, and 500-2,640 ft. (0.5 mi) respectively (Figure 5). Zone D consists of *Critical Stream Segments*, which are defined as defined as the reach of the watercourse beginning 500 feet below a public water system intake and extending for 10 miles upstream. Figure 6 shows the generalized SWP Area and Zones for Big Mesa MDWCA. Rather than showing the individual critical stream elements, a 10-mile radius around the intake shows the limits of this area; the SWP Team looked for PSOCs within the drainages in this radius.

4 Potential Sources of Contamination and Other Issues of Concern

The third step in creating a SWP Plan is to find any potential sources of contamination (PSOCs) and other issues of concern to the system's drinking water within the SWP Zones. The SWP Plan then finds best management practices (BMPs) that can help to safeguard the area from these PSOCs.

A *PSOC* is any facility or activity that stores, uses, or produces, as a product or by-product, regulated contaminants by the SDWA with the potential for release of contaminants that could pose a concern for drinking water sources. One of the most direct pathways of contamination into an aquifer is through surface water seepage, such as stormwater run-off.

A release may never occur from a potential contaminant source, particularly if BMPs are being used. Many PSOCs are regulated at the federal or state level, or both, to reduce the risk of release. When a business facility or other property is identified as having a PSOC, it should not be interpreted to mean that it is in violation of any local, state, or federal environmental law or regulation. What it does mean is that the potential for contamination exists due to the nature of the business, industry, or operation.

Contamination can enter a water system through point source or nonpoint source (NPS) pollutants. Point source pollution refers to discrete, discernible pollution sources, such as those coming from ditches, containers, and concentrated animal feeding operations. NPS pollution comes from many different sources. It is caused by rainfall or snowmelt moving over and through the ground and subsurface. As the runoff moves and infiltrates, it picks up and carries away natural and human-made pollutants, depositing them into lakes, rivers, wetlands, coastal waters, and drinking water sources. Sediment from forest land runoff and eroding streambeds, precipitation, atmospheric deposition, drainage, and seepage or hydrologic modifications can result in NPS pollution. Stormwater runoff from paved and unpaved roads is another example of nonpoint source contamination, with the potential to introduce motor fuels, solvents, road salts, and automotive water into a SWP Area.

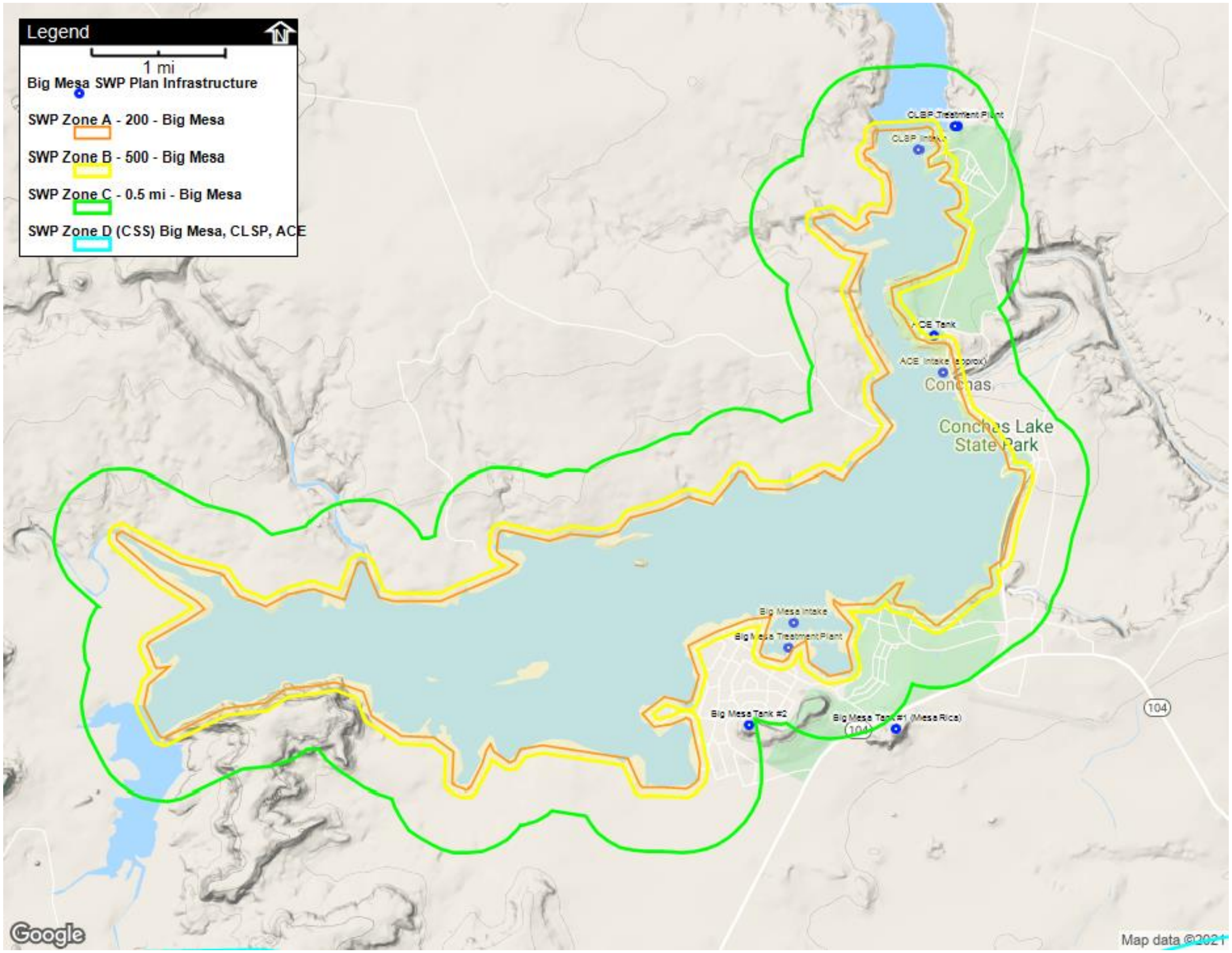

Figure 6. Big Mesa MDWCA Showing SWP Zones A-C.

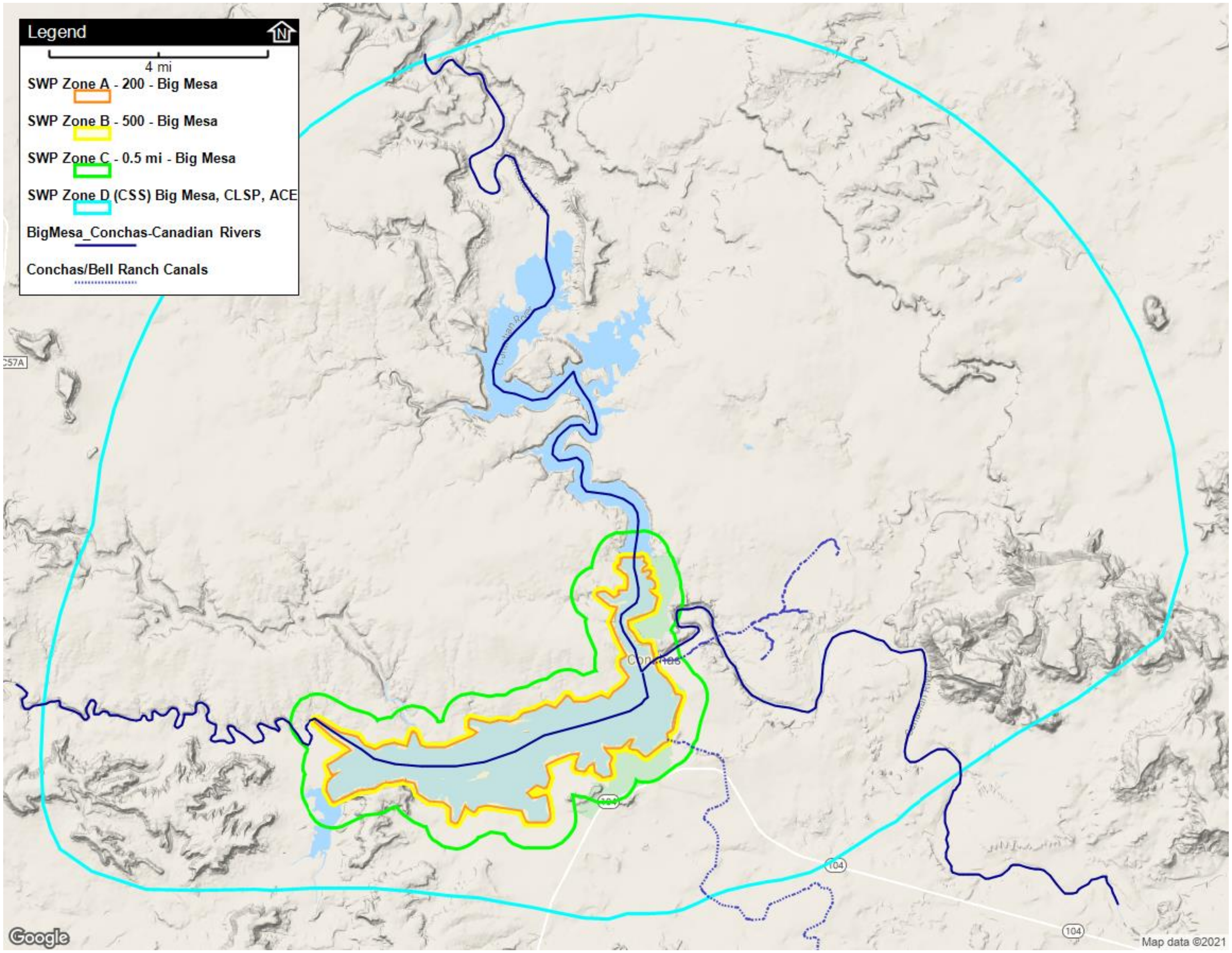

Figure 7. Big Mesa MDWCA SWP Area, Showing SWP Zones A-D.

Most surface water quality issues are caused by NPS water pollution. Nonpoint sources of contamination within a SWP Area have the potential to affect the drinking water supply adversely.

The SWP Team included an on-the-ground survey, visual reviews of the NMED EnviroMap and Google Earth, and information known to members of the SWP Team and community members to name PSOCs within the SWP Area.

4.1 Natural Sources of Contamination

In 1936 and between April 1939 and July 1949, the ACE collected water samples as part of a quality of water study (Hem 1952). The water samples from 1936 were collected from the Conchas and Canadian Rivers. The samples taken between 1939 and 1949 were taken from Conchas Lake after the dam had been completed and the reservoir filled. Hem characterized Conchas Dam as "a multiple-purpose project" and stated that "The quality-of-water studies were made to determine the suitability of the stored water for irrigation and municipal uses" (Hem 1952). His conclusions were that, although "... the water of Conchas Reservoir is very hard ... the water from Conchas Reservoir could be used satisfactorily as a municipal supply. Treatment to assure sanitary purity would be required, and treatment to reduce the hardness would be desirable" (Hem 1952). Hem noted that lake levels affect the water chemistry as well.

None of these natural contaminants are new information now. The Big Mesa MDWCA's water treatment plant transforms the raw water from Conchas Lake into safe drinking water of good quality for the community.

Another natural source of contamination for Big Mesa MDWCA is *lake turnover*. Water in a lake is stratified into different temperature layers. During the summer, water is warmer at the top of the lake and cooler at the bottom. In the fall, with changing air temperature and winds, the water at the top of the lake cools. Winds mix the water by stirring up the lake's surface and cooling the air and water temperatures. The cooler water then moves down to the bottom of the lake and the water at the bottom moves to the surface. This process is called *lake turnover*, or *lake destratification*.

Conchas Lake goes through this process, roughly when temperatures fall to about 39 degrees Fahrenheit, or 4 degrees Celsius, and the water is most dense. When the surface water flips with the stratified layer below it, the bottom layer brings up sediment from the lake bottom. For the Big Mesa MDWCA, this means high levels of turbidity and increased treatment to maintain water quality for the community. With Big Mesa MDWCA's current treatment facility, as turbidity increases there is no place for suspended solids to mix with the coagulant, mature, and settle out. Consequently, it ends up on the filters, and they must be backwashed often to be kept clear. The new treatment system that Big Mesa MDWCA is putting in will significantly improve efficiency and treatment during the periods of lake turnover.

4.2 Permitted and Regulated Sources of Contamination

Based on the SWP Teams observations and the NMED Open EnviroMap (https://gis.web.env.nm.gov/oem/?map=egis), the following are permitted and regulated entities within the Big Mesa MDWCA SWP Area (Figure 8):

- Public water systems: Big Mesa MDWCA and Conchas Lake State Park
- Aboveground petroleum storage tank
- Inactive underground petroleum storage tanks (including leaking underground storage tanks)
- Groundwater discharge permits for the ACE's Southside Campground and Lodge Recreational Facility, and Conchas Lake State Park.

Liquid waste permits (for septic systems and other small wastewater facilities) are not included on the Open EnviroMap. However, the Mora-San Miguel-Guadalupe Regional Water Plan (DBS&A 2005) estimates 194 septic tanks for Big Mesa MDWCA and 155 for Conchas Dam (inclusive of ACE and CSLP?).

4.3 Potential Sources of Contamination

Table 2 is the PSOC inventory that the SWP Team found through observation, discussions with knowledgeable individuals, and literature review. Figures 9 – 11 show the SWP Zones and PSOCs within those zones. Table 2 includes the Feature Types shown in the figures, along with their occurrence in the SWP Zones. The maps are insufficient to show the scale of the SWP Area while showing specific PSOCs. Moreover, many of the PSOCs are the same, and in relatively the same places. Thus, the figures give a general impression of the PSOCs located in the SWP Area. While the SWP Plan includes the types of POSCs located within the SWP Area, their location and distribution in the figures are not intended to be exhaustive. Table 3 gives information on the contaminants associated with the PSOCs. Big Mesa MDWCA and the SWP Team will update the inventory yearly or as necessary.

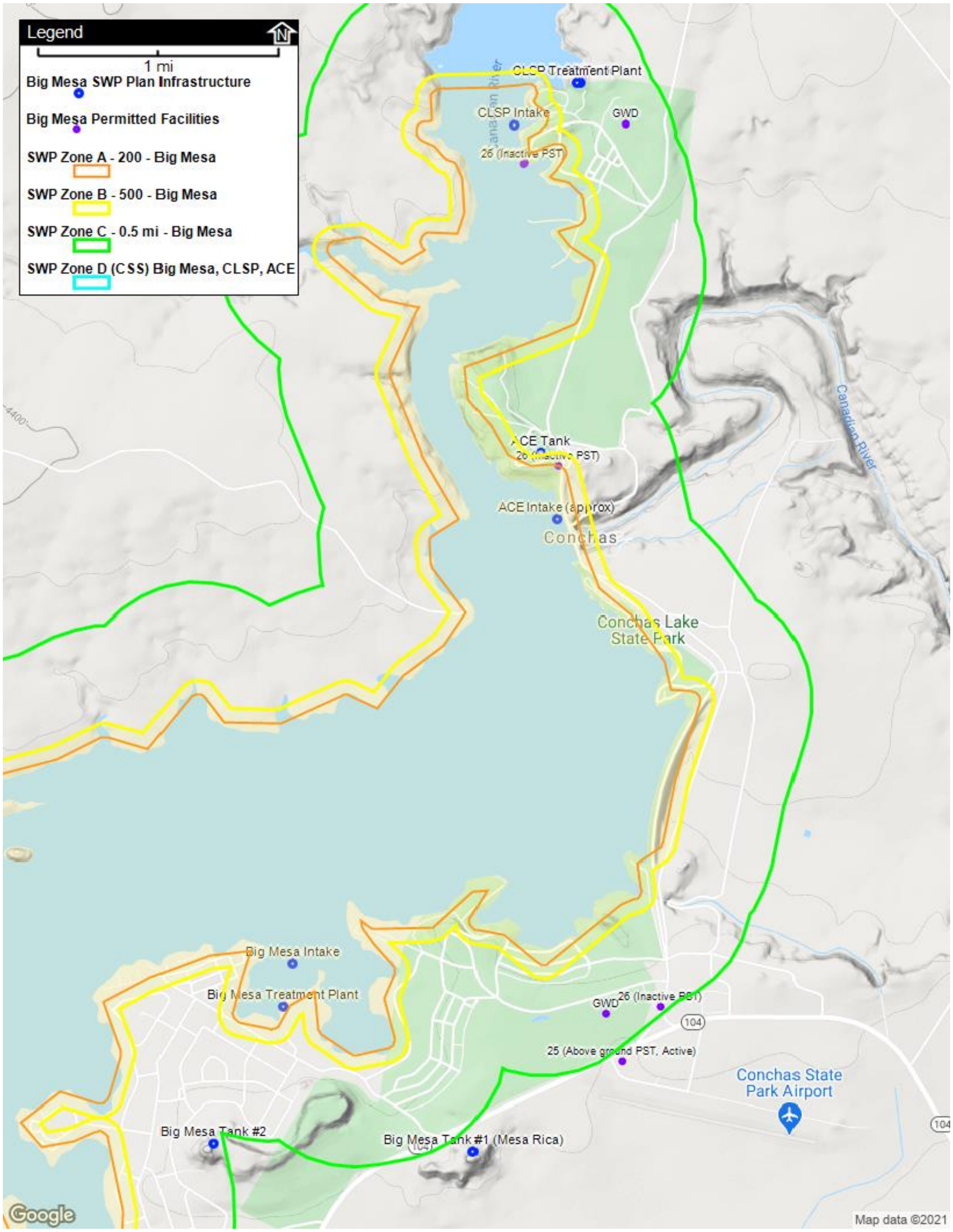

Figure 8. Permitted and Regulated Facilities in the Big Mesa SWP Area. In addition to drinking water-related facilities are groundwater discharge permits (GWD) and petroleum storage tanks (PST).

Table 2. List of PSOCs identified for the Big Mesa MDWCA SWP Zone.

Feature Type	PSOC Description	Zone A	Zone B	Zone C	Zone D*
1	Abandoned/Razed structures			Y	Y
2	Animal pens/Corrals				Y
3	Canal			Y	
4	Drainage	Y	Y	Y	Y
5	Land use: Agriculture				Y
6	Land use: Forest/Open Rangeland	Y	Y	Y	Y
7	Land use: Residential - Septic system	Y	Y	Y	Y
8	Major Transportation/Utility Corridor		Y	Y	Y
10	Road (paved)	Y	Y	Y	
10	Parking lot				
10	Dam Feature (Spillway)				
11	Road (unpaved)	Y	Y	Y	Y
12	Utility Feature		Y	Y	
15	Canadian River			Y	Y
16	Land use: Commercial			Y	Y
18	Airport/Airstrip				Y
19	Land use: Water Recreation (Boat ramp)	Y			
20	Land use: Outdoor Recreation (Campground)	Y	Y	Y	
21	Land use: Outdoor Recreation (Campground - Toilet facilities)	Y	Y	Y	
22	Cemetery				Y
23	Community Collection Station				Y
25	PST (Above ground)				Y
26	PST (Inactive)	Y		Y	
	PST (Inactive, leaking [closed])				
27	Stock tank/Water impoundment				Y
28	Storage Area (Boat/RV)			Y	Y
	Storage area (Vehicles)	Y	Y	Y	Y
1, 17	Abandoned structures/Salvage areas				Y
20, 16	Land use: Outdoor Recreation/Commercial		Y		
20, 16	Land use: Commercial/Outdoor recreation (Golf course)			Y	
7, 16	Land use: Residential/Commercial - Septic System	Y	Y		
29, 30 GWD	Land use: Residential/Commercial - GWD Permit		Y		
GWD	Lagoons (Groundwater Discharge Permit)			Y	
IT	PWS Feature - Intake	Y			
TF	PWS Feature - Water treatment facilities			Y	
WH	Wellhouse			Y	
WT	Water tank			Y	

*Zone D is limited to critical stream segments between 1-10 miles from the intakes in Conchas Lake.

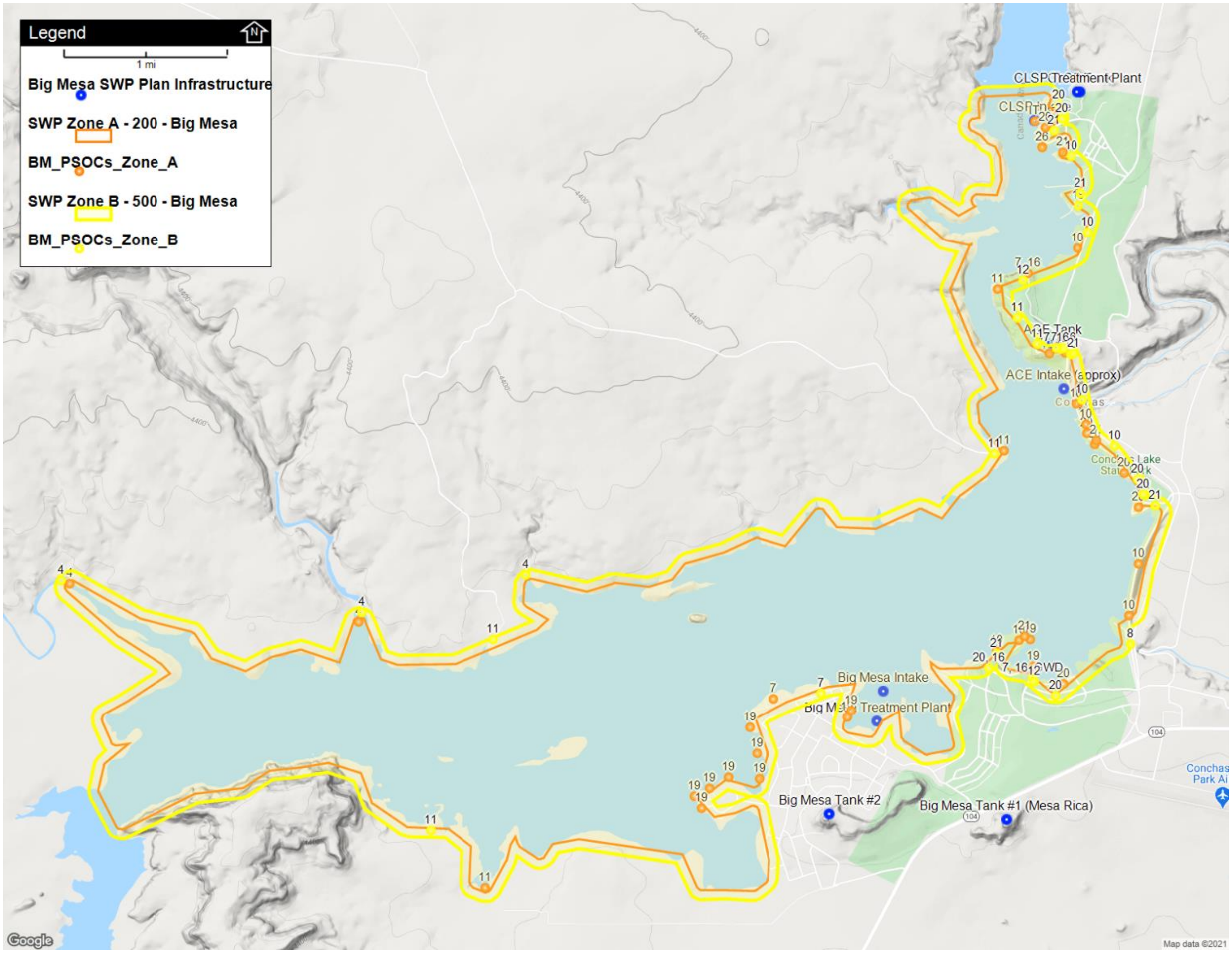

Figure 9. PSOCs in Big Mesa MDWCA SWP Zones A and B.

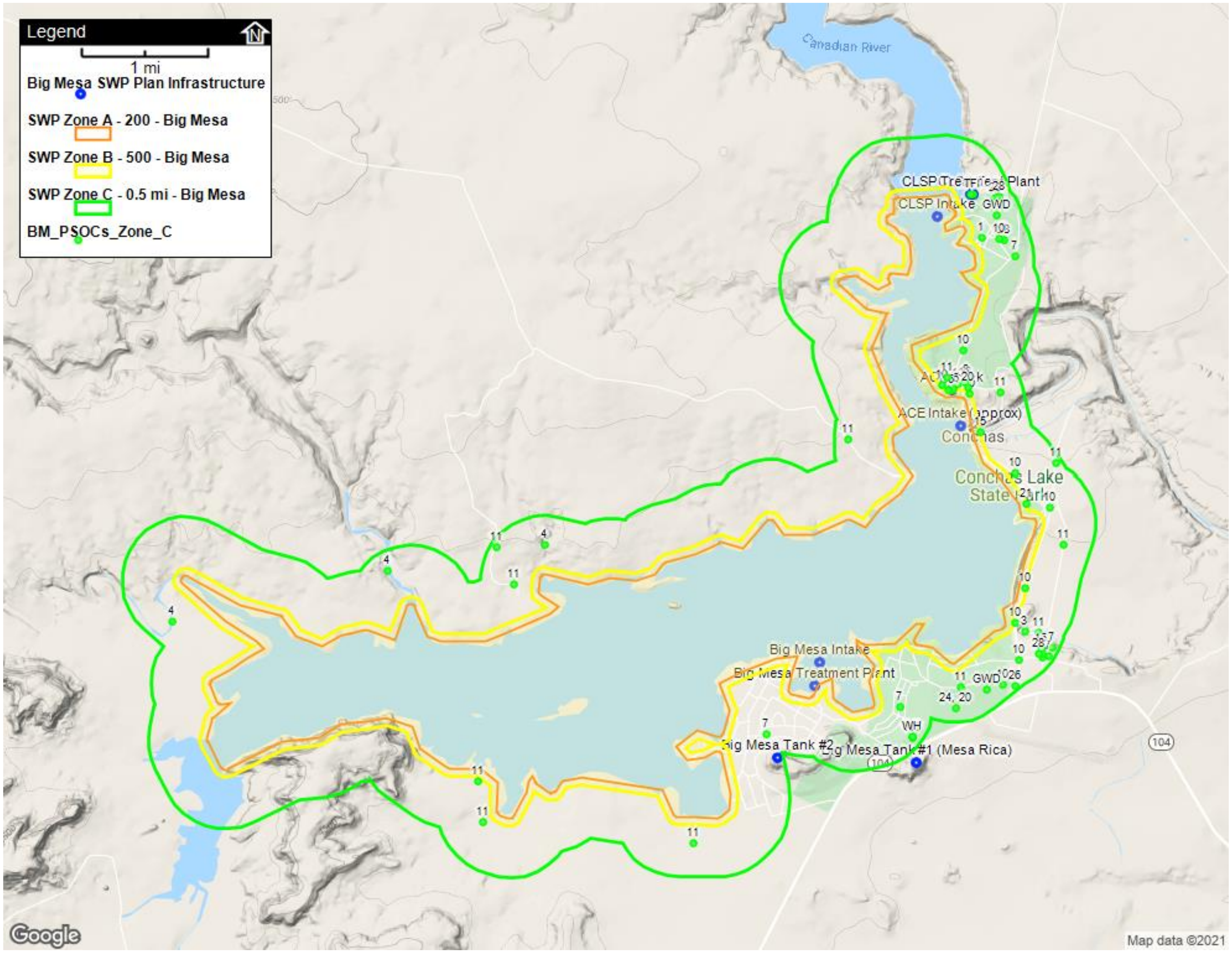

Figure 10. PSOCs in Big Mesa MDWCA SWP Zone C.

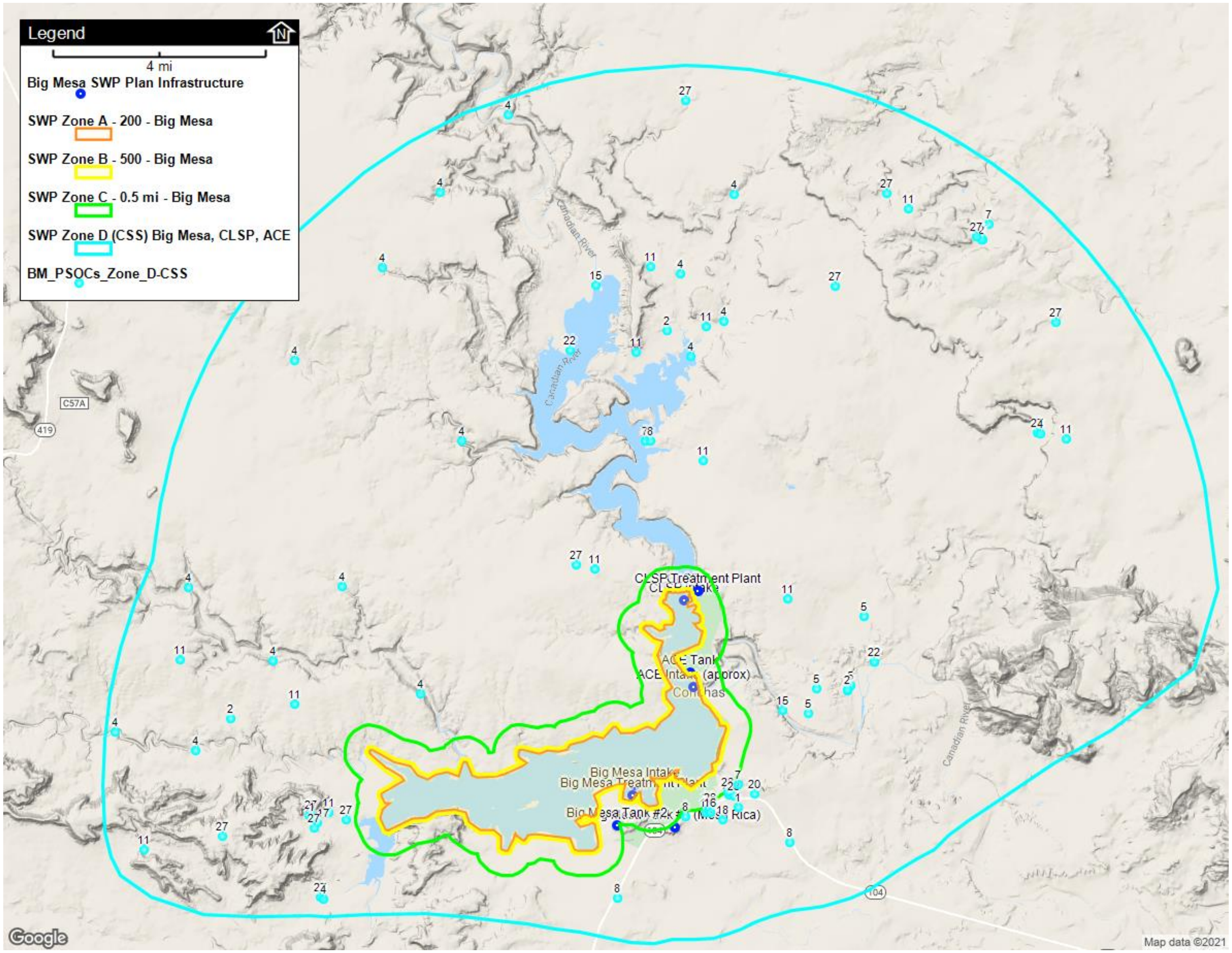

Figure 11. PSOCs in Big Mesa MDWCA SWP Zone D.

Table 3. Contaminants Associated with Identified PSOCs by general land use, and Level of Concern. The Level of Concern is based on general knowledge of the PSOC and likelihood of it affecting source water (See also Appendices C and D).

Feature Types	PSOC	Types of Contaminants	Land Use	Level of Concern
	Land use: Agriculture			
3, 4, 15	Acequias, Arroyos, Ditches, Streams, Rivers, And Other Waterways Acequias, arroyos, riverside drains, ditches, and streams are intimately linked with the adjacent groundwater formations. It is possible for contaminants such as pesticides, fertilizers, and salts to. Contaminants such as pesticides, fertilizers, and salts, can enter the aquifer system through these waterways, or be carried to surface water bodies including the Canadian and Conchas Rivers and Conchas Lake.	Pesticides, Herbicides, Fertilizers, Nitrate, Pathogens	Agriculture	Low
5	Agricultural / farming practices The use of pesticides, herbicides, fertilizers, and manures can cause field leaching or runoff into surface and ground water. The two main components of fertilizer that are of greatest concern to source water quality are nitrogen and phosphorus. Nitrogen fertilizer is biologically transformed to nitrate that is highly soluble in water and can readily be absorbed and used by plants. Soluble nitrate is highly mobile and can move with water through the soil. Excess fertilizer use and poor application methods on these fields can cause fertilizer movement into surface and groundwater.	Pesticides, Herbicides, Fertilizers, Nitrate, Ammonia, Chloride, Phosphate, Pathogens	Agriculture	Moderate
2	Animal Pens / Corrals / Pens / Feeding Areas Corrals, pens, and areas where livestock are kept can concentrate their waste. A study performed in the U.S. shows that animal waste is generated at a rate 13 times greater than human waste. The environment can be affected by livestock waste through direct discharges, open feedlots, animal housing, and pastures. The greatest health concern from animal waste consists of pathogens such as Cryptosporidium and Giardia lamblia. Animal waste may also have solids that increase turbidity and decrease the aesthetic value of water. There is increasing evidence to suggest that domesticate animals in concentrated numbers may be responsible for elevated levels of hormones in some water sources.	Pesticides, Herbicides, Fertilizers, Nitrate, Ammonia, Phosphate, Chloride, Pathogens, Pharmaceuticals, Fungicides	Agriculture	Low
3, 27,	Drainage Canals, Ditches or Acequias-Unlined, Wells (Private, Stock wells, and Irrigation) Contaminants such as pesticides, fertilizers, and salts, can enter the aquifer system through arroyos, canals, drainages, and irrigation ditches, as well as streams and creeks.	Pesticides, Herbicides, Fertilizers, Nitrate, Pathogens	Agriculture	Low

Feature Types	PSOC	Types of Contaminants	Land Use	Level of Concern
2, 5, 6,	Ranching and farming Ranching activities, including livestock (cattle) grazing can affect riparian health, stream-channel conditions, and water quality. Common water quality impacts include pathogen contamination, sedimentation, and increased water temperatures from loss of vegetative stream coverage.	Nitrate, Ammonia, Phosphate, Chloride, Pesticides, Pathogens	Agriculture	Low
	Land use: Commercial			
16	Adobe Bell Resort/ACE Complex See Septic and other wastewater systems	Pesticides, Fertilizers, Organic/Inorganic Chemicals, Septage, Septic Effluent, Pathogens, Nitrate, Ammonia, Chloride, Paints, Solvents	Commercial	Moderate
18	Airport/Airstrip Typically, small airports and airstrips are associated with a variety of potential pollutants, including aircraft fuels, deicers, diesel fuel, chlorinated solvents, automobile wastes, pesticides, and fertilizers. These can leach into surface or groundwater or enter surface and groundwater systems as part of stormwater runoff. According to the EPA (2006b), the main activities resulting in pollutants at air transport facilities are aircraft deicing/anti-icing; runway deicing/anti-icing; aircraft servicing; aircraft fueling; aircraft, ground vehicle, and equipment maintenance and washing; and runway maintenance.	Aircraft Fuels, Deicers, Batteries, Diesel Fuel, Chlorinated Solvents, Automobile Wastes, Heating Oil, Building Wastes, Sewage, Septage, Pathogens, Pesticides, Fertilizers	Commercial	Low
28	Boat and RV Storage Area Lots where recreational vehicles are occupied or stored may have a variety of potential contaminants on site. If residents do not dispose of RV wastewater responsibly, these wastes could enter PRWUA's water supply. Moreover, leaks or spills of automotive fluids or improper disposal of household hazardous waste may affect the drinking water supply. Generally, these may affect groundwater and surface water through stormwater runoff. Oils, volatile organics, and other compounds can also soak into the ground and be carried into the aquifer. RV owners should maintain their wastewater systems.	Gasoline, Diesel Fuels, Septage, Wood Treatment Chemicals, Paints, Varnishes, Automotive Wastes, Solvents, Building Wastes	Outdoor Recreation	Moderate
20	Campground (unsewered) See Septic and other wastewater systems	Septage, Gasoline, Pesticides, Organic/Inorganic Chemicals	Outdoor Recreation	Moderate

Feature Types	PSOC	Types of Contaminants	Land Use	Level of Concern
22	Cemeteries Upon death, human remains are typically cremated or inhumed (buried), with inhumation usually occurring in cemeteries. Decomposition of inhumed bodies results in leachates (liquids). Leachates may include embalming fluids, materials from the coffin and from clothing, or ornaments/decorations laid with the body. Over time, leachates seep into soil and may contaminate ground or surface water.	Leachate, Arsenic, Mercury, Pesticides, Fertilizers	Commercial	Low
16, 20, 24	Golf course Primary contaminants of concern are fertilizers, especially those containing nitrogen and phosphorus, which can leach into groundwater or be carried in runoff into surface waters after application. Although application practices can affect water quality, a greater risk could come from spills of larger volumes of the concentrated chemicals used to mix fertilizers and pesticides for application. Other potentially hazardous materials, such as fuels and paints that are used in everyday operation and maintenance, can contaminate water quality if accidentally released. In some cases, fecal matter by resident and migrating waterfowl may contribute to water quality impairment through nutrient enrichment.	Fertilizers, Pesticides, Gasoline, Automotive Wastes, Batteries, Septage	Commercial	Low
1, 23	Historic Dump/Landfill Historic dumps often have unknown contaminants, such as solvents, fuels, and volatile organic compounds, in unknown quantities. These sites might not have been developed with the same safety measures now required. Pollution may contaminate ground water and surface water or pose a direct threat to public health by seeping into pipes that deliver finished drinking water	Leachate of Organic/Inorganic Chemicals, Acids, Bases, Metals, Solvents, Gasoline, Diesel Fuel, Pesticides, PCB's, Automotive Wastes	Commercial	Low
25, 26	Petroleum storage tank (above/below ground) (in/active) Small amounts of fuel spilled when filling above-ground storage tanks, during careless fuel delivery, or because of poor management can slowly contaminate the soil. A leak of only one drop per second can release about 400 gallons of petroleum into the environment in one year, resulting in significant soil and groundwater pollution. Until the mid-1980s, most underground storage tanks (UST) were made of bare steel. Corrosion results when bare metal and soil and moisture conditions combine to produce an underground electric current that destroys hard metal. Over time, unprotected USTs can corrode and leak their contents into the environment. Faulty installation or inadequate operating and maintenance procedures also can cause USTs to release their contents into the environment.	Gasoline, Diesel Fuel, Organic/Inorganic Chemicals	Commercial	High

Feature Types	PSOC	Types of Contaminants	Land Use	Level of Concern
	The greatest potential hazard from a leaking underground storage unit (LUST) is that the petroleum or other hazardous substance can seep into the soil and contaminate groundwater, the source of drinking water for nearly half of all Americans. A LUST can present other health and environmental risks, including the potential for fire and explosion.			
16, 20, 28	Recreational vehicle campsites / lots Recreational vehicle campsites can concentrate high volumes of use into relatively small areas. Sites or lots where recreational vehicles (e.g., motor homes, "fifth wheels," etc.) park may be developed – suppling amenities for user comfort – or be an undeveloped area - the site of a temporary residential camp. When parked near or on waterbodies, the potential for water quality degradation increases. Continuous or recurring use at a site can also cause excessive soil compaction, damage to vegetation, and erosion. Potential pollutants generated by use at developed recreation sites include, but are not limited to, human and animal waste, leaks or spills of automotive fluids, or the improper disposal of household hazardous waste or RV wastewater.	Septage, Gasoline, Pesticides, Organic/Inorganic Chemicals	Outdoor Recreation	Moderate
	Land use: Forest/Open rangeland			
6	Forest/Open rangeland Sources of nonpoint source pollution associated with forestry activities include removal of streamside vegetation, road construction and use, timber harvesting. Excessive amounts of sediment in a water body can negatively affect water quality, increase turbidity, and reduce the ability of aquatic organisms to survive.	Nitrate, Ammonia, Phosphate, Chloride, Pesticides, Pathogens	Forest/Open Rangeland	Low
5, 6	Livestock and wildlife Conchas Lake and the surrounding area are home to many types of wildlife –birds, small mammals such as beaver and rodent species, and large mammals including deer, elk, and bears. These animals can affect riparian health, stream-channel conditions, and water quality. Many of the area residents run cattle, horses, and sheep on their lands. The most common water quality impacts from wildlife and livestock are pathogen contamination, sedimentation, and increased water temperatures from loss of vegetative stream coverage. Grazing activities with the highest potential for direct and indirect impacts to water resources include long-term concentrated grazing in riparian areas, and trampling/trailing near water sources. Direct bank damage may	Nitrate, Ammonia, Phosphate, Chloride, Pesticides, Pathogens	Forest/Open Rangeland	Low

Feature Types	PSOC	Types of Contaminants	Land Use	Level of Concern
	add large amounts of sediment directly into streams, especially in wet meadow streams or erosive topography that is prone to gully formation. Wild birds and small mammals also can introduce microorganisms into a water supply through direct contact or from watershed runoff. Wildlife commonly associated with microbial contamination of drinking water supplies include deer, beavers, muskrats, rodents, and geese.			
2	Stock tank/ Water Impoundments Corrals, pens, and areas where livestock are kept can concentrate their waste. A study performed in the U.S. shows that animal waste is generated at a rate 13 times greater than human waste. The environment can be affected by livestock waste through direct discharges, open feedlots, animal housing, and pastures. The greatest health concern from animal waste consists of pathogens such as Cryptosporidium and Giardia lamblia. Animal waste may also have solids that increase turbidity and decrease the aesthetic value of water. There is increasing evidence to suggest that domesticate animals in concentrated numbers may be responsible for elevated levels of hormones in some water sources.	Pesticides, Herbicides, Fertilizers, Nitrate, Ammonia, Phosphate, Chloride, Pathogens, Pharmaceuticals, Fungicides	Forest/Open Rangeland	Low
6	Wildfire and postfire debris flow Wildland fire has the potential to negatively impact drinking water systems by damaging infrastructure and negatively effecting water quality. Postfire impacts can include flooding, debris flows, and landslides. The effect of wildfire on a watershed can be highly variable, depending on the nature of the wildfire and the watershed.	Nutrients, Dissolved Organic Carbon, Major Ions, Metals	Forest/Open Rangeland	Moderate
	Land use: Industrial			
8, 12	Major Transportation / Utility Corridor In addition to the typical pollutant associated with paved and unpaved roads, transportation corridors generally have powerlines and other utilities alongside the road. Maintaining the roads during adverse weather can require the application of road salt or other de-icing materials. Common pollutants include automotive waste, diesel fuels, gasoline, metals, organic/inorganic chemicals, pathogens, PCB's, pesticides, sewage, stormwater runoff, and trash. Offal and other byproducts from hunting and fishing sometimes are dumped at rest stops or along the road.	Pesticides, Gasoline, Diesel Fuels, Automotive Wastes, Organic/Inorganic Chemicals, PCB's, Sewage, Metals, Storm water Runoff, Pathogens	Industrial	Moderate
10, 11	Parking lot/Road (paved/unpaved) Both paved and unpaved road surfaces accumulate pollutants deposited from vehicles during travel. Typical pollutants associated with roads are nutrients, metals, oils and	Pesticides, Gasoline, Diesel Fuels, Automotive Wastes, Organic / Inorganic	Industrial	Moderate

Feature Types	PSOC	Types of Contaminants	Land Use	Level of Concern
	grease, salts, and volatile organic compounds. Road drainage systems also collect contaminants from atmospheric deposition, soil erosion, street dirt and liter, leaf litter and animal waste.	Chemicals, PCB's, Sewage, Metals, Storm water Runoff, Pathogens		
	Land use: Outdoor Recreation			
6, 19, 20, 21	Outdoor Recreation Camping, hiking, horseback riding, and off-road-vehicle use where legal, can pose threats to forested lands and streams. Some undesirable impacts include severely eroded soils, user-created unplanned roads, disrupted wetland ecosystems, as well as general habitat destruction and degraded water quality throughout forested lands. Untreated human waste from campers can enter and contaminate the water system. Some impacts that people taking part in outdoor recreation have on water biology and chemistry are limited spatially to the areas closest to the recreation sites, and temporally occurring only during occupation of the sites. Studies monitoring levels of bacteria (e.g., fecal coliform bacteria), protozoans, and viruses (e.g., Giardia, or Cryptosporidium) show that improper disposal of human and pet waste has the potential, although small, to contaminate drinking water or harm human health. Increased soil compaction and a loss of vegetative cover that can result in higher runoff, and erosion rates.	Nitrate, Ammonia, Phosphate, Chloride, Pesticides, Pathogens, Septage, Gasoline, Pesticides, Organic / Inorganic Chemicals	Outdoor Recreation	Moderate
19	Water Recreation (Boating / Boat ramp) Along a lake shore, residences may be associated with lake access via private boat launches, docks or slips, and shore access for personal watercraft. Boating and physical contact can introduce petroleum products and other volatile organic compounds (VOC's) into the reservoir from marine engines. Human waste and garbage can also be an issue with boating. Personal and non-motorized watercraft such as canoes, kayaks, rowboats, and small sailboats eliminate the risk of petroleum products, but may increase the likelihood of human wastes being released into the lake. Recreational boating activities can also increase the risk of the introduction of aquatic invasive species. Motorboats and personal watercraft are both considered a route for invasive species to travel from water body to water body.	Gasoline, Diesel Fuels, Septage, Wood Treatment Chemicals, Paints, Varnishes, Automotive Wastes, Solvents, Building Wastes	Outdoor Recreation	High
	Land Use: Residential			

Feature Types	PSOC	Types of Contaminants	Land Use	Level of Concern
7	Residences (unsewered) See Septic and other wastewater systems	Septage, Pathogens, Nitrate, Ammonia, Chloride, Heavy Metals, Household Pesticides, Herbicides, Cleaning Agents and Solvents, Fuels	Residential	High
PH, WH	Water supply wells/water treatment plant The easiest way to contaminate an aquifer is by surface runoff running down the well casing into the aquifer. This is a consideration when water supply wells share the same aquifer. The risk of contamination is greater for abandoned and unused wells where proper care of the well might no longer be done. It might also be greater with private wells and wells used for irrigation and stock, which are not regulated in the State of New Mexico.	Organic / Inorganic Chemicals, Chlorine	Residential	Low
	Land Use: Residential/Multiple		Residential/ Multiple	Level of Concern
1	Abandoned structures Abandoned buildings may contribute to blight, illegal activity, degradation of neighborhoods, and be a risk to first responders, the community, and children that live in the area. Many have asbestos insulation, asbestos floor and ceiling tile, lead-based paint, and biological hazards such as mold or animal feces. Abandoned commercial or industrial buildings may have hazardous waste, oil, polychlorinated biphenyls (PCBs), or chemicals such as mercury and acids. Whether any of these hazards could affect source water depends on the nature of the hazard, distance, and direction to the well, soil permeability, and other factors	Pesticides, Herbicides, Fertilizers, Nitrate, Ammonia, Chloride, Phosphate, Pathogens	Residential/ Multiple	Low
29, 30, GWD	Groundwater Discharge Permit See Septic and other wastewater systems		Residential/ Multiple	Moderate
7, 16	Hazardous household waste Products like motor oil, pesticides, left-over paint or paint cans, mothballs, flea collars, weed killers, household cleaners, and CFL light bulbs have materials that, if improperly used, stored, or disposed of, may inadvertently contaminate the water. Pharmaceuticals – over-the-counter drugs and prescription medications, particularly hormones, antibiotics, and cancer medications –can enter the environment, and ultimately drinking water systems. Unmetabolized drugs can pass through humans	Chlorine, Potassium Chloride, Pharmaceuticals, Household Chemicals	Residential/ Multiple	Moderate

Feature Types	PSOC	Types of Contaminants	Land Use	Level of Concern
	and animals and enter the environment. In the past, people were advised to flush unused and expired medications down sinks or toilets, which can contaminate groundwater.			
6, 3, 4, 15	Illegal dumping (especially in/near arroyos, drainages, and streams) Household waste, inorganic and organic chemicals and metals are examples of PSOCs that could stem from illegally dumped debris pile. These debris piles should be cleaned-up and disposed of at a proper waste handling facility as soon as possible. Additionally, "no dumping" signage should be posted in the immediate area of these locations where debris pile to prevent further dumping. Information about illegal dumping should be included in any SWP Plan public outreach activities.	Organic / Inorganic Chemicals, Automotive Wastes, Oil, Gasoline, Runoff from Adjacent Sites	Residential/ Multiple	Moderate
17	Salvage areas Salvage areas, where used motor vehicles and other machines or appliances are stored or dismantled, may have a variety of potential contaminants on site. Generally, these may affect groundwater and surface water through stormwater runoff. Oils, volatile organics, and other compounds can also soak into the ground and be carried into the aquifer.	Leachate of Organic / Inorganic Chemicals, Acids, Bases, Metals, Solvents, Gasoline, Diesel Fuel, Pesticides, PCB's, Automotive Wastes	Residential/ Multiple	Low
7, 17, GWD	Septic and other wastewater systems Ground water contaminants from wastewater systems include coliform bacteria, nitrates, and household hazardous waste. These and other contaminants from septic tanks can cause waterborne disease outbreaks and other serious health effects. Improperly maintained or poorly constructed wastewater systems, including vault toilets and septic systems, are a potential source of ground water contaminants including but not limited to coliform bacteria, nitrates, and household hazardous waste. Ground water contamination from vault toilets and septic tanks can cause waterborne disease outbreaks and other serious health effects. Bacteria and viruses present in the effluent can cause gastrointestinal illness, cholera, hepatitis A, blue baby syndrome, and typhoid if consumed. Inadequate operation and maintenance of septic systems can cause them to fail even if they have been properly installed.	Septage, Septic Effluent, Pathogens, Nitrate, Ammonia, Chloride, Sewage, Pathogens, Metals, Organic / Inorganic Chemicals	Residential/ Multiple	High

4.4 Other Issues of Concern

In addition to the PSOCs named above, the SWP Team has found several issues of concern that could affect Big Mesa MDWCA's drinking water. San Miguel County hazard mitigation plan is not available as it is being updated. Apparently, there are few hazards that could significantly affect Big Mesa MDWCA or the other communities at Conchas Lake. It is worth noting, however, that most hazard mitigation plans do not specifically address hazards to public drinking water systems. Because Big Mesa MDWCA gets its source water directly from Conchas Lake, drought, flooding, wildfire and postfire impacts are natural processes that could change the water system's ability to provide the community with drinking water of the quality and quantity needed.

4.4.1 Conchas Lake for Drinking Water, Recreation, Irrigation, and Flood Control

The initial legislation authorizing Conchas Lake allowed for its use as a municipal water source. Studies done after Conchas Dam was built and the reservoir filled were conducted with this possibility in mind. In addition to Big Mesa MDWCA, both CLSP and the ACE have intakes in the lake and each of the three use it as their sole source of drinking water.

Nevertheless, the Conchas Lake is now managed nearly exclusively for irrigation, flood control, and recreation. The reservoir supplies appropriated water to irrigated lands around Tucumcari, New Mexico. Over one hundred miles of irrigation canals extend the project southeast across the surface of the land. Underground are over six miles of tunnels and three miles of siphons (New Mexico Museum of Art 2010). The Bureau of Reclamation, through the Arch Hurley Conservancy District, oversees the irrigation project.

On May 7, 2020, the ACE released a public notice to inform the public of its plan to revise the Conchas Lake Master Plan and to seek public participation on the plan. The ACE encouraged members of the public to send written comments and suggestions before June 22, 2020. Appendix B (Wastrell 2020) has Graham's questions and comments, sent on behalf of Big Mesa MDWCA, and ACE's responses.

> USACE defines the master plan as the strategic land use management document that guides the comprehensive management and development of all recreational, natural, and cultural resources throughout the life of the water resource development project. … Key topics to be addressed in the revised master plan include revised land classifications, revised natural, cultural, and recreational resource management objectives, recreation facility needs, and special topics such as invasive species management and threatened and endangered species habitat. (McGuire 2020)

In addition to the Conchas Lake Master Plan, the ACE has a "Conchas Lake Shoreline Management Plan" (ACE 2002) to manage the shoreline, and a "Water Control Manual" as the management plan for the water. For the most part, drinking water quality and quantity is absent from these plans:

- ❖ The subject of water quality is only addressed informationally in the master plan. (Wastrell 2020)
- ❖ Water supply is not a primary mission at Conchas Lake and there are no plans to add it as a primary mission at this time. (Wastrell 2020)

- ❖ The subject of water supply is not part of the master plan. USACE addresses issues of climate change, droughts, and floods in terms of environmental and cultural resource impacts at Conchas. (Wastrell 2020)
- ❖ Our water control manual is ... outdated [and] does not have any details on the three drinking water intakes ... The manual is focused on the water quantity (irrigation) and flood control operations. (personal communication, Roberta Ball, March 30, 2021)

The Shoreline Management Plan acknowledges the presences of the Big Mesa MDWCA intake:

> 1-06 i. **Prohibited Access Area** – Those areas in which public access is not allowed or is restricted for health, safety or security reasons. These include hazardous areas near the dam, spillway, irrigation intake structure, work areas, and water intake structures. No shoreline use permits will be issued in Prohibited Access Areas. (ACE 2002)

The ACE considers aspects of the drinking water intakes for recreational areas and emergency response capabilities like contamination events around the intakes. For example, fueling stations at the water's edge and houseboats on the lake were allowed in the past and now are prohibited. These prohibitions should continue because of the risks to the lake water (fuel and sewage) that these activities pose.

The SWP Team recommends that the Master Plan Revision address climate change directly, including drought, extreme temperatures, and sustainability. It should be explicit in its relative balance of recreational use, irrigation, and public water supply.

The Conchas Lake State Park Draft Management Plan (CLSP 2018) shows specific issues and recommendations relating to its water and wastewater systems, and the ability to provide these amenities to its visitors. It does not, however, address drinking water quality or quality issues. Neither the ACE or CLSP have addressed PSOCs or source water protection for their own drinking water intakes. It appears that neither is set up administratively to do so – at least, perhaps, without outside collaboration.

These plans have provisions in place that address aspects of PSOCs named in this SWP Plan. What seems to be missing is planning that specifically considers that Conchas Lake is the source of drinking water for several communities, both seasonally and year-round.

Both the ACE and CLSP manage Conchas Lake for a variety of purposes. The ACE Master Plan and the CLSP Draft Management Plan anticipate improvements to existing recreational facilities and possibly the development of more amenities – pedestrian and biking trails are referenced specifically in the CLSP Draft Management Plan. Since the ACE Master Plan was last updated in 1976, and the current Master Plan is still in development, it is unclear what the new plan will look like.

The SWP Team recommends that Big Mesa MDWCA share this SWP Plan with both the ACE and CLSP and invite the two entities to collaborate with Big Mesa on how best to meet the multiple use requirements for Conchas Lake while acknowledging it as a critical drinking water source. The

SWP Team believes that BMPs contained in this plan can inform on planning decisions that either agency would make. The BMPs and planning decisions would help protect the quality of Conchas Lake's drinking water without unduly burdening the agencies.

4.4.2 Climate Change

The processes discussed here, as well as other such as extreme weather and excessive heat, are intensified with climate change. Conchas Lake's multiple purposes – recreation, irrigation, flood control, and as a municipal water source - could affect Big Mesa MDWCA's ability to handle any of these natural processes adequately. Warming temperatures exacerbate the conditions that lead to drought, flooding, and wildfire. According to Tebaldi et al., New Mexico is the sixth-fastest-warming state in the nation (2012, cited in Union of Concerned Scientists 2016).

4.4.2.1 Drought

Droughts can have significant economic, social, environmental impacts on public water systems. Generally, these include poor source water quality that may affect treatment and the ability to meet drinking water standards, loss of water supply, Stressed alternative and supplementary water sources due to high demand by other drought-affected users, and increased customer demand. Cost increases and reduced revenues related to drought response are likely to occur as well.

Changes in precipitation and runoff timing, coupled with higher temperatures due to climate change, may lead to diminished reservoir water quality. Increased usage of the water for irrigation could further lower lake levels. As a result of reduced water flow, raw water could have higher concentration of contaminants such as nitrates and less total dissolved oxygen due to stagnation.

High water temperatures, often worsened by low water levels, and an influx of nutrients from upstream farms, grazing lands, or even wastewater treatment plants, can cause blue-green algae blooms. The blooms can be toxic to humans and animals. Blue-green algae blooms closed Abiquiu and Cochiti lakes in 2019, and Elephant Butte has also been monitored for toxic algae. Fortunately, Conchas Lake has not experienced any toxic algae blooms to date. With a warming climate and lowered water levels, however, Conchas Lake may experience algae blooms in the future.

After periods of little or no precipitation runoff can increase if the ground has become dry and compacted. This runoff, carrying more sediment and debris, can increase turbidity and bring more contaminants into the Conchas and Canadian Rivers. It is unclear whether these processes could affect the lake's water quality to the point that it would require more treatment by the Big Mesa MDWCA to keep the level of water quality mandated by the State and acceptable to the community.

Typically, New Mexico's droughts are worst during the summer, which is peak tourist season at Conchas Lake. Seasonal increases in water demand increase the certainty that drought will affect the system. Big Mesa MDWCA's reliance on a reservoir currently managed primarily for irrigation and flood control and the system's limited storage capacity compounds the impact that severe drought could have on the water system and the community. This situation also applies to both the CLSP and ACE's water systems and communities.

4.4.2.2 Flood

According to the EPA, flooding is one of the most common hazards in the United States, and causes more damage than any other severe weather-related event (EPA 2014, https://www.epa.gov/sites/production/files/2015-08/documents/flood_resilience_guide.pdf, accessed November 8, 2020). Loss of power, damaged infrastructure, and changes to water quality are all possible outcomes for a water system experiencing a flood event. Increased sediment not only creates turbidity issues that require more treatment measures but can also clog the system's intake.

> Conchas Lake was originally authorized for flood control, irrigation, and water supply under The Relief Act of 1935 as part of the Works Relief Program. Thereafter, the project was authorized by Congress and fully funded as a flood control project by the Flood Control Act of 1936 as amended by The Flood Control Act of 1938.

There have been four major floods since Conchas Dam was completed – in May and September 1941, September 1942, and June 1965 (http://conchasdam.com/history.htm). Severe storms in June 1965 caused substantial increases in the streamflow of the waters feeding the reservoir. The level of the reservoir rose 11 feet on June 14, and an additional 16 feet by June 18th (CLSP 2018). Big Mesa MDWCA's Contingency and Emergency Response Plans should address the possible affects of flooding on treatment and infrastructure, although this seems a relatively unlikely hazard to the system currently.

Conchas Lake has had no known dam incidents and/or failures (Quay County Emergency Management and the City of Tucumcari 2018). As a federally owned dam, Conchas Dam is required to maintain an Emergency Action Plan (EAP). EAPs include inundation maps as well as lists of critical facilities that may be threatened by the dams. It is unknown whether the Conchas Dam EAP also addresses consequences *within* the dam. For example, whether there has been an assessment about if a dam breach would leave the drinking water intakes in Conchas Lake high and dry.

4.4.3 Wildfire, and its Aftereffects

Within the last decade, New Mexico has experienced wildfires for the greatest acreage burned and most property destroyed in its recorded history. The potential of catastrophic wildfire means potential damage to water quality and quantity and a water system's infrastructure.

San Miguel County (SMC) completed its Community Wildfire Protection Plan (CWPP) in 2007 (AnchorPoint Group 2008). It updated the CWPP in 2018 (AnchorPoint Group 2018). The 2018 Update to the CWPP "… identifies progress made towards wildfire risk reduction goals since the adoption of the 2008 San Miguel County CWPP." Neither the original CWPP or the 2018 update includes an assessment of Big Mesa, but the 2008 CWPP lists the relative hazard risk for the community of Conchas Lake – presumably, this is meant to include Big Mesa, CLSP, and the ACE – as ***moderate***. The SMC CWPP recommends survivable space treatments, homeowner outreach and education, home hardening, and reductions of flammable yard debris, which the Big Mesa MDWCA and residents of the community should adopt.

The impact of wildfire and post debris flow on municipal water systems can be underrated. Although wildfire risk is moderate for the communities at Conchas Lake, the following discussion is useful for knowing what to expect in the case of wildfire and postfire debris flows in the area. A significant fire above Conchas Lake could still impact these communities' drinking water. Following the Las Conchas Fire (2011), the Albuquerque Bernalillo County Water Utility Authority had to close its surface water intakes because of ash and debris in Cochiti Reservoir and the Rio Grande. Bonito Lake was a surface water source for the town of Carrizozo, until the Little Bear Fire (2012). The town estimates that it will be at least another year (2022) before they will be able to use water from the lake again.

Sham et al. (2013) surveyed representatives of fire-impacted water systems in the United States, Canada, and Australia. Wildfire impacts are most devastating on drinking water systems whose source water is surface water. Wildfire can affect groundwater systems negatively, too. Figures 6 and 7 are taken from of Figures 3.6 and 3.7 of Sham et al. (2013:56 and 57 respectively). These figures illustrate the types of long- and short-term damages that a drinking water system can sustain due to wildfire.

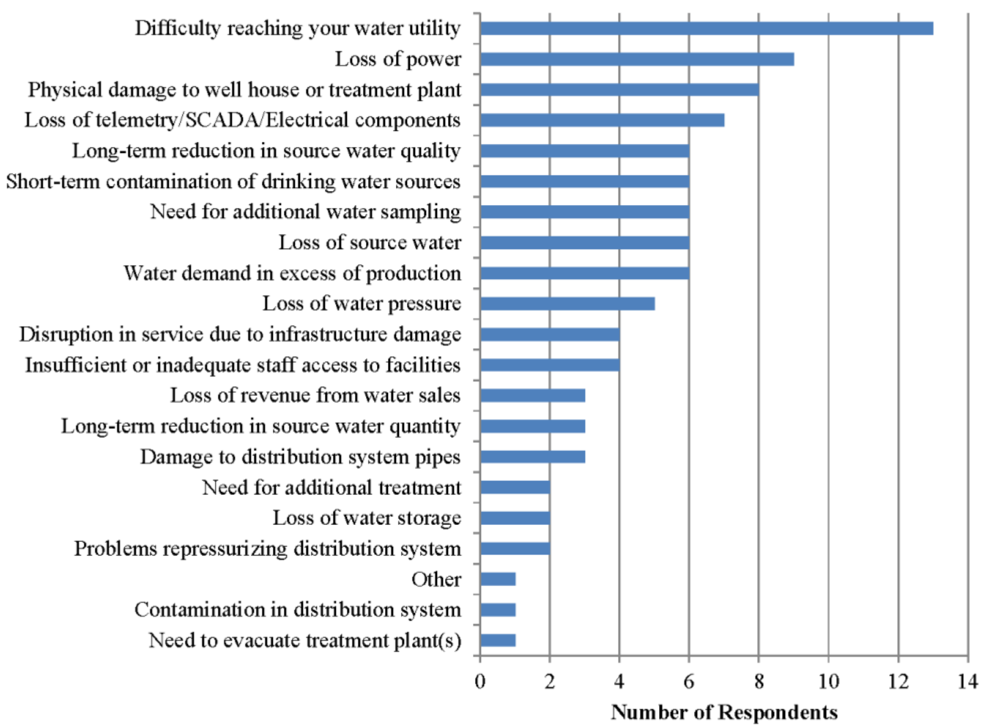

Figure 12. Damages Sustained by Drinking Water Utilities during a Wildfire (Sham et al. 2013).

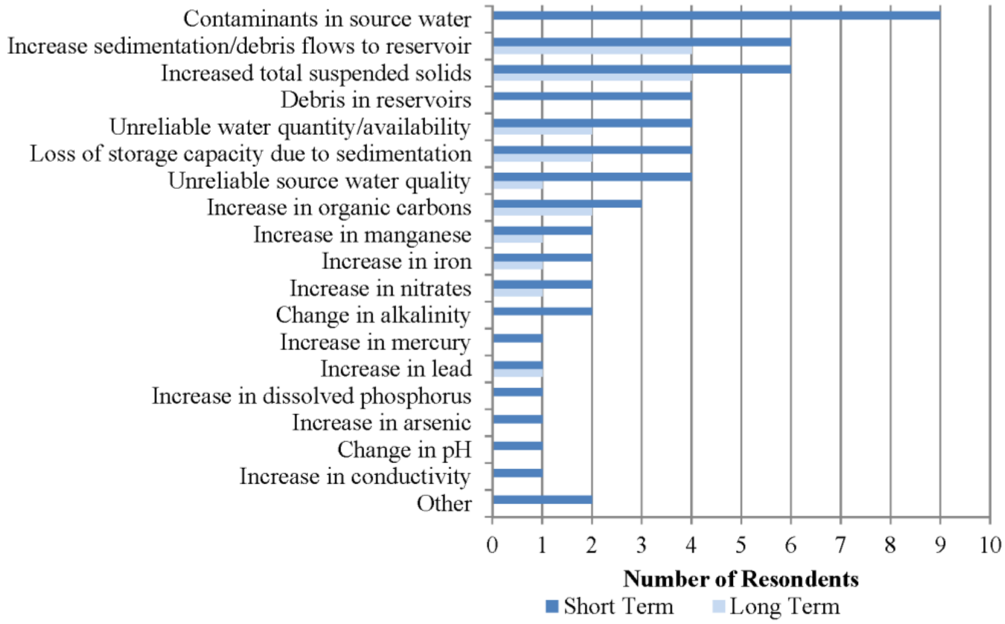

Figure 13. Short Term and Long-Term Impacts Resulting from Wildfire (Sham et al. 2013).

Initial effects of wildfire might be in the form of debris-flows affecting reservoirs, intakes, and other water treatment facilities (Sham et al. 2013). The first heavy rains could significantly affect water quality. Affects to water quality could include elevated turbidity, dissolved organic carbon, increased nitrogen and phosphorous, increased pH and alkalinity, and elevation of some heavy metals and minerals. One possible outcome of wildfire would be changes in how, or whether, the source water is treated. The water system may see watershed and water quality effects that last for over a year (Sham et al. 2013, citing Clark 2010). Other research has showed a return to pre-fire water quality for some systems that spans 5-10 years (SWCA 2018).

The effects that wildfire and postfire debris-flows would have on a water system are highly variable, depending on factors ranging from the severity of the fire to the topography to the nature of the water system. Surface water systems are likely to experience more immediate and more long-term effects than are groundwater systems, although the infrastructure of both types of systems is vulnerable.

The ramifications of forest treatments, wild/prescribed fire and postfire processes on drinking water systems is not well or explicitly integrated into forest management plans. Fortunately, this situation is changing. Initially, it might take added effort on the part of water systems and their communities to reach out to the federal, state, and local agencies to educate them about the importance of maintaining high quality drinking water for communities. Stressing the vulnerability of antiquated infrastructure while acknowledging that these are the systems on which communities are relying is also important.

5 Managing the Source Water Protection Area

Protective strategies integrate the information collected in the delineation and inventory steps and provide workable strategies for preventing, detecting, and responding to ground water contamination within a SWP Area. These strategies range from local regulations or ordinances to public education and voluntary action. Using a combination of regulatory and nonregulatory methods Big Mesa MDWCA can manage the PSOC that we found in its SWP Area. Regulatory methods can include zoning ordinances that address land uses, design standards on new or existing facilities, and mandatory use of certain practices that reduce or prevent pollution. Nonregulatory approaches rely on voluntary implementation to be effective. At the core of any nonregulatory method is information and education. The goal of public education is to inform the public so they can support drinking water protection efforts.

5.1 Regulatory Approaches

5.1.1 Bylaws, Resolutions, and Signage

As an unincorporated community, Big Mesa is does not have the ability to write laws or regulations. As a mutual domestic, however, the Big Mesa MDWCA functions as a government on some levels. It can pass resolutions or amend its bylaws on source water protection. It can also apply to San Miguel County, as well as the ACE, to set up protections on behalf of Big Mesa and its drinking water system. The ACE already has designated the area around the intake as a Prohibited Access Area. The SWP Team or Big Mesa MDWCA should confirm that this area is adequate for protecting the intake (e.g., a 200-foot to 500-foot radius around intake) and designate it as a Source Water Protection Zone.

Another regulatory approach, which the Big Mesa MDWCA already implements is to secure its treatment plant and limit access to critical infrastructure. Posting signage prominently on or around the perimeter of the storage tank and the treatment facility can be considered another regulatory approach. For a small fee, the NMRWA can provide signage saying that tampering with the facility is a federal office. We recognize that, in some communities, posting signage has served more as an invitation than a warning.

5.1.2 Water Quality Monitoring

Federal rules state that all public drinking water systems must monitor their water supply for public health threats. Following Federal and State regulatory statutes, Big Mesa MDWCA samples monthly for bacterial analysis and annually for listed SDWA analytes for Consumer Confidence Reporting.

The New Mexico Water Conservation Fee funds this sample collection (except for lead and copper sampling) and testing for primary inorganic, organic, and radiological contaminants following SDWA monitoring requirements. The fee also covers routine microbiological testing, but not collection of the samples. The NMED DWB handles sample collection for routine chemical monitoring. Costs related to sample collection and testing for secondary contaminants are the responsibility of the individual water system.

The above-mentioned approaches can be used to help reduce water contamination risks from specific contaminant sources. Regulatory options alone, however, are not always as practical or necessary for effective source water protection in small systems as other approaches such as educational programs and community conservation efforts.

5.2 Nonregulatory Approaches

The nonregulatory management approaches discussed here are intended to reach as broad a spectrum of the community as possible. Protection of Big Mesa's drinking water is best ensured when the whole community cooperates to achieve protection.

5.2.1 Best Management Practices (BMP)

The SWP Plan is a planning and management tool. Several considerations in establishing baseline information for the SWP Area are to inventory the full range of PSOCs, assess the current level of risk, and compile BMPs that will help ensure minimal risk to the Big Mesa MDWCA's source water into the future. Table 4 lays out the basic BMPs to follow for the PSOCs that we list in this SWP Plan. Appendix C gives more information about the PSOCs and BMPs that are discussed here.

Table 4. Best Management Practices for PSOCs Identified within the Big Mesa MDWCA SWP Area.

Potential Source of Contamination	**Best Management Practices**
Abandoned structures	*See Household hazardous waste, Illegal dumping, and Salvage areas*
Agriculture and farming practices	1. Cut excess use of agricultural chemicals by planting native plants and grasses. 1. Time the application of chemicals with periods of greatest crop uptake 2. Avoid applying chemicals near wells, drainages, and any type of surface waters. 3. Store and dispose of chemicals properly, following the directions on the label. 4. Avoid bulk storage of these substances
Animal corrals /pens and watering/feeding areas	1. Divert clean water away from manure piles to avoid contaminating runoff that might enter water sources. 2. Compost to eliminate and reduce the volume of manure. Locate compost sites away from SWP Areas to prevent leaching during precipitation events. Composting requires proper temperatures and a proper amount of time to kill the pathogens. 3. None of the livestock operations within the Big Mesa MDWCA SWP Area appear to rise to the level requiring State regulation (Agriculture Compliance Section of NMED's Groundwater Quality Bureau).
Cemeteries	1. Require proper sealing and drainage of site. 2. Outreach to owners and maintenance personnel 3. Work with owners for proper pesticide / fertilizer application *NB: Both cemeteries are historic and unlikely to have the PSOCs typically associated with modern cemeteries. BMPs are included here for completeness and general guidance*
Drainages (acequias/rivers/ streams)	1. Coordinate with the ACE and State Park on waters feeding into the Conchas Lake. 2. Involve individuals living near drainages in outreach activities in the SWP Area. 3. Encourage proper irrigation techniques, which decrease the risk of surface contaminants from entering the groundwater. 4. In cooperation with others, such as ranchers and federal and state land managing entities routinely check the condition of arroyos and drainages and follow the BMPs to prevent any contamination.

Potential Source of Contamination	Best Management Practices
Forest lands/open rangeland	1. Grazing activities with the highest potential for direct and indirect impacts to water resources include long-term concentrated grazing in riparian areas, and trampling/trailing near water sources. 2. Reduce erosion and sedimentation by a controlling the volume and flow rate of runoff water, keep the soil in place, and reduce soil transport. 3. Reduce the impacts of grazing on water quality, by adjusting grazing intensity, keeping livestock out of sensitive areas, giving them alternative sources of water and shade, and promoting revegetation of ranges, pastures, and riparian zones. 4. Implement deferred rotation and rotate livestock through several pastures to prevent over-grazing. 5. Placing salt blocks at a distance from water sources to keep livestock from trampling riparian areas and lessen the potential for pathogens.
Historic landfill	1. Identify historic disposal sites and the materials disposed of in the landfill. 2. Define populations that may be at risk from historic disposal practices. 3. Estimate users and uses of groundwater near the sites. 4. Identify areas of potential air releases from historic fill activities. 5. Conduct future investigations if necessary. *NB: According to the ACE (Peter Drevnik, personal communication April 15, 2021), the Conchas City landfill "is located under the rocks at the irrigation headworks. It was located in 2012 and surveyed extensively for archeological artifacts and hazards around that time. None were found and rock was placed this year to prevent further erosion." The landfill is down stream of Conchas lake and leaching into the lake is highly unlikely.*
Household hazardous waste	1. Read labels and watch for products that say they might need special handling (e.g., caution, flammable, toxic, corrosive, explosive, poison). Follow directions, use recommended amounts, recycle/dispose of properly. 2. Contact local officials before pouring products down the drain or for instructions on handling corroding containers. Households with septic systems should be especially careful and only dispose of small quantities of diluted products. 3. Do not flush old or unused pharmaceuticals down the drain. 4. Take unwanted drugs to a collection site or dispose of following DEA or EPA recommended procedures.
Illegal dumping in arroyos, drainages, and streams	1. Enforce litter and trash removal. 2. Involve the individuals living or recreating near these arroyos and drainages in outreach activities regarding source water protection. 3. In cooperation with others, monitor the condition of arroyos and drainages and develop appropriate ordinances and land use recommendations near streams and arroyos. 1. Enforce "Leave No Trace" and standard guidance for motorized and unmotorized recreational vehicles.
Outdoor recreation – Land based	1. Work with the ACE and Conchas Lake State Park to educate campers and hikers. 2. Establish setbacks for campsites from surface water and proper waste containment and disposal least 200 feet away from water sources. 3. Avoid transmission of pathogens or contamination of water sources in wildland recreation by depositing waste in 6- to 8-inch-deep cat holes at least 200 feet away from the nearest water source. 4. Minimize the effects of recreational activities within the watershed from both motorized and non-motorized activities. Prevent recreational vehicle damage to stream banks and wetland areas within SWP Areas.

Potential Source of Contamination	Best Management Practices
	5. For permitted activities using horses or other animals, inform permittees about source water protection. Recommend best practices to ensure activities avoid or minimize impacts in or near springs and streams.
Outdoor recreation – Water based	1. Work with the ACE and Conchas Lake State Park to educate boaters and fishers. 2. Develop/Review protocols for gas and oil spills near the intakes. 3. Signage and outreach materials on dumping in the lake, etc.
Pesticide application	1. Implement education program and notification program for spraying by the public within SWPA. Education outreach may include mailings and personal communication to promote watershed stewardship to minimize water quality impacts. 2. Consider monitoring at the intake for pesticides. 3. Review and monitor the BMP's and regulations that agencies and other organizations use (e.g., ACE, CLSP). 4. Time herbicide application in relation to soil moisture, expected weather conditions, and recommended measures to protect water supplies. Monitor the weather (temperature, wind speed, wind direction, and humidity) and avoid application of herbicide when heavy rains are forecast to prevent runoff of herbicide into nearby waterways. Avoid application during windy weather to prevent drift of herbicide into waterways or buffer zone. 5. Communicate with farmers and ranchers in the area so that they are aware that Conchas Lake serves as a drinking water source for Big Mesa MDWCA, ACE, and CLSP.
Ranching and farming	1. Maintain awareness about water quality and land use. 2. Adopt pasture or grazing management methods that keep livestock from concentrating around bodies of water. Fencing can prevent damage to stream banks and keep livestock from defecating in or near streams and intakes. 3. Supply alternate water sources and hardened stream crossings for livestock to reduce impacts on water quality.
Roads	1. Maintain roads and trails to minimize erosion and control runoff. 2. Limit routes for off-road vehicles to avoid accidental spills within SWP Areas.
Salvage areas	1. Clean up, collect, and contain debris in storage areas on a regular schedule. Inspect drums, tanks, and containers for leaks and structural conditions. 2. Minimize exposing potential pollutant sources to precipitation by covering materials or activities or moving them indoors. 3. Limit erosion on areas of the site that may be subject to erosion due to topography, activities, soils, cover, materials, or other factors. Implement erosion control measures first and use sediment control to back-up erosion control.
Septic and other wastewater systems	1. Septic tank owners should continuously monitor the operation of their septic system. 2. Septic tanks should be pumped and inspected periodically (usually every 2 years). 3. Follow NMED setback requirements for the siting of septic systems. Septic tanks must be at least 100 feet from a community wellhead and the leach field must be at least 200 feet from the wellhead. 4. Provide signage naming SWP Areas and appropriate treatment of trash, human and dog waste, and other possible pollutants. 5. Supply educational materials about the appropriate disposal of human and pet waste.
Stormwater runoff	1. Preserve undisturbed vegetative cover during land development rather than destroying these features and constructing new stormwater management practices to replace their functions. 2. Manage runoff through healthy soil development and vegetative filter strips that trap sediment, nutrients, pesticides, and bacteria away from streams or other waterways.
Water supply wells /treatment plant	1. Ensure that the treatment plant is free of PSOCs and has intact integrity. 2. Follow federal and state guidelines for storing chemicals used to treat drinking water.

Potential Source of Contamination	Best Management Practices
Wildfire and postfire impacts	1. Consider making Big Mesa a Firewise USA community 2. Engage with San Miguel County emergency responders and forest and fire professionals to educate them about Big Mesa MDWCA and appropriate considerations of the system during forest treatments and fire/postfire activities within the Conchas and Upper Canadian Watersheds. 3. Anticipate postfire impacts such as erosion and debris flows in developing forest treatments. 4. Implement equipment that can track quickly rising water flows such as could be seen in a flood (or quickly-dropping - meaning maybe a debris jam somewhere). These instruments included stream gauges, rain gauges, a RAWS (remote automated weather station), and a temporary Doppler system. Coordinate with ACE and/or CLSP if they have and maintain this equipment.
Wildlife and livestock	1. Increase landowner/permittee consciousness about water quality and land use. 2. Address land management measures to minimize high impacts around water sources. 3. Adopt pasture or grazing management methods that keep livestock from concentrating around bodies of water. Fencing can prevent damage to stream banks and keep livestock from defecating in or near streams and intakes. Supplying alternate water sources and hardened stream crossings for livestock can assist in reducing the impact on water quality.

5.2.2 Collaborating on Source Water Protection on Conchas Lake

Conchas Lake is the sole drinking water source for three public water systems – Big Mesa MDWCA, Conchas Lake State Park, and the US Army Corp of Engineers. Besides Big Mesa MDWCA's members who live in the community year-round, the water system has many weekend and vacation residents. At the height of the summer, the population can get as high as 500. CSLP, although a noncommunity system, lists its population served as 450. Thus, although not constant, Conchas Lake supplies drinking water to a significant number of people at various times of the year.

As discussed above, neither the ACE nor CLSP have a specific mandate to manage Conchas Lake as a drinking water source. While each of the three systems have some measures in place to protect this source water, the SWP Team believes that a more comprehensive approach is needed. The SWP Team recommends that the three entities review the Big Mesa MDWCA SWP Plan together and develop a plan that can coordinate the needs of the public water systems to protect their source water. The SWP Team does not see such an approach as calling for a change in the mission of either the ACE or CLSP, rather as being added protection of the waters and watersheds of Conchas Lake. NMRWA's SWP Specialist is available to help convene and facilitate these discussions.

5.2.3 Climate Change Resilience

The SWP Team found drought, flooding, and wildfire as addition areas of concern for the Big Mesa MDWCA. Climate is trending towards more extreme weather events. One definition of *climate resilience* is "the ability to anticipate, prepare for, and respond to hazardous events, trends, or disturbances related to climate" (Center for Climate and Energy Solutions, www.c2es.org). Drought, flooding, warming temperatures, and wildfire are natural processes worsened by changing climatic conditions. Building Big Mesa MDWCA's into a more water resilient system can lessen current concerns about these processes while anticipating the potential for worsening conditions. Reservoir water quality can be maintained or improved by a combination of watershed management, to reduce pollutant runoff and promote groundwater recharge and reservoir management methods, such as lake aeration.

Table 5 gives strategies and BMPs for the other issues of concern that the SWP Team found for the Big Mesa MDWCA SWP Plan. The information on Drought and Flooding comes primarily from the EPA resource page *Climate Impacts on Water Utilities* (https://www.epa.gov/arc-x/climate-impacts-water-utilities). More information and other resources are available at that website. NMRWA has developed the information on wildfire and postfire impacts from the sources referenced below and in consultation with a variety of New Mexico's public water systems and state and federal agencies. Not all the strategies in Table 5 are feasible. Nevertheless, the information in Table 5 serves as a starting point to consider what is possible for the Big Mesa MDWCA in the long-term.

Table 5. Strategies and BMPs for Other Issues of Concern within the Big Mesa MDWCA SWP Area.

Drought	1. Construct New Infrastructure ▪ Build infrastructure needed for aquifer storage and recovery. ▪ Diversify options for water supply and expand current sources. ▪ Increase water storage capacity. 2. Increase System Efficiency ▪ Finance and help system to recycle water. ▪ Practice conjunctive use. Conjunctive use involves the coordinated, best use of both surface water and groundwater, both intra- and inter-annually. 3. Model Climate Risk ▪ Develop models to understand potential water quality changes. ▪ Model and monitor groundwater conditions. 4. Modify Land Use ▪ Implement watershed management. 5. Modify Water Demand ▪ Encourage and support practices to reduce water use locally power plants. ▪ Model and reduce agricultural and irrigation water demand. ▪ Practice water conservation and demand management 6. Monitor Operational Capabilities ▪ Monitor surface water conditions. 7. Plan for Climate Change ▪ Develop emergency response plans. ▪ Update drought contingency plans 8. Repair and Retrofit Facilities ▪ Retrofit intakes to accommodate lower flow or water levels. In areas where streamflow declines due to climate change, water levels may fall below intakes for water treatment plants.
Flooding/Storms	1. Construct New Infrastructure ▪ Build flood barriers to protect infrastructure. ▪ Plan and set up alternative or on-site power supply. ▪ Relocate facilities to higher elevations. 2. Model Climate Risk ▪ Conduct extreme precipitation events analyses. ▪ Develop models to understand potential water quality changes. ▪ Model and monitor groundwater conditions. ▪ Model and reduce inflow/infiltration in the sewer system.

	3. Modify Land Use ▪ Buy and manage ecosystems. ▪ Partner with regional floodplain managers, landowners and managers, and other stakeholders to protect and manage lands within the SWP Area. ▪ Implement green infrastructure at campgrounds and other recreational and administrative areas. Examples of green infrastructure include bio-retention areas (rain gardens), low impact development methods, green roofs, swales (depressions to capture water) and the use of vegetation or pervious materials instead of impervious surfaces. ▪ Integrate flood management and modeling into land use planning. 4. Monitor Operational Capabilities ▪ Monitor current weather conditions. ▪ Monitor flood events and drivers. 5. Plan for Climate Change ▪ Find and protect vulnerable facilities. ▪ Integrate climate-related risks into capital improvement plans. 6. Repair and Retrofit Facilities ▪ Implement policies and procedures for post-flood and/or post-fire repairs. ▪ Improve pumps for backflow prevention. ▪ Increase capacity for wastewater and stormwater collection and treatment. ▪ Increase treatment capabilities
Wildfire and postfire impacts	1. See section below on a Fire Adapted Public Water System. 2. Engage with emergency responders and watershed and fire professionals to educated them about Big Mesa MDWCA and considerations of the system during watershed/forest treatments and fire/postfire activities. 3. Provide input on forest treatment plans to thin private, state, and national forests to prevent catastrophic wildfire and high-severity burns. 4. Partner with Federal, State, and private landowners, and NGOs on improving watershed and forest health. 5. Anticipate postfire impacts such as erosion and debris flows in developing forest treatments. 6. Implement equipment that can track quickly rising water flows such as could be seen in a flood (or quickly-dropping - meaning a debris jam somewhere). These instruments included stream gauges, rain gauges, a RAWS (remote automated weather station), and a temporary Doppler system. 7. Contact the NOAA/National Weather Service to watch weather patterns and issue warnings.

5.2.3.1 Fire Adapted Public Water System

Weather, topography, and fuel are the three factors controlling wildfire behavior. *Fuel* is the only one of these factors that people can influence effectively. Even in this context, control is limited, and usually does not extend to other landowners' property. Nevertheless, the practices recommended below are the basis for a fire adapted water system. They are relevant to Big Mesa MDWCA not only to protect the system's buildings and assets, but to improve the quality, and perhaps quantity, of the water entering Conchas Lake. Improved water quality and quantity can mean treatment savings for Big Mesa MDWCA.

Watershed and Forest Health

One of the most effective ways control fuel loads and minimize the potential for catastrophic wildfire is to address watershed and forest health. While it appears that there are no watershed projects in northeastern New Mexico currently, coordinating with other entities with common interest is an effective way to share resources. Conchas Lake and its watersheds are included in the most recent Forest Action Plan Priority Landscapes "Top 500 Watersheds" (New Mexico Forestry Division 2020). As implementing this SWP Plan, the SWP Team and Big Mesa MDWCA may want to inquire into working whether there are projects that could affect Big Mesa MDWCA's source water and could benefit from the system's participation. This applies, as well, to the potential to collaborate with the ACE and CLSP on watershed-related actions.

Wildfire Threat Reduction

The following information comes from some information available via Firewise USA website (https://www.nfpa.org/Public-Education/By-topic/Wildfire/Firewise-USA , accessed January 23, 2019) and the USFS Fire & Aviation website (http://www.fs.fed.us/fire/index.html, accessed January 23, 2019). Recommendations for reducing the threat of wildfire are presented in three categories: The Built Zone, the Defensible Space Zone, and the Access Zone.

The Built Zone consists of the main structures at the locale and includes how the structures are constructed and maintained. The goal for the Built Zone is to improve the ignition resistance of the structures; if a structure does not ignite, then it cannot burn. While flame contact and radiated heat are a concern, the most significant threat in the built zone comes from flying embers igniting the structure. The roof is the most vulnerable part of a structure to wildfire, as well as being the best predictor of house survivability during wildfire. All vent openings need to be covered with ¼-inch or smaller noncorrosive wire mesh that will not melt or burn. The siding covering the structure's exterior walls and any eaves should also be fireproofed.

The Defensible Space Zone consists of vegetation growing near the structures and other facilities or objects at the locale. It is made up of three areas:

- the *Noncombustible Area* – the area immediately adjacent to the structure and extending at least 3 feet out from the structure;
- the *Lean, Clean, and Green Area*– the area extending at least 30 feet from the Noncombustible Area around the structure; and
- the *Wildland Fuel Reduction Area* – the area around the *Lean, Clean, and Green Area* where native plants grow.

The size of an effective defensible space, extending outward from the structure in all directions, varies depending on the type of vegetation present and the steepness of slope at and around the location. For structures found on flat to gently sloping terrain in piñon-juniper woodland, the recommended defensible space distance is 100 feet from the structure. For structures found on slopes greater than 20 percent, the recommended distance is 200 feet.

Within this zone, dead vegetation should be removed, and living plants should be spaced openly rather than being crowded. On flat to gently sloping terrain, trees within the defensible space zone should be separated from one another by at least twice the height of the average tree and individual shrubs. Small clumps of shrubs should be separated from one another by at least twice the height of the average shrub. In locations on steeper slopes, the separation distance should be greater. There also should be a separation between the lower growing vegetation and the lowest tree branches. "Ladder fuel" is vegetation that can carry fire from lower to taller plants. The recommended separation for ladder fuels is three times the height of the lower vegetation layer. If no understory vegetation is present, lower tree branches should be removed to at least 2 feet above the ground.

Maintain the *Lean, Clean, and Green Area* by not allowing dead vegetation or flammable debris within 30 feet of the structure. Reevaluate the location before each fire season and implement appropriate actions to maintain the defensible space.

The Access Zone is the area that allows firefighters to find and arrive at the locale in a timely manner. Make sure addresses and street signs are clearly visible and made of reflective and fire-resistant materials. Remove flammable vegetation from the sides of a driveway and provide at least a 15-foot vertical clearance.

5.2.4 Public Education

Public education is an essential tool for drinking water protection. Most nonregulatory approaches to source water protection rely on public education for effective implementation. The SWP Team recommends that the information in this SWP Plan be available to all Big Mesa MDWCA members to help promote the necessity of protecting the water supply. The SWP Team further recommends sharing it with the ACE and CLSP.

Public education activities can include any one or a combination of the following: newspaper articles, drinking water protection messages attached to water bills, and school district activities. Big Mesa MDWCA could give educational materials through mailings or public outreach events, such as a *Source Water Protection Day*, to teach and encourage residents to keep their septic systems responsibly, the right ways to handle animal feeding areas and pens, to properly care for private wells, and the proper means to seal abandoned wells. Appendix E includes educational materials on these topics.

Big Mesa MDWCA's Operators and Board can attend training seminars held by NMRWA and receive newsletters having articles on Source Water Protection. NMRWA's Source Water Protection Specialist is available to answer any questions, help in outreach events, and give onsite technical help to the system.

5.2.5 Water Conservation

Another nonregulatory management approach that Big Mesa MDWCA could pursue is to encourage water conservation efforts. Many rural communities in New Mexico already implement water conservation practices such that their daily water use is below the state average. Appendix E also has resources on conservation and sustainability.

5.3 Implementing the SWP Plan – Priorities, Actions, and Responsible Parties

Many aspects of source water protection and Big Mesa MDWCA's SWP Area are beyond its Board's jurisdiction. To effectively implement the Big Mesa SWP Plan, it may be useful to develop a strategy that prioritizes the PSOCs. Developing these priorities PSOCs will help the Big Mesa MDWCA SWP Team, the community, and others decide where to put their efforts in managing the SWP Area. Appendix D outlines an approach for assessing risks and impacts and setting priorities. The SWP Team recommends completing the assessment in Appendix D as a first step in executing the Big Mesa MDWCA SWP Plan.

6 Contingency and Emergency Planning

The fifth step in the SWP planning process is contingency planning. The PSOC Inventory and BMPs provide the Big Mesa MDWCA SWP Team with a starting point to discuss drinking water protection. The inventory of contaminants pinpoints contaminant sources within the SWP Area. However, to mitigate these contaminants, the Big Mesa MDWCA and its SWP Team need to work with the community and landowners to eliminate contaminants or prevent land use practices that could threaten drinking water.

A contingency plan is a blueprint outlining roles and responsibilities if the Big Mesa MDWCA experiences a disruption in its water supply or services. Examples of such a disruption, where it cannot supply services, include contamination; loss of power; natural disasters such as fire or flooding; or accidental hazardous spills within the SWP Areas. Emergency Response Plans can, but do not always, might cover everything that would be included in a Contingency Plan. Contingency and Emergency Response Plans help a water system make well thought-out, educated decisions about the drinking water system under the most adverse conditions. The implementation of these plans increases the likelihood that correct and immediate action will be taken and that any disruption, damage, or potential health risk, both in the long and short term, will be minimized. The availability of some emergency funding is contingent on the Big Mesa MDWCA – and sometimes San Miguel County – having a plan in place that covers the contingency and is ready to implement.

If it is not already a member, the Big Mesa MDWCA should consider joining New Mexico Water/Wastewater Agency Response Network (NM WARN). NM WARN is a private, voluntary agreement between systems to help each other out in emergency situations. The agreement sets out rules that will govern the request and help processes for WARN drinking water and wastewater members.

7 Summary and Conclusions

Appendix D provides a means of assessing risk and control that will more clearly articulate the level of concern for the PSOCs that the SWP Team found. This assessment will help the SWP Team and Big Mesa MDWCA prioritize its efforts in implementing this SWP Plan. Based on the initial priorities listed in Table 3, the Big Mesa MDWCA SWP Team found a high level of concern for only a few PSOCs. These are:

- Septic and other wastewater systems (Campgrounds, Residences, Resorts/Commercial buildings)
- Petroleum storage tank (above/below ground) (in/active)
- Water Recreation (Boating / Boat ramp)

Many of Big Mesa MDWCA's residences have old septic systems, sometimes not well maintained. Contamination from septic systems is one of the most common sources of groundwater contamination in New Mexico. USDA offer loans and grants, at both the community and individual level (e.g., low income seniors) to upgrade septic systems. Graham can help get this information to the community, if requested. The ACE and CLSP wastewater systems are also of concern. Water recreational activities and petroleum storage tanks offer two PSOCs the could introduce fuels and organic and inorganic compounds into Conchas Lake and the surrounding ground surface, with the potential to contaminate groundwater. Offering educational materials, adhering to proper operating procedures, and state and federal oversight are important for preventing fuel leaks and spills.

PSOCs of moderate concern are:

- Agricultural/farming practices
- Boat and RV Storage Area
- Hazardous household waste
- Illegal dumping (especially in/near arroyos, drainages, and streams).
- Major Transportation/Utility Corridor
- Outdoor Recreation
- Parking lot/Road (paved/unpaved)
- Recreational vehicle campsites/lots
- Wildfire and postfire debris flow

The concern in the case of many of these PSOCs is stormwater runoff, either around Conchas Lake (e.g., from roads and parking lots, campgrounds, vehicle storage areas) or in the open rangeland where herbicides, pesticides, and animal waste, and contaminants from illegal dumps, can flow into Conchas Lake via drainages. Implementing BMPs and raising the awareness of the potential for these activities to affect the water quality of Conchas Lake should be part of Big Mesa MDWCA's implementint this SWP Plan.

The PSOCs that the SWP Team found for Big Mesa MDWCA SWP Area can be applied to the ACE and CLSP too. Collaborating with the ACE and CLSP on keeping the quality of their common source of drinking water as high as possible could be one of the most important ways to maintain Big Mesa MDWCA's drinking water quality and quantity for its members. Moreover, the issues of drought, flooding, and warming temperatures are all processes that affect the three drinking water systems. Each water system will benefit from coordinated efforts to address in planning contingencies for these changing environmental conditions.

In conclusion, Big Mesa MDWCA has an established record of working to provide its community with a safe and reliable drinking water supply. The most effective way to protect the water supply is to prevent contamination. This plan serves the interests of the people who live and work in Big Mesa by protecting the drinking water supply at minimal cost to consumers, while supporting compliance with drinking water program regulations. It further serves the interests of those who visit Conchas Lake State Park and the ACE facilities. With the continued dedication of the Big Mesa MDWCA's staff and board, and a heightened awareness of source water protection by community residents and neighboring landowners and land managers, Big Mesa is likely to have a clean, reliable water supply for years to come.

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