Crist Engineers, Inc.

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Consulting Engineers

Stewart W. Noland
Leslie B. Price
Matthew D. Dunn
Craig A. Johnson

August 15, 2018

VIA E-MAIL and U.S. Mail

RECEIVED
AUG 16 2018
RDS 4:25pm

Mr. Miles Johnson
Enforcement – Water Division
Arkansas Department of Environmental Quality
5301 Northshore Drive
North Little Rock, AR 72118-5317

RE: City of Walnut Ridge, Arkansas
CAO LIS 17-040: AR0046566, AFIN 38-00040
Progress Report 02

Dear Miles:

The following components are a brief synopsis of progress regarding the CAO.

Item No.	Date	Description
02-1	2/15/18	Submitted Progress Report 01
02-2	5/22/18	Public election to approve initiative to pledge sales tax revenue for wastewater system improvements - PASSED
02-3	6/18/18	Preliminary Engineering Report findings for Wastewater System Improvements presented to Walnut Ridge City Water Works
02-4	6/18/18	City Council passes resolution for Authorization to Proceed for sales and use tax bonds
02-5	7/18/18	Sales tax initiative Pubic Offering Statement (POS) finalized
02-6	7/30/18	Bond Resolution and bond purchase agreement resolution approved by City Council
02-7	9/11/18	City Scheduled to Receive Bond Funds

Progress Report 02 Summary

A courtesy copy of the Preliminary Engineering Report is included for your records. Should you need any further supplemental information regarding the progress descriptions above, please don't hesitate to give me a call.

With the funding distribution on the project scheduled on September 11, 2018, Crist Engineers, Inc. has provided an updated schedule for the design and construction of wastewater system improvements, which is outlined below. This schedule was presented to the City Water Works Commission on August 14, 2018.

Item No.	Date	Description
1.	9/15/18	Notice to Proceed (Funds Available)
2.	1/2019	50% Complete Design Documents
3.	5/2019	100% Complete Design Documents
4.	5/2019	Submit ADEQ NPDES Modification and Construction Permit
5.	11/2019	Receive ADEQ NPDES Modification and Construction Permit Approval
6.	12/2019	Advertise Project for Bids
7.	2/2020	Award Project to Lowest Qualified Bidder
8.	*6/1/2020*	*ADEQ CAP Deadline for Compliance – Corrective Action Plan, 8/10/17*
9.	5/2021	Complete Construction
10.	6/2021	Proposed Final Compliance

WWTP Schedule of Improvements

As you may be aware, we have scheduled a meeting with your staff at 10am on September 29, 2018, to discuss the current progress and update you on the schedule presented above. We look forward to our visit.

Sincerely,
Crist Engineers, Inc.

Craig A. Johnson, P.E.
Associate

Enclosures: PER for Wastewater System Improvements, June 2018

Cc: Bailey Taylor
ADEQ (no enclosure)

Jon Kopp
City Water Works Manager (no. enclosure)

City of Walnut Ridge
Arkansas 1874

CITY OF WALNUT RIDGE, ARKANSAS
for the CITY WATER WORKS

PRELIMINARY ENGINEERING REPORT
WASTEWATER SYSTEM IMPROVEMENTS
JUNE 2018

CRIST ENGINEERS, INC.
205 EXECUTIVE COURT
LITTLE ROCK, ARKANSAS
501.664.1552
CRISTENGINEERS.COM

City of Walnut Ridge
Preliminary Engineering Report: Wastewater Improvement Project
Table of Contents

Appendix Contents

1. PROJECT PLANNING

This Preliminary Engineering Report (PER) was developed in accordance with the United States Department of Agriculture (USDA) Rural Utilities Service (RUS) Bulletin 1780-2 (October 2013).

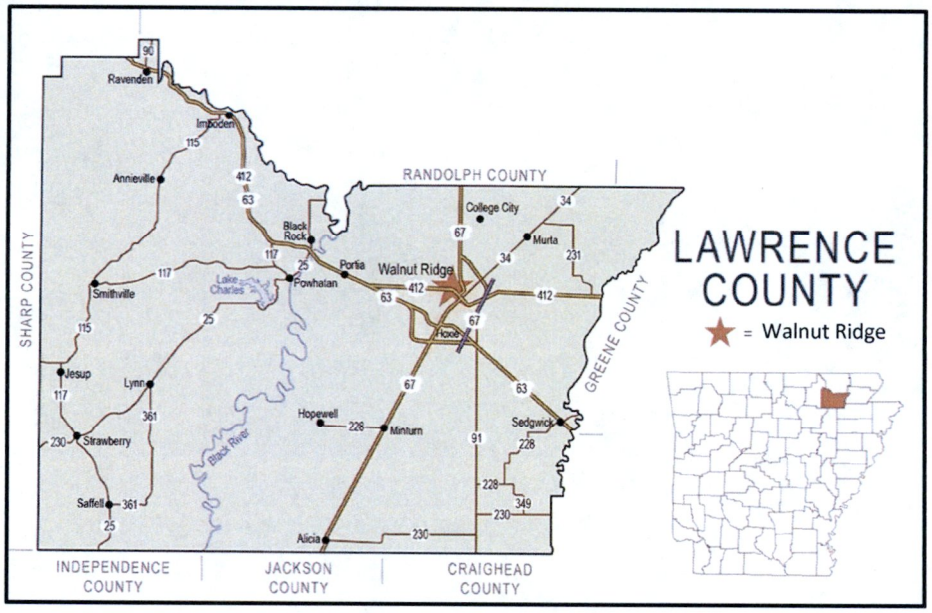
The PER was prepared for the various proposed facility improvements at the existing wastewater treatment facility (WWTF) which includes new headworks screening and replacement of the current biological treatment train with an extended aeration, activated sludge plant. The City of Walnut Ridge (City) owns and has operated the existing wastewater treatment facility since constructing the facility in 1994, after decommissioning and combining the City of Walnut Ridge Wastewater Pond and the Airport/Industrial Park Wastewater Pond near College City.

The existing facility has not been upgraded since construction and many components of the facility have reached their useful life, hindering treatment capacity and capability. The facilities ability to consistently meet effluent discharge standards is challenged due to treatment equipment/unit process capacity limitations. For compliance in accordance with National Pollutant Discharge Elimination System (NPDES) permit requirements, the City of Walnut Ridge is currently operating the facility under a Corrective Action Plan (CAP) in coordination with the Arkansas Department of Environmental Quality (ADEQ) as part of an ADEQ issued Consent Administrative Order (CAO) to address the current discharge deficiencies. A thorough rehabilitation effort has been deemed necessary for reliable treatment and correcting violations. If permanent wastewater treatment plant improvements are not made, NPDES discharge permit limits will not be consistently met.

1.1 LOCATION

The City of Walnut Ridge (City) is located in Lawrence County, in the north east part of Arkansas. It is located approximately 125 miles northeast of Little Rock, where the City lies between the Black River to the west and the Cache River to the east. A location map of the City of Walnut Ridge in Lawrence County, Arkansas is shown in **Figure 1.0**.

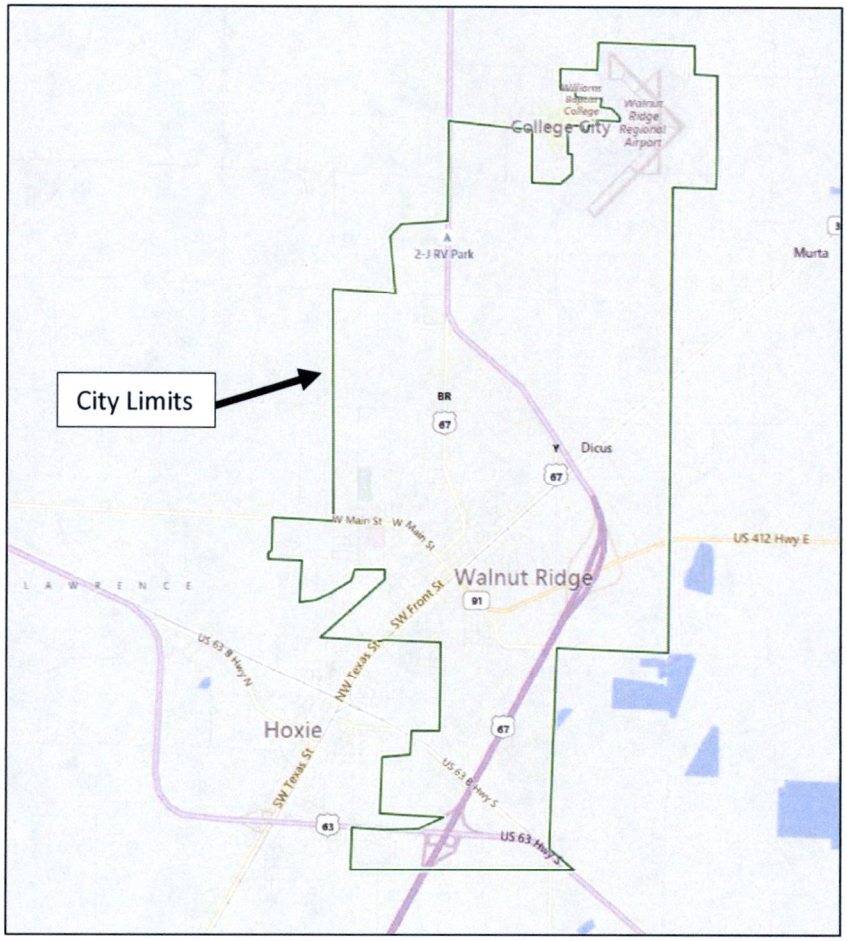
Figure 1.0: Location Map of Walnut Ridge, Lawrence County, Arkansas



The existing service area includes both residential and commercial activities, and minimal industrial activities. The service area is concentrated to the east of the WWTF (Walnut Ridge) and north east of the WWTF (College City). The Walnut Ridge City Water Works is a component unit of the City of Walnut Ridge, Arkansas. The City Water Works provides water and sewer services to the citizens of Walnut Ridge, and the recently incorporated College City area.

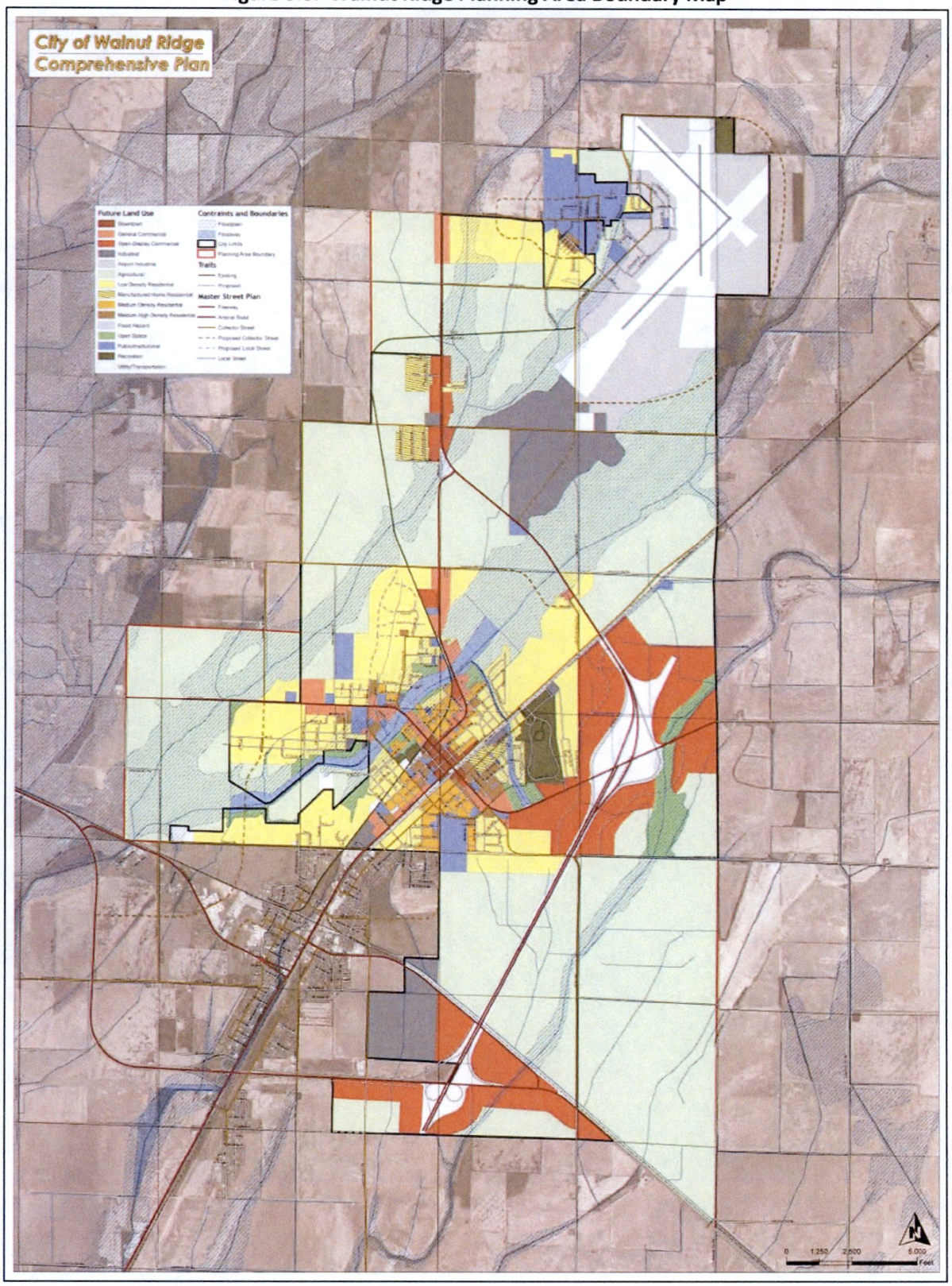
The project planning area is the existing service area, which includes the incorporated city limits of Walnut Ridge see **Figure 2.0**, as well as the Walnut Ridge planning area. The incorporated city limits of Walnut Ridge consist of a total area of approximately 16.01 square-miles, of which 16.01 square-miles is land and 0.00 square-miles is water.

Figure 2.0: City of Walnut Ridge City Limits and Existing Service Area



In 2014, the City of Walnut Ridge contracted with Urban Planning Associates, Inc. to develop a Comprehensive Plan for the future growth and development of the Walnut Ridge area. The plan serves as an official policy statement of the City of Walnut Ridge for directing orderly growth and development within its city limits and planning area. The Walnut Ridge Planning Area Boundary map, created with the 2014 Comprehensive Plan commissioned by Walnut Ridge, is shown as **Figure 3.0** below. The Planning Area Map was prepared in accordance with statutes found in the Arkansas Codes, Annotated §14-56-413.

Figure 3.0: Walnut Ridge Planning Area Boundary Map



The Planning Area Boundary depicted includes those lands within the territorial jurisdiction of Walnut Ridge for which it may prepare plans, ordinances, and regulations. This area extends beyond the city limits to include those areas most likely to become a part of the city within the planning period of twenty-five (25) years. The City of Walnut Ridge will, in accordance with A.C.A. §14-56-422, file the plans, ordinances, and regulations as they pertain to the territory beyond the corporate limits with the county recorder of Lawrence County.

The existing wastewater treatment facility (WWTF) serving the Walnut Ridge service area is located approximately 1-mile west of the Walnut Ridge town center at 1002 West Oak Street. The coordinates of the facility are Latitude 36° 04' 3.46" N and Longitude 90° 58' 21.7" W. This land has been developed as a WWTF since prior to 1990. The WWTF is located within Section 34 of Township 17 North, Range 1 East. **Figure 4.0** provides an aerial map of the general location of the WWTP in relation to the City of Walnut Ridge.

Figure 4.0: General WWTP Location and Walnut Ridge City Limits Aerial Map

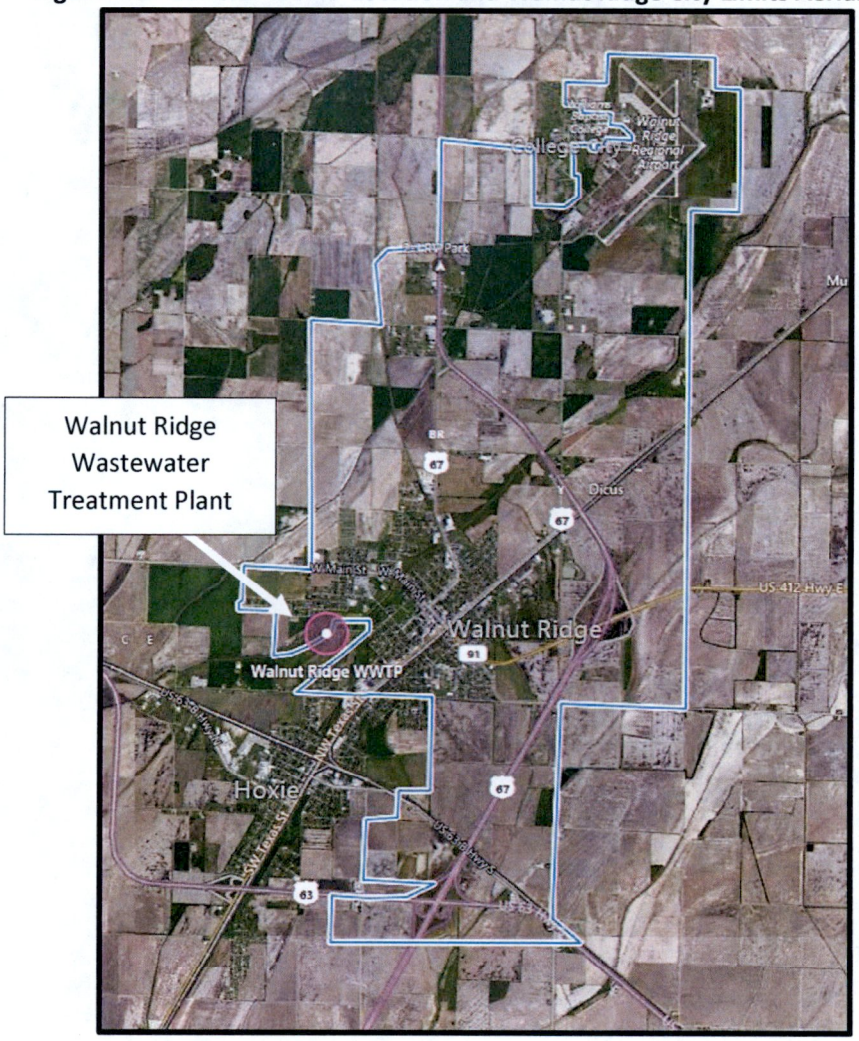


Exhibit 1.0 in **Appendix A** shows the boundaries of the planning area and the city limits of Walnut Ridge, as well as the topographic features of the area.

1.2 ENVIRONMENTAL RESOURCES PRESENT

Walnut Ridge and Lawrence County lie in the northeast quadrant of Arkansas, just east of the Ozark Highlands. Consideration of environmental issues were a part of the engineering planning regarding improvements at the existing WWTF, including any environmental impacts to the effluent receiving stream and outfall. This section includes a brief discussion of the environmental resources present within the Walnut Ridge area, and specifically at the WWTF site. Environmental resources discussed in this section include climate, geology, ecology, hydrology, wetlands, and floodplains. The following summarized descriptions of this section are fully defined in the Environmental Report (ER) for the proposed project.

In summary, historic information provided by resource and regulatory agencies have found there are no critical or significantly adverse impacts to habitats, threatened and endangered species, national or state parks or forests, fish and wildlife refuges, national natural landmarks, archeological or historic properties, or wild and scenic rivers in the project planning area. There are, however, floodplains, wetlands, and prime farmland located within the City planning area. Almost all of the land surrounding the corporate limits of Walnut Ridge is either wetland or prime farmland. The White Oak Slough, which is located to the east of Walnut Ridge, is a nearby recognized wetlands area. Since the proposed project improvements occur on the existing WWTF site, the project should have no significant impact on wetlands. In the mid-1990's, during project planning for the existing WWTF, the Arkansas Game and Fish Commission determined that the project would have an insignificant adverse impact upon non-endangered fish and wildlife resources. The project is not expected to have any adverse effects on either the ecosystems in the planning area or the relationship between the ecosystems, and other critical elements of the planning area.

1.2.1 CLIMATE

This section illustrates the typical climate as recorded by the weather station at the Walnut Ridge Regional Airport, based on statistical analysis of historical hourly weather reports and model reconstructions from January 1, 1980 to December 31, 2016.

For the Walnut Ridge area, the summers are hot and muggy; the winters are short, very cold, and wet; and it is partly cloudy year around. Spring has the most abrupt and violent weather changes. Strong fronts can be accompanied by turbulent weather with high intensity rain. High dewpoints and high humidity are brought in from the Gulf of Mexico. Evaporation from rivers, streams, lakes, and flooded rice fields contributes to higher humidity. Relative humidity averages about 70-percent during the year. Over the course of the year, the temperature typically varies from 30-degrees F to 90-degrees F and is rarely below 16-degrees F for above 97-degrees F.

The 'hot season' lasts for 3.8 months, from May 24 to September 19, with an average daily high temperature above 81-degrees F. The hottest day of the year is July 21, with an average high of 90-degrees F and an average low of 72-degrees F. The 'cold season' lasts for 2.9 months, from November 28 to February 26, with an average daily high temperature below 54-degrees F. The coldest day of the year is January 16, with an average low of 30-degrees F and an average high of 46-degrees F.

The nearly treeless, predominantly cultivated plain in the vicinity of Walnut Ridge provides little resistance to wind. The average hourly wind speed and direction experience significant seasonal variation throughout the year. Winds are generally from the south, southwest during the warmer months (for 9.8 months, March 1 to December 27, of the year) and north, northwest during the colder months (for 2.2

months, December 27 to March 1, of the year). The windier part of the year lasts for 6.9 months, from October 23 to May 19, with average wind speeds of more than 6.5 miles per hour. The windiest day of the year is March 2, with an average hourly wind speed of 8.4 miles per hour. The calmer time of year lasts for 5.1 months, from May 19 to October 23. The calmest day of the year is July 29, with an average hourly wind speed of 4.6 miles per hour.

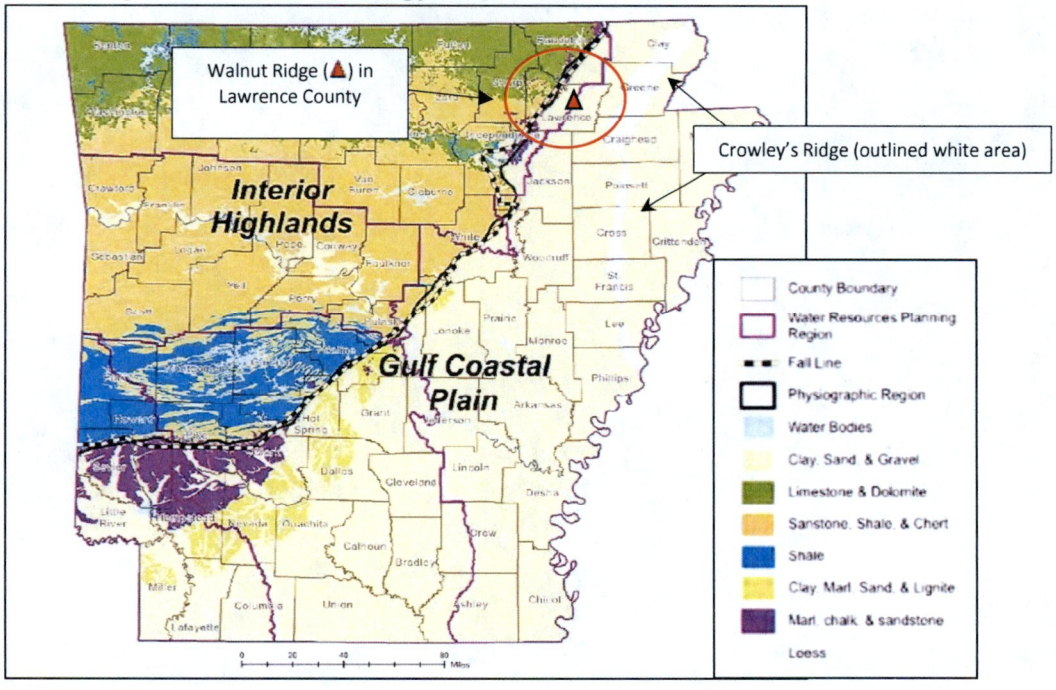
Walnut Ridge experiences significant seasonal variation in monthly rainfall. A 'wet day' is defined as one with at least 0.04-inches of liquid or liquid-equivalent precipitation (i.e. rain, snow, or a mixture of the two). The wet season lasts 4.9 months, from March 16 to August 11, with a greater than 30-percent chance of a given day being a 'wet day'. The chance of a 'wet day' peaks at 39-percent on May 15. The dry season lasts 7.1 months, from August 11 to March 16. The smallest chance of a 'wet day' is 22-percent on January 23. The rainiest month is April with an average total accumulation of 4.8-inches. The least rainy month is August with an average total accumulation of 2.4-inches. Precipitation averages about 48-inches of total rainfall per year. There are approximately 219 sunny days in Walnut Ridge. The average growing season is about 233 days (7.6 months from around March 23 to around November 10).

In accordance with 40 CFR Part 58, Subpart B § 58.10, the State of Arkansas is required to submit an annual air monitoring network plan to the EPA's Region 6 office. From the 2017 report, the State of Arkansas, and therefore the Walnut Ridge area, ambient air quality is in attainment with National Ambient Air Quality Standards (NAAQS).

1.2.2 GEOLOGICAL

Arkansas is divided into two main physiographic regions whose boundaries divide the state in nearly equal parts. These two regions are the Interior Highlands ("the highlands") that includes the Ouachita and the Ozark Plateaus provinces and the Coastal Plain province ("the lowlands"). **Figure 5.0** shows the general geology of the State of Arkansas, taken from the 2014 Arkansas Water Plan update.

Figure 5.0: General Geology of the State of Arkansas



The Interior Highlands and the Gulf Coastal Plains are divided by the "Fall Line" (see **Figure 5.0**), which is a prominent geophysical and hydrogeologic line generally identified as the line between the consolidated Paleozoic formations of northwestern Arkansas, and the unconsolidated Cretaceous, Tertiary, and Quaternary sand and clay strata of southeastern Arkansas. This Fall Line separates Arkansas into the two main physiographic regions.

Walnut Ridge, located in Lawrence County, is in the Gulf Coastal Plain province, although Lawrence County is divided by the two provinces. The Gulf Coastal Plain occupies about 27,370 square miles, or about 52 percent of the total area of the state. The Gulf Coastal Plain province is divided into two sections – the West Gulf Coastal Plain, located in the southwestern portion of the state; and the Mississippi River Valley Alluvial Plain (aka "the Delta"), located in the eastern part of the state. The Gulf Coastal Plain province is made up of the West Gulf Coastal Plain section, which is a southward-sloping, hilly terrain of unconsolidated sedimentary strata, and the Mississippi River Valley Alluvial Plain section, which is a relatively flat topographical plain with underlying clay, silt, sand, lignite, and gravel strata. Walnut Ridge is located in the Mississippi River Valley Alluvial Plain section.

A prominent geophysical feature located within the Mississippi River Valley Alluvial Plain section, and to the east of Walnut Ridge, is Crowley's Ridge, see **Figure 5.0**. This ridge extends from southeastern Missouri to near Helena in eastern Arkansas and has a topographic prominence of 250 to 550 feet above the mean elevation of the surrounding alluvial plain. The ridge consists of underlying sand and clay strata, which divides the surrounding alluvial plain, and a surface layer of fine-grained silt or clay, rich loam deposits.

The area around Walnut Ridge is comprised mainly of level and undulating lowlands of alluvial sediments high in content of both sand and silt. Slope gradients range from 1-percent to 8-percent and differences in elevation seldom exceed 15-feet. The predominantly level landscape is broken by abandoned river channels, artificial channels, and natural drainageways that flow into Village Creek to the West and White Oak Slough to the east.

Soils in the vicinity of Walnut Ridge include the Dundee-Dubbs association to the west and the Jackport-Crowley association to the east. The Dundee-Dubbs soils were formed in sediments and the loamy soils are somewhat poorly to well drained. Permeability is moderate to moderately slow, and ranges from 0.6 to 2.0 inches per hour for both soil types. Bedrock is generally greater than 6-feet. The Jackport-Crowley soils were formed in alluvial sediments that are poorly drained, clayey and loamy soils with a clayey subsoil. The Jackport series has a high clay content while the Crowley series has a high silt content. The soils have very slow permeability which ranges from less than 0.06 to 0.2 inches per hour. Bedrock is generally greater than 6-feet. The Dundee-Dubbs and Crowley series soils are easy to till while the Jackport series soils are difficult to till when wet.

1.2.3 ECOLOGY

A natural division is a geographic region which is occupied by a major natural system. There are 84 Level III Ecoregions identified across the United States. The Environmental Protection Agency (EPA) defines an ecoregion as an area containing generally similar ecosystems, as well as (generally similar) types, qualities, and quantities of environmental resources. Soils, vegetation, climate, geology, and physiography are relatively homogeneous within an ecoregion. Ecoregions are general purpose regions that are critical for structuring and implementing ecosystem management strategies across federal agencies, state agencies, and nongovernment organizations that are responsible for different types of resources in the same geographical areas. A Roman numeral hierarchical scheme, Level I through Level IV, has been established

for the different levels of ecological regions from Level I as the "coarsest" level to Level IV, which are further subdivisions of Level III ecoregions.

Of these 84 Level III Ecoregions, seven (7) occur across the state of Arkansas, these are the South-Central Plains, Ouachita Mountains, Arkansas Valley, Boston Mountains, Ozark Highlands, Mississippi Alluvial Plain, and Mississippi Valley Loess Plains. As mentioned in the previous section, Walnut Ridge is located in the Mississippi Alluvial Plain. These seven Level III ecoregions are further subdivided into thirty-two level IV ecoregions. The Level III and Level IV Ecoregions located in Arkansas are listed and shown on a map located in the Environmental Report (ER).

The Mississippi Alluvial Plain extends along the Mississippi River from the confluence of the Ohio and Mississippi rivers southward to the Gulf of Mexico; temperatures and annual average precipitation increase toward the south. This ecoregion is a nearly level, agriculturally-dominated alluvial plain. River terraces, swales, and levees provide limited relief, but overall, the Mississippi Alluvial Plain is flatter than neighboring ecoregions in Arkansas. Streams and rivers in this ecoregion have very low gradients, ill-defined stream channels, and contain fine-grained substrates.

This ecoregion provides important habitat for fish and wildlife and includes the largest continuous system of wetlands in North America. It is also a major bird migration corridor used in fall and spring migrations. Natural vegetation is largely southern floodplain forest. The Mississippi Alluvial Plain has been widely cleared and drained for cultivation; resulting in widespread loss or degradation of forest and wetland habitat. Presently, most of this ecoregion is cropland where soybeans, cotton, and rice are the major crops. Agricultural runoff containing fertilizers, herbicides, pesticides, and livestock waste have degraded surface water quality. Concentrations of total suspended solids, total dissolved solids, total phosphorus, ammonia nitrogen, sulfates, turbidity, biological oxygen demand, chlorophyll a, and fecal coliform are consistently found in higher levels in the rivers, streams, and ditches of this ecoregion than elsewhere in other Arkansas ecoregions. Fish communities in least altered streams typically have an insignificant proportion of sensitive species, where sunfishes are dominant followed by minnows. Man-made flood control levees in this ecoregion (specifically near the Mississippi River) have, in effect, separated the river and its adjoining habitat from the remainder of its natural hydrologic system and thereby interfering with sediment transfer and reducing available habitat for many species.

Between the levees that parallel the Mississippi River is a corridor known as the "batture lands". Batture lands are hydrologically linked to the Mississippi River, are flood-prone, and contain remnant habitat for "big river" species (e.g., pallid sturgeon) as well as river-front plant communities. These batture lands are too narrow to map as a separate level IV ecoregion.

Earthquakes in the early nineteenth century offset river courses in this ecoregion. Small to medium size earthquakes still frequently occur where they are magnified by the alluvial plain's unconsolidated deposits, creating regional land management issues.

Within the Mississippi Alluvial Plain ecoregion, there exists ten (10) sub-ecoregions or Level IV ecoregions. These sub-ecoregions include the Level IV ecoregion titled the "Western Lowlands Pleistocene Valley Trains" wherein which Walnut Ridge is located. The terraces of the Western Lowlands Pleistocene Valley Trains are largely composed of Pleistocene glacial outwash that was transported to Arkansas by the Mississippi River and deposited by braided streams. Physiography is widely muted by windblown silt deposits (loess), sand sheets, or sand dunes. Many interdunal depressions called "sandponds" occur and are either in contact with the water table or have a perched aquifer. Elevations are higher than adjacent

sub-ecoregions, so consequently, uplands are rarely if ever flooded. Native plant communities are different from more frequently inundated ecoregions. Sandpond forest communities are generally dominated by overcup oak, water hickory, willow oak, and pin oak; understory in a few sandponds may include pondberry (Lindera melissifolia), federally listed as endangered. Other important trees found in the planning area include green ash, cherrybark oak, nuttall oak, water oak, Shumard oak, sweetgum, eastern cottonwood, loblolly pine, and shortleaf pine. Other important understory vegetation found in the planning area includes switchgrass, bluestem, indiangrass, eastern gammagrass, wildryes (Virginia), panicums, sedges, forbes, shrubs, plumegrasses, giant cane, uniolas, rushes, and vines. Today, cropland is extensive and the main crops are soybeans and cotton. Commercial crawfish, baitfish, and catfish farms are common. The Western Lowlands Pleistocene Valley Trains ecoregion is a wintering ground for water fowl and duck hunting is widespread.

Within the ecoregions in Arkansas, the Arkansas Game and Fish Commission has further classified 47 different land habitats within Arkansas. Wildlife in Lawrence County includes openland wildlife, woodland wildlife, and wetland wildlife. Openland wildlife includes birds and mammals that normally reside in meadows, pastures, and open areas where grasses, herbs, and shrubby plants grow. Openland wildlife includes dove, meadowlark, sparrows, rabbits, and fox. Woodland wildlife includes birds and mammals that normally reside in wooded areas of hardwood trees, shrubs, and coniferous trees. Woodcocks, thrushes, wild turkey, vireos, deer, squirrel, and racoons are typical examples. Wetland wildlife are birds and mammals that commonly live om wet areas, marshes, and swamps. Ducks, geese, rails, shore birds, herons, minks, and muskrats are typical wetland wildlife. Since the proposed project occurs at the existing WWTF site, it is unlikely that any Federally-endangered, threatened, or proposed fish and wildlife species will be affected by the project.

1.2.4 HYDROLOGICAL

Arkansas has nine major river basins and five water resources planning regions. Walnut Ridge is located in the St. Francis River Basin as part of the East Arkansas water resources planning region.

Walnut Ridge lies almost equidistant between the Black River to the west and the Cache River to the east. The Black River flows from Missouri south into Arkansas. It is joined by the Current, Eleven Point, Spring, and Strawberry Rivers before it merges with the White River near Newport, Arkansas. The Cache River also flows from Missouri south into Arkansas. It is joined by Bayou de View before it merges with the White River near Clarendon, Arkansas.

Village Creek, the existing WWTF effluent receiving stream, and its tributary Coon Creek, are located southwest, west of Walnut Ridge. White Oak Slough, another tributary of Village Creek, is located southeast, east of Walnut Ridge. Village Creek flows south from Walnut Ridge to its confluence with the White River south of Newport, Arkansas. **Exhibit 1.0** in **Appendix A** shows the location of Walnut Ridge in respect to relevant surrounding surface water bodies and other hydrological features. Due west, the Black River is located approximately 8.6 miles from the City of Walnut Ridge. Due east, the Cache River is located approximately 7.3 miles from the City of Walnut Ridge. The largest and most productive of the state's major aquifers are in the Gulf Coastal Plain. Major aquifers in the Gulf Coastal Plain include the Cane River, Carrizo, Ozan, Tokio, Trinity, Nacatoch, Wilcox, Sparta/Memphis, Cockfield, Sparta, and Mississippi River Valley alluvial aquifers. The hydrogeology of the Gulf Coastal Plain can be described as layers of unconsolidated silt, sand, and gravel that contain aquifers yielding large quantities of water to wells. Walnut Ridge is currently authorized to discharge its wastewater to Village Creek under the National Pollutant Discharge Elimination System (NPDES) permit number AR0046566.

1.2.5 WETLANDS

Wetlands perform important functions, including storage of floodwaters, filtering of water to improve water quality, and storage of carbon. In addition, wetlands provide habitat for a number of important bids and animal species. In the mid-1990's, during the design process for the existing WWTF, four (4) wetland areas in the Walnut Ridge planning area were identified by the Soil Conservation Service. The Wetlands Mapper (and Geodatabase) developed by the U.S. Fish and Wildlife Service National Wetlands Inventory, utilizing esri based mapping, delivers map views of U.S. wetland resources. Access to Wetlands Mapper shows three (3) of the four (4) wetlands areas identified in 1991 are still today identified as wetlands. **Figure 6.0** shows the identified wetlands near the WWTF site. The wetland area types, size, and recreational use are shown on **Table 1.0**, as identified in **Figure 6.0**.

Figure 6.0: Nearest Wetlands Locations to Walnut Ridge WWTF Site/Project Site

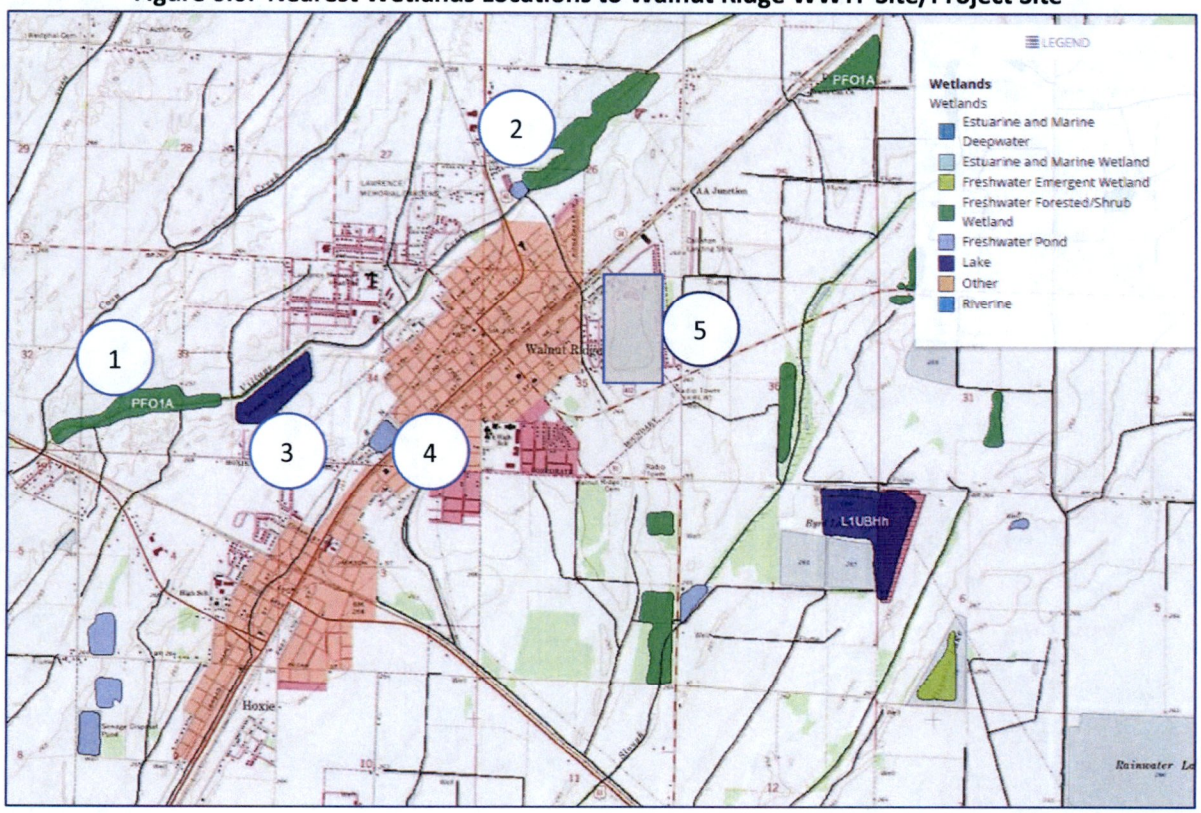


Table 1.0: Identified Wetland Areas

Figure 6.0 No.	Identification	Type	Size (Ac.)	Potential Uses
1	PFO1A	Freshwater Forested / Shrub Wetland	52.06	Wildlife Habitat
2	PUBH/PFO1A	Freshwater Pond / Freshwater Forested / Shrub Wetland	3.69 / 73.07	Wildlife Habitat
3	L1UBHh	Lake	40.11	Wastewater Pond: None
4	PUBHh	Freshwater Pond	9.73	Diked: Commercial Use
5	City Park	City Park	N/A	Recreational Use, Wildlife Habitat, and Biological Use

The wetland identification code consists of various combinations of the following: a "System" letter classification, a "Sub-System" number classification, a "Class" letter classification, a "Sub-Class" number classification, and a "Water Regime" letter classification. Identification Code Descriptions for wetlands shown on **Figure 6.0** and in **Table 1.0**, are shown in **Table 2.0** below.

Table 2.0: Wetland Identification Code Descriptions

Identification Code	ID Code Title	Description
	Systems	
P	PALUSTRINE	The Palustrine System includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 ppt. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2.5 m (8.2 ft) at low water; and (4) salinity due to ocean-derived salts less than 0.5 ppt.
L	LACUSTRINE	The Lacustrine System includes wetlands and deep-water habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with 30 percent or greater areal coverage; and (3) total area of at least 8 hectares (ha) (20 acres). Similar wetlands and deep-water habitats totaling less than 8 ha are also included in the Lacustrine System if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin equals or exceeds 2.5 m (8.2 ft) at low water. Lacustrine waters may be tidal or nontidal, but ocean-derived salinity is always less than 0.5 ppt.
	Sub-Systems	
1	LIMNETIC	This subsystem includes all deep-water habitats (i.e., areas > 2.5 m [8.2 ft] deep below low water) in the Lacustrine System. Many small Lacustrine Systems have no Limnetic Subsystem.
	Class	
FO	FORESTED	Characterized by woody vegetation that is 6 m tall or taller.
UB	UNCONSOLIDATED BOTTOM	Includes all wetlands and deep-water habitats with at least 25% cover of particles smaller than stones (less than 6-7 cm), and a vegetative cover less than 30%.
	Sub-Class	
1	Broad-Leaved Deciduous	Woody angiosperms (trees or shrubs) with relatively wide, flat leaves that are shed during the cold or dry season; e.g., black ash.
	Water Regime	
A	Temporary Flooded	Surface water is present for brief periods (from a few days to a few weeks) during the growing season, but the water table usually lies well below the ground surface for the most of the season.
H	Permanently Flooded	Water covers the substrate throughout the year in all years.
	Special Modifier	
h	Diked/Impounded	These wetlands have been created or modified by a man-made barrier or dam that obstructs the inflow or outflow of water.

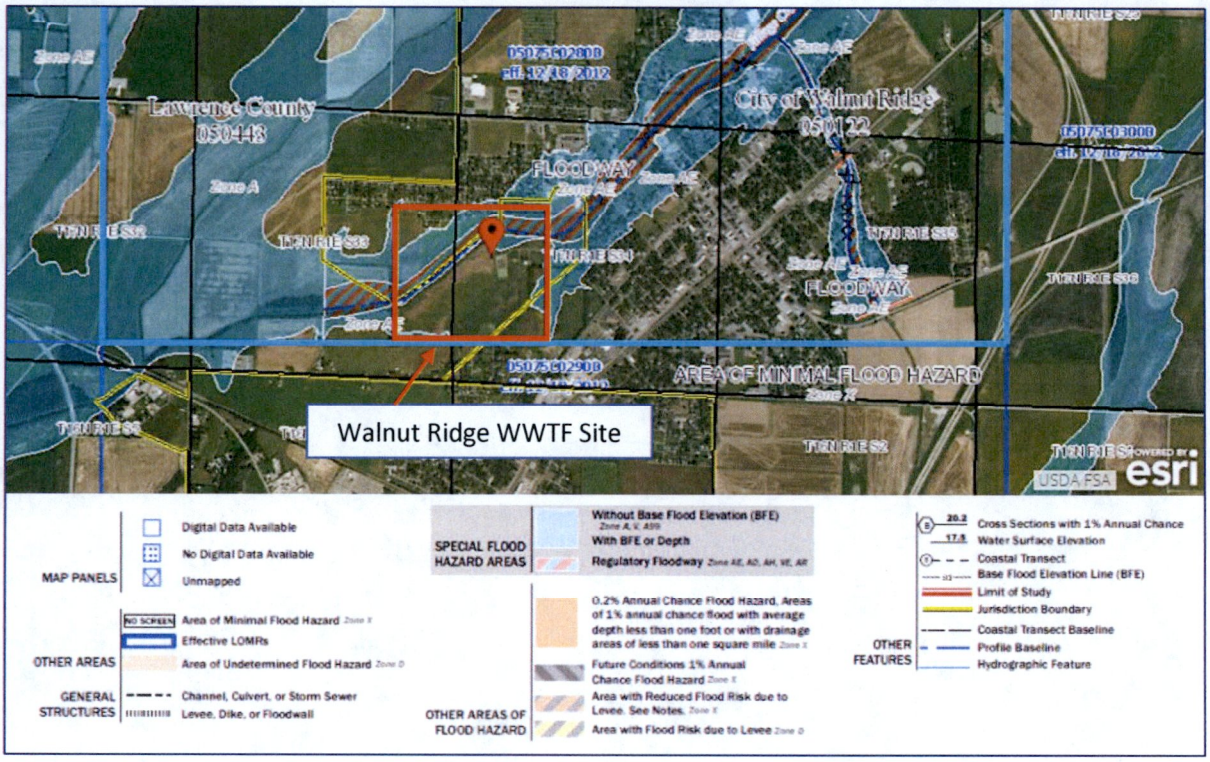
On **Figure 6.0**, note that Area 5 is not a wetland according to the Wetland Mapper and is classified as a City Park/Recreational Use area. Area 4 is an area that was not included in the 1991 wetlands identification and is a drainage pond near a commercially developed area. The proposed improvements project occurs at the existing WWTF site. The WWTF site is bordered by Village Creek to the North and West, and by roads and development to the South and East. Immediate direct impacts which may occur within this area would be due to construction activities and would mostly be contained to this area.

It should be noted that certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery used as the primary data source to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deep-water reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, can go undetected by aerial imagery. These excluded habitats are not present in the project planning area so therefore have no effect on the accuracy of the wetlands mapping. By policy, the Service also excludes certain types of "farmed wetlands" as may be defined by the Food Security Act or that do not coincide with the accepted definition of wetlands.

1.2.6 FLOODPLAINS

The Corps of Engineers and FEMA updated the flood plain maps for the Walnut Ridge area in 2012. The proposed site for the upgrades are integral with the existing WWTF. The floodplain data shows that the existing conditions for the WWTF are outside the 100-year floodplain, as indicated in the Environmental Report (ER). The limit of the 100-year flood plain at the project site is shown on **Figure 7.0** and on **Exhibit 3.0** in **Appendix A**.

Figure 7.0: Project Area Floodplain Map



Normal flows for both Coon and Village Creeks are well confined within their banks. However, because each creek has a slope of about one foot per mile, and because the land surrounding both creeks is relatively flat, the floodplains along both creeks are rather wide. Consequently, large areas of adjacent developed land and farm land are flooded during periods of high runoff. The footprint of the proposed upgrade is on the existing WWTF site, and is minor, and will have minimal environmental impact, and none of the proposed project features will be located in a 100-year floodplain. The proposed project therefore should have no significant impact on floodplains.

1.2.7 CULTURAL RESOURCES

Review by the State Historic Preservation Office (SHPO) data obtained in 1991 indicated that the proposed project should have no effect on any known archeological or historic sites within the planning area.

1.3 POPULATION TRENDS

1.3.1 POPULATION

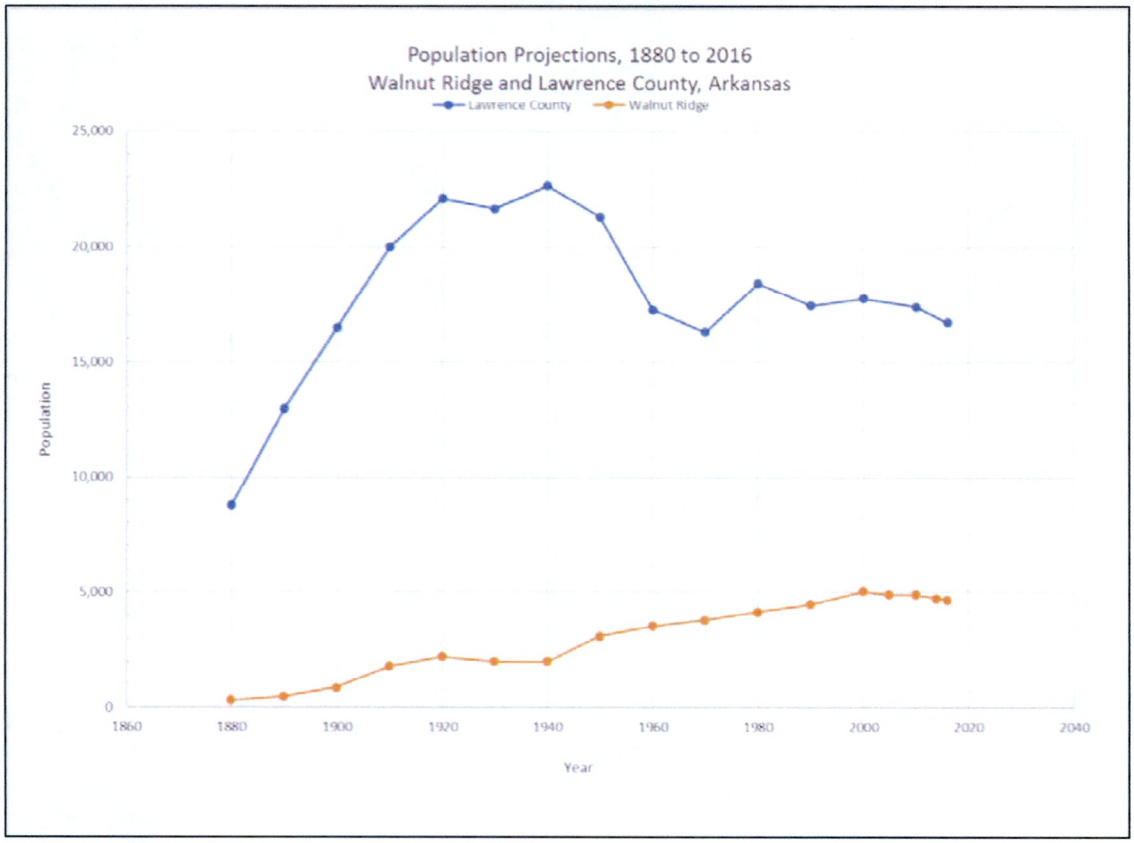
An important component of any planning effort is the projection of future population. Anticipated population growth will influence the future needs for utility capacities, especially that of collection lines, pumping facilities, and treatment facilities.

Historical population data for Lawrence County and the City of Walnut Ridge, from 1880 to 2016, is provided in **Table 3.0** and the following graph **Figure 8.0**. The population of the City of Walnut Ridge increased from 301 people in 1880 to 4,674 people in 2016. The University of Arkansas at Little Rock (UALR) State Data Center does not provide projected population estimates for cities.

Table 3.0: Historical Population Data, U.S. Census Bureau

Census Year	U.S. Census Data (Population)	
	Lawrence County	Walnut Ridge
1880	8782	301
1890	12984	457
1900	16491	845
1910	20001	1798
1920	22098	2226
1930	21663	2007
1940	22651	2013
1950	21303	3106
1960	17267	3547
1970	16320	3800
1980	18447	4152
1990	17457	4472
2000	17774	5034
2005	---	4903
2010	17415	4890
2014	---	4734
2016*	16735	4674
** 2016 population data, estimated U.S. Decennial Census Data*		

Figure 8.0: Historical Population Graph, U.S. Census Bureau



As can be noted, the population of Walnut Ridge peaked in 2000 at 5,034 people. Since 2000, the population of Walnut Ridge has slowly declined with a negative population growth rate (from 2000 to 2016) of -0.15 percent per year. From 1880 to 2000, the population of Walnut Ridge increased by approximately 4,733 people, with an average growth rate of 3.07 percent per year. The largest increase in population in Walnut Ridge occurred from 1900 to 1910, with an approximate yearly growth rate if 11.28 percent per year, growing an additional 953 people in 10 years. However, since 2005, population patterns indicate a slow decline, -0.50 percent per year, and perhaps a stabilizing of the decreasing population. The projected population, further discussed below, indicates a steady increase in population for the 20-year planning period. Based on trend analysis of historical populations, the 2037 projected population of Walnut Ridge is 6,691 people, or approximate of 2,000 additional people. This projection is based on average growth rate of 1.78 percent per year. The calculated 20-year population estimate is presented in **Table 4.0**, in 5-year increments, for a 20-year planning period of 2017 to 2037.

Table 4.0: 20-year Population Forecast by 5-year Increments, Walnut Ridge

Year	Projected Population
2017	4757
2022	5181
2027	5642
2032	6144
2037	6691

The 2014 City of Walnut Ridge Comprehensive Plan points out that Walnut Ridge's historic growth rates suggest a return to population growth. According to the plan, Walnut Ridge's historical growth rate data from 1970 onward indicates the population could reach 5,552 people by 2030. Projections calculated from Lawrence County population projections from the UALR Institute for Economic Advancement shows the population declining to 4,735 in 2030. The plan further uses three population growth scenarios to predict future growth. The first scenario is based on linear extrapolation of trends over the last 30-years, yielding 5,552 people by 2030. The second scenario, provided by data based on UALR projections for Lawrence County, yield a population of 4,735 people by 2030. A third scenario assumes a one-percent annual growth rate to yield 5,967 people by 2030.

The three scenarios presented in the Comprehensive Plan, as well as the projections calculated for this report, show a range of growth possibilities for the city. It is possible that over the course of the next 20 years that Walnut Ridge could experience population change resembling any of the three presented scenarios and the calculated projection. Therefore, the population projection presented herein, as calculated and shown in **Table 4.0**, is used to determine future growth for utility needs of the city.

1.4 COMMUNITY ENGAGEMENT

The City of Walnut Ridge will present information concerning the ongoing WWTF improvements at Council meetings and will provide updated information at each Monthly meeting as milestone schedule targets are developed and achieved. The Walnut Ridge Planning Commission meets on the third Thursday of each month at 5:30 p.m. and is open to the public.

The funding agency, U.S. Department of Agriculture Rural Development, shall require a comment period regarding the improvements defined herein, as well as a public meeting.

2.0 EXISTING FACILITIES

2.1 LOCATION MAP

The wastewater treatment facility (WWTF) serving the Walnut Ridge service area is located approximately 1-mile west of the Walnut Ridge town center at 1002 West Oak Street. **Figure 9.0** provides a general location of the WWTF in relation to the City of Walnut Ridge. The coordinates of the existing WWTP are Latitude 36° 04' 3.46" N and Longitude 90° 58' 21.7" W. **Exhibit 1.0** in **Appendix A** identifies the existing service areas and boundaries.

2.2 HISTORY

The current WWTF was constructed in 1994, as a result of consolidating the two (2) facilities serving the Walnut Ridge area. Prior to 1994, Walnut Ridge owned two wastewater treatment facilities. One, known as the Airport Industrial Park (AIP) plant, served an area around College City and included the Walnut Ridge Municipal Airport and Industrial Park, and Southern Baptist College. The AIP plant consisted of a 12-acre oxidation pond and discharged to an unnamed tributary of Coon Creek, itself a tributary of Village Creek. The second plant, Walnut Ridge City (WRC), served the city of Walnut Ridge. The WRC plant consisted of a 40-acre oxidation pond and discharged to Village Creek. In 1994, the Walnut Ridge WWTF was completed and put into service. The WWTF effluent discharges into Village Creek which then flows south to the White River in Segment 4C of the White River Basin.

Since construction in 1994, no upgrades or major improvements have been completed at the WWTF. Now that the facility is reaching 25-years in age, mechanical processes are beginning to fail due to age and extended use. Many components of the facility have reached their useful life and consideration for a thorough rehabilitation effort has been deemed necessary to continue reliable treatment. Due to the plant effluent consistently failing to meet permit requirements, the Arkansas Department of Environmental Quality (ADEQ) negotiated the terms of a Consent Administrative Order (CAO), dated May 25, 2017 and effective on July 10, 2017, with the City of Walnut Ridge to address the plant efficiency and failures. The CAO proposed was due also to a pattern of non-compliance on similar permit parameters related to previous CAO's administered in 1995, 2000, 2003, 2007, and 2010. The approved CAP, milestone schedule, and final compliance were issued a final date June 1, 2020. The City of Walnut Ridge understands the necessity for compliance in accordance with National Pollutant Discharge Elimination System (NPDES) permit requirements and is currently operating under a Corrective Action Plan (CAP), dated August 2017, addressing current discharge deficiencies.

Historically, inhibition of nitrification has been as issue at the WWTP due to the presence of quaternary ammonium compounds ("Quats") and the inability to sustain biomass during wet weather events, with the latter being more prevalent. Wet weather treatment and compliance has been an inherent problem over the past 15 years. The increase in flow during the rain events removes total suspended solids (TSS) containing biochemical oxygen demand in the biomass, causing a degradation of the effluent quality by exceeding dissolved oxygen (DO), total residual chlorine (TRC), total suspended solids (TSS), 5-day carbonaceous biological oxygen demand ($CBOD_5$), and ammonia nitrogen permit limits. From January 1, 2013 through January 31, 2017, discharge effluent exceeded the TSS limit 8 times, $CBOD_5$ 6 times, and ammonium nitrogen 27 times. The increase in the WWTP influent flow during wet weather occurrences reduces biomass solids and the solids retention time, whereby limiting the nitrification process of the ammonia nitrogen. This degradation of the WWTP effluent quality further exacerbates toxicity non-compliance of the receiving stream Village Creek.

An outline of the Walnut Ridge wastewater system and existing WWTF history is shown in **Table 5.0**.

Table 5.0: History of Walnut Ridge Wastewater Treatment

Year	Description
1991	Begin design and construction of new WWTF, ADPC&E Project No. CS-050682.
1994	Construction of new treatment facility at existing WWT site (Walnut Ridge).
1995	ADEQ Issued Consent Administrative Order (CAO).
1995	NPDES Discharge Permit Issued, Permit No. AR0046566 and AFIN 38-00040, Exp. 2000.
2000	ADEQ Issued Consent Administrative Order (CAO).
2000	NPDES Discharge Permit Renewal, Permit No. AR0046566 and AFIN 38-00040, Exp. Sept. 30, 2005
2003	ADEQ Issued Consent Administrative Order (CAO).
2005	NPDES Discharge Permit Renewal, Permit No. AR0046566 and AFIN 38-00040, Exp. Sept. 30, 2010.
2007	ADEQ Issued Consent Administrative Order (CAO).
2010	ADEQ Issued Consent Administrative Order (CAO).
2010	Notice of Coverage, "No Exposure Exclusion" under the Industrial Stormwater General Permit ARR000000, Permit Tracking No. ARR000538 and AFIN 38-00040, Exp. June 30, 2014.
2010	NPDES Discharge Permit Renewal, Permit No. AR0046566 and AFIN 38-00040, Exp. Oct. 31, 2015.
2014	Notice of Coverage, "No Exposure Exclusion" under the Industrial Stormwater General Permit ARR000000, Permit Tracking No. ARR000538 and AFIN 38-00040, Exp. June 30, 2019.
2014	City of Walnut Ridge Comprehensive Plan completed.
2016	NPDES Discharge Permit Renewal, Permit No. AR0046566 and AFIN 38-00040, Exp. June 30, 2021.
2016	The City of Walnut Ridge and the City Water Works recognize the need to re-evaluate the WWTF treatment ability to serve long term expansion and growth plans, as well as to reliably meet discharge requirements.
2017	ADEQ Issued Consent Administrative Order (CAO), May 2017, CAO LIS 17-040.
2017	Submittal of Corrective Action Plan (CAP), August 2017.
2017	Treatment Corrective Action Testing initiated, Sept. 2017.
2017	Procurement of Professional Engineer, Oct. 2017.
2018	Submitted PER to WWAC for funding options, February 2018.
2018	Received funding option recommendations from the WWAC, April 2018.
2018	Preliminary Engineering Report (CAP Milestone, April 2018), submittal to ADEQ April 2018.

2.3 CONDITION OF EXISTING FACILITIES

2.3.1 WASTEWATER TREATMENT PLANT - OVERVIEW

The existing WWTF is permitted to discharge 1.19 MGD of treated effluent to Village Creek, under National Pollution Discharge Elimination System (NPDES) Permit Number AR0046566, thence to the White River in Segment 4C of the White River Basin (Upper White-Village Creek Basin). The receiving stream with USGS Hydrologic Unit Code (H.U.C.) of 11010013 and reach #014 is a Water of the State classified for primary and secondary contact recreation, raw water source for domestic (public and private), industrial, and agricultural water supplies, propagation of desirable species of fish and other aquatic life, and other compatible uses.

The receiving stream, Village Creek reach #014, is on the 2008-303(d) list in category 5(f) for Dissolved Oxygen. Category 5(f) states, "These are waters that are not currently meeting a water quality standard." However, "the basis for not meeting an applicable water quality standard is not caused by a pollutant but is attributed to other types of pollution." This means that the cause of the Dissolved Oxygen impairment in Village Creek is unknown and not attributed to domestic discharges. The current permit contains a Dissolved Oxygen limit based on meeting the Water Quality Standard of the receiving stream.

Village Creek is included in a Total Maximum Daily Load (TMDL) report for Turbidity, "TMDLs for Turbidity for Village Creek, AR." (January 2006). The TMDL sets the waste-load allocations to zero because the surrogate used for turbidity (TSS) is considered to represent inorganic solids (i.e., soil and sediment particles from erosion or sediment resuspension). The suspended solids discharged by point sources into Village Creek watershed are assumed to consist primarily of organic solids rather than inorganic solids. Discharges of organic suspended solids from point sources is addressed by ADEQ through the current permit, to maintain water quality standards.

The existing facility consists of a bar screen, a biological treatment system that includes nutrient removal and aeration (extended aeration activated sludge treatment), clarification, chlorination/dechlorination. Refer to the Appendices of this report for the existing treatment plant site plan and flow schematic. **Figure 9.0** is a Schematic of the Existing WWTF (with aerial image insert).

Figure 9.0: Schematic of Existing WWTP (with aerial image insert)

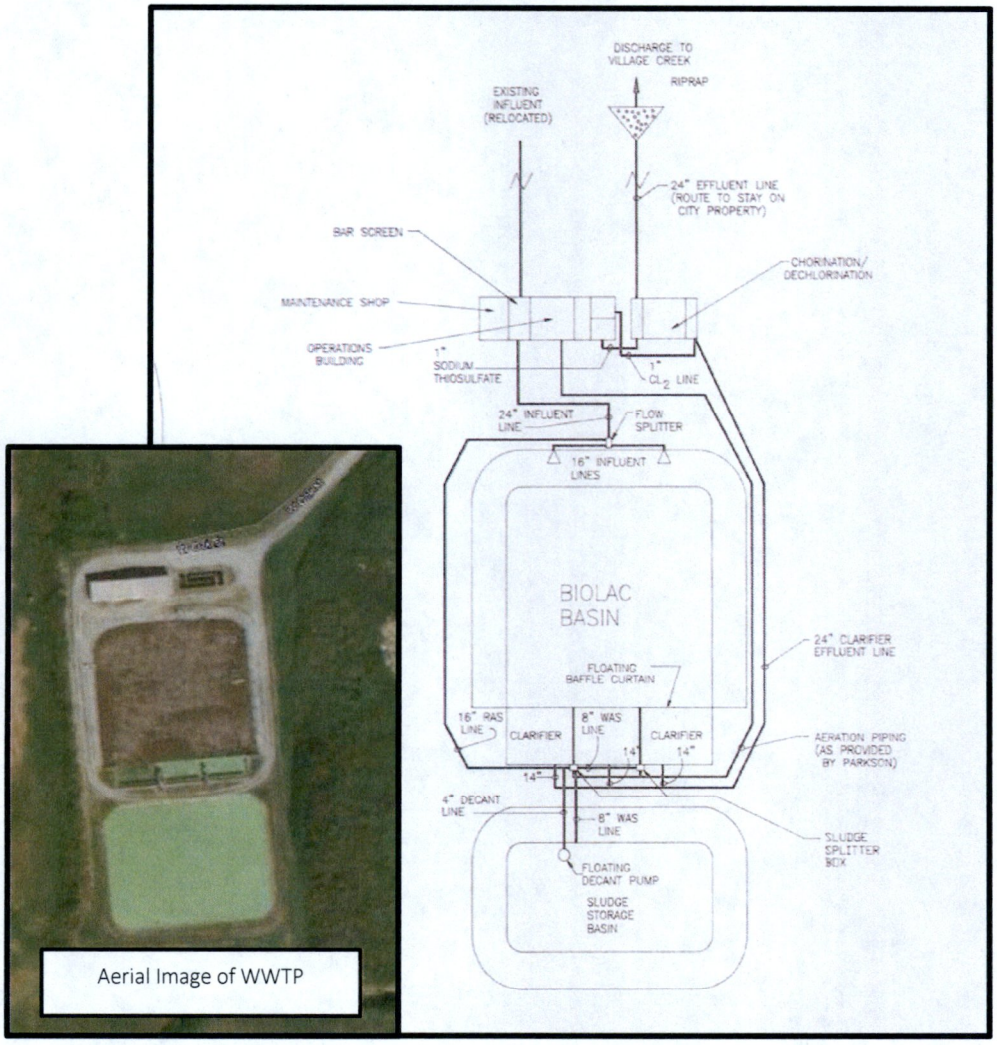


Figure 10.0 is a map showing the location of the existing WWTF, the existing outfall, and other features shown on a topographic map. A larger map is included in **Appendix A** of this report.

Figure 10.0: Existing WWTF Site Topo Map

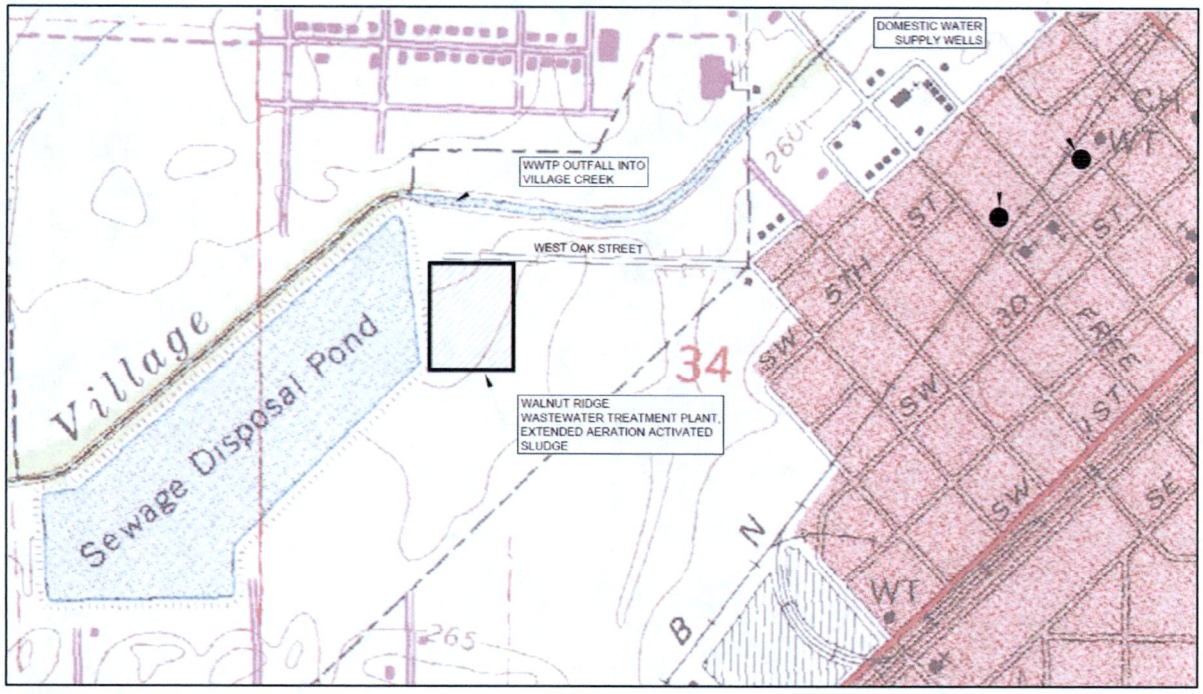
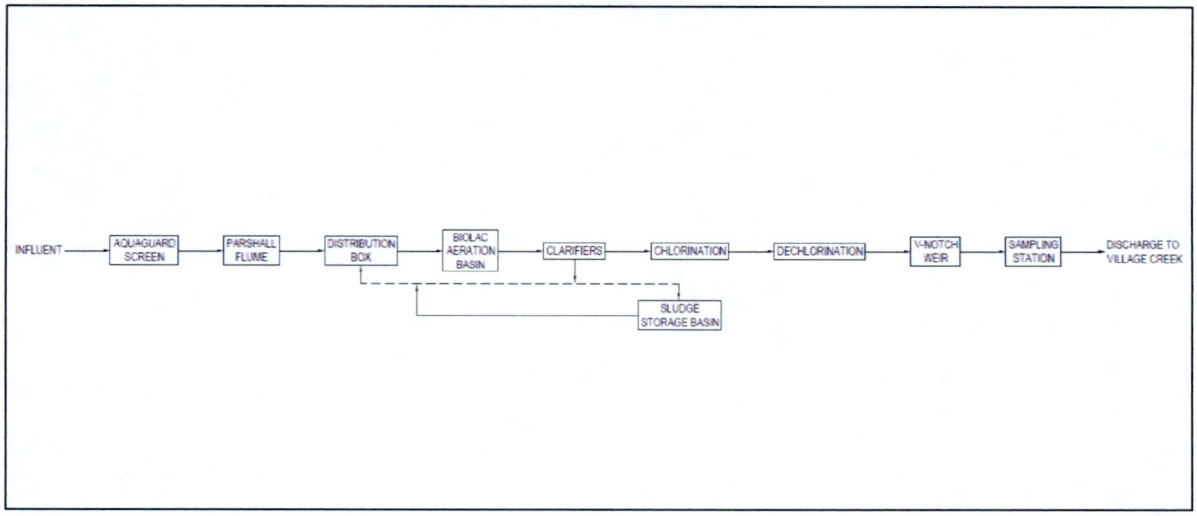


Figure 11.0 is the process flow diagram of the existing WWTF. A larger version of this diagram is included in **Appendix A** of this report.

Figure 11.0: Process Flow Diagram



2.3.2 UNIT PROCESS DESCRIPTIONS

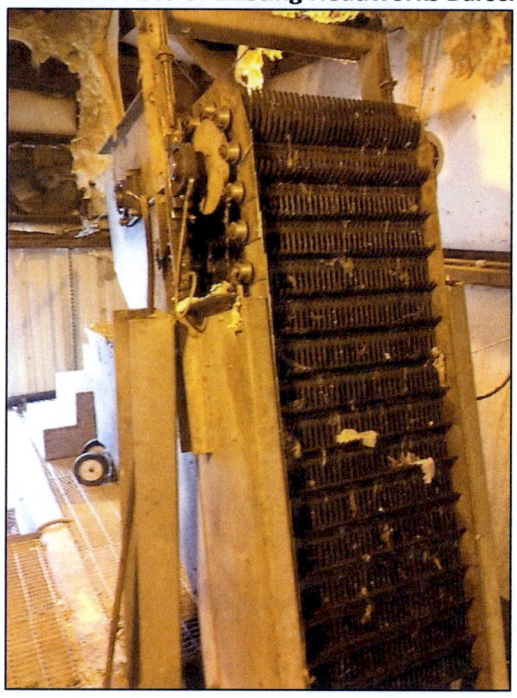
The following information summarizes individual treatment system processes. Photographs of the existing WWTP and facility processes are included in the body of this report.

2.3.2.1 HEADWORKS

The headworks process area, which is enclosed within the Operations and Maintenance Building, includes an Influent Channel, Screening and Screening Removal System, and Flow Metering (by Parshall Flume).

The Operations and Maintenance Building consists of one level and includes a maintenance shop, a blower and standby generator room, an office/laboratory, one (1) rest room, storage, a chlorine storage room, and a chlorination/dechlorination equipment room. Influent wastewater enters the building via a 12-inch buried forcemain pipe at the bar screen area of the building, which is between the maintenance shop and the blower/generator room. The influent is screened through a mechanically cleaned barscreen, see the **Figure 12.0** below. Influent wastewater then flows through a Parshall Flume with the flume effluent passing through a discharge box and on into a 24-inch Ultra-Rib PVC pipe which conveys the screened influent to the influent splitter box for the secondary treatment process. The existing headworks includes one (1) mechanically cleaned barscreen and influent flow measurement through the Parshall Flume with an ultrasonic sensor.

Figure 12.0: Photo of Existing Headworks Barscreen



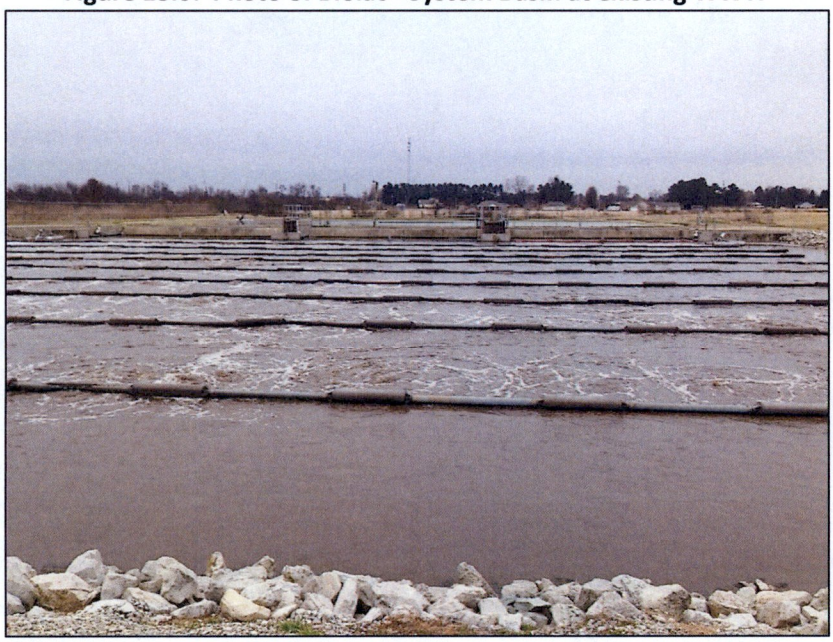
2.3.2.2 BIOLOGICAL TREATMENT PROCESS

Screened flow is combined with Return Activated Sludge (RAS) in the Flow Splitter Box which then splits flows to one of two 16-inch pipes to the influent of the Biolac® (which stands for BIOLogical Aeration Chains) System Basin, see photo in **Figure 13.0** below. The Biolac® system is an activated sludge process using extended aeration and retention of biological solids. The in-ground earthen basin, with a gunite apron that extends 1-foot below water level, has a moving aeration chain system for mixing and oxygen

transfer. The aeration system is a stationary fine-bubble aeration system designed to supply 4 cubic-feet-per-minute (CFM) of air per 1,000 cubic feet of aeration basin volume (where stationary fine bubble aeration systems typically require 8 to 10 CFM of air per 1,000 cubic feet of aeration basin volume). The aeration/mixing system is supplied by three blowers, located in the Blower Room of the Headworks Building. The mixed liquor from the Biolac® Basin flows to the clarifiers over a floating baffle curtain.

A. Basin Number: One (1)
B. Basin Dimensions:
    1. Depth Water: 10-feet
    2. Basin Side Wall: 12-feet
    3. Basin Width: 145-feet
    4. Basin Length: 145-feet
C. Aeration:
    1. Ten (10) aeration chains (aeration float/diffuser assemblies).
    2. Seventeen (17) floats per aeration chain.
    3. Six (6) diffusers per float.
D. Blowers:
    1. Number: Three (3)
    2. Horsepower: 50 HP
    3. Rate: (1,401 ICFM) 1,232 SCFM at 5.4 pounds per square inch, gauge (psig).
    4. Electrical: 230/460 VAC, TEFC Enclosure.

Figure 13.0: Photo of Biolac® System Basin at existing WWTF



2.3.2.3 CLARIFIERS

The Biolac® basin is followed by integral Biolac EZClear® secondary clarifiers with v-notched effluent weirs. The clarifiers include rotary skimmer assembly, flocculator rake assembly, sludge airlift/screen/gate assembly, weir and trough assembly, and scum pump assembly. The clarifier area is 145-feet long and 25-feet wide and divided into three sections. The clarifier water depth is 16-feet with a side wall depth of 18-feet. 14-inch each clarifier section to 24-inch header. Sludge is collected at two Sludge Collection

Boxes where sludge is returned (RAS) to the influent Flow Splitter Box through a 16-inch pipe, or Waste Activated Sludge (WAS) is sent to the Sludge Storage Basin via an 8-inch pipe. The three clarifier sections each discharge to a 14-inch pipe where the effluent then flows through a 24-inch pipe to the disinfection basin.

2.3.2.4 DISINFECTION

Clarifier effluent is disinfected using chlorine gas injection and contact time. The disinfection basin consists of three chambers, with the middle chamber acting as the baffle area, therefore the total travel length is approximately 108-feet. **Figure 14.0** below is a photo of the existing disinfection basin. The design volume of the chlorine basin is 50,150 gallons with a chlorine contact time (CT) of 18.8 minutes for peak day flow, and a CT time of 60 minutes for average day flow. The chlorine contact basin is followed by post-aeration, and dechlorination with sodium thiosulfate. The treated wastewater effluent is then discharged and measured over a 90-degree V-notch weir, see **Figure 15.0** below, to a 24-inch effluent line discharging at the permitted Village Creek outfall.

Figure 14.0: Photo of Existing Disinfection Basin

Figure 15.0: Photo of Existing Effluent V-Notch Weir

2.3.2.5 STAND-BY POWER

The existing plant has a Generac® emergency generator installed inside the blower building.

2.3.2.6 SLUDGE

Currently, the site has an on-site sludge storage pond that is periodically cleaned-out and the solids are hauled away for disposal to a landfill, under ADEQ State Permit No. 4800-W. This hauling and disposal of the generated sludge is contracted on an as-needed basis. Sludge depth in the storage pond was measured in April 2015 with a depth of 6.87-feet. The sludge pond volume is approximately 1.5 Million-gallons (MG), which is removed once annually.

2.3.2.7 CURRENT OVERALL ENERGY CONSUMPTION ESTIMATE FOR THE EXISTING FACILITY

Estimated energy consumption and cost of the existing WWTF includes consideration of equipment (i.e. motors), operating loads, annual run times, and estimated annual power costs. The budgeted annual energy consumption cost for the Walnut Ridge Wastewater Treatment plant is approximately $100,000 annually, as provided by the City of Walnut Ridge and the City Water Works. Budgeted annual operating cost for the existing WWTF, as provided, is included in **Appendix C** of this report.

2.3.3 EXISTING WWTF USEFUL LIFE

Plant operations data indicate the facility's capability becomes challenged at peak flows, and due to observed capacity and process limitations, the plant has reached its useful life and can no longer consistently produce effluent within permit limits. The existing concrete chlorination basin appears to be in good condition, which is planned for reuse with the proposed improvements, and is believed to have an additional 20 years of useful life (this will be verified during design phase). The existing metal building components, except for the steel columns and beams, are near the end of useful life and will therefore be replaced. The existing V-notch effluent weir appears to be in good condition and is planned for reuse, with minor modifications (determined during the design phase).

2.3.4 WASTEWATER FLOWS

2.3.4.1 OPERATIONAL PARAMETERS

The existing WWTF is authorized to discharge wastewater under the National Pollutant Discharge Elimination System (NPDES) and the Arkansas Water and Air Pollution Control Act through Permit Number AR0046566 and AFIN 38-00040. The current permit went into effect on July 1, 2016 and expires June 30, 2021. **Table 6.0** provides a summary of effluent permit limits for the existing WWTF taken from the current NPDES Discharge Permit.

Table 6.0: NPDES Effluent Limitations and Monitoring Requirements, Walnut Ridge WWTF

Effluent Characteristics	Discharge Limitations			Monitoring Requirements	
	Mass (lbs/day), *unless otherwise specified*	Concentration (mg/l) *unless otherwise specified*		Frequency	Sample Type
	Monthly Avg.	Monthly Avg.	7-Day Avg.		
Flow	N/A	Report, MGD	Report, MGD (Daily Maximum)	five/week	totalizing meter
Overflows	Monthly Total SSOs (occurrences/month)			See Comments[1]	
Overflow Volume	Monthly Total Volume of SSOs (gallons/month)			See Comments[1]	
Carbonaceous Biochemical Oxygen Demand (CBOD5)	99.2	10.0	15.0	three/week	composite
Total Suspended Solids (TSS)	148.9	15.0	22.5	three/week	composite
Ammonia Nitrogen (NH3-N)					
(May-Oct)	39.7	4.0	6.0	three/week	composite
(Nov-Apr)	59.5	6.0	9.0	three/week	composite
Dissolved Oxygen (DO)					
(May-Oct)	N/A	5.0 (Inst. Min.)		three/week	grab
(Nov-Apr)	N/A	6.0 (Inst. Min.)		three/week	grab
Fecal Coliform Bacteria (FCB)					
(Apr-Sept)	N/A	200	400	three/week	grab
(Oct-Mar)	N/A	1000	2000	three/week	grab
Total Residual Chlorine (TRC)[2]	N/A	0.011 mg/l (Inst. Max.)		three/week[2]	grab[3]
Total Phosphorus (TP)	report	report	report	once/quarter	grab
Nitrate + Nitrite Nitrogen (NO3 + NO2-N)	report	report	report	once/quarter	grab
Total Recoverable Mercury	report	report	report	once/month	grab
pH	N/A	Min. 6.0 s.u.	Max. 9.0 s.u.	two/month	grab

Comments:

[1]See Condition No. 5 of Part II (SSO Condition). If there are no overflows during the entire month, report, "zero" ("0").

[2]TRC must be measured using any approved test method established in 40 CFR 136 capable of meeting a detection level of 0.033 mg/l or lower. If TRC is not detected at the required detection level (i.e., lab result is "ND"), report "zero" ("0") on the Discharge Monitoring Report (DMR). Report the concentration if TRC is detected and measured in the sample.

[3]TRC shall be measured within fifteen (15) minutes of sampling.

Under Environmental Protection Agency regulations, if a treatment works has a flow greater than or equal to 1.0 MGD or has (or is required to have) a pretreatment program or is otherwise required by the permitting authority to provide the data, then the utility is to provide effluent testing data, for the listed pollutants, to the regulatory agency for further review. At a minimum, effluent testing data is to be based on at least three pollutant scans and must be no more than four and one-half years old. **Table 7.0** shows the Whole Effluent Toxicity (WET) limit for lethal and sub-lethal endpoints and the Daily Average Lethality and 7-Day Minimum Lethality (7-Day NOEC) of the current NPDES discharge permit for the Walnut Ridge WWTF.

Table 7.0: NPDES Effluent Limitations and Monitoring Requirements, Walnut Ridge WWTP

Effluent Characteristics	Discharge Limitations			Monitoring Requirements	
	Mass (lbs/day, unless otherwise specified)	Concentration (mg/l, unless otherwise specified)		Frequency	Sample Type
	Monthly Avg.	Monthly Avg.	7-Day Avg.		
Whole Effluent Toxicity (22414)[4,5] (7-day NOEC)[4] 22414 *Ceriodaphnia dubia* & *Pimephales promelas*	N/A	Not < 100%		once/quarter	24-hr comp
Chronic Sub-Lethality Wet Limit[5,6] (51714) *Pimephales promelas*	N/A	Not < 80%		once/quarter	24-hr comp
Chronic Sub-Lethality *Ceriodaphnia dubia*	N/A	report (%)		once/quarter	24-hr comp
Pimephales promelas (Chronic)[4,5,6] Pass/Fail Lethality (7-day NOEC) TLP6C Pass/Fail Growth (7-day NOEC) TGP6C Survival (7-day NOEC) TOP6C Coefficient of Variation (Growth) TQP6C Growth (7-day NOEC) TPP6C		7-Day Average Report (Pass=0/Fail=1) Report (Pass=0/Fail=1) Report % Report % Report %		once/quarter once/quarter once/quarter once/quarter once/quarter	24-hr comp 24-hr comp 24-hr comp 24-hr comp 24-hr comp
Ceriodaphnia dubia (Chronic)[4,5,6] Pass/Fail Lethality (7-day NOEC) TLP3B Pass/Fail production (7-day NOEC) TGP3B Survival (7-day NOEC) TOP3B Coefficient of Variation (Reproduction) TQP3B Reproduction (7-day NOEC) TPP3B		7-Day Average Report (Pass=0/Fail=1) Report (Pass=0/Fail=1) Report % Report % Report %		once/quarter once/quarter once/quarter once/quarter once/quarter	24-hr comp 24-hr comp 24-hr comp 24-hr comp 24-hr comp

Comments:

[4]See Condition No. 10 of Part II (WET Testing Condition).

[5]Whole Effluent Toxicity limit is for lethal endpoints. The Daily Average Lethality and 7-Day Minimum Lethality (7-day NOEC) value shall not be less than 100% effluent. The Daily Average Lethality (7-Day NOEC) value is defined as the greatest effluent concentration, which does not elicit lethality that is statistically different from the control (0% effluent) at the 95% confident level.

(Continued)

[6]Whole Effluent Toxicity limit is for P. promelas sub-lethal endpoints. The Daily Average Sub-Lethality and 7-Day Minimum Sub-Lethality (7-Day NOEC) value shall not be less than 80% effluent. The Daily Average Sub-Lethality (7-Day NOEC) value is defined as the greatest effluent concentration, which does not elicit sub-lethality that is statistically different from the control (0% effluent) at the 95% confident level.

Definitions:

LOEC (Lowest Observed Effect Concentration) – The lowest concentration of an effluent or toxicant that results in adverse effects on the test organisms (where the values for the observed endpoints are statistically different from the control).

NOEC (No Observed Effect Concentration) – Is the highest tested concentration of an effluent or toxicant at which no adverse effects are observed on the aquatic test organisms at a specific time of observation.

2.3.4.2 PRESENT FLOWS AND CHARACTERISTICS

Wastewater flow data was obtained from Walnut Ridge utilizing the discharge monthly reports (DMR's). Historical average day flow rate data for 2012 to 2016 is given in **Table 8.0**. The average monthly flow rates vary from 0.37 mgd in 2016 to 1.07 mgd in 2015. The average daily flow rate and the maximum daily flow rate for the 5-year period of 2012 to 2016 is 0.59 mgd and 3.95 mgd, respectfully.

Table 8.0: Historical Average Day Flow Rates (mgd), 2012 - 2015

Month	2012	2013	2014	2015	2016
January	0.58	0.79	0.56	0.59	0.52
February	0.51	0.70	0.52	0.63	0.44
March	0.93	0.56	0.72	0.82	0.88
April	0.50	0.67	0.27	0.78	0.72
May	0.49	0.78	0.67	0.93	0.70
June	0.57	0.52	0.68	0.46	0.45
July	0.50	0.43	0.40	0.51	0.42
August	0.38	0.74	0.40	0.47	1.02
September	0.47	0.39	0.43	0.39	0.52
October	0.43	0.48	0.48	0.44	0.37
November	0.40	0.40	0.40	1.07	0.44
December	0.54	0.92	0.51	0.88	0.57
Average	***0.53***	***0.62***	***0.50***	***0.66***	***0.59***

Historical flow rate data, from **Table 8.0**, was used to estimate peaking factors for maximum month and maximum day, as given in **Table 9.0** below.

Table 9.0: Historical Flow Rates and Resulting Peaking Factors

Flow Rate Category	Rate, mgd	Peaking Factor
Average Day	0.59	1.00
Maximum Month	1.07	1.81
Maximum Day	3.95	6.70

Based on historical average day flow rates, presented in **Table 8.0**, and the yearly historical population for the City of Walnut Ridge, an average wastewater flow rate per capita per day (gpcd) can be calculated for years 2012 to 2016. The estimated yearly population, the average day WWTP flow rate, and the calculated average day wastewater flow rate per capita per day is presented in **Table 10.0**.

Table 10.0: Per Capita Average Day Wastewater Flow Rates

Year	Estimated Population	Average Day WW Flow Rate	
		mgd	*gpcd*
2012	4812	0.53	110
2013	4773	0.62	130
2014	4734	0.50	106
2015	4704	0.66	140
2016	4674	0.59	126
	Average of Rates	**0.59**	**122**

Wastewater characterization data was obtained from historical Discharge Monthly Reports (DMR's), which were used to evaluate wastewater loading and effluent parameters at the wastewater treatment plant (WWTP). The data capture was from 2012 through 2015. The historical DMR data includes permit and sample criteria as established by the ADEQ issued NPDES permit. **Table 11.0** provides a summary of the analyzed data from 2012 through 2015.

Table 11.0: Historical Effluent Characteristics, 2012-2015

Effluent Characterization	2012 through 2015 Effluent Characterization		
	Avg.	***Min.***	***Max.***
Flow, Avg. Day (MGD)	0.58	0.27	1.05
Flow, Max. Day (MGD)	1.84	0.28	3.95
CBOD5, Mass (lbs/day)	15.99	2.30	37.20
CBOD5, 7-Day (mg/L)	4.91	2.40	11.00
CBOD5, Max. Mo. (mg/L)	3.44	2.00	7.00
TSS, Mass (lbs/day)	36.06	2.50	135.20
TSS, 7-Day (mg/L)	10.40	4.00	41.70
TSS, Max. Mo. (mg/L)	6.50	0.60	14.00
pH Min.	6.99	0.14	7.70
pH Max.	7.80	7.00	8.41
May-October			
NH3-N, Mass (lbs/day)	8.06	0.30	62.10
NH3-N, 7-Day (mg/L)	3.75	0.20	19.50
NH3-N, Max. Mo. (mg/L)	1.91	0.15	13.40
DO, (mg/L)	6.48	5.10	7.90
November-April			
NH3-N, Mass (lbs/day)	12.71	0.41	101.70
NH3-N, 7-Day (mg/L)	3.65	0.10	20.50
NH3-N, Max. Mo. (mg/L)	2.38	0.09	17.30
DO, (mg/L)	8.04	6.50	9.40
April-September			
Fecal Coliform (FCB), Mo. Avg.	26.68	3.00	121.00
Fecal Coliform (FCB), 7-Day Avg.	187.16	4.00	935.00
October-March			
Fecal Coliform (FCB), Mo. Avg.	21.54	2.00	85.00
Fecal Coliform (FCB), 7-Day Avg.	240.90	4.00	1865.00
Total Residual Chlorine (mg/L)	0.08	0.01	0.10

Walnut Ridge has one (1) Significant Industrial User (SIU) that discharges to the treatment works. Industrial Metals (formerly Custom Plating, merged with Industrial Metals Company) has industrial processes comprising electroplating, polishing, anodizing, and coloring of metals. In 2016, the average daily process wastewater flow rate was 3,740 gpd (discharged intermittently) and the average daily non-process wastewater flow rate was 80 gpd (discharged intermittently). The SIU is not subject to local pretreatment standard limits. The facility discharge has not caused or contributed to any problems at the WWTF in the past three (3) years (since 2016).

The treatment works does not receive and has not received in the past three (3) years RCRA hazardous waste by truck, rail, or dedicated pipe. The treatment works does not currently, and has not been notified that it will, receive wastewater from CERCLA (SUPERFUND) activities, RCRA Remediation/Correction Action activities, or other remedial activities.

Walnut Ridge has three major highways and two major railroads running through the city, as well as an airport, the Walnut Ridge Regional Airport, which is capable of handling large air craft. Walnut Ridge has a large agricultural industry which includes rice, soybeans, wheat, and corn. Williams Baptist College is located next to the airport and the Walnut Ridge industrial park. Lawrence Memorial Hospital provides emergency and comprehensive healthcare services to the city. Industries such as Frit Industries, Morgan Buildings and Spas, and Douglas/Quikut all provide jobs for the area. Other businesses and industries provide a relatively diverse commercial and industrial base for Walnut Ridge, with a wide range of goods and services represented.

The Walnut Ridge Industrial park is located adjacent to the Walnut Ridge Airport. The 2,200-acre industrial park is served by water, wastewater, natural gas, electricity, communications, railroad, and the airport.

2.3.5 INFLOW AND INFILTRATION/EXFILTRATION

The city's problems with inflow and infiltration are primarily limited to the southeast portion of the city, south of Main Street and east of Front Street. The City of Walnut Ridge currently does not specifically measure infiltration and inflow; therefore I/I can only be estimated from wastewater influent flow records and customer base records. However, in 1990, an infiltration/inflow study was conducted on the Walnut Ridge collection system. In summary, the study concluded that the Walnut Ridge collection system is not subject to excessive infiltration or inflow. Then in 2007, a Comprehensive Sewer Evaluation was completed where the inflow/infiltration was estimated at 100,000 gpd.

The current collection system still generally performs well except during periods of wet weather. The wastewater influent flow to the existing WWTF is comprised of 100-percent sanitary sewer and is not a part of combined sewer and stormwater system. It is therefore assumed that the Walnut Ridge system follows a typical municipal wastewater flow rate pattern in that as seasonal precipitation increases, wastewater flow rates increase.

For purposes of estimating a wastewater collection system's infiltration/inflow condition, the Environmental Protection Agency (EPA) has determined that the average for dry weather flows is 120 gpcd. This includes domestic wastewater flow, infiltration, and nominal industrial and commercial flows. The EPA indicates this average dry weather flow should be used as an indicator to determine the limit of non-excessive infiltration. If the average daily flow per capita (excluding major industrial and commercial flows greater than 50,000 gpd each) is less than 120 gpcd (measured during periods of high groundwater), the amount of infiltration is considered non-excessive. Comparing the historical daily flow rate data to the yearly historical population data, the average, minimum, and maximum flow per capita per day, for 2013 through 2016, is as follows in **Table 12.0**.

Table 12.0: Average, Minimum, and Maximum Flow per Capita per Day, 2013-2016

Flow Rate Parameter	Year			
	2013	2014	2015	2016
*Population**	*4,773*	*4,734*	*4,704*	*4,674*
Average, gpcd	129	129	141	126
Minimum, gpcd	30	54	2	40
Maximum, gpcd	827	624	804	794
** - Yearly population derived from historical population.*				

Excessive infiltration and inflow into the sanitary sewer system can potentially cause overflows at manholes and other locations which are considered unpermitted discharges. To assess the potential of infiltration and inflow, the ADEQ's sanitary sewer overflow (SSO) database was analyzed from December 2001 through October 2017. **Table 13.0** provides the history of the SSO's frequency by year. There were no recorded SSO's during 2016 and 2017.

Table 13.0: History of Walnut Ridge Reported SSOs

Year	SSO Occurences
2001	2
2002	None Recorded
2003	None Recorded
2004	None Recorded
2005	None Recorded
2006	4
2007	1
2008	None Recorded
2009	3
2010	None Recorded
2011	7
2012	3
2013	5
2014	2
2015	4
2016	None Recorded
2017*	None Recorded
Total	***31***
**No record for entire year.*	

Since January 2018, City Water Works has replaced 350-linear-feet of collapsed gravity flow sewer line on Old Pocahontas Road in Walnut Ridge, Arkansas. This line failure was the cause of several of the SSOs that had been reported in the past. In addition, City Water Works contracted Cline Construction to replace 125-feet creek crossing on HWY 67B that was permitting inflow to the collection system. To continue infiltration abatement, further work includes the raising of manholes that were below flood stage in the vicinity of Village Creek.

2.3.6 COMPLIANCE WITH CLEAN WATER ACT AND STATE REQUIREMENTS

The existing WWTF is reaching 25-years in age and many components of the facility have reached their useful life resulting in incomplete treatment. Wet weather treatment and compliance has been an inherent problem over the past 15 years.

Historically, inhibition of nitrification has been as issue at the WWTP due to the presence of quaternary ammonium compounds ("Quats") and the inability to sustain biomass during wet weather events, with the latter being more prevalent. The increase in flow during the rain events removes total suspended solids (TSS) containing biochemical oxygen demand in the biomass, causing a degradation of the effluent quality by exceeding dissolved oxygen (DO), total residual chlorine (TRC), total suspended solids (TSS), 5-day carbonaceous biological oxygen demand (CBOD5), and ammonia nitrogen permit limits. From January 1, 2013 through January 31, 2017, discharge effluent exceeded the TSS limit 8 times, CBOD5 6 times, and

ammonium nitrogen 27 times. Quats are positively charged polyatomic ions that are strongly cationic and attach to inorganic and organic surfaces. The strong positive charge of the Quats attaches to negatively charged bacteria and causes membrane leakage and bacteria death, which means destruction of the biomass in a biological treatment plant. Quats compounds can be used to produce products that reduce plant growth and the development of disinfectants, which are used to remove organic material. Common sources include hospitals, restaurants, and nursing homes where strong disinfectants or sanitizing agents are commonly used.

The increase in the WWTP influent flow during wet weather occurrences reduces biomass solids and the solids retention time, whereby limiting the nitrification process of the ammonia nitrogen. This degradation of the WWTP effluent quality further exacerbates toxicity non-compliance of the receiving stream Village Creek. The WET test is utilized to measure the acute (lethal) and chronic (sub-lethal) effect of effluent on biology in the receiving stream. The test utilizes a series of effluent dilutions (critical dilution) for a measurement of biological survival for vertebrates (fathead minnow) and invertebrate species (water flea). The dilution series is based on flow of the receiving stream, 7Q10, which is the lowest flow in seven consecutive days in a 10-year period. WET testing failure results of the Walnut Ridge WWTP effluent, from 2011 through 2016, are shown in **Table 14.0** below.

Table 14.0: WET Testing Failures 2011 to 2016

Parameter	Result
Vertebrate Lethal Failures, <100%	1
Vertebrate Sublethal Failures, <80%	5
Invertebrate Lethal Failures	3
Invertebrate Sublethal Failures	13

There were two (2) successive 100-percent survival rates for both vertebrate and invertebrate lethal and sublethal tests in July and August 2016. Furthermore, the WWTP Ammonia-Nitrogen Testing failed in 2016 as well. These results are in **Table 15.0** below. After implementing new caustic dosages in July 2016, there was a noticeable reduction in all Ammonia-Nitrogen values.

Table 15.0: Ammonia-Nitrogen Testing Failures 2016

Parameter	Result
30-Day Ammonia-Nitrogen Failures	8
7-Day Ammonia-Nitrogen Failures	8
Ammonia-Nitrogen Loading Failures	5
Invertebrate Sublethal Failures	13

Due to the plant effluent consistently failing to meet permit requirements, the Arkansas Department of Environmental Quality (ADEQ) negotiated the terms of a Consent Administrative Order (CAO), dated May 25, 2017 and effective on July 10, 2017, with the City of Walnut Ridge to address the plant efficiency and failures. The CAO proposed was due also to a pattern of non-compliance on similar permit parameters related to previous CAO's administered in 1995, 2000, 2003, 2007, and 2010. The approved CAP, milestone schedule, and final compliance were issued a final date June 1, 2020. The City of Walnut Ridge understands the necessity for compliance in accordance with National Pollutant Discharge Elimination System (NPDES) permit requirements and is currently operating under a Corrective Action Plan (CAP), dated August 2017, addressing current discharge deficiencies.

2.4 FINANCIAL STATUS OF ANY EXISTING FACILITIES

2.4.1 OVERVIEW

The City of Walnut Ridge receives revenue to support the water and sewer systems by billing each customer. **Table 16.0** below details the Annual Operating Costs for the Walnut Ridge Wastewater Treatment Plant, as provided by the City Water Works.

Table 16.0: WWTF Annual Operating Costs

Operation/Maintenance Item	Cost
Permit (ADEQ)	$5,300
Permit Renewal	$5,000
Lab Fees	$24,000
WET Testing	$12,000
Water Use (CL2)	$15,000
Electricity	$100,000
Chemicals (CL2, Sodium Bisulfite)	$3,900
Sludge Removal	$25,000
TOTAL	**$185,200**

The City Water Works Audited Financial Statements for years ending June 30, 2014, June 30, 2015, June 30, 2016, and June 30, 2017, as well as 2018 budgetary information is included in the Appendices of this report. Operating revenues and expenses generally result from providing services and producing and delivering goods in connection with a proprietary fund's principle ongoing operations. The principle operating revenues of the enterprise funds include the cost of sales and services, administrative expenses, and depreciation on capital assets. All revenues and expenses not meeting these definitions are reported as non-operating revenues and expenses. Descriptions and information regarding Capital Assets, Long-Term Debt, Bond Requirements, and Monthly Rates are included in the financial statements included in the Appendices. A summarized accounting of the financial statements for the Walnut Ridge Water and Sewer Works is shown in **Table 17.0** below.

Table 17.0: Summary of Walnut Ridge City Water Works Financial Information

Account	2014	2015	2016	2017	2018 (Budget)
Water Revenue	$ 766,246	$ 754,262	$ 779,504	$ 884,861	$ 945,000
Sewer Revenue	$ 497,225	$ 474,497	$ 525,895	$ 515,028	$ 545,000
Late Payment Charges	$ 25,623	$ 31,397	$ 30,746	$ 35,496	$ 36,000
Misc. Income	$ 19,519	$ 13,605	$ 13,043	$ 24,550	$ 20,000
Total Operating Revenue	***$ 1,308,613***	***$ 1,273,761***	***$ 1,349,188***	***$ 1,459,935***	***$ 1,546,000***
Total Operating Expense	***$ 1,332,380***	***$ 1,363,302***	***$ 1,364,185***	***$ 1,382,835***	***$ 1,497,250***
TOTAL OPERATING INCOME (LOSS)	***($ 23,767)***	***($ 89,541)***	***($ 14,997)***	***$ 77,100***	***$ 48,750***
Total Non-Operating Revenues (Expenses)	***($ 42,672)***	***($ 40,518)***	***($ 40,921)***	***($ 35,148)***	***N/A***
TOTAL CHANGE IN NET	**($ 66,439)**	**($ 130,059)**	**($ 55,918)**	**($ 41,952)**	**N/A**
TOTAL NET	**$ 3,327,034**	**$ 3,196,975**	**$ 3,141,057**	**$ 3,183,009**	**N/A**

Operating revenues and expenses generally result from providing services and producing and delivering goods in connection with a proprietary fund's principle ongoing operations. The principle operating revenues of the enterprise funds include the cost of sales and services, administrative expenses, and depreciation on capital assets. All revenues and expenses not meeting these definitions are reported as non-operating revenues and expenses.

The proceeds from established rates or sales tax will be used for the purpose of operating and maintaining the Walnut Ridge wastewater system. Rates for water and wastewater utilities were recently increased in October 2016. The raise in 2016 was to offset the rising cost of labor and equipment expenses, as the utility reportedly lost $33,775.05 in 2015. As part of the funding acquisition process, a review of the existing wastewater rates may again be examined to ensure there is adequate funding for operation, maintenance, and replacement costs, as well as adequate funding for other necessary costs. Operation, maintenance, and replacement costs for the proposed project improvements are therefore subject to the established, and possibly increased, sewer rates.

The Walnut Ridge City Water Works operates and maintains the water and wastewater utility systems for the city. The department operation expenses from 2014 through 2017 are shown on the statements included in the Appendices of this report. Descriptions and information regarding Capital Assets and Monthly Rates are also included in the financial statements included in the Appendices. The proposed project is not expected to significantly change the Operation and Maintenance Costs associated with treatment and collection of wastewater from the Walnut Ridge system. There are no new customers being added to the system as part of this project.

2.4.2 EXISTING DEBT

Walnut Ridge Water & Sewer Works must maintain certain requirements after receiving bonds from the United States Department of Agriculture (USDA). The bonds require that funds be established as described below, as provided in the 2016 – 2017 Financial Statement.

The USDA issued the 3.25% 92 01 and 92 02 Debt Service Reserve & Short Lived Asset Reserve in the amount of $787,388 and $115,129 on July 30, 2011. Walnut Ridge Water & Sewer Works is required to deposit a sum equal to the installment of the principle and interest due on the next monthly installment payment plus the sum of $358 into the Debt Reserve Fund. Integrity First Bank provided a note at 4.00% in the amount of $266,008, beginning April 28, 2017, principle and interest payment of $2,346.

Descriptions and information regarding Long-Term Debt and Bond Requirements are included in the financial statements included in the Appendices.

2.4.3 CURRENT RATE STRUCTURE

The City Water Works provides water and sewer services to its customers from a system owned distribution network. The City of Walnut Ridge has three types of sewer customer classifications: Residential, Commercial, and Industrial. Walnut Ridge City Water Works currently serves a total of 2,807 sewer customers where there are 2,450 Residential sewer customers, 334 Commercial sewer customers, and 23 Industrial sewer customers.

The Walnut Ridge City Council passed an updated sewer rate ordinance in November 2016 that defined a sewer rate increase of $1.80 per 1,000 gallons. Monthly sewer usage is estimated by the monthly water usage via water meters. The ordinance also defines the minimum monthly charge (or 'minimum bill') for

each customer classification. The minimum monthly sewer bill, which is the same for all three customer classes, is $4.40 per 1,000 gallons with a 1,000-gallon minimum. The current sewer bill for 4,000 gallons is $17.60. Data based on 11 months, December 2016 to October 2017, show that the City of Walnut Ridge monthly sewer revenue is $40,483. The average monthly bill is $17.85. Additional fees that are charged to customers include the following, in **Table 18.0**.

Table 18.0: Additional Monthly Fees

Description of Additional Monthly Fee	Additional Monthly Fee
Trash Pick-Up	$12.00
Fire Protection	$5.00
Mosquito Spraying	$1.50
Health Department Fee	$0.30
Taxes (on Water, Trash, and Spray)	10%

The minimum monthly water bill is $10.25 per 1,000 gallons with a 1,000-gallon minimum. Currently, Lawrence County Regional Water is the only wholesale water customer of the City Water Works, with a flat rate of $3.50 per 1,000-gallons. The current average use for this wholesale water customer is approximately 140,000 gallons per month which supplies about 40 customers. The Walnut Ridge City Water Works does no currently have any wholesale wastewater customers.

3.0 NEED FOR PROJECT

3.1 HEALTH, SANITATION, AND SECURITY

The following sections discuss the current and projected permit conditions and WWTF performance in terms of the health and sanitation criteria. Due to the fairly well-controlled access points to the existing facility the security is not a project needs driver. Currently, the majority of the treatment equipment and controls are located within an area that has access-control, in locked buildings, and/or can be accessed by authorized personnel only.

However, if Walnut Ridge continues to not meet its wastewater permit requirements, ADEQ could impose fines and other restrictions on the City Water Works. Such actions would have a significant adverse economic impact on the facility planning area. Furthermore, the existing treatment train process has reached its useful life and improvements or upgrades to the existing system are uneconomical and not justified, as the treatment capacity and capability cannot be improved by any such modifications.

The high-level need for completion of this project is to protect both the local community health and sanitation through completion of the proposed treatment plant improvements project. The two primary purposes for this project are to replace and upgrade the existing WWTF and to consistently provide NPDES discharge compliance for the planning period.

The Walnut Ridge planning area is adequately served by the existing parks and recreational facilities, educational, airport, industrial park, and medical facilities. The railroad and highway transportation systems appear adequate for the area. The planning area is served by water, wastewater, electric, natural gas, and communications utilities. With the exception of the wastewater system, the other utilities have adequate capacity and capability to serve the area. With the exception of the need to upgrade and improve the wastewater system, there are no known deficiencies in the planning area public services.

3.2 AGING INFRASTRUCTURE

The wastewater treatment plant (WWTP) is located approximately 1-mile west of the town center, at the end of W Oak Street. The current WWTP was constructed in 1994, replacing a single cell oxidation pond which was abandoned. The Walnut Ridge Wastewater Treatment Facility has provided good service to the community over the last 24 years, with some portions of the collection system over 70-years old. Most treatment and collection facilities are designed for a 20-year planning period. Aging equipment and processes which have exceeded their design service life have resulted in the facility being unable to consistently meet required NPDES discharge limits.

There are some possible safety issues with the facility. Metal buildings and enclosures constructed when the plant was built in 1994 have deteriorated under the moist environment. Many of the safety devices, such as handrails, lack the updating required by OSHA. The electrical systems are at the end of their service life and have failing switches, conduit deterioration, and circuit failures. Aging facility, obsolete equipment, and NPDES permitting requirements require an upgrade of the facility.

The initial Walnut Ridge collection system was constructed in the 1940's, with additions continually being made. The system currently consists of approximately 17,801 feet of forcemain, approximately 164,500 feet of gravity pipe, and approximately 531 manholes. A majority of the gravity sewer lines are 6-inch or 8-inch diameter, with the remaining gravity sewer lines being 10-inch, 12-inch, and 15-inch in diameter. Early materials of construction included vitrified clay and concrete pipes with brick masonry manholes; while ductile iron and plastic pipe were included as later construction materials.

3.3 REASONABLE GROWTH

As stated in Section 1, growth is expected to increase 1.78-percent per year. Using the estimated population and the average day wastewater flow rates, as given in Section 1 of this report, a per capita average day wastewater flow rate of 122 gallons per capita day (gpcd) is calculated. Applying the average rate of 122 gpcd to the projected population, and using the peaking factors developed, yields the projected wastewater flow rates presented in **Table 19.0**.

Table 19.0: Projected Wastewater Flow Rates

Year	Population	Flow Rate (mgd)		
		Average Day	*Maximum Month PF = 1.81*	*Maximum Day PF = 6.70*
2017	4757	0.58	1.05	3.89
2022	5181	0.63	1.14	4.23
2027	5642	0.69	1.25	4.61
2032	6144	0.75	1.36	5.02
2037	6691	0.82	1.48	5.47

Currently, the City of Walnut Ridge has 2,807 sewer customers of which 2,450 are Residential Customers, 334 are Commercial Customers, and 23 are Industrial Customers. There are no new users projected to be added to the customer base with the proposed improvements detailed herein.

4.0 ALTERNATIVES CONSIDERED

4.1 GENERAL INFORMATION FOR ALTERNATIVES CONSIDERED

To meet short-term and long-term flow demand and to meet effluent requirements, upgrades to the existing WWTF are necessary. The proposed project, the Walnut Ridge Wastewater Improvements Project ('the project') for work at the wastewater treatment plant (WWTP), includes decommissioning the existing aerated Biolac® biological treatment system and components, and installing an extended aeration treatment system while maintaining other plant processes such as the chlorine contact/dechlorination basin and the sludge holding tank. The project alternatives considered for upgrading the WWTF are listed in **Table 20.0** and further described herein. The first (**Alternative 1**), second (**Alternative 2**), fourth (**Alternative 4**), and fifth (**Alternative 5**) alternatives include keeping the current discharge location at Village Creek. The third alternative (**Alternative 3**) is for a partial mix aerated lagoon wastewater treatment plant with discharge to the Black River.

Table 20.0: Project Alternatives

Alternative No.	Description
1	Field-Erected (FE) Extended Aeration Package Plant by Evoqua (Davco)
2	Field-Erected Extended Aeration CSR Package Plant, Model GR by Schreiber Corporation
3	Partial Mix Aerated Lagoon by EDI with New Outfall to Black River
4	Closed Loop Reactor (CLR) extended-aeration, complete-mix system with clarification
5	OxyStream BNR system with clarification

The following alternatives were explored but found to be unsuitable or impractical, and therefore detailed design and cost estimating was not executed:

4.1.1 Optimizing the Current Facility

Additional optimization and minor upgrades, without significant infrastructure and/or process upgrades, would not be able to meet effluent quality requirements. The existing wastewater treatment plant effluent currently does not consistently meet the ADEQ NPDES Permit Requirements for discharge to Village Creek. If alternative wastewater treatment facilities are not provided, discharge from the existing treatment facility can be expected to continue to violate permit requirements.

Other than an inability to meet the discharge permit requirements, the no action alternative would have no other noticeable environmental impacts on the facility planning area. However, if Walnut Ridge continues to not meet its wastewater permit requirements, ADEQ could impose fines and other restrictions on the City Water Works. Such actions would have a significant adverse economic impact on the facility planning area. Furthermore, the existing treatment train process has reached its useful life and improvements or upgrades to the existing system are uneconomical and not justified, as the treatment capacity and capability cannot be improved by any such modifications. The no action alternative is therefore undesirable from a water quality and, perhaps, an economic perspective, and is therefore eliminated from further consideration. Furthermore, due to the inability to upgrade the existing treatment system, such improvements are therefore eliminated from further consideration as well.

4.1.2 Regionalization

The Walnut Ridge City Water Works (and Sewer Department) is the largest wastewater system within 10-miles of the City of Walnut Ridge, regionalization is not practical.

4.1.3 Small Cluster or Individual Facilities

Currently, the sewer collection system conveys the service area's wastewater to the existing wastewater treatment plant. The development and area of the city make it most practical to maintain one central treatment facility in the existing treatment location.

Table 21.0 and **Table 22.0** present a summary of the overall basis of design for the proposed Walnut Ridge WWTF improvements. Each evaluated alternative is sized and configured to meet these design criteria.

Table 21.0: Overall Design Criteria

Design Flow, MGD		
Maximum Month Average Daily Flow, NPDES Permit	1.19	
Annual Average Daily Flow	0.59	
Maximum Month	1.07	
Maximum Day	3.95	
Influent Concentrations and Loadings *1		
	mg/L	**lbs./day**
CBOD5, Range (mg/L): 120 – 484	239	490
Total Suspended Solids (TSS), Range (mg/L): 70 – 332	172	341
N Ammonia Nitrogen (NH_3-N), Range (mg/L): 18.3 – 51.60	30.9	63.0
Alkalinity, Range (mg/L): 228 - 368	318	n/a
Other Design Parameters		
Temperature, ambient-typical (degrees F)	30 (min.) – 90 (max.)	
Elevation, ft MSL	260	
**1 – Data from September 6, 2017 to December 13, 2017, Avg. Temp.: 57-degrees F, Range (degrees-F): 36 – 77.*		

Table 22.0: Effluent Requirements

Design Concentrations and Loadings, NPDES Permit*1		
	mg/L	**lbs./day**
CBOD5	10	99.2
Total Suspended Solids (TSS)	15	148.9
Ammonia Nitrogen (NH_3-N), May-Oct.	4	39.7
Ammonia Nitrogen (NH_3-N), Nov.-Apr.	6	59.5
Dissolved Oxygen (DO), May-Oct.	5	N/A
Dissolved Oxygen (DO), Nov.-Apr.	6	N/A
Fecal Coliform Bacteria (FCB), Monthly Avg./7-Day Avg., Apr.-Sept.	200/400	N/A
Fecal Coliform Bacteria (FCB), Monthly Avg./7-Day Avg., Oct.-Mar.	1000/2000	N/A
Total Residual Chlorine (TRC)	0.011	N/A
pH, s.u.	6 (min.) – 9 (max.)	
**1 – Existing NPDES permit limits. Loadings expected to remain the same for future permit.*		

4.2 Common Elements for Treatment Alternatives Evaluation

The Walnut Ridge WWTF improvements focus on upgrades to the secondary and tertiary treatment processes. Other aspects of the WWTF will generally remain the same regardless of the secondary and tertiary treatment process chosen. The common elements applicable to each alternative are described below. If any changes to a common project element are unique to a specific alternative, these modifications are noted in the alternative description. The general arrangement of the alternatives can be found in the Appendices of this report.

4.2.1 Development of Operations and Maintenance Costs

For the evaluated alternatives, the operation and maintenance costs were estimated from determining electrical use, water use, chemicals, lab fees, and testing costs; which are included in the present worth calculations. For **Alternative 3**, due to the added need for moving the outfall to the Black River by an effluent pump station.

4.2.2 Influent and Headworks Improvements

For each evaluated alternative, the existing screening channel is to be re-furbished and re-used, and the remaining building components are to be demolished. The screening channel outlet would be a live tie-in and the influent wastewater temporary diverted. This live tie-in would take place as one of the final steps of construction of the new treatment process so that the existing wastewater treatment process can remain in service during construction.

The alternatives include the installation of a new single, 5/8-inch mechanically-cleaned bar screen. The bar screen structure will discharge to a new 24-inch ductile iron pipe to a manhole and then to a splitter box. The proposed splitter box is for properly dividing influent flow between the treatment units, by use of adjustable weirs. The splitter box will also have a 24-inch pipe for full flow diversion from the bar screen and treatment units if a need for such ever arises. **Alternative 3** does not include the splitter box as the design is a partial-mix lagoon system.

4.2.3 Effluent and Disinfection

Effluent from the treatment units will flow by a new 24-inch ductile iron pipe that would tie-into the existing 24-inch clarifier effluent pipe of the existing treatment process. The existing chlorine contact/dechlorination basin is adequately designed for a maximum flow of 4.475 MGD, based only on volume and the minimum allowable chlorine contact time of 15-minutes. These preliminary calculations are included in the Appendices of this report. Further detailed calculations will be completed as design of the process progresses. The existing 90-degree V-notch effluent weir may be raised or modified and is contained within the chlorine contact/dechlorination basin.

The existing disinfection system consists of chlorine gas and dechlorination by sodium bisulfate. With the construction of the new building, each alternative includes a new sodium hypochlorite disinfection system and a new dechlorination system with sodium bisulfite.

As a safer alternative to chlorine gas, each alternative is based on disinfection by use of sodium hypochlorite (liquid chlorine or aka "bleach"), delivered to the site. A sodium hypochlorite/bisulfite pumping and metering system will be constructed to disinfect a maximum flow of 4.5 mgd. Sodium hypochlorite solution will be metered into the wastewater effluent with a contact time for from 30 minutes during average flows to 15 minutes at peak flows. Sodium hypochlorite may be delivered in liquid form (i.e. bleach) or it may be generated on-site. Sodium bisulfite will be used for removal (dechlorination) of residual chorine. The sodium hypochlorite would be piped to be injected into the upstream portion of the contact basin and the sodium bisulfate will be injected into the downstream portion of the contact basin, at the current injection location. The basic chlorination/dechlorination system for each alternative includes solution tank(s), metering pumps, chemical tubing, a diffuser (to inject the solution into the water), chlorine analyzer with controls, and piping. Additional pump and metering accessories will include back pressure valves, pressure relief valves, injection check valves and containment areas for both sodium hypochlorite and sodium bisulfate systems. An eye wash shower will be located inside each of the chemical storage rooms.

4.2.4 Sludge Handling

Sludge is pumped and stored in an uncovered sludge holding pond and then hauled to landfill. The existing sludge handing and disposal is to pay for it to be hauled away after removal from the WWTP site sludge pond. This is expected to be the continued practice unless the City Water Works decides to look into other options. From a regulatory perspective, the options available for ultimate disposal of municipal sewage sludge are limited. All practical sludge disposal options currently available generally involve either land application (including treatment and reuse options), surface disposal (including landfills), and incineration. Currently, there are no plans to modify the current process. Currently, waste sludge is removed from the Biolac® secondary clarifiers by air-lift pumping and is conveyed to a sludge pond. Because the sludge is not routinely wasted from the current treatment process, there is little information available concerning sludge production at the Walnut Ridge WWTP from which to base any production estimates; however, operations staff say that the pond is 1.5 million-gallons (MG) and is cleaned out once a year. When the sludge pond approaches capacity, it will be necessary to remove the sludge from the lagoon for ultimate disposal. With this facility, method of land application is usually accomplished on a competitive-bid contract basis. The sludge generated is based on a sludge production of 1,043 pounds per day (ppd). The expected storage capacity is projected to be 100 to 150 days, therefore the sludge removal process will increase to 2.5 to 3.65 times per year. Detailed sludge production calculations are included in the appendices of this report. Sludge removal and disposal is estimated to be $91,250 per year. For all evaluated alternatives, the existing sludge pond and sludge handling process will be utilized. Detailed sludge calculations are included in the Appendices of this report.

4.2.5 Administration Building, Blower Building, and Other Improvements

Each alternative evaluated also includes the construction of a new 1,200-square-foot Administration/Chemical/Storage/Laboratory building. The building is proposed to be a 33-feet by 36.5-feet metal building with an office, restroom, storage room, electrical room, and chemical storage/process areas. For alternatives requiring blowers, an additional 200 square-feet is added to the cost estimate. Other treatment site improvements include decommissioning of the existing Biolac® treatment system, the existing headworks building, and the existing blower building, building new gravel access roads, installation of concrete sidewalks, and electrical/controls modifications and additions. A new 250 kW generator is proposed for installation as well.

4.2.6 Outfall Location at the Black River

The third alternative (**Alternative 3**) is for a partial mix aerated lagoon wastewater treatment plant with discharge to the Black River. Effluent flow to the Black River is required with this system, as the treatment capability of the current design is not adequate for discharge at the existing outfall location on Village Creek. The existing 24-inch effluent pipe to Village Creek would be decommissioned and a new 14-inch PVC effluent forcemain and pump station would be installed to pump the wastewater effluent for discharge to the Black River. The proposed effluent pump station contains four (4) new pumps, two (2) at 1,100 gpm at 100-feet total dynamic head (TDH) and two (2) at 2,400 gpm at 100-feet TDH, where one (1) of the 2,400 gpm pumps act as a "stand-by". The proposed effluent pipeline route, 8.45-miles long, is shown on **Exhibit 4.0** in **Appendix A** of this report. The detailed cost estimate for the forcemain and pump station is included in the Appendices of this report.

4.3 ALTERNATIVE 1: FIELD-ERECTED (FE) EXTENDED AERATION PACKAGE PLANT

4.3.1 DESCRIPTION

For this alternative, the proposed new treatment units will bypass the existing Biolac® treatment system, which will be decommissioned at the end of new plant construction. The new field erected WWTF will consist of two (2) extended aeration, activated sludge units as provided by Evoqua (Davco), installed in below-ground, steel and reinforced concrete basins. In a single reactor basin, the system accomplishes aeration and clarification. **Figure 16.0** shows an example of the Davco Field-Erected System and **Figure 17.0** shows the Davco Field-Erected System General Treatment Schematic.

Figure 16.0: Davco Field-Erected System Example, 1MG Dual-Path Process

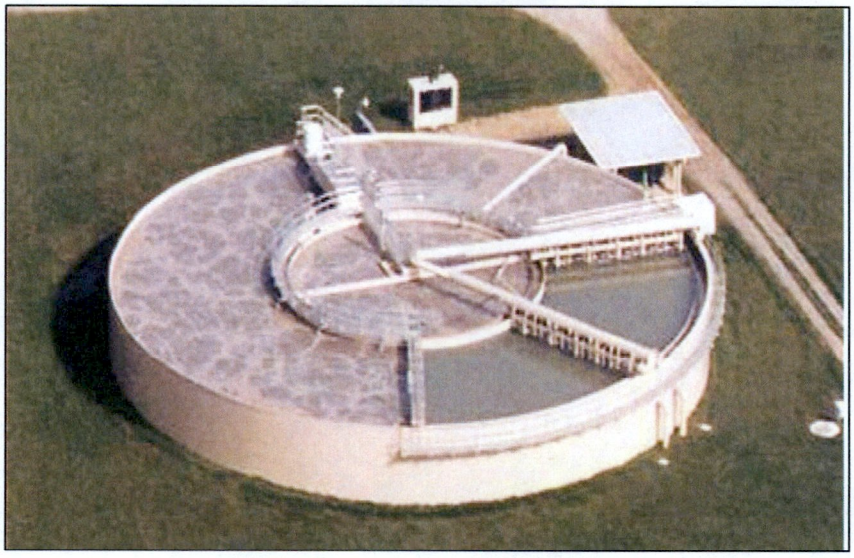
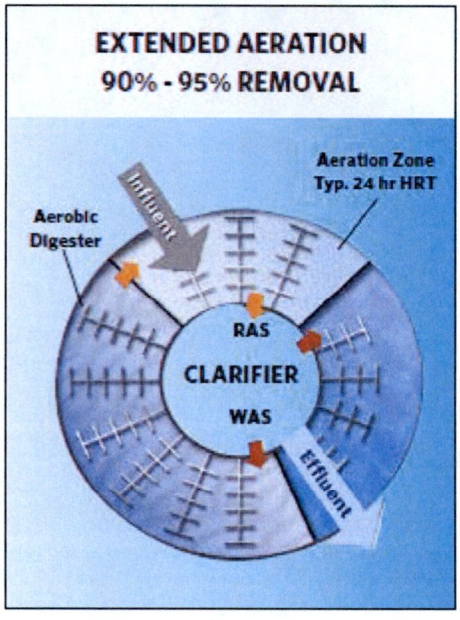


Figure 17.0: Davco Field-Erected System General Treatment Schematic



This package plant approach is pre-engineered and typically factory-built; this system will be built in-ground. For this alternative, there will be two (2) 108.5-foot diameter units with an average day capacity of 625,000 gallons-per-day (GPD) each, which can operate in parallel and serve as redundancy. These units will be designed with a 3.0 peaking factor, allowing for a total influent flow of 3.75 MGD to be treated. Further information on this system, as well as the design proposal, can be found in the Appendices of this report. The design proposal includes the addition of the digester section of each tank, but the digester is currently not being considered in final design which reduces the cost by about 10-percent. The steel tank units will be partially buried which will require additional reinforcement and concrete for installation. The treatment process aeration will include the installation of three (3) new 100-Hp blowers in the proposed blower building. The blowers included in the preliminary design are centrifugal multistage blowers. **Table 23.0** presents a summary description of the facility components included with this alternative. Further information on this system, as well as the design proposal, can be found in the Appendices of this report.

Table 23.0: Alternative 1 Components

Process Area	Description of Included Components
Headworks Improvements	▪ New piping to/from bar screen ▪ New bar screen
FE Extended Aeration Package System by Evoqua (Davco)	▪ New Partially-Buried Steel Wall Basins with concrete slab: Two (2) at 108.5-foot diameter ▪ Two (2) Evoqua (Davco) System Components with Aeration Zone and Clarification
Equipment & Process Piping	▪ Aeration system (blowers, aeration piping, and diffusers) ▪ WAS Pumps and Piping (in Splitter Box) ▪ PLC-based control system ▪ Yard piping, Utilities, and Air Piping
Administrative & Blower Building	▪ New 1,400-SF building with an office, restroom, storage room, and electrical/MCC room, blowers, mechanical and chemical storage)
Sludge Storage	▪ Reuse existing sludge storage ponds
Disinfection	▪ New Sodium Hypochlorite Disinfection System and Dechlorination System. ▪ Continue to use existing chlorine contact basin, minor modifications ▪ Use existing 90-degree V-notch weir, minor modifications
Site Work	▪ General clean-up and site work ▪ Fence, gravel road, sidewalks
Electrical Controls	▪ New electrical service, equipment, and controls

4.3.2 DESIGN CRITERIA

Preliminary sizing and evaluation of this alternative has been performed to satisfy the design criteria for flow, loading, and effluent quality. The preliminary sizing is summarized in **Table 24.0**.

Table 24.0: Alternative 1 Design Criteria

Design Parameter	Value	Units
Total Aerobic Basin Volume, each	630,657	gallons
Total Structure Diameter	108.5	feet
Max. Water Level	15	feet
Freeboard	1.5	feet
Design MLSS	3,500	mg/L
Design D.O. Concentration	2.0	mg/L
Design MLVSS	2,625	mg/L
Biosolids Yield Factor	0.65	lbs VSS/lbs BOD
RAS Rate, % Design Flow	50	%
Aerobic SRT/HRT	17 / 24.2	Days / hours @ Design
AOR/SOR	2,588 / 7,620	lbs. O_2/day
Air Flow Required	1,207	SCFM
Clarifier Diameter	51.5	feet
Clarifier Surface Area	2,083.1	sq. ft.
Clarifier Volume	192,102	gallons
Surface Overflow Rate, Average	300	gpd/ft^2
Surface Overflow Rate, Peak	900	gpd/ft^2
Solids Loading Rate, Average	13	lbs/day/ft^2
Solids Loading Rate, Peak	39	lbs/day/ft^2
Sludge Production	1,043	lbs/day

4.3.3 MAP

The general arrangement of **Alternative 1** can be seen on **Exhibit 5.0** in the Appendices of this report.

4.3.4 ENVIRONMENTAL IMPACTS

The **Alternative 1** system is contained entirely within the existing site. There are no environmental impacts identified or expected.

4.3.5 LAND REQUIREMENTS

The current WWTF site has sufficient area and no additional land is needed.

4.3.6 POTENTIAL CONSTRUCTION PROBLEMS

Within the existing WWTF property, the construction may encounter high water table and poor soils, which may increase construction excavation costs. The new WWTF will be located on the area of the filled-in wastewater lagoon that was decommissioned in 1994 with the construction of the Biolac system. Access to and around the existing treatment processes during construction may be difficult.

4.3.7 OPERATIONAL ASPECTS

Operators will need training on operations and maintenance of the proposed bar screen and biological treatment system with this alternative. Operation and maintenance of the system is expected to be

similar to the system currently in place and includes equipment for continual maintenance (extra blower parts and lubricants, extra lubrication and spare parts for pumps), as well as operation and replacement costs. The yearly Operation and Maintenance cost for **Alternative 1** is $239,900.

4.3.8 OPINION OF PROBABLE CONSTRUCTION COST

A summary of the project costs for this alternative is shown in **Table 25.0**. The cost estimate includes treatment equipment, process equipment, installation of equipment, civil site work, concrete work, electrical and mechanical work, and a pre-engineered metal building. Total project cost, used to compare alternatives in this report, is the sum of the initial capital cost, plus the present worth of operation and maintenance (O&M) costs, minus the present worth of the salvage value at the end of the 20-year planning period. The details of this preliminary cost estimate are included in the Appendices of this report.

Annual O&M costs were based on calculated annual plant O&M as required for the system alternative. For each evaluated alternative, the present worth of the operational and maintenance cost was calculated by using the calculated operational costs and a real discount rate of 2.75-percent over 20-years. Operating expenses include power, chemicals, water use, testing, lab fees, replacement fund, and maintenance supplies. Operation of these plants is not highly labor intensive. Based on plant size and monitoring requirements, which are not expected to changed from the existing requirements, the current labor burden should not change and will not require additional personnel.

Salvage value is only needed if the useful life is longer than the planning period, otherwise if the useful life is equal to the planning period, the salvage value is zero. The useful life of the existing facility is assumed to be reached, and a scrap value for the decommissioned processed is estimated at $25,000. The useful life of **Alternative 1** is assumed to be 30-years. Salvage value was calculated by assuming a straight-line depreciation and 20-year analysis where the salvage value of the facility at the 20th year is equal to the initial capital cost times the years of service remaining at the end of the planning horizon over the total useful life.

Table 25.0: Alternative 1 Cost Estimate

Net Present Worth Cost Inputs	Amount (2018 $)
Construction Cost	$5,724,350
Contingency Cost	$515,700
Engineering Cost[1]	$873,700
Total Initial Capital Cost	$7,113,750
Annual O&M Cost	$239,920
Energy Cost (Note: included in Annual O&M Cost)	$98,550
20-Year Present Worth of Annual O&M Costs[2]	$5,042,753
20-Year Present Worth of Salvage Value	-$1,378,289
Existing WWTP Scrap Value	-$25,000
Total 20-Year Present Worth Cost	**$10,753,214**

[1] Engineering cost for final design and Construction Admin/Inspection).
[2] Based on 20-year life cycle at a discount rate of 2.75-percent.

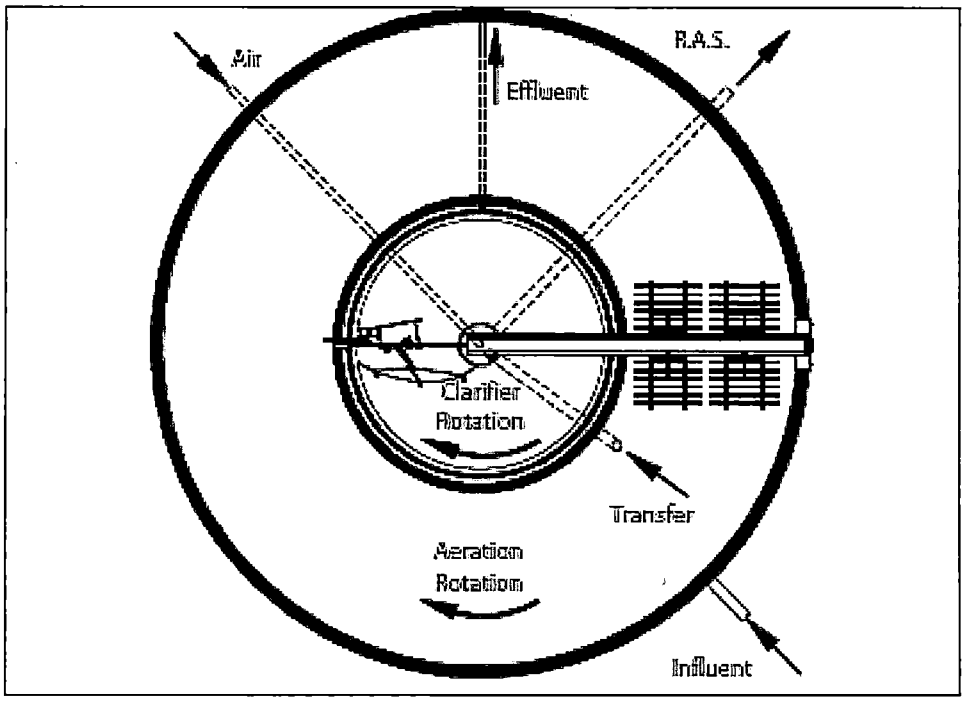
4.4 ALTERNATIVE 2: FIELD-ERECTED (FE) CSR PACKAGE PLANT

4.4.1 DESCRIPTION

For this alternative, the proposed new treatment units will bypass the existing Biolac® treatment system, which will be decommissioned at the end of new plant construction. The new field erected WWT units will be extended aeration, activated sludge continuously sequencing reactor (CSR) type treatment units as provided by Schreiber. The treatment units are Biological Nutrient Removal (BNR) systems contained in a single basin. It sequences through the three (3) process phases required for BNR – Oxic, Anoxic, and Anaerobic. The three phases do not occur at the same time in the basin but occur sequentially, one after the other, repetitively, over time. During the Oxic phase, the entire basin is Oxic (i.e. aerobic). When the air is turned off, the entire basin becomes anoxic and then ultimately anaerobic. With the CSR system, the diffusers are constantly moving through the water. The contents of the basin are mixed as the rotating bridge moves around the basin. After the anaerobic phase is completed, the air is turned back on and the cycle repeats. This system is designed for complete separation of aeration and mixing and has a 100% aeration turndown capability (which allows low energy mixing without aeration). The Schreiber FlexControls can be programed for many alternative scenarios, which can be as simple as a DO system with timers or can be an online monitoring of BNR process parameters.

The Model GR basin configuration proposed for this project utilizes the CSR system to provide high-efficiency aeration and separate low energy mixing for activated sludge. The GR unit incorporates aeration and clarification within the same structure to optimize space utilization. **Figure 18.0** shows the Schreiber CSR Model GR typical basin configuration as proposed for this alternative.

Figure 18.0: Schreiber CSR Model GR Typical Basin Configuration



For this alternative, there will be two (2) 140-foot diameter units with an average day capacity of 1.25 MGD each, with a peak flow of 3.13 MGD each. The unit will include four (4) dual arm rotating aeration assemblies, two (2) single arm rotating aeration assemblies, three (3) 60-Horsepower blowers with manifold and powder coated enclosure, a Dissolved Oxygen (D.O.) Process Control System, all necessary scraper assemblies, scum removal equipment, effluent weirs, scum baffles and brackets. Further information on this system, as well as the design proposal, can be found in the Appendices of this report. **Table 26.0** presents a summary description of the facility components included with this alternative.

Table 26.0: Alternative 2 Components

Process Area	Description of Included Components
Headworks Improvements	▪ New piping to/from bar screen ▪ New bar screen
FE Extended Aeration, Activated Sludge CSR Package System by Schreiber	▪ New Partially-Buried Concrete Basins: Two (2) at 140-foot diameter ▪ Two (2) Schreiber GR Aeration and Clarifier Systems
Equipment & Process Piping	▪ Aeration system (blowers, aeration piping, and diffusers) ▪ WAS Pumps and Piping (in Splitter Box) ▪ PLC-based control system ▪ Yard Piping, Utilities, and Air piping
Administrative & Blower Building	▪ New 1,400-SF building with an office, restroom, storage room, and electrical/MCC room, blowers, mechanical and chemical storage)
Sludge Storage	▪ Reuse existing sludge storage ponds
Disinfection	▪ New Sodium Hypochlorite Disinfection System and Dechlorination System. ▪ Continue to use existing chlorine contact basin, minor modifications ▪ Use existing 90-degree V-notch weir, minor modifications
Site Work	▪ General clean-up and site work ▪ Fence, gravel road, sidewalks
Electrical Controls	▪ New electrical service, equipment, and controls

4.4.2 DESIGN CRITERIA

Preliminary sizing and evaluation of this alternative has been performed to satisfy the design criteria for flow, loading, and effluent quality. The preliminary sizing is summarized in **Table 27.0.**

Table 27.0: Alternative 2 Design Criteria

Design Parameter	Value	Unit
GR Aeration System Diameter	140	Feet
Side Water Depth (SWD)	15	Feet
MLSS Concentration	4,000	mg/L
Hydraulic Detention	25.45	hours
Biological Loading Rate	11.76	lbs. BOD/1000 cu. Ft.
Linear Feet of Rotating Diffusers	1,050	Feet
GR Process Volume per Basin	175,538	Cubic feet
Total CSR Volume	1.33	MG
GR Clarifier Diameter	65	Feet
Side Water Depth (SWD)	14	Feet
Surface Settling Rate, Average	377	gpd/sq. ft.
Surface Settling Rate, Peak	942	gpd/sq. ft.
Design MLVSS	2,720	mg/L
Food:Mass Ratio	0.070	
Average RAS flow	0.83	MGD
Design Blower Operating Hours per Day	24	hours
Combined Oxic(N) + Anoxic (DN) Time	4.68	hours
SOR/AOR Ratio	1.90	
SOR from AOR using (SOR:AOR ratio)	8,339	lbs. O_2/day

4.4.3 MAP

The general arrangement of **Alternative 2** can be seen on **Exhibit 5.0** in the Appendices of this report.

4.4.4 ENVIRONMENTAL IMPACTS

The **Alternative 2** system is contained entirely within the existing site. There are no environmental impacts identified or expected.

4.4.5 LAND REQUIREMENTS

The current WWTF site has sufficient area and no additional land is needed. In comparison to **Alternative 1, Alternative 2** requires more concrete and excavation/dirt work for construction; however, **Alternative 2** requires less concrete and excavation/dirt work than **Alternatives 3, 4,** and **5.**

4.4.6 POTENTIAL CONSTRUCTION PROBLEMS

Within the existing WWTF property, the construction may encounter high water table and poor soils, which may increase construction excavation costs. The new WWTF will be located on the area of the filled-in wastewater lagoon that was decommissioned in 1994 with the construction of the Biolac system. Access to and around the existing treatment processes during construction may be difficult.

4.4.7 OPERATIONAL ASPECTS

Operators will need training on operations and maintenance of the proposed bar screen and biological treatment system with this alternative. Operation and maintenance of the system is expected to be

similar to the system currently in place and includes equipment for continual maintenance (extra blower parts and lubricants, extra lubrication and spare parts for pumps), as well as operation and replacement costs. The yearly Operation and Maintenance cost for **Alternative 2** is $194,300.

4.4.8 OPINION OF PROBABLE CONSTRUCTION COST

A summary of the project costs for this alternative is shown in **Table 28.0.** The cost estimate includes treatment equipment, process equipment, installation of equipment, civil site work, concrete work, electrical and mechanical work, and a pre-engineered metal building. Total project cost, used to compare alternatives in this report, is the sum of the initial capital cost, plus the present worth of operation and maintenance (O&M) costs, minus the present worth of the salvage value at the end of the 20-year planning period. The details of this preliminary cost estimate are included in the Appendices of this report.

Annual O&M costs were based on the calculated annual plant O&M as required for the system alternative. For each evaluated alternative, the present worth of the operational and maintenance cost was calculated by using the calculated operational costs and a real discount rate of 2.75-percent over 20-years. Operating expenses include power, chemicals, water use, testing, lab fees, replacement fund, and maintenance supplies. Operation of these plants is not highly labor intensive. Based on plant size and monitoring requirements, which are not expected to changed from the existing requirements, the current labor burden should not change and will not require additional personnel.

Salvage value is only needed if the useful life is longer than the planning period, otherwise if the useful life is equal to the planning period, the salvage value is zero. The useful life of the existing facility is assumed to be reached, and a scrap value for the decommissioned processed is estimated at $25,000. The useful life of **Alternative 2** is assumed to be 30-years. Salvage value was calculated by assuming a straight-line depreciation and 20-year analysis where the salvage value of the facility at the 20th year is equal to the initial capital cost times the years of service remaining at the end of the planning horizon over the total useful life.

Table 28.0: Alternative 2 Cost Estimate

Net Present Worth Cost Inputs	Amount (2018 $)
Construction Cost	$6,409,540
Contingency Cost	$577,400
Engineering Cost[1]	$978,200
Total Initial Capital Cost	$7,965,140
Annual O&M Cost	$194,304
Energy Cost (Note: included in Annual O&M Cost)	$42,661
20-Year Present Worth of Annual O&M Costs[2]	$4,348,221
20-Year Present Worth of Salvage Value	-$1,543,246
Existing WWTP Scrap Value	-$25,000
Total 20-Year Present Worth Cost	**$10,745,115**

[1] Engineering cost for final design and Construction Admin/Inspection).
[2] Based on 20-year life cycle at a discount rate of 2.75-percent.

4.5 ALTERNATIVE 3: PARTIAL MIX AERATED LAGOON

4.5.1 DESCRIPTION

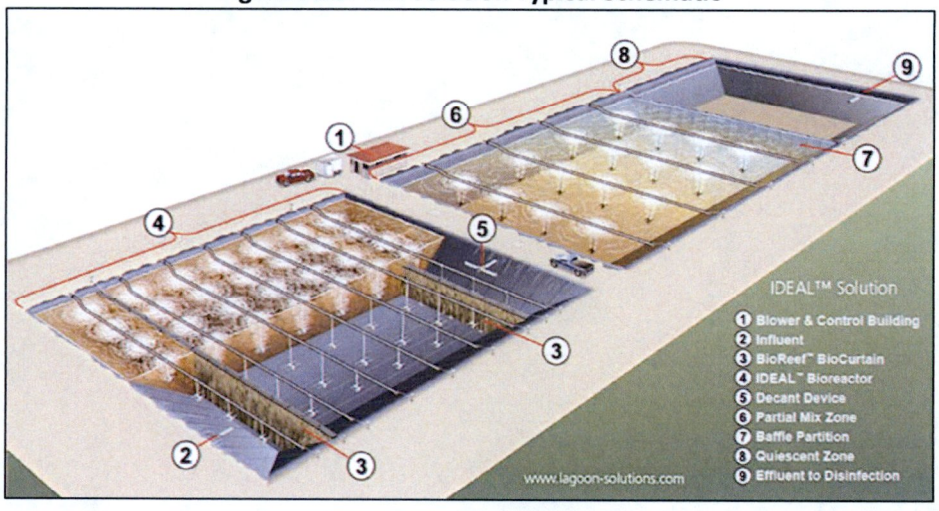
For this alternative, the proposed new treatment units will bypass the existing Biolac® treatment system, which will be decommissioned at the end of new plant construction. The Partial Mix (PM) lagoon is an enhanced facultative lagoon process to simultaneously remove BOD and provide solids separation and digestion, as provided by Environmental Dynamics International (EDI). The enhancement is achieved by the circulation of the lagoon bulk liquid whereby soluble CBOD is introduced to biosolids more efficiently than in a purely facultative flow-through lagoon. The EDI Aerated Lagoon System may be comprised of a single pond or a series of two or more ponds or zones within a single basin. These zones or ponds are characterized as complete mix, partial mix, and quiescent.

Note the difference between this and a Complete Mix lagoon which uses greater airflows to keep all biosolids in suspension so a higher concentration can come in contact with soluble CBOD more efficiently than the PM. Screening and grit removal are generally not required for PM lagoon systems but use of the screening pretreatment can help avoid nuisance floating materials and improve aesthetics. PM lagoons are typically several days' detention (generally more than 5 days). Aeration is only provided to maintain oxygen in the liquid portion of the lagoon, and air flow is limited to the process oxygen demand from CBOD removal. Solids settling and digestion is facilitated in the same reactor. Mixing (i.e., solids suspension) via aeration is not a factor in the design so a low-energy system is possible. Typical BOD removal and oxygen demand in the PM lagoon is defined by biological reaction rates as published in US EPA design manual EPA-625-83-015, "Municipal Wastewater Stabilization Ponds." Removals are based on first order kinetics for detention times and temperature of the lagoon. Nitrogen is removed in PM reactors primarily via assimilation by heterotrophic organisms. Very little autotrophic nitrification can be expected on a consistent basis, although nitrification may become established with the combination of a warm climate and long detention time. Alternate provisions must be employed if nitrogen removal is desired. As mentioned previously in the body of this report, effluent flow to the Black River is required with this system, as the treatment capability for this type of system is not adequate for discharge at the existing outfall location on Village Creek. For consideration of discharging effluent to Village Creek, instead of moving the outfall to the Black River, filters could possibly be installed but are highly maintenance and operational intensive.

The design for **Alternative 3** for this system involves two basins divided into four (4) separate zones. The first basin is divided into three (3) zones by baffle curtains. **Figure 19.0** is a photo of a typical EDI Solution installation. **Figure 20.0** shows a general schematic of a typical EDI Solution system.

Figure 19.0: Typical EDI Solution Installation Photo

Figure 20.0: EDI Solution Typical Schematic



Note that **Alternative 3** does not include the first basin shown in **Figure 20.0**, the IDEAL™ Bioreactor. Further information on this system, as well as the design proposal, can be found in the Appendices of this report. **Table 29.0** presents a summary description of the facility components included with this alternative.

Table 29.0: Alternative 3 Components

Process Area	Description of Included Components
Headworks Improvements	▪ New piping to/from bar screen ▪ New bar screen
Partial Mix Aerated Lagoon(s)	▪ Two basins, lined with 40 mil HDPE liner. ▪ EDI System Components (Partial-Mix Aeration Lagoon System)
Equipment & Process Piping	▪ Aeration system (blowers, aeration piping, and diffusers) ▪ WAS Pumps and Piping, located in lagoons ▪ PLC-based control system ▪ Yard Piping, Utilities, and Air Piping
Administrative & Blower Building	▪ New 1,400-SF building with an office, restroom, storage room, and electrical/MCC room, blowers, mechanical and chemical storage)
Sludge Storage	▪ Reuse existing sludge storage ponds
Disinfection	▪ New Sodium Hypochlorite Disinfection System and Dechlorination System. ▪ Continue to use existing chlorine contact basin, minor modifications ▪ Use existing 90-degree V-notch weir, minor modifications
Site Work	▪ General clean-up and site work ▪ Fence, gravel road, sidewalks
Electrical Controls	▪ New electrical service, equipment, and controls
New Outfall Forcemain and Pump Station, Black River	▪ Approximately 45,000 linear feet of 14-inch C900 PVC forcemain, with valves and air/vacuum relief valves ▪ Effluent pump station, includes two (2) – 60 Hp submersible pumps and two (2) – 100 Hp submersible pumps

4.5.2 DESIGN CRITERIA

Preliminary sizing and evaluation of this alternative has been performed to satisfy the design criteria for flow, loading, and effluent quality. The preliminary sizing is summarized in **Table 30.0 and Table 31.0.**

Table 30.0: Alternative 3 Design Summary Information

Parameter	Zone 1	Zone 2	Zone 3	Zone 4
Volume, MG	5.1	5.5	5.1	10.5
Retention Time, Days	4.1	4.4	4.1	8.4
Operating Regime	Partial Mix	Partial Mix	Partial Mix	Partial Mix
Expected Winter Effluent Concentration (BOD5 and TSS), mg/L	149	89	56	25
Length x Width, feet x feet	227 x 300	224 x 300	227 x 300	280 x 500
Depth, feet	10	10	10	10

Table 31.0: Air/Blower Design Information

Parameter	Design
Airflow Requirements, scfm	1898
Design Blower Operating Pressure, psig	5.8
# of Duty Blowers	1
# of Standby Blowers	1
% of Blower Capacity	87
Motor Size, hp	75

4.5.3 MAP

The general arrangement of **Alternative 3** can be seen on **Exhibit 6.0** in the Appendices of this report.

4.5.4 ENVIRONMENTAL IMPACTS

The **Alternative 3** system is contained entirely within the existing site. There are no environmental impacts identified or expected. There will be a need for erosion control on-site and stormwater pollution control, during construction. With a lagoon system, groundwater monitoring wells may be required in areas with a high water table (within 5-feet of the lagoon invert).

4.5.5 LAND REQUIREMENTS

The current WWTF site has sufficient area and no additional land is needed. The lagoon system proposed for **Alternative 3** requires more land use and excavation, than required for **Alternatives 1** and **2**, but only more excavation in comparison to **Alternative 4** and **5.**

For this alternative, due to the need for a new outfall at the Black River, any required or new utility right-of-way easements and lands will be obtained by the City of Walnut Ridge, working in concert with the Walnut Ridge City Water Works, the City Engineer, landowners, the City Attorney, and any other necessary individuals. Each easement will be properly recorded at the County Courthouse.

4.5.6 POTENTIAL CONSTRUCTION PROBLEMS

Within the existing WWTF property, the construction may encounter high water table and poor soils, which may increase construction excavation costs. The new WWTF will be located on the area of the filled-in wastewater lagoon that was decommissioned in 1994 with the construction of the Biolac system. Access to and around the existing treatment processes during construction may be difficult. The increase in disturbed area will result in higher site work costs.

4.5.7 OPERATIONAL ASPECTS

Operators will need training on operations and maintenance of the proposed bar screen and biological treatment system with this alternative. Operation and maintenance of the system is expected to be more intensive than the system currently in place due to the addition of approximately 45,000 linear feet of forcemain and an effluent pump station. Additional training and labor for this alternative is included in the operation and maintenance cost calculation, and also includes equipment for continual maintenance (extra blower parts and lubricants, extra lubrication and spare parts for pumps), as well as operation and replacement costs. Because sludge is retained in the first cell of the process there is no need to operate and maintain sludge return pumps. The yearly Operation and Maintenance cost for **Alternative 3** is $205,773.

4.5.8 OPINION OF PROBABLE CONSTRUCTION COST

A summary of the project costs for this alternative is shown in **Table 32.0**. The cost estimate includes treatment equipment, process equipment, installation of equipment, civil site work, concrete work, electrical and mechanical work, and a pre-engineered metal building. Total project cost, used to compare alternatives in this report, is the sum of the initial capital cost, plus the present worth of operation and maintenance (O&M) costs, minus the present worth of the salvage value at the end of the 20-year planning period. The total **Alternative 3** project includes the proposed partial mixed aerated lagoon by EDI and a new outfall, with 14-inch forcemain and effluent pump station, at the Black River. The details of this preliminary cost estimate are included in the Appendices of this report.

Annual O&M costs were based on current day, annual plant O&M as required for the system alternative. For each evaluated alternative, the present worth of the operational and maintenance cost was calculated by using the calculated operational costs and a real discount rate of 2.75-percent over 20-years. Operating expenses include power, chemicals, water use, testing, lab fees, replacement fund, and maintenance supplies. Operation of these plants is not highly labor intensive. Based on plant size and monitoring requirements, which are not expected to changed from the existing requirements, the current labor burden should not change and will not require additional personnel.

Salvage value is only needed if the useful life is longer than the planning period, otherwise if the useful life is equal to the planning period, the salvage value is zero. The useful life of the existing facility is assumed to be reached, and a scrap value for the decommissioned processed is estimated at $25,000. The useful life of **Alternative 3** is assumed to be 30-years. Salvage value was calculated by assuming a straight-line depreciation and 20-year analysis where the salvage value of the facility at the 20th year is equal to the initial capital cost times the years of service remaining at the end of the planning horizon over the total useful life.

Table 32.0: Alternative 3 Cost Estimate

Net Present Worth Cost Inputs	Amount (2018 $)
Construction Cost, WWTF	$6,736,130
Contingency Cost	$606,900
Engineering Cost[1]	$1,028,100
Total Initial Capital Cost	$8,371,130
Annual O&M Cost	$205,773
Energy Cost (Note: included in Annual O&M Cost)	$49,231
20-Year Present Worth of Annual O&M Costs[2]	$4,552,861
20-Year Present Worth of Salvage Value	-$1,621,906
Existing WWTP Scrap Value	-$25,000
Total 20-Year Present Worth Cost, WWTF	**$11,247,084**
Construction Cost, Black River Outfall	$3,286,893
Contingency Cost	$289,200
Engineering Cost[1]	$500,700
Total Initial Capital Cost	$4,076,793
Annual O&M Cost	$49,303
20-Year Present Worth of Annual O&M Costs[2]	$750,758
Total 20-Year Present Worth Cost, Forcemain	**$4,827,551**
Summary of Alternative 3 Costs	
Total Initial Capital Cost	**$12,447,923**
Total 20-Year Present Worth Cost	**$16,074,635**

[1] Engineering cost for final design and Construction Admin/Inspection).
[2] Based on 20-year life cycle at a discount rate of 2.75-percent.

4.6 ALTERNATIVE 4: CLOSED LOOP REACTOR (CLR) EXTENDED-AERATION, COMPLETE-MIX SYSTEM

4.6.1 DESCRIPTION

For this alternative, the proposed new treatment units will bypass the existing Biolac® treatment system, which will be decommissioned at the end of new plant construction. The Closed Loop Reactor (CLR) process is a modified form of the extended aeration complete mix process that provide biological nutrient removal, as provided by Lakeside Equipment Corporation. The system utilizes long solids retention times to provide a more stable operation over a wide range of influent flow and organic loading conditions, minimizing the time and effort to control or adjust the system. This alternative also includes the construction of two clarifiers, as proposed by Lakeside Equipment Corporation and WesTech Inc.

A component of the CLR process is the horizontal, bladed rotor aerator. The rotor aerator provide oxygen and mixing to the basin with reliable operation and efficiency. The rotor aerator provides complete mixing for aeration basins, provide greater oxygen transfer than other mechanical surface aerators, and has a shaft mounted drive that allows for flexibility in speed changes and easy access for maintenance and operator convenience. This process is supplied with covers for the rotors which extend over the baffles to contain mist and spray. Velocity control baffles direct flow downward creating a rolling motion to ensure uniform distribution of oxygen throughout the basin. By adjusting the effluent weir, the operator can control the oxygen input into the basin to optimize treatment and save energy costs. Process monitoring and control systems can be provided to continuously monitor and adjust the operation of the biological reactors to optimize the process performance and reduce power costs.

Alternative 4 includes a dual train, racetrack design CLR process and two (2) clarifiers. The design includes submersible mixers and a gate between the CLR basins. **Figure 21.0** shows a typical CLR installation with clarifiers. Further information on this system, as well as the design proposal, can be found in the Appendices of this report.

Figure 21.0: Typical CLR Installation with Clarifiers

Table 33.0 presents a summary description of the facility components included with this alternative.

Table 33.0: Alternative 4 Components

Process Area	Description of Included Components
Headworks Improvements	▪ New pipe to/from bar screen ▪ New bar screen
Dual CLR lagoon system and secondary clarifiers	▪ Dual CLR trains with rotors, mixers, covers, and components ▪ Two (2) clarifiers with all components
Equipment & Process Piping	▪ RAS/WAS Pumps and Piping (in Splitter Box No. 2) ▪ Two (2) splitter boxes ▪ PLC-based control system ▪ Yard Piping and Utilities
Administrative & Chemical/Storage Building	▪ New 1,200-SF building with an office, restroom, storage room, and electrical/MCC room, mechanical, and chemical storage)
Sludge Storage	▪ Reuse existing sludge storage ponds
Disinfection	▪ New Sodium Hypochlorite Disinfection System and Dechlorination System. ▪ Continue to use existing chlorine contact basin, minor modifications ▪ Use existing 90-degree V-notch weir, minor modifications
Site Work	▪ General clean-up and site work ▪ Fence, gravel road, sidewalks
Electrical Controls	▪ New electrical service, equipment, and controls

4.6.2 DESIGN CRITERIA

Preliminary sizing and evaluation of this alternative has been performed to satisfy the design criteria for flow, loading, and effluent quality. The preliminary sizing is summarized in **Table 34.0.**

Table 34.0: Alternative 4 Design Criteria

Design Parameter	Value	Unit
CLR Process		
CLR Process Total Length	154	feet
CLR Process Total Width	25	feet
Length of Rotors, Baffles, and Covers	19	feet
Length of Hinged Plate Weirs	11	feet
Rotor Diameter	42	inches
Motor Horsepower	30	hp
Maximum Rotor Speed	60	rpm
Maximum Blade Immersion	13.1	inches
Maximum Oxygen Transfer	88.4	lbs.O_2 / hour/ rotor
Clarifiers		
Clarifier Diameter	54	feet
Sidewater Depth (SWD)	12 to 13	feet
Freeboard	1 to 1.5	feet
Average Flow Rate	0.625	MGD
Peak Flow Rate	2	MGD

4.6.3 MAP

The general arrangement of **Alternative 4** can be seen on **Exhibit 7.0** in the Appendices of this report.

4.6.4 ENVIRONMENTAL IMPACTS

The **Alternative 4** system is contained entirely within the existing site. There are no environmental impacts identified or expected.

4.6.5 LAND REQUIREMENTS

The current WWTF site has sufficient area and no additional land is needed. The system proposed for **Alternative 4** requires more land use than required for **Alternatives 1** and **2** and less excavation in comparison to all the other alternatives. **Alternative 4** requires more concrete than **Alternative 1**, but less concrete than **Alternatives 2 and 5**.

4.6.6 POTENTIAL CONSTRUCTION PROBLEMS

Within the existing WWTF property, the construction may encounter high water table and poor soils, which may increase construction excavation costs. The new WWTF will be located on the area of the filled-in wastewater lagoon that was decommissioned in 1994 with the construction of the Biolac system. Access to and around the existing treatment processes during construction may be difficult. The increase in disturbed area will result in higher site work costs.

4.6.7 OPERATIONAL ASPECTS

Operators will need training on operations and maintenance of the proposed bar screen, CLR Process, and Clarifier operation with this alternative. Operation and maintenance of the system is expected to be more similar to the system currently in place, but considerations for additional training is included in this report. Operation and maintenance includes equipment for continual maintenance (extra lubrication and spare parts for pumps), as well as operation and replacement costs. The yearly Operation and Maintenance cost for **Alternative 4** is $205,419.

4.6.8 OPINION OF PROBABLE CONSTRUCTION COST

A summary of the project costs for this alternative is shown in **Table 35.0**. The cost estimate includes treatment equipment, process equipment, installation of equipment, civil site work, concrete work, electrical and mechanical work, and a pre-engineered metal building. Total project cost, used to compare alternatives in this report, is the sum of the initial capital cost, plus the present worth of operation and maintenance (O&M) costs, minus the present worth of the salvage value at the end of the 20-year planning period. The details of this preliminary cost estimate are included in the Appendices of this report.

Annual O&M costs were based on current day, annual plant O&M as required for the system alternative. For each evaluated alternative, the present worth of the operational and maintenance cost was calculated by using today's operational costs and a real discount rate of 2.75-percent over 20-years. Operating expenses include power, chemicals, water use, testing, lab fees, replacement fund, and maintenance supplies. Operation of these plants is not highly labor intensive. Based on plant size and monitoring requirements, which are not expected to changed from the existing requirements, the current labor burden should not change and will not require additional personnel.

Salvage value is only needed if the useful life is longer than the planning period, otherwise if the useful life is equal to the planning period, the salvage value is zero. The useful life of the existing facility is assumed to be reached, and a scrap value for the decommissioned processed is estimated at $25,000.

The useful life of **Alternative 4** is assumed to be 30-years. Salvage value was calculated by assuming a straight-line depreciation and 20-year analysis where the salvage value of the facility at the 20th year is equal to the initial capital cost times the years of service remaining at the end of the planning horizon over the total useful life.

Table 35.0: Alternative 4 Cost Estimate

Net Present Worth Cost Inputs	Amount (2018 $)
Construction Cost	$3,839,250
Contingency Cost	$343,600
Engineering Cost[1]	$585,600
Total Initial Capital Cost	$4,768,450
Annual O&M Cost	$205,419
Energy Cost (Note: included in Annual O&M Cost)	$92,330
20-Year Present Worth of Annual O&M Costs[2]	$4,517,470
20-Year Present Worth of Salvage Value	-$923,887
Existing WWTP Scrap Value	-$25,000
Total 20-Year Present Worth Cost	**$8,337,033**

[1] Engineering cost for final design and Construction Admin/Inspection).
[2] Based on 20-year life cycle at a discount rate of 2.75-percent.

4.7 ALTERNATIVE 5: OXIDATION AND CLARIFICATION BY WESTECH

4.7.1 DESCRIPTION

For this alternative, the proposed new treatment units will bypass the existing Biolac® treatment system, which will be decommissioned at the end of new plant construction. The OxyStream™ is a modified, activated-sludge, biological treatment process, as provided by WesTech Inc. The system process combines vertically mounted, low-speed surface aerators with a continuous racetrack layout to maximize oxygen transfer efficiency with the flexibility of power turndown. The system has greater side-water depths and fewer required aerators than a conventional brush rotor or disc rotor oxidation ditch. For this option, the capability to add biological selector zones to meet more stringent nutrient limits if that occurs. This alternative also includes the construction of two clarifiers, as proposed by Lakeside Equipment Corporation and WesTech Inc.

The OxyStream™ system has five stages of the process: Anaerobic selectors, Pre-anoxic Zone, Aerobic Channels, Post-Anoxic Zone, and a Re-aeration Zone. In stage 1 the return activated sludge and the influent wastewater mix together without oxygen or nitrate present, to promote phosphorus uptake in the aerobic channels. In stage 2 the activated sludge and wastewater mixture then combines with a nitrate recycle stream in the pre-anoxic zone, removing nitrogen as gas through the denitrification process. In Stage 3, oxygen and mixing allows the complete oxidation of BOD and ammonia. Organisms selected in the fermentation stage accumulate phosphorus for removal in the waste sludge. Stage 4 removes any remaining nitrate through endogenous respiration. In stage 5 the activated sludge receives oxygen in the final step to prevent anaerobic conditions and the secondary release of phosphorus. Components of the system include selector zone mixers, turning vanes, internal recycle gates, dissolved oxygen probes, effluent weirs, aeration decks, and surface aerators. The OxyStream™ oxidation ditch system combines slow-speed surface aerators with an oxidation ditch design based on site-specific conditions and WesTech's proprietary hydraulic model.

Alternative 5 includes a dual train, racetrack design with aeration/anoxic mixing boxes and two (2) clarifiers. **Figure 22.0** shows an aerial photo of a WesTech OxyStream™ and COP™ Spiral Blade Clarifier installation. **Figure 23.0** and **Figure 24.0** show the various stages and components in schematic form. Further information on this system, as well as the design proposal, can be found in the Appendices of this report.

Figure 22.0: Aerial Photo of a WesTech OxyStream™ and COP™ Spiral Blade Clarifier Installation

Figure 23.0: WesTech OxyStream™ Component Schematic (A)

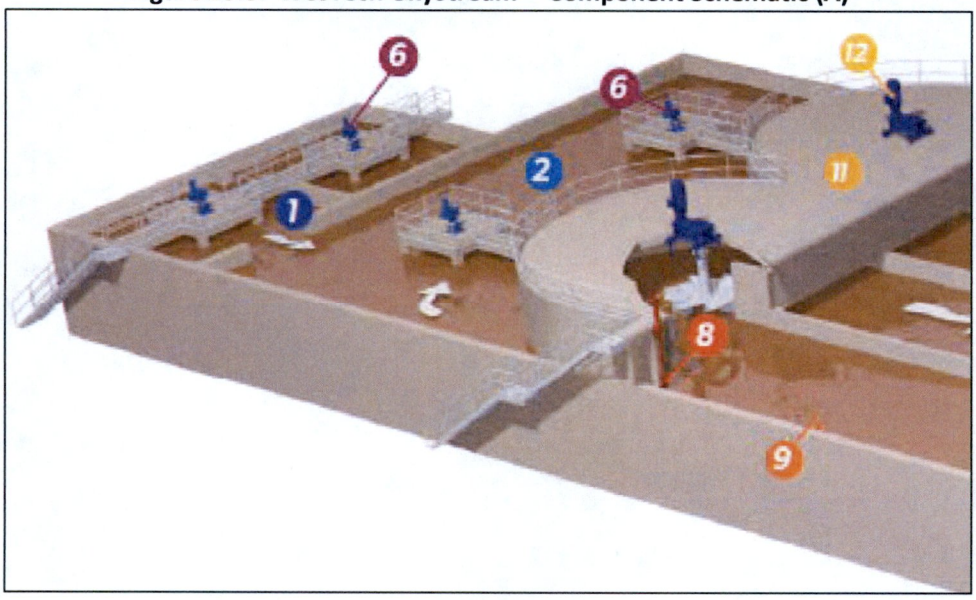
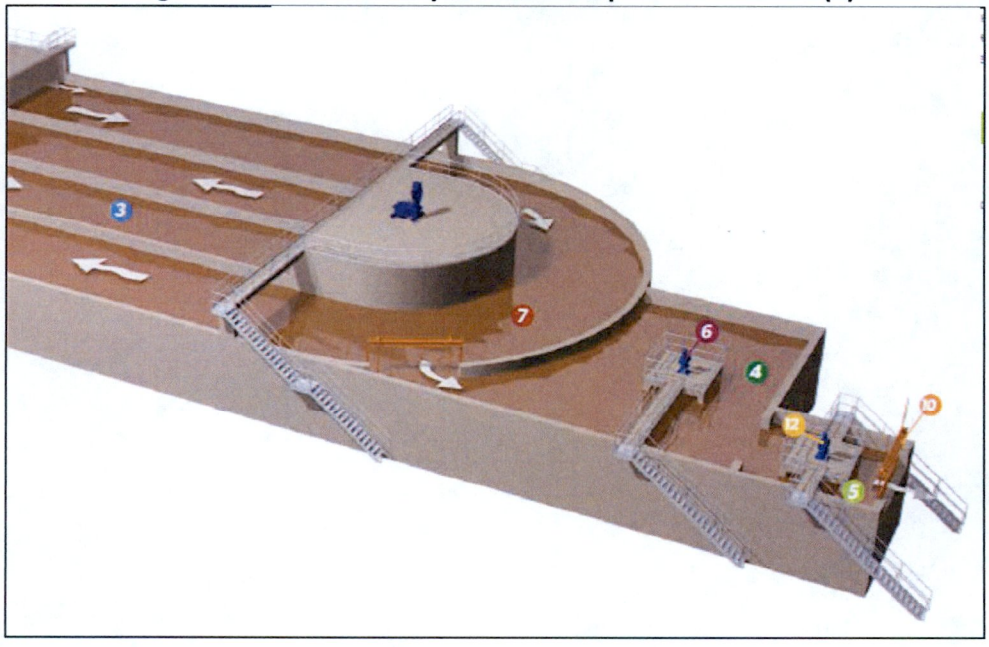


Figure 24.0: WesTech OxyStream™ Component Schematic (B)



The WesTech Calrifier Optimization Package (COP) are designed to optimize the clarification process, produce the cleanest possible effluent, and maximize underflow concentration. The influent center of the COP clarifier is sized and ported to prevent settling and to reduce incoming velocities. Flow enters at the water surface, ensuring that the full volume of the flocculation well is used for gentle mixing and flocculation of the biological solids. Opposing adjustable gates are arranged so that incoming flow impinges on itself, dissipating the incoming energy and eliminating focused flow streams that could carry into the clarification zone. The clarifier package includes a Premium Drive Unit, Spiral Rake Blades for solids removal, Density Current Baffle to eliminate wall currents and prevent short-circuiting, Scum

Removal, Flocculating Feedwell, Center Column, and Sludge Withdrawal Ring that reduces the depth of the sludge blanket. **Figure 25.0** shows a photo of a WesTech COP™ Spiral Blade Clarifier installation.

Figure 25.0: Photo of a WesTech COP™ Spiral Blade Clarifier

Table 36.0 presents a summary description of the facility components included with this alternative.

Table 36.0: Alternative 5 Components

Process Area	Description of Included Components
Headworks Improvements	▪ New pipe to/from bar screen ▪ New bar screen
OxyStream™ activated sludge oxidation basins and secondary COP™ Spiral Blade Clarifiers	▪ Dual OxyStream™ trains with zone mixers, turning vanes, internal recycle gates, dissolved oxygen probes, effluent weirs, aeration decks, and surface aerators covers. ▪ Two (2) clarifiers with all components
Equipment & Process Piping	▪ RAS/WAS Pumps and Piping (in Splitter Box No. 2) ▪ Two (2) splitter boxes ▪ PLC-based control system ▪ Yard Piping and Utilites
Administrative & Chemical/Storage Building	▪ New 1,200-SF building with an office, restroom, storage room, and electrical/MCC room, mechanical, and chemical storage)
Sludge Storage	▪ Reuse existing sludge storage ponds
Disinfection	▪ New Sodium Hypochlorite Disinfection System and Dechlorination System. ▪ Continue to use existing chlorine contact basin, minor modifications ▪ Use existing 90-degree V-notch weir, minor modifications
Site Work	▪ General clean-up and site work ▪ Fence, gravel road, sidewalks
Electrical Controls	▪ New electrical service, equipment, and controls

4.7.2 DESIGN CRITERIA

Preliminary sizing and evaluation of this alternative has been performed to satisfy the design criteria for flow, loading, and effluent quality. The preliminary sizing is summarized in **Table 37.0.**

Table 37.0: Alternative 5 Design Criteria

Design Parameter	Value	Unit
OxyStream™ System		
Flow (Average/Design)	1.25	MGD
BOD (Influent/Effluent)	240/10	Mg/L
TSS (Influent)	170	Mg/L
TKN (Influent)	50	Mg/L
Ammonia (Effluent)	4	Mg/L
Aerators, 4 total	40	HP
DO Control System, 0-20.0 mg/L	2	Probes
DO Control System	1	Controller
VFD, 40 HP (480/3/60)	4	Stand Alone Panel
No. of Ditches	2	
Aerators/Ditch	2	
Depth	11	feet
Channel Width	22	Feet
Straight Length	69.02	feet
Channel Freeboard	1.5	feet
Aeration Freeboard	6	feet
Aerobic Width x Length	45 x 113.02	feet x feet
Anoxic Width x Length	45 x 46.99	feet x feet
Anaerobic1 Width x Length	22 x 10.77	feet x feet
Anaerobic2 Width x Length	22 x 10.77	feet x feet
Aerobic Volume	0.375	MGal
Anoxic Volume	0.174	MGal
Anaerobic1 Volume	0.02	MGal
Anaerobic2 Volume	0.02	MGal
Clarifiers		
Clarifier Diameter	54	feet
Sidewater Depth (SWD)	13	feet
Average Flow Rate	0.625	MGD
Peak Flow Rate	2	MGD
Drive Motor Size	0.5	HP
Drive Motor Speed	1800	RPM

4.7.3 MAP

The general arrangement of **Alternative 5** can be seen on **Exhibit 7.0** in the Appendices of this report.

4.7.4 ENVIRONMENTAL IMPACTS

The **Alternative 5** system is contained entirely within the existing site. There are no environmental impacts identified or expected.

4.7.5 LAND REQUIREMENTS

The current WWTF site has sufficient area and no additional land is needed. The system proposed for **Alternative 5** requires more land use than required for **Alternatives 1** and **2** and less excavation in comparison to all the other alternatives, except **Alternative 4. Alternative 5** requires more concrete than **Alternative 4**, but less concrete than **Alternatives 1** and **2**.

4.7.6 POTENTIAL CONSTRUCTION PROBLEMS

Within the existing WWTF property, the construction may encounter high water table and poor soils, which may increase construction excavation costs. The new WWTF will be located on the area of the filled-in wastewater lagoon that was decommissioned in 1994 with the construction of the Biolac system. Access to and around the existing treatment processes during construction may be difficult. The increase in disturbed area will result in higher site work costs.

4.7.7 OPERATIONAL ASPECTS

Operators will need training on operations and maintenance of the proposed bar screen, OxyStream™ oxidation ditch system, and Clarifier operation with this alternative. Operation and maintenance of the system is expected to be more similar to the system currently in place, but considerations for additional training is included in this report. Operation and maintenance includes equipment for continual maintenance (extra lubrication and spare parts for pumps), as well as operation and replacement costs. The yearly Operation and Maintenance cost for **Alternative 5** is $214,377.

4.7.8 OPINION OF PROBABLE CONSTRUCTION COST

A summary of the project costs for this alternative is shown in **Table 38.0**. The cost estimate includes treatment equipment, process equipment, installation of equipment, civil site work, concrete work, electrical and mechanical work, and a pre-engineered metal building. Total project cost, used to compare alternatives in this report, is the sum of the initial capital cost, plus the present worth of operation and maintenance (O&M) costs, minus the present worth of the salvage value at the end of the 20-year planning period. The details of this preliminary cost estimate are included in the Appendices of this report.

Annual O&M costs were based on current day, annual plant O&M as required for the system alternative. For each evaluated alternative, the present worth of the operational and maintenance cost was calculated by using today's operational costs and a real discount rate of 2.75-percent over 20-years. Operating expenses include power, chemicals, water use, testing, lab fees, replacement fund, and maintenance supplies. Operation of these plants is not highly labor intensive. Based on plant size and monitoring requirements, which are not expected to changed from the existing requirements, the current labor burden should not change and will not require additional personnel.

Salvage value is only needed if the useful life is longer than the planning period, otherwise if the useful life is equal to the planning period, the salvage value is zero. The useful life of the existing facility is assumed to be reached, and a scrap value for the decommissioned processed is estimated at $25,000. The useful life of **Alternative 5** is assumed to be 30-years. Salvage value was calculated by assuming a straight-line depreciation and 20-year analysis where the salvage value of the facility at the 20th year is equal to the initial capital cost times the years of service remaining at the end of the planning horizon over the total useful life.

Table 38.0: Alternative 5 Cost Estimate

Net Present Worth Cost Inputs	Amount (2018 $)
Construction Cost	$4,515,270
Contingency Cost	$404,500
Engineering Cost[1]	$688,800
Total Initial Capital Cost	$5,608,570
Annual O&M Cost	$214,377
Energy Cost (Note: included in Annual O&M Cost)	$91,148
20-Year Present Worth of Annual O&M Costs[2]	$4,653,872
20-Year Present Worth of Salvage Value	-$1,086,660
Existing WWTP Scrap Value	-$25,000
Total 20-Year Present Worth Cost	**$9,150,781**

[1] Engineering cost for final design and Construction Admin/Inspection).
[2] Based on 20-year life cycle at a discount rate of 2.75-percent.

5.0 SELECTION OF AN ALTERNATIVE

5.1 LIFE CYCLE COST ANALYSIS

Table 39.0 presents the life cycle cost analysis summary, using the following criteria: capital cost, operations and maintenance cost, salvage value, and scrap value of existing WWTP.

Table 39.0: Present Worth (Life Cycle) Cost Analysis for Treatment Process Alternatives

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Initial Capital Cost	$7,113,750	$7,965,140	$12,447,923	$4,768,450	$5,608,570
O&M Annual Costs, PW	$5,042,753	$4,348,221	$5,273,619	$4,517,470	$4,653,872
Salvage Value, PW	($1,378,289)	($1,543,246)	($1,621,906)	($923,887)	($1,086,660)
Scrap Value of Ex. WWTP	($25,000)	($25,000)	($25,000)	($25,000)	($25,000)
Net Present Value (NPV)	**$10,753,214**	**$10,745,115**	**$16,074,635**	**$8,337,033**	**$9,150,781**

Calculations utilize the 'Real" Discount Rate of 2.75-percent, as taken from the current available Appendix C of OMB circular A-94.

5.2 NON-MONETARY FACTORS

All alternatives would allow the City of Walnut Ridge to comply with current regulatory requirements. However, the alternatives differ, besides in cost, regarding other criteria and considerations, including social and environmental aspects, such as: operations, operator training, facility aesthetics/footprint (such as concrete and excavation), process reliability, and treatment effectiveness. **Table 40.0** presents the alternatives comparison summary of concrete and excavation costs as a percentage of the total project capital cost.

Table 40.0: Alternatives Concrete/Excavation Comparison

	Alternative 1		Alternative 2		Alternative 3	
(CY/$)	Quantity	Cost	Quantity	Cost	Quantity	Cost
Concrete	1,066	1,066,000	1,885	1,857,500	N/A	N/A
Excavation/ Dirt Work	10,656	213,120	18,348	366,960	129,745	2,594,900
Total Cost		1,279,120		2,224,460		2,594,900
% of Total Project Capital Cost (Construction Only)	**22%**		**35%**		**39%**	
	Alternative 4		**Alternative 5**			
(CY/$)	Quantity	Cost	Quantity	Cost		
Concrete	1,420	996,500	1,863	1,351,500		
Excavation/ Dirt Work	7,903	158,060	8,103	162,060		
Total Cost		1,154,560		1,513,560		
% of Total Project Capital Cost (Construction Only)	**30%**		**34%**			

It should be noted that **Alternative 3** does not include concrete costs for the treatment processes as the basins are dirt basins with a geosynthetic liner, estimated at $1,765,000, which added with the excavation/dirt work cost is 65-percent of the total project capital cost (construction only).

Table 41.0 presents an alternatives comparison summary using an evaluation matrix that considers relative importance (weight) for the identified criteria and calculates a "score" for each alternative. The alternative with the highest score is considered the "best" alternative.

Table 41.0: Alternatives Comparison Matrix

Selection Criteria	Weight	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5	
		Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
Aesthetics/ Footprint	10%	4	8	4	8	1	2	3	6	3	6
Cost	25%	3	15	3	15	1	5	5	25	4	20
Implementation	10%	4	8	4	8	1	2	5	10	5	10
Reliability	20%	3	12	3	12	2	8	5	20	5	20
Operations	15%	2	6	2	6	4	12	3	9	3	9
Treatment Effectiveness	20%	4	16	4	16	2	8	5	20	5	20
Total	**100%**	--	**65**	--	**65**	--	**37**	--	**90**	--	**85**

From **Tables 40.0 and 41.0**, the lowest capital cost alternative is **Alternative 4**. After considering non-monetary factors, the alternative with the highest score is **Alternative 4** at 90. Due to cost and budgetary considerations, **Alternative 4** is the best-fit for the proposed City of Walnut Ridge WWTF Improvements Project.

6.0 PROPOSED PROJECT (RECOMMENDED ALTERNATIVE)

Based on the alternatives analysis that considered both cost and non-cost evaluation criteria, the selected alternative is to replace and upgrade the City of Walnut Ridge's existing WWTF at the existing site with **Alternative 4**, the CLR Process by Lakeside with Spiraflo clarifiers by Lakeside, process for treatment to produce consistent, permit-compliant, effluent.

The proposed improvements will provide CBOD5 and TSS removal, and Total Nitrogen and phosphorous control to comply with the facility's current discharge permit and protect Village Creek.

6.1 PROJECT DESIGN

This section presents a summary of the City of Walnut Ridge's selected alternative, the WWTF is rated at an average day flow of 1.25 MGD, with an influent BOD and TSS of 2,085 lbs/day (200 mg/L), to meet the wastewater treatment needs of the projected population growth over the 20-year planning period. The design BOD loading is 0.219 lbs/capita-day. The justification for selecting this alternative and the related preliminary opinion of probably capital and O&M costs are presented in the previous sections. In addition, **Appendix E** presents the Preliminary Design Drawings including:

1. Oxidation Ditch Splitter Box
2. Oxidation Ditch Plan
3. Clarifier Plan and Profile
4. Building Floor Plan

6.1.1 COLLECTION SYSTEM/RECLAIMED WATER SYSTEM LAYOUT

A map of the collection system is shown on **Exhibit 8.0** in **Appendix A** of this report. Improvements to the existing headworks include demolition of the existing headworks building and all components, except the bar screen concrete channel will be reused and a new 5/8" mechanically cleaned bar screen will be installed, and the existing 12-inch influent forcemain will not be disturbed. No improvements to the collection system are proposed with this alternative. **Table 42.0** below is a summary of the components of the existing Walnut Ridge collection system.

Table 42.0: Collection System Components Summary

Sub Basin	Manholes (MH)	Gravity						Force				
		Unknown	6"	8"	10"	12"	15"	4"	6"	8"	10"	12"
1	99	3,490	1,440	15,218	5,272	2,635	0	0	0	3,791	1,924	0
2	77	6,276	10,009	8,657	0	0	0	0	1,900	0	0	0
3	108	2,302	17,261	7,252	5,200	0	0	2,402	1,227	519	0	0
4	123	6,220	7,266	23,620	734	2,540	0	0	0	0	0	0
5	116	1,606	9,712	18,712	3,142	1,050	2,699	0	0	519	0	0
Not in Basin	8	272	0	1,808	0	79	0	2,030	0	0	2,129	1,360
Total	531	20,166	45,687	75,267	14,348	63,04	2,699	4,432	3,128	4,829	4,053	1,360
Total MH = 531		Total Gravity = 164,472 feet; 31.1 miles						Total Force Main = 17,801; 3.4 miles				
Total Pump Stations = 23 (above-ground: 17, below-ground: 3, grinder stations: 3)												

Repairs to the existing collection system are ongoing through the City; infiltration and inflow loading reduces as the system is improved. Additional system improvements will include continued reduction in the infiltration and inflow, and upsizing lines, if required, to address any capacity issues.

6.1.2 PUMPING STATIONS

Walnut Ridge collection system contains 23 pump stations ranging from 180 gallons-per-minute (gpm) vacuum prime-type pump stations to 1-½" grinder pump stations. Oak Street, Village Creek, and Frit Pump Stations contain two Smith & Loveless brand, 180 gpm pumps. Oak Street and Village Creek Pump Stations are vacuum primed, above-ground stations. The Frit Pump Station is an older below-ground station. Midway Road, Hope Street, Wal-Mart, Highway 412, School, Bowling Alley, Skil Drive, Brushed Road, Teel Road, Luther Bridges Road, Ray Martin, Highway 34, State Street, and Burris Road Pump Stations are all Smith & Loveless brand, above-ground, "dog-house" type pump stations, each with two 80 gpm vacuum assist pumps, which range in age from 2001 to 2012. Farm Service and North Ridge Pump Stations each contain two 1-½" grinder pumps. The North Ridge Pump Station grinder pump is a 2014 model. The Farm Service Pump Station grinder pumps were installed in the late 1980's. Skil Pump Station is a Smith & Loveless brand, below-ground station with two 80 gpm pumps that were installed in 1980. Poplar Street is a Smith & Loveless brand, above-ground pump station with two 100 gpm pumps that were installed in 1985. The 4th Street Pump Station is a small station with a single 3-inch grinder pump installed. Robin Lane Pump Station is a Smith & Loveless brand, below-ground, station with two 80 gpm pumps.

The wastewater collection system will maintain all the existing pump stations. Aside from process pumping systems within the proposed wastewater treatment facility, no additional pump stations will be required.

6.1.3 STORAGE

The proposed wastewater treatment facility improvements do not include equalization storage. The system alternatives presented herein can operate effectively under high, or varying, flows and varying loads.

6.1.4 TREATMENT

6.1.4.1 TECHNICAL DESCRIPTION

For this alternative, the proposed new treatment units will bypass the existing Biolac® treatment system, which will be decommissioned at the end of new plant construction. **Alternative 4** includes a dual train, racetrack design Closed Loop Reactor (CLR) process and two (2) clarifiers. The design includes submersible mixers and a gate between the CLR basins. Further information on this system, as well as the design proposal, can be found in the Appendices of this report. The CLR process is a modified form of the extended aeration complete mix process that provide biological nutrient removal, as provided by Lakeside Equipment Corporation. The system utilizes long solids retention times to provide a more stable operation over a wide range of influent flow and organic loading conditions, minimizing the time and effort to control or adjust the system. This alternative also includes the construction of two clarifiers, as proposed by Lakeside Equipment Corporation, the Spiraflo Clarifier.

A component of the CLR process is the horizontal, bladed rotor aerator. The rotor aerator provide oxygen and mixing to the basin with reliable operation and efficiency. The rotor aerator provides complete mixing for aeration basins, provide greater oxygen transfer than other mechanical surface aerators, and has a shaft mounted drive that allows for flexibility in speed changes and easy access for maintenance and

operator convenience. This process is supplied with covers for the rotors which extend over the baffles to contain mist and spray. Velocity control baffles direct flow downward creating a rolling motion to ensure uniform distribution of oxygen throughout the basin. By adjusting the effluent weir, the operator can control the oxygen input into the basin to optimize treatment and save energy costs. Process monitoring and control systems can be provided to continuously monitor and adjust the operation of the biological reactors to optimize the process performance and reduce power costs.

The Spiraflo is a peripheral feed clarifier designed for superior removal of suspended solids for secondary clarification system. The wastewater enters the outer perimeter of the clarifier tank and is directed along the narrow raceway formed by the skirt and the outer wall. This flow pattern dissipates the wastewater's hydraulic energy as it flows around the raceway, eventually spiraling down underneath the skirt and into the main settling area. The flow travels inward from the skirt towards the center of the tank, coinciding with the direction of the sludge, and the clarified water rises into the centrally located effluent weir trough. The combination of the spiraling flow pattern and the skirt eliminates all possibility of short-circuiting and provides better utilization of the total tank volume for more effective settling.

The improvements to the existing WWTF will include the following new or upgraded facilities and processes:

1. Headworks building demolished, including maintenance area and blower/generator/chemical areas;
2. Installation of a new 5/8-inch mechanically cleaned bar screen in the re-furbished bar screen concrete channel;
3. New Dual-Train, Racetrack Design CLR Oxidation Ditch Process and two (2) new Spiraflo, exterior fed Clarifiers with a diameter of 54-feet.
4. WAS/RAS Pumps and Piping (located in the clarifier splitter box, i.e. Splitter Box No. 2);
5. Replace the existing Administration Building with a new 1200-SF Administration Building (36.5-ft by 33-ft metal building with an office, restroom, storage room, electrical/MCC room, a sodium hypochlorite area, and a sodium bisulfite area);
6. Rerouting and new yard piping (24-inch, 16-inch, 12-inch, and 8-inch) plus utility piping and drainage piping;
7. New Chlorination/Dechlorination System (Sodium Hypochlorite/Sodium Bisulfite);
8. Modifications to the existing Chlorine Contact Basin;
9. Modifications to the existing 90-degree V-notch effluent weir;
10. Upgraded facility electrical service and motor control center;
11. Upgraded facility instrumentation and controls, including SCADA;
12. Site grading, landscaping, chain link fence, sidewalks, gravel/concrete parking and drives;
13. Other miscellaneous improvements as noted in the cost estimate.

The existing sludge pond is proposed to be re-used and has a volume of 1.5 million-gallons (MG). As noted in this report, the projected solids production will require the sludge pond to be emptied and the sludge disposed of, about 2 to 4 times a year. It is anticipated that sludge management will continue in the same fashion as currently exists, as described above. A specific sludge management plan may be further detailed during the design and construction phases of the proposed project, if deemed necessary.

6.1.4.2 HYDRAULIC CALCULATIONS

Detailed calculations including hydraulic calculations and construction of a hydraulic profile will be developed in the preliminary design phase. Preliminary process parameters for the selected alternative are shown in the manufacturer's proposal included in the appendices of this report.

6.2 PROJECT SCHEDULE

The following table, **Table 43.0**, is an approximate of the project timetable, assuming the project is funded by the USDA-RD program.

Table 43.0: Project Implementation Schedule

Project Tasks	Estimated Duration, Months
Pre-Contract/Contract, includes: Resolution of Intent & Signatory Authority; Negotiate and Procure Professional Services; Regulatory Review and Approval.	3 to 5
WWAC Report and Reviews, includes: Prepare and Submit WWAC Report; Receive WWAC Comment Letter.	2 to 4
Draft Reports, Ordinances, and Reviews, includes: Prepare and Submit Draft Engineering Report (ER); Prepare and Submit Draft Environmental Information Document (EID); Submit Draft Rate and Sewer Use Ordinance (if Required); Regulatory Review and Comment.	6 to 12
Public Hearings and Reports, includes: Advertise for and Conduct Public Meeting; Revise PER and EID as Required; Advertise for and Conduct Public Hearing; Submit Final Engineering Report; Submit Final EID with Public Participation Documents; Regulatory Review and Approvals	3 to 6
Preparation and Approval of Plans, Specifications, and Ordinances, includes: Submit Draft Drawings and Specifications; Submit Draft Project Performance Work Plan; Regulatory Review and Comment; Submit Enacted Ordinances; Submit Final Drawings and Specifications; Submit Final Project Performance Plan; Regulatory Approvals.	12 to 18
Bidding/Pre-Construction, includes: Negotiate Engineering Agreement for Construction; Regulatory Review and Approval; Update Application as Required; Bond Ordinance; Bond Purchase Agreement; Loan Closing; Regulatory Reviews and Approvals.	6 to 12
Construction (1-year) and Post-Construction (1-year Project Performance).	24

6.3 PERMIT REQUIREMENTS

Permitting required for the project will include an ADEQ Construction Permit. No change will be needed with regards to the discharge permit.

6.4 SUSTAINABILITY CONSIDERATIONS

Sustainability considerations are not applicable to this project.

6.5 TOTAL PROJECT COST ESTIMATE (ENGINEER'S OPINION OF PROBABLE COST)

The following cost estimate in **Table 44.0** is a summary of the proposed project, the Walnut Ridge Improvements Project, **Alternative 2**. The detailed cost estimates are included in the Appendices of this report.

Table 44.0: Cost Estimate Summary of Chosen Alternative

Estimated Item Description	Estimated Cost
Construction Improvements (Construction)	$3,839,250
Contingency	$343,600
Engineering Cost (Final Design and Construction Admin/Insp)	$585,600
Total Estimated Cost	**$4,768,450**

The cost estimate information shown includes costs for construction, engineering, and contingencies as well as the assumption that funding will be by the selling of bonds by the City of Walnut Ridge.

6.6 ANNUAL OPERATING BUDGET

Discussion regarding the annual operating budget can be found in the body of this report. The annual operation and maintenance cost is estimated at $296,669 per year, which includes a cost of $92,330 a year in electrical costs and a cost of $91,250 per year for sludge disposal.

Copies of the City Water Works operation and maintenance budgets are included in the Appendices of this report. Additional operation and maintenance requirements or expenses are not expected with the implementation of the proposed project and improvements. Copies of the financials for the City of Walnut Ridge are included in the Appendices of this report. These financial statements include sources of income for the system, annual operation and maintenance costs, debt repayments, and reserves (including debt reserves and short-lived asset reserves), as previously discussed in this report. No additional staff to the present Walnut Ridge City Water Works department are anticipated as a consequence of the proposed project and improvements.

6.7 PLANNING AREA NEEDS

The Walnut Ridge planning area is adequately served by the existing parks and recreational facilities, educational, airport, industrial park, and medical facilities. The railroad and highway transportation systems appear adequate for the area.

The planning area is served by water, wastewater, electric, natural gas, and communications utilities. With the exception of the wastewater system, the other utilities have adequate capacity and capability to serve the area.

With the exception of the need to upgrade and improve the wastewater system, there are no known deficiencies in the planning area public services.

6.8 SOCIAL AND ECONOMIC CONDITIONS

Median household income in Walnut Ridge in 2016 was $40,957, compared to the State of Arkansas median household income in 2016 of $44,334. Approximately 40-percent of the number of households in Walnut Ridge in 2016 had a median household income range of $10,000 to $40,000. The median per capita income in Walnut Ridge in 2016 was $19,754, compared to the State of Arkansas median per capita income in 2016 of $24,264. Residents with income below the poverty level in 2016 was 24.0-percent, compared to that of the State of Arkansas in 2016 of 23.3%. The unemployment rate of Walnut Ridge in 2015 was 5.4-percent, compared to the State of Arkansas in 2015 at 4.8-percent.

The most common industries in Walnut Ridge, in order of the greatest percentage, are health care, educational services, machinery, construction, accommodation and food services, food and beverage stores, and professional, scientific, and technical services.

END OF REPORT

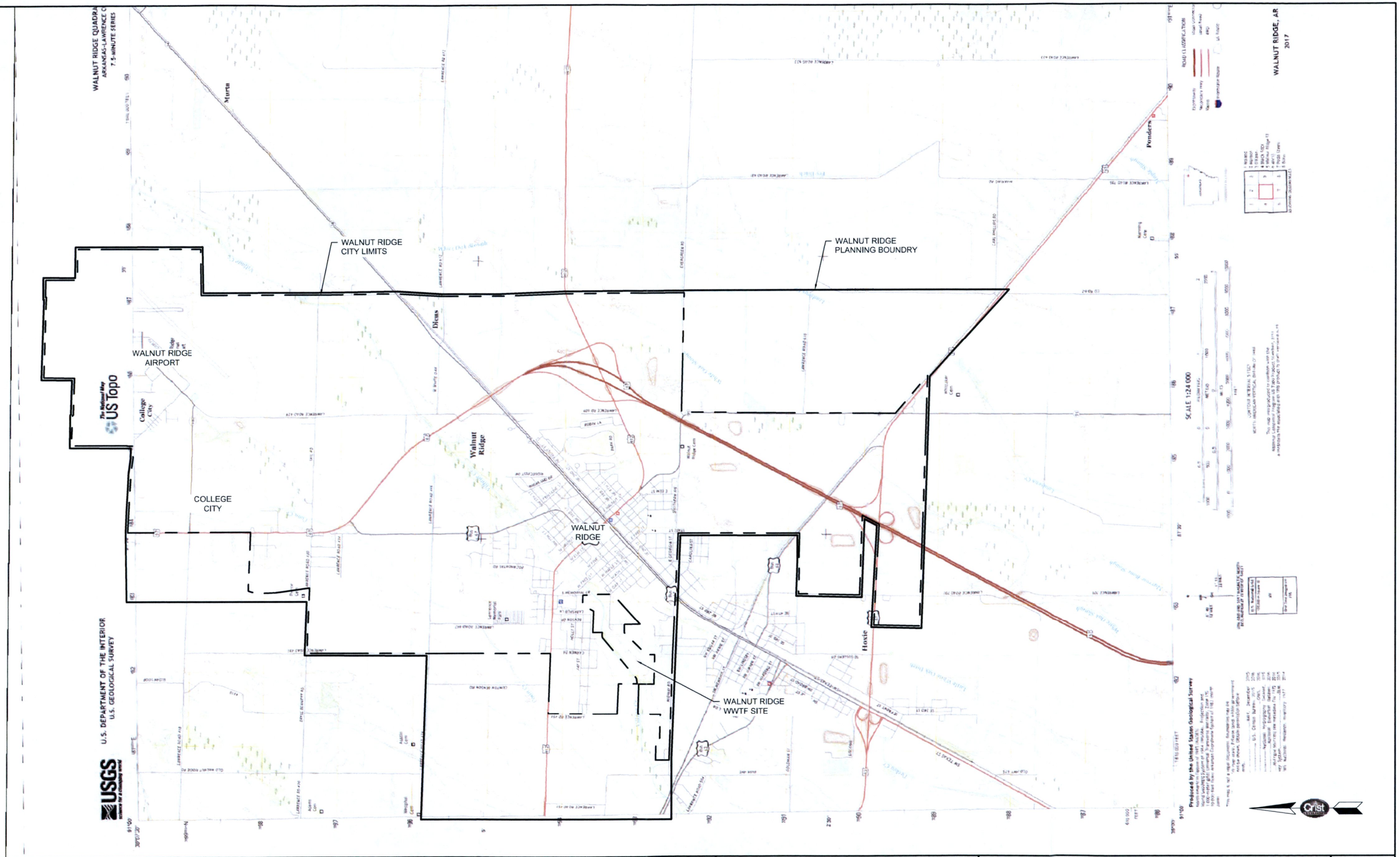
APPENDIX A

MAPS AND EXHIBITS

CRIST JOB NO.
1618

City of Walnut Ridge
Arkansas 1874

PRELIMINARY ENGINEERING REPORT
WASTEWATER IMPROVEMENTS
JUNE 2018



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TELEPHONE: (501) 664-1552
FAX: (501) 664-8579
WWW.CRISTENGINEERS.COM

WALNUT RIDGE, ARKANSAS

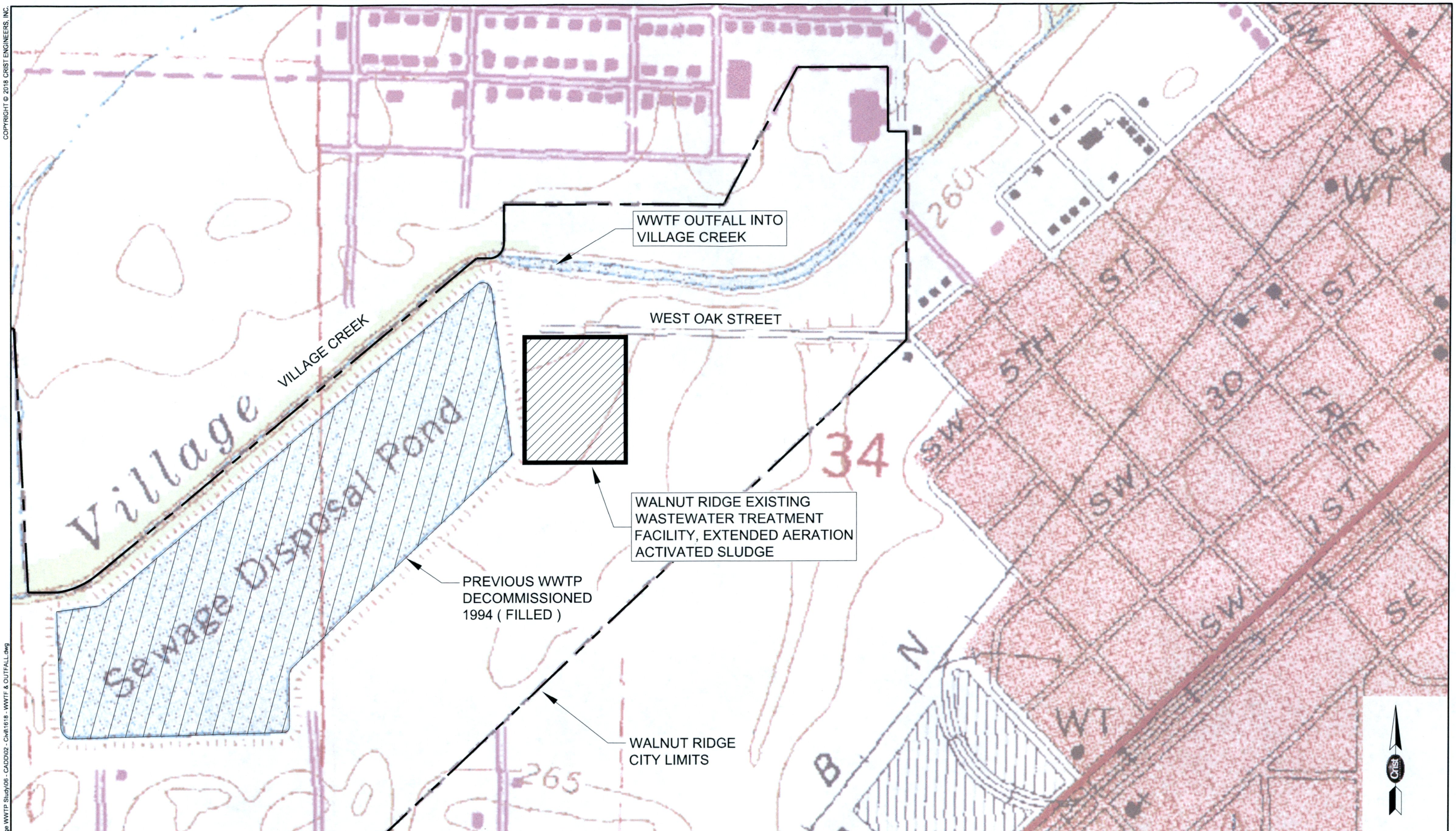
PROPOSED WWTP IMPROVEMENTS

EXHIBIT 1.0: WALNUT RIDGE PLANNING AREA

JOB NO. 1618

SHEET NO. 1.0

P:\2016 Projects\1618 - Walnut Ridge WWTP Study\06 - CADD\02 - Civil\1618 - Topo Map.dwg



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WALNUT RIDGE, ARKANSAS
PROPOSED WWTP IMPROVEMENTS

EXHIBIT 2.0: WALNUT RIDGE WWTF & OUTFALL LOCATION

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SHEET NO. 2.0

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WALNUT RIDGE, ARKANSAS

PROPOSED WWTP IMPROVEMENTS

EXHIBIT 3.0: 100-YEAR FLOOD PLAIN & WWTF SITE

JOB NO. 1618

SHEET NO. 3.0

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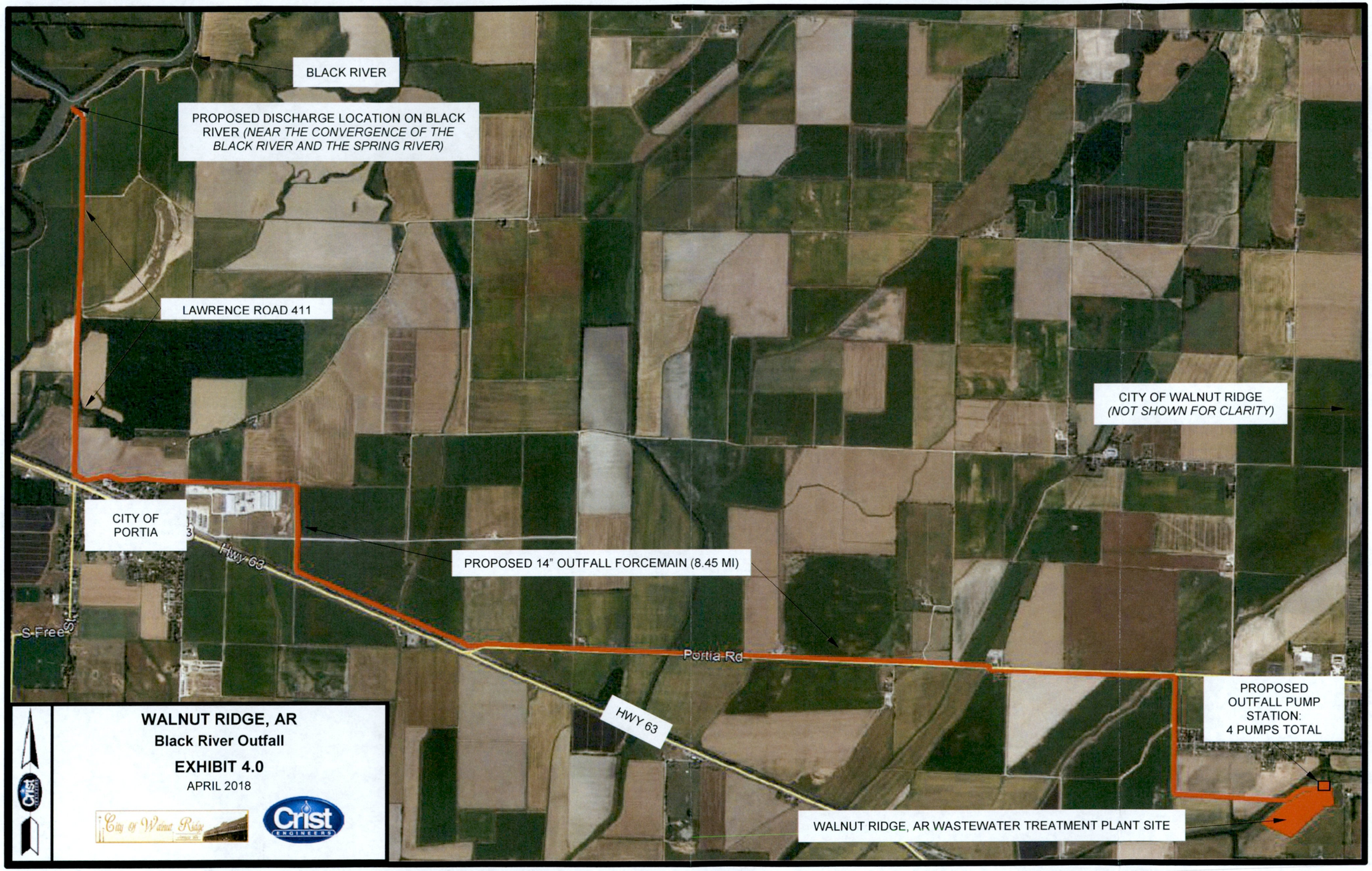
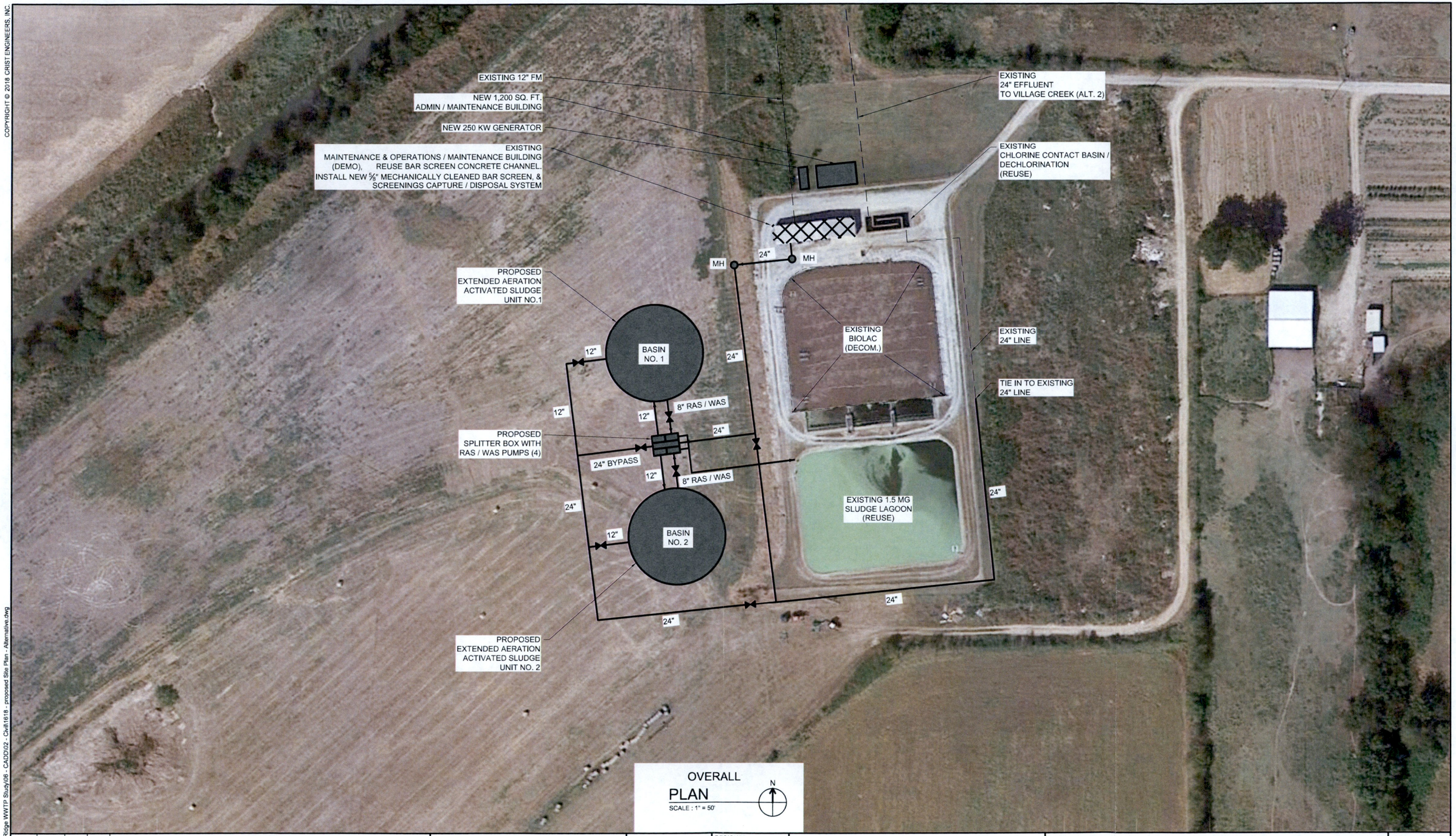

BLACK RIVER
PROPOSED DISCHARGE LOCATION ON BLACK RIVER (NEAR THE CONVERGENCE OF THE BLACK RIVER AND THE SPRING RIVER)
LAWRENCE ROAD 411
CITY OF WALNUT RIDGE (NOT SHOWN FOR CLARITY)
CITY OF PORTIA
Hwy 63
S Free St
PROPOSED 14" OUTFALL FORCEMAIN (8.45 MI)
Portia Rd
HWY 63
PROPOSED OUTFALL PUMP STATION: 4 PUMPS TOTAL
WALNUT RIDGE, AR WASTEWATER TREATMENT PLANT SITE
WALNUT RIDGE, AR
Black River Outfall
EXHIBIT 4.0
APRIL 2018
City of Walnut Ridge
Crist ENGINEERS



OVERALL
PLAN
SCALE : 1" = 50'

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WALNUT RIDGE, ARKANSAS

ALTERNATIVES NO. 1 AND NO. 2

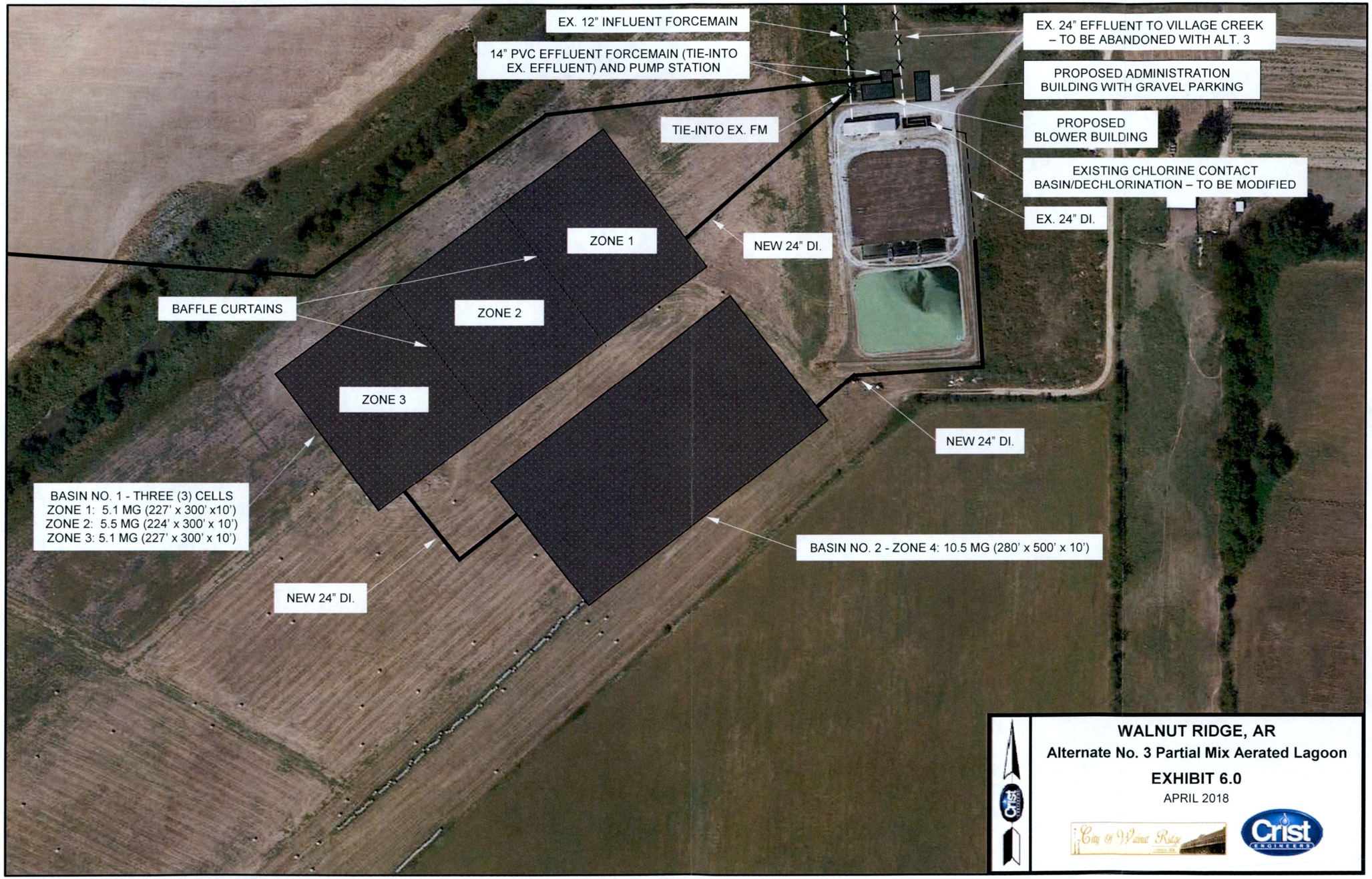
DAVCO (NO.1) & SCHREIBER (NO. 2)

EXHIBIT 5.0

JOB NO. 1618

SHEET NO. 5.0

P:\2016 Projects\1618 - Walnut Ridge WWTP Study\06 - CADD\02 - Civil\1618 - proposed Site Plan - Alternative.dwg

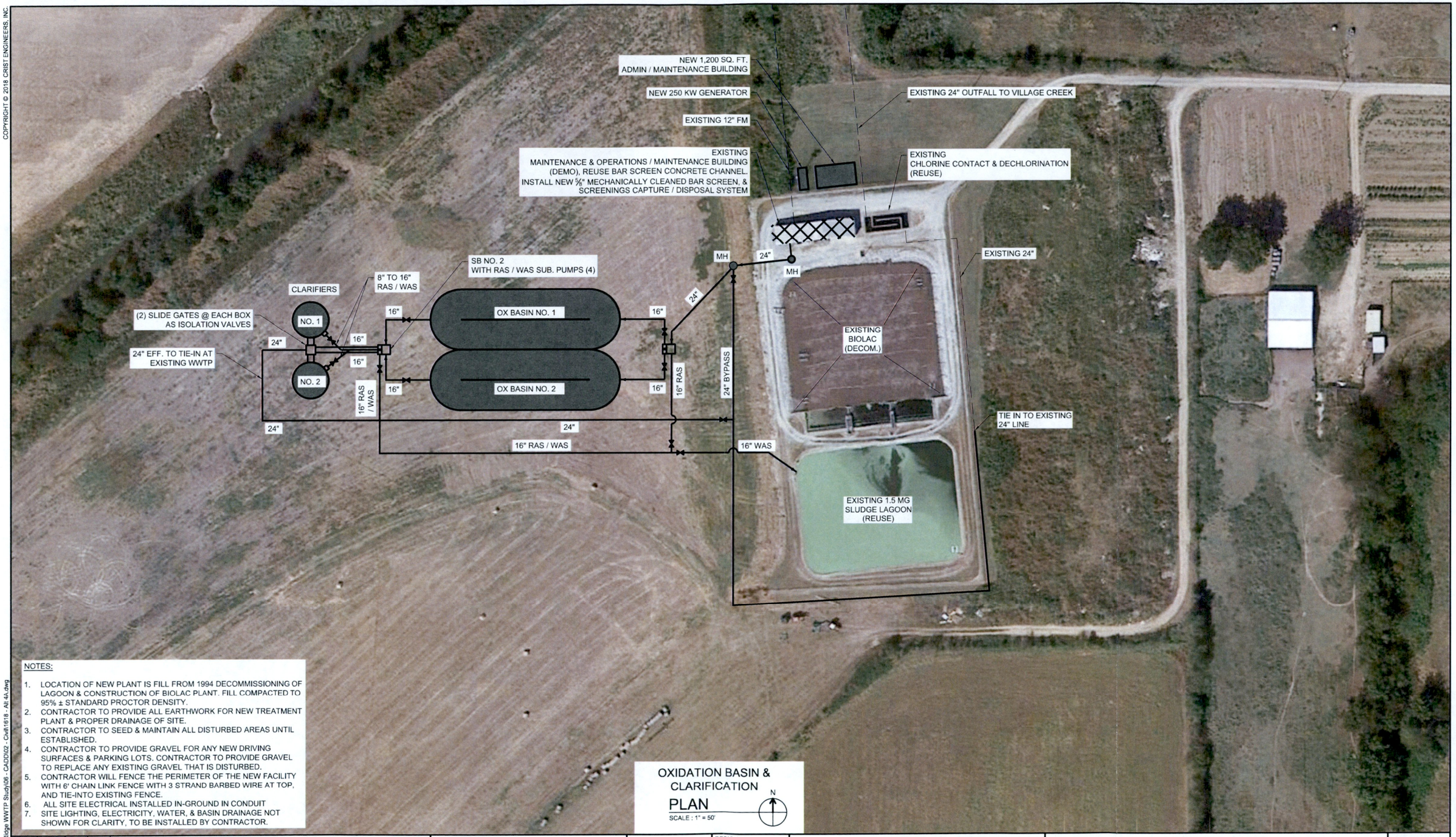


WALNUT RIDGE, AR

Alternate No. 3 Partial Mix Aerated Lagoon

EXHIBIT 6.0

APRIL 2018



NOTES:

1. LOCATION OF NEW PLANT IS FILL FROM 1994 DECOMMISSIONING OF LAGOON & CONSTRUCTION OF BIOLAC PLANT. FILL COMPACTED TO 95% ± STANDARD PROCTOR DENSITY.
2. CONTRACTOR TO PROVIDE ALL EARTHWORK FOR NEW TREATMENT PLANT & PROPER DRAINAGE OF SITE.
3. CONTRACTOR TO SEED & MAINTAIN ALL DISTURBED AREAS UNTIL ESTABLISHED.
4. CONTRACTOR TO PROVIDE GRAVEL FOR ANY NEW DRIVING SURFACES & PARKING LOTS. CONTRACTOR TO PROVIDE GRAVEL TO REPLACE ANY EXISTING GRAVEL THAT IS DISTURBED.
5. CONTRACTOR WILL FENCE THE PERIMETER OF THE NEW FACILITY WITH 6' CHAIN LINK FENCE WITH 3 STRAND BARBED WIRE AT TOP, AND TIE-INTO EXISTING FENCE.
6. ALL SITE ELECTRICAL INSTALLED IN-GROUND IN CONDUIT
7. SITE LIGHTING, ELECTRICITY, WATER, & BASIN DRAINAGE NOT SHOWN FOR CLARITY, TO BE INSTALLED BY CONTRACTOR.

OXIDATION BASIN &
CLARIFICATION
PLAN
SCALE : 1" = 50'

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WALNUT RIDGE, ARKANSAS

ALTERNATIVES NO. 4 & NO. 5

OXIDATION DITCH WITH CLARIFICATION
(LAKE SIDE & WESTECH)

JOB NO. 1618

SHEET NO. 7.0

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LEGEND

- Manhole
- Pump Station

GRAVITY SEWER

- UNKNOWN
- 6-INCH
- 8-INCH
- 10-INCH
- 12-INCH
- 15-INCH

FORCE MAIN

- 4
- 6
- 8
- 10
- 12
- Sub-Basin01
- Sub-Basin02
- Sub-Basin03
- Sub-Basin04
- Sub-Basin05

PUMP STATIONS

1. Oak Street PS
2. Village Creek PS
3. Frit Pump Station (College City)
4. Midway Road PS
5. Hope Street PS
6. Wal-Mart PS
7. Highway 412 PS
8. School PS
9. Bowling Alley PS
10. Skil Drive PS
11. Brushes PS
12. Teel Road PS
13. Luther Bridges Road PS
14. Ray Martin PS
15. Highway 34 PS
16. State Street PS
17. Burris PS
18. Farm Service PS
19. North Ridge PS
20. Skil PS
21. Poplar Street PS
22. 4th Street PS
23. Robin Lane PS

College City

Walnut Ridge

Hoxie

Wastewater Treatment Plant

SB-01

SB-02

SB-03

SB-04

SB-05

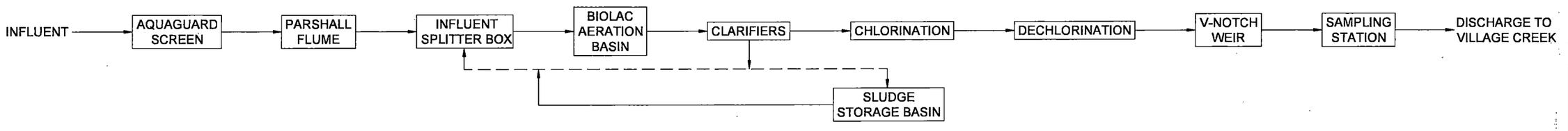
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

WALNUT RIDGE, AR
Existing Sewer System
EXHIBIT 8.0

APRIL 2018

City of Walnut Ridge

Crist Engineers



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WALNUT RIDGE, ARKANSAS

PROPOSED WWTP IMPROVEMENTS

WALNUT RIDGE EXISTING WWTP PROCESS FLOW DIAGRAM

JOB NO. 1618

SHEET NO. ----

APPENDIX B

FINANCIAL AUDIT STATEMENTS AND USER RATE CHARGE

CRIST JOB NO.
1618

PRELIMINARY ENGINEERING REPORT
WASTEWATER IMPROVEMENTS
JUNE 2018

Form WA-RD 442-2 (11-2004)

USDA Rural Development

Statement of Income and Expense

Walnut Ridge Water and Sewer	Walnut Ridge, AR			
Fiscal Year End	Prior Year Actual	Recent Year Budget	7/1/16-6/30/17 Recent Year Actual	7/1/17-6/30-18 Proposed Budget
Operating Income				
1 Water Revenue			884,861.00	945000
2 Sewer Revenue			515,028.00	545000
3 Penalty Income			35,496.00	36000
4 Misc. Incom			24,550.00	20000
5 Interest			346.00	300
6				
9				
10 Total Income	$ -	$ -	$1,460,281.00	$1,546,300.00
Operating Expenses				
11 Purchased Water			557,079.00	600,000.00
12 Salories Wages and Benefits			298,384.00	310,000.00
13 Payroll Taxes			21,470.00	21,750.00
14 Depreciation			163,221.00	158,000.00
15 Utilities			117,744.00	118,000.00
16 Maintenance materials & Contractual Services			100,881.00	100,000.00
17 Insurance			7,494.00	7,500.00
18 Office Expense			28,672.00	30,000.00
19 Lab Fees			34,135.00	47,000.00
20 Bad Debt			12,012.00	15,000.00
21 Professional Services			24,836.00	75,000.00
22 Other Expense			16,907.00	15,000.00
23				
24				
25				-
26			-	
27 Total Expenses	$ -	$ -	$1,382,835.00	$1,497,250.00
28 Net Operating Income (Loss)	$ -	$ -	$ 77,446.00	$ 49,050.00
Debt Service				
29 USDA Bond			42,780.00	42,780.00
30 Regions Bank Bond			27,576.00	26,954.00
31				
32				
33				
34				
35 Total Debt Service	$ -	$ -	$ 70,356.00	$ 69,734.00
Transfers to Reserves				
36 Debt Service Reserve $312 and $46 monthly			4,296.00	4,296.00
37 Short Lived Asset Reserve			13,333.00	13,333.00
38				
39				
40				
41 Total Reserves	$ -	$ -	$ 17,629.00	$ 17,629.00
Other Income (Loans, Grants, Transfers from Reserves)				
42 Depreciation ADDED Back	$ -	$ -	$ 163,221.00	$ 158,000.00
43				
44				
45				
46 Total Non-Operating Income	$ -	$ -	$ 163,221.00	$ 158,000.00
Capital Improvements				
47				
48				
49				
50				
51 Total Capital Improvements	$ -	$ -	$ -	$ -
52 Income/Loss	$ -	$ -	$ 152,682.00	$ 119,687.00
53 Beginning Cash		$ -	$ -	$ 152,682.00
54 Ending Cash	$ -	$ -	$ 152,682.00	$ 272,369.00

2017-2018 CWW Budget revised

Certified to be correct by:

Authorized Official

Form WA-RD 442-2 (11-2004)

USDA Rural Development

Statement of Income and Expense

Walnut Ridge Water and Sewer		Walnut Ridge, AR			
	Fiscal Year End	Prior Year Actual	Recent Year Budget	7/1/15-6/30/16 Recent Year Actual	7/1/16-6/30-17 Proposed Budget
	Operating Income				
1	Water Revenue			764,943.00	895,000.00
2	Sewer Revenue			472,792.00	500,000.00
3	Misc. Income			7,853.00	12,000.00
4	Penalty Income			30,746.00	33,000.00
5	Interest			388.00	500.00
6	Charge Offs			514.00	525.00
9					
10	Total Income	$ -	$ -	$1,277,236.00	$1,441,025.00
	Operating Expenses				
11	NEAPWA			577,346.00	525,000.00
12	Office personel/expenses and Management			148,431.00	139,500.00
13	Chemicals & Materials			52,192.00	55,000.00
14	Insurance-Group and Company			53,456.00	57,000.00
15	Labor & Contracted Services			145,148.00	155,000.00
16	Depreciation Expense			130,000.00	129,550.00
17	Truck/Digger & Water/Sewer Expense			34,355.00	35,000.00
18	Utilities and Telephone			122,389.00	125,000.00
19	Lab and Permit			38,644.00	40,000.00
20	Bad Debt			10,887.00	12,500.00
21	Employee Retirement			22,060.00	23,000.00
22	Taxes			39,263.00	35,000.00
23	Sludge Disposal	-		-	50,000.00
24					-
25					
26				-	
27	Total Expenses	$ -	$ -	$1,374,171.00	$1,381,550.00
28	Net Operating Income (Loss)	$ -	$ -	$ (96,935.00)	$ 59,475.00
	Debt Service				
29	USDA Bond			42,780.00	42,780.00
30	Regions Bank Bond			27,576.00	27,576.00
31					
32					
33					
34					
35	Total Debt Service	$ -	$ -	$ 70,356.00	$ 70,356.00
	Transfers to Reserves				
36	Debt Service Reserve $312 and $46 monthly			4,296.00	4,296.00
37	Short Lived Asset Reserve			13,333.00	13,333.00
38					
39					
40					
41	Total Reserves	$ -	$ -	$ 17,629.00	$ 17,629.00
	Other Income (Loans, Grants, Transfers from Reserves)				
42	Depreciation ADDED Back	$ -	$ -	$ 130,000.00	$ 129,550.00
43					
44					
45					
46	Total Non-Operating Income	$ -	$ -	$ 130,000.00	$ 129,550.00
	Capital Improvements				
47					
48					
49					
50					
51	Total Capital Improvements	$ -	$ -	$ -	$ -
52	Income/Loss	$ -	$ -	$ (54,920.00)	$ 101,040.00
53	Beginning Cash		$ -	$ -	$ (54,920.00)
54	Ending Cash	$ -	$ -	$ (54,920.00)	$ 46,120.00

Certified to be correct by:

Authorized Official

WALNUT RIDGE WATER & SEWER WORKS
(A Component Unit of the City of Walnut Ridge, Arkansas)

Audited Financial Statements

For the Years Ended June 30, 2017 and 2016

Thomas, Speight & Noble
Certified Public Accountants
2210 Fowler Avenue
Jonesboro, AR 72401
(870) 932-5858

Walnut Ridge Water & Sewer Works

(A Component Unit of the City of Walnut Ridge, Arkansas)

Audited Financial Statements

For the Years Ended June 30, 2017 and 2016

CONTENTS

THOMAS, SPEIGHT & NOBLE
2210 FOWLER AVENUE, JONESBORO, AR 72401 (870) 932-5858

A PROFESSIONAL ASSOCIATION OF CERTIFIED PUBLIC ACCOUNTANTS
MEMBER OF THE PRIVATE COMPANIES PRACTICE SECTION OF THE AMERICAN INSTITUTE OF CERTIFIED PUBLIC ACCOUNTANTS

INDEPENDENT AUDITORS' REPORT

To the Board of Commissioners
Walnut Ridge Water & Sewer Works

Report on the Financial Statements

We have audited the accompanying financial statements of Walnut Ridge Water & Sewer Works, a component unit of the City of Walnut Ridge, Arkansas, as of and for the year ended June 30, 2017 and 2016, and the related notes to the financial statements, which collectively comprise Walnut Ridge Water & Sewer Works basic financial statements as listed in the table of contents.

Management's Responsibility for the Financial Statements

Management is responsible for the preparation and fair presentation of these financial statements in accordance with accounting principles generally accepted in the United States of America; this includes the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditors' Responsibility

Our responsibility is to express opinions on these financial statements based on our audit. We conducted our audit in accordance with auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. Accordingly, we express no such opinion. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinions.

Opinions

In our opinion, the financial statements referred to above present fairly, in all material respects, the respective financial position of Walnut Ridge Water & Sewer Works as of June 30, 2017 and 2016, and the respective changes in financial position and cash flows thereof for the year then ended in accordance with accounting principles generally accepted in the United States of America.

Emphasis of Matter

As discussed in Note 1, the financial statements present only the Walnut Ridge Water & Sewer Works and are not intended to present fairly the financial position of the City of Walnut Ridge, Arkansas, and the results of its operations and cash flows in conformity with accounting principles generally accepted in the United States of America.

Other Matters

Required Supplementary Information

Management has omitted the management's discussion and analysis that accounting principles generally accepted in the United States of America require to be presented to supplement the basic financial statements. Such missing information, although not a part of the basic financial statements, is required by the Governmental Accounting Standards Board who considers it to be an essential part of financial reporting for placing the basic financial statements in an appropriate operational, economic, or historical context. Our opinion on the basic financial statements is not affected by this missing information.

Other Reporting Required by *Government Auditing Standards*

In accordance with *Government Auditing Standards*, we have also issued our report dated September 15, 2017, on our consideration of Walnut Ridge Water & Sewer Works internal control over financial reporting and on our tests of its compliance with certain provisions of laws, regulations, contracts, and grant agreements and other matters. The purpose of that report is to describe the scope of our testing of internal control over financial reporting and compliance and the results of that testing, and not to provide an opinion on internal control over financial reporting or on compliance. That report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering Walnut Ridge Water & Sewer Works internal control over financial reporting and compliance.

Thomas, Speight & Noble, CPAs

Thomas, Speight & Noble, CPAs
Jonesboro, Arkansas
September 15, 2017

Walnut Ridge Water and Sewer Works
(A Component Unit of the City of Walnut Ridge, Arkansas)
Statements of Net Position
June 30, 2017 and 2016

	Water 2017	Sewer 2017	Total	2016
ASSETS				
CURRENT ASSETS				
Cash and cash equivalents - unrestricted	$ 39,471	$ 39,471	$ 78,942	$ 4,496
Customer accounts receivable	72,087	72,087	144,174	146,131
Accrued interest receivable	1,499	1,499	2,998	388
Prepaid insurance	5,263	5,263	10,526	10,525
Materials inventory (at cost)	20,345	20,345	40,690	35,268
Total current assets	138,665	138,665	277,330	196,808
NON-CURRENT ASSETS				
Cash and cash equivalents - restricted	160,087	194,730	354,817	302,277
Certificates of deposit - restricted	77,689	77,689	155,378	155,376
Capital assets				
Capital assets, net of accumulated depreciation	940,532	2,847,620	3,788,152	3,877,941
Total non-current assets	1,178,308	3,120,039	4,298,347	4,335,595
TOTAL ASSETS	$ 1,316,973	$ 3,258,704	$ 4,575,677	$ 4,532,403
LIABILITIES AND NET POSITION				
CURRENT LIABILITIES				
Accounts payable	$ 50,789	$ 111	$ 50,900	$ 49,730
Sales tax payable	4,822	4,822	9,644	8,431
Accrued and withheld payroll taxes	2,494	2,494	4,988	5,078
Accrued wages	1,314	1,314	2,628	2,148
Accrued retirement	9,598	9,598	19,196	16,074
Accrued compensated absences	4,111	4,111	8,222	7,445
Current portion of long-term debt	15,643	15,643	31,286	29,509
Due to other governments	18,789	18,789	37,578	34,185
Total current liabilities	107,560	56,882	164,442	152,600
LONG-TERM DEBT, net of current maturities	553,110	553,110	1,106,220	1,128,183
LIABILITIES PAYABLE FROM RESTRICTED ASSETS				
Customer deposits	120,692	136	120,828	109,387
Accrued interest	589	589	1,178	1,176
Total liabilities payable from restricted assets	121,281	725	122,006	110,563
TOTAL LIABILITIES	781,951	610,717	1,392,668	1,391,346
NET POSITION				
Net investment in capital assets	371,779	2,278,867	2,650,646	2,720,249
Restricted for debt service	38,806	194,005	232,811	203,849
Unrestricted	124,437	175,115	299,552	216,959
Total net position	535,022	2,647,987	3,183,009	3,141,057
TOTAL LIABILITIES AND NET POSITION	$ 1,316,973	$ 3,258,704	$ 4,575,677	$ 4,532,403

The accompanying notes are an integral part of these financial statements.

Walnut Ridge Water and Sewer Works
(A Component Unit of the City of Walnut Ridge, Arkansas)
Statements of Revenues, Expenses and Changes in Net Position
For the Years Ended June 30, 2017 and 2016

	Water 2017	Sewer 2017	Total	2016
OPERATING REVENUES				
Water revenue	$ 884,861	$ -	$ 884,861	$ 779,504
Sewer revenue	-	515,028	515,028	525,895
Late payment charges	17,748	17,748	35,496	30,746
Miscellaneous income	12,275	12,275	24,550	13,043
Total operating revenue	914,884	545,051	1,459,935	1,349,188
OPERATING EXPENSES				
Purchased water	557,079	-	557,079	579,442
Salaries, wages & benefits	149,192	149,192	298,384	287,422
Payroll taxes	10,735	10,735	21,470	19,564
Depreciation	49,418	113,803	163,221	161,153
Utilities	27,185	90,559	117,744	116,549
Maintenance materials & contractual services	42,658	58,223	100,881	105,022
Insurance	3,747	3,747	7,494	9,017
Office expense	14,336	14,336	28,672	26,644
Lab fees	-	34,135	34,135	33,267
Bad debts	6,006	6,006	12,012	10,380
Professional fees	12,418	12,418	24,836	11,656
Other expense	8,454	8,454	16,907	4,069
Total operating expenses	881,228	501,607	1,382,835	1,364,185
OPERATING INCOME (LOSS)	33,656	43,444	77,100	(14,997)
NON-OPERATING REVENUES (EXPENSES)				
Interest income	173	173	346	448
Interest expense	(17,747)	(17,747)	(35,494)	(41,369)
Non-operating revenues (expenses)	(17,574)	(17,574)	(35,148)	(40,921)
CHANGE IN NET POSITION	16,083	25,869	41,952	(55,918)
NET POSITION AT BEGINNING OF YEAR	518,939	2,622,118	3,141,057	3,196,975
NET POSITION AT END OF YEAR	$ 535,022	$ 2,647,987	$ 3,183,009	$ 3,141,057

The accompanying notes are an integral part of these financial statements.

Walnut Ridge Water and Sewer Works
(A Component Unit of the City of Walnut Ridge, Arkansas)
Statements of Cash Flows
For the Years Ended June 30, 2017 and 2016

	2017	2016
Cash flows from operating activities:		
Cash receipts from customers	$ 1,461,892	$ 1,341,989
Cash payments to suppliers for goods and services	(897,728)	(931,650)
Cash payments to employees	(319,854)	(328,481)
Net cash provided by (used in) operating activities	244,310	81,858
Cash flows from capital and related financing activities:		
Principal payments on long-term debt	(20,186)	(28,390)
Interest payments on long-term debt	(35,494)	(41,369)
Purchases of capital assets	(73,432)	(609)
Net cash provided by (used in) financing activities	(129,112)	(70,368)
Cash flows from investing activities:		
Purchase of investments	-	(29,622)
Interest received	346	347
Net cash provided by (used in) investing activities	346	(29,275)
Cash flows from non-capital financing activities:		
Customer meter deposits (net)	11,441	507
Net cash provided by (used in) non-capital financing activities	11,441	507
NET INCREASE (DECREASE) IN CASH AND CASH EQUIVALENTS	126,986	(17,278)
CASH AND CASH EQUIVALENTS - BEGINNING OF YEAR	306,773	324,051
CASH AND CASH EQUIVALENTS - END OF YEAR	$ 433,759	$ 306,773
RECONCILIATION OF OPERATING INCOME TO NET CASH PROVIDED BY OPERATING ACTIVITIES		
Operating income (loss)	$ 77,100	$ (14,997)
Adjustments to reconcile operating income (loss) to net cash provided by operating activities:		
Depreciation	163,221	161,153
(Increase)/Decrease In:		
Customer accounts receivable	1,957	(7,199)
Accrued interest receivable	(2,610)	-
Materials inventory	(5,422)	7,385
Increase/(Decrease) In:		
Accounts payable	1,170	(10,107)
Sales tax payable	1,213	1,947
Accrued and withheld payroll taxes	(90)	1,127
Accrued wages	480	-
Accrued retirement	3,122	(3,350)
Accrued compensated absences	777	(19,272)
Due to other governments	3,393	(34,829)
NET CASH PROVIDED BY (USED IN) OPERATING ACTIVITIES	$ 244,310	$ 81,858

The accompanying notes are an integral part of these financial statements.

Walnut Ridge Water & Sewer Works
(A Component Unit of the City of Walnut Ridge, Arkansas)
Notes to Financial Statements
June 30, 2017 and 2016

NOTE 1: ORGANIZATION AND SUMMARY OF SIGNIFICANT ACCOUNT POLICIES

Organization

The Walnut Ridge Water & Sewer Works (the Department) is a component unit of the City of Walnut Ridge, Arkansas. These financial statements present the financial position, results of operations and cash flows of the Department and are not intended to present that of the City of Walnut Ridge or any of its other activities.

The Department provides water and waste water treatment services to its citizens from a system owned distribution network. All activities of the Department are considered business type activities. The accounts of the Walnut Ridge Water & Sewer Works are organized on the basis of a proprietary fund type specifically an enterprise fund. The activities of this fund are accounted for with a separate set of self-balancing accounts that comprise assets, liabilities, net assets, revenues, and expenses. Enterprise funds account for the activities (i) that are financed with debt that is secured solely by a pledge of net revenues from fees and charges of the activity; (ii) that are required by laws or regulations that the activity's costs of providing services, including capital costs (such as depreciation or debt service), be recovered with fees and charges, rather than with taxes or similar revenues; or (iii) that the pricing policies of the activity establish fees and charges designed to recover its costs, including capital costs (such as depreciation or debt service).

The basis of accounting determines when transactions and economic events are reflected in financial statements, and measurement focus identifies which transactions and events should be recorded. Enterprise Funds use the accrual basis of accounting to record the flow of all economic resources (measurement focus). This basis of accounting and measurement focus emphasizes the measurement of net income similar to the approach used by commercial enterprises, revenues are recorded when earned and expenses are recorded when incurred. Net position is segregated into invested in capital assets, restricted, and unrestricted components.

Use of Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect certain reported amounts and disclosures. Accordingly, actual results could differ from those estimates.

Cash and Cash Equivalents

For the purpose of the statements of cash flows, the Department considers all highly liquid investments with an original maturity of three months or less to be cash equivalents.

Customer Accounts Receivable

Walnut Ridge Water & Sewer Works uses the direct write-off method for accounting for bad debt. Water charges receivables as shown in the statements of net position are stated at net realizable value. The use of this method is not materially different from the values reported under the allowance method.

Materials Inventory

Inventory, consisting of supplies and materials, is stated at the lower of cost or market using the first-in first-out method.

Restricted assets

Restricted assets consist of cash and investments used to satisfy debt covenants, meter deposits held in trust, and funds set aside for retirement, and renewal and replacement.

Capital Assets

The cost of additions and major replacements of retired units of property are capitalized. Walnut Ridge Water and Sewer Works defines capital assets as assets with an initial, individual cost of more than $500 and an estimated useful life in excess of two years. The cost and accumulated depreciation of property sold or retired is deducted from capital assets and any profit or loss resulting from the disposal is credited or charged in the non-operating section of the statements of revenues, expenses, and changes in net position. The cost of current repairs, maintenance, and minor replacements is charged to expense when incurred.

NOTE 1: ORGANIZATION AND SUMMARY OF SIGNIFICANT ACCOUNT POLICIES (Continued)
Depreciation of capital assets is charged as an expense against operations. Depreciation rates have been applied on a straight-line basis, with estimated useful lives as follows:

Distribution System	10-50 Years
Buildings	20-30 Years
Equipment	3-7 Years

Operating Revenues and Expenses
Operating revenues and expenses generally result from providing services and producing and delivering goods in connection with a proprietary fund's principal ongoing operations. The principal operating revenues of the enterprise funds are charges to customers for sales and services. Operating expenses for enterprise funds include the cost of sales and services, administrative expenses, and depreciation on capital assets. All revenues and expenses not meeting these definitions are reported as non-operating revenues and expenses.

Net Position
Net position comprises the various net earnings from operating income, non-operating revenues and expenses, and capital contributions. Net position is classified in the following three components:

Net investment in capital assets – This component of net position consists of capital assets, net of accumulated depreciation and reduced by the outstanding balances of any bonds, mortgages, notes or other borrowings that are attributable to the acquisition, construction or improvement of those assets. If there are significant unspent related debt proceeds at year-end, the portion of the debt attributable to the unspent proceeds is not included in the calculation of net investment in capital assets. Rather, that portion of the debt is included in the same net position component as the unspent proceeds.

Restricted for debt service– This component of net position consists of constraints imposed by creditors (such as through debt covenants), grantors, contributors, or laws or regulations of other governments or constraints imposed by law through constitutional provisions or enabling legislation. When an expense is incurred for purposes for which there are both restricted and unrestricted net position available, it is Walnut Ridge Water & Sewer's policy to apply those expenses to restricted net position to the extent such are available and then to unrestricted net position.

Unrestricted– This component of net position consists of net assets that do not meet the definition of "restricted" or "net investment in capital assets."

Budgets and Budgetary Accounting
Prior to the beginning of the new fiscal year, the Board of Commissioners adopt an annual budget for Walnut Ridge Water & Sewer Works. The budget is adopted under a basis consistent with GAAP, except that depreciation, certain capital expenses, and non-operating income and expense items are not considered. All annual appropriations lapse at year-end.

NOTE 2: CAPITAL ASSETS

As summary of changes in property, plant, and equipment for the years ended June 30, 2017 and 2016 are as follows:

	Balance 6/30/2016	Additions	Deletions	Balance 6/30/2017
Capital assets not being depreciated:				
Land	$ 95,778	$ -	$ -	$ 95,778
Construction in process	-			-
Total capital assets not being depreciated	95,778	-	-	95,778
Other capital assets				
Buildings	37,257	-		37,257
Distribution system	7,724,818	-	-	7,724,818
Equipment	299,486	73,432	-	372,918
Total other assets at historical cost	8,061,561	73,432	-	8,134,993
Less accumulated depreciation for:				
Buildings	(37,006)		-	(37,006)
Distribution system	(3,961,902)	(151,113)	-	(4,113,015)
Equipment	(280,490)	(12,108)	-	(292,598)
Total accumulated depreciation	(4,279,398)	(163,221)	-	(4,442,619)
Total capital assets, being depreciated, net	3,782,163	(89,789)	-	3,692,374
Total capital assets, net	$ 3,877,941	$ (89,789)	$ -	$ 3,788,152

NOTE 2: CAPITAL ASSETS (Continued)

	Balance 6/30/2015	Additions	Deletions	Balance 6/30/2016
Capital assets not being depreciated:				
Land	$ 95,778	$ -	$ -	$ 95,778
Construction in process	-			-
Total capital assets not being depreciated	95,778	-	-	95,778
Other capital assets				
Buildings	37,257	-		37,257
Distribution system	7,724,209	609	-	7,724,818
Equipment	299,486	-	-	299,486
Total other assets at historical cost	8,060,952	609	-	8,061,561
Less accumulated depreciation for:				
Buildings	(37,006)		-	(37,006)
Distribution system	(3,809,845)	(152,057)	-	(3,961,902)
Equipment	(271,394)	(9,096)	-	(280,490)
Total accumulated depreciation	(4,118,245)	(161,153)	-	(4,279,398)
Total capital assets, being depreciated, net	3,942,707	(160,544)	-	3,782,163
Total capital assets, net	$ 4,038,485	$ (160,544)	$ -	$ 3,877,941

NOTE 3: CASH AND CERTIFICATES OF DEPOSIT - RESTRICTED

Cash and cash equivalents – restricted and certificates of deposit – restricted consist of reserves restricted by long-term debt covenants and customer deposits. The long-term debt covenants require minimum reserves for bond payments and a depreciation fund (see Note 7).

	2017	2016
Debt service reserves	$ 232,813	$ 203,849
Customer deposits	187,553	138,224
Depreciation and replacement	18,770	61,591
Retirement	71,059	53,989
	$ 510,195	$ 457,653

NOTE 4: CUSTODIAL CREDIT RISK OF BANK DEPOSITS AND INVESTMENTS

Custodial credit risk is the risk that in the event of a bank failure, Walnut Ridge Water & Sewer Works deposits may not be returned to it. Walnut Ridge Water & Sewer Works deposit policy for custodial risk is compliant with bond requirements. At year end June 30, 2017 and 2016, Walnut Ridge Water & Sewer Works had bank deposits in the amount of $605,147 and $448,987, respectively. Due to the dollar amounts of cash deposits and investments, and the limits of the Federal Deposit Insurance Corporation (FDIC), Walnut Ridge Water & Sewer Works was required to secure additional monies by pledging securities held by the pledging financial institution's trust department or agent at year end June 30, 2017. At June 30, 2017, there were pledged securities in the amount of $332,264. The amount of unsecured cash deposits as of June 30, 2017 was $8,208.

NOTE 5: RETIREMENT PLAN

The entity provides pension benefits for all of its full-time employees through the Employees Retirement Plan of the City Water Works of Walnut Ridge, Arkansas (the "Plan"). The Plan is a single-employer defined contribution plan and is administered by the Walnut Ridge Water & Sewer Works. The Plan is authorized and may be amended by the entity's City Council.

In a defined contribution plan, the benefits depend solely on amounts contributed to the plan, plus investment earnings. Employees are eligible to participate after a one-year exclusionary period. The entity contributes 8% of the employee's base salary each month. The entity's contributions for each employee (and interest allocated to the employee's account) are vested 20% annually for each year of participation. The matching contribution amount accrued for the 12 months ended June 30, 2017 and 2016 was $19,196 and $16,072 respectively.

NOTE 6: COMPENSATED ABSENCES

Vested or accumulated vacation, sick leave, and compensatory time are recorded as an expense and liability as the benefits accrue to employees, and are included as accrued compensated absences on the statements of net position.

NOTE 7: BOND REQUIREMENTS

Walnut Ridge Water & Sewer Works must maintain certain requirements after receiving bonds from the United States Department of Agriculture (USDA). The bonds require that funds be established as described below.

The USDA issued the 3.25% 92 01 and 92 02 Debt Service Reserve & Short Lived Asset Reserve in the amount of $787,388 and $115,129 on July 30, 2011. Walnut Ridge Water & Sewer Works is required to deposit a sum equal to the installment of the principal and interest due on the next monthly installment payment plus the sum of $358 into the Debt Reserve Fund.

These funds with deposits in excess of the amounts insured by FDIC must be secured by bonds or other direct or fully guaranteed obligations of the United States of America.

NOTE 8: LONG-TERM DEBT

	2017	2016
Integrity First Bank, note payable of $266,008, interest rate of 4.00%; principal and interest payable monthly beginning April 28, 2017; principal & interest payment of $2,346; matures December 1, 2029	$ 262,738	$ 268,827
2012 Debt Reserve Bond issue – USDA, 3.250%, $823,000; principal and interest payable monthly beginning July 30, 2011; principal & interest payment of $3,111; matures April 27, 2049	763,160	775,470
2012 Debt Reserve Bond issue - USDA, 3.250% $120,000: principal and interest payable monthly beginning July 30, 2011; principal & interest payment of $454; matures April 27, 2049	111,608	113,395
	$ 1,137,506	$ 1,157,692

All bonds are secured by revenues and water system of Walnut Ridge Water & Sewer Works.

Maturities and analysis of long-term debt changes to Walnut Ridge Water & Sewer Works long-term debt are as follows:

	2017	2016
Total long-term debt at beginning of year	$ 1,157,692	$ 1,186,082
Note payable retirements	(20,186)	(28,390)
Total long-term debt at the end of the year, net	1,137,506	1,157,692
Less current portion	(31,286)	(29,509)
Non-current portion	$ 1,106,220	$ 1,128,183

NOTE 8: LONG-TERM DEBT (Continued)

Maturities of long-term debt at June 30, 2017 are as follows:

	Principal	Interest	Total
2018	$ 31,286	$ 38,407	$ 69,693
2019	32,448	37,286	69,734
2020	33,630	36,104	69,734
2021	34,903	34,831	69,734
2022	36,271	33,463	69,734
Thereafter	968,968	454,487	1,423,455
	$ 1,137,506	$ 634,578	$ 1,772,084

Interest expense was $35,494 for year ended June 30, 2017 and $41,369 for year ended June 30, 2016.

NOTE 9: RISK MANAGEMENT AND LITIGATION

Walnut Ridge Water & Sewer Works is exposed to various risks of loss to torts, thefts of, damage to, and destruction of assets, errors and omissions, injuries to employees, and natural disasters. Expenditures and claims are recognized when it is probable that a loss has occurred and the amount of the loss can be reasonably estimated. In determining claims, events that might create claims, but for which none have been reported, are considered.

NOTE 10: MONTHLY WATER RATES

Walnut Ridge Water & Sewer Works shall be determined by meter measurements. The consumption per month will be charged $5.90/1,000 gallons of water with a 1,000-gallon minimum per the rate increase in November 2016. Sewer charges are $4.40/1,000 gallons with a 1,000-gallon minimum per the rate increase in November 2016.

NOTE 11: SUBSEQUENT EVENTS

Management has evaluated subsequent events through September 15, 2017, the date on which the financial statements were available to be issued.

THOMAS, SPEIGHT & NOBLE
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A PROFESSIONAL ASSOCIATION OF CERTIFIED PUBLIC ACCOUNTANTS
MEMBER OF THE PRIVATE COMPANIES PRACTICE SECTION OF THE AMERICAN INSTITUTE OF CERTIFIED PUBLIC ACCOUNTANTS

INDEPENDENT AUDITORS' REPORT ON INTERNAL CONTROL OVER FINANCIAL REPORTING AND ON COMPLIANCE AND OTHER MATTERS BASED ON AN AUDIT OF FINANCIAL STATEMENTS PERFORMED IN ACCORDANCE WITH *GOVERNMENT AUDITING STANDARDS*

To the Board of Commissioners
Walnut Ridge Water & Sewer Works
Walnut Ridge, Arkansas

We have audited, in accordance with the auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards* issued by the Comptroller General of the United States, the financial statements of the business-type activities of the Walnut Ridge Water & Sewer Works, as of and for the year ended June 30, 2017, and the related notes to the financial statements, which collectively comprise the Walnut Ridge Water & Sewer Works' basic financial statements and have issued our report thereon dated September 15, 2017.

Internal Control over Financial Reporting

In planning and performing our audit of the financial statements of Walnut Ridge Water & Sewer Works as of and for the year ended 2017, in accordance with auditing standards generally accepted in the United States of America, we considered Walnut Ridge Water & Sewer Works' internal control over financial reporting (internal control) as a basis for designing audit procedures that are appropriate in the circumstances for the purpose of expressing our opinions on the financial statements, but not for the purpose of expressing an opinion on the effectiveness of Walnut Ridge Water & Sewer Works' internal control. Accordingly, we do not express an opinion on the effectiveness of Walnut Ridge Water & Sewer Works' internal control.

A *deficiency in internal control* exists when the design or operation of a control does not allow management or employees, in the normal course of performing their assigned functions, to prevent, or detect and correct, misstatements on a timely basis. A *material weakness* is a deficiency, or a combination of deficiencies in internal control, such that there is a reasonable possibility that a material misstatement of the entity's financial statements will not be prevented, or detected and corrected, on a timely basis. A *significant deficiency* is a deficiency, or a combination of deficiencies, in internal control that is less severe than a material weakness, yet important enough to merit attention by those charged with governance.

Our consideration of internal control was for the limited purpose described in the first paragraph of this section and was not designed to identify all deficiencies in internal control that might be material weaknesses or significant deficiencies and therefore material weaknesses or significant deficiencies may exist that were not identified. However, as discussed below, we did identify a certain deficiency in internal control described below, that we consider to be a material weakness.

2017-1 To ensure proper safeguarding of assets, financial accounting duties relating to initiating, receipting, depositing, disbursing, and recording transactions should be distributed among appropriate employees. Walnut Ridge Water & Sewer Works' management did not segregate these duties to sufficiently reduce the risks of fraud and error and properly safeguard assets, because of limited resources. We recommend the financial accounting duties be segregated among employees to the extent possible.

Management has responded and indicated that financial accounting duties relating to initiating, receipting, depositing, disbursing, and recording transactions will be segregated to the extent possible with current staffing levels.

Compliance and Other Matters

As part of obtaining reasonable assurance about whether the Walnut Ridge Water & Sewer Works' financial statements are free from material misstatement, we performed tests of its compliance with certain provisions of laws, regulations, contracts, and grant agreements, noncompliance with which could have a direct and material effect on the determination of financial statement amounts. However, providing an opinion on compliance with those provisions was not objective of our audit, and accordingly, we do not express such an opinion. The results of our tests disclosed no instances of noncompliance that are required to be reported under *Government Auditing Standards*.

Walnut Ridge Water & Sewer Works' Response to Findings

Management's response to the findings identified in our audit is described above. Management's response was not subjected to the auditing procedures applied in the audit of the financial statements and, accordingly, we express no opinion on it.

Purpose of this Report

The purpose of this report is solely to describe the scope of our testing of internal control and compliance and the results of that testing, and not to provide an opinion on the effective of the entity's internal control or on compliance. This report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering the entity's internal control and compliance. Accordingly, this communication is not suitable for any other purpose.

Thomas, Speight & Noble, CPAs

Thomas, Speight & Noble, CPAs
Jonesboro, Arkansas
September 15, 2017

WALNUT RIDGE WATER & SEWER WORKS
(A Component Unit of the City of Walnut Ridge, Arkansas)

Audited Financial Statements

For the Years Ended June 30, 2016 and 2015

Thomas, Speight & Noble
Certified Public Accountants
2210 Fowler Avenue
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Walnut Ridge Water & Sewer Works

(A Component Unit of the City of Walnut Ridge, Arkansas)

Audited Financial Statements

For the Years Ended June 30, 2016 and 2015

CONTENTS

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A PROFESSIONAL ASSOCIATION OF CERTIFIED PUBLIC ACCOUNTANTS
MEMBER OF THE PRIVATE COMPANIES PRACTICE SECTION OF THE AMERICAN INSTITUTE OF CERTIFIED PUBLIC ACCOUNTANTS

INDEPENDENT AUDITORS' REPORT

To the Board of Commissioners
Walnut Ridge Water & Sewer Works

Report on the Financial Statements

We have audited the accompanying financial statements of Walnut Ridge Water & Sewer Works as of and for the year ended June 30, 2016 and 2015, and the related notes to the financial statements, which collectively comprise Walnut Ridge Water & Sewer Works basic financial statements, as listed in the table of contents.

Management's Responsibility for the Financial Statements

Management is responsible for the preparation and fair presentation of these financial statements in accordance with accounting principles generally accepted in the United States of America; this includes the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditor's Responsibility

Our responsibility is to express opinions on these financial statements based on our audit. We conducted our audit in accordance with auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. Accordingly, we express no such opinion. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinions.

Opinions

In our opinion, the financial statements referred to above present fairly, in all material respects, the respective financial position of Walnut Ridge Water & Sewer Works as of June 30, 2016 and 2015, and the respective changes in financial position and cash flows thereof for the years then ended in accordance with accounting principles generally accepted in the United States of America.

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Other Matters

Required Supplementary Information

Management has omitted the management's discussion and analysis that accounting principles generally accepted in the United States of America require to be presented to supplement the basic financial statements. Such missing information, although not a part of the basic financial statements, is required by the Governmental Accounting Standards Board who considers it to be an essential part of financial reporting for placing the basic financial statements in an appropriate operational, economic, or historical context. Our opinion on the basic financial statements is not affected by this missing information.

Other Reporting Required by *Government Auditing Standards*

In accordance with *Government Auditing Standards*, we have also issued our report dated August 22, 2016, on our consideration of Walnut Ridge Water & Sewer Works internal control over financial reporting and on our tests of its compliance with certain provisions of laws, regulations, contracts, and grant agreements and other matters. The purpose of that report is to describe the scope of our testing of internal control over financial reporting and compliance and the results of that testing, and not to provide an opinion on internal control over financial reporting or on compliance. That report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering Walnut Ridge Water & Sewer Works internal control over financial reporting and compliance.

Thomas, Speight & Noble, CPAs

Thomas, Speight & Noble, CPAs
Jonesboro, Arkansas
August 22, 2016

Walnut Ridge Water and Sewer Works
Statements of Net Position
June 30, 2016 and 2015

	Water 2016	Sewer 2016	Total	2015
ASSETS				
CURRENT ASSETS				
Cash and cash equivalents - unrestricted	$ 2,248	$ 2,248	$ 4,496	$ 17,214
Customer accounts receivable	73,066	73,065	146,131	138,932
Accrued interest receivable	194	194	388	286
Prepaid insurance	5,263	5,262	10,525	10,525
Materials inventory (at cost)	17,634	17,634	35,268	42,653
Total current assets	98,405	98,403	196,808	209,610
NON-CURRENT ASSETS				
Cash and cash equivalents - restricted	125,007	177,270	302,277	306,837
Certificates of deposit - restricted	77,688	77,688	155,376	125,754
Capital assets				
Capital assets, net of accumulated depreciation	988,747	2,889,194	3,877,941	4,038,485
Total non-current assets	1,191,443	3,144,152	4,335,595	4,471,076
TOTAL ASSETS	$ 1,289,848	$ 3,242,555	$ 4,532,403	$ 4,680,686
LIABILITIES AND NET POSITION				
CURRENT LIABILITIES				
Accounts payable	49,620	$ 110	$ 49,730	$ 59,837
Sales tax payable	4,216	4,215	8,431	6,484
Accrued and withheld payroll taxes	2,539	2,539	5,078	3,951
Accrued wages	1,074	1,074	2,148	2,148
Accrued retirement	8,036	8,038	16,074	19,424
Accrued compensated absences	3,723	3,722	7,445	26,715
Current portion of long-term debt	14,755	14,754	29,509	28,390
Due to other governments	17,093	17,092	34,185	69,014
Total current liabilities	101,056	51,544	152,600	215,963
LONG-TERM DEBT, net of current maturities	564,092	564,091	1,128,183	1,157,692
LIABILITIES PAYABLE FROM RESTRICTED ASSETS				
Customer deposits	105,173	4,214	109,387	108,879
Accrued interest	588	588	1,176	1,177
Total liabilities payable from restricted assets	105,761	4,802	110,563	110,056
TOTAL LIABILITIES	770,909	620,437	1,391,346	1,483,711
NET POSITION				
Net investment in capital assets	409,900	2,310,349	2,720,249	2,825,422
Restricted for debt service	101,924	101,925	203,849	186,220
Unrestricted	7,115	209,845	216,959	185,333
Total net position	518,939	2,622,118	3,141,057	3,196,975
TOTAL LIABILITIES AND NET POSITION	$ 1,289,848	$ 3,242,555	$ 4,532,403	$ 4,680,686

The accompanying notes are an integral part of these financial statements.

Walnut Ridge Water and Sewer Works
Statements of Revenues, Expenses and Changes in Net Position
For the Years Ended June 30, 2016 and 2015

	Water 2016	Sewer 2016	Total	2015
OPERATING REVENUES				
Water revenue	$ 779,504	$ -	$ 779,504	$ 754,262
Sewer revenue	-	525,895	525,895	474,497
Late payment charges	15,373	15,373	30,746	31,397
Miscellaneous income	6,522	6,521	13,043	13,605
Total operating revenue	801,399	547,789	1,349,188	1,273,761
OPERATING EXPENSES				
Purchased water	579,442	-	579,442	539,620
Salaries, wages & benefits	143,711	143,711	287,422	342,560
Payroll taxes	9,782	9,782	19,564	19,463
Depreciation	48,180	112,973	161,153	162,535
Utlities	16,474	100,075	116,549	106,258
Maintenance materials & contractual services	45,340	59,682	105,022	74,470
Insurance	4,509	4,508	9,017	11,956
Office expense	13,322	13,322	26,644	25,373
Lab fees	-	33,267	33,267	39,184
Bad debts	5,190	5,190	10,380	9,283
Professional fees	5,828	5,828	11,656	16,495
Other expense	2,035	2,034	4,069	16,105
Total operating expenses	873,813	490,372	1,364,185	1,363,302
OPERATING INCOME (LOSS)	(72,414)	57,417	(14,997)	(89,541)
NON-OPERATING REVENUES (EXPENSES)				
Interest income	224	224	448	1,880
Interest expense	(20,685)	(20,684)	(41,369)	(42,398)
Nonoperating revenues (expenses)	(20,461)	(20,460)	(40,921)	(40,518)
CHANGE IN NET POSITION	(92,875)	36,957	(55,918)	(130,059)
NET POSITION AT BEGINNING OF YEAR	611,814	2,585,161	3,196,975	3,327,034
NET POSITION AT END OF YEAR	$ 518,939	$ 2,622,118	$ 3,141,057	$ 3,196,975

The accompanying notes are an integral part of these financial statements.

Walnut Ridge Water and Sewer Works
Statements of Cash Flows
For the Years Ended June 30, 2016 and 2015

	2016	2015
Cash flows from operating activities:		
Cash receipts from customers	$ 1,341,989	$ 1,253,859
Cash payments to suppliers for goods and services	(931,650)	(838,942)
Cash payments to employees	(328,481)	(342,523)
Net cash provided by (used in) operating activities	81,858	72,394
Cash flows from capital and related financing activities:		
Principal payments on long-term debt	(28,390)	(27,313)
Interest payments on long-term debt	(41,369)	(42,398)
Purchases of capital assets	(609)	(7,000)
Net cash provided by (used in) financing activities	(70,368)	(76,711)
Cash flows from investing activities:		
Purchase of investments	(29,622)	(723)
Interest received	347	1,880
Net cash provided by (used in) investing activities	(29,275)	1,157
Cash flows from non-capital financing activities:		
Customer meter deposits (net)	507	220
Net cash provided by (used in) non-capital financing activities	507	220
NET INCREASE (DECREASE) IN CASH AND CASH EQUIVALENTS	(17,278)	(2,940)
CASH AND CASH EQUIVALENTS - BEGINNING OF YEAR	324,051	326,991
CASH AND CASH EQUIVALENTS - END OF YEAR	$ 306,773	$ 324,051
RECONCILIATION OF OPERATING INCOME TO NET CASH PROVIDED BY OPERATING ACTIVITIES		
Operating income (loss)	$ (14,997)	$ (89,541)
Adjustments to reconcile operating income (loss) to net cash provided by operating activities:		
Depreciation	161,153	162,535
(Increase)/Decrease In:		
Customer accounts receivable	(7,199)	(19,902)
Materials inventory	7,385	(4,523)
Prepaid insurance	-	1,860
Increase/(Decrease) In:		
Accounts payable and accrued expenses	(29,655)	16,939
Due to other governments	(34,829)	5,026
NET CASH PROVIDED BY (USED IN) OPERATING ACTIVITIES	$ 81,858	$ 72,394

The accompanying notes are an integral part of these financial statements.

NOTE 1: ORGANIZATION AND SUMMARY OF SIGNIFICANT ACCOUNT POLICIES

Organization

The Walnut Ridge Water and Sewer Works (the Department) is a department of the City of Walnut Ridge, Arkansas. These financial statements present the financial position, results of operations and cash flows of the Department and are not intended to present that of the City of Walnut Ridge or any of its other activities.

The Department provides water and waste water treatment services to its citizens from a system owned distribution network. All activities of the Department are considered business type activities. The accounts of the Walnut Ridge Water & Sewer Works are organized on the basis of a proprietary fund type specifically an enterprise fund. The activities of this fund are accounted for with a separate set of self-balancing accounts that comprise assets, liabilities, net assets, revenues, and expenses. Enterprise funds account for the activities (i) that are financed with debt that is secured solely by a pledge of net revenues from fees and charges of the activity; (ii) that are required by laws or regulations that the activity's costs of providing services, including capital costs (such as depreciation or debt service), be recovered with fees and charges, rather than with taxes or similar revenues; or (iii) that the pricing policies of the activity establish fees and charges designed to recover its costs, including capital costs (such as depreciation or debt service).

The basis of accounting determines when transactions and economic events are reflected in financial statements, and measurement focus identifies which transactions and events should be recorded. Enterprise Funds use the accrual basis of accounting to record the flow of all economic resources (measurement focus). This basis of accounting and measurement focus emphasizes the measurement of net income similar to the approach used by commercial enterprises, revenues are recorded when earned and expenses are recorded when incurred. Net position is segregated into invested in capital assets, restricted, and unrestricted components.

Use of Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect certain reported amounts and disclosures. Accordingly, actual results could differ from those estimates.

Cash and Cash Equivalents

For the purpose of the statements of cash flows, the Department considers all highly liquid investments with an original maturity of three months or less to be cash equivalents.

Customer Accounts Receivable

Walnut Ridge Water & Sewer Works uses the direct write-off method for accounting for bad debt. Water charges receivables as shown in the statements of net position are stated at net realizable value. The use of this method is not materially different from the values reported under the allowance method.

Materials Inventory

Inventory, consisting of supplies and materials, is stated at the lower of cost or market using the first-in first-out method.

Restricted assets

Restricted assets consists of investments used to satisfy debt covenants, meter deposits held in trust, and funds set aside for renewal and replacement.

NOTE 1: ORGANIZATION AND SUMMARY OF SIGNIFICANT ACCOUNT POLICIES (Continued)

Capital Assets

The cost of additions and major replacements of retired units of property are capitalized. Walnut Ridge Water and Sewer Works defines capital assets as assets with an initial, individual cost of more than $500 and an estimated useful life in excess of two years. The cost and accumulated depreciation of property sold or retired is deducted from capital assets and any profit or loss resulting from the disposal is credited or charged in the non-operating section of the statements of revenues, expenses, and changes in net position. The cost of current repairs, maintenance, and minor replacements is charged to expense when incurred.

Depreciation of capital assets is charged as an expense against operations. Depreciation rates have been applied on a straight-line basis, with estimated useful lives as follows:

Water & Sewer Systems	10-50 Years
Buildings	20-30 Years
Equipment	5-7 Years
Vehicles	3-5 Years

Operating Revenues and Expenses

Operating revenues and expenses generally result from providing services and producing and delivering goods in connection with a proprietary fund's principal ongoing operations. The principal operating revenues of the enterprise funds are charges to customers for sales and services. Operating expenses for enterprise funds include the cost of sales and services, administrative expenses, and depreciation on capital assets. All revenues and expenses not meeting these definitions are reported as non-operating revenues and expenses.

Net Position

Net position comprises the various net earnings from operating income, non-operating revenues and expenses, and capital contributions. Net position is classified in the following three components:

Net investment in capital assets – This component of net position consists of capital assets, net of accumulated depreciation and reduced by the outstanding balances of any bonds, mortgages, notes or other borrowings that are attributable to the acquisition, construction or improvement of those assets. If there are significant unspent related debt proceeds at year-end, the portion of the debt attributable to the unspent proceeds is not included in the calculation of invested in capital assets, net of related debt. Rather, that portion of the debt is included in the same net position component as the unspent proceeds.

Restricted for debt service– This component of net position consists of constraints imposed by creditors (such as through debt covenants), grantors, contributors, or laws or regulations of other governments or constraints imposed by law through constitutional provisions or enabling legislation. When an expense is incurred for purposes for which there are both restricted and unrestricted net position available, it is Walnut Ridge Water & Sewer's policy to apply those expenses to restricted net position to the extent such are available and then to unrestricted net position.

Unrestricted– This component of net position consists of net assets that do not meet the definition of "restricted" or "invested in capital assets, net of related debt.

NOTE 1: ORGANIZATION AND SUMMARY OF SIGNIFICANT ACCOUNT POLICIES (Continued)

Budgets and Budgetary Accounting

Prior to the beginning of the new fiscal year, the Board of Commissioners adopt an annual budget for Walnut Ridge Water & Sewer Works. The budget is adopted under a basis consistent with GAAP, except that depreciation, certain capital expenses, and non-operating income and expense items are not considered. All annual appropriations lapse at year-end.

NOTE 2: CAPITAL ASSETS

As summary of changes in property, plant, and equipment for the years ended June 30, 2016 and 2015 are as follows:

	Balance 6/30/2015	Additions	Deletions	Balance 6/30/2016
Capital assets not being depreciated:				
Land	$ 95,778	$ -	$ -	$ 95,778
Construction in process	-			-
Total capital assets not being depreciated	95,778	-	-	95,778
Other capital assets				
Buildings	37,257	-		37,257
Distribution system	7,724,209	609	-	7,724,818
Equipment	299,486	-	-	299,486
Total other assets at historical cost	8,060,952	609	-	8,061,561
Less accumulated depreciation for:				
Buildings	(37,006)		-	(37,006)
Distribution system	(3,809,845)	(152,057)	-	(3,961,902)
Equipment	(271,394)	(9,096)	-	(280,490)
Total accumulated depreciation	(4,118,245)	(161,153)	-	(4,279,398)
Total capital assets, being depreciated, net	3,942,707	(160,544)	-	3,782,163
Total capital assets, net	$ 4,038,485	$ (160,544)	$ -	$ 3,877,941

NOTE 2: CAPITAL ASSETS (Continued)

	Balance 6/30/2014	Additions	Deletions	Balance 6/30/2015
Capital assets not being depreciated:				
Land	$ 95,778	$ -	$ -	$ 95,778
Construction in process	-			-
Total capital assets not being depreciated	95,778	-	-	95,778
Other capital assets				
Buildings	37,257	-		37,257
Distribution system	7,724,209	-	-	7,724,209
Equipment	292,486	7,000	-	299,486
Total other assets at historical cost	8,053,952	7,000	-	8,060,952
Less accumulated depreciation for:				
Buildings	(37,006)		-	(37,006)
Distribution system	(3,657,546)	(152,299)	-	(3,809,845)
Equipment	(261,177)	(10,217)	-	(271,394)
Total accumulated depreciation	(3,955,729)	(162,516)	-	(4,118,245)
Total capital assets, being depreciated, net	4,098,223	(155,516)	-	3,942,707
Total capital assets, net	$ 4,194,001	$ (155,516)	$ -	$ 4,038,485

NOTE 3: CUSTODIAL CREDIT RISK OF BANK DEPOSITS AND INVESTMENTS

Custodial credit risk is the risk that in the event of a bank failure, Walnut Ridge Water & Sewer Works deposits may not be returned to it. Walnut Ridge Water & Sewer Works deposit policy for custodial risk is compliant with bond requirements. At year end June 30, 2015, Walnut Ridge Water & Sewer Works had bank deposits in the amount of $448,987. Due to the dollar amounts of cash deposits and investments, and the limits of the Federal Deposit Insurance Corporation (FDIC), Walnut Ridge Water & Sewer Works is required to secure additional monies by pledging securities held by the pledging financial institution's trust department or agent at year end June 30, 2015. At year end June 30, 2016, Walnut Ridge Water & Sewer Works had bank deposits in the amount of $477,953. At June 30, 2016, there were pledged securities in the amount of $425,613 held on the Department's behalf. The amount of unsecured cash deposits as of June 30, 2016, was $52,340.

NOTE 4: RETIREMENT PLAN

The entity provides pension benefits for all of its full-time employees through the Employees Retirement Plan of the City Water Works of Walnut Ridge, Arkansas (the "Plan"). The Plan is a single-employer defined contribution plan and is administered by the Walnut Ridge Water & Sewer Works. The Plan is authorized and may be amended by the entity's City Council.

In a defined contribution plan, the benefits depend solely on amounts contributed to the plan, plus investment earnings. Employees are eligible to participate after a one-year exclusionary period. The entity contributes 8% of the employee's base salary each month. The entity's contributions for each employee (and interest allocated to the employee's account) are vested 20% annually for each year of participation. The matching contribution amount accrued for the 12 months ended June 30, 2016 and 2015 was $16,072 and $17,334 respectively.

NOTE 5: COMPENSATED ABSENCES

Vested or accumulated vacation, sick leave, and compensatory time are recorded as an expense and liability as the benefits accrue to employees, and are included as accrued compensated absences on the statements of financial position.

NOTE 6: LONG-TERM DEBT

	2016	2015
Regions Bank, note payable of $412,371, interest rate of 4.5%; principle and interest payable monthly beginning July 1, 2003; principle & interest payment of $2,278; matures December 1, 2029	$ 268,827	$ 283,567
2012 Debt Reserve Bond issue – USDA, 3.250%, $823,000; principal and interest payable monthly beginning July 30, 2011; principle & interest payment of $3,111; matures April 27, 2049	775,470	787,386
2012 Debt Reserve Bond issue - USDA, 3.250% $120,000: principle and interest payable monthly beginning July 30, 2011; principle & interest payment of $454; matures April 27, 2049	113,395	115,129
	$ 1,157,692	$ 1,186,082

All bonds are secured by revenues and water system of Walnut Ridge Water & Sewer Works.

NOTE 6: LONG-TERM DEBT (Continued)

Maturities and analysis of long-term debt changes to Walnut Ridge Water & Sewer Works long-term debt are as follows:

	2016	2015
Total long-term debt at beginning of year	$ 1,186,082	$ 1,213,395
Additonal borrowings	-	-
Note payable retirements	(28,390)	(27,313)
Total long-term debt at the end of the year, net	1,157,692	1,186,082
Less current portion	(29,509)	(28,390)
Non-current portion	$ 1,128,183	$ 1,157,692

Maturities of long-term debt at June 30, 2016 are as follows:

	Principal	Interest	Total
2017	$ 29,509	$ 40,607	$ 70,116
2018	30,677	39,439	70,116
2019	31,891	38,225	70,116
2020	33,155	36,961	70,116
2021	34,468	35,648	70,116
Thereafter	997,992	492,959	1,490,951
	$ 1,157,692	$ 683,839	$ 1,841,531

Interest expense was $41,369 for year ended June 30, 2016 and $42,398 for year ended June 30, 2015.

NOTE 7: BOND REQUIREMENTS

Walnut Ridge Water & Sewer Works must maintain certain requirements after receiving bonds from the United States Department of Agriculture (USDA). The bonds require that funds be established as described below.

The USDA issued the 3.25% 92 01 and 92 02 Debt Service Reserve & Short Lived Asset Reserve in the amount of $787,388 and $115,129 on July 30, 2011. Walnut Ridge Water & Sewer Works is required to deposit a sum equal to the installment of the principal and interest due on the next monthly installment payment plus the sum of $358 into the Debt Reserve Fund.

These funds with deposits in excess of the amounts insured by FDIC must be secured by bonds or other direct or fully guaranteed obligations of the United States of America.

NOTE 8: RISK MANAGEMENT AND LITIGATION

Walnut Ridge Water & Sewer Works is exposed to various risks of loss to torts, thefts of, damage to, and destruction of assets, errors and omissions, injuries to employees, and natural disasters. Expenditures and claims are recognized when it is probable that a loss has occurred and the amount of the loss can be reasonably estimated. In determining claims, events that might create claims, but for which none have been reported, are considered.

NOTE 9: MONTHLY WATER RATES

Walnut Ridge Water & Sewer Works shall be determined by meter measurements. The consumption per month will be charged $5.90/1,000 gallons of water with a 1,000 gallon minimum per the rate increase in January 2014. Sewer charges are $3.50/1,000 gallons with a 1,000 gallon minimum, with next 1,000 gallons $3.50 thereafter all over 2,000 gallons at $4.40 per 1,000 per the rate increase in 2003.

NOTE 10: SUBSEQUENT EVENTS

Management has evaluated subsequent events through August 22, 2016, the date on which the financial statements were available to be issued.

THOMAS, SPEIGHT & NOBLE
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A Professional Association of Certified Public Accountants
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INDEPENDENT AUDITOR'S REPORT ON INTERNAL CONTROL OVER FINANCIAL REPORTING AND ON COMPLIANCE AND OTHER MATTERS BASED ON AN AUDIT OF FINANCIAL STATEMENTS PERFORMED IN ACCORDANCE WITH *GOVERNMENT AUDITING STANDARDS*

To the Board of Commissioners
Walnut Ridge Water & Sewer Works
Pocahontas, Arkansas

We have audited, in accordance with the auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards* issued by the Comptroller General of the United States, the financial statements of the business-type activities of the Walnut Ridge Water and Sewer Works, as of and for the year ended June 30, 2016, and the related notes to the financial statements, which collectively comprise the Walnut Ridge Water and Sewer Works' basic financial statements and have issued our report thereon dated August 22, 2016.

Internal Control over Financial Reporting

In planning and performing our audit of the financial statements, we considered the Walnut Ridge Water and Sewer Works' internal control over financial reporting (internal control) to determine the audit procedures that are appropriate in the circumstances for the purpose of expressing our opinions on the financial statements, but not for the purpose of expressing an opinion on the effectiveness of the Walnut Ridge Water and Sewer Works' internal control. Accordingly, we do not express an opinion on the effectiveness of the Walnut Ridge Water and Sewer Works' internal control.

A *deficiency in internal control* exists when the design or operation of a control does not allow management or employees, in the normal course of performing their assigned functions, to prevent, or detect and correct, misstatements on a timely basis. A *material weakness* is a deficiency, or a combination of deficiencies, in internal control such that there is a reasonable possibility that a material misstatement of the entity's financial statements will not be prevented, or detected and corrected on a timely basis. A *significant deficiency* is a deficiency, or a combination of deficiencies, in internal control that is less severe than a material weakness, yet important enough to merit attention by those charged with governance.

Our consideration of internal control was for the limited purpose described in the first paragraph of this section and was not designed to identify all deficiencies in internal control that might be material weaknesses or significant deficiencies and therefore, material weaknesses or significant deficiencies may exist that were not identified. However, as discussed below, we identified a certain deficiency in internal control that we consider to be a material weakness.

2016-1 To ensure proper safeguarding of assets, financial accounting duties relating to initiating, receipting, depositing, disbursing, and recording transactions should be distributed among appropriate employees. Walnut Ridge Water and Sewer Works' management did not segregate these duties to sufficiently reduce the risks of fraud and error and properly safeguard assets, because of limited resources. We recommend the financial accounting duties be segregated among employees to the extent possible.

Management has responded and indicated that financial accounting duties relating to initiating, receipting, depositing, disbursing, and recording transactions will be segregated to the extent possible with current staffing levels.

Compliance and Other Matters

As part of obtaining reasonable assurance about whether the Walnut Ridge Water and Sewer Works' financial statements are free from material misstatement, we performed tests of its compliance with certain provisions of laws, regulations, contracts, and grant agreements, noncompliance with which could have a direct and material effect on the determination of financial statement amounts. However, providing an opinion on compliance with those provisions was not an objective of our audit, and accordingly, we do not express such an opinion. The results of our tests disclosed no instances of noncompliance or other matters that are required to be reported under *Government Auditing Standards.*

Purpose of this Report

The purpose of this report is solely to describe the scope of our testing of internal control and compliance and the results of that testing, and not to provide an opinion on the effectiveness of the entity's internal control or on compliance. This report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering the entity's internal control and compliance. Accordingly, this communication is not suitable for any other purpose.

Thomas, Speight & Noble, CPAs

Thomas, Speight & Noble, CPAs
Jonesboro, Arkansas
August 22, 2016

WALNUT RIDGE WATER & SEWER WORKS
(A Component Unit of the City of Walnut Ridge, Arkansas)

Audited Financial Statements

For the Years Ended June 30, 2015 and 2014

Thomas, Speight & Noble
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Walnut Ridge Water & Sewer Works

(A Component Unit of the City of Walnut Ridge, Arkansas)

Audited Financial Statements

For the Years Ended June 30, 2015 and 2014

CONTENTS

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INDEPENDENT AUDITORS' REPORT

To the Board of Commissioners
Walnut Ridge Water & Sewer Works

Report on the Financial Statements

We have audited the accompanying financial statements of Walnut Ridge Water & Sewer Works as of and for the year ended June 30, 2015 and 2014, and the related notes to the financial statements, which collectively comprise Walnut Ridge Water & Sewer Works basic financial statements as listed in the table of contents.

Management's Responsibility for the Financial Statements

Management is responsible for the preparation and fair presentation of these financial statements in accordance with accounting principles generally accepted in the United States of America; this includes the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditor's Responsibility

Our responsibility is to express opinions on these financial statements based on our audit. We conducted our audit in accordance with auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. Accordingly, we express no such opinion. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinions.

Opinions

In our opinion, the financial statements referred to above present fairly, in all material respects, the respective financial position of Walnut Ridge Water & Sewer Works as of June 30, 2015 and 2014, and the respective changes in financial position and cash flows thereof for the years then ended in accordance with accounting principles generally accepted in the United States of America.

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Other Matters

Required Supplementary Information

Management has omitted the management's discussion and analysis that accounting principles generally accepted in the United States of America require to be presented to supplement the basic financial statements. Such missing information, although not a part of the basic financial statements, is required by the Governmental Accounting Standards Board who considers it to be an essential part of financial reporting for placing the basic financial statements in an appropriate operational, economic, or historical context. Our opinion on the basic financial statements is not affected by this missing information.

Other Reporting Required by *Government Auditing Standards*

In accordance with *Government Auditing Standards*, we have also issued our report dated April 28, 2016, on our consideration of Walnut Ridge Water & Sewer Works internal control over financial reporting and on our tests of its compliance with certain provisions of laws, regulations, contracts, and grant agreements and other matters. The purpose of that report is to describe the scope of our testing of internal control over financial reporting and compliance and the results of that testing, and not to provide an opinion on internal control over financial reporting or on compliance. That report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering Walnut Ridge Water & Sewer Works internal control over financial reporting and compliance.

Thomas, Speight & Noble, CPAs

Thomas, Speight & Noble, CPAs
Jonesboro, Arkansas
April 28, 2016

Walnut Ridge Water and Sewer Works
Statements of Net Position
June 30, 2015 and 2014

	2015	2014
ASSETS		
CURRENT ASSETS		
Cash and cash equivalents - unrestricted	$ 17,214	$ 30,672
Customer accounts receivable	138,932	119,030
Accrued interest receivable	286	286
Prepaid insurance	10,525	12,385
Materials inventory (at cost)	42,653	38,130
Total current assets	209,610	200,503
NON-CURRENT ASSETS		
Cash and cash equivalents - restricted for debt service	306,837	296,319
Restricted investments	125,754	125,031
Capital assets		
Capital assets, net of accumulated depreciation	4,038,485	4,194,001
Total non-current assets	4,471,076	4,615,351
TOTAL ASSETS	$ 4,680,686	$ 4,815,854
LIABILITIES AND NET POSITION		
CURRENT LIABILITIES		
Accounts payable	$ 59,837	$ 64,101
Sales tax payable	6,484	6,484
Accrued and withheld payroll taxes	3,951	3,717
Accrued wages	2,148	2,111
Accrued retirement	19,424	18,970
Accrued compensated absences	26,715	6,168
Customer deposits	108,879	108,659
Accrued interest	1,177	1,227
Current portion of long-term debt	28,390	27,313
Due to other governments	69,014	63,988
Total current liabilities	326,019	302,738
LONG-TERM DEBT, net of current maturities	1,157,692	1,186,082
TOTAL LIABILITIES	1,483,711	1,488,820
NET POSITION		
Net investment in capital assets	2,825,422	2,980,606
Restricted for debt service	2,279	2,427
Unrestricted	369,274	344,001
Total net position	3,196,975	3,327,034
TOTAL LIABILITIES AND NET POSITION	$ 4,680,686	$ 4,815,854

The accompanying notes are an integral part of these financial statements.

Walnut Ridge Water and Sewer Works
Statements of Revenues, Expenses and Changes in Net Position
For the Years Ended June 30, 2015 and 2014

	2015	2014
OPERATING REVENUES		
Water revenue	$ 754,262	$ 766,246
Sewer revenue	474,497	497,225
Late payment charges	31,397	25,623
Miscellaneous income	13,605	19,519
Total operating revenue	1,273,761	1,308,613
OPERATING EXPENSES		
Purchased water	539,620	514,029
Salaries, wages & benefits	342,560	300,442
Payroll taxes	19,463	22,347
Depreciation & amortization	162,535	161,061
Utlities	106,258	79,317
Maintenance materials & contractual services	74,470	131,585
Insurance	11,956	19,805
Office expense	25,373	33,484
Lab fees	39,184	33,895
Bad debts	9,283	14,713
Professional fees	16,495	14,977
Other expense	16,105	6,725
Total operating expenses	1,363,302	1,332,380
OPERATING INCOME (LOSS)	(89,541)	(23,767)
NON-OPERATING REVENUES (EXPENSES)		
Interest income	1,880	1,094
Interest expense	(42,398)	(43,766)
Nonoperating revenues (expenses)	(40,518)	(42,672)
CHANGE IN NET POSITION	(130,059)	(66,439)
NET POSITION AT BEGINNING OF YEAR	3,327,034	3,393,473
NET POSITION AT END OF YEAR	$ 3,196,975	$ 3,327,034

The accompanying notes are an integral part of these financial statements.

Walnut Ridge Water and Sewer Works
Statements of Cash Flows
For the Years Ended June 30, 2015 and 2014

	2015	2014
Cash flows from operating activities:		
Cash receipts from customers	$ 1,253,859	$ 1,319,731
Cash payments to suppliers for goods and services	(838,942)	(869,585)
Cash payments to employees	(342,523)	(317,109)
Net cash provided by (used in) operating activities	72,394	133,037
Cash flows from capital and related financing activities:		
Principal payments on long-term debt	(27,313)	(26,297)
Interest payments on long-term debt	(42,398)	(45,628)
Purchases of capital assets	(7,000)	(22,556)
Net cash provided by (used in) financing activities	(76,711)	(94,481)
Cash flows from investing activities:		
Purchase of investments	(723)	(720)
Interest received	1,880	1,094
Net cash provided by (used in) investing activities	1,157	374
Cash flows from non-capital financing activities:		
Customer meter deposits (net)	220	3,648
Net cash provided by (used in) non-capital financing activities	220	3,648
NET INCREASE (DECREASE) IN CASH AND RESTRICTED CASH	(2,940)	42,578
CASH AND CASH EQUIVALENTS - BEGINNING OF YEAR	326,991	284,413
CASH AND CASH EQUIVALENTS - END OF YEAR	$ 324,051	$ 326,991
RECONCILIATION OF OPERATING INCOME TO NET CASH PROVIDED BY OPERATING ACTIVITIES		
Operating income (loss)	$ (89,541)	$ (23,767)
Adjustments to reconcile operating income (loss) to net cash provided by operating activities:		
Depreciation and amortization	162,535	161,061
(Increase)/Decrease In:		
Customer accounts receivable	(19,902)	7,424
Materials inventories	(4,523)	(989)
Prepaid insurance	1,860	6,038
Increase/(Decrease) In:		
Accounts payable and accrued expenses	16,719	(25,804)
Customer deposits	220	3,648
Due to other governments	5,026	5,426
NET CASH PROVIDED BY (USED IN) OPERATING ACTIVITIES	$ 72,394	$ 133,037

The accompanying notes are an integral part of these financial statements.

NOTE 1: ORGANIZATION AND SUMMARY OF SIGNIFICANT ACCOUNT POLICIES

Organization

The Walnut Ridge Water and Sewer Works (the Department) is a department of the City of Walnut Ridge, Arkansas. These financial statements present the financial position, results of operations and cash flows of the department and are not intended to present that of the City of Walnut Ridge or any of its other activities.

The Department provides water and waste water treatment services to its citizens from a system owned distribution network. All activities of the Department are considered business type activities. The accounts of the Walnut Ridge Water & Sewer Works are organized on the basis of a proprietary fund type specifically an enterprise fund. The activities of this fund are accounted for with a separate set of self-balancing accounts that comprise assets, liabilities, net assets, revenues, and expenses. Enterprise funds account for the activities (i) that are financed with debt that is secured solely by a pledge of net revenues from fees and charges of the activity; (ii) that are required by laws or regulations that the activity's costs of providing services, including capital costs (such as depreciation or debt service), be recovered with fees and charges, rather than with taxes or similar revenues; or (iii) that the pricing policies of the activity establish fees and charges designed to recover its costs, including capital costs (such as depreciation or debt service).

The basis of accounting determines when transactions and economic events are reflected in financial statements, and measurement focus identifies which transactions and events should be recorded. Enterprise Funds use the accrual basis of accounting to record the flow of all economic resources (measurement focus). This basis of accounting and measurement focus emphasizes the measurement of net income similar to the approach used by commercial enterprises, revenues are recorded when earned and expenses are recorded when incurred. Net position is segregated into invested in capital assets, restricted, and unrestricted components.

Use of Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect certain reported amounts and disclosures. Accordingly, actual results could differ from those estimates.

Cash and Cash Equivalents

For the purpose of the statements of cash flows, the Department considers all highly liquid investments with an original maturity of three months or less to be cash equivalents.

Customer Accounts Receivable

Walnut Ridge Water & Sewer Works uses the direct write-off method for accounting for bad debt. Water charges receivables as shown in the balance sheets are stated at net realizable value. The use of this method is not materially different from the values reported under the allowance method.

Materials Inventory

Inventory, consisting of supplies and materials, is stated at the lower of cost or market using the first-in first-out method.

Restricted assets

Restricted assets consists of investments used to satisfy debt covenants, meter deposits held in trust, and funds set aside for renewal and replacement.

NOTE 1: ORGANIZATION AND SUMMARY OF SIGNIFICANT ACCOUNT POLICIES (Continued)

Capital Assets

The cost of additions and major replacements of retired units of property are capitalized. Walnut Ridge Water and Sewer Works defines capital assets as assets with an initial, individual cost of more than $500 and an estimated useful life in excess of two years. The cost and accumulated depreciation of property sold or retired is deducted from capital assets and any profit or loss resulting from the disposal is credited or charged in the non-operating section of the statements of revenues, expenses, and changes in net position. The cost of current repairs, maintenance, and minor replacements is charged to expense when incurred.

Depreciation of capital assets is charged as an expense against operations. Depreciation rates have been applied on a straight-line basis, with estimated useful lives as follows:

Water & Sewer Systems	10-50 Years
Buildings	20-30 Years
Equipment	5-7 Years
Vehicles	3-5 Years

Operating Revenues and Expenses

Operating revenues and expenses generally result from providing services and producing and delivering goods in connection with a proprietary fund's principal ongoing operations. The principal operating revenues of the enterprise funds are charges to customers for sales and services. Operating expenses for enterprise funds include the cost of sales and services, administrative expenses, and depreciation on capital assets. All revenues and expenses not meeting these definitions are reported as non-operating revenues and expenses.

Net Position

Net position comprises the various net earnings from operating income, non-operating revenues and expenses, and capital contributions. Net position is classified in the following three components:

Net investment in capital assets – This component of net position consists of capital assets, net of accumulated depreciation and reduced by the outstanding balances of any bonds, mortgages, notes or other borrowings that are attributable to the acquisition, construction or improvement of those assets. If there are significant unspent related debt proceeds at year-end, the portion of the debt attributable to the unspent proceeds is not included in the calculation of invested in capital assets, net of related debt. Rather, that portion of the debt is included in the same net position component as the unspent proceeds.

Restricted for debt service– This component of net position consists of constraints imposed by creditors (such as through debt covenants), grantors, contributors, or laws or regulations of other governments or constraints imposed by law through constitutional provisions or enabling legislation. When an expense is incurred for purposes for which there are both restricted and unrestricted net position available, it is Walnut Ridge Water & Sewer's policy to apply those expenses to restricted net position to the extent such are available and then to unrestricted net position.

Unrestricted– This component of net position consists of net assets that do not meet the definition of "restricted" or "invested in capital assets, net of related debt.

Budgets and Budgetary Accounting

Prior to the beginning of the new fiscal year, the Board of Commissioners adopt an annual budget for Walnut Ridge Water & Sewer Works. The budget is adopted under a basis consistent with GAAP, except that depreciation, certain capital expenses, and non-operating income and expense items are not considered. All annual appropriations lapse at year-end.

NOTE 2: CAPITAL ASSETS

As summary of changes in property, plant, and equipment for the years ended June 30, 2015 and 2014 are as follows:

	Balance 6/30/2014	Additions	Deletions	Balance 6/30/2015
Capital assets not being depreciated:				
Land	$ 95,778	$ -	$ -	$ 95,778
Construction in process	-			-
Total capital assets not being depreciated	95,778	-	-	95,778
Other capital assets				
Buildings	37,257	-		37,257
Distribution system	7,724,209	-	-	7,724,209
Equipment	292,486	7,000	-	299,486
Total other assets at historical cost	8,053,952	7,000	-	8,060,952
Less accumulated depreciation for:				
Buildings	(37,006)		-	(37,006)
Distribution system	(3,657,546)	(152,299)	-	(3,809,845)
Equipment	(261,177)	(10,217)	-	(271,394)
Total accumulated depreciation	(3,955,729)	(162,516)	-	(4,118,245)
Total capital assets, being depreciated, net	4,098,223	(155,516)	-	3,942,707
Total capital assets, net	$ 4,194,001	$ (155,516)	$ -	$ 4,038,485

NOTE 2: CAPITAL ASSETS (Continued)

	Balance 6/30/2013	Additions	Deletions	Balance 6/30/2014
Capital assets not being depreciated:				
Land	$ 95,777	$ -	$ -	$ 95,777
Construction in process	-			-
Total capital assets not being depreciated	95,777	-	-	95,777
Other capital assets				
Buildings	37,257	-		37,257
Distribution system	7,724,209	-	-	7,724,209
Equipment	287,698	20,771	(15,983)	292,486
Total other assets at historical cost	8,049,164	20,771	(15,983)	8,053,952
Less accumulated depreciation for:				
Buildings	(37,006)		-	(37,006)
Distribution system	(3,504,423)	(153,123)	-	(3,657,545)
Equipment	(269,220)	(7,939)	15,983	(261,176)
Total accumulated depreciation	(3,810,649)	(161,062)	15,983	(3,955,728)
Total capital assets, being depreciated, net	4,238,516	(140,291)	0	4,098,224
Total capital assets, net	$ 4,334,293	$ (140,291)	$ 0	$ 4,194,001

NOTE 3: CUSTODIAL CREDIT RISK OF BANK DEPOSITS AND INVESTMENTS

Custodial credit risk is the risk that in the event of a bank failure, Walnut Ridge Water & Sewer Works deposits may not be returned to it. Walnut Ridge Water & Sewer Works deposit policy for custodial risk is compliant with bond requirements. At year end June 30, 2014, Walnut Ridge Water & Sewer Works had bank deposits in the amount of $458,366. Due to the dollar amounts of cash deposits and investments, and the limits of the Federal Deposit Insurance Corporation (FDIC), Walnut Ridge Water & Sewer Works is required to secure additional monies by pledging securities held by the pledging financial institution's trust department or agent at year end June 30, 2014. At year end June 30, 2015, Walnut Ridge Water & Sewer Works had bank deposits in the amount of $448,987. There were no unsecured funds at year end June 30, 2015

NOTE 4: RETIREMENT PLAN

The entity provides pension benefits for all of its full-time employees through the Employees Retirement Plan of the City Water Works of Walnut Ridge, Arkansas (the "Plan"). The Plan is a single-employer defined contribution plan and is administered by the Walnut Ridge Water & Sewer Works. The Plan is authorized and may be amended by the entity's City Council.

In a defined contribution plan, the benefits depend solely on amounts contributed to the plan, plus investment earnings. Employees are eligible to participate after a one-year exclusionary period. The entity contributes 8% of the employee's base salary each month. The entity's contributions for each employee (and interest allocated to the employee's account) are vested 20% annually for each year of participation. The matching contribution amount accrued for the 12 months ended June 30, 2015 and 2014 was $17,334 and $18,970 respectively.

NOTE 5: COMPENSATED ABSENCES

Vested or accumulated vacation, sick leave, and compensatory time are recorded as an expense and liability as the benefits accrue to employees, and are included as accrued compensated absences on the statements of financial position.

NOTE 6: LONG-TERM DEBT

	2015	2014
Regions Bank, note payable of $412,371, interest rate of 4.5%; principle and interest payable monthly beginning July 1, 2003; principle & interest payment of $2,278; matures December 1, 2029	$ 283,567	$ 297,665
2012 Debt Reserve Bond issue – USDA, 3.250%, $823,000; principal and interest payable monthly beginning July 30, 2011; principle & interest payment of $3,111; matures April 27, 2049	787,386	798,924
2012 Debt Reserve Bond issue - USDA, 3.250% $120,000: principle and interest payable monthly beginning July 30, 2011; principle & interest payment of $454; matures April 27, 2049	115,129	116,806
	$ 1,186,082	$ 1,213,395

All bonds are secured by revenues and water system of Walnut Ridge Water & Sewer Works.

NOTE 6: LONG-TERM DEBT (Continued)

Maturities and analysis of long-term debt changes to Walnut Ridge Water & Sewer Works long-term debt are as follows:

	2015	2014
Total long-term debt at beginning of year	$ 1,213,395	$ 1,239,692
Additonal borrowings	-	-
Note payable retirements	(27,313)	(26,297)
Total long-term debt at the end of the year, net	1,186,082	1,213,395
Less current portion	(28,390)	(27,313)
Non-current portion	$ 1,157,692	$ 1,186,082

Maturities of long-term debt at June 30, 2015 are as follows:

	Principal	Interest	Total
2016	$ 28,390	$ 41,726	$ 70,116
2017	29,511	40,605	70,116
2018	30,677	39,439	70,116
2019	31,891	38,225	70,116
2020	33,155	36,961	70,116
Thereafter	1,032,458	528,607	1,561,065
	$ 1,186,082	$ 725,563	$ 1,911,645

Interest expense was $42,398 for year ended June 30, 2015 and $43,766 for year ended June 30, 2014.

NOTE 7: BOND REQUIREMENTS

Walnut Ridge Water & Sewer Works must maintain certain requirements after receiving bonds from the United States Department of Agriculture (USDA). The bonds require that funds be established as described below.

The USDA issued the 3.25% 92 01 and 92 02 Debt Service Reserve & Short Lived Asset Reserve in the amount of $787,388 and $115,129 on July 30, 2011. Walnut Ridge Water & Sewer Works is required to deposit a sum equal to the installment of the principal and interest due on the next monthly installment payment plus the sum of $358 into the Debt Reserve Fund.

These funds with deposits in excess of the amounts insured by FDIC must be secured by bonds or other direct or fully guaranteed obligations of the United States of America.

NOTE 8: RISK MANAGEMENT AND LITIGATION

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NOTE 9: MONTHLY WATER RATES

Walnut Ridge Water & Sewer Works shall be determined by meter measurements. The consumption per month will be charged $5.90/1,000 gallons of water with a 1,000 gallon minimum per the rate increase in January 2014. Sewer charges are $3.50/1,000 gallons with a 1,000 gallon minimum, with next 1,000 gallons $3.50 thereafter all over 2,000 gallons at $4.40 per 1,000 per the rate increase in 2003.

NOTE 10: SUBSEQUENT EVENTS

Management has evaluated subsequent events through April 28, 2016, the date on which the financial statements were available to be issued.

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A PROFESSIONAL ASSOCIATION OF CERTIFIED PUBLIC ACCOUNTANTS
MEMBER OF THE PRIVATE COMPANIES PRACTICE SECTION OF THE AMERICAN INSTITUTE OF CERTIFIED PUBLIC ACCOUNTANTS

INDEPENDENT AUDITOR'S REPORT ON INTERNAL CONTROL OVER FINANCIAL REPORTING AND ON COMPLIANCE AND OTHER MATTERS BASED ON AN AUDIT OF FINANCIAL STATEMENTS PERFORMED IN ACCORDANCE WITH *GOVERNMENT AUDITING STANDARDS*

To the Board of Commissioners
Walnut Ridge Water & Sewer Works
Pocahontas, Arkansas

We have audited, in accordance with the auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards* issued by the Comptroller General of the United States, the financial statements of Walnut Ridge Water & Sewer Works as of and for the years ended June 30, 2015 and 2014, and the related notes to the financial statements as listed in the table of contents and have issued our report thereon dated April 28, 2016.

In planning and performing our audit of the financial statements, we considered Walnut Ridge Water & Sewer Works internal control over financial reporting (internal control) to determine the audit procedures that are appropriate in the circumstances for the purpose of expressing our opinions on the financial statements, but not for the purpose of expressing an opinion on the effectiveness of Walnut Ridge Water & Sewer Works internal control. Accordingly, we do not express an opinion on the effectiveness of the Walnut Ridge Water & Sewer Works internal control.

Our consideration of internal control was for the limited purpose described in the first paragraph of this section and was not designed to identify all deficiencies in internal control that might be material weaknesses or, significant deficiencies and therefore, material weaknesses or significant deficiencies may exist that were not identified. However, as discussed below, we identified a certain deficiency in internal control that we consider to be a material weakness.

A *deficiency in internal control* exists when the design or operation of a control does not allow management or employees, in the normal course of performing their assigned functions, to prevent, or detect and correct, misstatements on a timely basis. A *material weakness* is a deficiency, or a combination of deficiencies, in internal control, such that there is a reasonable possibility that a material misstatement of the entity's financial statements will not be prevented, or detected and corrected on a timely basis. A *significant deficiency* is a deficiency, or a combination of deficiencies, in internal control that is less severe than a material weakness, yet important enough to merit attention by those charged with governance. We consider the following deficiency to be a material weakness.

2015-1 To ensure proper safeguarding of assets, financial accounting duties relating to initiating, receipting, depositing, disbursing, and recording transactions should be distributed among appropriate employees. Walnut Ridge Water & Sewer Works management did not segregate these duties to sufficiently reduce the risks of fraud and error and properly safeguard assets, because of limited resources. We recommend that the financial accounting duties be segregated among employees to the extent possible.

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Compliance and Other Matters

As part of obtaining reasonable assurance about whether the Walnut Ridge Water & Sewer Works financial statements are free from material misstatement, we performed tests of its compliance with certain provisions of laws, regulations, contracts, and grant agreements, noncompliance with which could have a direct and material effect on the determination of financial statement amounts. However, providing an opinion on compliance with those provisions was not an objective of our audit, and accordingly, we do not express such an opinion. The results of our tests disclosed no instances of noncompliance or other matters that are required to be reported under *Government Auditing Standards.*

Purpose of this Report

The purpose of this report is solely to describe the scope of our testing of internal control and compliance and the results of that testing, and not to provide an opinion on the effectiveness of the entity's internal control or on compliance. This report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering the entity's internal control and compliance. Accordingly, this communication is not suitable for any other purpose.

Thomas, Speight & Noble, CPAs

Thomas, Speight & Noble, CPAs
Jonesboro, Arkansas
April 28, 2016

APPENDIX C

DETAILED COST ESTIMATES

CRIST JOB NO.
1618

City of Walnut Ridge
Arkansas 1874

PRELIMINARY ENGINEERING REPORT
WASTEWATER IMPROVEMENTS
JUNE 2018

Walnut Ridge Wastewater Treatment Plant

Annual Operating Cost

Permit (ADEQ)	$5,300
Permit Renewal	$5000
Lab Fees (Arkansas Testing)	$24,000
WETT Testing (Bio-Analytical)	$12,000
Water used (CL2)	$15,000
Electricity	$100,000
Chemicals (CL2, Sodium Bisulfite)	$3,900
Sludge Removal	$25,000
TOTAL:	**$185,200**

Crist Engineers, Inc.

Walnut Ridge Wastewater Treatment Improvements

Yard Piping Cost Estimates

June 4, 2018 (Update)

Crist Project No. *1618*

Item No.	Description	Quanity	Unit	Material Unit Cost	Unit Installation Cost (40%)	Total Unit Cost	Total Cost
Alternative No. 1 and Alternative No. 2							
1	12" Forcemain	120	LF	$ 25.12	$ 10.05	$ 35.17	$ 4,220.16
2	24" Ductile Iron	1275	LF	$ 60.06	$ 24.02	$ 84.08	$ 107,207.10
3	16" Ductile Iron	645	LF	$ 35.99	$ 14.40	$ 50.39	$ 32,498.97
4	8" Ductile Iron	270	LF	$ 18.00	$ 7.20	$ 25.20	$ 6,804.00
5	10" Air Piping (Stainless Steel Pipe, Fittings, and Valves)	500	LF	$ 28.60	$ 11.44	$ 40.04	$ 20,020.00
6	24" Plug Valve (Buried Service, Manual Operation)	2	EA	$ 4,290.00	$ 1,716.00	$ 6,006.00	$ 12,012.00
7	16" Plug Valve (Buried Service, Auto Operation)	5	EA	$ 2,900.00	$ 1,160.00	$ 4,060.00	$ 20,300.00
8	12" Plug Valve (Buried Serivce, Manual Operation)	1	EA	$ 1,600.00	$ 640.00	$ 2,240.00	$ 2,240.00
9	8" Plug Valve (Buried Service, Manual Operation)	2	EA	$ 1,075.00	$ 430.00	$ 1,505.00	$ 3,010.00
10	8" Plug Valve (Buried Service, Auto Operation)	2	EA	$ 1,450.00	$ 580.00	$ 2,030.00	$ 4,060.00
11	Ductile Iron MJ Fittings (15% Ductile Iron Total Cost)	1	LS	--	--	$ 22,609.53	$ 22,609.53
12	Additional Yard Piping (Drains)	1	LS	--	--	$ 35,247.26	$ 35,247.26
13	Bedding Material	280	TON	$ 21.43	$ 8.57	$ 30.00	$ 8,400.56
						Total Cost Estimate for Yard Piping, Alternative No. 1 and Alternative No. 2 (rounded-up)	**$ 278,630**
Alternative No. 3							
1	12" Forcemain	120	LF	$ 25.12	$ 10.05	$ 35.17	$ 4,220.16
2	24" Ductile Iron	1225	LF	$ 60.06	$ 24.02	$ 84.08	$ 103,002.90
3	8" Ductile Iron	350	LF	$ 18.00	$ 7.20	$ 25.20	$ 8,820.00
4	10" Air Piping (Stainless Steel Pipe, Fittings, and Valves)	500	LF	$ 28.60	$ 11.44	$ 40.04	$ 20,020.00
5	24" Plug Valve (Buried Service, Auto Operation)	4	EA	$ 4,680.00	$ 1,872.00	$ 6,552.00	$ 26,208.00
6	12" Plug Valve (Buried Serivce, Manual Operation)	1	EA	$ 1,600.00	$ 640.00	$ 2,240.00	$ 2,240.00
7	8" Plug Valve (Buried Service, Manual Operation)	4	EA	$ 1,075.00	$ 430.00	$ 1,505.00	$ 6,020.00
8	Ductile Iron MJ Fittings (15% Ductile Iron Total Cost)	1	LS	--	--	$ 17,406.46	$ 17,406.46
9	Additional Yard Piping (Drains)	1	LS	--	--	$ 28,190.63	$ 28,190.63
10	Bedding Material	220	TON	$ 21.43	$ 8.57	$ 30.00	$ 6,600.44
						Total Cost Estimate for Yard Piping, Alternative No. 3 (rounded-up)	**$ 222,730**
Alternative No. 4 and Alternative No. 5							
1	12" Forcemain	120	LF	$ 25.12	$ 10.05	$ 35.17	$ 4,220.16
2	24" Ductile Iron	1473	LF	$ 60.06	$ 24.02	$ 84.08	$ 123,855.73
3	16" Ductile Iron	400	LF	$ 35.99	$ 14.40	$ 50.39	$ 20,154.40
4	8" Ductile Iron	180	LF	$ 18.00	$ 7.20	$ 25.20	$ 4,536.00
5	10" Air Piping (Stainless Steel Pipe, Fittings, and Valves)	500	LF	$ 28.60	$ 11.44	$ 40.04	$ 20,020.00
6	24" Plug Valve (Buried Service, Manual Operation)	3	EA	$ 4,290.00	$ 1,716.00	$ 6,006.00	$ 18,018.00
7	16" Plug Valve (Buried Service, Auto Operation)	4	EA	$ 2,900.00	$ 1,160.00	$ 4,060.00	$ 16,240.00
8	16" Plug Valve (Buried Service, Manual Operation)	3	EA	$ 2,500.00	$ 1,000.00	$ 3,500.00	$ 10,500.00
9	12" Plug Valve (Buried Serivce, Manual Operation)	1	EA	$ 1,600.00	$ 640.00	$ 2,240.00	$ 2,240.00
10	8" Plug Valve (Buried Service, Manual Operation)	2	EA	$ 1,075.00	$ 430.00	$ 1,505.00	$ 3,010.00
11	8" Plug Valve (Buried Service, Auto Operation)	2	EA	$ 1,450.00	$ 580.00	$ 2,030.00	$ 4,060.00
12	Ductile Iron MJ Fittings (15% Ductile Iron Total Cost)	1	LS	--	--	$ 22,914.94	$ 22,914.94
13	Additional Yard Piping (Drains)	1	LS	--	--	$ 37,465.39	$ 37,465.39
14	Bedding Material	270	TON	$ 21.43	$ 8.57	$ 30.00	$ 8,100.54
						Total Cost Estimate for Yard Piping, Alternative No. 4 and Alternative No. 5 (rounded-up)	**$ 295,340**

Crist Engineers, Inc.

Walnut Ridge Wastewater Treatment Improvements

Alternative No. 1 (Davco) Cost Summary

June 4, 2018 (Update)

Crist Project No. *1618*

Alternative 1: Field-Erected SBR Package Plant by Evoqua (Davco)

Item No.	Description	Total Quanity	Unit	Unit Cost	Total Cost
1	New 5/8" Mech. Cleaned Bar Screen, Slide Gates, Reuse Ex. Concrete Channel	1	LS	$ 150,000	$ 150,000
2	WAS Pumps and Piping (at Spiltter Box)	1	LS	$ 80,000	$ 80,000
3	Field-Erected SBR Package Plant by Evoqua, 2 Basins	1	LS	$ 2,250,000	$ 2,250,000
4	Splitter Box No. 1 (Includes excavation, concrete, and weir gates)	1	LS	$ 53,250	$ 53,250
5	Structural Concrete Slab	1066	CY	$ 1,000	$ 1,066,000
6	Structural Support (Additional for partial bury) and Grout	1	LS	$ 30,000	$ 30,000
7	Dirt Work (Excavation, Fill, Haul, Disposal)	10656	CY	$ 20	$ 213,120
8	Blowers (100HP)	3	EA	$ 93,350	$ 280,050
9	Office/Lab/Blower/Chemical Feed Building	1400	SF	$ 120	$ 168,000
10	Modifications to Existing Chlorine Contact Basin	1	LS	$ 15,000	$ 15,000
11	Chlorination/Dechlorination System	1	LS	$ 225,000	$ 225,000
12	Yard Piping	1	LS	$ 278,630	$ 278,630
13	New 250 kW Generator	1	LS	$ 75,000	$ 75,000
14	Site Work (1% Subtotal)	1	LS	$ 43,000	$ 43,000
15	Electrical/Mechanical/Plumbing (5% of items E/M/P)	1	LS	$ 165,000	$ 165,000
16	6' Chain Link Fence	1600	LF	$ 25	$ 40,000
17	Decommissioning of Existing Units	1	LS	$ 25,000	$ 25,000
18	Miscellaneous & Incidental Work (2% Subtotal)	1	LS	$ 103,140	$ 103,140
19	Storm Water, Pollution Prev. Plan & Silt Control (0.5% Subtotal)	1	LS	$ 25,790	$ 25,790
20	Trench and Excavation Safety (1% Subtotal)	1	LS	$ 51,570	$ 51,570
21	Mobilization/Demobilization (7.5%)	1	LS	$ 386,800	$ 386,800
22	Contingency (10%)	1	LS	$ 515,700	$ 515,700
				Total Estimated Construction Cost	$ 6,240,050
				Engineering Cost (Design and Construction Admin./Inspection, 14%)	$ 873,700
				Total Estimated Capital Cost	**$ 7,113,750**

Crist Engineers, Inc.

Walnut Ridge Wastewater Treatment Improvements

Alternative No. 2 (Schreiber) Cost Summary

June 4, 2018 (Update)

Crist Project No. *1618*

Alternative 2: Field-Erected CSR Model GR Package Plant by Schreiber Corp.

Item No.	Description	Total Quanity	Unit	Unit Cost	Total Cost
1	New 5/8" Mech. Cleaned Bar Screen, Slide Gates, Reuse Ex. Concrete Channel	1	LS	$ 150,000	$ 150,000
2	WAS Pumps and Piping (at Spiltter Box)	1	LS	$ 80,000	$ 80,000
3	Field-Erected CSR Model GR Package Plant by Schreiber (40% added for install, incl blowers)	2	EA	$ 1,120,000	$ 2,240,000
4	Splitter Box No. 1 (Includes excavation, concrete, and weir gates)	1	LS	$ 53,250	$ 53,250
5	Structural Concrete Slab	1835	CY	$ 1,000	$ 1,835,000
6	Structural Conrete Walls (Vertical)	50	CY	$ 450	$ 22,500
7	Dirt Work (Excavation, Fill, Haul, Disposal)	18348	CY	$ 20	$ 366,960
8	Office/Lab/Blower/Chemical Feed Building	1400	SF	$ 120	$ 168,000
9	Modifications to Existing Chlorine Contact Basin	1	LS	$ 15,000	$ 15,000
10	Chlorination/Dechlorination System	1	LS	$ 225,000	$ 225,000
11	Yard Piping	1	LS	$ 278,630	$ 278,630
12	New 250 kW Generator	1	LS	$ 75,000	$ 75,000
13	Site Work (1% Subtotal)	1	LS	$ 49,000	$ 49,000
14	Electrical/Mechanical/Plumbing (5% of items E/M/P)	1	LS	$ 151,000	$ 151,000
15	6' Chain Link Fence	1600	LF	$ 25	$ 40,000
16	Decommissioning of Existing Units	1	LS	$ 25,000	$ 25,000
17	Miscellaneous & Incidental Work (2% Subtotal)	1	LS	$ 115,490	$ 115,490
18	Storm Water, Pollution Prev. Plan & Silt Control (0.5% Subtotal)	1	LS	$ 28,870	$ 28,870
19	Trench and Excavation Safety (1% Subtotal)	1	LS	$ 57,740	$ 57,740
20	Mobilization/Demobilization (7.5%)	1	LS	$ 433,100	$ 433,100
21	Contingency (10%)	1	LS	$ 577,400	$ 577,400
				Total Estimated Construction Cost	$ 6,986,940
				Engineering Cost (Design and Construction Admin./Inspection, 14%)	$ 978,200
				Total Estimated Capital Cost	**$ 7,965,140**

Crist Engineers, Inc.

Walnut Ridge Wastewater Treatment Improvements

Alternative No. 3 (EDI) Cost Summary

June 4, 2018 (Update)

Crist Project No. *1618*

Alternative 3: Partial Mix Aerated Lagoon by EDI

Item No.	Description	Total Quanity	Unit	Unit Cost	Total Cost
1	New 5/8" Mech. Cleaned Bar Screen, Slide Gates, Reuse Ex. Concrete Channel	1	LS	$ 150,000	$ 150,000
2	Partial Mix Aerated Lagoon Components (40% added for install)	1	EA	$ 560,000	$ 560,000
3	Lagoon HDPE Liner, 40 mil, single	353000	SF	$ 5	$ 1,765,000
4	Dirt Work (Excavation, Fill, Haul, Disposal)	129745	CY	$ 20	$ 2,594,900
5	Office/Lab/Maintenance/Blower/Chemical Feed Building	1400	SF	$ 120	$ 168,000
6	Modifications to Existing Chlorine Contact Basin	1	LS	$ 15,000	$ 15,000
7	Chlorination/Dechlorination System	1	LS	$ 225,000	$ 225,000
8	Yard Piping	1	LS	$ 222,730	$ 222,730
9	New 250 kW Generator	1	LS	$ 75,000	$ 75,000
10	Site Work (2% Subtotal)	1	LS	$ 112,000	$ 112,000
11	Electrical/Mechanical/Plumbing (5% of items E/M/P)	1	LS	$ 66,000	$ 66,000
12	6' Chain Link Fence	3600	LF	$ 25	$ 90,000
13	Decommissioning of Existing Units	1	LS	$ 25,000	$ 25,000
14	Miscellaneous & Incidental Work (2% Subtotal)	1	LS	$ 121,370	$ 121,370
15	Storm Water, Pollution Prev. Plan & Silt Control (0.5% Subtotal)	1	LS	$ 30,340	$ 30,340
16	Trench and Excavation Safety (1% Subtotal)	1	LS	$ 60,690	$ 60,690
17	Mobilization/Demobilization (7.5%)	1	LS	$ 455,100	$ 455,100
18	Contingency (10%)	1	LS	$ 606,900	$ 606,900
				Total Estimated Construction Cost	$ 7,343,030
				Engineering Cost (Design and Construction Admin./Inspection, 14%)	$ 1,028,100
				Total Estimated Capital Cost	**$ 8,371,130**

Crist Engineers, Inc.

Walnut Ridge Wastewater Treatment Improvements

14" Forcemain and Pump Station for Outfall at Black River Cost Summary

June 4, 2018 (Update)

Crist Project No. *1618*

Alternative Description: Forcemain to Black River

Item No.	Description	Total Quanity	Unit	Unit Cost	Total Cost
1	14" AWWA C-900 (PC200) PVC Forcemain, Open Cut	44616	LF	$ 30	$ 1,338,480
2	2" Vacuum/Air Release Valve Assembly	2	EA	$ 4,000	$ 8,000
3	14" Isolation Valve	2	EA	$ 3,640	$ 7,280
4	Package Pump Station (Q @ 4.75 MGD, Pumps: 2 @ 60 Hp and 2 @ 100 Hp)	1	LS	$ 1,000,000	$ 1,000,000
5	Electrical	1	LS	$ 50,764	$ 50,764
6	Pavement Repair	290	LF	$ 110	$ 31,900
7	18" Steel Encasement Pipe, Hwy. 412 Bore	100	LF	$ 300	$ 30,000
8	Creek Crossing	2	EA	$ 15,000	$ 30,000
9	Granular Bedding Material	4500	TON	$ 30	$ 135,000
10	Forcemain Route Clearing	1	LS	$ 40,154	$ 40,154
11	Forcemain Location Signs, every 1000-feet	45	EA	$ 35	$ 1,575
12	Site Work (1% Subtotal of Material Work)	1	LS	$ 27,000	$ 27,000
13	Acceptance Testing	44616	LF	$ 2.50	$ 111,540
14	Miscellaneous & Incidental Work (2% Subtotal of Material Work)	1	LS	$ 53,500	$ 53,500
15	Storm Water, Pollution Prev. Plan & Silt Control (0.5% Subtotal of Material Work)	1	LS	$ 13,400	$ 13,400
16	Trench and Excavation Safety (1% of Pipeline Cost)	1	LS	$ 13,400	$ 13,400
17	Permanent Easement Acquisition	1	LS	$ 178,000	$ 178,000
18	Mobilization/Demobilization (7.5%)	1	LS	$ 216,900	$ 216,900
19	Contingency (10%)	1	LS	$ 289,200	$ 289,200
				Total Estimated Construction Cost	$ 3,576,093
				Engineering Cost (Design and Construction Admin./Inspection, 14%)	$ 500,700
				Total Estimated Capital Cost	**$ 4,076,793**

Crist Engineers, Inc.

Walnut Ridge Wastewater Treatment Improvements

Alternative No. 4 (Lakeside CLR Process) Cost Summary

June 4, 2018 (Update)

Crist Project No. *1618*

Alternative 4: CLR Process by Lakeside with Clarifiers (by Lakeside)

Item No.	Description	Total Quanity	Unit	Unit Cost	Total Cost
1	New 5/8" Mech. Cleaned Bar Screen, Slide Gates, Reuse Ex. Concrete Channel	1	LS	$ 150,000	$ 150,000
2	RAS/WAS Pumps and Piping (at Splitter Box No. 2)	1	LS	$ 140,000	$ 140,000
3	Splitter Box No. 1 (Includes excavation, concrete, and weir gates)	1	LS	$ 53,250	$ 53,250
4	Splitter Box No. 2 (Includes excavation, concrete, and weir gates)	1	LS	$ 46,450	$ 46,450
5	CLR Process Components and Accessories (40% added for install)	1	LS	$ 531,400	$ 531,400
6	Clarifier Components and Accessories (40% added for install)	1	LS	$ 392,280	$ 392,280
7	Structural Concrete Slab and Grout - Oxidation Ditch	458	CY	$ 1,000	$ 458,000
8	Structural Concrete Vertical Walls - Oxidation Ditch	505	CY	$ 450	$ 227,250
9	Structural Concrete Slab and Grout - Clarifier	192	CY	$ 1,000	$ 192,000
10	Structural Concrete Vertical Walls - Clarifier	265	CY	$ 450	$ 119,250
11	Dirt Work (Excavation, Fill, Haul, Disposal)	7903	CY	$ 20	$ 158,060
12	Office/Lab/Chemical Feed Building	1200	SF	$ 120	$ 144,000
13	Modifications to Existing Chlorine Contact Basin	1	LS	$ 15,000	$ 15,000
14	Chlorination/Dechlorination System	1	LS	$ 225,000	$ 225,000
15	Yard Piping	1	LS	$ 295,340	$ 295,340
16	New 250 kW Generator	1	LS	$ 75,000	$ 75,000
17	Site Work (1% Subtotal)	1	LS	$ 33,000	$ 33,000
18	Electrical/Mechanical/Plumbing (5% of items E/M/P)	1	LS	$ 91,000	$ 91,000
19	6' Chain Link Fence	3600	LF	$ 25	$ 90,000
20	Decommissioning of Existing Units	1	LS	$ 25,000	$ 25,000
21	Miscellaneous & Incidental Work (2% Subtotal)	1	LS	$ 68,730	$ 68,730
22	Storm Water, Pollution Prev. Plan & Silt Control (0.5% Subtotal)	1	LS	$ 17,180	$ 17,180
23	Trench and Excavation Safety (1% Subtotal)	1	LS	$ 34,360	$ 34,360
24	Mobilization/Demobilization (7.5%)	1	LS	$ 257,700	$ 257,700
25	Contingency (10%)	1	LS	$ 343,600	$ 343,600
				Total Estimated Construction Cost	$ 4,182,850
				Engineering Cost (Design and Construction Admin./Inspection, 14%)	$ 585,600
				Total Estimated Capital Cost	**$ 4,768,450**

Crist Engineers, Inc.

Walnut Ridge Wastewater Treatment Improvements

Alternative No. 5 (WesTech Oxidation) Cost Summary

June 4, 2018 (Update)

Crist Project No. *1618*

Alternative 5: Oxidation by WesTech with Clarifiers (by WesTech)

Item No.	Description	Total Quanity	Unit	Unit Cost	Total Cost
1	New 5/8" Mech. Cleaned Bar Screen, Slide Gates, Reuse Ex. Concrete Channel	1	LS	$ 150,000	$ 150,000
2	RAS/WAS Pumps and Piping (at Splitter Box No. 2)	1	LS	$ 140,000	$ 140,000
3	Splitter Box No. 1 (Includes excavation, concrete, and weir gates)	1	LS	$ 53,250	$ 53,250
4	Splitter Box No. 2 (Includes excavation, concrete, and weir gates)	1	LS	$ 46,450	$ 46,450
5	OxyStrem™ BNR Components and Accessories (40% added for install)	1	LS	$ 581,700	$ 581,700
6	Future BNR Addition (40% added for install)	1	LS	$ 259,980	$ 259,980
7	Clarifier Components and Accessories (40% added for install)	1	LS	$ 322,000	$ 322,000
8	Structural Concrete Slab and Grout - Oxidation Ditch	741	CY	$ 1,000	$ 741,000
9	Structural Concrete Vertical Walls - Oxidation Ditch	669	CY	$ 450	$ 301,050
10	Structural Concrete Slab and Grout - Clarifier	192	CY	$ 1,000	$ 192,000
11	Structural Concrete Vertical Walls - Clarifier	261	CY	$ 450	$ 117,450
12	Dirt Work (Excavation, Fill, Haul, Disposal)	8103	CY	$ 20	$ 162,060
13	Office/Lab/Chemical Feed Building	1200	SF	$ 120	$ 144,000
14	Modifications to Existing Chlorine Contact Basin	1	LS	$ 15,000	$ 15,000
15	Chlorination/Dechlorination System	1	LS	$ 225,000	$ 225,000
16	Yard Piping	1	LS	$ 295,340	$ 295,340
17	New 250 kW Generator	1	LS	$ 75,000	$ 75,000
18	Site Work (1% Subtotal)	1	LS	$ 36,000	$ 36,000
19	Electrical/Mechanical/Plumbing (5% of items E/M/P)	1	LS	$ 98,000	$ 98,000
20	6' Chain Link Fence	3600	LF	$ 25	$ 90,000
21	Decommissioning of Existing Units	1	LS	$ 25,000	$ 25,000
22	Miscellaneous & Incidental Work (2% Subtotal)	1	LS	$ 80,910	$ 80,910
23	Storm Water, Pollution Prev. Plan & Silt Control (0.5% Subtotal)	1	LS	$ 20,230	$ 20,230
24	Trench and Excavation Safety (1% Subtotal)	1	LS	$ 40,450	$ 40,450
25	Mobilization/Demobilization (7.5%)	1	LS	$ 303,400	$ 303,400
26	Contingency (10%)	1	LS	$ 404,500	$ 404,500
				Total Estimated Construction Cost	$ 4,919,770
				Engineering Cost (Design and Construction Admin./Inspection, 14%)	$ 688,800
				Total Estimated Capital Cost	**$ 5,608,570**

Crist Engineers, Inc.

Walnut Ridge Wastewater Treatment Improvements

Alternative No. 1 (Davco) Cost Summary

June 4, 2018 (Update)

Crist Project No. *1618*

PRESENT WORTH

Alternative 1: Field-Erected SBR Package Plant by Evoqua (Davco)

Item No.	Description			Total Cost
1	Construction Cost (without Contingency (10%), "Non-Construction Cost")			$ 5,724,350
2	Non-Construction Cost, includes:			
	A. Contingency (10%)			$ 515,700
	Subtotal Construction and Non-Construction Costs			$ 6,240,050
3	Engineering Cost (Final Design and Construction Admin./Inspection, 14%)			$ 873,700
	Total Initial Capital Cost			***$ 7,113,750***
4	Annual O&M Cost			$ 331,165
	A. Maintenance & Replacement			$ 85,865
	B. Utilities Cost (Lab Fees, Water, Electricity, Chemicals, Testing)			$ 154,050
	C. Sludge Disposal ($25,000/1.5 MG)			$ 91,250
5	20-Year Present Worth of Annual O&M Costs			$ 5,042,753
	Calculation: Annual O&M Cost multiplied by the uniform series present worth factor for 2.75% for 20-years.	*Uniform Series Present Worth Factor =*	*15.2273*	
6	20-Year Present Worth of Salvage Value (30-Year Service Life)			$ 1,378,289
	Calculation: Salvage Value multiplied by the single payment present worth factor for 2.75% and 20-years.	*Single Payment Present Worth Factor =*	*0.58125*	
		Future Salvage Value =	*$ 2,371,250*	
7	Scrap Value of Existing Plant Components			$ 25,000
	Total 20-Year Present Worth Cost			**$ 10,753,214**

Crist Engineers, Inc.

Walnut Ridge Wastewater Treatment Improvements

Alternative No. 2 (Schreiber) Cost Summary

June 4, 2018 (Update)

Crist Project No. *1618*

PRESENT WORTH

Alternative 2: Field-Erected CSR Model GR Package Plant by Schreiber Corp.

Item No.	Description			Total Cost
1	Construction Cost (without Contingency (10%), "Non-Construction Cost")			$ 6,409,540
2	Non-Construction Cost, includes:			
	A. Contingency (10%)			$ 577,400
		Subtotal Construction and Non-Construction Costs		$ 6,986,940
3	Engineering Cost (Final Design and Construction Admin./Inspection, 14%)			$ 978,200
		Total Initial Capital Cost		***$ 7,965,140***
4	Annual O&M Cost			$ 285,554
	A. Maintenance & Replacement			$ 96,143
	B. Utilities Cost (Lab Fees, Water, Electricity, Chemicals, Testing)			$ 98,161
	C. Sludge Disposal ($25,000/1.5 MG)			$ 91,250
5	20-Year Present Worth of Annual O&M Costs			$ 4,348,220.99
	Calculation: Annual O&M Cost multiplied by the uniform series present worth factor for 2.75% for 20-years.	*Uniform Series Present Worth Factor =*	*15.2273*	
6	20-Year Present Worth of Salvage Value (30-Year Service Life)			$ 1,543,246
	Calculation: Salvage Value multiplied by the single payment present worth factor for 2.75% and 20-years.	*Single Payment Present Worth Factor =*	*0.58125*	
		Future Salvage Value =	*$ 2,655,047*	
7	Scrap Value of Existing Plant Components			$ 25,000
		Total 20-Year Present Worth Cost		**$ 10,745,115**

Crist Engineers, Inc.

Walnut Ridge Wastewater Treatment Improvements

Alternative No. 3 (EDI) Cost Summary

June 4, 2018 (Update)

Crist Project No. *1618*

PRESENT WORTH

Alternative 3: Partial Mix Aerated Lagoon by EDI

Item No.	Description			Total Cost
1	Construction Cost (without Contingency (10%), "Non-Construction Cost")			$ 6,736,130
2	Non-Construction Cost, includes:			
	A. Contingency (10%)			$ 606,900
		Subtotal Construction and Non-Construction Costs		$ 7,343,030
3	Engineering Cost (Final Design and Construction Admin./Inspection, 14%)			$ 1,028,100
		Total Initial Capital Cost		***$ 8,371,130***
4	Annual O&M Cost			$ 297,023
	A. Maintenance & Replacement			$ 101,042
	B. Utilities Cost (Lab Fees, Water, Electricity, Chemicals, Testing)			$ 104,731
	C. Sludge Disposal ($25,000/1.5 MG)			$ 91,250
5	20-Year Present Worth of Annual O&M Costs			$ 4,522,861
	Calculation: Annual O&M Cost multiplied by the uniform series present worth factor for 2.75% for 20-years.	*Uniform Series Present Worth Factor =*	*15.2273*	
6	20-Year Present Worth of Salvage Value (30-Year Service Life)			$ 1,621,906
	Calculation: Salvage Value multiplied by the single payment present worth factor for 2.75% and 20-years.	*Single Payment Present Worth Factor =*	*0.58125*	
		Future Salvage Value =	*$ 2,790,377*	
7	Scrap Value of Existing Plant Components			$ 25,000
		Total 20-Year Present Worth Cost		**$ 11,247,084**

Crist Engineers, Inc.

Walnut Ridge Wastewater Treatment Improvements

14" Forcemain and Pump Station for Outfall at Black River Cost Summary

June 4, 2018 (Update)

Crist Project No. *1618*

PRESENT WORTH

Alternative Description: Forcemain to Black River

Item No.	Description			Total Cost
1	Construction Cost (without Contingency (10%), "Non-Construction Cost")			$ 3,286,893
2	Non-Construction Cost, includes:			
	A. Contingency (10%)			$ 289,200
		Subtotal Construction and Non-Construction Costs		$ 3,576,093
3	Engineering Cost (Final Design and Construction Admin./Inspection, 14%)			$ 500,700
		Total Initial Capital Cost		***$ 4,076,793***
4	Annual O&M Cost			$ 49,303
5	20-Year Present Worth of Annual O&M Costs			$ 750,757.68
	Calculation: Annual O&M Cost multiplied by the uniform series present worth factor for 2.75% for 20-years.	*Uniform Series Present Worth Factor =*	*15.2273*	
		Total 20-Year Present Worth Cost		**$ 4,827,551**

Crist Engineers, Inc.

Walnut Ridge Wastewater Treatment Improvements

Alternative No. 4 (Lakeside CLR Process) Cost Summary

June 4, 2018 (Update)

Crist Project No. *1618*

PRESENT WORTH

Alternative 4: CLR Process by Lakeside with Clarifiers (by Lakeside)

Item No.	Description			Total Cost
1	Construction Cost (without Contingency (10%), "Non-Construction Cost")			$ 3,839,250
2	Non-Construction Cost, includes:			
	A. Contingency (10%)			$ 343,600
		Subtotal Construction and Non-Construction Costs		$ 4,182,850
3	Engineering Cost (Final Design and Construction Admin./Inspection, 14%)			$ 585,600
		Total Initial Capital Cost		***$ 4,768,450***
4	Annual O&M Cost			$ 296,669
	A. Maintenance & Replacement			$ 57,589
	B. Utilities Cost (Lab Fees, Water, Electricity, Chemicals, Testing)			$ 147,830
	C. Sludge Disposal ($25,000/1.5 MG)			$ 91,250
5	20-Year Present Worth of Annual O&M Costs			$ 4,517,470.15
	Calculation: Annual O&M Cost multiplied by the uniform series present worth factor for 2.75% for 20-years.	*Uniform Series Present Worth Factor =*	*15.2273*	
6	20-Year Present Worth of Salvage Value (30-Year Service Life)			$ 923,887
	Calculation: Salvage Value multiplied by the single payment present worth factor for 2.75% and 20-years.	*Single Payment Present Worth Factor =*	*0.58125*	
		Future Salvage Value =	*$ 1,589,483*	
7	Scrap Value of Existing Plant Components			$ 25,000
		Total 20-Year Present Worth Cost		**$ 8,337,033**

Crist Engineers, Inc.

Walnut Ridge Wastewater Treatment Improvements

Alternative No. 5 (WesTech Oxidation) Cost Summary

June 4, 2018 (Update)

Crist Project No. *1618*

PRESENT WORTH

Alternative 5: Oxidation by WesTech with Clarifiers (by WesTech)

Item No.	Description			Total Cost
1	Construction Cost (without Contingency (10%), "Non-Construction Cost")			$ 4,515,270
2	Non-Construction Cost, includes:			
	A. Contingency (10%)			$ 404,500
		Subtotal Construction and Non-Construction Costs		$ 4,919,770
3	Engineering Cost (Final Design and Construction Admin./Inspection, 14%)			$ 688,800
		Total Initial Capital Cost		***$ 5,608,570***
4	Annual O&M Cost			$ 305,627
	A. Maintenance & Replacement			$ 67,729
	B. Utilities Cost (Lab Fees, Water, Electricity, Chemicals, Testing)			$ 146,648
	C. Sludge Disposal ($25,000/1.5 MG)			$ 91,250
5	20-Year Present Worth of Annual O&M Costs			$ 4,653,871.73
	Calculation: Annual O&M Cost multiplied by the uniform series present worth factor for 2.75% for 20-years.	*Uniform Series Present Worth Factor =*	*15.2273*	
6	20-Year Present Worth of Salvage Value (30-Year Service Life)			$ 1,086,660
	Calculation: Salvage Value multiplied by the single payment present worth factor for 2.75% and 20-years.	*Single Payment Present Worth Factor =*	*0.58125*	
		Future Salvage Value =	*$ 1,869,523*	
7	Scrap Value of Existing Plant Components			$ 25,000
		Total 20-Year Present Worth Cost		**$ 9,150,781**

Appendix D

Design Criteria and Design Information

Crist Job No.
1618

Preliminary Engineering Report
Wastewater Improvements
June 2018

Walnut Ridge, Arkansas, Crist Job No. 1618

WWTP Chlorine Contact Basin Capacity Calculations Summary

December 11, 2017

Plans from construction of basin (see note 4 on sheet WR-9208) state the following: "Chlorination Basin has a volume of 50,150 gallons, which will provide detention time of 18.8-minutes at peak flow rate and 60 minutes at average design flow."

Flow Rate (Peak): 3.84 MGD (Design)
Flow Rate (Average): 1.176 MGD (Design)
Water Depth (Peak): 10.21-feet (94.22-feet MSL)

A. Determine Maximum Capacity of Chlorine Contact Basin, based only on Freeboard Depth

Ten State Standards: A minimum contact time of 15 minutes at design peak hourly flow or maximum rate of pumpage shall be provided after thorough mixing. (mixing: turbulent flow or mechanical mixer).

****Per 100-3, Part 102.44: For evaluation of existing chlorine contact tanks, field tracer studies should be done to assure adequate contact time.*

****Total Residual Chlorine limit modified with permit renewal, **from 0.1 mg/L to 0.011 mg/L**, see 12.A.1 of Fact Sheet in Permit.*

1. Determine Limiting Factors:

a. Interior Suppressed Weir Elevations: 93.5 FT
Maximum Allowable Head Over 5-foot suppressed weir: 2.5 FT
Maximum Water Depth at Suppressed Weirs = 96 FT
Water Depth in Basin = 96FT – 84FT = 12-feet

b. Interior Baffle Walls Elevation: 95.5 FT
With 1' Freeboard = 94.5 FT
With 1.5' Freeboard = 94.0 FT
Water Depth in Basin, 1' FB = 94.5FT – 84FT = 10.5-feet
Water Depth in Basin, 1.5' FB = 94.0FT – 84FT = 10.0-feet

c. V-Notch Weir (90-degrees) at Effluent Elevation: 91.5 FT (bottom), 93.5 FT (top)
Maximum Allowable Head Over 90-Degree V-Notch Weir: 2.0 FT
Maximum Water Depth at V-Notch Weir = 91.5FT + 2.0FT = 93.5FT

2. Determine Maximum Depth:

Since Elevation of 96.0 FT is > Elevation of interior baffle walls of 95.5 FT, Discard depth of 12 FT.
Maximum Elevation at Interior Baffle Walls of 94.5 FT or 94 FT
Maximum Allowable Head over V-notch Weir, Elevation: 93.5 FT

Cannot Discard due to Elevation at V-notch Weir because it can be replaced at a higher elevation. Maximum water depth allowed with current structure = 10.5 feet. Effluent area of contact basin has dechlorination and aeration, do not use for calculations.

Minimum allowable contact time (per 10 State Standards) = 15 minutes

3. Depth of Interior Weir Walls, each end of Baffled Area: 9.5-feet (Elev. 93.5-feet MSL)

Area 1 Dimensions:	Width: 8-feet	Length: 18-feet
Area 2 Dimensions:	Width: 16-feet	Length: 32-feet

4. Determine Maximum Flow Rate:

At 10.5 feet: Area = 5376 CF	Q = 459 CFM (4.95 MGD)
At 10.0 feet: Area = 5120 CF	Q = 437 CFM (4.71 MGD)
At 9.5 feet: Area = 4864 CF	Q = 415 CFM (4.475 MGD)

Conclusion No. 1: Based only on volume and the minimum allowable contact time of 15-minutes, the Maximum Flow Rate Range:

4.475 MGD to 4.95 MGD

- ***Consideration of Permit Conditions, not part of these calculations: Total Residual Chlorine = 0.011 mg/L and Fecal Coliform Limit (200#/100ML or 400#/100ML).***

B. Determine Maximum Capacity of Chlorine Contact Basin, based on Actual Contact Time

Ten State Standards: A minimum contact time of 15 minutes at design peak hourly flow or maximum rate of pumpage shall be provided after thorough mixing. (mixing: turbulent flow or mechanical mixer).

****Per 100-3, Part 102.44: For evaluation of existing chlorine contact tanks, field tracer studies should be done to assure adequate contact time.*

****Total Residual Chlorine limit modified with permit renewal,* ***from 0.1 mg/L to 0.011 mg/L****, see 12.A.1 of Fact Sheet in Permit.*

1. Flow Rate for Future Design:

Q1 = 3.0 MGD (4.64 CFS)
Q2 = 3.5 MGD (5.415 CFS)
Q3 = 4.0 MGD (6.19 CFS)

2. Calculate Required Volume for Flow Rates, based on minimum Chlorine Contact Time (15 minutes):

For Q1 (@3.0 MGD): 4176 CF (31,239 Gal)
For Q2 (@3.5 MGD): 4874 CF (36,460 Gal)
For Q3 (@4.0 MGD): 5571 CF (41,674 Gal)

3. Calculate Water Depth at Flow Rates:

**Suppressed 5-foot Weirs at inlet and outlet of baffle area. Water depth will vary depending on the headloss over the two suppressed weirs. Suppressed weir wall (both) depth is 9.5-feet.*

Headloss Q1: H = 0.43-feet	Water Depth = 9.93-feet
Headloss Q2: H = 0.47-feet	Water Depth = 9.97-feet
Headloss Q3: H = 0.52-feet	Water Depth = 10.02-feet

4. Calculate Depth/Width (D/W) for each Flow Rate:

Channel Width1 = 5-feet (Two 5-foot wide channels)
Channel Width2 = 6-feet (One 6-foot wide channel)

Q1 @ 3.0 MGD	Depth = 9.93-feet	D/W @ 5' = 1.986	D/W @ 6' = 1.66
Q2 @ 3.5 MGD	Depth = 9.97-feet	D/W @ 5' = 1.99	D/W @ 6' = 1.66
Q3 @ 4.0 MGD	Depth = 10.02-feet	D/W @ 5' = 2.00	D/W @ 6' = 1.67

D/W Ratio Range: 1.66 to 2.00 > 1.0, Not Adequate Design

Note: Maximum allowable depth from Part A is 10.5-feet (94.5-Feet MSL), with 1-foot freeboard. D/W ratio should be 1.0 or less in chlorine disinfection basins. The drag on the sides of a deep, narrow tank or channel causes relatively poor dispersion characteristics.

5. Calculate Cross-Section Areas (Required) using Water Depths calculated in Step B3:

@ 3.0 MGD (9.93'):	Cross-Section @ 5' = 49.65 SF	Cross-Section @ 6' = 59.58 SF
@ 3.5 MGD (9.97'):	Cross-Section @ 5' = 49.85 SF	Cross-Section @ 6' = 59.82 SF
@ 4.0 MGD (10.02'):	Cross-Section @ 5' = 50.10 SF	Cross-Section @ 6' = 60.12 SF

6. Calculate Total Length (Required), using the Volume calculated in Step B2:

@ 3.0 MGD, Volume Q1 = 4176 CF	@ 5-feet Width: 84'	@ 6-feet Width: 70'
@ 3.5 MGD, Volume Q2 = 4874 CF	@ 5-feet Width: 98'	@ 6-feet Width: 81.5'
@ 4.0 MGD, Volume Q3 = 5571 CF	@ 5-feet Width: 111'	@ 6-feet Width: 93'

7. Calculate Actual Length of Chlorine Contact Basin, Area 2 (Baffled Area) Plus Area 1 (Influent):

*Note: Length of Baffled Area of Basin is 32-feet, total existing length is 32-feet * 3 channels = 96-feet. Basin influent area length is 18-feet (width 8-feet), total existing length is 96-feet + 18-feet = 114-feet.*

Total Existing Length of Influent and Baffle Area of Contact Basin: 114-feet

8. Calculate the exiting L/W Value:

Length (Baffle Area Only): 96-feet

Average Channel Width: 5.333-feet

L/W Ratio: 96-feet / 5.333-feet = 18.0 < 40 to 70, Not Adequate Design

Note: Adequate plug-flow tanks can be achieved by Length/Width (L/W) ratios of 40-70 to 1.

Wastewater Treatment Plant Improvements
Sludge Production & Storage Calculations

SLUDGE PRODUCTION

INITIAL SLUDGE PRODUCTION, 2017

SLUDGE PRODUCTION: The average sludge produced per day in pounds is assumed as 1,043 lb/day.

SLUDGE PRODUCTION CHECK: MOP 8 uses pounds per capita per day to determine theoretical solid retention time. Conservatively, the following calculation omits commercial and industrial water meters when determining water customers.

Assumed Solids Retention Time = 17 days

2017 Walnut Ridge Population Estimate = 4,757 people

2037 Walnut Ridge Population Estimate = 6,691 people

Equation #1 Pounds per capita per day (2017) = Avg. sludge production per day/
Population
(customers)
= 1,043 lb/day / 4,757 customers
= 0.219 lb/capita·day

Metcalf-Eddy finds that 0.2087 lb/capita·day equates to a solid retention time of 15 days and 0.1947 lb/capita·day equates to a solid retention time of 20 days. The theoretical solid retention times above correspond with assumed solid retention time of 17 days; therefore:

Sludge Production, yr 2017 = 1,043 lb/day
= 7,301 lb/wk
= 380,695 lb/yr (190 ton/yr)

PROJECTED SLUDGE PRODUCTION, 2037

The population estimate of Walnut Ridge in year 2037 is 6,691.

Equation #2 Sludge Production, yr 2037 = Pounds per capita per day (Eq. # 1) x
Population
= 0.219 lb/capita·day x 6,691 capita
= 1,465 lb/day
= 10,257 lb/wk
= 534,845 lb/yr (267 ton/yr)

INITIAL WET SLUDGE VOLUME, 2017

Daily Sludge Volume is assumed to be 0.8%to 1.2% of Daily Total Solids Produced (TS). The unit weight of sludge is assumed to be 65 lb/ft^3.

Equation #3 Daily Wet Sludge Weight = 1 day x Initial Weekly Sludge production / working days / (%TS/100)
= 1 day x 7,301 lb/wk / 7 days / (0.8/100)
= 130,375 lb

Equation #4 Daily Wet Sludge Volume = Daily Wet Weight (Eq. #3) / Unit Weight
= 130,375 lb / 65 lb/ft^3
= 2,006 ft^3

Equation #5 Daily Wet Sludge Volume = Volume (Eq. #4) x (7.48 gallons/ft^3)
= 15,006 gallons per day (gpd) (5.5 MG/yr)

Frequency of Sludge Removal = 5.5 MG/yr / 1.5 MG = 3.66 times per year

Equation #3 Daily Wet Sludge Weight = 1 day x Initial Weekly Sludge production / working days / (%TS/100)
= 1 day x 7,301 lb/wk / 7 days / (1.2/100)
= 86,917 lb

Equation #4 Daily Wet Sludge Volume = Daily Wet Weight (Eq. #3) / Unit Weight
= 86,917 lb / 65 lb/ft^3
= 1,337 ft^3

Equation #5 Daily Wet Sludge Volume = Volume (Eq. #4) x (7.48 gallons/ft^3)
= 10,001 gallons per day (gpd) (3.65 MG/yr)

Frequency of Sludge Removal = 3.65 MG/yr / 1.5 MG = 2.5 times per year

Alternative 1

Field-Erected Extended Aeration Package Plant by Evoqua (Davco)

Crist Job No.
1618

City of Walnut Ridge
Arkansas 1879

Preliminary Engineering Report
Wastewater Improvements
June 2018

From: Chad Cooley
To: Craig Johnson
Subject: Walnut Ridge, AR - WWTP
Date: Thursday, October 12, 2017 4:49:46 PM
Attachments: Walnut Ridge, AR WWTP - Evoqua FETP - Budget Proposal.pdf
E18-26577 Walnut Ridge WWTP Blower Scope.pdf
GM 090S DN-250 P A SE GB-005917 revB.pdf
Continental Budget Proposal Walnut Ridge AR WWTP.pdf
TDS US MODEL 77.pdf

Craig –

God afternoon. Please find attached a budget proposal from Evoqua Water Technologies to provide two (2) parallel Davco Field Erected Treatment Plants (FETP's) for the referenced project, per your request. Note the proposal includes a detailed scope of supply, design summary and a sketch of the proposed layout. Please also note the following options to this configuration:

- These plants can be installed below grade, if desired, but will require additional structural support for the exterior walls. We can have Davco evaluate this, but it will likely result in a slight increase to the budget prices listed below.
- The digesters can be eliminated, if you prefer to use existing facilities for this purpose. Such elimination will lower the budget prices below by about 10%.

I have also attached blower proposals from both Aerzen (PD) and Continental (Multi-Stage), to give you a couple of blower options for the project. The budget prices for all of the equipment described therein is listed below.

Budget Pricing:

- Two (2) parallel 625,000 gpd FETP from Davco: **$2,250,000**
- Three (3) 125-HP PD blowers from Aerzen: **$ 300,000**
- Three (3) 100-HP M-S blowers from Continental: **$ 200,000**

The budget price for a Davco FETP with Aerzen blowers is **$2,550,000**.

The budget price for a Davco FETP with Continental blowers is **$2,450,000**.

Please review the attached proposal at your convenience If you have any questions, or require additional information, please do not hesitate to contact me. We appreciate your continued interest in ETEC and the manufacturers we represent.

Thanks,
Chad B. Cooley, P.E.
Vice President
Environmental Technical Sales, Inc.
900 S. Shackleford, Suite 300
Little Rock, AR 72211
Phone: (501) 978-1025 Fax: (501) 978-1026
Cell: (501) 690-3721
http://etec-sales.com/
E-mail: ccooley@etec-sales.com

EVOQUA BUDGET PROPOSAL

EVOQUA WATER TECHNOLOGIES LLC
1828 METCALF AVE
THOMASVILLE, GA 31792

TELEPHONE 229-227-8706
FACSIMILE 229-228-0312

TO	**Chad Cooley (ETEC)**	**CC**	**Jimmy Speigner**	**P#180008-A0**
CELL	**501-690-3721**	**TEL**	**501-978-1025**	
FROM	**Mike Bennett**	**DATE**	**10-10-2017**	**PAGE 1 OF 4**
SUBJECT	**Walnut Ridge, AR WWTP (1,250,000 GPD)**			

MESSAGE

Budget price to manufacture, deliver, unload, field erect, field paint, and start-up two (2) mirror image 625,000 GPD above ground extended aeration ring steel Davco™ field erected WWTP's is $ **Rep to advise** dollars.

Note: The scope of supply and pricing is based on EVOQUA's standard equipment selection, standard terms of sale and warranty terms. Any variations from these standards may affect this budgetary proposal. Additionally, please note that this budgetary proposal is for review and informational purposes only and does not constitute an offer for acceptance.

Items included in above pricing for each WWTP:

Hydrostatic steel inner & outer tank walls for each plant
Two (2) hydrostatic steel bulkheads with center kick-braces for each plant
304SS influent box with a 304SS manual clean bar screen and drying deck for each plant
Plant air distribution system with 304SS diffuser drop-pipes for each plant
Fine bubble flexible membrane diffusers for aeration zone in each plant
Coarse bubble diffusers for aerobic sludge digester zone in each plant
Clarifier effluent launderer and scum baffle for each plant
Clarifier scum control system for each plant
Clarifier sludge collector mechanism with ½ HP chain & sprocket drive for each plant
RAS/WAS system with sludge airlift and 304SS splitter box for each plant
4" Digester supernatant return airlift for each plant
Main access bridge with aluminum handrails, toeplates and bar grating for each plant
Equipment access walkways with aluminum handrails, toeplates and bar grating for each plant
One (1) access stairway w/intermediate landing, aluminum handrails and stair treads
Interconnecting bridge between plants with aluminum handrails, toeplates and bar grating
Plant clarifier controls in a NEMA 4X 304SS UL stamped enclosure for each plant
3 mils DFT epoxy primer & 6 mils DFT epoxy topcoat inside & out of each plant

EVOQUA BUDGET PROPOSAL

EVOQUA WATER TECHNOLOGIES LLC
1828 METCALF AVE
THOMASVILLE, GA 31792

TELEPHONE 229-227-8706
FACSIMILE 229-228-0312

Items not included in above pricing for WWTP:

Sitework with concrete slabs and clarifier grout
Raw sewage influent pump station with force main to each WWTP
WWTP final effluent outfall line
Interconnecting yard piping and valves
Plant blowers & blower controls
Piping from plant blowers to each WWTP air header connection
Mechanical screen and grit removal system
Comminutor
Odor control system
Disinfection equipment (UV or Chlorination)
Main electrical distribution panel
Standby power generator with automatic transfer switch
Main power line from power pole to main electrical distribution panel
Power lines from main electrical distribution panel to each WWTP panel
Plant & area lighting
On plant field run electrical conduit and wiring
3 phase electrical disconnect switches
Mechanical sludge dewatering with chemical feed
Sludge drying beds
Operation's building
Roads, site fencing and holding ponds
Landscaping with trees, shrubs, & grass seeding
State permitting
Performance and payment bond
Contractor's markup
Taxes of any kind

EVOQUA WATER TECHNOLOGIES LLC

Walnut Ridge, AR WWTP
DAVCO BIOLOGICAL TREATMENT SYSTEMS
PRELIMINARY DESIGN SUMMARY
October 10, 2017

Rev No: 0
Prep By: Mike Bennett
Proposal #: 180008-A0D1

I. DESIGN BASIS:

**Sizing represents one of two equal-sized plants operated in parallel.*

Total Design Flow: 1.250 MGD
Design Flow/FETP (Q): 0.625 MGD
Peaking Factor: 3.0
Total Peak Flow: 3.750 MGD
Peak Flow/FETP: 1.875 MGD

	Influent	
	Conc. (mg/L)	Load/FETP (lbs/day)
BOD	250	1,303
TSS	250	1,303
NH3-N	30	156
TKN	40	209
NO3-N	--	--
TP	7	36

	Secondary Clarifier Effluent		
	Conc. (mg/L)	Expected (mg/L)	
CBOD	10.0	< 10.0	*
TSS	15.0	< 15.0	*
NH3-N	4.0	< 4.0	
TN		not req'd	
NO3-N		not req'd	
TP		not req'd	

**** Chemical addition and/or filtration may be required.***

Maximum Wastewater Temperature: 20 °C 68 °F
Minimum Wastewater Temperature: 10 °C 50 °F
Site Elevation: 269 ft. MSL

Use NO3 or TN for design? None

II. PROCESS ASSUMPTIONS & VARIABLES:

Influent VSS Fraction: 80%
Design MLSS: 3,500 mg/L
% MLVSS: 75%
Design MLVSS: 2,625 mg/L
Biosolids Yield Factor: 0.65 lbsVSS/lbsBOD
Design DO Conc: 2.0 mg/L
RAS Rate, %Q: 50%
Max Water Level (Bio): 15.000 ft
Freeboard (Bio): 1.500 ft

Recommended Clarifier Hydraulic Loading: 1,000 gpd/ft2 (at Peak flow)

III. PROCESS DESIGN PARAMETERS:

Aeration Basin 282.5 °

Number of Aeration Basins:	1	Aerobic Volume per Basin:	630,657 gallons
Total Aerobic Volume:	630,657 gallons	AOR:	2,588 lbs. O2/day
Aerobic SRT:	17.0 days	SOR:	7,620 lbs. O2/day*
Aerobic HRT:	24.2 hours @ Q	Air Flow Required:	1,207 SCFM*
BOD Loading:	15.5 lbs BOD/1000cf/day	Aeration Diffuser Type:	Fine Bubble
Aerobic F/M:	0.094 lbs BOD/lbs MLVSS	**Diffuser supplier to confirm SOR/SCFM values at final design*	

Secondary Clarifier

Clarifier Diameter:	51.50 feet	Surface Overflow Rate:	300 gpd/ft^2 (avg)
Sludge Production:	1,043 lbs/day		900 gpd/ft^2 (peak)
Clarifier Surface Area:	2,083.1 ft^2	Solids Loading Rate:	13 lb/day/ft^2 (avg)
Total Clarifier Volume:	192,102 gallons		39 lb/day/ft^2 (peak)

Aerobic Digester 77.5 °

Number of Digester Basins:	1	Digester Volume per Basin:	173,012 gallons
Digester Volume:	173,012 gallons	Air Flow Required:	694 SCFM*
Digester SRT:	30.1 days	**Assumes 30 SCFM/1000 cuft & coarse bubble*	

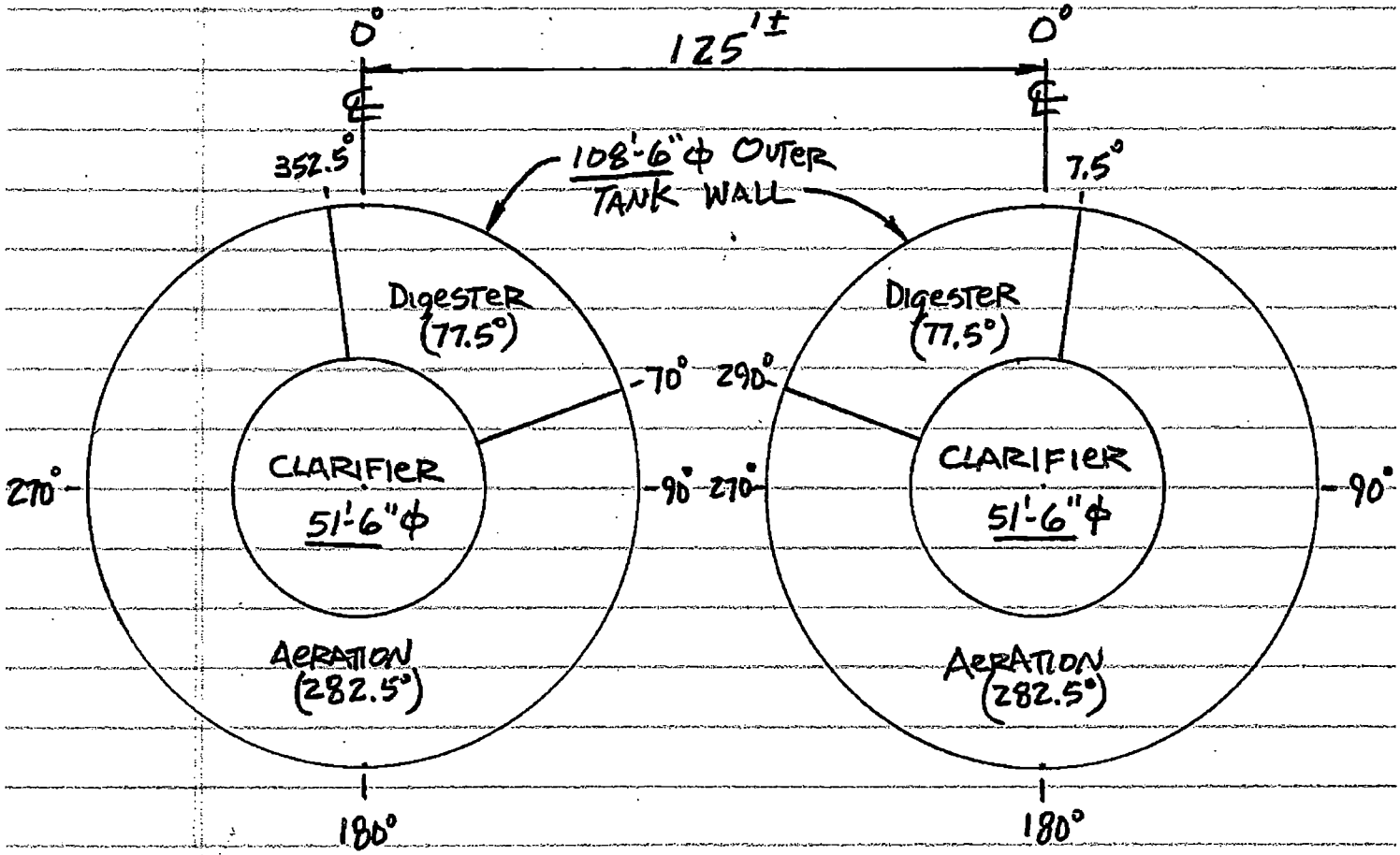
Tank Sizing & Air Flow

Plant O.W. Diameter:	108.50 feet	Total SCFM Required*:	1,901 SCFM	Per Plant
Plant I.W. Diameter:	51.50 feet	**Excluding Airlifts*	59 SCFM	Per Plant
Bulkhead Length:	28.50 feet	Total SCFM w/ Airlifts	1,960 SCFM	Per Plant
Total Bio Process (no EQ) Volume:	0.631 MG			

Note: In order to guarantee the process, all values for Design Basis, Process Assumptions and Process Parameters must be verified by Owner/Consultant prior to final design.

WALNUT Ridge, AR WWTP

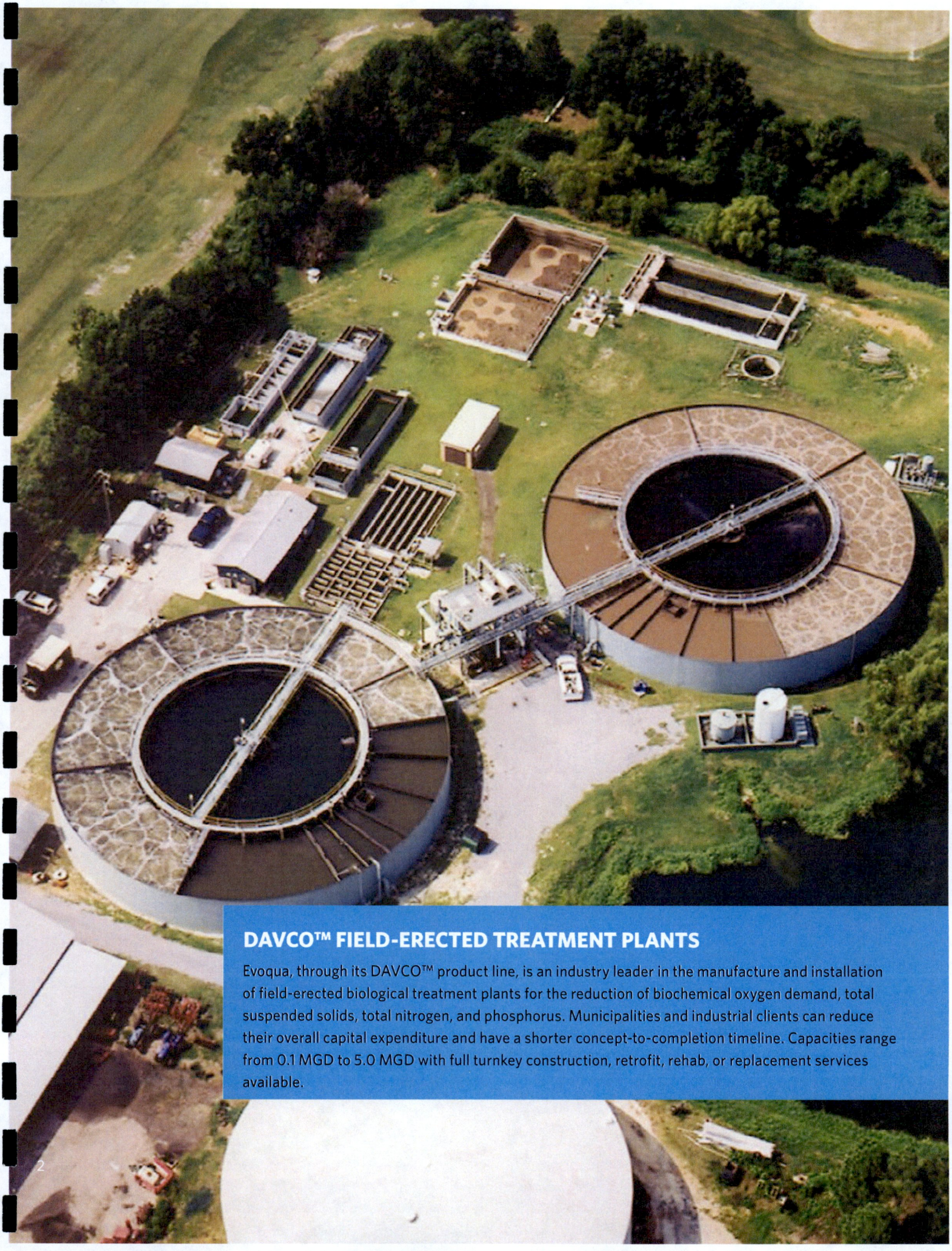
(Duplex MIRROR IMAGE 625,000 GPD FETP's)



PLANT Height: 16'-6" w/18" Freeboard

evoqua
WATER TECHNOLOGIES

DAVCO™ FIELD-ERECTED WASTEWATER TREATMENT SYSTEMS



DAVCO™ FIELD-ERECTED TREATMENT PLANTS

Evoqua, through its DAVCO™ product line, is an industry leader in the manufacture and installation of field-erected biological treatment plants for the reduction of biochemical oxygen demand, total suspended solids, total nitrogen, and phosphorus. Municipalities and industrial clients can reduce their overall capital expenditure and have a shorter concept-to-completion timeline. Capacities range from 0.1 MGD to 5.0 MGD with full turnkey construction, retrofit, rehab, or replacement services available.

Turnkey Wastewater Treatment Solution in less than six months.

CONCEPT TO COMPLETION
THE COMPREHENSIVE TREATMENT SOLUTION

DAVCO™ field-erected treatment plants are ideal for the reduction of biochemical oxygen demand, total suspended solids, total nitrogen, and phosphorus. Evoqua's DAVCO product and service teams have worked with municipalities, developers and engineers for more than 50 years to deliver turnkey projects and solutions in as fast as six months.

DAVCO field-erected treatment plants offer optimum application flexibility relative to physical size, flow rates, treatment levels, and site requirements. Treatment capacities range from 0.1 to 5.0 million gallons per day (mgd) and are available in a variety of configurations, including activated sludge processes, sequencing batch reactors, and oxidation ditch configurations. Treatment plant material options include carbon steel, galvanized steel, stainless steel, concrete, or any combination of these materials.

Overall capital, maintenance, and operating costs can be reduced with a shorter concept-to-completion timeline. Full turnkey, retrofit or upgrade solutions are also available.

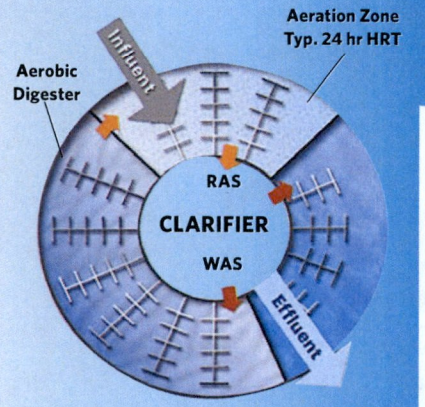
KEY FEATURES

- Over 50 years of experience and biological process expertise
- Engineering to Start-up: Single-source responsibility
- Equipment engineering and quality manufacturing
- Short on-site completion timelines with full technical support
- Retrofit and Rehab of existing equipment available (regardless and manufacturer)

APPLICATIONS:

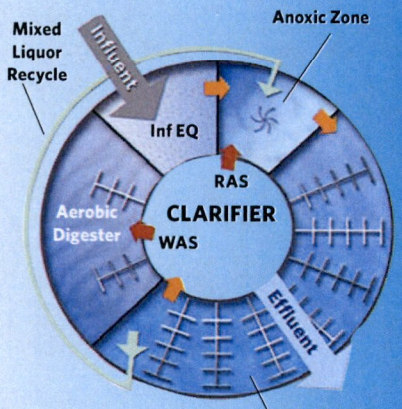
- Municipal Wastewater
- Industrial Wastewater
- Commercial or Home Developers
- Reuse and Reclamation
- Biological Nutrient Removal (BNR)
- BOD/COD/TSS/Reduction

EXTENDED AERATION
90% - 95% REMOVAL



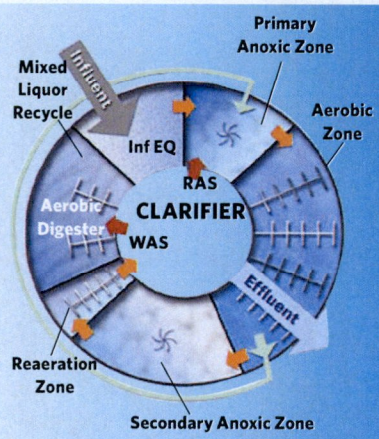
- BOD/TSS
- NH3 < 1 mg/L
- TP (Chemically)

BIOLOGICAL NUTRIENT REMOVAL
2 STAGE



- BOD/TSS
- TN < 8 mg/L
- TP (Chemically)

BIOLOGICAL NUTRIENT REMOVAL
4 STAGE



- BOD/TSS
- TN < 3 mg/L
- TP (Chemically)

EFFICIENCY & ECONOMY IN A SINGLE PACKAGE

DAVCO™ field-erected treatment plants integrate the industry's most advanced treatment processes into a cost effective package solution. The result is a highly flexible and efficient treatment facility that can be operational in weeks, instead of months.

Evoqua's biological treatment process experts are always available to guide process selection and to assist with technical support in all phases of application refinement, process design, and specification development.

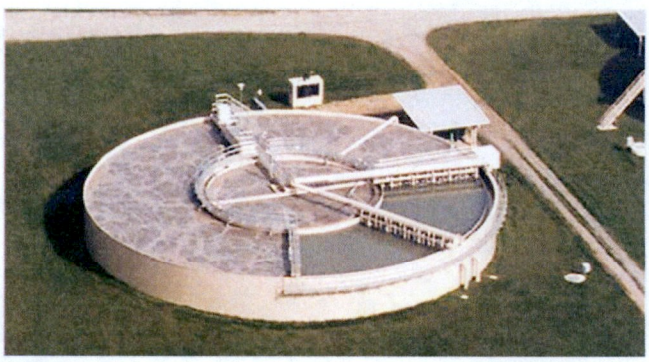
One of the unique innovative Evoqua processes is the dual path, providing complete process redundancy meeting EPA Class I, II, or III reliability standards in a single DAVCO™ field-erected treatment plant tank. In reuse applications, and other instances where process redundancy is required, the innovative and reliable dual path design offers significant savings in both capital cost and land utilization, while achieving even strict biological nutrient removal.

Evoqua treatment processes utilizing a DAVCO treatment plant design are guaranteed to meet or exceed all Federal, State, and Local government requirements. Evoqua has more than two decades of experience in the design of biological nutrient removal processes, meeting stringent effluent requirements.

EFFLUENT PARAMETERS

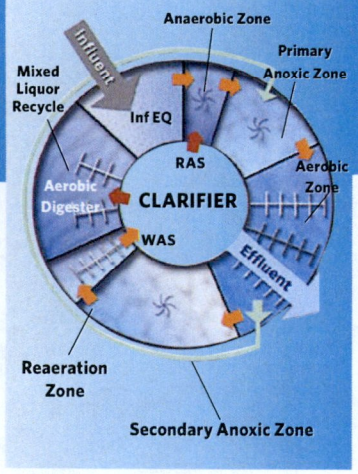
For flows from 0.1 to 5.0 mgd (Before Filtration)

- Biological Oxygen Demand BOD
  < 10 mg/L
- Total Suspended Solids
  TSS < 10 mg/L
- Ammonia
  Nh3 < 1 mg/L
- Total Nitrogen
  TN < 3 mg/L
- Total Phosphorus
  TP < 1 mg/L



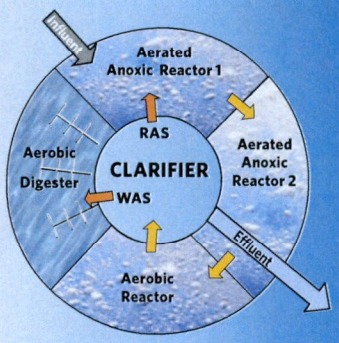
Dual Path Process 1 MGD installation in North Carolina

BIOLOGICAL NUTRIENT REMOVAL 5 STAGE



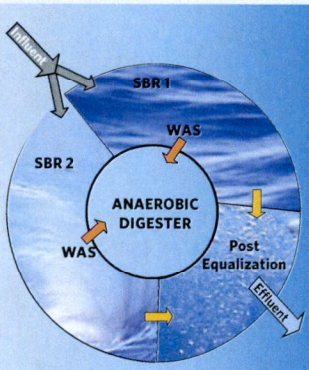
- BOD/TSS
- TN < 3 mg/L
- TP < 1 mg/L (Biologically)

AERATED ANOXIC



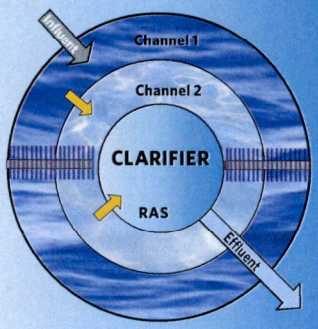
- BOD/TSS
- TN < 6 mg/L
- TP (Chemically)

OMNIPAC® SBR PACKAGE PLANTS



- BOD/TSS
- TN < 3 mg/L
- TP (Chemically)

ORBAL® SYSTEMS



- BOD/TSS
- TN < 6 mg/L
- TN < 4 mg/ with MLSS recycle
- TP (Chemically)

DAVCO™ field-erected treatment plants provide a cost-effective long-life solution to treatment plant construction. This package plant approach is considerably less capital intensive than form-built, concrete basin type treatment plants due to the weather-related delays and labor-intensive conditions associated with built-in-place approaches.

The field-erected plants are simpler and faster to install because they require less physical space, less yard piping and electrical conduit, less maintenance, and significantly less site preparation.

Both the capital costs and life-cycle costs of Field-Erected Treatment Plants are only a fraction of these same costs in site-built concrete plants.

Biological Nutrient Removal Process 1 MGD Installation in Alabama

OTHER PROCESSES OFFERED

- Orbal® Multichannel Oxidation Ditch
- VLR® Looped Reactor Process
- OMNIPAC® Sequencing Batch Reactors (SBR)
- Tow-Bro® Clarifiers
- Membrane Bio Reactors (MBR)
- Envirex® Rotating Biological Contactors (RBC)

Field-erected plants installed in cold-climate conditions may be partially or fully buried to utilize the earth as insulation conserving the latent heat of the incoming raw sewage and to prevent freezing.

COST-EFFECTIVE, LONG-LIFE TREATMENT SOLUTION

Evoqua's DAVCO™ product and service team is the industry's most experienced, relative to the field-erected treatment plant assembly methods, procedures, and quick start-up techniques. Over the years, the Evoqua installation team has earned an enviable reputation for its quality on-site workmanship, and its reliability in meeting strict schedule and budget parameters. With the use of the Evoqua installation team, sole-source responsibility is assured.

In addition, DAVCO field-erected treatment plants save money in many ways - both initially and over time, eliminating the need for multiple tankage, separate clarification systems and sludge recycle systems. Engineering and construction costs are dramatically reduced by the use of pre-engineered components and the precision factory fabrication of individual assemblies.

Davco field-erected plants have proven their long-life functionality and durability over decades and in all types of climatic extremes. They provide an immediate solution that outlasts other options which often cost many times more and take far longer to construct.

Cost Effective

Pre-Engineered

Factory-Built Components

Field Erection/Installation

Long-Life Solution

Evoqua's single source approach integrates experience with equipment design, steel fabrication, field installation/construction, and commissioning services.

THE DAVCO™ FIELD-ERECTED TREATMENT PLANT CYCLE

Contract-to-completion timelines for site-built concrete treatment plants can be exceedingly long often ranging from months to years. In contrast, DAVCO™ field-erected treatment plants are pre-engineered and factory built in our Thomasville, GA fabrication facility. The components and internal piping assemblies in these field-erected plants benefit from the machine shop atmosphere of factory construction, and provide a major advantage with short on-site installation time.

DAVCO field-erected treatment plant components are trucked to the site and installed on a concrete base slab (typically the site is prepared and excavated as necessary and the slab poured while the system is manufactured). The field installation primarily involves assembling and welding the components, then cleaning and coating the entire system.

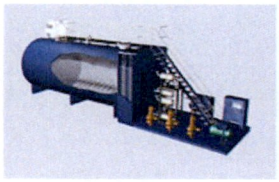
Evoqua offers a single source approach that integrates industry-leading expertise and equipment with design, build, installation and commissioning services, and can deliver a high-quality project in as fast as six months.

DAVCO™ PRODUCTS AND SERVICES

FAST, TURNKEY, OEM SOLUTIONS FOR FILTRATION, SCREW PUMPS, AND FIELD ERECTED WASTEWATER TREATMENT PLANTS

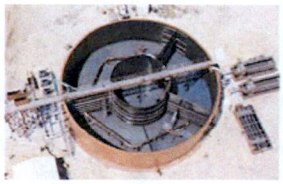
BIOLOGICAL TREATMENT

DAVCO™ Field Erected Treatment Plants



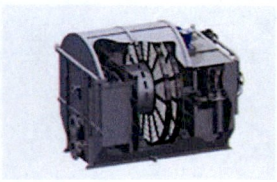
X-Press™ MBR Systems

Package Plants



OMNIPAC® SBR Field Erected Package Plant

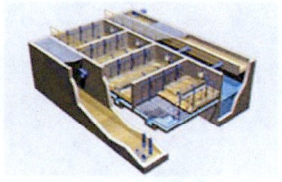
TERTIARY FILTRATION



Forty-X™ Disc Filters

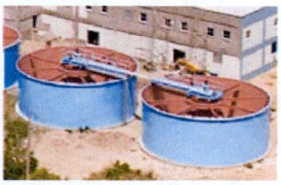
Continuous Backwash Filters

Gravisand® Traveling Bridge Filters



Hydro-Clear® Sand Filters

CLARIFICATION



Modular & Field Erected Clarifiers

SCREW PUMPS

Internalift® and Externalift™ Screw Pumps

Deep-Bed Sand Filters

NxClear® Denitrification Filters

ABOUT THE DAVCO PRODUCT LINE

Evoqua, through its Davco product line is an industry leader in the manufacture and installation of water and wastewater treatment equipment and systems including field erected biological treatment plants, screw pumps, filtration equipment and clarifier rehabilitation. Davco products and services are supported by experienced project teams that have been working with municipalities, developers and engineers for more than 50 years to deliver turnkey treatment projects and solutions. Evoqua offers a single source approach that integrates industry-leading expertise and equipment with design, build, installation and commissioning services, and can deliver a high quality project in as fast as six months.

PROJECT CAPABILITIES

- Applications & Design Engineering
- Equipment Manufacturing
- Project Management
- Field Erection & Installation
- Turnkey Project Solutions
- Performance Warranties
- Commissioning

DAVCO™
an EVOQUA brand

EVOQUA
WATER TECHNOLOGIES

1828 Metcalf Ave., Thomasville, GA 31792

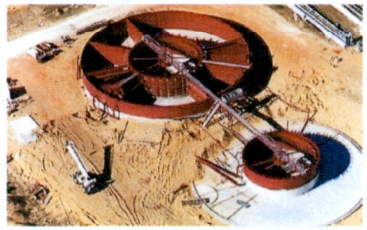
+1 (800) 841-1550 (toll-free) **+1 (229) 226-5733** (toll) www.evoqua.com/davco

evoqua
WATER TECHNOLOGIES

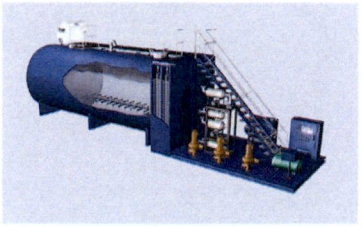
DAVCO PRODUCTS AND SERVICES

FAST, TURNKEY, OEM SOLUTIONS FOR FILTRATION, SCREW PUMPS, AND FIELD ERECTED WASTEWATER TREATMENT PLANTS

BIOLOGICAL TREATMENT



DAVCO™ Field Erected Treatment Plants

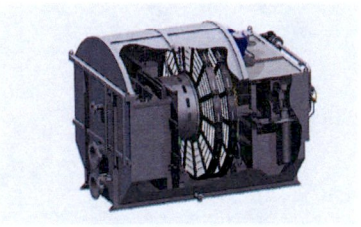


X-Press™ MBR Systems

Package Plants

OMNIPAC® SBR Field Erected Package Plant

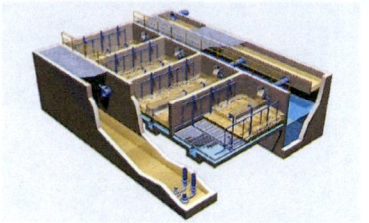
TERTIARY FILTRATION



Forty-X™ Disc Filters

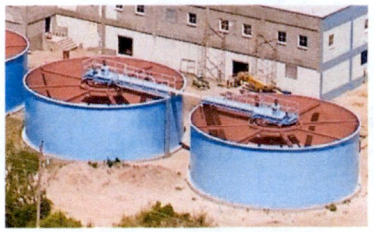
Continuous Backwash Filters

Gravisand® Traveling Bridge Filters



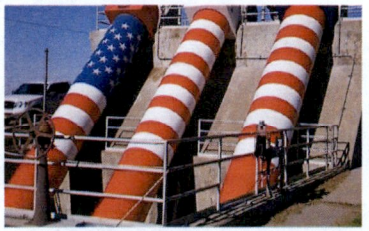
Hydro-Clear® Sand Filters

CLARIFICATION

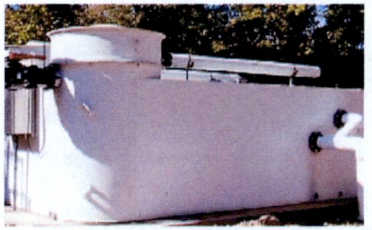


Modular & Field Erected Clarifiers

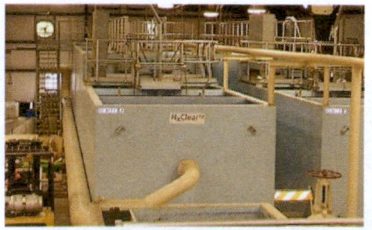
SCREW PUMPS



Internalift® and Externalift™ Screw Pumps



Deep-Bed Sand Filters



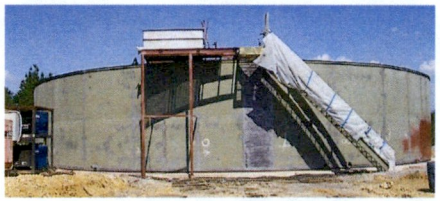
NxClear® Denitrification Filters

DAVCO PRODUCTS AND SERVICES

FAST, TURNKEY, OEM SOLUTIONS FOR FILTRATION, SCREW PUMPS, AND FIELD ERECTED WASTEWATER TREATMENT PLANTS

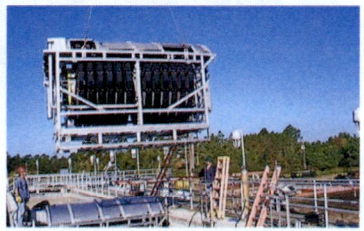
RETROFIT, REHAB, & REPLACEMENT SERVICES

When demand increases, regulations change, and plant equipment reaches its useful life, Evoqua Water Technologies responds. The Davco product offering includes retrofit, rehab, and replacement parts, equipment, and services for water and wastewater filtration, separation, clarification, aeration, biological treatment, and screw pumps. Our application experts and complete database of OEM (Original Equipment Manufacturer) drawings provides for faster, more cost effective, and responsive project execution.



Increase performance of existing wastewater treatment equipment and field erected plants

Inspect, repair or replace screw pumps



Upgrade or convert sand filtration to Forty-X™ Disc Filters

PROJECT CAPABILITIES

- Applications & Design Engineering
- Treatability & Pilot Testing
- Equipment Manufacturing
- Project Management
- Field Erection & Installation
- Turnkey Project Solutions
- Performance Warranties
- Commissioning

ABOUT THE DAVCO PRODUCT LINE

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Alternative 2

Field-Erected CSR Package Plant, Model GR by Schreiber Corporation

Crist Job No.
1618

City of Walnut Ridge
Arkansas 1874

Preliminary Engineering Report
Wastewater Improvements
June 2018

From: Chad Cooley
To: Craig Johnson
Subject: RE: Walnut Ridge - WWTP Options - EDI
Date: Thursday, September 28, 2017 5:11:31 PM
Attachments: Walnut Ridge TSC 9-22-17.pdf
Schreiber - Continuously Sequencing Reactor.pdf
Aeration GR Brochure.pdf

Craig –

Good afternoon. Please find attached a Technical Solution Calculations report from Schreiber Corporation. Note this is basically a set of design calculations and proposed scope of supply for the referenced project. The personnel responsible to send my budget pricing are already at WEFTEC, so it will be a few days before I can get budget pricing. I just wanted to get this scope in your hands so that you could see how Schreiber plans to approach the project.

I have also attached some literature for your use and information. If you have any questions, or require additional information, please do not hesitate to contact me.

Thanks,
Chad B. Cooley, P.E.
Vice President
Environmental Technical Sales, Inc.
900 S. Shackleford, Suite 300
Little Rock, AR 72211
Phone: (501) 978-1025 Fax: (501) 978-1026
Cell: (501) 690-3721
http://etec-sales.com/
E-mail: ccooley@etec-sales.com

From: Craig Johnson [mailto:cjohnson@cristengineers.com]
Sent: Friday, September 15, 2017 10:56 AM
To: Chad Cooley <ccooley@etec-sales.com>
Subject: RE: Walnut Ridge - WWTP Options - EDI

New construction. Here is a site plan of the area. Don't plan on using any existing facilities except chlorination and dichlorination basin at the existing plant.

From: Chad Cooley [mailto:ccooley@etec-sales.com]
Sent: Friday, September 15, 2017 9:51 AM
To: Craig Johnson <cjohnson@cristengineers.com>
Subject: Re: Walnut Ridge - WWTP Options - EDI

Are there any existing lagoons/basins that can be used, or will this be all new construction?

Thanks,
Chad Cooley
(501) 690-3721

On Sep 14, 2017, at 9:18 AM, Craig Johnson <cjohnson@cristengineers.com> wrote:

> Chad – We are working with Walnut Ridge to evaluate WWTP options. The existing facility is a Biolac unit that has reached its service life and has struggled to maintain permit. The client has an interest to return to lagoon technology. I want to engage EDI in this effort. There are two specific options we are looking at. One is to stay with the existing outfall on Village Creek or construct a new outfall to the Black River. We have room at the existing site to construct lagoons. Outlined below are the discharge parameters for each discharge location. I would like to know EDI thoughts and the application of their technology for both options. I will also be evaluating a mechanical plant option for the existing discharge at Village Creek as well, and we can discuss more on that. Regarding influent parameters, you can assume typical municipal characterization. We are gathering additional data on the influent at this time. I want to target a design flow of 1.25 MGD.
>
> Village Creek Outfall Parameters
>
> CBOD5/TSS/NH3-N/DO (mg/L)
> 10.0/15.0/4.0/6
>
> Black River Outfall Parameters
>
> BOD5/TSS/DO (mg/L)
> 30.0/30.0/2.0
>
> Let me know if you have any questions.
>
> Craig A. Johnson, P.E.
> Associate Engineer
> Crist Engineers, Inc.
> 205 Executive Court
> Little Rock, AR 72205
> V: 501.664.1552 F: 501.664.8579
> C: 501.993.2922
> E: cjohnson@cristengineers.com
> www.cristengineers.com

SCHREIBER®
Pure Ingenuity

Technical Solution Calculations
for

Walnut Ridge WWTF

AR
1.250 MGD ADF Facility

Representative
ETEC

September 22, 2017

SCHREIBER
Pure Ingenuity

Walnut Ridge WWTF

Flows Given or Assumed

	Average Flow			Peak Daily Flow	
	MGD	gpm		MGD	gpm
Design Flow	**1.25**	**868**	Ratio: 2.50	**3.13**	**2,170**
Headworks Flow	1.25	868		3.13	2,170
Equipment					
Bar Screen	1.25	868		**3.13**	**2,170**
Fine Screen	--	--		--	--
Washer Compactor	--				
Grit & Grease	--	--		--	--
Aeration GR - AOR	**1.25**	**868**		3.13	2,170
Aeration GRO - AOR	--	--		--	--
Digester	--	--		--	--
Clarifier	--	--		--	--
Fuzzy Filter				--	--
RAS		--			
Open Flight		--			
Tube Pump		--			

Notes:

This Technical Solutions Calculation Basis of Design has been prepared exclusively for the convenience of the design engineer. The design parameters used have been obtained from other sources. Schreiber assumes no responsibility for the accuracy of the design parameters.

The design engineer is responsible for the final facility design. Schreiber LLC's sole function is to supply equipment based upon the final facility design.

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Summary of Equipment

SCHREIBER CleanScreens — Frontloader Bar Screen

Model :	FR 220	
Number of Units:	1	
Width :	24	inches

SCHREIBER CSR CONTINUOUSLY SEQUENCING REACTOR — GR Aeration System

	Design	
Model :	GR	
Number of Units:	1	
Diameter :	140	feet
SWD :	15.0	feet
Raceway:	139.5	feet
F:M Ratio :	0.07	
MLSS Concentration :	4,000	mg/ L
Hydraulic Detention :	25.45	hours
Biological Loading Rate:	11.76	lb. BOD / 1000 cu. ft.
Linear feet of rotating diffusers:	1,050	feet
Linear feet of stationary diffusers:	0	feet
Concrete Quantity Estimate :	1,267	total cubic yards

Aeration Blowers

Model :	PD 130	
Number of Duty Blowers :	2	
Number of Standby Blowers :	1	
Horsepower (each) :	60	hp
ICFM (each) :	853	ICFM
SCFM (each) :	728	SCFM

Blower / Process Control

Dissolved Oxygen Monitoring	yes	
Nitrate Monitoring	0	
Ammonia Monitoring	0	

GR Clarification

Model :	GR	

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Summary of Equipment

Number of Duty Units:	1	
Number of Standby Units:	0	
Diameter :	65	feet
SWD :	14.0	feet
Surface Settling Rate @ Avg Flow :	377	gpd / sq. ft.
Surface Settling Rate @ Peak Flow :	942	gpd / sq. ft.

SCHREIBER

CleanScreens

Frontloader Bar Screen System Calculations

Design Criteria

1. Peak Daily Flow Q = 2,170 gpm or 3.13 MGD
2. Velocity Range in Front of Screen - 2 ft. / sec. to 3 ft. / sec.
3. A 10% Blinding Factor.
4. Design Head Loss of 8 inches at maximum flow
5. Minimum 1' - 6" foot freeboard upstream at maximum flow
6. Calculations are based on using (1) barscreen unit.

Cross-Sectional Area Required (Width x Side Water Depth):

1. $Q = \frac{\text{Peak Daily Flow}}{(60 \times 7.48)} = \frac{2{,}170}{(60 \times 7.48)} =$ 4.84 cfs

2. $A = \frac{Q}{V} = \frac{4.84 \text{ cfs}}{\text{Assume 2.00 ft/sec}} =$ 2.42 sq ft @ Peak Daily Flow

Bar Screen Equipment Sizing and Selection:

1.	Number of Duty Units	1 Duty Unit(s)
	Number of Standby Units	0 Standby Unit(s)
	Width of Screen	2 feet 0 inches
2.	Screen Drive Horsepower	0.75 hp each
3.	Max. Side Water Depth (Upstream)	2 feet 4 inches
	Recommended Minimum Channel Depth	3 feet 10 inches
4.	Width of screen bars	0.375 inches
	Spacing of bars (center to center)	1.000 inches
	Clear opening between bars	0.625 inches

Notes:

If a bypass channel and overflow weir is utilized, the maximum upstream sidewater depth, channel depth, and water level elevations need to be evaluated relative to the weir configuration and resulting head over the weir.

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CSR
CONTINUOUSLY SEQUENCING REACTOR

Aeration

Flows

			Design
Average Daily Flow	ADF	MGD	1.25
Peak Flow	PDF	MGD	3.13

Site Conditions

			Design
Wastewater Temperature	T	°C	15
Site Elevation		feet	250
Dissolved Oxygen	DO	mg/L	2.00
Air Temperature		°F	110
Vapor Pressure @ T		psi	1.275
Relative Humidity	RH		80%

BOD

			Design
BOD Influent	BOD_{Inf}	mg/L	200
BOD Influent		PPD	2,085
BOD Effluent Limit	BOD_{Eff}	mg/L	10
Pounds of Oxygen required per pound BOD		# O2/#BOD	1.5
Assumed Volatile Portion of Solids	%VSS		68%
TSS Influent	TSS_{Inf}	mg/L	200
TSS Effluent	TSS_{Eff}	mg/L	12

Nitrogen

			Design
TKN Influent	TKN_{Inf}	mg/L	31
TKN Effluent	TKN_{Eff}	mg/L	1.5
TKN Removed = Nitrate (NO3) Produced	TKN_{Rem}	mg/L	29.5
Influent Nitrates & Nitrites	$NO3_{Inf}$	mg/L	1.0
Total Nitrogen Influent	TN_{Inf}	mg/L	32.0
Organic N Influent	$Org\ N_{Inf}$	mg/L	1.0
Organic N Effluent	$Org\ N_{Eff}$	mg/L	1.0
Ammonia Influent	$NH3_{Inf}$	mg/L	30.0
Ammonia Effluent	$NH3_{Eff}$	mg/L	0.5

Nitrates Produced by Nitrification	NO3 prod by N	mg/L	29.50
Total Nitrates Loading	$NO3_{Load}$	mg/L	30.50
Nitrates Removed	$NO3_{Rem}$	mg/L	0.00
Carbon Ratio	$BOD:NO3_{Rem}$		NA
Nitrates Effluent	$NO3_{Eff}$	mg/L	30.50
Total Nitrogen Effluent	TN_{Eff}	mg/L	32.00

Reactor Design

Volume & Suspended Solids

			Design
Food:Mass Ratio	F:M		0.070
Mixed Liquor Suspended Solids	MLSS	mg/L	4,000
Mixed Liquor Volatile Suspended Solids	MLVSS	mg/L	2,720
Total Process Volume Required	$Vol_{(process)}$	MG	1.31
Pounds of Mixed Liquor Volatile Suspended Solids	#MLVSS	pounds	29,786

Nitrification Kinetics

			Design

SCHREIBER CSR
CONTINUOUSLY SEQUENCING REACTOR

Maximum specific growth rate of Nitrifiers @ 15°C	μ_N, max	g NVSS / g NVSS-day	0.45
Nitrifier Yield Coefficient	a_N	g NVSS/ g NH3	0.15
Half-Saturation Coefficient for Nitrogen	K_N	mg/L	0.50
Half-Saturation Coefficient for Oxygen	K_O	mg/L	0.30
Heterotrophs yield coefficient	a	g VSS / g BOD	0.55
Maximum Specific Growth Rate of Nitrifiers @ T	μ_N, max @ T	g NVSS / g NVSS-day	0.450
Specific Growth Rate of Nitrifiers	μ_N	g NVSS / g NVSS-day	0.196
Specific Rate of Nitrification	q_N	g NH3 / g NVSS - day	1.304
Fraction of nitrifying organisms	F_N		0.0406
Nitrification Rate	R_N	mg/L NH3 rem / day	144.13
Specific Nitrification Rate, # NH3 / #MLVSS - d	SNR_d	# NH3 / # MLVSS - day	0.0530
Specific Nitrification Rate, # NH3 / #MLVSS - hr @ T	SNR	# NH3 / #MLVSS - hour @ T°C	0.0022

Denitrification Kinetics

			Design
Specific Denitrification Rate per day at 20°C	$SDNR_d$	# NO3/# MLVSS - Day @ 20°C	0.03110
Specific Denitrification Rate per hour @ 20°C	SDNR @20°	# NO3/# MLVSS - Hour @ 20°	0.00130
Specific Denitrification Rate per hour @ T°C	SDNR	# NO3/# MLVSS - Hour @ T°C	0.00107

Process Phase Times

Oxic Time (Aerobic/Nitrification/"N" time)

			Design
BOD Reduction: NH3 Reduction Ratio			8
Specific BOD Reduction Rate @T°C	SBRR	#BOD / #MLVSS-hr	0.018
Time for Total BOD Reduction	T_{TBOD}	hours per day	3.76
Time for Soluble BOD Reduction	T_{SBOD}	hours per day	1.27
Time for Nitrification	T_N	hours per day	4.68
Minimum Oxic (Aerobic) Time Required	T_{omin}	hours per day	4.68
Percent Oxic (Aerobic) Time In CSR	$\%T_{oxic}$		100%
Design Blower Operating Hours per day		hours per day	24.00

Anoxic Time (Denitrification/"DN" Time)

Required Time for Anoxic(Denitrification)	T_{DN}	hours per day	0.00

Calculate Combination times

Combined Oxic(N) + Anoxic(DN) Reaction Time	$T_{Omin+DN}$	hours	4.68

Air Calculations

Actual Oxygen Required (AOR)

			Design
Oxygen required in PPD	O2 reqd	PPD	4,386
Oxygen Recovery via Denitrification		PPD	-
Allowed Oxygen Recovery via DN	$O2_{Rec}$	PPD	-
Actual Oxygen Required in PPD	AOR	PPD	4,386

Standard Oxygen Transfer Rate

Saturation Concentration (C*∞20)	C*∞20	mg/L	10.50
Select Alpha	α		0.70
Aged Diffusers Factor	F		0.99
Theta	Θ		1.024
Standard Pressure	Ps	psia	14.696
Site Pressure	Pb	psia	14.578
Pressure Correction	Ω		0.992
Oxygen Saturation @ 20°C	C^*_{s20}	mg/L	9.09
Oxygen Saturation @ T	C^*_T	mg/L	10.08
Oxygen Saturation Correction	τ		1.11

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CONTINUOUSLY SEQUENCING REACTOR

Beta	β		0.95
Standard Oxygen Transfer Rate lbs/day	SOTR	lbs/day	8,339
Standard Oxygen Transfer Rate lbs/hour	SOR	lbs/hour	347

SOR to AOR Ratio

Calculated SOR/AOR ratio			1.90
Selected SOR/AOR ratio for Design			1.90
SOR from AOR using (SOR:AOR ratio)		# O2/Day	8,339

Process Control

Process Monitoring			Design
Dissolved Oxygen Monitoring			yes
Nitrate Monitoring			0
Ammonia Monitoring			0

Aeration GR

GR Aeration

GR			Design
Number of GR Aeration/Clarifier Basins		basins	1
GR Aeration SWD		feet	15.00

CSR Volume and Diameter

Total GR CSR Volume Required (Vol(process) - Vol(DNB))		million gallons	1.31
GR Process Volume per Basin, MG		million gallons	1.31
GR Process Volume per Basin, CF		cubic feet	175,538
GR Aeration Basin Diameter		feet	140.00
GR Channel Width		feet	36.25
Total CSR Volume		million gallons	1.33

Volumetric Loading

GR Volumetric Loading		# BOD /per day/ 1,000 CF	11.76

Maximum Cycle Times, (MCTs)

Max "Air On" Cycle Time	T_{ONmax}	hours	12.73
Max "Air Off" Cycle Time	$T_{OFFcycle}$	hours	0.00
Max Cycle Time	T_{CYmax}	hours	12.73

GR Clarifier

GR Clarifier

Clarifier Model			GR
Number of Clarifier Duty Units			1
Underflow Concentration - MLSS			10,000

Minimum Clarifier Surface Area

Minimum Clarifier Diameter		feet	72.08
GR Clarifier Inner Diameter		feet	65.00

Surface Settling Rate

Surface Settling Rate @ Qav		gal/day/sq. ft.	377
Surface Settling Rate @ Qpk		gal/day/sq. ft.	942

Solids Loading Rate

Average RAS Flow		MGD	0.83

Depth Based on German Standards

h1 (Clean Water Zone)

h1 - Clean Water Zone in feet		feet	1.64

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CONTINUOUSLY SEQUENCING REACTOR

h2 (Separation/Return Flow Zone)

h2 - Separation Zone in feet		feet	7.29

h3 (Density flow and storage zone)

h3 - Storage Zone in feet		feet	3.15

h4 (Thickening and sludge removal zone)

h4 - Thickening and Sludge Removal Zone in feet		feet	3.50

Clarifier Depth

Clarifier Depth based on German Standards		feet	15.57
Clarifier Depth based on US Standard Design Practices		feet	12
Clarifier Depth = 1 ft less than Aeration Depth		feet	14
Actual Clarifier Depth Desired (SWD) >12'		feet	14

GR Blower Air Requirements

Transfer Efficiency of deepest diffusers			Design
Height of deepest diffuser off bottom		feet	0.67
Diffuser submergence		feet	14.33
O2 transfer, %/Meter			5.20%
Net Transfer Efficiency			22.71%

Discharge Pressure

Minimum Blower Discharge Pressure		psi	8.08
Blower Design Pressure		psi	9.23

Air required - SCFM, ICFM, Ratio

GR SCFM Required		SCFM	1,457
Site Elevation		feet	250
Inlet Pressure = Pa - Pv*RH		psi	13.558
ICFM Required @ Site Conditions:		ICFM	1,705

Horsepower of Blowers

Operating Horsepower of Blowers		HP	84.98
Design Horsepower of Blowers		HP	95.20

GR Diffusers Required

Diffusers Required			Design
GR air flow rate thru diffuser		scfm/lf	1.60

Rotating Headers

Rotating diffusers per GR basin		diffusers	420
Linear feet of rotating diffusers per GR basin		linear feet	1050
GR rotating diffuser submergence		feet	14.33

Stationary Headers

Number of stationary diffusers per GR basin		diffusers	0
Linear feet of stationary diffusers per GR basin		linear feet	0
GR stationary diffuser submergence		feet	14.33

Total Diffusers per basin

Total number of diffusers per GR basin		diffusers	420
Total linear feet of diffusers per GR basin		linear feet	1,050

Total Diffusers for System

Total linear feet of rotating diffusers for system		linear feet	1,050
Total linear feet of stationary diffusers for system		linear feet	-
Total linear feet of diffusers for system		linear feet	1,050

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CONTINUOUSLY SEQUENCING REACTOR

Percent GR diffusers that are rotating		percent	100%
Percent GR diffusers that are stationary		percent	0%
GR diffuser loading at design		SCFM/LF	1.39
GR average net transfer, %			22.72%
GR weighted transfer efficiency			5.20%

GR Blower Arrangement

Number of Blowers			Design
Number of operating blowers for rotating diffusers			2
Number of operating blowers for stationary diffusers			0
Number of standby blowers			1
Total number of blowers			3

Blowers for Rotating Headers

Selected rotating blower capacity in SCFM		SCFM	728
Selected rotating blower capacity in ICFM		ICFM	853

Blowers for Stationary Headers

Selected stationary blower capacity in SCFM		SCFM	--
Selected stationary blower capacity in ICFM		ICFM	--

Blower Model

Schreiber blower model designation		Model	PD 130
Motor HP of selected blower model		HP	60.0
Operating BHP of selected blower model		HP	48.5
Includes enclosure(s)			yes
BHP of selected model for aged diffuser			60.0

Diffuser Loading

Actual GR rotating diffuser loading		SCFM/LF	1.39
Actual GR stationary diffuser loading		SCFM/LF	--

GR Aeration/Clarifier Mechanical & Structural

Mechanical Details			Design
Type GR Bridge			Honeycomb
Materials of Construction			Carbon Steel

Motors

Aeration Bridge Drive Motor Horsepower		hp	5.00
Aeration Bridge Drive Operating Horsepower		hp	3.75
Clarifier Beam Drive Motor Horsepower		hp	0.20
Clarifier Beam Drive Operating Horsepower		hp	0.16

Structural/Concrete

Floor Slab Thickness		feet	1.25
GR Freeboard		feet	2.00
GR Wall Height		feet	17.00
GR Aeration Wall Thickness		feet	1.25
GR Clarifier Wall Thickness		feet	1.25
Total Cubic Yards of Concrete		cubic yards	1,267

GR Aeration/Clarifier Options

Optional Epoxy Coated			No
Optional Electric Drill			Yes
Optional Manifold Header			No
Optional Fabricated Skirt			No
Optional Launder Brush			No
Optional Scum Trough			No

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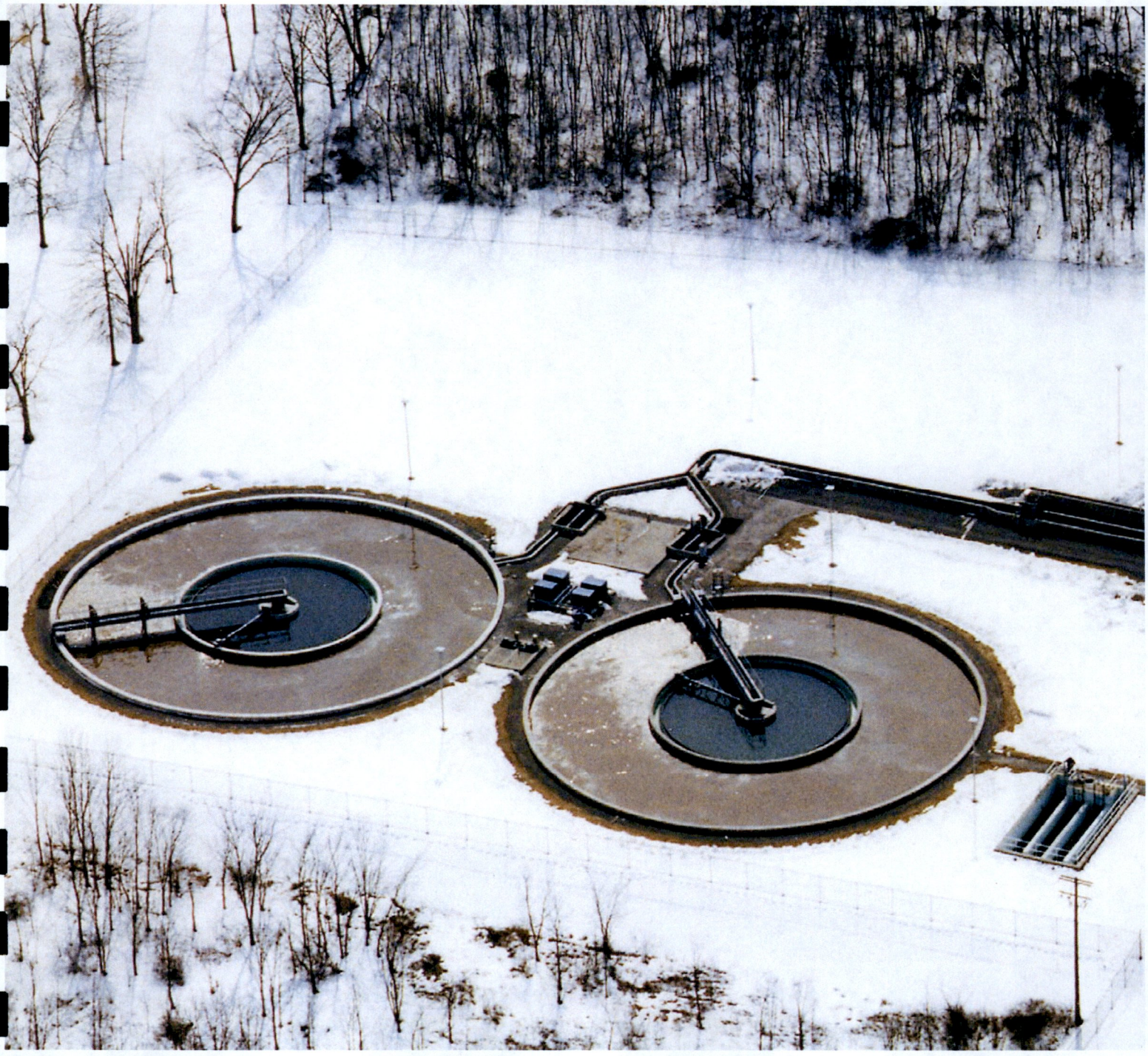
Improving Water Through Technology

COUNTER CURRENT®
AERATION

Model GR

Aeration/clarification in a single basin suitable for ADFs up to 1.5 MGD.

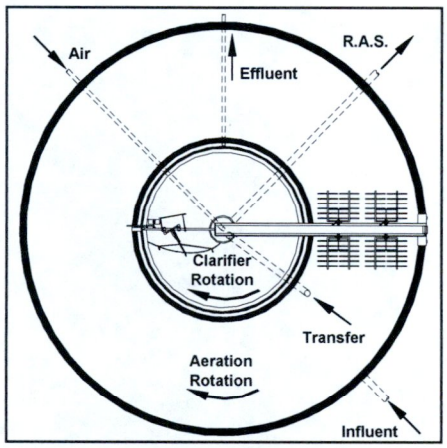


SCHREIBER®
Improving Water Through Technology

Model GR Aeration

Schreiber's Model GR basin configuration utilizes Schreiber's patented *Counter Current Aeration* system, which provides high efficiency aeration and ***separate*** low energy mixing for activated sludge. Designed for smaller flows, the GR unit incorporates aeration and clarification within the same structure for optimum space utilization. A single GR aeration / clarification basin is capable of handling average daily flows to 1.5 MGD.

The GR model utilizes a circular tank with an aeration diameter up to 168' with typical sidewater depths from 10'-20'. Circular structures provide the most economical construction - minimum concrete and excavation with maximum basin volumes. A concentric internal wall is built within the aeration tank to form the clarifier structure. Helical scraper assemblies are suspended from a lightweight beam arm that rotates within the clarifier section of the basin. Independent from the clarifier arm, flexible membrane diffusers are suspended just inches above the basin floor, within the aeration ring, from a peripherally driven rotating aeration bridge. The continuous rotation of the bridge in the aeration ring provides constant mixing (separate from aeration) with minimal energy consumption. The movement of the diffusers through the water enhances fine bubble aeration, achieving high oxygen transfer efficiency. The design of Schreiber's diffusers permits 100% turndown of aeration while maintaining complete mixing.



Features:
- Maximum process flexibility
- Separation of aeration from mixing
- Hot-dip galvanized for corrosion protection
- Minimal heat loss and aerosol release
- Low life-cycle costs
- Retrievable membrane diffusers
- Low mixing costs
- High oxygen transfer

COUNTER CURRENT® AERATION **Model GR -** SReactor™

With *Counter Current Aeration*, the air to the diffusers may be turned off as the aeration bridge continues to mix the contents of the basin. In a single basin, a continuous sequence of oxic, anoxic, and anaerobic phases can be achieved as a result of the ability to turn air on and off to the diffusers while the continuously rotating aeration bridge maintains the organics in suspension. It is by this advanced concept that the GR unit becomes a ***Continuously*** *Sequencing Reactor* (CSR) for biological nutrient removal, Schreiber's 21st century advancement over the *Sequencing* ***Batch*** *Reactor* (SBR).

COUNTER CURRENT® AERATION **Model GR -** SReactor™ **, incorporating...** SCHREIBERFLEX™ Process Control System

With only the addition of direct monitoring process control equipment, a GR unit operating as a *Continuously Sequencing Reactor* (CSR) can achieve the highest level of biological nutrient removal for nitrogen and phosphorus. *SchreiberFlex* is Schreiber's unique process control system utilizing direct monitoring to meet today's tightest effluent limits.

100 Schreiber Drive · Trussville, Alabama 35173

Telephone 205-655-7466 · Facsimile 205-655-7669 · www.schreiberwater.com

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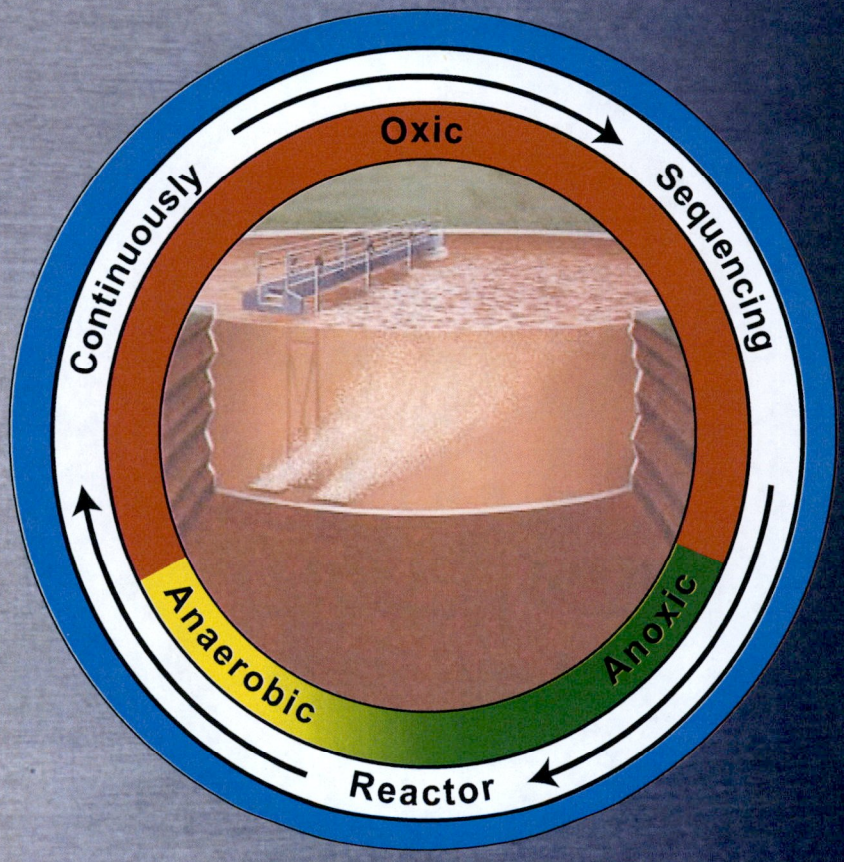
CSR

CONTINUOUSLY SEQUENCING REACTOR



A Biological Nutrient Removal (BNR) system utilizing continuous flow in a single basin.

SCHREIBER CSR
CONTINUOUSLY SEQUENCING REACTOR

The Schreiber Continuously Sequencing Reactor, or CSR, is a Biological Nutrient Removal (BNR) system contained in a *Single Basin*. It sequences through the 3 process phases required for BNR – Oxic, Anoxic and Anaerobic – in one basin. The 3 phases do not occur at the same time in the basin. They occur sequentially – one after the other, repetitively, over time. During the Oxic phase, the entire basin is Oxic (i.e. aerobic). When the air is turned off, the entire basin becomes anoxic and then ultimately anaerobic. After the anaerobic phase is completed, the air is turned back on and the cycle repeats –over and over - i.e. a Continuously Sequencing Reactor.

For the CSR, the secret to this "phase sequence-ability" lies in its unique design for *complete separation of aeration and mixing*. It has a *100% aeration turndown capability*! This important feature allows the aeration to be turned completely off while the CSR applies its low energy mixing without aeration. Through the use of Schreiber FlexControls, the CSR process can be advanced to meet the most stringent of requirements for today and the future.

HIGH OXYGEN TRANSFER

High Oxygen Transfer depends on maximizing air bubble surface area and contact time. Conventional diffused air systems mix via air lift pumping, which produces vertical circulating currents that are detrimental to Oxygen transfer since they actually reduce contact time. With CSR, since the diffusers are constantly moving through the water, there is minimum coalescence of the small bubbles (coalescence decreases total bubble surface area). Consequently, optimum surface area is maintained and the rise rate of the air bubbles provide maximum contact time. The resulting CSR oxygenation efficiency amounts to over 4.65 lbs. O_2 / hr per wire horsepower. Compared to 2.5 to 3.5 lbs. O_2/hr per wire horsepower for conventional diffused and mechanical aeration systems, the efficiency of the CSR results in savings of 35% to 50%.

CONVENTIONAL DIFFUSED AIR

Stationary diffusers alone create a vertical updraft of water, increasing bubble rise rate, reducing contact time, and leading to a coalescence of bubbles that reduces available O_2 surface area for low oxygen transfer.

ROTATING DIFFUSERS ONLY

The CSR utilizes rotating diffusers that distribute small air bubbles in a uniform pattern, leading to well dispersed free-rising bubbles that maximize contact time and yield high oxygen transfer.

ROTATING & STATIONARY DIFFUSERS

By moving the water horizontally over stationary diffusers, the CSR's rotating diffusers eliminate the updraft problem created by stationary diffusers alone. The combination of rotating and stationary diffusers can greatly increase aeration capacity for higher basin loadings.

LOWER ENERGY COSTS FOR MIXING

The contents of the basin are mixed as the rotating bridge moves around the basin. Retrievable diffuser support components, and diffuser units suspended from the bridge, provide the driving force for complete mixing. Close proximity of these components to the tank bottom provides localized scouring to maintain suspension of solids. As a result, the power requirement for mixing is 2.5 to 3.5 HP/MG.

ADVANCING LEVELS OF PROCESS CONTROL

The Schreiber ***FlexControl*** process control system can be as simple as a DO system with timers or as sophisticated as online monitoring of BNR process parameters. As the name Schreiber ***FlexControl*** implies, the Schreiber process control system is very flexible, yet simple to operate.

DESIGN FLEXIBILITY

Schreiber aeration systems are suitable for aeration designs ranging from basic secondary treatment to advanced nutrient removal processes such as MLE, VIP, etc.

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Alternative 3

Partial Mix Aerated Lagoon by Environmental Dynamics International (EDI)

Crist Engineers

Crist Job No.
1618

Preliminary Engineering Report
Wastewater Improvements
June 2018

Aerated Lagoon Budgetary Design

Partial Mix Aerated Lagoon for Wastewater Treatment
in
Walnut Ridge, AR

September 27, 2017

Prepared for:

Crist Engineers
Little Rock, AR

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Table of Contents

I. Wastewater Design Basis

The preliminary EDI IDEAL process proposal has been developed based on the following wastewater influent conditions. Customer to confirm design values for final design and warranty criteria.

A. Influent Wastewater Flow

Parameter	Value	Unit
Design Average Flow	1.25	MGD

* Estimated value

B. Influent Wastewater Quality

Parameter		Design Value	Unit
Average BOD_5	Concentration*	250	mg/L
	Design Load*	2608	lb/d

* Estimated value

C. Site Conditions

Parameter	Value	Unit
Operational Winter Water Temperature*:	0	°C
Relative Humidity (Summer)*:	85	%
Site Elevation (at berm)*	260.0	ft

* Estimated Value

D. Effluent Quality Criteria

Parameter (Monthly Average Concentration)	Design Value	Unit
BOD_5	30	mg/L
Total Suspended Solids	30	mg/L

II. Total Lagoon Solutions

Whatever your treatment challenge, EDI is committed to provide peace of mind as the single source for your complete lagoon solution. Too often are owners and operators caught in a blame game between multiple suppliers that are bundled together at bid-time to provide lowest overall project cost without consideration for operational and troubleshooting convenience. EDI offers a variety of options that are offered as a complete package for single-source responsibility and optimal convenience. EDI asks you to engage our sales representatives to learn more about how EDI can provide total support from package estimates through ongoing process support and maintenance; or as we call it, *Aeration for Life™*.

A. Superior Lagoon Technology

Advanced Efficiency Suspended Panel Aeration System

EDI is the only aeration provider on the market to take high efficiency panel diffuser technology and apply it to a curvilinear design that allows for ease of membrane maintenance and maximum aeration efficiency. EDI's suspended panel aeration system provides several benefits:

- The innovative suspended panel configured with floating laterals support low flux rate applications for ultra-high oxygen transfer efficiency performances. Custom system designs are made to meet client needs of price and efficiency.
- Internal ballasting of aeration units reduces contractor install time and materials expense.
- Curvilinear panel design allows for quick and easy membrane changes compared to traditional flat panels that often require aeration units to be sent back to the factory.
- Easily configurable to any lagoon footprint.
- Comes with extensive array of membrane options to fit your unique wastewater application, including state of the art PTFE embedded Matrix Plus membranes.

Premium Positive Displacement Blowers

EDI has over 40 years of experience providing aerated lagoon systems. That experience has led to the conclusion that the client can be best served by having a single point of responsibility when it comes to their aerated lagoon process. By providing the line-to-bubble system, EDI can ensure a seamless project with equipment that is integrated for maximum performance. EDI's standard is to offer premium positive displacement blowers because of their low maintenance and high reliability. The high-quality blowers provided by EDI can be configured to continuously run at a set air flow for overall operational simplicity or can be controlled by in-situ sensors for maximum process efficiency.

Integrated Motor Starters and System Controls

Motor starters and system controls are an integral part of any water resource reclamation system. EDI provides an ideal integration of controls and motor starters that ensure equipment longevity and owner satisfaction. Lifespan for blower equipment can be increased when the proper motor starters are used. Control systems can be equipped with upgrades including DO blower control, BioMizer™ lagoon aeration and mixing system, SCADA, and ArcArmor™ technology for the ultimate in operator safety and convenience.

BioInsulate™ Thermal Covers

EDI's modular cover system is comprised of a series of individual thermal panels that are encapsulated in a protective membrane sheath. The panels are available in a number of configurations and can provide insulation values up to R-30. The panel-type insulating cover is superior to other insulating cover options, such as particulate covers, due to their ability to resist environmental conditions (e.g., wind) and disturbance caused by treatment aeration systems.

BioShade™ Algal Prevention Covers

There are several options available on the market for algae control and prevention. EDI's BioShade eliminates the vast portion of ultraviolet light that enters the treatment lagoon and provides algae with the means to achieve photosynthetic growth. No UV, no algae. The BioShade cover is a floating, permeable lagoon cover that allows gas (from facultative lagoons or from aerobic lagoon aeration) to escape while allowing rainwater to pass through – thereby reducing or eliminating pooling on top of the cover.

Baffles

EDI lagoon baffles provide for greater design flexibility by reshaping hydraulic flow in existing or new lagoons. Baffles are a way to address the potential for short-circuiting in a lagoon. They can also be used to create a series of small cells in series, rather than one large complete mix or partial mix basin, to increase the efficiency of the overall treatment process.

B. Additional Support Programs

Complete lagoon solutions from EDI not only simplify the design and provision of lagoon upgrades. They also allow for worry-free communication and coordination, because EDI can provide installation, start-up, and maintenance for your lagoon system.

Aeration Works Installation

EDI Aeration Works™ division was created to give contractors and operators of aeration systems a source for fast, reliable installation and maintenance. The EDI Aeration Works group is made up of experienced installers and field service professionals. Aeration Works personnel are experts at the installation and maintenance of aeration systems with process and operational optimization objectives.

Aeration Works (AW) expert installers are faster and more thorough than someone new to installing in-basin components of EDI aeration systems. AW experts know what tools are needed, how to perform installations quickly, and how to ensure it is done exactly to manufacturer's specifications. Utilizing Aeration Works' expertise for system installation ensures the job is done right.

Benefits of planning for Aeration Works installation include:

- Mechanical warranty against defects and workmanship increases from 2 to 5 years.
- Eliminates inspection requirements for validation of process warranty.
- Project completed more quickly with seamless communication and familiarity between installation crew and manufacturer.
- Decreased contractor administrative duties (inspection scheduling, inventory, subcontractor scheduling, etc.)
- Single-point responsibility should any future issues arise.

Preventative Maintenance Program

For maintenance or preventative maintenance, the Aeration Works group has the experience to evaluate the degree of work needed then properly refurbish a system for maximum long term performance. When construction crews or contractors have already been selected, Aeration Works can also provide supervision to assure the work is done to manufacturer's specification.

A maintenance plan allows facility operators to outsource scheduled maintenance of their aeration systems to EDI Aeration Works group. When this program is chosen as part of a new IDEAL Process sale, the mechanical warranty of the aeration system is extended as long as a service agreement is in place. Aeration Works can inspect any existing aeration or treatment system and a preventative maintenance program can be developed. The benefits of a preventative maintenance plan include:

- Minimizing unscheduled outages
- Easy budgeting with a single annual expense to cover all parts and labor
- Increased energy efficiency and savings
- Decreased operating costs

Infinity Program™

This program incorporates the mechanical warranty and services of the Preventative Maintenance Program but goes one step further by guaranteeing the performance of the aeration system. Under this program, EDI maintains the physical condition of the membranes through preventative maintenance procedures and will periodically measure the performance of the membrane. Aeration Works will replace or adjust the equipment to ensure the aeration system operates within a pre-determined performance envelope.

III. Process Selection Details

The EDI Aerated Lagoon System may be comprised of a single pond or a series of two or more ponds or zones within a single basin. These zones or ponds are characterized as Complete Mix, Partial Mix and Quiescent. Additionally, there are a number of ancillary system components that round out EDI's aerated lagoon processes.

A. Partial Mix Lagoon

The Partial Mix (PM) lagoon is an enhanced facultative lagoon process to simultaneously remove BOD and provide solids separation and digestion. The enhancement is achieved by the circulation of the lagoon bulk liquid whereby soluble cBOD is introduced to biosolids more efficiently than in a purely facultative flow-through lagoon. Note the difference between this and a Complete Mix lagoon which uses greater airflows to keep all biosolids in suspension so a higher concentration can come in contact with soluble cBOD more efficiently than the PM. Screening and grit removal are generally not required for PM lagoon systems, but use of the screening pretreatment can help avoid nuisance floating materials and improve aesthetics.

PM lagoons are typically several days' detention (generally more than 5 days). Aeration is only provided to maintain oxygen in the liquid portion of the lagoon, and air flow is limited to the process oxygen demand from cBOD removal. Solids settling and digestion is facilitated in the same reactor. Mixing (i.e., solids suspension) via aeration is not a factor in the design so a low-energy system is possible. Typical BOD removal and oxygen demand in the PM lagoon is defined by biological reaction rates as published in US EPA design manual EPA-625-83-015, "Municipal Wastewater Stabilization Ponds." Removals are based on first order kinetics for detention times and temperature of the lagoon.

Nitrogen is removed in PM reactors primarily via assimilation by heterotrophic organisms. Very little autotrophic nitrification can be expected on a consistent basis, although nitrification may become established with the combination of a warm climate and long detention time. Alternate provisions must be employed under any circumstance if nitrogen removal is desired.

PM lagoons are generally used as a part of a more robust treatment scheme when used in series with other processes:

A. Multiple PM reactors in series
B. CM and PM in series.
C. IDEAL™ Bioreactor and PM
    a. Quiescent Zone optional for polishing
    b. Filtration optional for advanced polishing
D. PM lagoon for side-stream sludge digestion and storage as part of an advanced lagoon processes
E. Disinfection

Important Note: It is critical to understand the difference between the mixing (i.e., solids suspension) that occurs in a CM lagoon versus the water circulation that occurs in a PM lagoon. The CM lagoon can achieve a higher level of treatment in a smaller volume due to the efficient

delivery of food to microorganisms. PM lagoons may use less energy but may require greater pond volumes with larger footprints, and are more limited in reaching high levels of treatment.

B. Existing Infrastructure and Construction

EDI does not have information regarding the site that would be used if discharging to the Black River. EDI assumes a large open space available with no restrictions on basin geometry.

Figure 2 shows an example of what the basin layout could be. Two basins assumed, the first split into 3 cells via baffle curtain. The final cell is one aerated zone. Note that the submerged lateral aeration system will need to be installed dry with a drained and dredged basin.

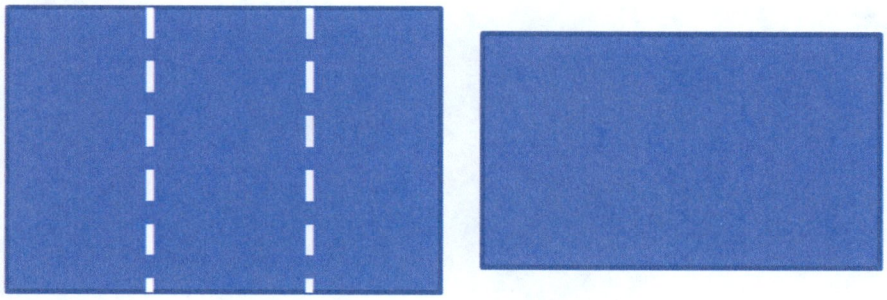


Figure 2. Assumed Layout

IV. Preliminary System Components Selection

A. Checklist and Description:

Four (4) Partial Mix Zones

	YES	Not Required	By Others
A. Premium Positive Displacement Blower Package	☑	☐	☐
B. Partial Mix Aeration System, Complete	☑	☐	☐
a. Submerged Laterals and Supports			
b. High-Efficiency Lagoon Panel Technology			
c. Retrievable Assemblies and Diffusers			
d. Purge and Miscellaneous			
C. Process Controls	☑	☐	☐
a. HOA Controls			
D. BioInsulate Thermal Cover	☐	☑	☐
E. BioShade UV Cover	☐	☑	☐
F. Lagoon Baffle(s)	☑	☐	☐
G. Engineering Support	☑	☐	☐
H. Training and Field Service	☑	☐	☐
a. Documentation and IOM Manuals			
b. On Site Start Up Support			
c. On Site Operator Process and Maintenance Training			
I. Mechanical and Process Warranties	☑	☐	☐
J. Freight to Site	☑	☐	☐
K. Optional Extended Maintenance Contract Available	☑	☐	☐

*Available with EDI Package once sizing determined.

B. Budgetary Cost Estimates*

EDI Partial Mix Lagoon Solution: **$ 400,000 U.S.D.**

Includes In-Basin aeration equipment, blowers, controls, baffles, 2 trips of field service, and freight to site.

*All prices to be reviewed upon confirmation of project scope and hardware specifications.

Optional Modules – To be selected by engineer and/or customer

V. Design Data Summary

Design Influent Conditions

Design Average Flow *		1.25	MGD
BOD5	concentration *	250	mg/L
	loading	2608	lb/d
TSS	concentration	250	mg/L
	loading	2608	lb/d
Min Lagoon Water Temp (Winter)*		0	°C
Max Water Temp (Summer)*		30	°C

Basin Summary Information

	Zone No. 1	Zone No. 2	Zone No. 3	Zone No. 4
Volume, MG	5.1	5.5	5.1	10.5
Retention Time, days	4.1	4.4	4.1	8.4
Operating Regime	Partial Mix	Partial Mix	Partial Mix	Partial Mix
Expected Winter Effluent Concentration, mg/L	149	89	56	25

Air / Blower Information

Airflow Requirement	1898	scfm
Design Blower Operating Pressure	5.8	psig
# of Duty Blowers	1	
# of Standby Blowers	1	
% of Blower Capacity	87%	
Motor Size	75	hp

Environmental Dynamics International

5601 Paris Road
Columbia, MO 65202

(PH) 877-334-2478
573-474-9456
(FX) 573-474-6988
www.environmentaldynamics.com

Alternative 4

Oxidation Ditch (CLR Process by Lakeside) and Secondary Clarification

Crist Job No.
1618

City of Walnut Ridge
Arkansas 1874

Preliminary Engineering Report
Wastewater Improvements
June 2018

Budgetary Proposal

March 18, 2018

LAKESIDE EQUIPMENT CORPORATION
Water Purification Since 1928

Jim Aitkenhead
630/837-5640, ext. 230
jra@lakeside-equipment.com

TO
Craig Johnson, P.E.
Crist Engineers
205 Executive Court
Little Rock, AR 72205

PROJECT
Walnut Ridge AR
Walnut Ridge WWTP

EQUIPMENT			UNIT	QTY	TOTAL
Magna Rotors with Baffles and Covers			**$76,900**	**6**	**$461,400**
Six (6)	19-ft	Single Magna Rotors			
Six (6)	19-ft	Adjustable Control Baffles			
Six (6)	19-ft	Type E Fiberglass Covers			
Two (2)	11-ft	Hinged Plate Weirs			

Due to the current volatility of stainless steel prices, budgetary cost of equipment may be subject to change.

SPECIFICATION

Rotor diameter:	42.0	inches	Maximum rotor speed:	60.0	rpm
Motor horsepower:	30.0	hp	Maximum blade immersion:	13.1	inches

Maximum oxygen transfer: 88.4 lbs O_2 / hour / rotor (Based on maximum rotor speed and blade immersion)

ROTOR
14-inch diameter painted steel torque tube
Stainless steel rotor blades (19-ft long per single rotor)
30 hp rotor drive assemblies
Aluminum splash plates and frames
Rotor bearings

BAFFLE - COVER - WEIR
Carbon steel rotor baffles with adjustment plates
Fiberglass rotor covers with painted steel supports
Hinged plate weirs with handwheel operators
Shop prime paint of all ferrous components
Anchorage (stainless steel)

EXCLUSIONS
Erection of equipment
Rotor service bridge
Piping and valves
Motor starters or controls
Electrical conduit or wiring
Spare parts or special tools

OPTIONAL ITEMS **UNIT PRICE**

NOTES

FOB:	Factory - Chariton, Iowa	Approvals:	6 to 8 weeks
Warranty:	One (1) year	Shipment after Approval:	18 to 20 weeks
Start-Up Service:	4 days in 2 trips	Freight:	Freight allowed to jobsite

Budgetary Proposal

March 8, 2018

LAKESIDE EQUIPMENT CORPORATION
Water Purification Since 1928

Jim Aitkenhead
630/837-5640, ext. 230
jra@lakeside-equipment.com

TO
Craig Johnson, P.E.
Crist Engineers
205 Executive Court
Little Rock, AR 72205

PROJECT
Walnut Ridge AR
Walnut Ridge WWTP

EQUIPMENT	UNIT	QTY	TOTAL
LAKESIDE SPIRAFLO CLARIFIER	**$ 140,100**	**2**	**$280,200**
54-ft Dia. x 12-ft SWD			

Due to the current volatility of steel prices, budgetary cost of equipment may be subject to change.

CLARIFIER DESIGN DATA

Diameter:	54.00	feet	Drive deign torque:	3,856	ft-lbs
Sidewater depth:	12.00	feet	Spur gear diameter:	36.25	inches
Freeboard:	1.50	feet	Rake arm tip speed:	7.9	feet / min
Floor slope:	0.75	inch / foot	Effluent weir length:	154	feet

CLARIFIER COMPONENTS

Half-span bridge assembly with steel checkered plate walkway
2-rail aluminum handrail
1/2 hp drive motor
8MCVD Winsmith reducer
Shear pin overload
Drive shaft
Scraper arms with steel squeegees
Inlet trough
Royalite skirt assembly
19.5-ft square effluent weir trough assembly with steel weir plates
14-in diameter effluent pipe (inside tank only)
10-in diameter scum pipe with tilting scum pipe handle
Single race skimmer
Shop prime painted steel components
Anchorage - stainless steel

Components are carbon steel construction unless noted otherwise

EXCLUSIONS

Erection of equipment
Access stairs to clarifier bridge
Handrail around clarifier tank perimeter
Piping, valves or fittings outside of clarifier tank wall
Sludge pipe from sludge hopper
Wall sleeves or wall fittings
Pressure relief valves
Electrical controls (i.e. motor starters, disconnects, etc..)
Electrical conduit and wiring
Finish paint

OPTIONAL ITEMS	UNIT PRICE
Mechanized full surface skimmer	$65,490
Ducking full surface skimmer	$33,760
Winsmith reducer with torque overload control device	$7,020
Fiberglass weir plates	$1,060
Hot-dip galvanized steel components	$13,670

NOTES

FOB:	Chariton, Iowa	Approvals:	6 to 8 weeks
Freight:	Freight allowed to jobsite	Shipment after Approval:	18 to 20 weeks
Start-Up Service:	2 days in 1 trip	Weight per Clarifier:	21,500 lbs
Warranty:	One (1) year	Installation Time per Clarifier:	144 hours

Alternative 5

Oxidation Ditch (OxyStream System by WesTech) and Secondary Clarification

Crist Job No.
1618

City of Walnut Ridge
Arkansas 1874

Preliminary Engineering Report
Wastewater Improvements
June 2018

Walnut Ridge WWTP

Arkansas

Represented by
Wes Ivory
Haynes Pump and Process
Little Rock, Arkansas
(800) 832-1580
wes@haynes-pump.com

Furnished by
Ian Fife
ifife@westech-inc.com

WesTech

WesTech Opportunity Number: 1860217
Wednesday, May 30, 2018

Item A – Two (2) OxyStream™ Biological Nutrient Removal Systems
WesTech Equipment Model AES2C3

Process Design

Description	Unit	Dimension/Capacity
Flow (Average/Design)	MGD	1.25
BOD (Influent/Effluent)	mg/L	240/10
TSS (Influent)	mg/L	170
TKN (Influent)	mg/L	50
Ammonia (Effluent)	mg/L	4
Waste Temp (Min/Max)	°C	10/20
Site Elevation	ft. above sea level	300

Equipment

Description	Type	Quantity
Aerators	Landy7	4
DO Control System	LDO	2 Probes, 1 Controller
VFD	Stand Alone Panel	4
PLC-Based Control	HMI Interface	1

Equipment Description (Aerators)

Description	Unit	Dimension/Capacity
Aerator		
Motor Power	HP	40
Motor Voltage	V/Ph/Hz	480/3/60
Motor Speed	rpm	1800
Motor Frame	-	TEFC, C-Face
Motor B-10 Bearing Life	hours	100,000
Motor Heater	V	120
Reducer Service Factor	-	2.5
Reducer B-10 Bearing Life	hours	100,000
Reducer B-10 Life (Output)	hours	250,000
Reducer Oil Heater	V	120
Impeller Diameter	mm	1800
Impeller Thickness	inches	3/8
Impeller Material	-	A36 Steel
Jackstuds Material	-	A307 ZP
Mounting Bars Material	-	A36 Steel

Equipment Description (DO Control System)

Description	Unit	Dimension/Capacity
DO Probes		
Probe Type	-	LDO
Mounting Configuration	-	Pole Mount
Cable Length	ft	33
Range	mg/L	0 – 20.0
Accuracy	-	± 0.05 ppm below 1 ppm ± 0.1 ppm below 5 ppm ± 0.2 ppm above 5 ppm
DO Controller		
Communication Protocol	-	MODBUS 232/485 Profibus DP
4-20 mA Outputs	-	2
Display	in	1.89 x 2.67

Equipment Description (Variable Frequency Drives)

Description	Unit	Dimension/Capacity
Variable Frequency Drives		
Power	HP	40
Power Feed	V/Ph/Hz	480/3/60
Enclosure Type	-	NEMA 12
Enclosure Cooling	-	6
VFD Rectifier	6/12/18 Pulse	6
dv/dt Filter	Y/N	N

Equipment Description (PLC Control System)

Description	Unit	Dimension/Capacity
PLC Control System		
Power Feed	V/Ph/Hz	120/1/60
Enclosure Type	-	NEMA 12
UPS	Y/N	N
UPS Runtime	Min	8
HMI Size	Inches	10
HMI Manufacturer	-	Allen Bradley
PLC Manufacturer	-	Allen Bradley
PLC Model	-	1769 CompactLogix

Coatings

All steel items, with the exception of the drive mechanism, will be prepared per SSPC-SP10 and coated with one (1) coats Tnemec N140 epoxy, 3-5 mils each. The drive mechanism will be finished painted in the shop with the manufacturer's recommended paint system.

On-Site Services

WesTech Trips to the Site	
Number of Trips	2
Number of Days	4

Field Service

Included field service is for installation inspection, startup, and operator training. Any additional trips that the customer may request can be purchased at the standard WesTech daily rates plus travel and living expenses.

Spare Parts

Spare Parts	
Low Oil Cutout Switch	1
High Speed Coupling	1

Comments and Clarifications

The proposed system was designed based on the information provided and WesTech's standard equipment. The proposed equipment is backed by a 1 Year warranty.

The proposed system treats the design flow in two (2) basins with two (2) 40 HP aerators per basin for mechanical and hydraulic redundancy.

Items Not Included in WesTech's Base Scope of Supply

- Electrical Wiring
- Conduit
- Piping
- Valves/Fittings
- Lubricating Oil/Grease
- Field Welding
- Field Erection

Option A-1 – Future BNR

Equipment		
Description	**Type**	**Quantity**
Anaerobic Mixers	Submersible	4
Anoxic Mixers	Submersible	4
Bypass Channel Gate	Manual	2

Equipment Description (Submersible Mixers)		
Description	**Unit**	**Dimension/Capacity**
Submersible Mixers		
Power Feed	V/Ph/Hz	480/3/60
Motor Power	HP	
Anaerobic		1
Anoxic		3
Impeller Material	-	304SS
Power/Hoist Cable Length	ft	25
Rail/Crane Material	-	316SS
Hoist Cable Material	-	304SS

Equipment Description (Bypass Channel Gate)		
Description	**Unit**	**Dimension/Capacity**
Bypass Channel Gate		
Manual/Automated	-	Manual
Gate Material	-	A36 Steel
Gate Width/Height/Thickness	ft/ft/in	2.5/10.5/0.25
Handwheel Material	-	Aluminum
Handwheel Diameter	in	20

This proposal has been reviewed and is approved for issue by Cody Maxfield on May 30, 2018.

Item B – Clarifier Mechanism, WesTech Model COPC1G

General Scope of Supply

Item	Unit	Value/Description
Number of Mechanisms	Each	2
Application	-	Activated Sludge Secondary
Tank Diameter	ft	54
Tank Side Water Depth	ft	13
Tank Bottom Slope	-	1 :12
Average Flow Rate	MGD	.625
Peak Flow Rate	MGD	2

Detailed Scope of Supply

Item	Unit	Qty	Size/Description	Material
Walkway Bridge	each	1	Beam Type	Steel
Walkway Handrail	-	-	2 Rail Component	Aluminum
Walkway Flooring	-	-	1-1/4" Grating	Aluminum
Platform Handrail	-	-	2 Rail Component	Aluminum
Platform Flooring	-	-	1/4" Checker Plate	Aluminum
Center Column Diameter	in	1	18	Steel
Dual-Gate EDI Diameter	ft	1	6	Steel
Dual-Gate EDI Total Height	ft	-	2.5	
Feedwell Diameter	ft	1	10	Steel
Feedwell Total Height	ft	-	5	
Feedwell Supports	-	-	Supported from the Cage	Steel
Full Radius Rake Arms	-	2	Box truss w/ spiral scrapers	Steel
Sludge Withdrawal Ring	-	1	20% of tank dia. w/ multiple ports	Steel
Squeegees	-	-	Bolted to scraper blades	304 SS
Scum Skimmer	each	2	Std. hinged skimmer blade	304 SS
Scum Box	each	1	3' Standard scum box	Steel
Scum Flushing Valve	each	1	Skimmer actuated	Polymer/SS
Anchor Bolts & Fasteners	-	-	-	304 SS

Drive Unit

Description	Unit	Value/Description
Drive Type	C31	Cage w/ Precision Bearing
Housing Material	-	Steel
Continuous Rated Torque	ft·lbs	14,700
Momentary Peak Torque	ft·lbs	29,400
Rake Tip Speed	ft/min	11.8
Motor Size	HP	0.5
Motor Speed/Voltage/Frequency/Phase	RPM / V / Hz / Phase	1800 / 460 / 60 / 3
Torque Control Settings	Alarm: ft·lbs	100%: 14,700
	Motor Cutout: ft·lbs	120%: 17,640
Main Gear and Pinion Lubrication	-	Oil
Main Bearing and Reducer Lubrication	-	Grease

Surface Preparation and Coating

Coating Area	Surface Preparation	Coating
Submerged	None	None
Non-Submerged	None	None
Drive Unit	SSPC-SP6	One (1) coat Tnemec N140F-1255 Epoxy, 3-9 mils DFT, and one(1) coat Tnemec 1074U-B5712 Polyurethane, 2-5 mils DFT

On-site Services

Item	Quantity
Total Number of Trips	2
Total Number of Days	2

For inspection, observation of torque testing, startup, and instruction of plant personnel. Additional on-site services may be purchased at standard WesTech daily rates plus travel and living expenses.

Clarifications and Comments

Any item not listed above to be furnished by others.

The information provided above is for budgetary purposes only. The equipment sizes listed may vary depending on the design criteria and plant flows.

Items Not Included in WesTech's Base Scope of Supply

- Electrical Controls and Wiring
- Piping, Valves, or Fittings
- Lubricants
- Unloading or Storage
- Erection or Assembly
- Weir, Scum Baffle, & Supports
- Concrete

This proposal has been reviewed and is approved for issue by Jake Bass on March 19, 2018.

Budget Pricing

Proposal Name: Walnut Ridge WWTP

Proposal Number: 1860217

Wednesday, May 30, 2018

1. Bidder's Contact Information

Company Name	WesTech Engineering, Inc.
Contact Name	Ian Fife
Phone	801.265.1000
Email	ifife@westech-inc.com
Address: Number/Street	3665 S West Temple
Address: City, State, Zip	Salt Lake City, UT 84115

2. Pricing

Currency	US Dollars

Scope of Supply

A	(2) OxyStream™ Biological Nutrient Removal Systems AES2C3	$415,500
A-1	Future BNR	$185,700
B	(2) 54' Diameter Clarifier Mechanisms COPC1G	$230,000
	Taxes (sales, use, VAT, IVA, IGV, duties, import fees, etc.)	Not Included

Prices are for a period not to exceed 30 days from date of proposal.

Field Service

Daily Rate	$1200

Prices do not include field service unless noted, but it is available at the daily rate plus expenses. The customer will be charged for a minimum of three days for time at the jobsite. Travel will be billed at the daily rate. Any canceled charges due to the customer's request will be added to the invoice. The greater of visa procurement time or a two week notice is required prior to trip departure date.

3. Payment Terms

Submittals Approved	15%
Release for Fabrication	35%
Net 30 days from Shipment	50%

All payments are net 30 days. Partial shipments are allowed. Other terms per WesTech proforma invoice.

4. Schedule

Submittals, after PO receipt	6 to 8 Weeks
Customer Review Period	2 weeks
Ready to Ship, after Submittal Approval	18 to 20 weeks
Total Weeks from PO to Shipment	**26 to 30 weeks**

Terms & Conditions: This proposal, including all terms and conditions contained herein, shall become part of any resulting contract or purchase order. Changes to any terms and conditions, including but not limited to submittal and shipment days, payment terms, and escalation clause shall be negotiated at order placement, otherwise the proposal terms and conditions contained herein shall apply.

Freight: Prices quoted are **F.O.B. shipping point** with freight allowed to a readily accessible location nearest to jobsite. All claims for damage or loss in shipment shall be initiated by purchaser.

Paint: If your equipment has paint included in the price, please take note to the following. Primer paints are designed to provide only a minimal protection from the time of application (usually for a period not to exceed 30 days). Therefore, it is imperative that the finish coat be applied within 30 days of shipment on all shop primed surfaces. Without the protection of the final coatings, primer degradation may occur after this period, which in turn may require renewed surface preparation and coating. If it is impractical or impossible to coat primed surfaces within the suggested time frame, WesTech strongly recommends the supply of bare metal, with surface preparation and coating performed in the field. All field surface preparation, field paint, touch-up, and repair to shop painted surfaces are not by WesTech.

OxyStream Layout and Concrete Estimate

WESTECH

Project Information

Project Name:	Walnut Ridge, AR	Project Number:	1860217
Engineer:	PCG Eng	Completed by:	CTM
Date:	6/1/2018	Checked by:	-

Design Parameters

Ditch Parameters

# of Ditches	2	
Aerators/Ditch	2	
Depth	11	ft
Channel Width	22	ft
Straight Length	69.02	ft
Channel Freeboard	1.5	ft
Aeration Freeboard	6	ft

Assumptions

Exterior Walls	14	in	thick
Interior Walls	12	in	thick
Deck	12	in	thick
Floor	10	in	thick
Footings	18	in	thick
Footings	60	in	tall

Volume

Aerobic	0.375	Mgal
Anoxic	0.174	Mgal
Anaerobic1	0.02	Mgal
Anaerobic2	0.02	Mgal
TOTAL	0.588	Mgal

Footprint

	Width	Length	
Aerobic	45.00	113.02	ft
Anoxic	45.00	46.99	ft
Anaerobic1	22.00	10.77	ft
Anaerobic2	22.00	10.77	ft
TOTAL (2 ditches)	93.33	175.11	ft

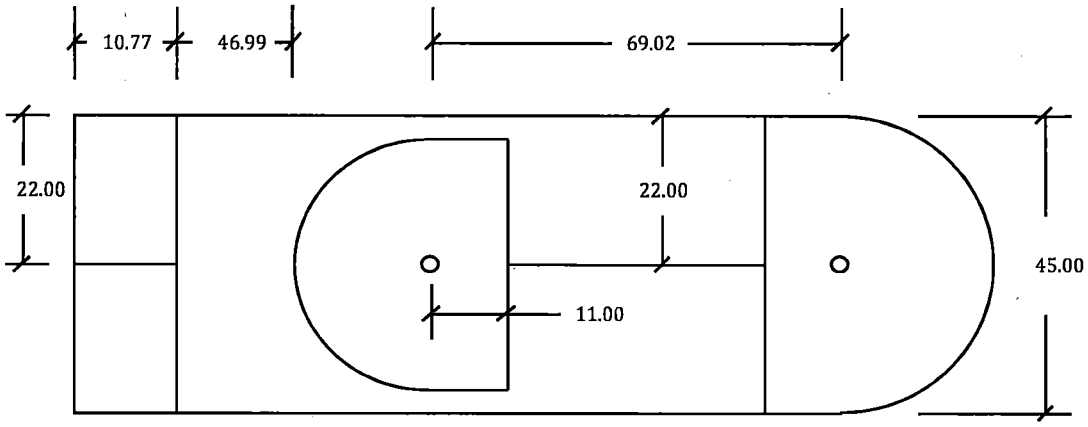
Concrete Estimate

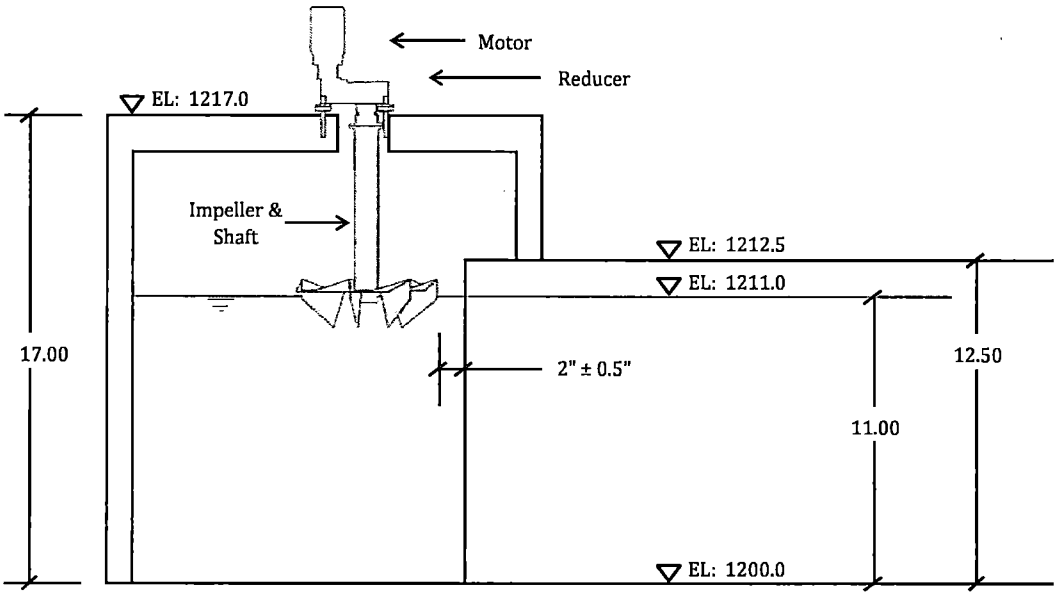
OxyStream BASIN OUTER WALLS	246	cu-yd
OxyStream BASIN INNER WALLS	320	cu-yd
OxyStream BASIN FLOOR	458	cu-yd
OxyStream BASIN FOOTINGS	283	cu-yd
Aerator Deck(s)	175	cu-yd
Total Estimated Concrete	**1481**	**cu-yd**

Ditch Layout

Drawing Not To Scale
Dimensions Given in Feet
Dimensions listed are interior dimensions

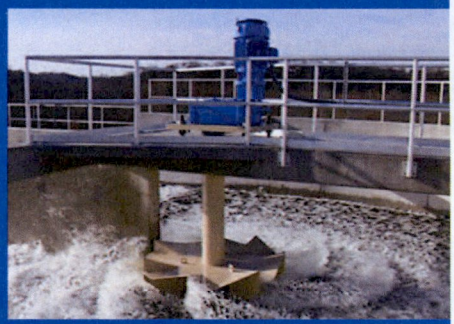
Shown: 1 of 2

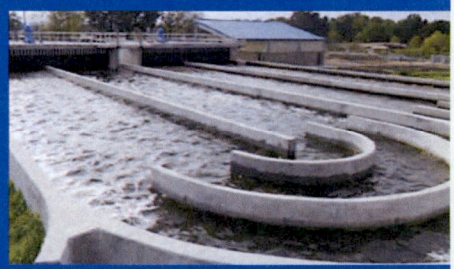




OxyStream™

Biological Nutrient Removal System





ISO 9001 WesTech CERTIFIED QUALITY SYSTEM

WesTech®

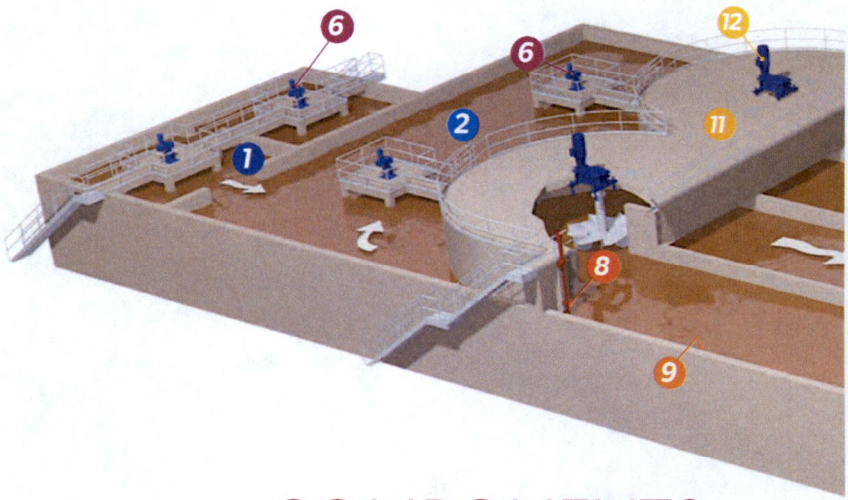
OxyStream™ Oxidation Ditch

The OxyStream™ oxidation ditch system combines slow-speed surface aerators with an oxidation ditch design based on site-specific conditions and WesTech's proprietary hydraulic model.

Why Choose an OxyStream™?

The OxyStream™ oxidation ditch is a modified, activated-sludge, biological treatment process that removes biodegradable organics from wastewater. The OxyStream™ process combines vertically mounted, low-speed surface aerators with a continuous racetrack layout to maximize oxygen transfer efficiency while maintaining the greatest flexibility for power turndown.

In addition, the OxyStream™ has greater side water depths and fewer required aerators than a conventional brush rotor or disc rotor oxidation ditch. The vertical slow-speed surface aerator eliminates maintenance-prone horizontal shafts, pillow-block bearings, and drive units near the water surface.



Process System

WesTech provides a complete and complementary process design for every OxyStream™ application. After a thorough review of the influent characteristics, WesTech's engineers generate process calculations and size the reactors. The oxidation ditch dimensions and oxygen requirements then dictate the proper impeller size and aerator horsepower.

If required, biological selector zones may be added to create a process flow sheet that can meet the most stringent nutrient limits. The OxyStream™ system is backed by a WesTech process guarantee and includes operator process training.

Features

- **Most Efficient Surface Aerator**
- **Increased Power Turndown**
- **Proven Technology**
- **Performance Guarantees**
- **Equipment Monitoring**
- **Flexible/Automated Operation**
- **No License Fees**

Benefits

- **Energy Savings**
- **Improved Pumping Capacity**
- **Minimized Downtime**
- **Extended Drive Unit Life with Lower Operational Forces**
- **Improved Process Performance**
- **High-quality Effluent**

COMPONENTS

6 Selector Zone Mixer

These mixers are sized to keep the solids in suspension for optimal contact time. Vertical turbine mixers are shown, however floating and submersible types can be used as well.

7 Turning Vanes

These walls minimize hydraulic losses, increase channel velocity, and prevent solids settling in the bend of the reactor.

8 Internal Recycle Gate

This gate allows the nitrate recycle stream to flow from the aerobic channels to the pre-anoxic zone without any pumping.

9 Dissolved Oxygen Probe

The dissolved oxygen (DO) probe controls the oxygen input of the surface aerators. The DO should be low prior to entering the pre-anoxic zone.

STAGES

1 Anaerobic Selectors

In this zone, return activated sludge and the influent wastewater mix together without oxygen or nitrate present, promoting increased phosphorus uptake in the aerobic channels.

2 Pre-anoxic Zone

The activated sludge and wastewater mixture then combines with a nitrate recycle stream in the pre-anoxic zone, removing nitrogen as gas through the denitrification process.

3 Aerobic Channels

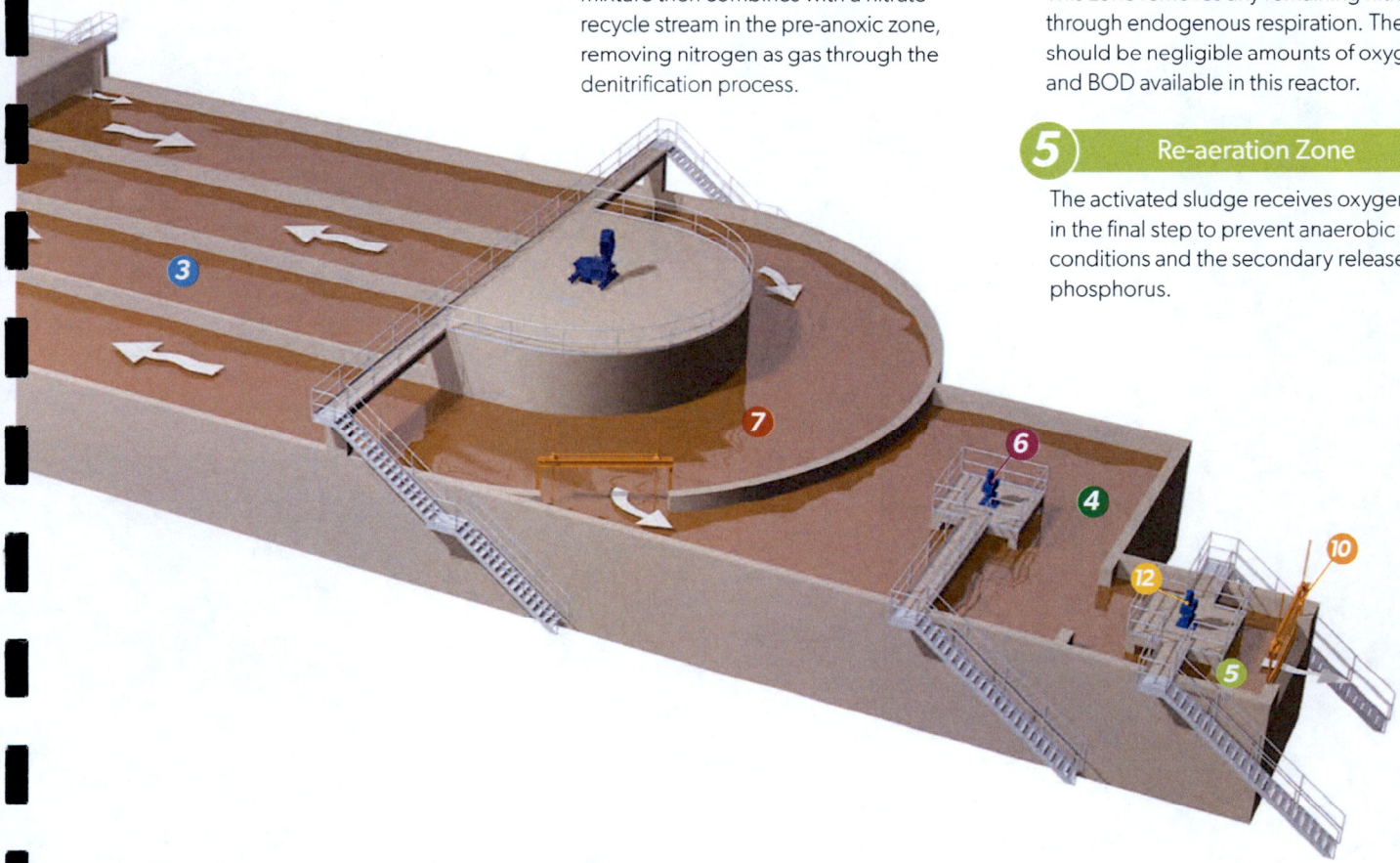
The proper amount of oxygen and mixing allows the complete oxidation of BOD and ammonia. Organisms selected in the fermentation stage accumulate phosphorus for removal in the waste sludge.

4 Post-anoxic Zone

This zone removes any remaining nitrate through endogenous respiration. There should be negligible amounts of oxygen and BOD available in this reactor.

5 Re-aeration Zone

The activated sludge receives oxygen in the final step to prevent anaerobic conditions and the secondary release of phosphorus.



10 Effluent Weir

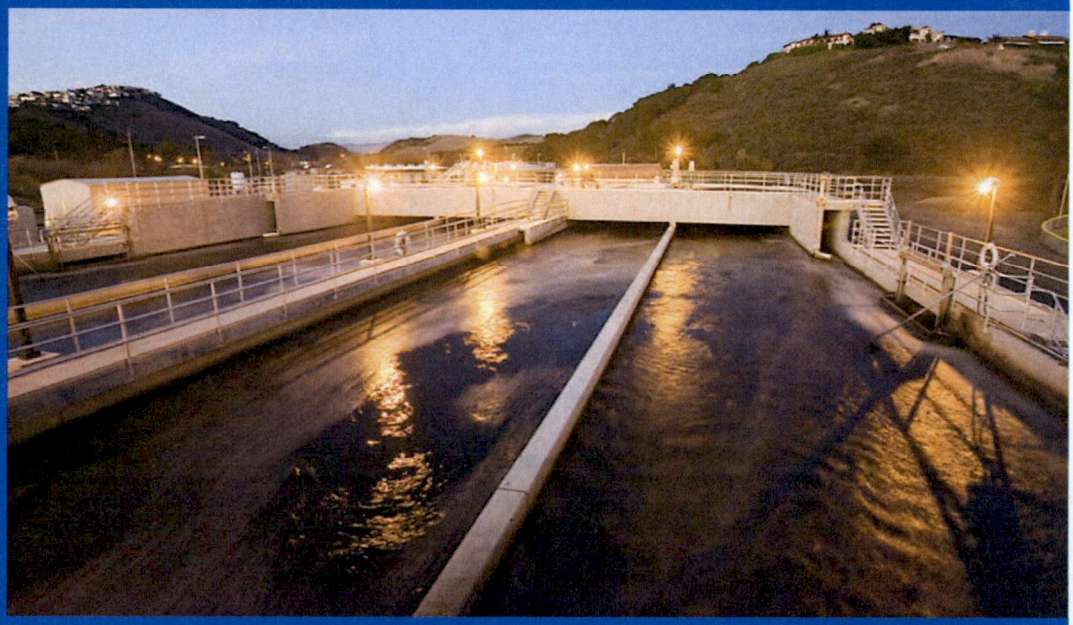
The flow moves over the weir to the secondary clarifier for liquid-solids separation. The weir can be adjusted to set the proper impeller submergence.

11 Aeration Deck

The aeration deck contains all splashing and aerosols from the aerator. It also provides a safe environment for routine maintenance.

12 Landy-7 Surface Aerators

At the heart of every OxyStream™ is the Landy-7 slow-speed surface aerator providing both aeration and mixing. This impeller has the highest oxygen transfer efficiency (OTE) of any slow-speed surface aerator on the market today, achieving a guaranteed minimum OTE of 3.8 pounds of oxygen per horsepower per hour in oxidation ditch applications.



Represented by:

WesTech®

Tel: 801.265.1000
westech-inc.com
info@westech-inc.com
Salt Lake City, Utah, USA

COP™ Spiral Blade Clarifier

Rapid Solids Removal

ISO 9001 WesTech CERTIFIED QUALITY SYSTEM

WesTech®

Clarifier Optimization Package

The WesTech Clarifier Optimization Package (COP™) is the result of research and design focused on building a better clarifier. Each COP™ is designed for the specific process requirements of each plant. Proprietary algorithms are utilized to result in a clarifier that provides high performance.

Why Choose a COP™ Clarifier?

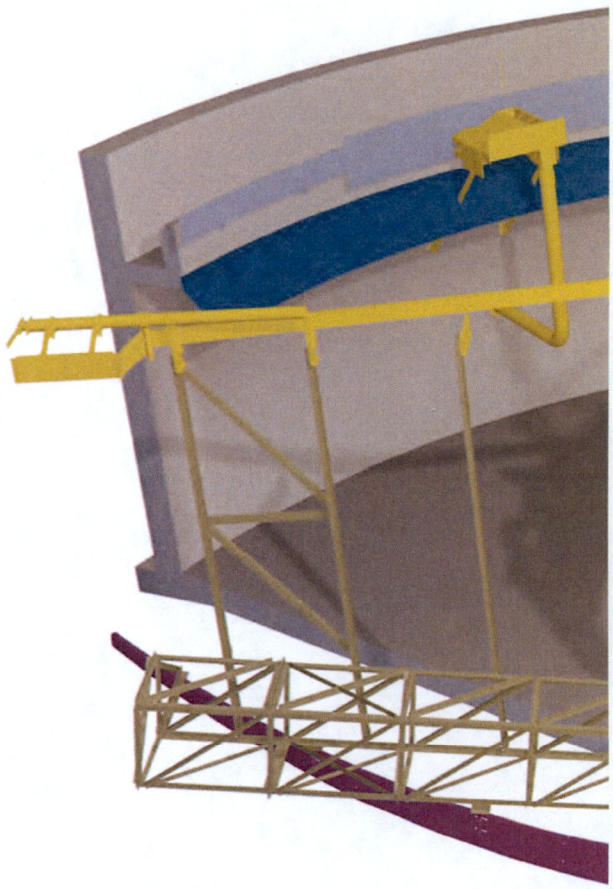
For nearly 30 years, with more than 1,500 installations, WesTech has been improving the performance of both primary and secondary clarifiers with our Clarifier Optimization Package (COP™). WesTech COP™ clarifiers:

- **optimize the clarification process**
- **produce the cleanest possible effluent**
- **maximize underflow concentration**

The influent center column of the COP™ clarifier is sized and ported to both prevent settling and to systematically reduce incoming velocities. WesTech's unique Dual-Gate™ EDI nearly eliminates hydraulic energy as the flow enters the feedwell. Flow enters at the water surface, ensuring that the full volume of the flocculation well is used for gentle mixing and flocculation of the biological solids. Opposing adjustable gates are arranged so that incoming flow impinges on itself, effectively dissipating incoming energy and eliminating focused flow streams that could carry into the clarification zone. The result is a well-flocculated mixed liquor that spreads gently and evenly into the clarifier without disturbing settled solids on the basin floor.

Side-by-side studies show a 27% reduction in effluent suspended solids when using the new Dual-Gate™ EDI versus a conventional EDI in shallow secondary clarifiers.

WesTech's Dual-Gate™ EDI is just one of many benefits provided by the Clarifier Optimization Package. Contact WesTech to find out more about why the COP™ may be a perfect fit for your plant.



Premium Drive Unit

Designed for torque requirements from 1,000 ft-lbs to 6,000,000 ft-lbs, the Premium Drive Unit provides rotational force to the clarifier mechanism while resisting torque loads and overturning moments.

Spiral Rake Blades

Increase sludge transport capacity, providing rapid solids removal, and lower sludge blankets. Eliminate septicity and denitrification.

Density Current Baffle

Eliminates wall currents and prevents short-circuiting. The wall-mounted baffle is low in cost and requires no maintenance.

Scum Removal

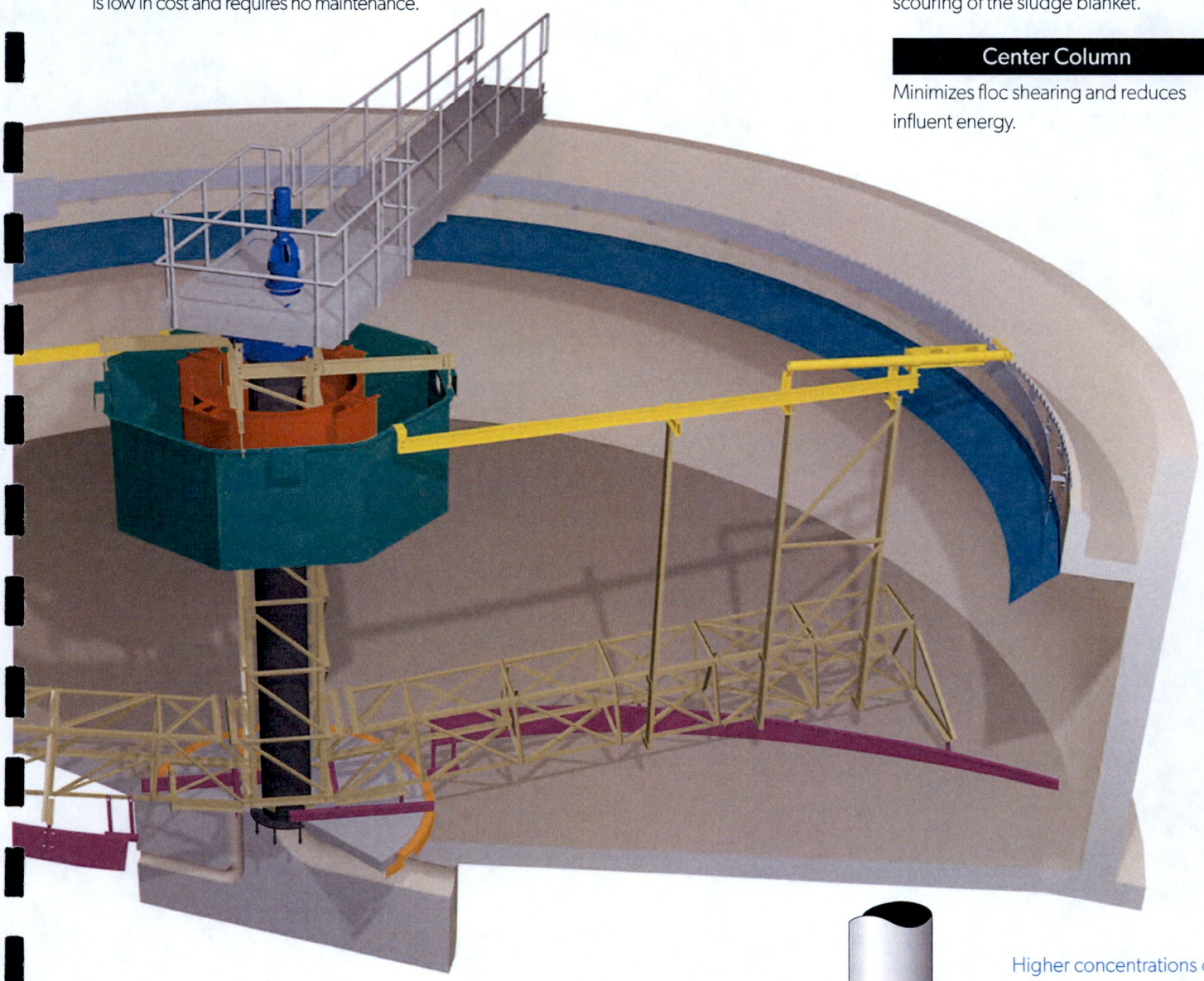
Removes scum build-up from within the feedwell and from the clarifier surface.

Flocculating Feedwell

Promotes hydraulic flocculation in the inlet area and is designed to eliminate scouring of the sludge blanket.

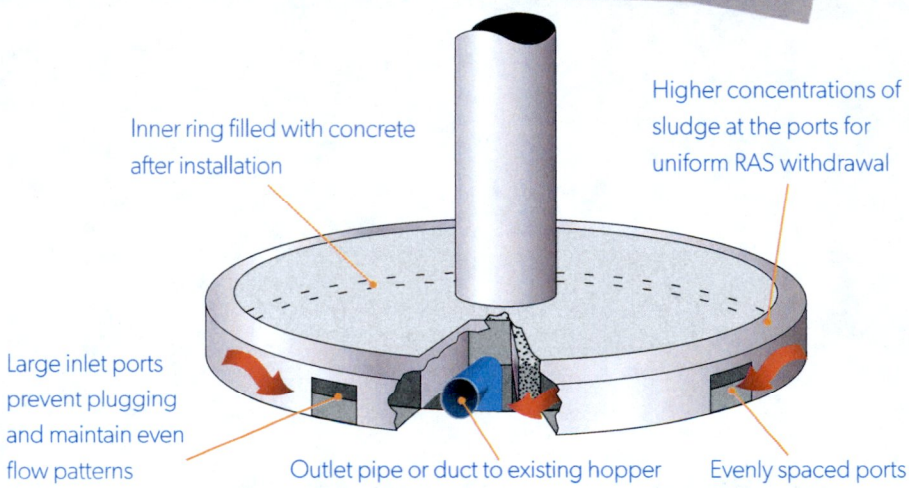
Center Column

Minimizes floc shearing and reduces influent energy.



Sludge Withdrawal Ring

Reduces the depth of the sludge blanket in a secondary clarifier – decreasing sludge scour and increasing hydraulic capacity, as well as reducing the possibility of denitrification and phosphorus removal in BNR processes. The Sludge Withdrawal Ring provides rapid solids removal in conjunction with Spiral Rake Blades.



Represented by:

WesTech®

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westech-inc.com
info@westech-inc.com
Salt Lake City, Utah, USA

Mechanically Cleaned Bar Screen

Design and Information Provided by Duperon

CRIST JOB NO.
1618

City of Walnut Ridge
Arkansas 1874

PRELIMINARY ENGINEERING REPORT
WASTEWATER IMPROVEMENTS
JUNE 2018

From: Stephen Eoff
To: Craig Johnson
Cc: "Mark Hickok"; "Sherman"
Subject: Walnut Ridge
Date: Tuesday, May 08, 2018 10:38:44 PM
Attachments: Controls Selection Guide.docx
LOW FLOW 4 FT.dwg
LOW FLOW 4 FT.pdf
P9766 Walnut Ridge AR Design Status Report.pdf
P9766 Walnut Ridge AR Preliminary Budget.pdf

Craig,
Please see attached scope of work and preliminary budget for Duperon Flex Rake, Low Flow, Fully Enclosed Bar Screen. Please let me know if you have any questions or need any additional information.

Thanks,
Stephen

Stephen Tyler Eoff
Sales Engineer
Jack Tyler Engineering, Inc.
6112 Patterson Road
Little Rock, AR 72209
Office: (501) 562-2296
Cell: (501) 804-7559
Email: steoff@jteng.com
www.jteng.com

Duperon ADAPTIVE TECHNOLOGY™

Let's Build a System that Works for You™

Date: May 7, 2018

Project: Walnut Ridge AR **Proposal Number:** 9766 R4

DESIGN STATUS REPORT

To: Craig A. Johnson, P.E.
Crist Engineers
205 Executive Ct
Little Rock AR, 72205
(501) 664-1552

From: Your Duperon® Team
Mike Olvera
Lead Sales Project Manager
(989) 754-8800
molvera@duperon.com

Rep: Stephen Eoff
Jack Tyler Engineering, Inc
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6112 Patterson Rd
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steoff@jteng.com

Mark Hickok
Regional Sales Manager
(989) 412-0289
mhickok@duperon.com

The **Design Status Report** is an integral part of the **Equipment and Project Scope.** Duperon® utilizes customer data and assumptions to follow design progress and ensure a comprehensive solution is developed and delivered.

In lieu of available data, Duperon® will assume standard data values which are indicated by an asterisk (*).

PROJECT STATUS & CUSTOMER NEED

Current Project Stage: Preliminary	**Project History:**
Project Timeline:	
Project Owner: Walnut Ridge AR	
Project Engineer: Crist Engineers	**Customer Desired Result:**
Retrofit or New: New Construction	New Low Flow Bar Screen
Application: Wastewater	

EQUIPMENT SUMMARY

Solution Scope		
Equipment Type	**Quantity**	**Model Designation**
Bar Screen(s)	1	LF - LowFlow
Perforated Plate Screen(s)		
Washer Compactor(s)		
Conveyor(s)		

SITE OPERATIONAL DATA

Flow Characteristics & Control		
*	Flow Characteristics:	WW
	Debris Characteristics:	
	Upstream Flow Control	
	Downstream Flow Control:	
	Upstream Depth Control:	
	Downstream Depth Control:	

SPECIAL SITE NOTES & CONSIDERATIONS

Duperon ADAPTIVE TECHNOLOGY™
Let's Build a System that Works for You™

Date: May 7, 2018

Project: Walnut Ridge AR **Proposal Number:** 9766 R4

PRELIMINARY BUDGET EQUIPMENT SCOPE

To: Craig A. Johnson, P.E.
Crist Engineers
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Duperon ADAPTIVE TECHNOLOGY™
Let's Build a System that Works for You™

Date: May 7, 2018

Project: Walnut Ridge AR **Proposal Number:** 9766 R3

PRELIMINARY BUDGET EQUIPMENT SCOPE

Thank you for considering **Duperon®** system solutions for your project. We appreciate the opportunity to provide you with a **Preliminary Budget Equipment Scope**. Please do not hesitate to contact your **Duperon® Team** with any questions as we work with you through the design process and ensure a successful project.

Equipment Scope

SCREENS: Assumptions made for missing information

QTY	UNIT	DESCRIPTION		
1	EA	**Duperon® FlexRake® - Front Clean Front-Return**		
		Model:	LF - LowFlow	
Notes: Based on peak flow the STD bar length had to be increased to 30" to meet the max water upstream required.		Enclosure (& Material):	Fully Enclosed (304)	
		Nom Width x Length:	2 ft wide x 4 ft deep Screen	
		Clear Opening Size:	0.5 in	
		Angle of Installation:	30	Deg. from Vertical
		Material Construction:	304	SSTL

CONTROLS

QTY	UNIT			
1	EA	**Main Control Panel:**	**1 Low Flow Screen**	
		Power:	480V/3ph/60hz	
Notes: Assumed controls. Attached please find the control selection guide for additional site specific controls		Panel Rating:	NEMA 4X	
		PLC/Relay Based:	Relay	
		Screen Instrumentation:	Single Mechanical Float	
		Local Pushbutton Station(s):	Three Button (E-Stop/Run/Jog Rev)	

TECH/FREIGHT

QTY	UNIT	DESCRIPTION		
1	LOT	**On-Site Technical Assistance**		
		Number of Trips:	1	Trip(s)
		Days On-Site per Trip:	1	8-hour man-day(s)
1	LOT	**Freight**		
		FOB Factory, Full Freight Allowed		

Clarifications:

- This is not a fully designed project; preliminary pricing may be affected by scope change/project development
- Operational, structural, wind, or seismic calculations are not included
- Scope is based on models and assumptions widely utilized in the industry
- Scope does not convey an offer to sell; installation and taxes are not included
- **For reference only:** Standard Delivery Schedule: Submittals 4-6 week from PO - Delivery 8-12 weeks from approval

PRELIMINARY BUDGET PRICING: **$71,000.00**

Duperon ADAPTIVE TECHNOLOGY™
Let's Build a System that Works for You™

Date: May 7, 2018

Project: Walnut Ridge AR **Proposal Number:** 9766 R3

OPTIONAL EQUIPMENT AND ACCESSORIES

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Optional Equipment

Washer Compactor

QTY	UNIT	DESCRIPTION	
1	EA		**Duperon® Washer Compactor**
		Model:	WC2.A1.5
Notes:		Appx Footprint:	2 ft wide x 7 ft long
		Motor HP:	0.75 HP
		Chute Allowance:	10 ft long w/ 1 bend (customizable)
		Material Construction:	304 SSTL
		ADD PRICE (EA):	**$55,000.00**

Conveyor

QTY	UNIT	DESCRIPTION	
1	EA	**Conveyor**	**Shaftless Screw Conveyor**
		Appx Footprint:	2 ft wide x 10 ft long
Notes:		Motor HP:	1 HP
		Material Construction:	304 SSTL
		ADD PRICE (EA):	**$18,000.00**

Optional Accessories

Bar Screen Deadplate Heat Pad
24" x 24" heat pad (power by others)
Thermostat

ADD PRICE (EA): $3,000

Bar Screen Deadplate Heat Pad
12" x 12" heat pad (power by others)
Thermostat

ADD PRICE (EA): $1,800

Washer Compactor Chute Extension
10 ft extension beyond the 10 ft supplied
Includes 1 support leg for extension
(Additional support legs $600 ea.)

ADD PRICE (EA): $2,100

Washer Compactor Elephant Drop Sleeve
Solid canvas flexible tube
10 ft overall length
Attaches directly to discharge chute

ADD PRICE (EA): $1,575

Washer Compactor Heat Trace & Blanket Kit
Required in applications where freezing temperature are possible
Teflon heat blanket (weather-proof) construction
Thermostat (NEXA 4X) with remote probe for temperature reading
Components are CLASS I DIVISION I rated

ADD PRICE (EA): $5,000

Washer Compactor Bagging System
Longofill cassette holder - SSTL & ABS plastic
Longopac PE continuous bagger cassette, 295 ft (90 m)

ADD PRICE (EA): $3,400

Washer Compactor Caster Frame System
304SSTL frame structure
4 highly durable casters
***NOTE:** All conduit, hardware, quick disconnects and field wiring between equipment shall be provided by others

ADD PRICE (EA): $3,855

Washer Compactor Open Channel Support Frame
304SSTL frame structure
Custom built to span open channels

ADD PRICE (EA): $1,770

Duperon ADAPTIVE TECHNOLOGY™
Let's Build a System that Works for You™

Date: May 3, 2018
Project: Walnut Ridge AR
Number: 9766

HYDRAULIC CALCULATIONS

Notes: 3-4 MGD Peak Flow max water called out below along with bar opening to meet peak flow

INPUT: Channel Physics

Flow in MGD	4.00	MGD
Upstream water level	1.60	ft
Channel width	2.00	ft
Channel depth	4.00	ft
Degree of blinding	25%	

INPUT: Screen Physics

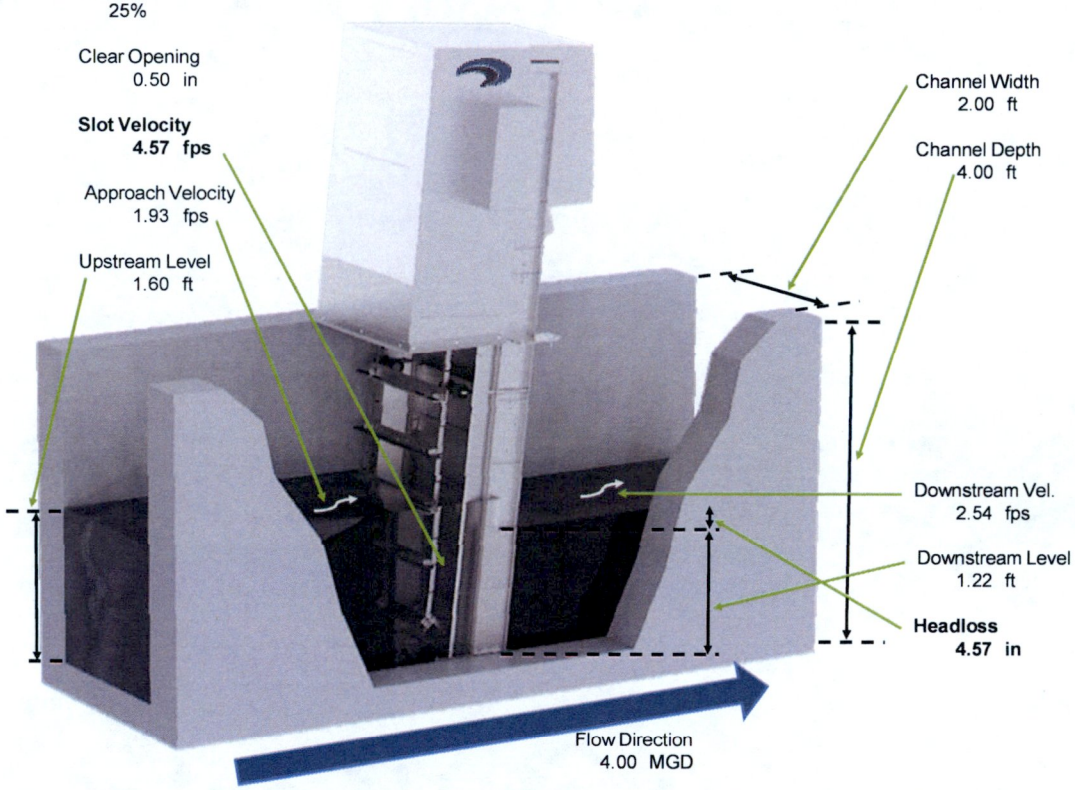
Clear Opening	0.50	in
Bar thickness	0.25	in
Thickness of side fab and closeout (2)	0.33	ft

Calculations

Side fab & closeout area	0.53	sft
Flow area between side fab & closeouts	2.67	sft
Number of bars	26.00	ea
Flow area taken up by bars	0.87	sft
Total Channel flow without screen	3.20	sft
Flow area after screen area and blinding taken out	1.35	sft
Approach Velocity	1.93	fps
Slot Velocity	4.57	fps
Downstream Velocity	2.54	fps
Downstream Depth	1.22	ft
Head Loss	4.57	in

Bernoulli Calculations

Velocity thru bar scren	4.57	fps
Velocity upstream of bar screen	1.93	fps
Gravitational acceleration (constant)	32.20	fps
Frictional coefficient (constant)	1.43	c
Headloss	0.38	ft
Headloss	4.57	inches



These calculations are an estimation based upon the information available. Flow channel hydraulics are highly dependent on water levels and the degree of blinding. The calculations above are a snapshot of only one condition. To fully analyze the hydraulics please contact your local Duperon representative.
Duperon recommends a minimum of 1.00 ft water depth when the unit is in operation to keep the SSTL FlexLinks lubricated and ensure an optimal amount of screening area.

1200 Leon Scott Court | Saginaw, MI 48601 | P 989.754.8800 | F 989.754.2175 | TF 800.383.8479 | www.duperon.com

The Advantage of FlexRake® Adaptive Technology™ for Low Flow Applications

FlexRake® Low Flow

Cost-Effective Screening for Low Flow Applications

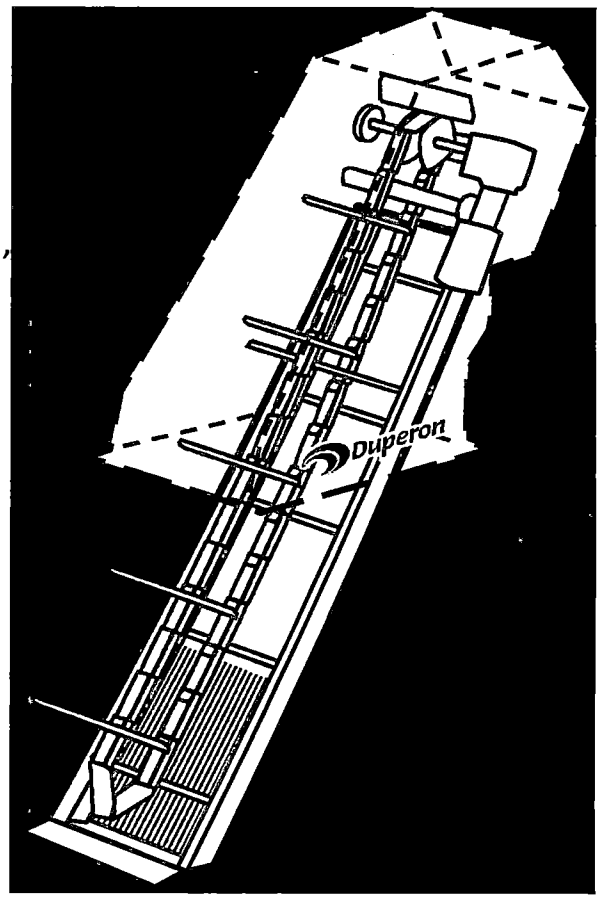
Unusually affordable, simple, front cleaning, front return bar screen technology. Specifically designed for plants of 1 mgd or less average flow with channels 2 to 6 feet deep by 1 to 2 feet wide. Available with bar openings of 1/4 inch, 1/2 inch, 3/4 inch and 1 inch.

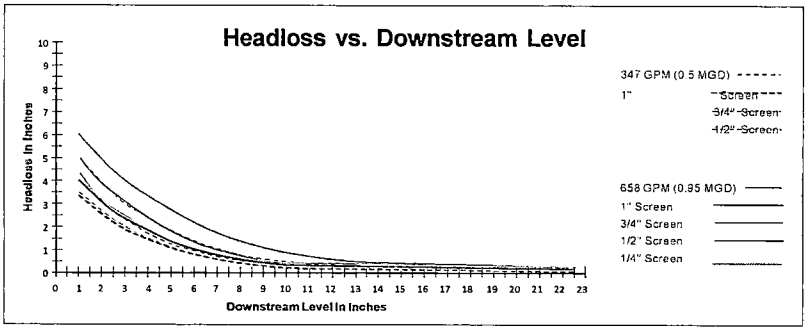
- Pre-Engineered to be Energy Efficient to Save You Time and Money
- Standard Features Include: Easy Controls, Spray Wash for Screenings, All Stainless Steel Construction
- Tear-Drop Shaped Bars Provide Highest Efficiency in the Industry; 25%-50% More Efficient
- Exclusive Thru-Bar™ Scrapers Clean 3 Sides of the Bar
- Proven Duperon® FlexRake® Technology: No Lower Bearings, Sprockets, Jam Points or Confined Space Entries

Duperon ADAPTIVE TECHNOLOGY™

The Duperon® FlexRake® Low Flow

- UHMW Low Flow SmartLink™— Completely Corrosion-Resistant Links Provide Long Life, Allows for "Dry" Operation
- Integral Enclosure Provides Easy Installation, Access and Viewing
- No Carryover, No Scheduled Lubrication, No Maintenance





GENERAL

Average Flow Capacity:	1 MGD
Peak Flow Capacity:	4 MGD
Channel Width:	1 - 2 ft wide nominal
Maximum Liquid Level:	22"
Screen Area:	3.5 ft (vertical projection)
Bar Opening:	¼", ½", ¾", 1"
Range of Channel Depth:	2' to 6'
Minimum Water Depth:	0"
Discharge Height:	32.5" as measured from deck max.
Unit Height:	65.5" measured from deck
Unit OAL Width:	41.5" measured at widest point
Lifting Capacity:	500 lb
Motor Size:	¼ hp, TEFC Standard

UTILITY

1 Phase	(115 volt or 230 volt)
3 Phase	(240 volt or 480 volt)

PERFORMANCE

Scraper spacing:	20.8" (every third link)
Discharge Rate/Cleaning:	Every 24.7 seconds
Scraper Travel Speed:	50.5"/minute
Sprocket Speed:	1.82 RPM

MATERIALS OF CONSTRUCTION

Drive Mechanics:	304 Stainless Steel
Enclosure / Dead plate:	304 Stainless Steel
Screen Bars:	316L Stainless Steel
Chain / Scrapers:	UHMW PE—UV Stable
Motor:	Steel with Std DC coatings

CONTROL FUNCTIONALITY

Emergency Stop • On-Off • Run Monitoring (Dry Contact)
Explosion-proof controls available***

***Custom site wiring is necessary with explosion-proof option. Main panel is remote mounted, explosion-proof motor and NEMA 7/9 push button station provided. Wiring completed per local requirements.

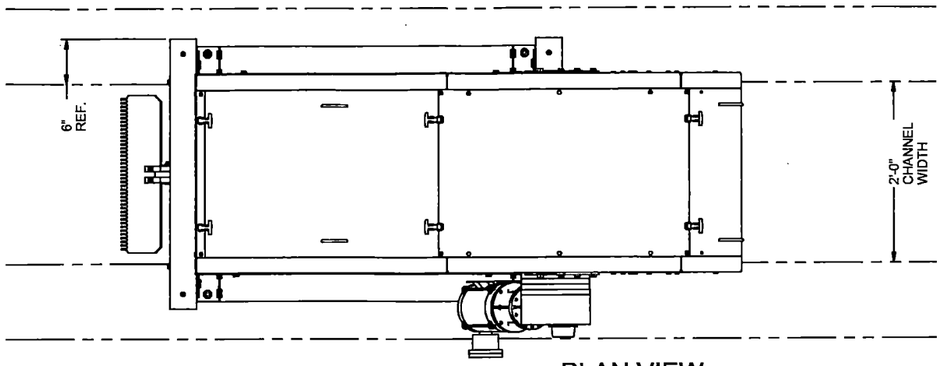
To Learn more about Duperon® Adaptive Technology™ scan this QR code or visit www.duperon.com

Duperon ADAPTIVE TECHNOLOGY
Let's Build a System that Works for You

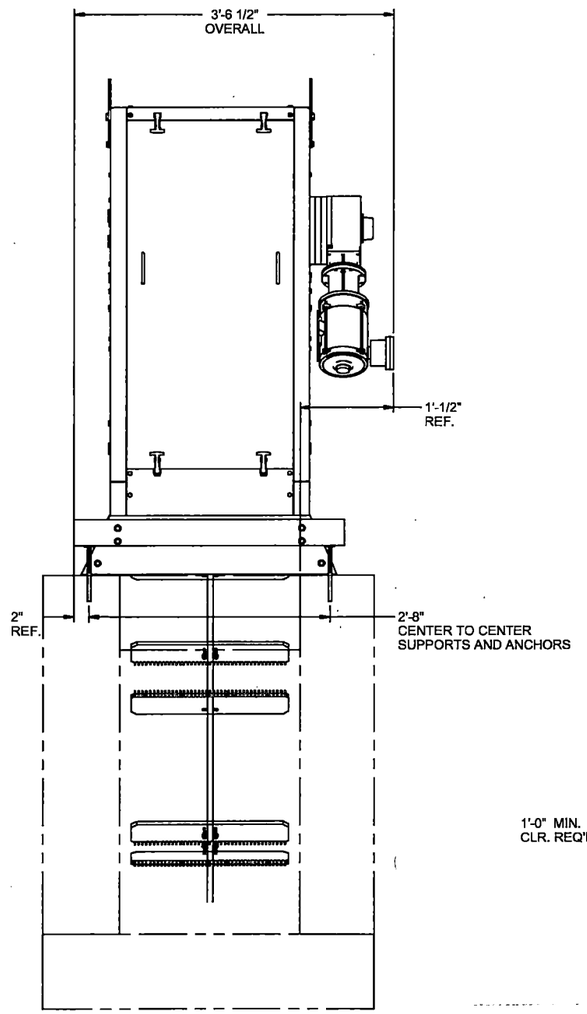
1200 Leon Scott Court | Saginaw, MI 48601 | P 989.754.8800 | F 989.754.2175 | TF 800.383.8479 | www.duperon.com

3007/3/16/0M

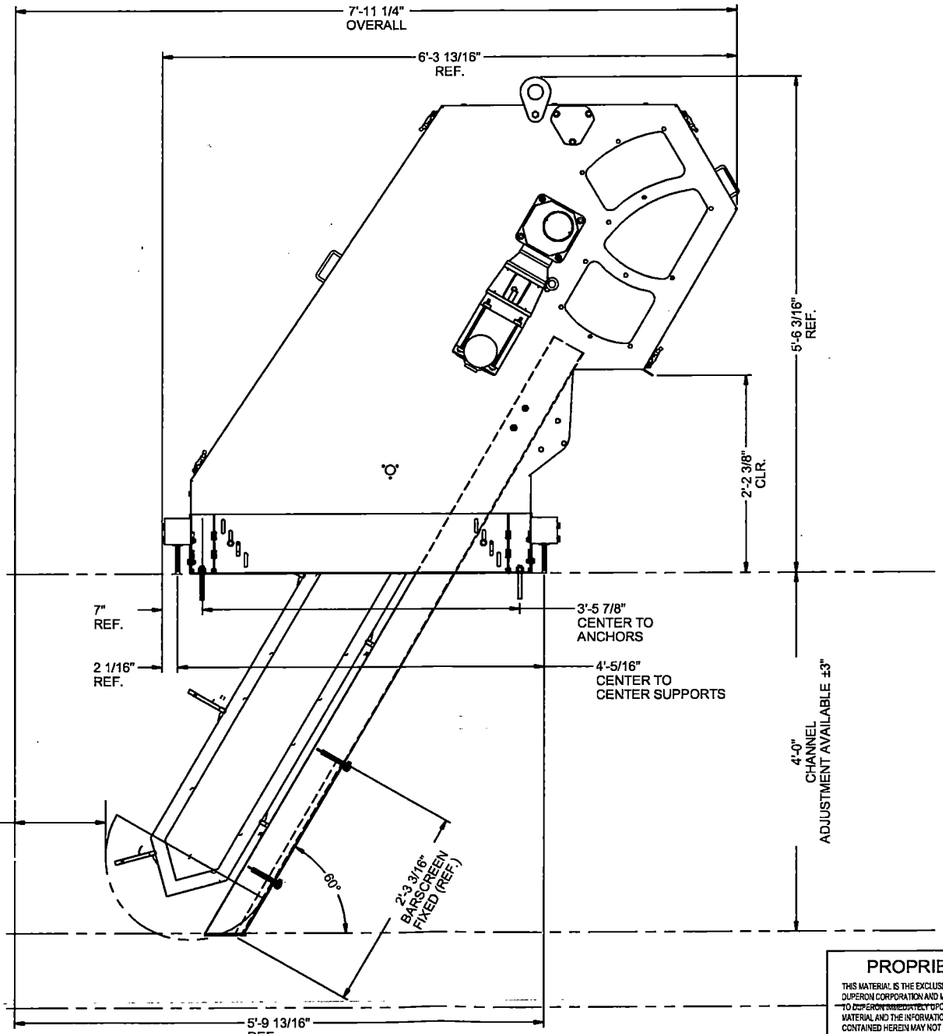
REVISIONS				
REV	DESCRIPTION	DATE	REVISED	APPROVED
1	UPDATED MODEL NAME AND DETAIL VIEW	08/25/09	JKL	-
2	UPDATED TITLE BLOCK LOGO	04/06/11	JKL	-



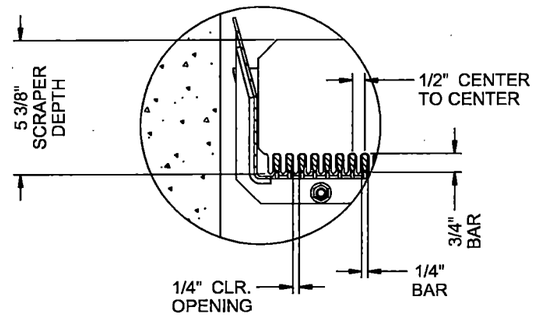
PLAN VIEW



FRONT VIEW



SIDE VIEW



DETAIL 1
1:4

SCRAPER DETAIL
1/4" CLEAR OPENING SHOWN
1/2", 3/4" & 1" OPENINGS AVAILABLE

PART MARK NO.	NO. OF PIECES REQ'D.	DESCRIPTION	MAT'L STOCK	WT#	FEET	INCH LENGTH	NOTES

TEMPLATE

DIMENSIONING & TOLERANCING IN ACCORDANCE WITH ANSI Y14.5M-1982
TOLERANCES - UNLESS OTHERWISE SPECIFIED
.X = ±0.03
.XX = ±0.005
.XXX = ±0.0005
.XXXX = ±0.00005
ANGULAR = ±0.5°

Duperon®
Saginaw, Michigan 48607
TF 800.383.8479

DRAWN	JKL	DATE 02/01/09
CHECKED	-	DATE -
APPROVED	-	DATE -
APPROVED		DATE
APPROVED		DATE

SHEET TITLE
DUPERON CORPORATION
Low Flow FlexRake®

PART NAME
MAIN LAYOUT

SIZE	FSCM NO.	DWG. NO.	REV
D		LF FR 24x 4 FT	2

SCALE - SHEET 1 OF 1

Duperon® ADAPTIVE TECHNOLOGY™

PRELIMINARY LIQUIDS/SOLIDS SEPARATION SYSTEMS

CONTROLS SELECTION GUIDE

1. Main control panel power feed?

☐ 480V 3Ph ☐ 230V 3Ph ☐ 208V 3Ph ☐ 240V 1Ph ☐ 120V 1Ph

2. For multiple equipment installations?

☐ Separate main control panel(s) ☐ Combined main control panel(s)

3. Is the main control panel indoors or outdoors?
Verify that the intended main control panel location is in an unclassified area.

☐ Indoors ☐ Outdoors

1. NEMA rating? ☐ NEMA 12 ☐ NEMA 4X

2. Panel material? ☐ 304SSTL ☐ 316SSTL ☐ Painted CS

3. Climate controlled room if indoors?

_____

4. Under cover or shade structure if located outdoors?

_____

5. Panel size restrictions?

_____

6. Highest ambient temperatures?

_____

4. Internet access at main control panel?

☐ None ☐ Wired ☐ Wireless

5. Interest in remote access and fault notifications via email/text (Internet access not required)?

☐ Yes ☐ No

6. Level control package preferred? (See Application Guide Below)

☐ A. No Level Control
☐ B. Single Upstream Float
☐ C. Dual Upstream Float
☐ D. Upstream Level Transducer
☐ E. Upstream/Downstream Level Transducer

7. Logic Control

☐ Relay
☐ Unitronics PLC
☐ Allen Bradley MicroLogix
☐ Other

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Duperon® ADAPTIVE TECHNOLOGY™
PRELIMINARY LIQUIDS/SOLIDS SEPARATION SYSTEMS

CONTROLS APPLICATION GUIDE

A. NO LEVEL CONTROL – CYCLE TIMER/REMOTE START

WHEN:

- Plants that see low flows and where the peak flows don't vary from average flows significantly. Debris loading should be consistent. Optimum cycle timing can be achieved based on performance over time.
- Also suitable for pump station applications where the Flexrakes© can be cleared (exercised) using the cycle timer, but continuous operation initiated using the remote start input prior to starting the pumps.

WHY:

- Very simple, maintenance free, low cost impact

B. SINGLE UPSTREAM FLOAT WITH CYCLE TIMER/REMOTE START

WHEN:

- Plants that experience low but varying flows and consistent debris loading.
  - At very low flow conditions, float not tipped, the FlexRake© clears (exercises) based on the cycle timer. At higher flows, float tipped, the FlexRake© runs continuously at low speed.

WHY:

- Simple, low maintenance, low cost Impact

C. DUAL UPSTREAM FLOAT WITH CYCLE TIMER/REMOTE START

WHEN:

- Plants that experience varying flows and/or debris loading.
  - At very low flow conditions, lower float not tipped, the FlexRake© clears (exercises) based on the cycle timer. At higher flows, lower float tipped, the FlexRake© runs continuously at low speed. As flow or debris loading increases, level will build until the upper float tips, increasing the FlexRake© speed to high.

WHY:

- Simple, low maintenance, low cost impact

D. UPSTREAM LEVEL TRANSDUCER WITH CYCLE TIMER/REMOTE START

WHEN:

- Functionally similar to the dual upstream float. Optional back up float switches are common.

WHY:

- Transducers can allow for easier level setpoint adjustability as well as multiple level setpoints and speed settings.
- Ultrasonic transducers provide for level sensing that is not in the flow.
- Submersible transducers require the addition of a PLC. They are generally easier to set up but do require occasional cleaning. Often used in very tight channels or where foaming is a concern.
- This is a more complex solution and may require a higher level of site expertise and training. It is also more expensive than float level control and those costs can vary widely depending on the transducer technology used and the PLC platform specified.

E. UPSTREAM AND DOWNSTREAM LEVEL TRANSDUCER WITH CYCLE TIMER/REMOTE START

WHEN:

- For plants with high and/or highly varying flows and debris. FlexRake© 3mm and FlexRake© Sentinel PFE applications
  - The use of upstream and downstream level transducers allow the differential level across a screen to be calculated. Differential level is a direct indication of screen blinding.

WHY:

- Differential level can be used to optimize FlexRake© performance. Generally, as the differential level increases, so does the speed of the FlexRake©. Upstream level is also used to increase the speed of the FlexRake©.
- Again, this is a more complex solution and may require a higher level of site expertise and training. It also has a higher cost impact than float level control and those costs can vary widely depending on the transducer technology used and the PLC platform specified.

Existing Chlorine Contact Basin

Maximum Volume and Performance Calculations

Crist Engineers

City of Walnut Ridge
Arkansas 1874

Crist Job No.
1618

Preliminary Engineering Report
Wastewater Improvements
June 2018

Walnut Ridge, Arkansas, Crist Job No. 1618

WWTP Chlorine Contact Basin Capacity Calculations Summary

December 11, 2017

Plans from construction of basin (see note 4 on sheet WR-9208) state the following: "Chlorination Basin has a volume of 50,150 gallons, which will provide detention time of 18.8-minutes at peak flow rate and 60 minutes at average design flow."

Flow Rate (Peak): 3.84 MGD (Design)
Flow Rate (Average): 1.176 MGD (Design)
Water Depth (Peak): 10.21-feet (94.22-feet MSL)

A. Determine Maximum Capacity of Chlorine Contact Basin, based only on Freeboard Depth

Ten State Standards: A minimum contact time of 15 minutes at design peak hourly flow or maximum rate of pumpage shall be provided after thorough mixing. (mixing: turbulent flow or mechanical mixer).

****Per 100-3, Part 102.44: For evaluation of existing chlorine contact tanks, field tracer studies should be done to assure adequate contact time.*

****Total Residual Chlorine limit modified with permit renewal, **from 0.1 mg/L to 0.011 mg/L**, see 12.A.1 of Fact Sheet in Permit.*

1. Determine Limiting Factors:

a. Interior Suppressed Weir Elevations: 93.5 FT
Maximum Allowable Head Over 5-foot suppressed weir: 2.5 FT
Maximum Water Depth at Suppressed Weirs = 96 FT
Water Depth in Basin = 96FT – 84FT = 12-feet

b. Interior Baffle Walls Elevation: 95.5 FT
With 1' Freeboard = 94.5 FT
With 1.5' Freeboard = 94.0 FT
Water Depth in Basin, 1' FB = 94.5FT – 84FT = 10.5-feet
Water Depth in Basin, 1.5' FB = 94.0FT – 84FT = 10.0-feet

c. V-Notch Weir (90-degrees) at Effluent Elevation: 91.5 FT (bottom), 93.5 FT (top)
Maximum Allowable Head Over 90-Degree V-Notch Weir: 2.0 FT
Maximum Water Depth at V-Notch Weir = 91.5FT + 2.0FT = 93.5FT

2. Determine Maximum Depth:

Since Elevation of 96.0 FT is > Elevation of interior baffle walls of 95.5 FT, Discard depth of 12 FT.
Maximum Elevation at Interior Baffle Walls of 94.5 FT or 94 FT
Maximum Allowable Head over V-notch Weir, Elevation: 93.5 FT

Cannot Discard due to Elevation at V-notch Weir because it can be replaced at a higher elevation. Maximum water depth allowed with current structure = 10.5 feet. Effluent area of contact basin has dechlorination and aeration, do not use for calculations.

Minimum allowable contact time (per 10 State Standards) = 15 minutes

3. Depth of Interior Weir Walls, each end of Baffled Area: 9.5-feet (Elev. 93.5-feet MSL)

Area 1 Dimensions:	Width: 8-feet	Length: 18-feet
Area 2 Dimensions:	Width: 16-feet	Length: 32-feet

4. Determine Maximum Flow Rate:

At 10.5 feet: Area = 5376 CF	Q = 459 CFM (4.95 MGD)
At 10.0 feet: Area = 5120 CF	Q = 437 CFM (4.71 MGD)
At 9.5 feet: Area = 4864 CF	Q = 415 CFM (4.475 MGD)

Conclusion No. 1: Based only on volume and the minimum allowable contact time of 15-minutes, the Maximum Flow Rate Range:

4.475 MGD to 4.95 MGD

- ***Consideration of Permit Conditions, not part of these calculations: Total Residual Chlorine = 0.011 mg/L and Fecal Coliform Limit (200#/100ML or 400#/100ML).***

B. Determine Maximum Capacity of Chlorine Contact Basin, based on Actual Contact Time

Ten State Standards: A minimum contact time of 15 minutes at design peak hourly flow or maximum rate of pumpage shall be provided after thorough mixing. (mixing: turbulent flow or mechanical mixer).

****Per 100-3, Part 102.44: For evaluation of existing chlorine contact tanks, field tracer studies should be done to assure adequate contact time.*

****Total Residual Chlorine limit modified with permit renewal,* ***from 0.1 mg/L to 0.011 mg/L****, see 12.A.1 of Fact Sheet in Permit.*

1. Flow Rate for Future Design:

Q1 = 3.0 MGD (4.64 CFS)
Q2 = 3.5 MGD (5.415 CFS)
Q3 = 4.0 MGD (6.19 CFS)

2. Calculate Required Volume for Flow Rates, based on minimum Chlorine Contact Time (15 minutes):

For Q1 (@3.0 MGD): 4176 CF (31,239 Gal)
For Q2 (@3.5 MGD): 4874 CF (36,460 Gal)
For Q3 (@4.0 MGD): 5571 CF (41,674 Gal)

3. Calculate Water Depth at Flow Rates:

**Suppressed 5-foot Weirs at inlet and outlet of baffle area. Water depth will vary depending on the headloss over the two suppressed weirs. Suppressed weir wall (both) depth is 9.5-feet.*

Headloss Q1: H = 0.43-feet	Water Depth = 9.93-feet
Headloss Q2: H = 0.47-feet	Water Depth = 9.97-feet
Headloss Q3: H = 0.52-feet	Water Depth = 10.02-feet

4. Calculate Depth/Width (D/W) for each Flow Rate:

Channel Width1 = 5-feet (Two 5-foot wide channels)
Channel Width2 = 6-feet (One 6-foot wide channel)

Q1 @ 3.0 MGD	Depth = 9.93-feet	D/W @ 5' = 1.986	D/W @ 6' = 1.66
Q2 @ 3.5 MGD	Depth = 9.97-feet	D/W @ 5' = 1.99	D/W @ 6' = 1.66
Q3 @ 4.0 MGD	Depth = 10.02-feet	D/W @ 5' = 2.00	D/W @ 6' = 1.67

D/W Ratio Range: 1.66 to 2.00 > 1.0, Not Adequate Design

Note: Maximum allowable depth from Part A is 10.5-feet (94.5-Feet MSL), with 1-foot freeboard. D/W ratio should be 1.0 or less in chlorine disinfection basins. The drag on the sides of a deep, narrow tank or channel causes relatively poor dispersion characteristics.

5. Calculate Cross-Section Areas (Required) using Water Depths calculated in Step B3:

@ 3.0 MGD (9.93'):	Cross-Section @ 5' = 49.65 SF	Cross-Section @ 6' = 59.58 SF
@ 3.5 MGD (9.97'):	Cross-Section @ 5' = 49.85 SF	Cross-Section @ 6' = 59.82 SF
@ 4.0 MGD (10.02'):	Cross-Section @ 5' = 50.10 SF	Cross-Section @ 6' = 60.12 SF

6. Calculate Total Length (Required), using the Volume calculated in Step B2:

@ 3.0 MGD, Volume Q1 = 4176 CF	@ 5-feet Width: 84'	@ 6-feet Width: 70'
@ 3.5 MGD, Volume Q2 = 4874 CF	@ 5-feet Width: 98'	@ 6-feet Width: 81.5'
@ 4.0 MGD, Volume Q3 = 5571 CF	@ 5-feet Width: 111'	@ 6-feet Width: 93'

7. Calculate Actual Length of Chlorine Contact Basin, Area 2 (Baffled Area) Plus Area 1 (Influent):

*Note: Length of Baffled Area of Basin is 32-feet, total existing length is 32-feet * 3 channels = 96-feet. Basin influent area length is 18-feet (width 8-feet), total existing length is 96-feet + 18-feet = 114-feet.*

Total Existing Length of Influent and Baffle Area of Contact Basin: 114-feet

8. Calculate the exiting L/W Value:

Length (Baffle Area Only): 96-feet

Average Channel Width: 5.333-feet

L/W Ratio: 96-feet / 5.333-feet = 18.0 < 40 to 70, Not Adequate Design

Note: Adequate plug-flow tanks can be achieved by Length/Width (L/W) ratios of 40-70 to 1.

Sludge Production: Current Day (2017)

Volume/Quantity and Frequency of Removal Calculations

Crist Job No.
1618

City of Walnut Ridge
Arkansas 1874

Preliminary Engineering Report
Wastewater Improvements
June 2018

Wastewater Treatment Plant Improvements
Sludge Production & Storage Calculations

SLUDGE PRODUCTION

INITIAL SLUDGE PRODUCTION, 2017

SLUDGE PRODUCTION: The average sludge produced per day in pounds is assumed as 1,043 lb/day.

SLUDGE PRODUCTION CHECK: MOP 8 uses pounds per capita per day to determine theoretical solid retention time. Conservatively, the following calculation omits commercial and industrial water meters when determining water customers.

Assumed Solids Retention Time = 17 days

2017 Walnut Ridge Population Estimate = 4,757 people

2037 Walnut Ridge Population Estimate = 6,691 people

Equation #1 Pounds per capita per day (2017) = Avg. sludge production per day/
Population
(customers)
= 1,043 lb/day / 4,757 customers
= 0.219 lb/capita·day

Metcalf-Eddy finds that 0.2087 lb/capita·day equates to a solid retention time of 15 days and 0.1947 lb/capita·day equates to a solid retention time of 20 days. The theoretical solid retention times above correspond with assumed solid retention time of 17 days; therefore:

Sludge Production, yr 2017 = 1,043 lb/day
= 7,301 lb/wk
= 380,695 lb/yr (190 ton/yr)

PROJECTED SLUDGE PRODUCTION, 2037

The population estimate of Walnut Ridge in year 2037 is 6,691.

Equation #2 Sludge Production, yr 2037 = Pounds per capita per day (Eq. # 1) x
Population
= 0.219 lb/capita·day x 6,691 capita
= 1,465 lb/day
= 10,257 lb/wk
= 534,845 lb/yr (267 ton/yr)

INITIAL WET SLUDGE VOLUME, 2017

Daily Sludge Volume is assumed to be 0.8%to 1.2% of Daily Total Solids Produced (TS). The unit weight of sludge is assumed to be 65 lb/ft^3.

Equation #3 Daily Wet Sludge Weight = 1 day x Initial Weekly Sludge production / working days / (%TS/100)
= 1 day x 7,301 lb/wk / 7 days / (0.8/100)
= 130,375 lb

Equation #4 Daily Wet Sludge Volume = Daily Wet Weight (Eq. #3) / Unit Weight
= 130,375 lb / 65 lb/ft^3
= 2,006 ft^3

Equation #5 Daily Wet Sludge Volume = Volume (Eq. #4) x (7.48 gallons/ft^3)
= 15,006 gallons per day (gpd) (5.5 MG/yr)

Frequency of Sludge Removal = 5.5 MG/yr / 1.5 MG = 3.66 times per year

Equation #3 Daily Wet Sludge Weight = 1 day x Initial Weekly Sludge production / working days / (%TS/100)
= 1 day x 7,301 lb/wk / 7 days / (1.2/100)
= 86,917 lb

Equation #4 Daily Wet Sludge Volume = Daily Wet Weight (Eq. #3) / Unit Weight
= 86,917 lb / 65 lb/ft^3
= 1,337 ft^3

Equation #5 Daily Wet Sludge Volume = Volume (Eq. #4) x (7.48 gallons/ft^3)
= 10,001 gallons per day (gpd) (3.65 MG/yr)

Frequency of Sludge Removal = 3.65 MG/yr / 1.5 MG = 2.5 times per year

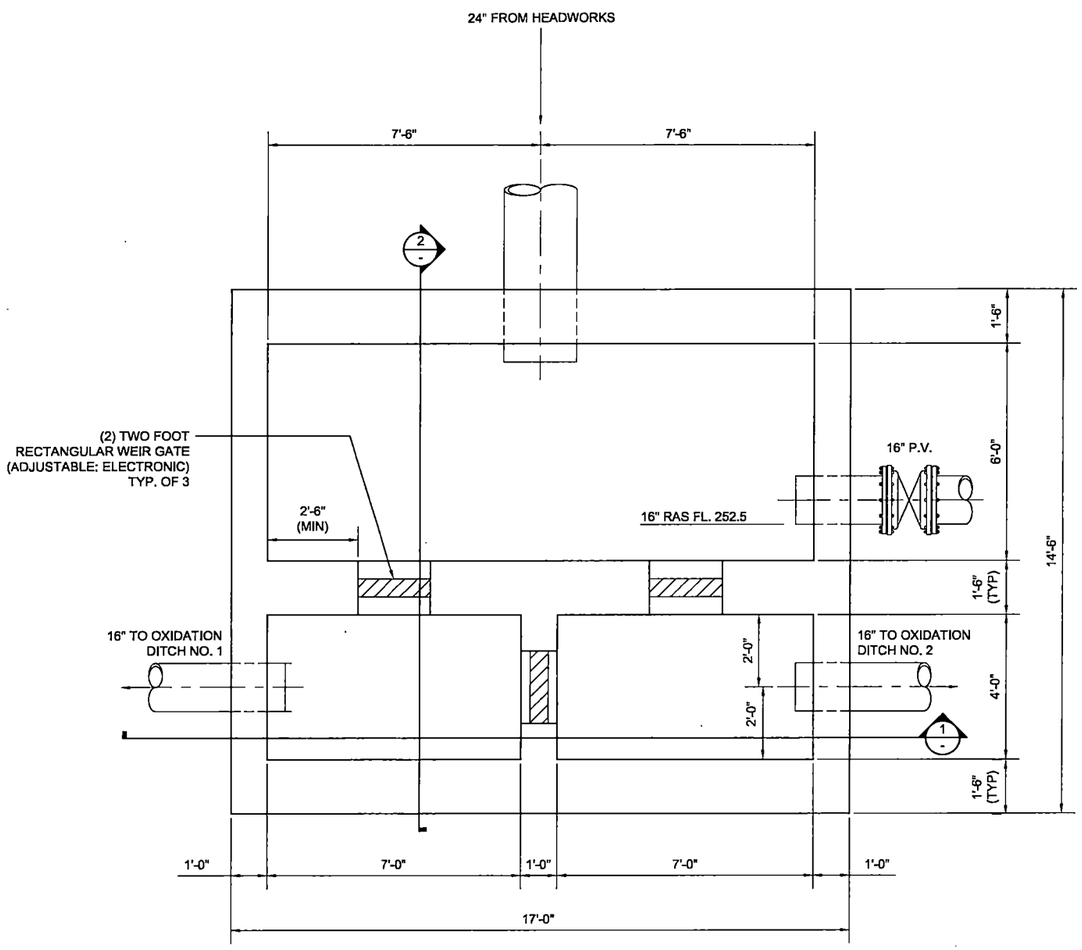
APPENDIX E

ALTERNATIVE 4 PRELIMINARY DESIGN PLANS

CRIST JOB NO.
1618

City of Walnut Ridge
Arkansas 1874

PRELIMINARY ENGINEERING REPORT
WASTEWATER IMPROVEMENTS
JUNE 2018

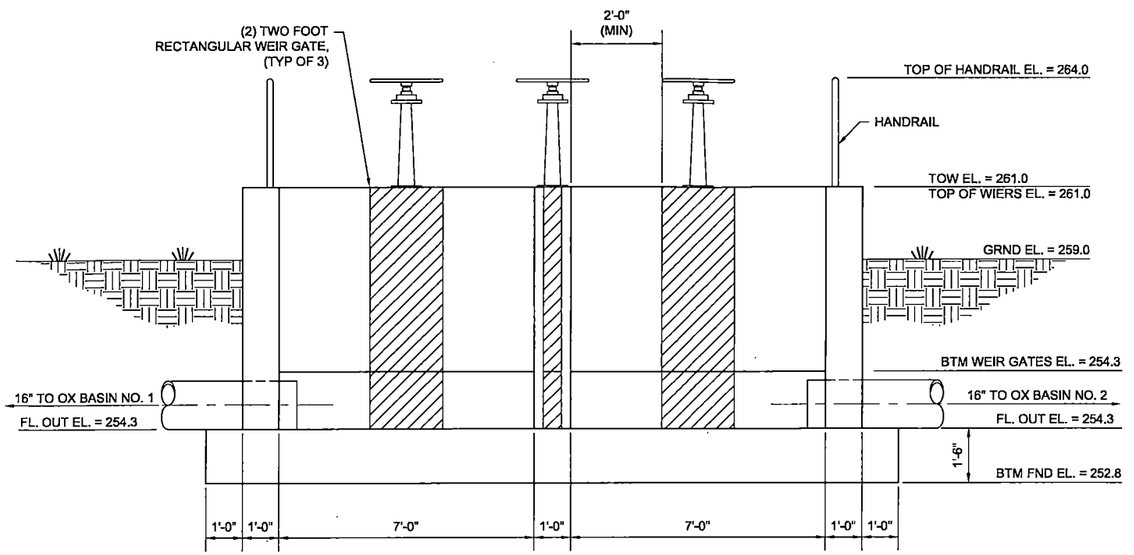


OXIDATION DITCH SPLITTER BOX

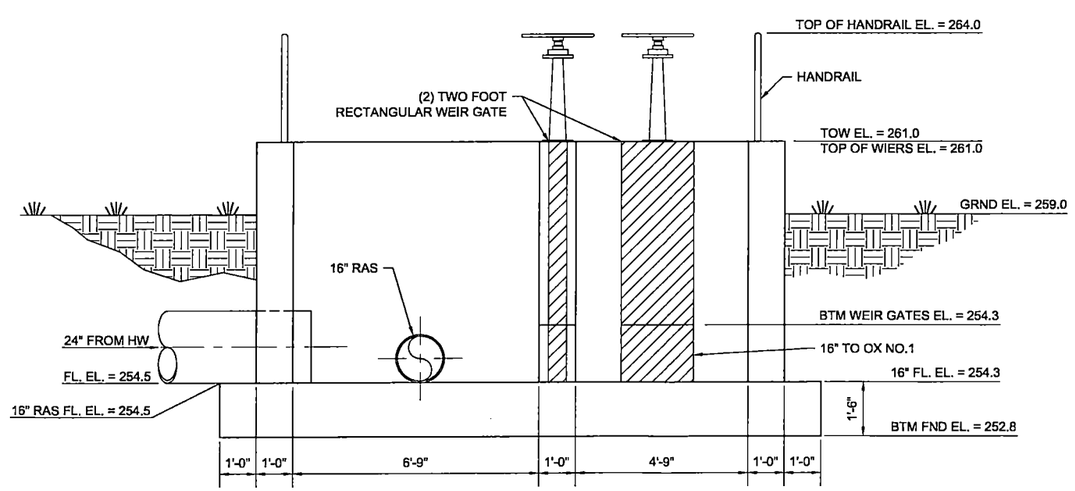
PLAN
SCALE: 1/2" = 1'-0"

NOTE:

1. DISTANCE FROM THE SIDE OF THE WEIR TO THE SIDE OF THE CHANNEL SHALL BE A MINIMUM OF TWO (2) FEET. CENTER WEIR AT INTENDED LOCATION.



SECTION 1
SCALE: 1/2" = 1'-0"



SECTION 2
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WALNUT RIDGE, ARKANSAS

PROPOSED WWTP IMPROVEMENTS

OXIDATION DITCH SPLITTER BOX

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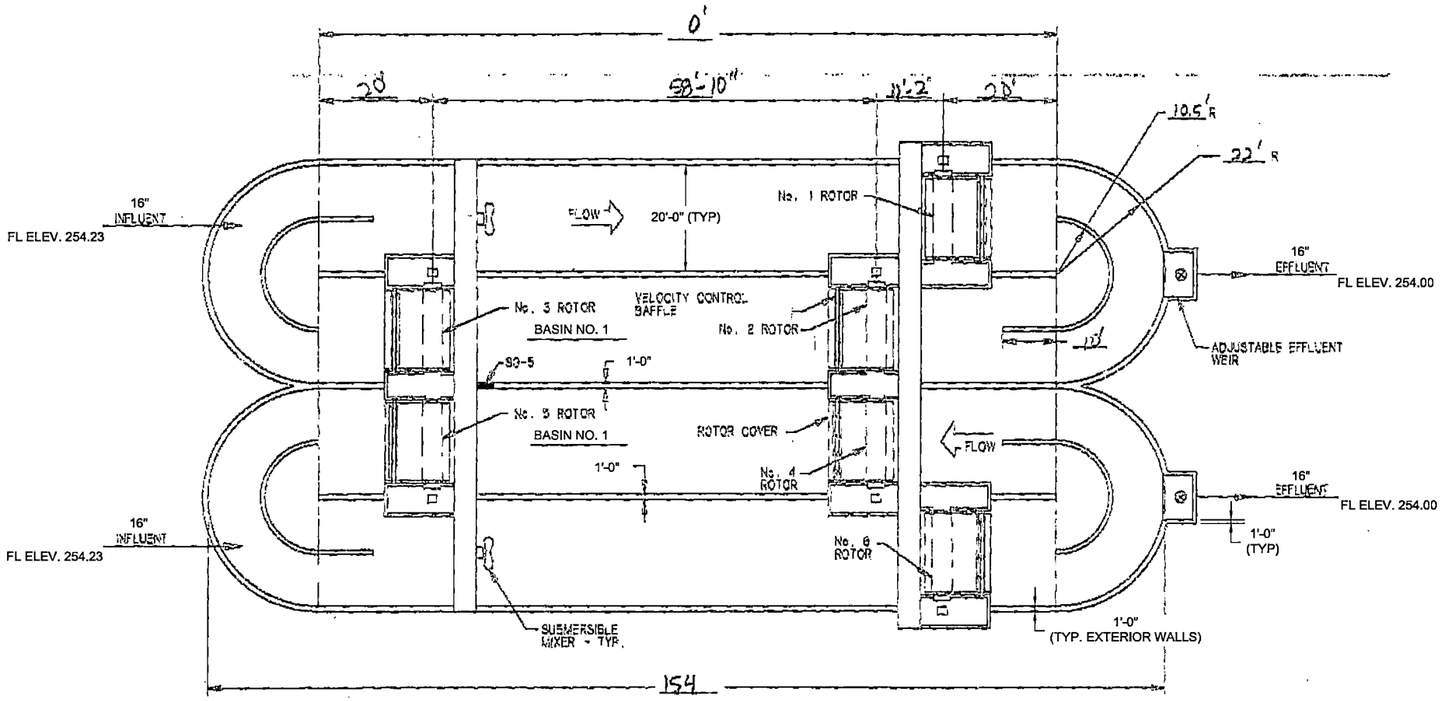

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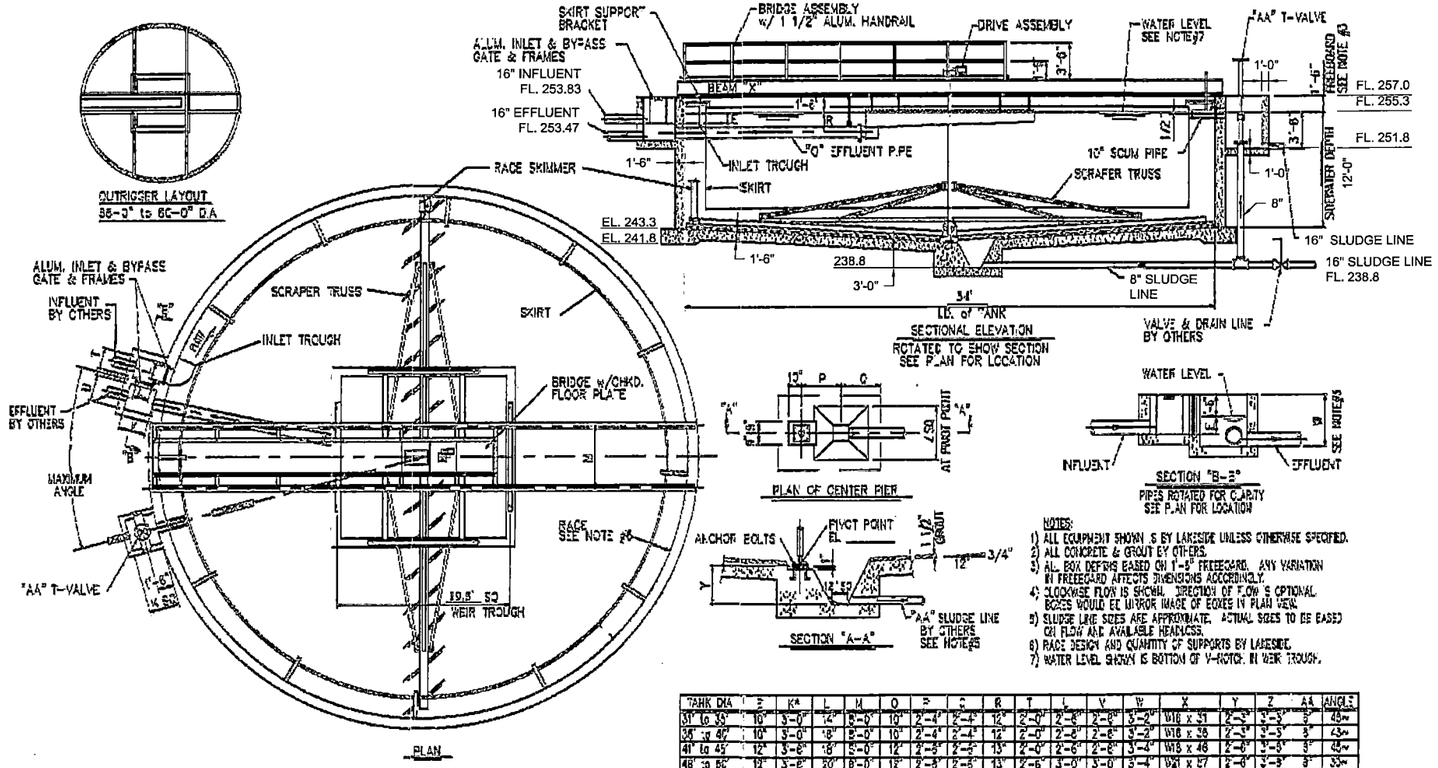

NOTES:
1) ALL EQUIPMENT SHOWN IS BY LAKESIDE UNLESS OTHERWISE SPECIFIED.
2) ALL CONCRETE & GROUT BY OTHERS.
3) ALL BOX DEPTHS BASED ON 1'-6" FREEBOARD. ANY VARIATION IN FREEBOARD AFFECTS DIMENSIONS ACCORDINGLY.
4) CLOCKWISE FLOW IS SHOWN. DIRECTION OF FLOW IS OPTIONAL. BOXES WOULD BE MIRROR IMAGE OF BOXES IN PLAN VIEW.
5) SLUDGE LINE SIZES ARE APPROXIMATE. ACTUAL SIZES TO BE BASED ON FLOW AND AVAILABLE HEADLOSS.
6) RAKE DESIGN AND QUANTITY OF SUPPORTS BY LAKESIDE.
7) WATER LEVEL SHOWN IS BOTTOM OF V-NOTCH IN WEIR TROUGH.

TANK DIA	E	K*	L	M	O	P	Q	R	T	U	V	W	X	Y	Z	AA	ANGLE
31' to 35'	10"	3'-0"	14"	8'-0"	10"	2'-4"	2'-4"	12"	2'-0"	2'-6"	2'-6"	3'-2"	W16 x 31	2'-3"	1'-3"	8"	48°
36' to 40'	10"	3'-0"	16"	8'-0"	10"	2'-4"	2'-4"	12"	2'-0"	2'-6"	2'-6"	3'-2"	W16 x 36	2'-3"	1'-3"	8"	43°
41' to 45'	12"	3'-6"	18"	8'-0"	12"	2'-3"	2'-5"	13"	2'-0"	2'-6"	2'-6"	3'-4"	W18 x 46	2'-6"	1'-3"	8"	48°
46' to 50'	12"	3'-6"	20"	8'-0"	12"	2'-3"	2'-5"	13"	2'-6"	3'-0"	3'-0"	3'-4"	W21 x 57	2'-6"	1'-3"	8"	33°
51' to 55'	14"	3'-6"	20"	8'-0"	14"	2'-3"	2'-9"	14"	2'-6"	3'-0"	3'-0"	3'-6"	W21 x 62	3'-0"	1'-3"	8"	30°
56' to 60'	16"	3'-6"	22"	8'-0"	16"	2'-3"	2'-9"	15"	2'-6"	3'-0"	3'-0"	3'-8"	W24 x 68	3'-0"	1'-3"	8"	30°

* RECOMMENDED MINIMUM DIMENSIONS

PLAN
SCALE: N.T.S.

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PROPOSED WWTP IMPROVEMENTS

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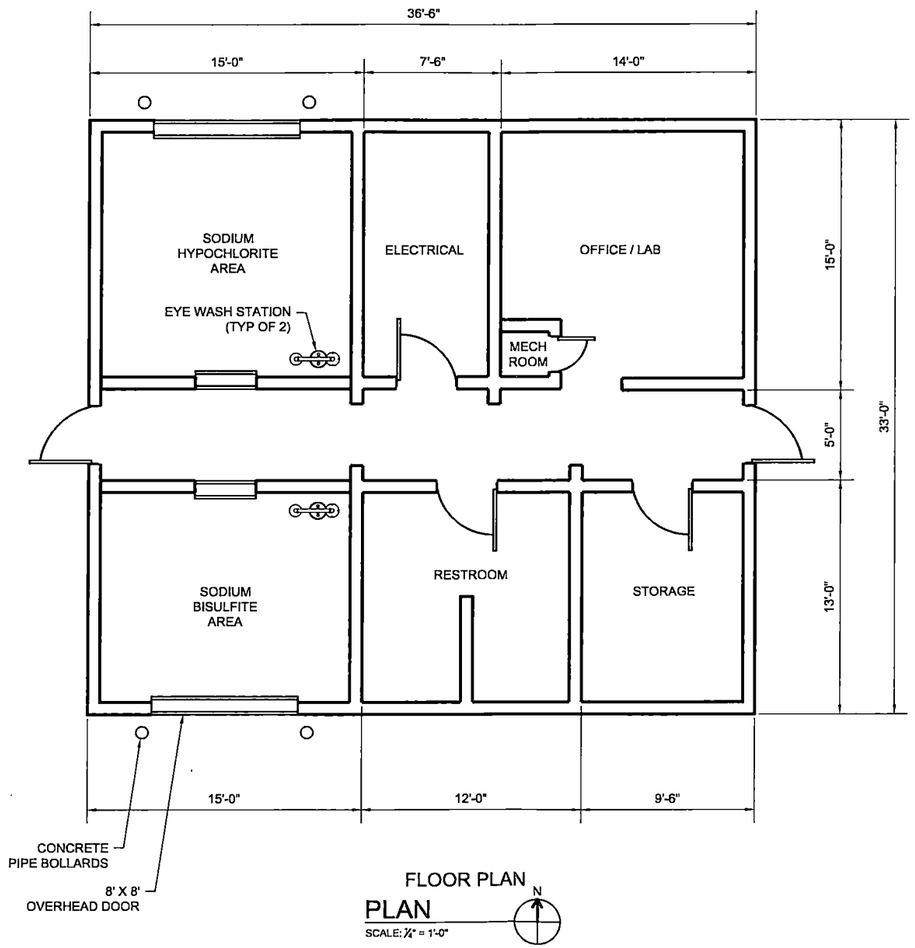

FLOOR PLAN

PLAN

SCALE: ¼" = 1'-0"

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WALNUT RIDGE, ARKANSAS

PROPOSED WWTP IMPROVEMENTS
ADMINISTRATION / MAINTENANCE / CHEMICAL
BUILDING FLOOR PLAN
FOR ALT. NO. 4 & ALT. NO. 5

JOB NO. 1618

SHEET NO. —

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Miles Johnson
ADEQ
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North Little Rock, AR 72118