RPA

CIVIL ENGINEERING / PLANNING / SURVEYING

TO: Tom Speelmon
Miles City
Public Utilities Director

FROM: Austin Wargo, PE
RPA
Senior Design Team Leader

DATE: June 10, 2026

SUBJECT: Miles City WWTP Rotors Replacement Analysis Memo

1. INTRODUCTION

The Miles City Wastewater Treatment Plant was constructed in 1979. It has received various upgrades and maintenance throughout the years. The existing oxidation ditch rotors were installed as part of the original Wastewater Treatment Facility in 1979 and have served their useful life. One out of the four oxidation ditch rotors is broken and non-operable. The control systems are also outdated. Miles City has requested RPA analyze options for replacement of the oxidation ditch rotors and their controls.

The rotors are the main component to be upgraded in this comparison, however, the supporting components such as the necessary electrical system for the rotors, necessary modifications, and other project costs will be included as well. With upgrading the rotors, there is also the opportunity to add (Dissolved Oxygen) DO control. Dissolved oxygen control would allow the rotors to automatically turn their speed down and use less power when the dissolved oxygen levels in the oxidation ditch are at sufficient levels. These power savings can be a significant reduction in energy used by the rotors which can be a substantial cost savings over time. The ability to set a precise dissolved oxygen level and maintain it consistently is also useful for providing consistent treatment. In the event denitrification is desired in the future, having the ability to maintain precise oxygen levels is essential.

The existing rotors are metal brush rotors manufactured by Zimpro-Passavant that spin metal brushes into the water causing agitation to add oxygen. There are two types of rotors which proposals were received from. The first are Lakeside rotors which have stainless steel blades that beat the water as it spins. The second is Evoqua rotors which are a plastic disc with texturing that grabs at the water as it spins. These two new rotor options will be further analyzed later in this memo.

2. PERMIT LIMITS

The current permit limits are listed below in **Table 1 – Current Discharge Permit Limits**. The current permit number MT0020001 was issued in 2018 and expired in 2023. The treatment facility is still operating under this permit until DEQ issues a new permit. The discharge point for the wastewater

treatment facility is into the Yellowstone River. The Average monthly limits are 30 mg/L for BOD and 30 mg/L for TSS with 85% removal required for both. E. coli is limited to 126 count/100 ml during the summer and 630 count/100 ml during the winter. The oxidation ditch rotors are a key component to BOD removal.

Table 1 – Current Discharge Permit Limits

Final Effluent Limitations – Outfall 001				
Parameter	**Units**	**Average Monthly Limit (1)**	**Average Weekly Limit (1)**	**Maximum Daily Limit (1)**
5-Day Biochemical Oxygen Demand (BOD_5)	mg/L	30	45	--
	lb/day	495	743	--
	% Removal	85	--	--
Total Suspended Solids (TSS)	mg/L	30	45	--
	lb/day	495	743	--
	% Removal	85	--	--
pH	s.u.	6.0 – 9.0 (Instantaneous)		
E. coli Bacteria, April – October 31	# org /100mL	126	252	--
E. coli Bacteria, November 1 – March 31	# org /100mL	630	1260	--
Oil and grease	mg/L	--	--	10
(1) See Definition section at end of permit for explanation of terms.				

In the future, it is possible that Montana DEQ could impose more stringent discharge permit requirements, potentially requiring lower effluent concentrations of BOD, TSS, and E. coli. In addition, there has been increasing discussion throughout the state regarding the potential implementation of nutrient removal requirements, particularly for nitrogen.

Of the nutrients that may be regulated in the future, nitrogen would be the most feasible to remove using the existing treatment process. Currently, the Miles City Wastewater Treatment Plant typically operates only one of its two oxidation ditches at a time. Under the current operating strategy, nitrogen removal would primarily rely on simultaneous nitrification and denitrification (SND) occurring within the ditch. While SND can be an effective method for nitrogen removal, its performance can vary significantly depending on process conditions and is often difficult to predict and consistently optimize.

DO control would be a critical factor in achieving effective simultaneous nitrification and denitrification. Maintaining targeted DO concentrations is necessary to promote both aerobic and anoxic conditions within the treatment process, allowing nitrification and denitrification to occur concurrently. The proposed equipment would provide improved process control capabilities, including more precise DO management, which could enhance the facility's ability to achieve some level of nitrogen removal under future regulatory requirements.

If a specific nitrogen effluent limit is established, it is likely that operating both oxidation ditches would be necessary to consistently achieve compliance. Under this scenario, one ditch could potentially be operated under predominantly anoxic conditions to facilitate denitrification, while the second ditch

would be operated under aerobic conditions to support nitrification. Additional process modifications may also be required to optimize treatment performance.

Because future nitrogen limits have not been established, it is difficult to accurately predict the specific facility modifications that may be required. As a result, the proposed equipment was not formally evaluated for its ability to achieve a particular nitrogen effluent concentration. However, discussions were held with the equipment suppliers regarding the plant's potential for future nitrogen removal. Both suppliers indicated that lower nitrogen limits could likely be achieved through operational changes and relatively modest process modifications, such as operating both ditches simultaneously, installing internal baffles to create distinct treatment zones, and/or adding mixers to improve hydraulic and process control within the oxidation ditches.

3. LAKESIDE ROTORS

The Lakeside rotors are shown below in **Figure 1 – Lakeside Rotors** where their rotor is shown with the splash guard/cover removed and a rotor with cover installed in the background. The Lakeside rotors feature a 60 hp motor that drives the rotor by a drive belt. The Lakeside rotors also include a baffle directly behind the rotor which directs the aerated water from the surface down into the oxidation ditch to enhance aeration and mixing.

Due to the Lakeside rotors using stainless steel "brushes" instead of a disc shape, they are not as susceptible to forces on their shafts that could be caused by cross currents. The proposed shafts also have capacity to accept more stainless steel "brushes" to expand capacity at a later date.

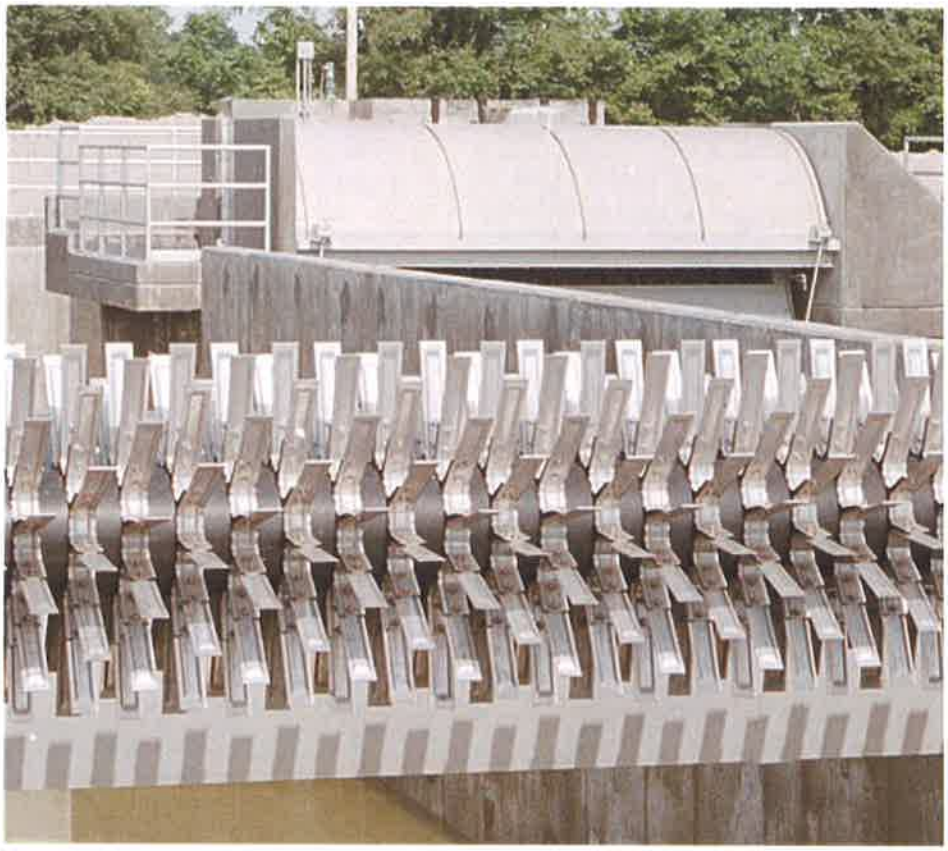
The Lakeside rotors are capable of meeting treatment at current max month flow and loading utilizing only one oxidation ditch. The larger horsepower motors and ability to add more brushes to these rotors give the Lakeside product the ability to provide treatment to a wider range of conditions. In the event of future growth, tighter permit limits, or the ability to continue to run one oxidation ditch at a time, the Lakeside rotors have more margin.

The Lakeside rotors have an oxygen transfer rate of 2.97 lbs O2/hr/hp. This oxygen transfer rate is less efficient and does require larger horsepower motors to provide effective treatment.

Installation of the Lakeside rotors would require modification to the concrete where the rotor connects to the oxidation ditch. The existing brush rotors measure 11" from the center of the rotor to normal operating water level, whereas the Lakeside proposal requires 15" from the center of the rotor to the normal operating water level. The mounting level of the rotor to the concrete would require a slightly different elevation, requiring some concrete demo and replacement in the location of the rotors' mounting attachments.

The estimated cost of installing the Lakeside rotors is approximately $2,504,320 and an additional $160,000 for adding dissolved oxygen control.

Figure 1 – Lakeside Rotors



4. EVOQUA ROTORS

The Evoqua rotors are shown below in **Figure 2 – Evoqua Rotors**. The Evoqua rotors utilize a plastic disc shape with texturing which pulls air into the water as it rotates. The Evoqua rotors do not utilize a covered hood and only use side splash guards. The disc shape of the Evoqua rotors, if exposed to cross currents or strong winds has the potential to transfer the force from the disc resisting the current into the shaft, potentially causing increased wear. The proposed rotors have the maximum number of plastic discs that the shafts can fit, resulting in no ability to increase their capacity in the future.

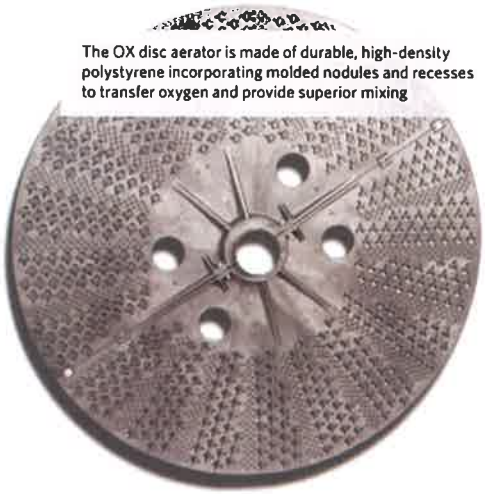
The Evoqua rotors are not cable of meeting treatment at max month flow and loading utilizing only one oxidation ditch. At maximum month flow, the Evoqua rotors would need to run both oxidation ditches to meet treatment. While there is likely some conservancy built into these calculations, and it is possible that treatment could still be met on one oxidation ditch with this system, the fact that this system would be operating closer to its limits on one ditch is worth noting.

The Evoqua rotors are more energy efficient, using an oxygen transfer rate of 3.45 lbs O2/hr/hp. These rotors are substantially more efficient allowing for smaller motors and potential cost savings overtime.

Installation of the Evoqua rotors would require nearly identical modifications as the Lakeside rotors to make them fit in the existing oxidation ditches. This would involve modifications to the concrete near the location of the rotors.

The estimated cost of installing the Evoqua rotors is approximately $2,502,400 and an additional $108,800 for adding dissolved oxygen control.

Figure 2 – Evoqua Rotors



5. CONCLUSION/SUMMARY

In summary, both the Lakeside and Evoqua rotors have been tried and tested around the country and are both valid options to consider. The Lakeside rotors are likely more durable, however, less energy efficient based on their increased horsepower and lower oxygen transfer rate compared to the Evoqua option. The Lakeside rotors have the advantage of increased treatment during high flows allowing for only one oxidation ditch running at current max month flow and load, whereas the Evoqua calculations show that both oxidation ditches would be required to be run to meet treatment under these same conditions. The Lakeside rotors also have the ability to add additional stainless-steel brushes if more treatment is desired at a later date. The Evoqua rotor shafts are unable to accept more discs to expand capacity and increase treatment in the future.

Both options involve very similar work to the existing oxidation ditch concrete, making contractor installation cost equivalent between the two. See **Attachment C** for the detailed cost estimates. The cost estimates show that the Lakeside and Evoqua rotors are nearly identical in cost with both at approximately $2.5 M. When considering the addition of dissolved oxygen control, the Lakeside dissolved oxygen control system costs approximately $50,000 more at $160,000 compared the Evoqua dissolved oxygen control at $108,800. The maintenance of both proposals would be expected to be similar to one another in both time and cost. Energy usage would be less with Evoqua's rotors on average; however the energy savings may be offset if both ditches need to operate in summer to provide treatment during max month conditions.

Staging the replacement of the rotors could be considered, such as installing these upgrades to only one oxidation ditch now, and the other oxidation ditch at a later date. While this would lower costs for a project, it would likely only reduce costs to approximately 60-70% of the cost to replace all the rotors at once. The other oxidation ditch rotors would then have the cost of a second project in the future, making this more expensive in the long run.

6. Attachments

- A – Lakeside Package
- B – Evoqua Package
- C – Cost Estimates

Miles City WWTP - Rotors Replacement - Lakeside

Robert Peccia & Associates, Inc.
*3147 Saddle Drive * Helena * Montana * (406) 447-5000*

Item No.	Quantity	Unit	Unit Description	Unit Price (Figures)	Total Price (Figures)	Bid Item Total (Figures)
1	1	LS	Mobilization, Bonding and Submittals (15%)	$ 255,500.00	$255,500.00	$255,500.00
2	1	LS	Demolition	$ 75,000.00	$75,000.00	$75,000.00
3	2	EA	Purchase Price of Rotors (Base Equipment per Ditch)	$ 396,000.00	$792,000.00	$792,000.00
4	1	LS	Equipment Installation	$ 200,000.00	$200,000.00	$200,000.00
5	4	EA	60 hp VFD enclosures	$ 76,000.00	$304,000.00	$304,000.00
6	1	LS	Electrical Upgrades	$ 200,000.00	$200,000.00	$200,000.00
7	1	LS	Ditch Modifications	$ 50,000.00	$50,000.00	$50,000.00
8	1	LS	Control Building Modifications to Accept New Panels	$ 60,000.00	$60,000.00	$60,000.00
9	1	LS	Site Restoration	$ 20,000.00	$20,000.00	$20,000.00
SUBTOTAL DIRECT CONSTRUCTION COSTS:						**$1,956,500.00**
CONTINGENCY (ESTIMATED 10%)						**$195,650.00**
ENGINEERING (ESTIMATED 18%)						**$352,170.00**
TOTAL BASE:						**$2,504,320.00**
10	1	LS	Dissolved Oxygen Control Panel With PLC and D.O. Sensors	$ 125,000.00	$125,000.00	$125,000.00
ADDITIVE ALTERNATE 1 DIRECT CONSTRUCTION COSTS:						**$125,000.00**
CONTINGENCY (ESTIMATED 10%)						**$12,500.00**
ENGINEERING (ESTIMATED 18%)						**$22,500.00**
ADDITIVE ALTERNATE 1 BASE:						**$160,000.00**
TOTAL COSTS INCLUDING CONTINGENCY AND ENGINEERING:						**$2,664,320.00**

Miles City WWTP - Rotors Replacement - Evoqua

Robert Peccia & Associates, Inc.
*3147 Saddle Drive * Helena * Montana * (406) 447-5000*

Item No.	Quantity	Unit	Unit Description	Unit Price (Figures)	Total Price (Figures)	Bid Item Total (Figures)
1	1	LS	Mobilization, Bonding and Submittals (15%)	$ 255,000.00	$255,000.00	$255,000.00
2	1	LS	Demolition	$ 75,000.00	$75,000.00	$75,000.00
3	2	EA	Purchase Price of Rotors (Base Equipment per Ditch)	$ 447,500.00	$895,000.00	$895,000.00
4	1	LS	Equipment Installation	$ 200,000.00	$200,000.00	$200,000.00
5	4	EA	40 hp VFD enclosures	$ 50,000.00	$200,000.00	$200,000.00
6	1	LS	Electrical Upgrades	$ 200,000.00	$200,000.00	$200,000.00
7	1	LS	Ditch Modifications	$ 50,000.00	$50,000.00	$50,000.00
8	1	LS	Control Building Modifications to Accept New Panels	$ 60,000.00	$60,000.00	$60,000.00
9	1	LS	Site Restoration	$ 20,000.00	$20,000.00	$20,000.00
SUBTOTAL DIRECT CONSTRUCTION COSTS:						**$1,955,000.00**
CONTINGENCY (ESTIMATED 10%)						**$195,500.00**
ENGINEERING (ESTIMATED 18%)						**$351,900.00**
TOTAL BASE:						**$2,502,400.00**
10	1	LS	Dissolved Oxygen Control Panel With PLC and D.O. Sensors	$ 85,000.00	$85,000.00	$85,000.00
ADDITIVE ALTERNATE 1 DIRECT CONSTRUCTION COSTS:						**$85,000.00**
CONTINGENCY (ESTIMATED 10%)						**$8,500.00**
ENGINEERING (ESTIMATED 18%)						**$15,300.00**
ADDITIVE ALTERNATE 1 BASE:						**$108,800.00**
TOTAL COSTS INCLUDING CONTINGENCY AND ENGINEERING:						**$2,611,200.00**

EVOQUA WATER TECHNOLOGIES

Quote Number: 03540833

Proposal For:

Miles City
Thomas Speelmon
Drawer 910
MILES CITY, MT 59301
Phone: 406-234-3493
tspeelmon@milescitymt.gov

James Moore
Evoqua Water Technologies
N19W23993 Ridgeview Pkwy, Suite 200
Waukesha, WI 53188
+12625218368
james.a.moore@xylem.com

Item Pricing Summary

Items

Item	Part No Description	Qty	Net Price	Ext Price
1	5300-5260-91 torque tube body 29'7" prime painted	2 EA	$30,690.00	$61,380.00
2	W2T831876 sealing ring	4 EA	$630.00	$2,520.00

Currency: USD

Quote Totals

Item(s) Subtotal:	$ 63,900.00
Freight:	$ 9,680.00
Total Net Price:	**$ 73,580.00**

Proposal Notes

lead time is 8-10 weeks ARO

Our Manufacturing Rep in your area is:

Representative: Nate Miller

Company: MISCOWATER INTERMOUNTAIN

Address: 651 CORPORATE CIR STE 100

GOLDEN, CO, 80401-5652

Phone:

Email: