HELENA MONTANA

QUEEN CITY OF THE ROCKIES

Helena Water Facilities Plan

CHAPTER 6 – TREATMENT PLANT ANALYSIS

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Introduction

The City of Helena has three potential sources of water to meet the long-term needs of their customers. The two main sources are the Tenmile and Missouri River supplies and the third is the Hale Zone supply. The City's three water sources each have limitations that need to be taken into consideration when planning for their future use. In this chapter, the Tenmile system will be used to meet system demands throughout the entire year, while the Missouri River system will be used to meet peaking demands that occur during the warmer months. The Hale Zone supply serves a localized area throughout the year.

In order to ensure that the water sources can meet the long-term needs of the City, the components that make up each of the sources must be individually evaluated. These components consist of:

- Raw water supply
- Raw water delivery
- Pretreatment
- Taste and odor control
- Disinfection
- Filtration
- Residuals handling
- Clearwell and finished water delivery
- Support facilities

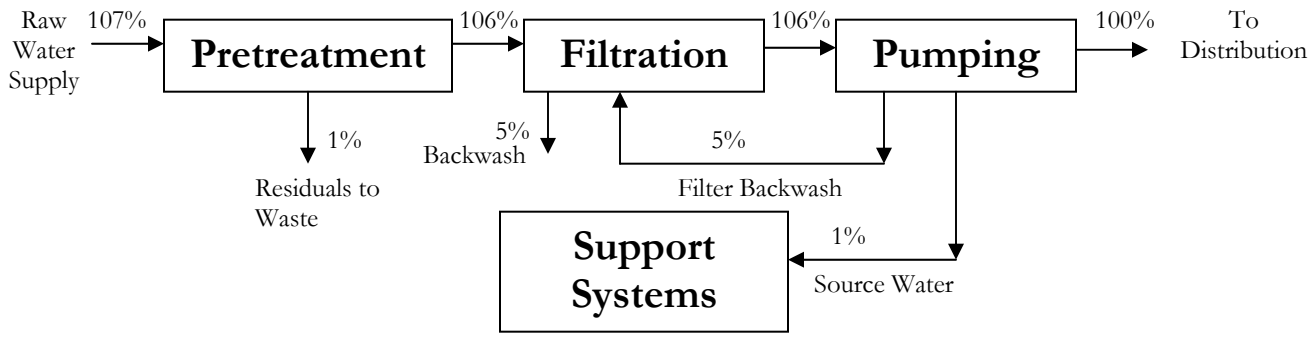
Prior to evaluating the individual components of the Tenmile, Missouri River, and Hale Zone water supply systems, the overall requirements and constraints that impact each system must be reviewed. Following is a discussion of these issues and the Tenmile, Missouri River and Hale Zone systems.

Water Supply Capacity Considerations

The quantity of finished water produced by the City's water treatment plants must be greater than the quantity of finished water delivered to the water distribution system, as both plants use water for in-plant purposes. The majority of the in-plant water use is for filter backwashing, which is about five percent of the finished water produced. In addition, about one percent additional finished water is used for plant service water (i.e. chemical systems makeup water, plant washdown water, pump seal water, landscape irrigation, etc.).

The quantity of raw water delivered to the plant must also take into account the quantity of water removed from the pretreatment process as part of residuals collection and disposal. The wasting of residuals from the pretreatment process accounts for about one percent of the plant flow. Figure 6-1 illustrates the water balance needed to deliver 100 percent of the system demand to the distribution system.

Figure 6-1 Water Treatment Plant Water Balance Diagram



Based on the above water balance diagram, the raw water delivered to the water treatment plant must exceed the plant output to the distribution system by seven percent. In addition, the pretreatment system must be sized for 107 percent of plant output and filters must be sized for 106 percent of plant output. As a result, the capacities that must be provided for both plants are shown in Table 6-1.

Table 6-1 Design Capacity for TTP and MRTP

	2025 Design Capacity Required	
Plant Flow	**TTP**	**MRTP**
Raw Water Delivery (107%)	8.56 MGD	13.91 MGD
Pretreatment (107%)	8.56 MGD	13.91 MGD
Filter (106%)	8.48 MGD	13.78 MGD
Finished Water to Distribution System (100%)	8.0 MGD	13.0 MGD

The above flows are based on projected demands for the City and the assumption that waste flows from the treatment process will continue to not be recycled to the head of the plant. Neither plant currently practices recycle.

Ability of Water Supplies to Meet Future Demands

The City of Helena's water supply must be capable of meeting the maximum day demand of the water system's customers. Both the raw water delivery and treatment facilities must be capable of meeting these requirements, with the raw water source capable of sustaining the supply of water throughout the year. The City's projected future water supply demands were discussed in Chapter 5. Table 6-2 summarizes the capacities of the existing raw water supplies and their estimated annual use in 2025 and 2045.

Table 6-2 Existing Capacities and Projected Use

Water Source	Estimated Capacity (MG/yr)			Projected Annual Use in 2025 (MG/yr)			Projected Annual Use in 2045 (MG/yr)		
	Raw	Finished	Percent	Raw	Finished	Percent	Raw	Finished	Percent
Tenmile Supply	1,960[1]	1,867	33.5%	1,960	1,867	59.5%	1,960	1,867	45.3%
MR Supply	3,676[2]	3,501	62.9 %	1,335	1,272	40.5%	2,370	2,257	54.7%
Hale Zone Supply	200	200	3.5%	0[3]	0[3]	0[3]	0[3]	0[3]	0[3]
Total	5,810	5,568	100%	3,295	3,139	100%	4,330	4,124	100%

[1] Dependable annual yield reported in 1978 Master Plan.
[2] Maximum water allocation available from BOR based on 11,284 AF/year.
[3] For purposes of this analysis, 0 MG/year water supply assumed from the Hale Zone source in the future. Refer to subsequent discussion on viability of the Hale Zone supply.

The above summary assumes that the Hale Zone supply would not be used in 2025 and 2045, in order to provide the worst case scenario water demand estimates for the Tenmile and Missouri River supplies.

In this analysis, the Tenmile supply will remain as the highest priority water source for the City in the future, with use of this source maximized, as shown in Table 6-2. Under existing conditions the Tenmile supply has almost reached capacity. When the Tenmile supply has reached its capacity, the Missouri River will supply the additional needed capacity. In 2045, the reliance on the Missouri supply grows, providing 55 percent of the total available water supply to the City (2,257 MG/yr out of 4,124 MG/yr of finished water produced).

Tenmile Treatment Plant Needs

The raw water supply, delivery, treatment and finished water delivery systems all operate using gravity flow, avoiding pumping except for the TTP support systems (i.e. filter backwashing, etc.). The conventional treatment facility is currently operated throughout the year and in this analysis, will continue to operate in that mode for the long-term. The following section describes the ability of the existing TTP to meet future demands to 2025.

TTP Raw Water Supply

Addition of solar aerators in Chessman Reservoir is recommended.

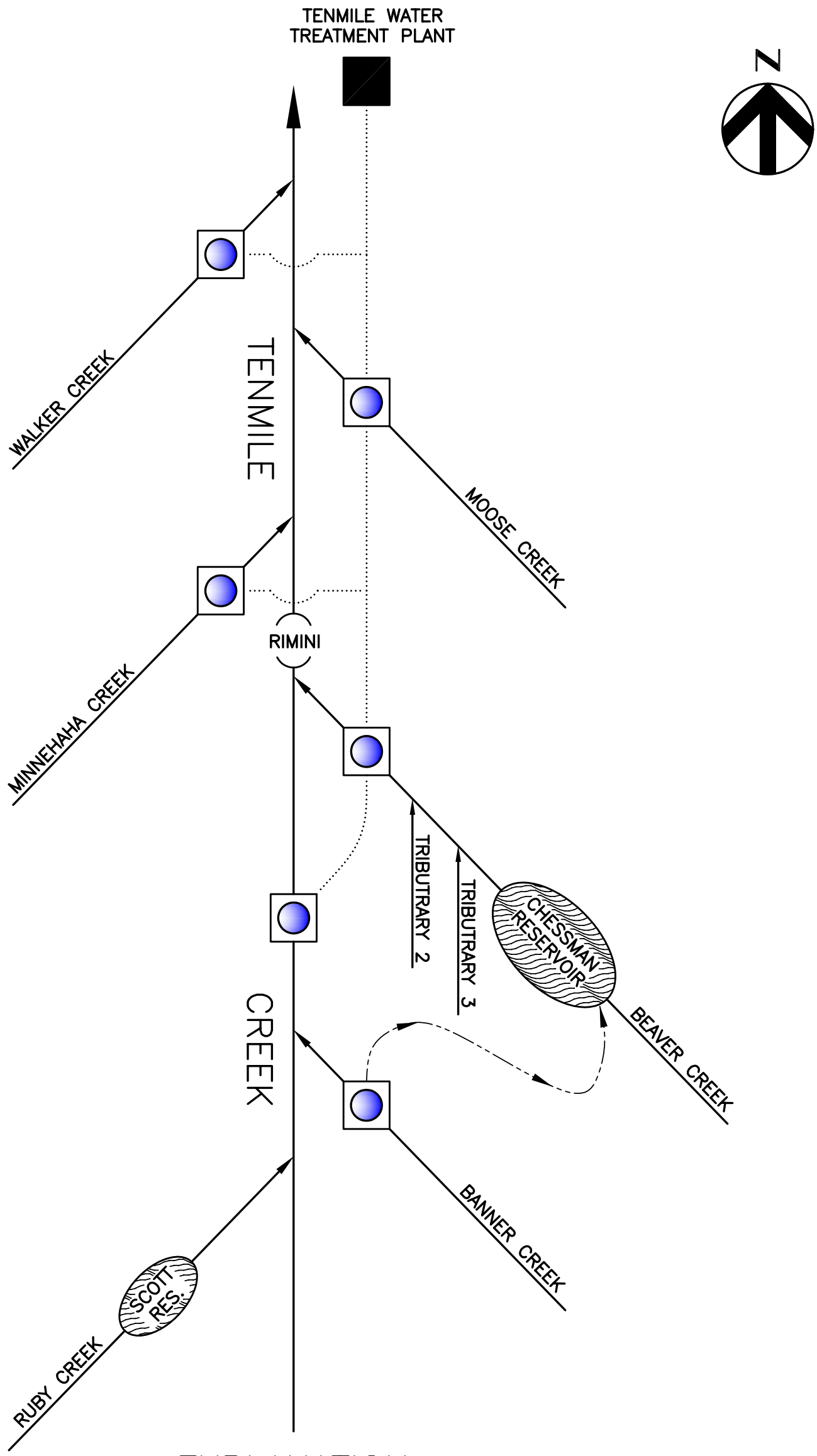
The TTP raw water supply is composed of a complex system of stream diversions and storage reservoirs. Figure 6-2 shows a schematic view of the TTP raw water system. Although the TTP watershed contains primarily forest lands, there are occasional water quality problems. Seasonally, algae growth accumulates in Chessman Reservoir, creating treatment problems. To prevent filter clogging and taste and odor issues associated with algae growth, the City staff treats the reservoir with approximately 10,000 pounds of copper sulfate, at a cost of approximately $15,000 per year in chemical cost and $2,000 in labor. Solar powered floating aerators would improve algae control and eliminate the introduction of chemicals to the reservoir. The City may choose to remove aerators during winter months, though manufacturers indicate this will not be necessary. The estimated capital cost of solar powered aeration of Chessman Reservoir is $150,000.

The streams from the reservoirs flow directly into diversions that feed TTP. During heavy runoff events on the streams, turbidity spikes occur in the water being supplied to TTP. These turbidity spikes potentially make the TTP vulnerable to increased concentrations of pathogens (i.e. *Giardia* and *Cryptosporidium*) in the raw water.

TTP Raw Water Delivery

The Tenmile raw water delivery system has a design capacity of approximately 9 MGD; however, when the flow in the existing pipeline approaches 8.8 MGD, manholes along the pipeline begin to overflow. In the wintertime, this flow is often limited due to freezing in the conveyance channels, thus limiting capacities.

There are six diversions in the TTP raw water delivery system, shown in Figure 6-2. One diversion transfers flow from Banner Creek to Chessman Reservoir, while the other five enter into the buried pipeline that feeds the plant. A 30-inch section of RCP-LH pipe reaching from the plant to about 2,000 feet upstream at the rock screen was replaced in 1989. The condition of this section of pipe is unknown, but thought to be leak free, with all valves are currently in working order. Upstream of the rock screen, the pipeline is constructed mostly of 4-foot sections of 18 inch concrete pipe that was installed in 1918. One section of 16 inch steel, at Minnehaha, was replaced in 1981 during the Rimini Road Bridge Improvements Project. The condition of these areas is unknown. Due to the low winter stream flows, there is nothing that can be done to prevent conveyance channels from freezing. While the raw water delivery system is old. it is operable. No major capital improvements are recommended at this time.



EXPLANATION

DIVERSION FOR TENMILE WATER

BURIED PIPE CONVEYING DIVERTED FLOW TO TREATMENT PLANT

FLUME FROM BANNER CREEK TO CHESSMAN RESERVOIR

Figure 6–2
Tenmile Raw Water System
Schematic

City of Helena
Water Facilities Plan

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TTP Pretreatment

The existing contact adsorption clarifiers (CAC) are designed to handle a maximum turbidity of about 50 NTU. Turbidities at TTP exceed 50 NTU from one to ten times per year depending on runoff conditions (larger rains lead to more events). These stream flows are allowed to bypass the plant until turbidities drop. High turbidity flows typically last 2 to 12 hours. During these bypasses, TTP is taken out of service.

Raw water storage at TTP would dampen the effect of these events and allow water to be constantly fed to the CAC units even during a significant turbidity event. However, the hydraulic grade coming into TTP is approximately 15 feet above the surrounding site, making low cost raw water storage with an earthen impoundment impractical. A raw water storage tank would be needed, serving as a presedimentation tank to remove the heavier sediment in the raw water. The tank could be of sufficient height to allow gravity flow in and out of the storage tank to TTP. However, in order to provide sufficient detention time to dampen turbidity spikes, the storage tank would need to provide several hours of storage, making the tank cost-prohibitive. As a result, continuing to bypass high turbidity flows is the most practical solution. Adding raw water quality monitoring on the raw water delivery system is recommended to give advance warning to the TTP staff in the event of a turbidity spike.

Raw water storage at TTP is not practical. Installing raw water monitoring equipment is recommended.

TTP Filtration

The existing Tenmile filters were evaluated in April 2004. It is recommended that the media be replaced, leaving the gravel in place if it can be verified that they are essentially undisturbed. The estimated capital cost for this work is $150,000. The full filter evaluation and recommendation report is included in Appendix 6-A. The existing filters are adequate to treat the necessary capacity of 8.32 MGD for the long-term, if the media replacement is completed.

TTP Disinfection

As discussed in Chapter 3, the existing chlorine gas system at TTP does not meet current building and fire code requirements. Four alternatives for disinfection at TTP were reviewed: chlorine gas (retrofit the existing system to current code), liquid chlorine (replace existing chlorine system), on-site chlorine generation (replace existing chlorine system) and ultraviolet disinfection (supplement existing chlorine system).

Chlorine Gas

The existing TTP uses chlorine gas for both primary and secondary disinfection. To bring the existing chlorine gas system up to current code requirements, a secondary containment vessel for chlorine cylinders and a new sprinkler system would be required (a scrubber is no longer required with secondary containment). The estimated capital cost of bringing the existing chlorine gas system into compliance is $350,000. Estimated operational cost is $30,000 per year.

Liquid Chlorine

In this approach, the existing gas system would be replaced and liquid chlorination would be implemented. At TTP, a liquid hypochlorite storage and feed facility would be designed

based on a peak usage of 83 gallons per day (assuming 8 MGD design flow and 1.3 mg/L chlorine dose). Three thousand gallons of liquid chlorine would last approximately one month at design flow, two months at normal flow. Since sodium hypochlorite is readily available, it would be recommended that it not be stored longer than one month to prevent deterioration of the solution. A storage tank and three metering pumps (one each for primary and secondary disinfection and one for redundancy), along with some piping, valves and instrumentation would be required. The liquid system could be constructed in the existing chlorine storage room with the addition of a double door to the room. The estimated capital cost of liquid chlorination is $200,000. The estimated annual operation and maintenance cost is $35,000.

On-site Generation

On-site generation produces a 0.8 percent chlorine solution, which can be used for both primary and secondary disinfection. On-site generation of hypochlorite uses electrodes, salt and water. To produce one pound of chlorine, typically three pounds of salt, 15 gallons of water and 2.5 kwh of electricity are required. Salt is delivered in 80-pound bags or in 2,500 pound super sacks. This system would be constructed in the existing chlorine storage area. The estimated capital costs for on-site generation is approximately $300,000. The estimated operation and maintenance cost is $50,000.

UV Disinfection

UV disinfection could be implemented in a closed vessel reactor to provide primary disinfection after filtration. An intermediate pump station would be required to provide a range of five to ten feet of head (due to throttling valve loss) to direct flow to the units. Approximately 350 square feet of building space would be required. The system could be located in the area of the existing backwash and surface wash pumps, east of the existing filters. The existing chlorine gas system could remain in place or could be converted to liquid chlorine to provide secondary disinfection. The estimated capital cost of UV, intermediate pumping facilities, and liquid chlorine for secondary disinfection is $1,000,000. The estimated annual operations and maintenance cost is $20,000.

If* Cryptosporidium *inactivation is required, UV disinfection may be needed.

Disinfection Recommendation

The four disinfection alternatives' capital cost, O&M costs and 20-year present worth costs are shown in Table 6-3. Detailed cost breakdowns are included in Appendix 6-B.

Table 6-3 TTP Disinfection Alternative Capital, O&M and 20-Year Present Worth

	Capital Cost	O&M Cost [1]	20-Year Present Worth Cost
Chlorine Gas	$350,000	$30,000	$600,000
Liquid Chlorine	$200,000	$35,000	$550,000
On-site Generation	$300,000	$50,000	$800,000
UV Disinfection	$1,000,000	$20,000	$900,000

[1] Based on power cost of $0.05/kwhr.

A key factor in assessing the disinfection alternatives for TTP is the potential need for inactivation of *Cryptosporidium* in the future. If inactivation becomes necessary, it will dictate

that UV, ozone, or chlorine dioxide disinfection be utilized as chlorine is not capable of meeting that requirement.

TTP Corrosion Control Treatment

The City adds an ortho/poly-phosphate blend to finished waste, which acts as a corrosion control inhibitor. This will need to be continued in the future in order to prevent lead and copper release in the distribution system. No improvements are recommended.

TTP Residuals Handling

The existing solids generated at the TTP are stored in three trapezoidal-shaped, earthen lagoons. There is an estimated 104 pounds of dry solids produced per million gallons of water treated, which leads to about 250,000 dry pounds of solids produced per year. The existing lagoons each hold approximately 1.2 MG. At design conditions, 118 MG/yr are produced (3.1 MG/day). These lagoons have operated successfully since the plant came on-line in 1990. No improvements are recommended for them at this time.

The last issued permit for TTP to discharge to groundwater can be found in Appendix 6-C. The State has recently administratively extended this permit.

TTP Clearwell/Finished Water Delivery

The existing clearwell at the plant is an earthen, membrane lined and covered basin. It has a capacity of approximately 4 million gallons. The existing plant hydraulics prevent backwash of the filters if the water level in the clearwell is below 8 foot of its 12 foot depth, so the City is only able to use about 2.8 MG out of the 4.0 MG capacity of the clearwell volume. A new backwash and surface wash pump station could be built between the clearwell and the filter building to take advantage of the full clearwell depth. This approach is reviewed in Chapter 7, along with other system storage needs.

The finished water pipeline from the clearwell to the service area has sufficient capacity to supply 8.0 MGD using gravity flow. The pipeline also provides additional contact time for disinfection purposes, as the first customer is several miles from the plant. Table 6-4 is a summary of the detention times required for TTP to meet the CT requirements of the SDWA for both winter and summer operation. An inspection of the existing pipeline is recommended to determine its condition. The estimated date of initial construction is the 1930s.

Table 6-4 TTP CT Requirements

Operating Condition	Peak Flow	Minimum Water Temperature	Minimum CT Required [1]	
			Viruses	*Giardia*
Winter	5.0 MGD	0.5 DegC	9	157
Summer	8.0 MGD	10 DegC	4	83

[1] Based on an alkalinity of 180 mg/l as $CaCO_3$

Based on these requirements, a chlorine concentration of 1.0 mg/L and a T_{10}/T flow circulation ratio of 0.40, a clearwell and pipeline detention volume of 1.37 MG is required in the winter and 1.14 MG in the summer. The existing storage volume is sufficient.

TTP Wells

The two existing shallow wells at the Tenmile Plant are in good condition. They provide operational flexibility to dilute raw surface water as needed. The wells can also be used to supply water to TTP during periods when surface water turbidity exceeds 50 NTU. No changes to the well system are recommended.

TTP Support Facilities

Plant support facilities include chemical systems, labs, administration, power, and SCADA systems. These support facilities at TTP are in generally good condition, as the plant is only 13 years old. The existing standby generator is capable of maintaining basic plant operation, including disinfection, valves, filter backwash and surface waste pumps. No further generator improvements are recommended.

Tenmile support facilities are in good condition.

Chemical feed systems are appropriately sized and operate effectively. No modifications are recommended. The Tenmile administrative facilities and lab are adequately sized and in good condition. No long-term improvements are needed.

Summary of TTP Recommendations

The TTP facilities are generally in good condition and well-suited to meet some of the City's long-term needs. However, several improvements are recommended to optimize the capabilities of the TTP facilities, including:

- Addition of solar powered aerators to Chessman Reservoir;
- Addition of raw water quality monitoring system to provide advance warning to City of upcoming raw water turbidity spike; and
- Replacement of filter media.

Missouri River Treatment Plant Needs

In this chapter, the MRTP will be analyzed as a peaking plant to supplement TTP, operating only during the late-spring to early-fall period as demand dictates. All finished water from MRTP must be pumped to the distribution system, while the raw water supply can be delivered by gravity to the plant. The conventional treatment facility is outdated and will need to be upgraded in order to meet the City's long-term needs. The following discussion reviews each major component at the MRTP and its ability to meet future needs.

The MRTP will need to be upgraded to meet the City's long-term needs.

MRTP Raw Water Supply

The Canyon Ferry Reservoir transfer system to the Regulating Reservoir has sufficient capacity to meet the long-term increased raw water demands for the City of Helena (maximum of 11,284 acre-foot per year available or 3,676 MG per year). That system will continue to keep the Regulating Reservoir full during the late March to mid-October irrigation season, with the reservoir filled at the end of the irrigation season. The water remaining in the Regulating Reservoir at the end of each irrigation season will be depleted more each year as water demands grow.

The Regulating Reservoir has a total storage capacity of 10,500 acre-feet (at water elevation 3820.1), with 5,900 acre-feet allocated for irrigation and municipal/industrial use. The water level fluctuates from a minimum of 3813.5 feet in March to a maximum of about 3820 feet in the summer, with a full pool maintained during irrigation season.

Algae Monitoring

The Regulating Reservoir has experienced periodic algae blooms in the past. Previous studies have indicated that the water pumped from Canyon Ferry Reservoir does not contain significant algae due to the deep depth from which water is withdrawn. Due to the presence of runoff nutrients, warm water temperatures and abundant sunlight in the late summer months at the Regulating Reservoir, algae growth can be stimulated. As a result, dissolved oxygen levels in the reservoir drop, with the bottom of the reservoir most likely experiencing oxygen depletion. Under anaerobic conditions on a lake bottom, geosmin and 2-methylisoborneal (MIB) are formed. Geosmin and MIB are major contributors to taste and odor in potable water supplies and are detectable at very low concentrations by the public (i.e. 5 ng/L).

Algae and their metabolites can significantly affect the treatment and quality of drinking water by clogging intake screens, increasing coagulant demand, shortening filter runs due to filter clogging or premature breakthrough of algae and other particulates, increasing filter backwash requirements, increasing chlorine demand, producing unpleasant tastes and odors, and increasing microbial growth in the distribution system. Detecting the onset of an algal bloom through monitoring and developing treatment strategies in advance of algae events can minimize the effects to water quality.

Utilities have used a variety of methods to monitor for increases in the number of algae. The most direct method is to perform counts. On-line measurement of dissolved oxygen and pH in source waters can provide real-time indications of algae concentrations. Increases in DO and pH are indicators of increased photosynthetic activity, which may be caused either by increases in algae concentration or by an increase in activity by a constant population. When DO and pH rise, algae counts can confirm an increase as long as the utility has baseline data (historical pH and DO values) for comparison.

Algae monitoring at the Regulating Reservoir is recommended.

Several test methods have been developed for use by operators that are more focused toward monitoring for earthy/musty odors, including the Attribute Rating Test and the 2-of-5 Odor Test. Both these test methods are effective for monitoring low levels of geosmin and MIB for odor control. The City currently tests for odors by using the "sniff" test, where the water is heated and "sniffed."

Algae Control

One of the most effective methods to address taste and odor problems occurring at a storage reservoir is to prevent the biological activity that creates the taste and odor from occurring in the water supplies to the treatment facilities. For the supply being provided from the Regulating Reservoir to the MRTP, there are a number of potential alternatives to mitigate the taste and odor problem. Changing from one intake level to another has been used in the past to avoid the algae-laden water near the surface of the reservoir. Other potential alternatives to reduce the taste and odor occurrences include:

- Provide lower lake level aeration of the reservoir for maintaining DO levels in the reservoir's lower depths to reduce geosmin/MIB formation in the reservoir bottom and reduce algae formation. Estimated cost $150,000.
- Provide aeration of the full reservoir depth to increase DO levels and destratify the reservoir, reducing algae growth and resultant taste and odor problems. Estimated cost $250,000.
- Relocate the intake for MRTP to near the reservoir inlet from the Canyon Ferry Reservoir transfer system to avoid water quality degradation that occurs in the Regulating Reservoir. A new pump station would also be provided. Estimated cost $2,000,000 (intake only).

The raw water intake for the MRTP is located on the opposite side of the Regulating Reservoir from the Canyon Ferry Reservoir transfer system and can be seen in Figure 6-3. The existing MRTP intake allows removal of water from the reservoir at two elevations. A channel is provided in the dam embankment along the alignment of the intakes, allowing flow from the reservoir to pass to the two intakes. As a result of the intake location and design, water quality degradation can occur in the Regulating Reservoir due to the long water residence time and the limited variability of water depth that can be withdrawn at the intakes.

The existing intakes are provided with small trash racks.

Modifying MRTP Raw Water Intake

Relocating the MRTP intake at the Regulating Reservoir closer to the Canyon Ferry Reservoir transfer system outlet will most likely require locating a new raw water pump station near the intake. This is necessary to allow routing the pipeline across the high ground east of the reservoir to connect back to the existing raw water pipeline to MRTP. Gravity flow from the relocated intake would not be practical. Figure 6-3 shows a potential location for the new intake/raw water pump station and route for the pipeline to connect back to the existing MRTP pipeline.

A water and air blast, "self-cleaning" barrel-type fish screen may be needed at the Reservoir.

Intake and Screening

The exiting MRTP intake located at the Regulating Reservoir does not have fish screens to prevent the entry of fish into the intake or to protect fish habitats. The trash rack at the front of the existing intakes only prevents large debris from entering and must be manually cleaned periodically. Bureau of Reclamation has expressed interest in providing fish protection on the intake. In order to provide this protection, it will be necessary to modify the intake to block fish from entering the intake pipes. Fish screens require a large surface area, with a maximum approach velocity of 0.5 feet per second and a maximum opening size of 1/8-inch. Should fish screens become necessary, their installation will eliminate the need for screening at the raw water booster station or the MRTP.

There are a number of options for adding fish screens at the existing MRTP intake at the Regulating Reservoir. However, addition of fish screens is complicated by the intake's use of two separate intake laterals at different elevations. If the existing intake configuration is to be maintained, separate fish screens would be needed at the intake to both intake laterals. The trash racks currently in place at both inlets would need to be replaced with much larger screen assemblies. In order to meet the 0.5 fps maximum approach velocity limitation, the screen surface areas shown in Table 6-5 would be needed at each inlet.

Table 6-5 MRTP Intake Screen Capacity and Surface Area

Design Year	Intake Capacity		Screen Area Required (ft^2)
	MGD	cfs	
2025	13.91	21.12	42.2
2045	19.95	30.88	61.7

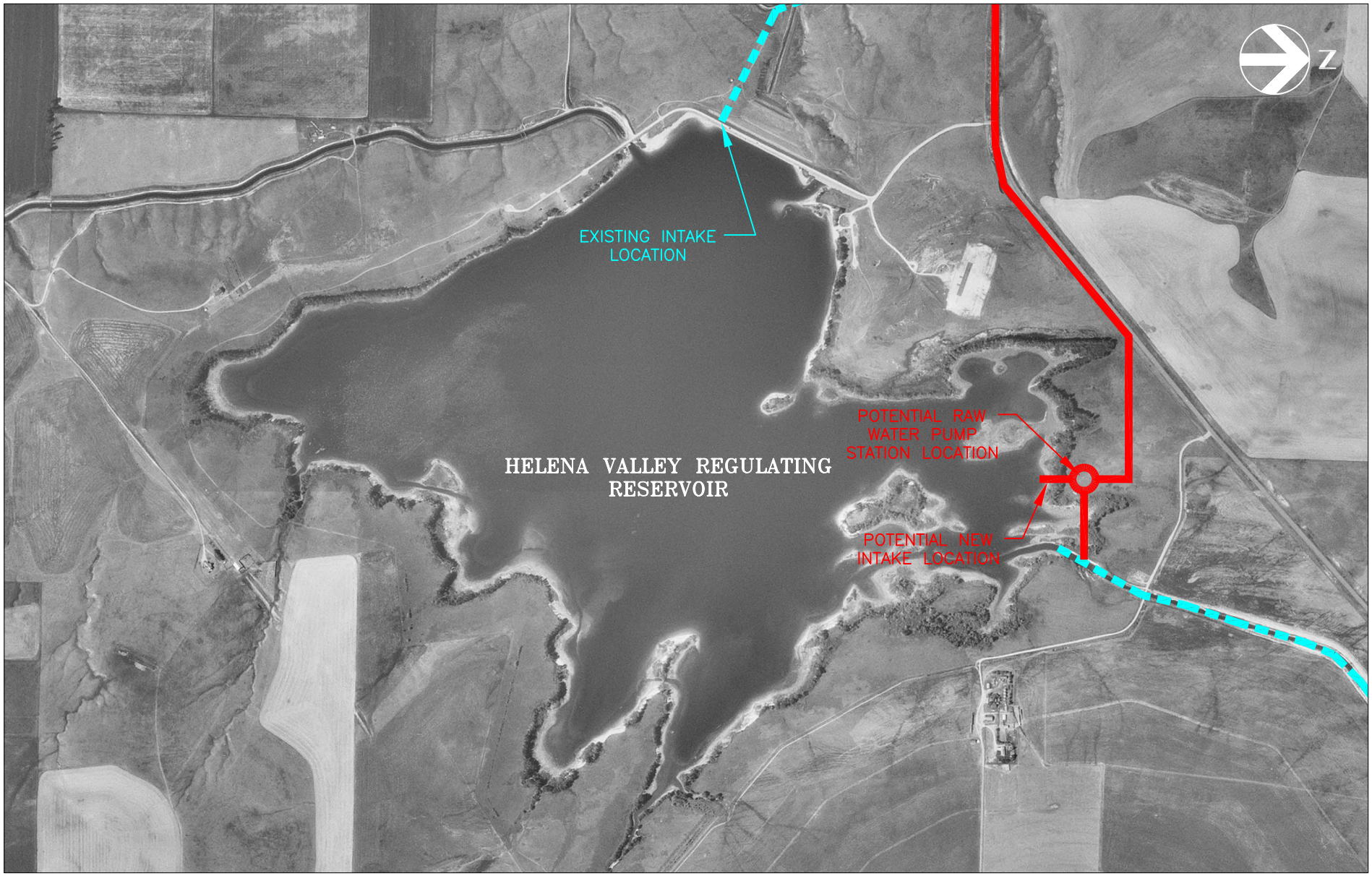
The existing trash racks provide approximately 12 square feet of surface area. Potential options for the fish screens at the existing Regulating Reservoir intake for MRTP include:

- Barrel screens mounted to the intake pipe, with air burst cleaning system.
- Vertical flat screens mounted in front of the intake inlet, with hydraulic flushing.

As an alternative to adding fish screens to the existing intake, a new intake would be constructed that would require only one fish screen assembly. The new intake would be constructed in conjunction with a new raw water pump station system, needed to increase delivery capacity to the MRTP. Options include:

- Constructing an intake tower in the reservoir, with fish screens attached to the structure at different intake levels and the tower connected by pipeline to the shoreline new water pump station (similar to the existing system at Chessman Reservoir).
- Constructing a wide channel from the reservoir to the shoreline, where screens could be mounted to the front face of an inlet structure, with an attached raw water pump station (similar to the existing system).

If fish screens are required at the MRTP intake, it is recommended that a new intake be constructed that can be specifically designed to incorporate the fish screen equipment. The screens should be self-cleaning and will eliminate the need for screening at MRTP.



NEW EXISTING

Figure 6–3
Alternative Intake and Pump Station Location at the Regulating Reservoir

City of Helena
Water Facilities Plan

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MRTP Raw Water Delivery

The raw water line from the Regulating Reservoir to MRTP has a 9 MGD capacity at low water level (elev. 3805.0) and 12 MGD at full pool (elev. 3820.5). To meet the long-term MRTP peak raw water summer demand (13.91 MGD), improvements to the raw water line will be necessary. There are several potential alternatives for increasing the capacity of the raw water line to the MRTP:

A raw water booster pump station is needed to meet the 2025 design capacity at MRTP.

- Construct a parallel pipeline for all or a portion of the raw water pipeline length.
- Increase the operating water level at the Regulating Reservoir
- Construct a booster pump station on the raw water line at one of the following locations:
  - At the Regulating Reservoir site.
  - Along the pipeline between the Regulating Reservoir and MRTP.
  - At the MRTP site.

Constructing a parallel line would be costly (more than $7,000,000) and would require construction in areas where the City does not currently have right-of-way. Raising the Regulating Reservoir operating water level is not practical given the BOR and HVID sensitivity to managing the system and the public use of the reservoir. Although the HVID manages the reservoir such that the water level is kept fairly full from April to September, the City does not manage the pumping facilities at Canyon Ferry that feed the reservoir. Constructing a raw water booster station allows BOR and the City the most flexibility and control to meet their long-term supply needs.

The raw water pump station should be located to allow delivery of the 19.95 MGD (2045 demand) to MRTP with the Regulatory Reservoir at low level (elev. 3805.5). Before a recommendation can be made, a detailed geotechnical study is needed to evaluate the feasibility of constructing a new combination intake and raw water pump station at the Regulating Reservoir, with the capability to provide fish screening. Locating the new facility near the existing intake and near the Canyon Ferry Reservoir transfer station outlet should be considered. The estimated cost for a new shoreline intake/raw water pump station is $4,500,000, not including the cost of the discharge pipeline needed to connect to the existing raw water pipeline to MRTP.

Constructing a raw water pumping station allows the City the most control.

MRTP Overall Treatment

The existing MRTP facilities need to be either improved or replaced to meet future water demands, with the exception of the recently renovated filters. The remainder of the MRTP facilities are not suitable to reliably produce the 2025 maximum day raw water demand at MRTP, including the pretreatment, disinfection, storage, high service pumping, residuals handling and support facilities. As a result, whether the existing filters are planned for use or will be abandoned in the future is a pivotal issue in evaluating the future needs for the MRTP. If the existing filters are to

The existing MRTP facilities need to be either improved or replaced to meet future water demands.

remain in use, continuing to use conventional treatment makes the most sense in order to take full advantage of the existing filters' capability. If the existing filters are to be abandoned, low pressure membrane treatment makes the most sense for constructing an entirely new treatment facility. For purposes of discussion, the use of the existing filters and upgrading the remainder of the plant will be evaluated first, followed by an evaluation of the use of membrane treatment, to provide a basis of comparison with the existing plant renovation alternative.

Reuse of the existing MRTP must take a number of factors into consideration, even if the plant is upgraded:

- The existing Flocculation Basin and Sedimentation Basin No. 3 are covered and located outside and will require removal of the cover and a building enclosure if reused in their current roles.
- The plant site has a high groundwater table and will require a significant dewatering effort for construction of below grade structures or piping.
- The plant facilities do not meet current building and fire codes and should be renovated if existing facilities are to continue in use.
- The existing plant facilities are structurally sound and are suitable for future long-term use by the City.
- The MRTP will need to deliver water directly to the low zones to reduce pumping costs.

MRTP Pretreatment

The existing pretreatment system at MRTP, consisting of screening, rapid mixing, flocculation and sedimentation facilities, is not capable of adequately treating 13.91 MGD (2025 raw water demand) of raw water needed to deliver 13 MGD of finished water to the distribution system. The current facilities have a number of deficiencies (identified in Chapter 3) that will prevent the pretreatment system from producing a settled water quality suitable for filtering by the eight existing dual media filters. This water quality standard is defined by the EPA as, "settled water turbidity less than 1.0 NTU 95 percent of the time when raw water turbidity is less than or equal to 10 NTU" or "settled water turbidity less than 2.0 NTU 95 percent of the time when raw water turbidity is greater than 10 NTU." In order to correct the pretreatment deficiencies, the existing screening, rapid mixing, flocculation and sedimentation facilities must either be upgraded or abandoned and replaced. Alternatives for upgrading the existing facilities are presented first, followed by the options for constructing entirely new facilities.

Screening

The screening facility currently in use at MRTP is located downstream of the jet mixer used for rapid mixing, resulting in the jet mixer plugging frequently. The raw water control valve is also located upstream of screening, but has not experienced any plugging problems to date. The screening facilities should be located ahead of both the control valve and rapid mixer to protect both from plugging or damage. The screens should be self-cleaning, capable of removing debris larger than 1/8-inch.

Open channel screens are best suited for this application, as pressurized screens directly piped to the raw water pipeline create too much headloss (i.e. 5-10 psi) for the hydraulic gradeline available at the MRTP. There are a wide variety of screens suitable for this application, including traveling screens and disc screens. The screens could be located either at the head of the MRTP or at the Regulating Reservoir raw water intake/booster pump station.

Rapid Mix

The existing rapid mixing facilities potentially can be reused with some modifications to the coagulant injection location to optimize mixing provided by the jet mixer. However, reuse of the exiting rapid mixing facilities is only practical if the existing flocculation basins immediately downstream are also reused in the expanded MRTP. Locating rapid mixing close to the flocculation basins is critical to providing good coagulation.

The existing rapid mix is undersized.

Flocculation

Both the existing rapid mix and flocculation facilities at MRTP were designed for 12.0 MGD. Increasing treatment flow to 13.91 MGD may require modification to the flocculation basins to increase mixing intensity, as the originally designed mixing gradients, 30-60 sec^{-1} (first stage) and 15-30 sec^{-1} (second stage) are marginal, even at the original 12.0 MGD design flow, and will be further compromised by increasing flow to 13.91 MGD.

Sedimentation

The existing sedimentation basins utilize tube settlers to enhance basin performance, with the basins designed for a maximum flow of 12.0 MGD. At the required design flow of 13.91 MGD, the tube settler loading rates in both the inside basins (Basin No. 1 and No. 2) and the outside basins (Basin No. 3) exceed acceptable surface loading rates for tube settlers. Addition of more tube settlers to the sedimentation basins is not practical.

Pretreatment Alternatives

The existing rapid mix, flocculation and sedimentation facilities are not capable of providing the 13.91 MGD of treatment capacity required in the future. As a result, the existing facilities must be either modified or replaced to achieve the necessary treatment capacity. There are several viable alternatives for upgrading the MRTP pretreatment facilities:

- Retrofit the existing interior and exterior sedimentation basins with plate settlers (replacing the tube settlers) and replace the flocculation mixers with higher intensity units.
- Retrofit the existing interior sedimentation basins with dissolved air flotation (DAF) systems, including rapid mix and flocculation, and abandon the exterior rapid mix, flocculation and sedimentation facilities.
- Abandon the existing rapid mix, flocculation and sedimentation facilities entirely and construct new ballasted sedimentation facilities (i.e. Actiflo or Densadeg).

- Abandon the existing rapid mix, flocculation and sedimentation facilities entirely and construct new contact adsorption clarification (CAC) facilities (i.e. Trident or ContaClarifier).

These alternatives were developed based on a number of considerations, which eliminated several potential pretreatment technologies. Following is a summary of those considerations.

- The pretreatment facilities should not create much headloss and must allow gravity flow to the existing filters.
- The pretreatment facilities should be located inside a building to allow routine access to the equipment for operations and maintenance and to protect the equipment from freezing.
- The existing sedimentation basins are too shallow to convert to ballasted sedimentation or CAC.
- High-rate sedimentation using ballasted sedimentation or CAC are the most cost effective pretreatment approaches when constructing new facilities at the MRTP, eliminating sedimentation using plate settlers or tube settlers from consideration.
- Since DAF or plate settlers will work within the existing basins, those technologies do not need to be considered for the new facilities alternatives as the new facilities would be higher in cost.

Following is a brief discussion of the candidate technologies for upgrading the existing pretreatment facilities or constructing entirely new facilities.

Plate Settling Sedimentation

One pretreatment option would be to add plate settling to the MRTP in lieu of current tube settlers. The theory of plate settling is to reduce the distance that coagulated particles have to settle, increasing the effective surface area in the settling zone. The surface area of the plates is significantly greater than the water surface area of the basin, allowing an approximate six-fold increase in flow rate compared to the same footprint in a traditional sedimentation basin. The plates work by solids settling onto the plates and building up. Once there is a slight buildup, the solids will slough down the steeply inclined plates and drop to the bottom of the basin. Mechanical equipment under the plates then moves the solids to a collection point for removal from the basin. Effluent troughs above the settling plates collect pretreatment effluent. Figure 6-4 shows an example of plate settling equipment.

Rapid mix and flocculation, which precedes the plate settlers, is similar to the processes for conventional sedimentation. Upgrading the existing rapid mix and flocculation facilities at MRTP, as discussed previously, will provide the necessary coagulation prior to the plate settlers. It would be possible to retrofit the existing basins to hold plate settling equipment; however, due to the size limit of the basins, the system would be strained at 100 percent of the design flow and could produce excessive strain on the system if an algae problem were presented. It would be most effective to add the plate settling equipment in a new building, or utilize both the inside basins and outside basins, where the system could provide sufficient settling time. The use of the outside basin would require the addition of a building over the basins and removal of the existing covers to increase accessibility for maintenance.

Advantages:

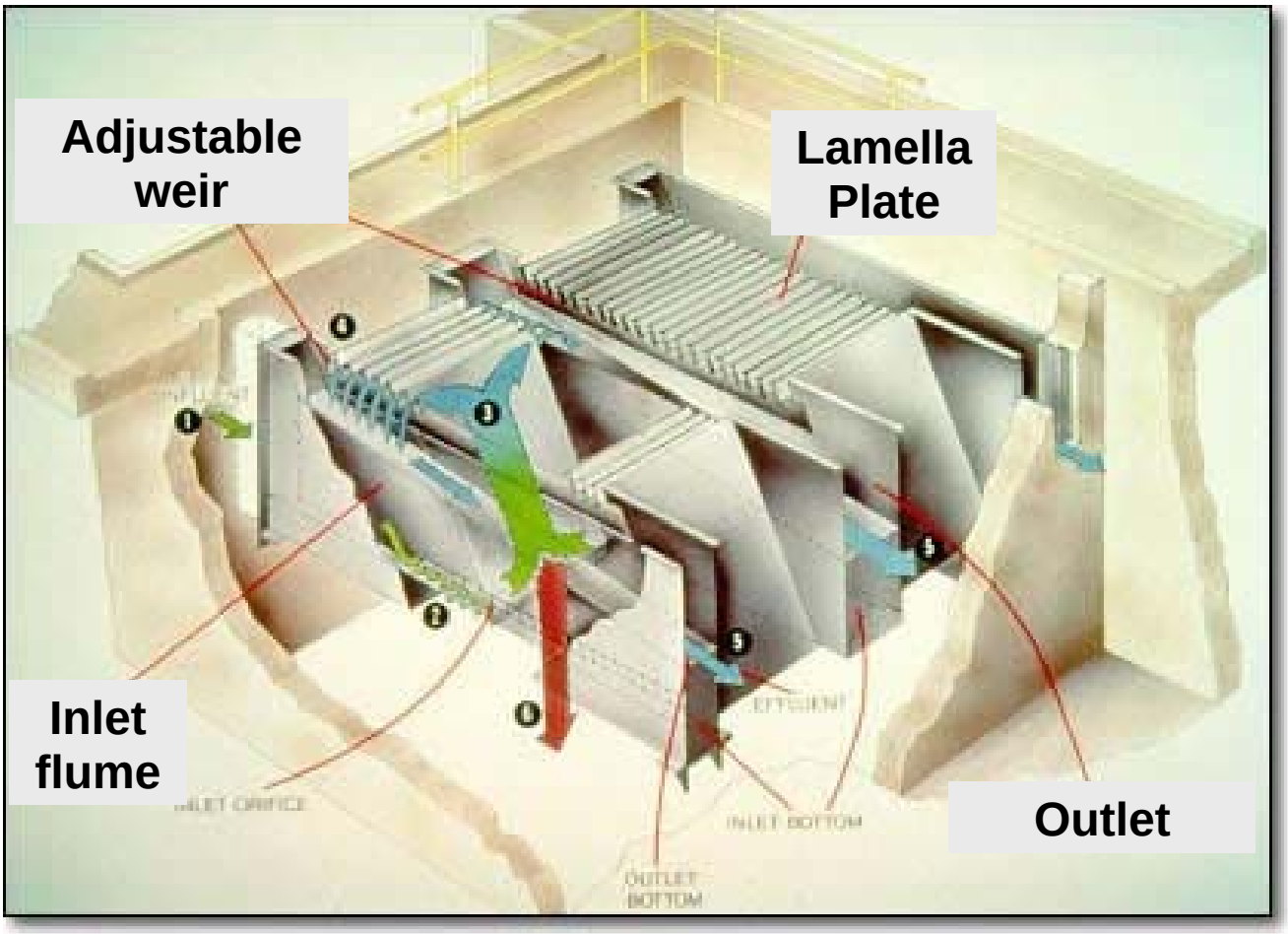
- Higher rate of sedimentation – 6 gpm/ft^2 of basin surface area

- Adaptable to existing basin shallow water depths
- Tolerant of high turbidity spikes (>50 NTU)
- Minimal modifications needed to existing basin structures
- Non-proprietary equipment supplied by several manufacturers

Disadvantages:

- Periodic draining of basins needed to clean plates
- Requires use of the existing outside basin, necessitating addition of a building enclosure
- Upgrade of existing rapid mix and flocculation facilities needed to accommodate higher flows

Figure 6-4 Plate Settling Process Diagram



Schematic courtesy of Parkson

Dissolved Air Flotation (DAF)

High rate DAF (loading rate of 11 gpm/sf) is suitable for use in the existing sedimentation basins at MRTP and requires only the two basins inside the plant building to achieve the 13.91 MGD pretreatment capacity required. The size of the existing basins are marginal for use with a conventional DAF system (6 gpm/sf loading rate), however, may still be achievable. The existing basins would need to have all internal components removed, with new internal walls and equipment installed. The basins would operate in parallel, with each DAF unit sized to treat half of the flow. New rapid mix and flocculation facilities would be provided at the front of the DAF units, all installed in the existing basins. The existing outside rapid mix, flocculation and sedimentation basin will not be required when using DAF.

DAF is a good fit with the MRTP water quality and the tankage requirements match existing.

In the DAF process, a recycle stream is saturated with air at high pressure and then injected into a flotation tank to mix with incoming flocculated water. As the recycle stream enters the flotation tank, the drop in pressure results in the release of the now supersaturated dissolved air. As the air bubbles form, they attach to floc particles and create a layer of sludge (or float) at the surface of the tank. The float is removed either by a mechanical scraper or by flooding the tank over a weir. The clarified water is collected near the bottom of the tank and passes to the filters. Figure 6-5 presents a schematic of a typical DAF process.

DAF matches well with both the available square footage and the recommended minimum operating depth (10 feet) with the existing tank (11.5 feet).

DAF is particularly effective in removing low-density particles from water, such as algae, protozoan cysts, coagulated natural organic matter, and floc from alum and ferric coagulants used on low-turbidity soft waters. These particles are a particular problem for a conventional treatment plant because they do not readily settle and usually require high coagulant doses and long flocculation and settling times. Carryover of these particles to the filters causes shorter filter runs. DAF is often the best available technology in these circumstances.

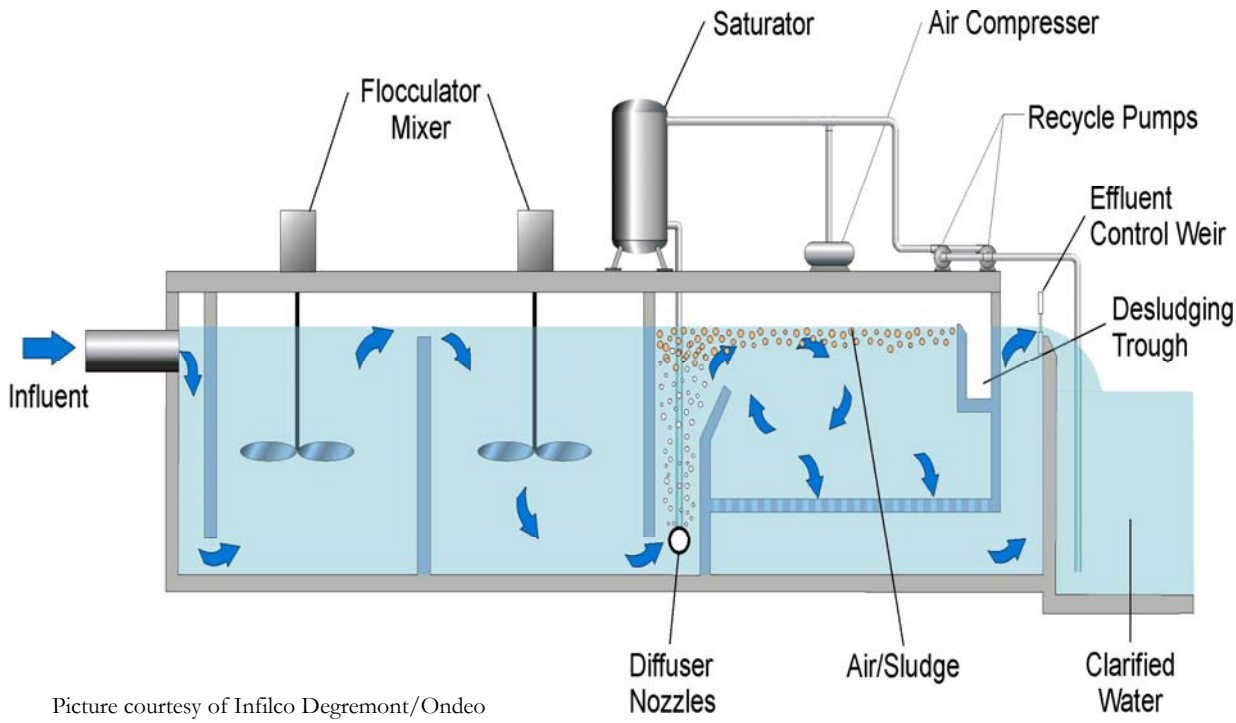
Advantages:

- Higher rate of sedimentation – up to 20 gpm/ft^2 of basin surface area
- Compact footprint due to higher loading rates
- Thicker sludge produced – 2 to 3 percent solids
- Shorter flocculation time needed
- Lower chemical costs

Disadvantages:

- Higher operator skill than sedimentation
- More maintenance than sedimentation
- Higher energy cost

Figure 6-5 Typical DAF Process Diagram



Picture courtesy of Infilco Degremont/Ondeo

Ballasted Sedimentation

Ballasted sedimentation cannot be used in the existing MRTP sedimentation basins, as the basin depth is too shallow. A minimum water depth of 14 feet is needed to allow installation of the ballasted sedimentation equipment. As noted earlier, there are two manufacturers of ballasted sedimentation systems: Actiflo and Densadeg. Both systems use proprietary technologies but are somewhat similar in design. For purposes of this evaluation, Actiflo was evaluated for use at the MRTP.

The Actiflo process is a high rate sedimentation process that uses microsand-enhanced flocculation to increase particle removal efficiency. The Actiflo process consists of rapid mix, coagulation, microsand and polymer injection, maturation of floc, and settling of floc. Figure 6-6 illustrates how the Actiflo process operates. The microsand ballasted sludge is pumped from the settling tank to a hydrocyclone, where the microsand is separated from the sludge by centrifugal force. The sludge is continuously removed for sludge treatment, whereas the microsand is reinjected back into the Actiflo system and continuously recycled.

Actiflo is an effective high rate pretreatment process. However, it cannot be used in the existing basins.

The first chamber is a mixing chamber, where the coagulant is mixed with the influent water. Polymer and microsand are added in the second mixing chamber, also called the sand injection chamber. Flocculation is provided in the third maturation chamber to enhance particle aggregation. Small particles attach to the heavier microsand that allows for rapid settling in the sedimentation basin.

Settled solids are removed from the sedimentation basin and directed to a hydrocyclone. The hydrocyclone provides a zone of very high turbulence to shear attached particles from the microsand and separate the sand from the lighter particles. Sand is returned to the second mixing chamber while the solids are discharged from the system.

Although a single Actiflo unit can handle the entire pretreatment capacity of 13.91 MGD, two units are recommended for redundancy purposes. The two Actiflo units would operate in parallel, treating half the flow each, and would be housed in a new structure/building at the plant site. Effluent from the Actiflo units would flow by gravity to the existing filters, similar to the existing sedimentation basins. A building with approximately 1,500 square feet is required for the Actiflo system. The optimum water depth for Actiflo operation is 15 feet.

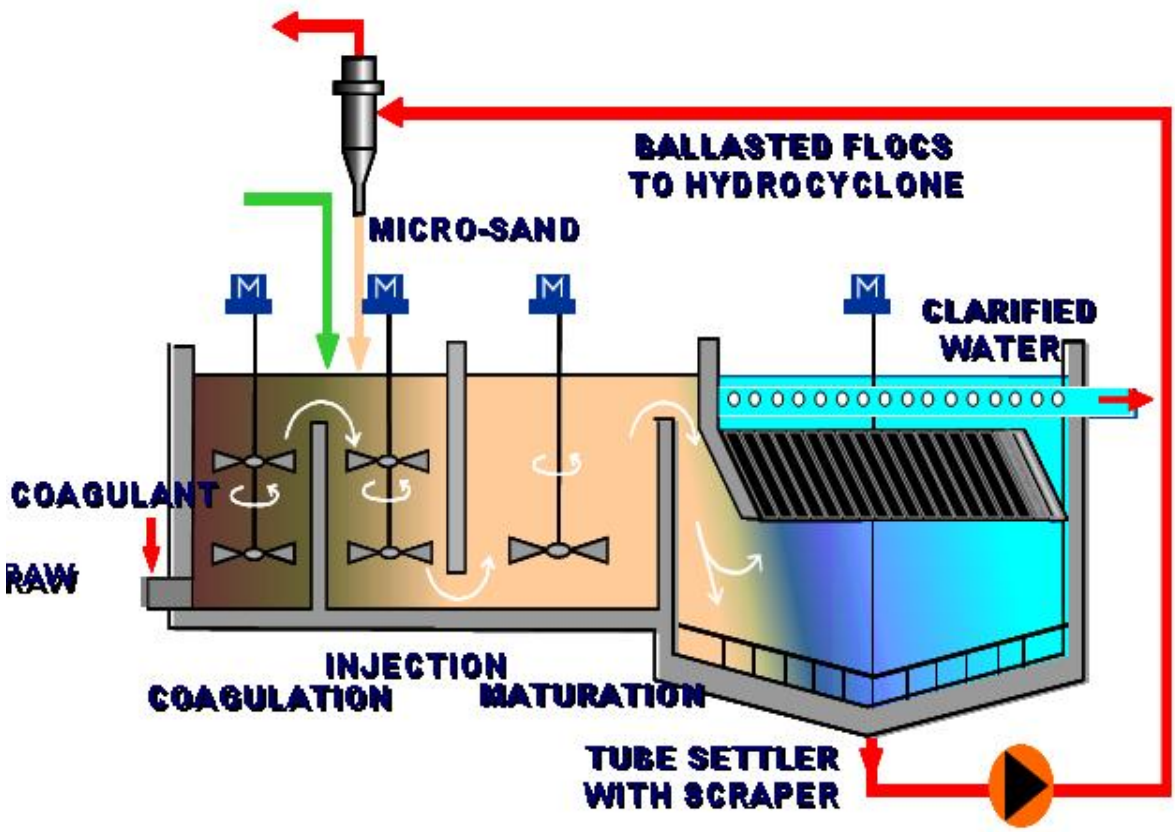
Advantages:

- Very high rate of sedimentation – up to 25 gpm/ft^2 of basin surface area
- Ease of operation – fully automated system
- Very compact footprint due to high loading rates
- Can effectively treat rapid spikes in raw water turbidity and organics
- Combines flocculation and clarification into one basin

Disadvantages:

- Minimum operating depth (14 feet) does not fit in existing basins (11 feet)
- System has limited competition
- Mechanically intensive system requires more maintenance
- Routine replacement of microsand required
- Can be limiting at high turbidities (i.e. >50 NTU)

Figure 6-6 Ballasted Sedimentation Schematic (Actiflo)



Pretreatment Process Comparison

Table 6-6 compares the three pretreatment alternatives considered for the MRTP expansion to 13.91 MGD. Regardless of the pretreatment system selected, a minimum of two parallel trains should be provided for redundancy. Each system would have chemical feed, rapid mix, flocculation and clarification zones. Collected sludge would be discharged by gravity to residuals handling. Also, all facilities would be enclosed in a building to prevent freezing of equipment and water surfaces. For DAF, the facilities would be located in the existing plant treatment building. For Actiflo and plate settings, new construction would be required.

Table 6-6 Design Criteria for Pretreatment Alternatives

Design Criteria	Plate Settling	DAF	Actiflo
Rapid Mix, detention time, seconds	30	30	120
Flocculation Zone, detention time, minutes	30	20	2/2 [1]
Clarification Overflow Rate, gpm/sf	6	14	25
Clarification Detention Time, hours	0.5	0.3	0.1

[1] These values correspond to 2 minutes of detention time for each of 2 units in series.

Table 6-7 presents the total estimated capital cost, estimated O&M annual cost and estimated 20-year present worth of the three pretreatment alternatives. Estimated detailed costs are included in Appendix 6-D.

Table 6-7 Pretreatment Alternative Costs [1]

Pretreatment Alternative	Estimated Capital Cost	Estimated O&M Annual Cost	Estimated 20-year Present Worth [2]
Plate Settling	$4,700,000 [3]	$40,000	$5,000,000
DAF	$4,100,000	$40,000	$4,500,000
Actiflo	$5,700,000 [3]	$40,000	$6,100,000

[1] Pretreatment capacity for 13.91 MGD
[2] Calculated at 8% interest.
[3] Assumes existing tankage is not reused.

The selection of which pretreatment alternative to use at MRTP may be impacted by the taste and odor control strategy. This is primarily a factor if Powder Activated Carbon (PAC) is selected to control taste and odor, as PAC requires a mixing zone with 30 minutes of detention time.

The DAF alternative and the plate settling have very similar capital and 20-year present worth costs, not taking into consideration the taste and odor control implications. Figure 6-7 shows the process diagrams for potential treatment trains at the MRTP. DAF treatment has proven to be more effective in locations with similar water quality and would most likely provide the optimum treatment for the cost.

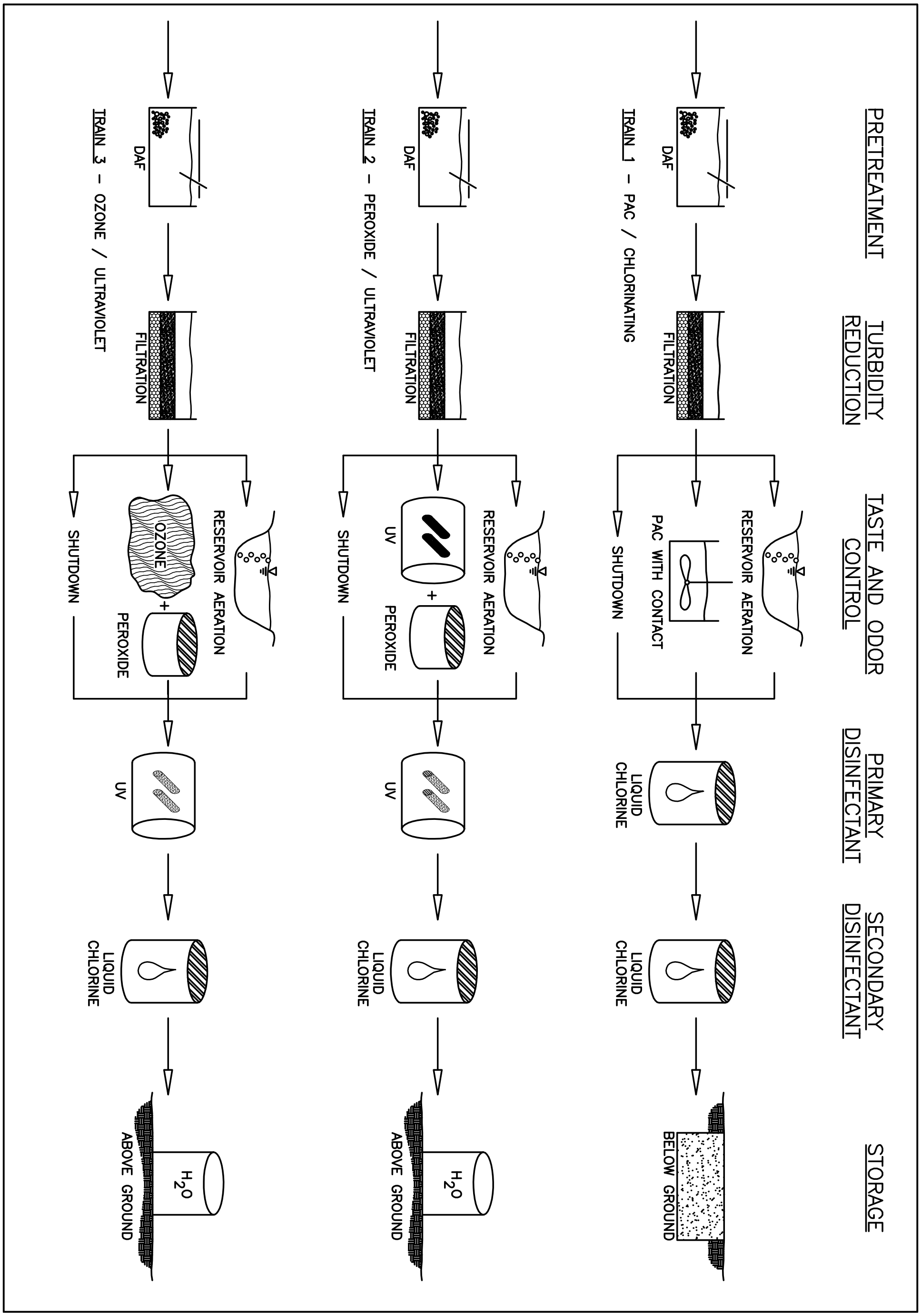


Figure 6–7
Treatment Train Options For MRTP

City of Helena
Water Facilities Plan

HELENA MONTANA
QUEEN CITY OF THE ROCKIES
ONE COMPANY | Many Solutions HDR

MRTP Taste and Odor Control

The existing MRTP is unable to currently accommodate severe taste and odor episodes and would shut down the plant during a severe event. Since these events have occurred in late summer-early fall, water demands are low enough at that time that the TTP can meet the systems demands. Taste and odor events that occur earlier in the summer are treated by adding PAC to the pretreatment system. With increasing demands on the MRTP in the future and the need to operate the plant for longer periods, the current MRTP taste and odor control strategy may not be considered practical for the future.

Algae have caused taste and odor events at MRTP.

The existing raw water delivery system to MRTP has a potassium permanganate ($KMnO_4$) feed system near the start of the raw water pipeline, located just below the Regulating Reservoir dam. $KMnO_4$ can be fed to the raw water flowing to MRTP, allowing oxidation of some taste and odor causing compounds and any iron/manganese present in the water. The $KMnO_4$ also serves to curtail biological growth on the raw water pipeline walls, reducing the growth of biofilms that would increase pipe hydraulic friction losses.

Three potential strategies for handling taste and odor events at the MRTP in the future have been identified: Chlorine dioxide (ClO_2)/power activated carbon (PAC), ozone (O_3)/ hydrogen peroxide (H_2O_2), and ultraviolet radiation (UV)/H_2O_2.

Chlorine Dioxide/PAC

Chlorine dioxide is an effective oxidant that can be used in combination with PAC to control taste and odors. The ClO_2 must be fed prior to PAC, providing a delay before PAC is fed in order for the ClO_2 to oxidize organics in the raw water. A minimum of 5 minutes of ClO_2 contact time before PAC is recommended.

Chlorine dioxide is an effective oxidant that can be used in combination with PAC to control taste and odors.

The ClO_2 must be generated on-site and fed immediately, as it cannot be stored. ClO_2 is generated using sodium chlorate as the base chemical, or sodium chlorate with a mixture of H_2O_2 and sulfuric acid. ClO_2 is formed by reacting sodium chlorite with chlorine gas, hypochlorous acid or hydrochloric acid.

The proposed MRTP PAC system would be similar to the existing system at TTP.

ClO_2 does not create any regulated disinfection byproducts, with the exception that chlorite and chlorate are formed. Both are regulated, limiting ClO_2 dosages to 1.5 -2.0 mg/L to the raw water. PAC will absorb ClO_2 in the raw water, necessitating that the ClO_2 be fed first.

PAC is a bituminous coal-based product activated at high temperature and pulverized to a powder form. The principal use of PAC in water treatment is to remove taste and odor. In some waters, PAC may also remove color or organics that otherwise would interfere with coagulation or filtration.

PAC dosages are usually in the range of 1 to 20 mg/L during taste and odor events. As much as one ton of product has been

used in the past for treatment in an 8-hour period at MRTP. PAC containing adsorbed contaminants is removed with the sludge from the pretreatment basins. The existing PAC system at MRTP requires operations staff to manually load 50 pound bags of PAC into a feeder. This system is outdated and operator unfriendly and needs to be replaced with a system that allows purchase of bulk carbon deliveries.

The recommended new PAC system would use a slurry storage tank, similar to TTP. The dry PAC would be unloaded into a slurry tank while mixing it with water to create a slurry, composed of 1 lb of PAC per gallon of water. The PAC is kept in suspension in the slurry storage tank with mechanically driven mixers. The PAC slurry is pumped from the bulk storage to a day tank and from the day tank through metering pumps to each point of application. Use of a slurry tank type of bulk storage reduces the carbon dust problem, as well as housekeeping and operator safety concerns.

The slurry tank would be 45,000 gallons (40 feet square) with a 5,500 gallon day tank. Mixers would stir both tanks. Metering pumps would feed PAC to the pretreatment flocculation zone.

A minimum of 30 minutes of contact time is required for the PAC to be effective for taste and odor control. The contact time must occur in a mixing zone that allows continuous contact of the PAC products with the raw water. The flocculation system proposed for each of the pretreatment systems provides the necessary mixing environment, but inadequate contact time. It may need to be supplemented by an additional mixing tank prior to the flocculation system. Table 6-8 below shows flocculation and mixing times required.

Table 6-8 Recommended Flocculation and Mixing Times for PAC

Pretreatment Alternative	Flocculation Time	Additional Mixing Time Required
Plate settlers	30 minutes	--
DAF	20 minutes	10 minutes
Actiflo	2 minutes	20 minutes

If DAF or Actiflo is used, supplemental contact time would be constructed or existing tankage used to allow the PAC time to adsorb organics. The existing flocculation basin could be converted to use as the contact basin for both the DAF and Actiflo pretreatment alternatives.

Advantages

- Plant staff is experienced in using PAC
- ClO_2 oxidizes iron/manganese in the raw water
- ClO_2 enhances settling of coagulated water
- ClO_2 and PAC system can be easily turned on and off
- Inactivation of *Giardia*

Disadvantages

- PAC provides marginal reduction of taste and odor

- ClO_2 doses are limited by downstream chlorite/chlorate concentration
- Addition of PAC produces more residuals that must be handled
- PAC requires significant treatment detention time in a mixed basin to function properly
- PAC slurry has a limited shelf life and should be used within 6 months
- PAC is messy to handle due to dust and difficult to feed due to abrasiveness

Advanced Oxidation Processes

The ozone/hydrogen peroxide and ultraviolet light/hydrogen peroxide alternatives are both considered advanced oxidation processes (AOP) that involve generation of a strong oxidant for the treatment of taste and odor compounds. The hydroxyl oxidant produced by the AOP chemically breaks down the taste and odor compounds into non-odorous components. Natural taste and odor producing compounds like MIB, geosmin and 2,4-heptadienal, as well as man made odorants like MTBE, can be effectively treated by AOP. Due to their great oxidizing potential, hydroxyl radicals produced by AOP are capable of destroying taste and odor producing compounds that traditional water treatment oxidants such, as permanganate, chlorine, chlorine dioxide, or ozone, are incapable of treating. AOP is also effective in destroying hard to treat organic contaminants, including many endocrine disrupting compounds.

Advanced oxidation processes are the most effective in treating taste and odor.

Currently, two AOP technologies are available on a commercial scale which use hydrogen peroxide for the generation of the hydroxyl radical. These include the use of ozone/ H_2O_2 and UV/H_2O_2.

Ozone/H_2O_2

The ozone system is normally composed of four subsystems: ozone generation, feed gas preparation, ozone contact and off-gas disposal. Ozone generators are available in three types: low-frequency (60 Hz), medium frequency (400-1000 Hz) and high frequency (up to 2000 Hz). Medium frequency is the most commonly used, with air directed past two electrodes, with oxygen in the air converted to ozone. Feed gas for the generators may be either air or liquid oxygen (LOX). Due to the higher efficiency available by using LOX, many recent installations have employed LOX in lieu of air. Ozone contactors must be designed to maximize the transfer of ozone gas into the water, maintaining the contact for a prescribed time period needed for the necessary reactions to occur. For taste and odor control, multi-step injections and contact is often needed, with 15 minutes of contact time provided in three cells. The contact basins are covered to allow the capture of off-gas. The off-gas can be handled a number of ways, but is normally treated with a thermal/catalytic destruct unit.

The H_2O_2 system would be relatively simple, consisting of a bulk storage tank (6000 gallons) and metering pumps. The system would need to be housed in a building and would allow bulk chemical deliveries using tanker trucks.

The chemistry of the ozone/H_2O_2 process is more complicated than the UV/ H_2O_2 process. This is because ozone, the hydroxyl radical and intermediate compounds formed during radical formation, and ozone decomposition can all contribute to the oxidation of taste and

odor causing compounds. The actual mix of oxidants is determined by factors such as water quality, concentrations of ozone and peroxide present and the relative ratio of peroxide to applied ozone. Similar to the UV/ H_2O_2 process, the ozone/ H_2O_2 process can result in the complete destruction of taste and odor causing compounds.

Advantages:

- Oxidizes iron/manganese in raw water
- Ozone is a proven taste and odor technology
- Ozone can be used for primary disinfection

Disadvantages

- Ozone creates assimilable organic carbon (AOC) that must be removed by creating a biologically active filter
- Ozone must be operated continuously to keep filters biologically active
- Ozone uses a large amount of power
- High doses are required to inactivate *Cryptosporidium*
- Contact basin must be provided

UV/H_2O_2

The UV system consists of a control panel, UV reactor and UVT monitor. The reactor houses the UV lamps, lamp sleeves, UV intensity sensors, cleaning mechanism and temperature sensors. UV reactors are either open-channel or closed reactors. Closed reactors are normally used for potable water, with low-pressure (LP) mercury vapor lamps, low-pressure high-output (LPHO) mercury vapor lamps used. LP and LPHO produce a nearly monochromatic UV light at 254 nm, while MP produced polychromatic UV light ranging from 200-300 nm. Normally used for disinfection purposes, UV has also proven to be effective for taste and odor control. A much higher UV intensity is needed to inactivate geosmim and MIB. As a result, two stages of UV make the most sense for MRTP. The first stage would meet the disinfection requirements, while the second stage (which can be bypassed or turned off) would only be used during taste and odor events. The UV system is best located downstream of the filters and creates 5-10 feet of headloss.

The H_2O_2 system would be similar to the system described for the ozone alternative. The H_2O_2 facilities could be located adjacent to the UV equipment.

The UV/hydrogen peroxide process employs photolysis (splitting chemical bonds with light) to create a strong oxidant by using ultraviolet light to cleave the O-O bond of the H_2O_2 molecule. Once created, the hydroxyl radical rapidly attacks and splits any electron-rich chemical bond it encounters. This in turn initiates a series of reactions which destroys the taste and odor causing compound.

Advantages

- UV provides inactivation of *Cryptosporidium* and *Giardia*
- Does not impact the formation of TTHM and HAA5
- Minimal detention time required for treatment to occur
- Very effective for taste and odor control

- Allows taste and odor control function to be activated only when required
- UV/H_2O_2 does not create AOC

Disadvantages

- UV/H_2O_2 is an emerging technology for T&O control
- Does not provide virus inactivation at low dosage rates
- Requires 1-6 feet of hydraulic head to operate properly (5-10 feet if flow splitting needed)
- Must be located downstream of filters to minimize interference
- Validation testing needed to receive inactivation credit

UV disinfection is effective for primary disinfection and taste and odor control when used with peroxide.

Taste and Odor Process Comparison

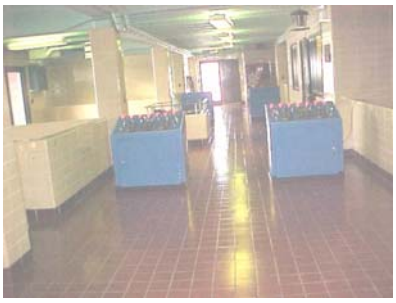
Table 6-9 compares capital, O&M and present worth for the three alternatives considered. Detailed costs are included in Appendix 6-E. Each system has unique capital and operational costs. All facilities would be enclosed in a building to allow easy access for operation and maintenance and to prevent freezing of equipment and water surfaces.

Table 6-9 Taste and Odor Alternative Costs

Alternatives	Estimated Capital Costs	Estimated Annual O&M Costs	Estimated 20-year Present Worth [1]
ClO_2/PAC [4]	$1,800,000	$70,000	$2,500,000
Ozone[2]/H_2O_2 [3]	$3,700,000	$150,000	$5,200,000
UV/ H_2O_2 [3]	$1,500,000	$60,000	$2,100,000

[1] Present worth based on 8% interest rate.
[2] Costs presented are for taste and odor control only and do not include *Cryptosporidium* inactivation.
[3] Estimated capital cost for H_2O_2 only is $200,000. Estimated O&M for H_2O_2 only is $30,000.
[4] Estimated cost of PAC only is $1,300,000.

The taste and odor control facilities alternative selected for the MRTP needs to take into consideration the potential primary disinfection benefits gained from the treatment processes employed for taste and odor control. For example, the UV and ozone systems used for two of the alternatives are very effective at primary disinfection. As a result, selection of the taste and odor control strategy will be evaluated in conjunction with the disinfection strategy at MRTP at the end of this chapter.



Filter capacity is limited by ineffective pre-treatment.

MRTP Filtration

The MRTP has historically been operated at a loading rate of 3 gpm/sf (8 MGD). The current filter loading rate is limited by three issues: ineffective pretreatment, the use of sweep coagulation (alum dose of 50 mg/L), and the limited capacity of high service pumping.

Pretreatment at MRTP is largely ineffective, with turbidities onto the filters virtually matching influent turbidities, even at high

alum doses. This poor performance means one of the plant's multiple barriers to pathogen pass-through is not functioning.

If pretreatment is improved, the capacity of the existing filters would increase to 13.78 MGD with one unit out of service at a conservative loading rate of 5.06 gpm/sf. With the improvements made in 2003-04, including new media and underdrains, the existing filters are capable of meeting the City's needs for turbidity removal up through 2025 at the MRTP.

MRTP Disinfection

As discussed in Chapter 3, the existing chlorine gas system at MRTP does not meet current building and fire code requirements. Chlorine serves as the primary disinfectant system and could be replaced with a new chlorination system, a UV disinfection system or ozone disinfection. UV is more cost effective than ozone when just disinfection is required in cold waters.

Secondary disinfection at MRTP can best be accomplished using chlorine, unless disinfection by-products become an issue in the future. Chlorine provides a consistent disinfecting residual in the existing distribution system and has worked well in the past. If disinfection byproduct concentrations in the distribution system become a problem in the future, ammonia feed can be added to convert the chlorine to chloramines. Chloramines minimize DBP formation in the distribution system and provide a longer residual life in the system than chlorine, but may have adverse effects on lead and copper release in the distribution system.

Chlorination

Three alternatives for chlorination as a disinfectant were reviewed in Appendix 6-B: chlorine gas, liquid chlorine and onsite generation. Chlorination with liquid sodium hypochlorite would require delivery by bulk tanker truck. One 3,000 gallon storage tank, at average conditions, would last approximately one month. Sodium hypochlorite would be delivered to the finished water with metering pumps. The chlorination room would include a secondary containment of the 5,000 gallon chlorine tank, a sprinkler fire suppression system and containment for 20 minutes of fire flow from sprinklers.

The advantages and disadvantages of chlorination as a primary disinfectant are:

Advantages:

- Simple to operate and maintain
- Low capital cost
- Chlorine gas scrubbers or secondary containment vessels not required

The existing MRTP chlorine gas system does not meet current codes.

Disadvantages:

- Not able to inactivate *Cryptosporidium*
- Higher operating costs
- Generates regulated disinfection byproducts

Ultraviolet (UV) Disinfection

UV disinfection is being used more commonly for disinfection of potable water. It leaves no residual, so requires use of a different technology for secondary disinfectant. The most common application point for UV is after filtration. UV reactors are available in two types: closed vessel and open channel (the City WWTP has open channel). Closed vessel is generally the preferred reactor for potable water because it has minimized exposure from airborne contaminants, a smaller footprint, modular design for similar installation, and minimal personnel exposure to UV. Contact times are short, on the order of seconds, so eliminating short circuitry is critical. The estimated building size for UV facilities is 400 square feet.

The advantages and disadvantages of UV as a primary disinfectant are:

Advantages:

- Capable of inactivating *Cryptosporidium*
- No contact time required
- No chemicals to deliver or store
- Does not create regulated disinfection byproducts

Disadvantages:

- Higher power cost
- Creates 5-10 feet of hydraulic headloss
- Compact equipment footprint
- Requires a separate secondary disinfectant
- Requires validation

Ozone Disinfection

Ozone is a powerful disinfectant, occasionally used for disinfection of potable water. It provides no residual disinfectant in the water, so requires use of a secondary disinfectant (chlorine). The most common location to use ozone in a water treatment plant is following sedimentation, prior to filtration. An ozone contact chamber with about 15 minutes of contact time is normally required, with the contact chamber baffled to assure good contact between the water and ozone. Ozone is generated on-site and fed into the contract chamber as a gas using diffusers.

Ozone would be added upstream of the filters.

When TOC is present in the water, ozone breaks the longer chain molecules down into smaller chains, creating a simple organic carbon (AOC) that serves as a food source for biological activity in the water system, particularly biofilms in the lining of water distribution system pipelines. In order to prevent the biofilms from occurring, it is necessary to remove the AOC. Normally, this is accomplished by using biological active filters (BAF), which can be implemented using conventional dual media filters like those at MRTP. The filters are allowed to grow biological organisms that consume the AOC, which necessitate that the ozone be routinely kept in operation to maintain the biological growth on the filter media.

Advantages:

- Very effective at meeting current disinfection "CT" requirements
- No chemical deliveries required

Disadvantages:

- Not capable of inactivating *Cryptosporidium*
- Very high power cost
- Requires addition of ozone contact chamber
- Ozone must be kept in operation to sustain BAF
- Ozone destruct system required for off-gases
- Ozone produces by-products that are not currently regulated, but are likely to be in the future

Disinfection Process Comparison

Table 6-10 compares capital, O&M, and present worth for the three alternatives considered. Detailed costs are included in Appendix 6-F. Each system has unique capital and operational costs. All facilities would be enclosed in a building to allow easy access for operation and maintenance and to prevent freezing of equipment and water surfaces.

Table 6-10 Disinfection Alternative Costs

Alternatives	Estimated Capital Costs	Estimated O&M Costs	Estimated 20-year Present Worth [1]
Liquid Chlorination	$350,000	$36,000	$700,000
UV [2]	$1,300,000	$30,000	$1,500,000
Ozone	$3,900,000	$175,000	$5,650,000

[1] Present worth based on 8% interest rate.
[2] Costs presented are for disinfection only.

The recommended approach for pretreatment taste and odor control and disinfection at MRTP is based on phased implementation of the improvements. DAF is recommended for pretreatment at the MRTP, as it has the lowest long-term cost and is compatible with the preferred taste and odor control strategy. The DAF system would need to be constructed in the first phase of construction. The first phase would include construction of liquid chlorination facilities and PAC. If the MRTP bin classification for *Cryptospridium* (to be completed in 2007) requires special treatment, UV could be constructed downstream of the filters. Given that the flow comes from a reservoir, it is not likely that a higher bin classification will be applicable. The settling effects that take place in a reservoir greatly reduce the likelihood of *Cryptosporidium* detection in the supply.

A phased approach to disinfection and taste and odor control is recommended.

If the taste and odor events at MRTP prove to be manageable with PAC, ClO_2 could be added to enhance treatment. However, if PAC is not effective, UV/H_2O_2 could be added downstream of the filters. If UV disinfection becomes necessary for *Cryptosporidium*, shifting away from PAC to UV/H_2O_2 may be worthwhile.

MRTP Corrosion Control

The City does not currently add corrosion control chemical to the treated water from the MRTP. A more thorough analysis of the source water and its potential impact on the lead and copper levels in the distribution system will need to be completed prior to increasing the

amount of MRTP water feeding the system. It is likely that chemical corrosion control addition will need to be added.

MRTP Residuals Handling

The existing residuals handling system at MRTP receives filter backwash wastewater and sedimentation basin sludge blowdown. Both flows are directed to two storage lagoons at the plant site. Due to evaporation and percolation into the subsoil, it has not been necessary to discharge any water from the lagoons in the past. However, increasing the quantity of flow to the lagoons, due to the increased finished water production by MRTP in the future, may exceed the evaporation/percolation capacity of the lagoons. Adding a third storage lagoon would most likely resolve this problem since the MRTP will continue to operate only seasonally.

The existing ponds have a large percolation capacity and have historically handled several backwashes daily (estimated 700,000 gpd). The new filter to waste (FTW) pumps will add an additional 20,000 gpd of flow to the lagoons. If, in the future, the percolation capacity of the lagoons is exceeded or declines, flow may be discharged to Prickly Pear Creek. The last issued discharge permit is in Appendix 6-G. The State has administratively extended this permit. If the percolation capacity is exceeded or if MDEQ removes the permit to discharge and a third lagoon is not constructed, a recycle pump station may be needed to return lagoon decant flow to the head of the plant.

If the City elects to recover lagoon water to maximize the use of the raw water supply, the estimated cost for maximizing the recovery by lining the ponds and constructing a backwash recovery pump station is $800,000. The City could recover approximately 600,000 gpd. The annual cost to delivery 600,000 gpd of raw water to the plant site is only $17,000, making it impractical since raw water supply is readily available.

MRTP Clearwell and Finished Water Pumping

The new clearwell and finished water pump station, designed in 2000 (but not constructed) for the MRTP, was intended to supplement the existing clearwell and replace the existing high service pumps. The clearwell was designed with a volume of 0.8 million gallons and the high service pump station with an 8.0 MGD high zone capacity.

An at-grade clearwell has advantages at MRTP.

The clearwell was positioned to allow gravity flow from the existing clearwells, requiring that the clearwell be buried. A maximum water depth of 12 feet was used for the clearwell, with the 90 foot by 105 foot cast-in-place rectangular structure buried under 3-1/2 feet of topsoil. The high service pump station included four 2.0 MGD vertical turbine high zone pumps, mounted in individual suction cans. The suction cans extend approximately 20 feet below the pump station floor and each are connected to a pipeline from the new clearwell. The building enclosing the pump equipment and surge tank is approximately 2,280 sf (not including the attached chlorine facilities). The pump station was designed to allow expansion of the structure to house future low zone high service pumps and/or additional high zone pumps.

The originally proposed clearwell and high service pump station facilities, designed in 2000, are no longer suitable for use at the MRTP for a variety of reasons:

- MRTP capacity will need to be increased to 13.78 MGD, significantly exceeding the 8 MGD design capacity.
- Clearwell capacity will need to be increased to at least 1.5 MG to meet both plant and distribution system needs. This significantly exceeds the current 0.8 MG design capacity.
- Low zone high service pumps will be needed to meet future distribution system needs, which are not included in the design.

Due to the increased size requirement of the new clearwell and high service pump station, it is worthwhile to consider alternatives to the original design concepts for both structures. Because of the high groundwater table at the MRTP site, construction costs for buried structures will be high due to the construction dewatering costs and the need to provide sufficient mass in the structure to overcome buoyancy. An on-site groundwater monitoring well is read annually. The most viable option to the buried clearwell at the MRTP is an above-grade clearwell. This type of structure would have a number of advantages over the buried clearwell:

- A low cost prestressed concrete tank would be used for the clearwell.
- A deeper water depth could be used in the clearwell, allowing a more efficient design to be used for the structure.
- Construction dewatering would be eliminated as the structure foundations would require shallow excavations.
- High service pump station could be an at-grade station located adjacent to the clearwell.
- Filter backwash pump could be eliminated by using the head from the tank to deliver backwash water to the filters.
- Clearwell contents would be above the flood level, protecting the contents from possible contamination.
- Provides a location to install UV disinfection equipment (located in transfer pump discharge) that fits with the plant hydraulic constraints.
- Eliminate constructing the high service pump station on over 20 feet of backfill, removing the potential for building settling in the future.

The biggest disadvantage of an above-grade clearwell is the need to provide transfer pumping between the existing clearwells and the new clearwell. There would be more pumps to maintain but no additional energy would be required.

The use of transfer pumps would also provide a good location for a UV disinfection system to be installed. The UV system requires about 5-10 feet of hydraulic head to operate properly, which could be provided by routing the transfer pump discharge through the UV reactors prior to flow entering the clearwell. The UV system could be located in the high service pump station building to simplify the new facilities required. Table 6-11 is a cost

An above-grade clearwell provides a space for future UV and eliminates costly clearwell dewatering and construction.

comparison of the clearwell and high service pump station components for the two options.

The required CT is for the MRTP is the same as the TTP. Table 6-12 is a summary of the detention times required for MRTP to meet the CT requirements of the SDWA for both winter and summer operation.

Table 6-11 MRTP Clearwell Cost Comparison

Item	Buried Clearwell (1.5 MG) [1]	Above-grade Clearwell (1.5 MG)
Building	$200,000	$200,000
Earthwork (excavation and backfill)	$100,000	$11,000
Dewatering (during construction)	$500,000	$-
Concrete (cast-in-place or prestressed)	$1,200,000	$900,000
Clearwell PVC Liner	$63,000	$ -
Clearwell Piping/Valving	$300,000	$200,000
Transfer Pumping (existing HSPS modifications)	$-	$71,000
High Service Pumping Equipment [2]	$300,000	$320,000
Surge Tank	$80,000	$80,000
Installation of Equipment (50%)	$200,000	$240,000
Electrical & Instrumentation (35%)	$200,000	$230,000
HVAC (10%)	$61,000	$70,000
Piping and Valves (30%)	$200,000	$200,000
Site Clearing and Grading (5%)	$45,000	$43,000
Engineering and Contingencies	$1,000,000	$870,000
Total Cost	**$4,449,000**	**$3,435,000**

[1] Based on escalated costs provided in 1999 Master Plan.
[2] Assumes separate pump station provides flow to the low zone.

Based on these requirements, a chlorine concentration of 1.5 mg/l and a T_{10}/T flow circulation ratio of 0.55, a clearwell and pipeline detention volume of 1.15 MG is needed in the winter and 0.91 MG in the summer.

Table 6-12 Required Detention Times to Meet CT Requirements

Operating Condition	Peak Flow	Minimum Water Temperature	Minimum CT Required [1]	
			Viruses	*Giardia*
Winter	8.7 MGD	0.5 DegC	9	157
Summer	13.0 MGD	10 DegC	4	83

[1] Based on an alkalinity of 180 mg/l as $CaCO_3$

Clearwell Recommendation

Based on the above cost comparison and the benefit of providing the flexibility to add UV disinfection in the future, an above-grade clearwell is recommended for the MRTP.

MRTP Support Facilities

The MRTP support facilities, including administration, SCADA system and chemical handling systems, need to be upgraded to meet the long-term requirements. The existing chlorine room being abandoned can be converted to a new central room, with the existing lab/office converted to an operating room with an improved lab. The plant SCADA system will need to be upgraded, using a PLC-based control system linked by a data highway to a central control computer. The plant's chemical systems will also need to be upgraded to meet code and to increase the treatment capacity.

The existing plant has a 0.5 KW standby power generator, capable of operating the PLC and filter valves only in a shutdown. More reliable standby power to operate high service pumps, disinfection, filtration and pretreatment, will be required. The estimated cost of a 2,000 KW generator that could operate one High Zone pump, and one Low Zone pump, and the other necessary equipment, would be about $400,000. The total cost of upgrading the support facilities is $2,600,000.

MRTP Membrane Treatment Alternative

As noted earlier, using membrane treatment at MRTP only makes sense if an entirely new facility is constructed. In order for membrane treatment to be cost-effective at MRTP, the membranes must be operable without sedimentation prior to the membranes. Coagulation ahead of the membranes will be necessary to remove color and organics from the raw water. Otherwise, only turbidity particles would be removed from the water. The membrane systems currently available are supplied as a package system, with all ancillary systems provided by the membrane manufacturer.

Developed in the late 1960s, membrane treatment processes have had a large impact upon water supply and treatment and have steadily grown to become a major facet of the potable water market. This growth and development has accelerated in the last 1990s and many municipal and private water utilities are evaluating membrane treatment technologies as a tool to provide safe economical water supplies. Their implementation can reduce chemical and manpower costs for utilities while providing a stable potable water supply.

Membrane filtration has been used successfully across the United States for various water purification applications. Continuous work is revealing that membrane filtration is an extremely effective means of removing *Giardia lamblia* and *Cryptosporidium parvum* from water supplies. Greater than 6-log removal has been successfully demonstrated for these organisms.

Water purification with membranes (micro- and ultrafiltration) is achieved by physically preventing particles greater than 0.1 micron in size from penetrating the membrane barrier. A low-pressure feed system forces water from the outside ("dirty-side") of the membrane to the inside ("clean-side") of the hollow fiber, or vice-versa in an inside-out membrane fiber. Contaminants larger than 0.1 micron, such as *Cryptosporidium* and *Giardia*, are excluded from passing through the membrane. As a result, the water that passes through the membrane is free from pathogens and bacteria and can be directed to the distribution system upon disinfection.

Depending on membrane fiber characteristics, feed water may be pre-chlorinated, oxidized, and/or dosed with a small amount of coagulant to remove dissolved contaminants, such as TOC, iron, manganese, or taste and odor compounds. Periodically, an air and/or hydraulic backwash removes particulate matter from the "dirty-side" of the membrane and flushes out the particulate cake that forms. Membrane backwashing is completed on a set time interval (approximately one to two minutes of backwash for every 20 to 30 minutes of operation) or based on an increase in pressure loss across the membrane.

Membrane filtration would be used if the existing plant were abandoned.

Due to the performance of low-pressure membranes in a wide variety of applications throughout the United States and preliminary cost comparisons with conventional treatment, low-pressure membranes are expected to provide the best treatment alternative for MRTP if a new treatment facility is necessary. For facilities larger than 10 MGD, submerged or vacuum membrane systems are normally the most cost-effective. Pressure systems, which are limited to a maximum of 1.5 to 2.0 MGD per skid, are not practical at this higher capacity.

Two leading vendors that supply submerged membrane systems for drinking water treatment are Zenon Environmental and USFilter/Memcor. Both vendors provide hollow fiber membrane modules in a packing configuration that can treat the water during high turbidity events without blinding or clogging the membranes. Both vendors' systems can handle high-turbidity feed water conditions, up to 100 NTU.

At the MRTP, pretreatment facilities (rapid mix and coagulation) would be provided ahead of the membranes, but the membrane plant will be designed to treat either raw water without pretreatment or pretreated water. A schematic diagram of the treatment units can be found in Figure 6-8.

Summary of MRTP Recommendations

The MRTP facilities are in poor condition, with the exception of the filters, and are not capable of meeting long term needs in the current plant roles. Several improvements are needed, including:

- Raw water pump station and intake ($4,500,000)
- New pretreatment with DAF ($4,100,000)
- New disinfection with liquid chlorine ($350,000)
- New transfer pump station, high zone pump station and clearwell ($3,400,000)
- Support facilities ($2,600,000)

The estimated total cost of these improvements at the plant is $14,950,000, less than the $17,000,000 estimated cost of a new membrane facility located on the plant site. The rehabilitation of the facilities in a phased fashion to meet grant funds is recommended.

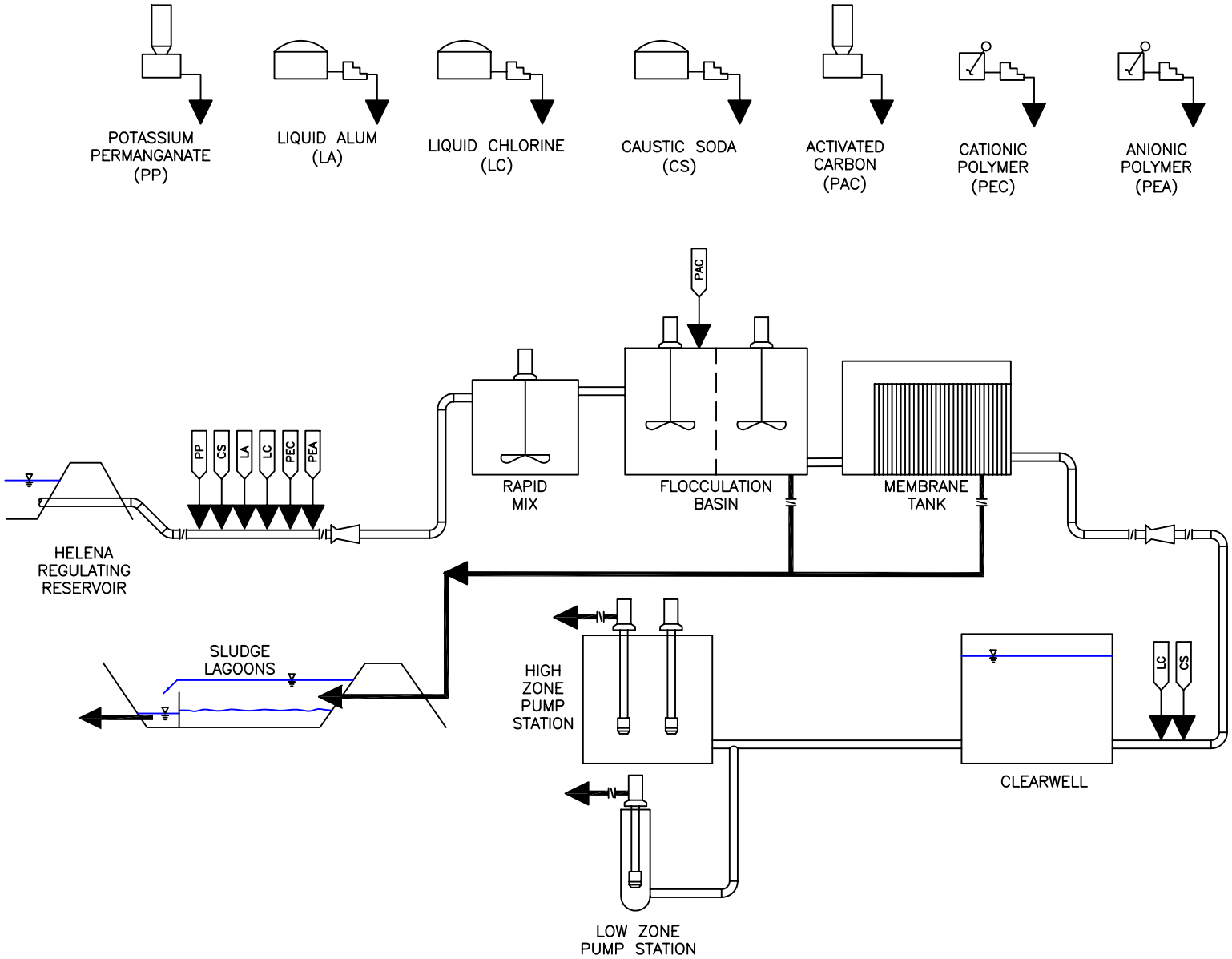


Figure 6–8
Schematic Diagram of MRTP Treatment Units – Membrane Filtration

City of Helena
Water Facilities Plan

HELENA MONTANA
QUEEN CITY OF THE ROCKIES

HDR
ONE COMPANY | Many Solutions

Hale Zone Needs

The Hale Zone supply consists of two water sources: Orofino and Eureka. The Orofino supply was classified as under the influence of surface water as described in Chapter 4. The Eureka pump station and well was not classified as under the influence, but will be impacted by the Groundwater Rule.

Orofino

The Orofino source is described in Chapter 3. The City has until March 1, 2006 to address the surface water classification. The State has given the following alternatives for addressing the listing:

1) Provide filtration treatment to the Orofino well water and comply with requirements for filtered systems as specified in the CFR 141.70.
2) Meet the criteria to avoid filtration and comply with requirements as specified in CFR 141.71.
3) Permanently disconnect the source water.
4) Seek a new source or rebuild the existing source.

In addition, the proposed LT2ESWTR discussed in Chapter 4, will require that unfiltered sources provide at least 2.0 log *Cryptosporidium* removal (more could be required based on source water *Cryptosporidium* levels). To maintain both sources, it will be necessary to provide filtration or secondary disinfection. For the purposes of this analysis, it is assumed that both Eureka well and the Orofino flows would be treated by the proposed methods as both flows come together as they enter the reservoir. Following is a summary of the three possible alternatives for treating both Hale Supply sources.

Alternative 1-Provide Filtration

Section 141.73 discusses four filtration methods, conventional filtration, direct filtration, slow sand filtration, and diatomaceous earth filtration. All of these are considered to provide 2 log *Cryptosporidium* removal if turbidity limits are met.

Membrane filtration is capable of providing at least 2 log *Cryptosporidium* removal. A membrane filtration system would require construction of a building to house the membrane (approximately 1,000 square feet), a pump station to push flow through the membranes, sewer discharge for the membrane reject stream, in addition to the membrane equipment and controls. The estimated capital cost for this alternative is $800,000. Additional operation and maintenance costs (O&M) would be required for system maintenance, power, and membrane replacement.

Alternative 2 - Avoid Filtration

The proposed LT2ESWTR, discussed in Chapter 4, will require that all unfiltered sources provide 2.0 log *Cryptosporidium* removal. In effect the rule requires two methods of disinfection, since chlorine is ineffective for *Cryptosporidium* inactivation, but is needed to provide system residual. With a source of this size, UV disinfection would be the most cost effective way to provide a second method for disinfection. Ozonation and chlorine dioxide would be less cost effective.

The UV system would require construction of a building, system controls, addition of a redundant power supply, in addition to the UV equipment itself. The estimated capital cost for UV disinfection is $700,000. O&M costs would include operator time, power to operate the system, and lamp replacement.

Alternative 3 –Disconnect the Source

The Hale Zone is fed by the Eureka pump station and well and Orofino. If Orofino was disconnected, the Hale Zone would rely on the Eureka pump station and well. No additional costs would be incurred. The Eureka system is capable of providing for the demands in the Hale and Upper Hale Zones, 0.57 MGD, peak day in 2025.

Connection of the Hale Zone to the main City sources will be recommended in Chapter 7 to provide additional system redundancy. This connection was recommended in the 1997 and would be recommended here regardless of the selected alternative.

Water collected from Orofino would likely be collected in the ditch along the south side of West Main Street and drain into a 54-inch storm drain that runs from Last Chance Gulch through downtown. This is an area of known flooding and a detention pond is planned for the area to fix the problem.

Alternative Comparison

Given the capital costs associated with Alternatives 1 and 2, and the additional O&M associated with those alternatives, disconnecting the source is recommended.

Table 6-13 Orofino Alternative Comparison

Alternative	Capital Cost
Alternative 1-Filtration	$800,000
Alternative 2-Avoid Filtration	$700,000
Alternative 3-Disconnect the Source	$0 [1]

[1] Cost does not reflect additional costs needed to provide additional treatment elsewhere

Eureka

The Eureka pump station and well has been classified as groundwater and the source will be impacted by the Groundwater Rule. The line that extends to the south on Main Street from Eureka well is not chlorinated and meets all current groundwater quality requirements for public water supply.

When the Groundwater Rule is finalized (estimated date of adoption is 2006), the rule would require installation of a chlorine feed system and adequate contact time to provide 4-log virus inactivation. In the current operating configuration, this would require construction of a chlorine feed system and storage tank for contact time at the Eureka pump station. Site space at the Eureka site is limited and making these additions would be costly. This line serves a limited number of customers and would be better served by connection to the main City supply.

Buildout Conditions

The projected maximum day flows for the City of Helena water service area in the buildout year, 2045, will be around 27.2 MGD. The recommended configuration for upgrading both water treatment facilities will require modification in order to meet this demand.

Due to stream flow constraints at the TTP, it is assumed that the maximum flow of the TTP would remain 8 MGD and 19.2 MGD would need to be supplied by the MRTP. It was recommended earlier in this chapter that the raw water intake be sized for buildout conditions. For pretreatment, the DAF system could either be expanded on site, or an Actiflo system with higher loading rates could be applied. To provide the most water in the smallest footprint, it would be recommended that membranes replace the existing filters. The buildout flow of 27.2 MGD could be produced within the existing filter footprint. Approximately 1 MG of clearwell storage and an additional 6.2 MGD of pumping capacity will be needed. The site has the space required to meet these needs. Solids handling will need to be modified in order to handle the increased flows. A third solids holding lagoon could be added or a backwash recycle station could be used to recycle flow and eliminate the need for an additional lagoon.

The current site is sufficient for handling the additional infrastructure that would be required to accommodate the increased flows.

References

USEPA Handbook – 1998 Edition. *Optimizing Water Treatment Plant Performance Using the Composite Correction Program*. EPA/625/6-91-027. Cincinnati, OH: USEPA, 2004.

Appendix 6-A Filter Evaluation and Recommended Report

The Cadmus Group, Inc
2620 Colonial Drive, Ste A.
Helena, MT 59601
406 443-9194
406-443-9194 fax

Memo

To: Don Clark – City of Helena

From: Dan Fraser, P.E.

Joe Steiner

Date: 6/23/2004

Re: **HELENA TEN MILE WATER TREATMENT PLANT FILTER EVALUATION**

On April 20 -22, 2004, we did an evaluation of the filters at the Ten Mile Water Treatment Plant. During the evaluation we attempted to review the backwash procedures and do a physical inspection of the filter media. We drained each filter, observed and measured the filter media surface, measured the media depth to the gravel layer, core sampled the media at various levels through out the media depth, and observed a filter backwash. During the process numerous complications occurred that impacted the evaluation. The plant staff found that you can not drain the filters to the waste ponds; the filters can only be drained to the clearwell. Because of this, the staff operate the filters in the filter-to-waste mode until the water quality is acceptable to be discharged to the clearwell in order to drain the filters. There were numerous computer "glitches" that occurred that did not allow the completion of some of the evaluations.

Some significant conclusions that were drawn during the evaluation were:

- The filters were not getting clean with the present backwashing procedure.
- The filter media does not meet the original specifications.
- The filter media has fines on the surface of the anthracite that were more abundant than recommended.
- The anthracite and sand sizing lends the filters to have large interface zones that could lead to reduced filter runs.

Recommendations:

- The city should develop a filter surveillance program that does periodic evaluations of the filters. This program should be done on an annual basis until such time as the city feels the filters are consistently providing the same good results.

- The city staff changed the backwash procedure while we were on site. They need to evaluate the effectiveness of those changes by repeating the sludge retention profile and backwash turbidity profile.

- The city needs to determine ways to better drain the filters to accommodate filter evaluations.

- The city should have their engineer review these results and make recommendations for improvements to the filters. If media is going to be replaced great care needs to be taken to match the new media to the existing media or better match the new media .

Helena Ten Mile Water Treatment Plant Filter Evaluation

Attached are the results of the evaluations. Here are some of the major findings:

Filter 1 – Evaluation completed 4/21/2004

Media Surface – smooth with variation of depth from the top of the backwash trough to top of media ± 2 inches. Freeboard measured at 60 inches.

Support Gravel Surface – smooth with a variation of the surface ± 4 inches.

Media Profile – Top 10 inches was anthracite with about four inches of fine anthracite on the surface. The interface, anthracite and sand mixed was about 10-11 inches. The sand layer that was visible in the hand digs was 9-10 inches.

Media expansion – Expansion was measured at 4 inches across the filter. Expansion percentage is 13 (typical expansion is in the 25-35 % range but this needs to be individually determined for each facility) using a media depth of 30 inches as measured during the filter evaluation. The computer printout of the flow rates indicated a rate of about 4700 gpm at the time the expansion test was done. This rate equates to 14 gpm/ft^2.

Backwash Water Turbidity Profile – The backwash water became clean (<10 ntu) after 6 minutes. The backwash procedure has met a point of diminishing returns with the present backwash procedure.

Backwash Water Flow Rates - A rise rate at low backwash rate was done to compare plant meter with volume displacement. Metered rate was 2400 gpm with calculated rate at 2120 gpm. The flow rate during this time was fluctuating so no definite conclusion can be made.

Sludge Retention Profile – The upper layer of the media is storing considerable volumes of matter and is cleaning up somewhat. The media below the interface layer (>20 inches deep) is dirty and is not being adequately cleaned. The low expansion rate related to the low backwash rate does not allow the media to become cleaned at the lower level.

Filter 2 – Evaluation completed 4/20/2004 (At time of evaluation the filter had 16-18 hours of run time and had a headloss of 1.5 feet.)

Media Surface – smooth with variation of depth from the top of the backwash trough to top of media ± 1 inch. Freeboard measured at 60 inches.

Support Gravel Surface – smooth with a variation of the surface ± 4 inches.

Media Profile – Top 10 inches was anthracite with about four inches of fine anthracite on the surface. The interface, anthracite and sand mixed was about 10-11 inches. The sand layer that was visible in the hand digs was 9-10 inches.

Media expansion – Expansion was measured at 5 inches across the filter. Expansion percentage is 17 using a media depth of 30 inches as measured during the filter evaluation. The computer printout of the flow rates indicated a rate of about 4700 gpm at the time the expansion test was done. This rate equates to 15 gpm/ft^2.

Backwash Water Turbidity Profile – The backwash water became clean (<10 ntu) after 8 minutes.

Backwash Water Flow Rates - A rise rate at low backwash rate was done to compare plant meter with volume displacement. Metered rate was 3600 gpm with calculated rate at 4169 gpm. The flow rate during this time was fluctuating so no definite conclusion can be made.

Sludge Retention Profile – The upper layer of the media is storing considerable volumes of matter. The after backwash profile was not done due to the filter not being drained. An assumption could be made that the after backwash profile would resemble the one for Filter 1.

Filter 3 – Evaluation completed 4/22/2004 (At time of evaluation the filter had 25 hours of run time and had a headloss of 2.2 feet.)

Media Surface – smooth with variation of depth from the top of the backwash trough to top of media ± 1 inch. There were a couple areas that had a slight mound (2-3 inches) but these were insignificant. Freeboard measured at 60 inches.

Support Gravel Surface – smooth with a variation of the surface ± 2 inches.

Media Profile – Top 10 inches was anthracite with about four inches of fine anthracite on the surface. The interface, anthracite and sand mixed was about 10-11 inches. The sand layer that was visible in the hand digs was 9-10 inches.

Media expansion – Expansion was measured at 6-7 inches across the filter. Expansion percentage is 20-23 using a media depth of 30 inches as measured during the filter evaluation. The computer printout of the flow rates indicated a rate of about 5400 gpm at the time the expansion test was done. This rate equates to 17 gpm/ft^2.

Backwash Water Turbidity Profile -- The backwash water became clean (<10 ntu) after 8 minutes.

Backwash Water Flow Rates - A rise rate at low backwash rate was done to compare plant meter with volume displacement. Metered rate was 3600 gpm (average)with calculated rate at 3050 gpm. The flow rate during this time was fluctuating so no definite conclusion can be made.

Sludge Retention Profile – The upper media is storing considerable volumes of matter and is cleaning up somewhat at all layers. The after backwash profile showed that the media was cleaning in the upper anthracite layer (upper 10 inches) but the lower areas are not getting clean. The operators had increased the backwash rate but reduced the time. The expansion rate has increased and the filter did clean up more but the lower layers of the filter were still dirty. The operator increased the rate again after this filter was evaluated.

Filter 4 – Evaluation completed 4/20/2004 (At time of evaluation the filter had 23.6 hours of run time and had a headloss of 2.09 feet.)

Media Surface – smooth with variation of depth from the top of the backwash trough to top of media ± 2 inch. Freeboard measured at 60 inches.

Support Gravel Surface – smooth with a variation of the surface ± 4 inches.

Media Profile – Top 10 inches was anthracite with about four inches of fine anthracite on the surface. The interface, anthracite and sand mixed was about 10-11 inches. The sand layer that was visible in the hand digs was 9-10 inches.

Media expansion – Expansion was measured at 5 inches across the filter. Expansion percentage is 17 using a media depth of 30 inches as measured during the filter evaluation. The computer printout of the flow rates indicated a rate of about 4700 gpm at the time the expansion test was done. This rate equates to 14 gpm/ft^2.

Backwash Water Turbidity Profile – Due to backwash problem and backwash turbidity profile was not done.

Sludge Retention Profile – The upper media is storing considerable volumes of matter and is cleaning up somewhat at all layers. The after backwash profile was not done due to backwash problems. An assumption could be drawn that the after backwash profile would be similar to Filters 1 and 3.

Filter Media Sieve Analysis

All the core samples from the filters were saved and sent to Maxim Technologies, Inc. for a multitude of sizing tests. The results of these tests have been sent to you previously but we would like to summarize the results. See Helena Ten Mile Water Treatment Plant Filter Media Evaluation – April 2004.

Anthracite:

Effective Size: With the exception of Filter 4, the effective size of the anthracite in the filters is smaller than specified.

Uniformity Coefficient: Filter 3's media slightly exceeded the specified limit. All other filters were within the specified limit.

Surface Fine Evaluation: All filters had significant quantities of fines on the surface. The top 2 inches ES was compared to the remaining filter. The size of the surface media was 48-68% of the balance of the media. With this much variation , it is recommended by several references that the surface of the media be skimmed off and replaced.

Sand:

Effective Size: All filter sand was smaller than specified.

Uniformity Coefficient: All sand met the specified uniformity coefficient.

Anthracite to Sand Comparison:

Anthracite D90 / Sand D10: The ratio for the filters was higher than what references suggest. Having this higher ratio causes excessive interface zones and shortens the filter runs. The hand digs and the split core samples showed interface zones of 10-11 inches. An ideal interface would be 2-4 inches in depth.

Helena Ten Mile Filter Specifications

Filter Construction Specifications

Anthracite - 22 inches
Sand - 9.5 inches
High density sand - 4.5 inches
High density support gravel - 3 inches
3/8 x 3/16 Support Gravel - 3 inches
3/4 x 3/8 Support Gravel - 3 inches
1 1/2 x 3/4 Support Gravel - 3 inches

Media Specifications

Anthracite
- Size ES 1 - 1.1 mm
- SG 1.55 - 1.75
- UC less than or equal to 1.7

Silica Sand
- Size ES 0.45 - 0.55 mm
- SG 2.6 +/- 0.05
- UC less than or equal to 1.8

High Density Sand
- Size ES 0.2 - 0.32 mm
- SG 3.8 minimum (4.0 requested)
- UC less than or equal to 2.2

High Density Gravel
- Size ES 1.14 - 1.16 mm
- SG 3.8 minimum
- UC less than or equal to 2.2

Tenmile WTP

Filter Evaluation Memorandum

November 2004

Prepared by:

Gary Fuller

HELENA MONTANA

QUEEN CITY OF THE ROCKIES

1.0 Introduction

As per your request, we have reviewed the 6/23/04 memo from the Cadmus Group, Inc (Cadmus), titled "Helena Ten Mile Water Treatment Plant Filter Evaluation." The memo presents the findings of field investigations undertaken by Cadmus on April 20-22, 2004 and subsequent analyses conducted on the media samples collected. The key conclusions presented in the memo are as follows:

- The filters are not getting clean with the present backwashing procedure.
- The filter media does not meet the original specifications.
- The filter media has fines on the surface of the anthracite that were more abundant than recommended.
- The anthracite and sand sizing lends the filters to have large interface zones that could lead to reduced filter runs.

Based on these conclusions, Cadmus recommended that the following actions be taken to correct the filter deficiencies that were identified:

- The City should develop a filter surveillance program that does periodic evaluations of the filters. This program should be done on and annual basis until such time as the city feels the filters are consistently providing the same good results.
- The City staff changed the backwash procedure while we were on site. They need to evaluate the effectiveness of those changes by repeating the sludge retention profile and backwash turbidity profile.
- The City needs to determine ways to better drain the filters to accommodate filter evaluations.
- The City should have their engineer review these results and make recommendations for improvements to the filters. If media is going to be replaced great care needs to be taken to match the new media to the existing media or better match the new media.

2.0 Filter Considerations

In general we concur with the findings and recommendations of the Cadmus memo. However, in reviewing the information presented, we have identified a number of additional concerns with the existing filters that should be addressed.

- The current maximum filter backwash rate of 15-17 gpm/ft^2 is marginal at best, and well below the normally accepted backwash rate of 18-20 gpm/ft^2 for mixed media filters. The optimum backwash rate will be affected by water temperature, with the backwash rate adjusted seasonally. The lowest rates are needed with cold water.

- The D_{90}/D_{10} ratio for the filter reading is well above acceptable limits, indicating that excessive intermixing is occurring between the anthracite and sand. Filters with ratios above 5.0 can be expected to perform less efficiently than well matched media (i.e. ratios of 3.0). The intermixing may be further compromised by ineffective backwash procedures in the filters.
- The filter sand effective size is very low and is very close in size to the high density sand (garnet), assuming the garnet was installed as specified. As a result, the garnet is not providing much turbidity removal capability as the sand captures the smaller filterable particles.
- The filter backwash procedure should be carefully reviewed to make sure it provides the 3 distinct stages of the backwash cycle necessary to assure an effective media cleaning;
    - Stage 1, media agitation with surface wash and low fluidization flow
    - Stage 2, high rate fluidization to allow trapped particles to escape the filter bed
    - Stage 3, re-stratification to allow the more easily fluidized sand to migrate to below the anthracite

The attached Figure shows how the filter backwash procedure should be programmed to achieve an effective backwash.

- The filter bed has approximately 30 inches of sand and anthracite. Since the garnet layer will not fluidize at normal backwash rates due to its high specific gravity, a 50 percent bed expansion will only raise the filter bed 15 inches. The expanded filter bed should not engage the bottom of the backwash troughs. The top of media is approximately 4.8 feet below the top of the backwash troughs, allowing good space for additional bed expansion.
- The small effective size of the filter sand and anthracite reduces the potential for penetrations of filterable particles into the filter bed needed to optimize filter run length. In light of the presence of a garnet layer to provide polishing of the filter water, a much larger media could be used in the upper layers to improve filter performance.
- The uniformity coefficient (UC) of sand and anthracite is around 1.0, above preferred UCs of less than 1.5. Some degradation of anthracite UC can be expected over the life of the media due to its friability, but the UC for sand does not normally change much over time.

3.0 Recommendations

The existing filter bed is in poor condition due to the high degree of intermixing, low effective sizes and high degree of fines on the surface of the media. Although filters can often perform reasonably well with media deficiencies of this type, the length of filter run and capability to prevent short-circuiting are usually compromised. At a minimum, the top 2-4 inches of the filter bed should be skimmed off and replaced. However, the best

approach would be to replace the existing filter sand and anthracite, leaving the garnet and gravel if it is found to have not been greatly disturbed. The new media should meet the following criteria:

Criteria	Sand	Anthracite
Effective size (mm)	0.45-0.50	0.90-1.00
Uniformity Coefficient	1.3 max	1.4 max
Media Depth (inches)	8	23.5

The media should be tested on site before installation as certified tests on the media are often for "representative" media and not the media shipped.

The filter backwashing procedure should also be modified to assure that the particles trapped in the lower filter bed are removed and to properly re-stratify the filter bed at the end of the backwash. This may require replacing the existing backwash pump to increase capacity from 15-17 gpm/ft^2 (4,875-5,525 gpm) to 18-20 gpm/ft^2 (5,850-6,500 gpm). The capacity of the backwash troughs and drain system must be verified to assure it will handle the higher flows.

Disinfection

The City of Helena currently uses chlorine gas for their water treatment disinfection. However, the City is looking at other forms of disinfection, specifically liquid sodium hypochlorite and on-site generation. This discussion describes an evaluation of alternative chlorination systems. The chlorination alternatives evaluated include chlorine gas, liquid sodium hypochlorite, and on-site generation of liquid sodium hypochlorite. Life cycle costs, including capital and O&M, were developed for each alternative.

Applicable regulations include the Occupational Safety and Health Administration (OSHA) Process Safety Management (PSM) requirements, the Environmental Protection Agency (EPA) Response Management Plan (RMP) regulations, and Article 81 of the Uniform Fire Code (UFC).

Labor required for the gas system is expected to be greater than purchased liquid sodium hypochlorite, due to cylinder replacement needs and scrubber maintenance under peak flow conditions. However, the chemical cost for sodium hypochlorite is much greater than gas. These offsetting labor and chemical cost differences yield a very similar projection of total annual costs for operation and maintenance.

Based on the safety benefits, liquid hypochlorite is recommended.

Since it is in liquid form, sodium hypochlorite is preferred from a safety perspective. However, sodium hypochlorite does not store well and operations will need to be carefully controlled to prevent chemical storage beyond two months. Chlorine in gas form provides better long-term storage characteristics, but increases the risk of exposure to City staff and the public through accidental releases. Building requirements for gas systems are particularly stringent due to the perceived risks of gas release. Based on the safety benefits of sodium hypochlorite, use of purchased sodium hypochlorite is recommended.

Disinfection System Design Criteria

Design parameters used as the basis for evaluating alternatives include the following:

MRTP

Peak demand:

- Flow - maximum day (13.0 MGD)
  average day (8.7 MGD)
- Chlorine Dose – 1.3 mg/l

Based upon these criteria, the chlorine gas usage is:

13.0 MGD x 1.3 mg/L x 8.34 (lb-L/mg-MG) = 141.0 pounds of chlorine per day

8.7 MGD x 1.3 mg/l x 8.34 (lb-L/mg-MG) = 94 pounds of chlorine per day

Based upon these criteria, the sodium hypochlorite usage is:

141.0 lb Cl_2/day x 0.96 gal NaOCl/lb Cl_2 = 135.0 gal of NaOCl/day

94 lb Cl_2/day x 0.82 gal NaOCl/lb Cl_2 = 91.0 gal of NaOCl/day

TTP

- Flow - maximum day (8.0 MGD)
  average day (8 MGD)
- Chlorine Dose – 1.3 mg/l

Based upon these criteria, the chlorine gas usage is:

8.0 MGD x 1.3 mg/L x 8.34 (lb-L/mg-MG) = 86.7 pounds of chlorine per day

Based upon these criteria, the sodium hypochlorite usage is:

86.7 lb Cl_2/day x 0.96 gal NaOCl/lb Cl_2 = 83.3 gal of NaOCl/day

Conceptual Alternatives

Chlorine Gas

Chlorine gas has been used at many water and wastewater treatment plants around the country because of its ease of use and cost-effectiveness and is currently in place at MRTP. However, safety issues and recent changes in the regulatory environment have made chlorine gas less desirable. Chlorine gas cylinders are currently delivered to the MRTP for approximately $720 per ton cylinder. In order for the existing chlorine gas system to be in compliance with the Uniform Fire Code (UFC), the following equipment must be installed:

- Secondary containment or emergency vapor scrubber
- Sprinkler system
- Chlorinators

The threshold quantity of chlorine that requires a scrubber is 500 pounds or 1,000 pounds in buildings with sprinklers. Article 80 of the UFC requires that the scrubber be sized to handle a full release of chlorine from the largest single storage container. The 2003 UFC was updated to allow the use of secondary containment vessels in place of a scrubber. Therefore, the existing chlorine gas system could be brought up to code by the addition of secondary containment. Should the City of Helena decide to keep the existing chlorine gas disinfection system, the City would be required to complete an OSHA Process Safety Management (PSM) Plan and a USEPA Risk Management Plan (RMP). The federal Emergency Planning and Community Right-to-Know (EPCRA), US Department of Transportation loading and unloading regulation, and local fire and building codes will also apply.

The existing chlorine system would be abandoned in place and a new chlorine system constructed. The existing system does not provide a gas cylinder lay down area or a reliable, safe method for chlorine transport. The new building area would be approximately 700 sf.

Liquid Sodium Hypochlorite

Hypochlorite can be delivered to the site for approximately $1.40 per gallon. As a 12.5 percent solution, hypochlorite can decay rapidly. The extent of this decay is affected by the duration of storage, temperature, exposure to UV light (i.e. sunlight), and contamination. Assuming no contamination, bulk hypochlorite can be expected to decay from 12.5 percent to 11 percent after 30 days of storage at 70°F. Based on a peak day hypochlorite usage of 135 gallons per day, the 5,000 gallon storage tank of 12.5 percent solution would last

approximately six weeks. Equipment required for a liquid hypochlorite system includes the following:

- One 5,000 gallon storage tank
- Two 8 gallon-per-hour (gph) metering pumps

Based on a average chlorine demand of 81 gallons per day, approximately 12,150 gallons per year of 12.5 percent hypochlorite would need to be delivered to the plant.

In addition, the new chlorine room would be designed to comply with Article 80 of the Uniform Fire Code. The most significant design requirements of a hypochlorite storage room include providing a fire suppression system and secondary containment of the volume of the storage tank plus 20 minutes of fire flow. The estimated square footage of 300 sf is less than half that needed for chlorine gas.

On-Site Sodium Hypochlorite Generation

The dependability and cost effectiveness of on-site hypochlorite generation has been proven in the past several years. Hypochlorite at approximately 0.8 percent solution strength is generated electrolitically from a 30 percent salt solution (brine). At this strength, approximately 15 gallons of solution are required to provide 1 pound of chlorine equivalent. Because the concentration of chlorine is relatively low, larger metering pumps are required.

The on-site generation of hypochlorite requires very pure salt (99.7%) to protect the electrodes from contamination. To produce one pound of chlorine equivalent, typically 3 pounds of salt, 15 gallons of water, and 2.5 kWh of electricity are required. Salt is typically delivered in 50-pound bags or 2,500 pound "super-sacks." Super-sacks are the logical choice given the estimated peak chlorine demand. Based on these requirements and the estimated chlorine demand, the following equipment would be required:

- One 300 pound per day on-site hypochlorite generation system.

A large part of the annual maintenance allowance goes to periodic replacement of the electrodes, which is needed about once every five years. On-site sodium hypochlorite generators are available from Severn Trent (Clor-Tec) and US Filter (OSEC). Assuming the salt and brine are stored indoors, the building required would be 750 SF.

Costs and Discussion

Capital and operating costs for each of the alternatives were developed based on constructing a new chlorine room. The annual operation and maintenance (O&M) costs for these alternatives are based on an annual average chlorine usage seen in the attached Table 6-14. Labor required for the gas system is expected to be greater than purchased sodium hypochlorite due to frequent cylinder replacement under peak flow conditions. However, the chemical cost for sodium hypochlorite is much greater than gas. These offsetting labor and chemical cost differences yield a very similar projection of total annual costs for operation and maintenance.

Table 6-14 Capital Costs for Chemical Alternatives

	Chlorine Gas	Liquid Sodium Hypochlorite	On-Site Generation
MRTP	$950,000	$350,000	$700,000
TTP	$350,000	$200,000	$300,000

Table 6-15 O&M Costs for Chemical Alternatives

	Chlorine Gas	Liquid Sodium Hypochlorite	On-Site Generation
MRTP	$30,000	$35,000	$50,000
TTP	$30,000	$35,000	$50,000

Since it is in liquid form, sodium hypochlorite is preferred from a safety perspective. However, sodium hypochlorite does not store well and operations will need to be carefully controlled to prevent chemical storage beyond two months. Chlorine in gas form provides better long-term storage characteristics, but increases the risk of exposure to City staff and the public through accidental releases. Based on the safety benefits of sodium hypochlorite, use of purchased sodium hypochlorite is recommended for both the MRTP and the TTP.

References

Water Treatment Plant Design, 3rd ed. American Water Works Association, New York, McGraw-Hill, 1998.

White, G. C., *Handbook of Chlorination and Alternative Disinfectants*, 4th ed., New York, John Wiley & Sons, Inc., 1999.

Appendix 6-C TTP Discharge Permit to Groundwater

Permit No.: MGWPCS-G2000

MONTANA DEPARTMENT OF HEALTH
AND
ENVIRONMENTAL SCIENCES

GENERAL PERMIT TO DISCHARGE WASTEWATER

FROM POTABLE WATER TREATMENT FACILITIES

UNDER THE MONTANA GROUND WATER POLLUTION CONTROL SYSTEM

In compliance with Section 75-5-101 et seq., MCA, and ARM 16.20.1022, and ARM 16.20.1317, applicants with an authorization letter for this "Potable Water Treatment Plant General Discharge Permit" are permitted to discharge wastewater from backwashing of treatment facility filters and bypass wastewater to ground water in accordance with effluent limitations, monitoring requirements, and other conditions set forth herein.

The permit shall become effective on the date of issuance.

A written authorization letter from the Department is required before an applicant is authorized to discharge under the "Potable Water Treatment Plant General Discharge Permit"

The permit and the authorization to discharge shall expire at midnight, December 1, 1999.

FOR THE MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

John L. Arrigo

John L. Arrigo, Manager
Ground Water Section
Water Quality Division

Dated this 23rd day of November 1994.

STATEMENT OF BASIS

APPLICANT: General Permit To Discharge Wastewater From Potable Water Treatment Plant Facilities Under The Montana Ground Water Pollution Control System (MGWPCS) Permit

PERMIT NUMBER: MGWPCS-G2000

A. Description Of The General Discharge Permit

This MGWPCS Permit will allow a permittee to discharge wastewater to ground water. Wastewater will be generated from the backwashing of potable water treatment plant filters or from bypass of raw water. These wastewaters will be discharged to ground water via percolation, land application into trenches, irrigation ditches, or sprinkler systems. The Department will review each application and issue a letter of authorization when background data, treatment systems, and monitoring requirements have been established.

The discharged water must be treated to the limits or meet the limit, at the boundary of the mixing zone outlined in the permit. The permit prohibits the discharge from degrading ground water.

B. Effluent Limitations and Self-Monitoring Requirements

The permittee is authorized to discharge wastewater during the period specified in the letter of authorization from the Department. It is anticipated that these wastewaters will be treated by settling in lagoons or infiltration ponds prior to land application into trenches, irrigation ditches, or sprinkler systems.

A mixing zone will be established from the perimeter of the lagoon system down into the top 15 feet of the saturated portion of an unconfined aquifer and 500 feet in the downgradient direction, from the furthest downgradient side, in accordance with 75-5-301, (4), MCA. Justifications for establishing the mixing zone are: 1) pollutants of concern are harmful but not toxic, 2) mixing of discharges with receiving ground water will likely result in nonsignificant changes in ground water quality in the immediate vicinity of the lagoon(s), 3) the Department believes that complete mixing will occur within 500 feet, and 4) this is the smallest practicable mixing zone that will result in a smallest practicable effect on water uses.

Discharges shall be limited and monitored by the permittee as specified below:

1. Effluent Limitations

   a. Wastewater must be treated by settling prior to land application.

b. Unless the existing quality of the receiving water naturally exceeds applicable standards cited below, limitations on the quality of the receiving ground water at the downgradient boundary of the mixing zone are:

	Instantaneous Maximum (mg/L)	
Parameter	Existing Sources	New/Increased Sources
TDS	500.0	An increase in the concentration in the receiving ground water equal to 15% of the water quality standard at the boundary of the applicable mixing zone**
Chloride*	250.0	
Aluminum, DIS*	0.75	
Copper, DIS*	1.0	
Iron, DIS*	0.3	
Manganese, DIS*	0.05	

* Analysis for these parameters is required if they are used as treatment additives. Metal analysis must be for total dissolved metals.

** When quality of receiving water is greater than 40% of the standard no increase in the quality of receiving water is allowed.

c. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units.

2. Effluent Limitation Rationale

a. The rationale for establishing the effluent limitations in this general permit for **existing discharges** to ground water are based on not exceeding ground water quality standards beyond limits of mixing zones.

b. The rationale for establishing the effluent limitations in this general permit for **new or increased discharges** to ground water are based on not degrading the quality of ground water.

3. Self-Monitoring Requirements

a. The permittee shall monitor the discharge as specified below:

Parameter	Frequency	Sample Type
pH	Semi-annually	Grab
TDS	Semi-annually	Grab
Chloride*	Semi-annually	Grab
Aluminum, DIS*	Semi-Annually	Grab

Permit No.: MGWPCS-G2000

MONTANA DEPARTMENT OF HEALTH
AND
ENVIRONMENTAL SCIENCES

GENERAL PERMIT TO DISCHARGE WASTEWATER

FROM POTABLE WATER TREATMENT FACILITIES

UNDER THE MONTANA GROUND WATER POLLUTION CONTROL SYSTEM

In compliance with Section 75-5-101 et seq., MCA, and ARM 16.20.1022, and ARM 16.20.1317, applicants with an authorization letter for this "Potable Water Treatment Plant General Discharge Permit" are permitted to discharge wastewater from backwashing of treatment facility filters and bypass wastewater to ground water in accordance with effluent limitations, monitoring requirements, and other conditions set forth herein.

The permit shall become effective on the date of issuance.

A written authorization letter from the Department is required before an applicant is authorized to discharge under the "Potable Water Treatment Plant General Discharge Permit"

The permit and the authorization to discharge shall expire at midnight, December 1, 1999.

FOR THE MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

John L. Arrigo

John L. Arrigo, Manager
Ground Water Section
Water Quality Division

Dated this 23rd day of November 1994.

STATEMENT OF BASIS

APPLICANT: General Permit To Discharge Wastewater From Potable Water Treatment Plant Facilities Under The Montana Ground Water Pollution Control System (MGWPCS) Permit

PERMIT NUMBER: MGWPCS-G2000

A. Description Of The General Discharge Permit

This MGWPCS Permit will allow a permittee to discharge wastewater to ground water. Wastewater will be generated from the backwashing of potable water treatment plant filters or from bypass of raw water. These wastewaters will be discharged to ground water via percolation, land application into trenches, irrigation ditches, or sprinkler systems. The Department will review each application and issue a letter of authorization when background data, treatment systems, and monitoring requirements have been established.

The discharged water must be treated to the limits or meet the limit, at the boundary of the mixing zone outlined in the permit. The permit prohibits the discharge from degrading ground water.

B. Effluent Limitations and Self-Monitoring Requirements

The permittee is authorized to discharge wastewater during the period specified in the letter of authorization from the Department. It is anticipated that these wastewaters will be treated by settling in lagoons or infiltration ponds prior to land application into trenches, irrigation ditches, or sprinkler systems.

A mixing zone will be established from the perimeter of the lagoon system down into the top 15 feet of the saturated portion of an unconfined aquifer and 500 feet in the downgradient direction, from the furthest downgradient side, in accordance with 75-5-301, (4), MCA. Justifications for establishing the mixing zone are: 1) pollutants of concern are harmful but not toxic, 2) mixing of discharges with receiving ground water will likely result in nonsignificant changes in ground water quality in the immediate vicinity of the lagoon(s), 3) the Department believes that complete mixing will occur within 500 feet, and 4) this is the smallest practicable mixing zone that will result in a smallest practicable effect on water uses.

Discharges shall be limited and monitored by the permittee as specified below:

1. Effluent Limitations

   a. Wastewater must be treated by settling prior to land application.

b. Unless the existing quality of the receiving water naturally exceeds applicable standards cited below, limitations on the quality of the receiving ground water at the downgradient boundary of the mixing zone are:

	Instantaneous Maximum (mg/L)	
Parameter	Existing Sources	New/Increased Sources
TDS	500.0	An increase in the concentration in the receiving ground water equal to 15% of the water quality standard at the boundary of the applicable mixing zone**
Chloride*	250.0	
Aluminum, DIS*	0.75	
Copper, DIS*	1.0	
Iron, DIS*	0.3	
Manganese, DIS*	0.05	

* Analysis for these parameters is required if they are used as treatment additives. Metal analysis must be for total dissolved metals.

** When quality of receiving water is greater than 40% of the standard no increase in the quality of receiving water is allowed.

c. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units.

2. Effluent Limitation Rationale

a. The rationale for establishing the effluent limitations in this general permit for **existing discharges** to ground water are based on not exceeding ground water quality standards beyond limits of mixing zones.

b. The rationale for establishing the effluent limitations in this general permit for **new or increased discharges** to ground water are based on not degrading the quality of ground water.

3. Self-Monitoring Requirements

a. The permittee shall monitor the discharge as specified below:

Parameter	Frequency	Sample Type
pH	Semi-annually	Grab
TDS	Semi-annually	Grab
Chloride*	Semi-annually	Grab
Aluminum, DIS*	Semi-Annually	Grab

Copper, DIS*	Semi-Annually	Grab
Iron, DIS*	Semi-Annually	Grab
Manganese, DIS*	Semi-Annually	Grab

* Analysis for these parameters is required if they are used as treatment additives. Metal analysis must be for total dissolved metals.

b. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations: 1) where wastewater leaves the water treatment plant and enters a lagoon system, infiltration system, or irrigation system and 2) from the nearest accessible point after final treatment but prior to actual discharge to ground water.

c. The Department may require the applicant to install ground water monitoring wells to measure changes in ground water quality.

C. Determination of Significance

The MGWPCS Permit No. G2000 will allow a permittee to discharge wastewater, from the backwashing of water treatment facility filters and from bypass of raw water, to ground water. The wastewater must be discharged in compliance with the stipulations in the permit and be treated as outlined in the letter of authorization. The permit prohibits the degradation of ground water beyond the boundary of the mixing zone.

The review of the activities allowed under MGWPCS Permit No. G2000 for significance was conducted using the criteria from Section 75-5-301 MCA. Although the determination of significance is ultimately the burden of the developer, the Department has made the following determination using the guidelines provided under Section 75-5-301(5)(c)(i,ii,iii,iv), MCA, for determining whether a proposed activity or class of activities will result in significant changes in water quality for any parameter:

i. Equate significance with the potential for harm to human health or the environment.

Review: The activities allowed under this general permit are designed to prohibit degradation of ground water and protect human health. A mixing zone will not be granted if beneficial uses would be impaired by the discharge.

ii. Considers both the quantity and the strength of the pollutant:

Review: Although the pollutants of concern are harmful they are not toxic or carcinogenic. The quantity and strength of the pollutant(s) of concern may change from case to case and will be evaluated as part of the authorization process.

iii. Considers the length of time the degradation will occur;

Copper, DIS*	Semi-Annually	Grab
Iron, DIS*	Semi-Annually	Grab
Manganese, DIS*	Semi-Annually	Grab

* Analysis for these parameters is required if they are used as treatment additives. Metal analysis must be for total dissolved metals.

b. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations: 1) where wastewater leaves the water treatment plant and enters a lagoon system, infiltration system, or irrigation system and 2) from the nearest accessible point after final treatment but prior to actual discharge to ground water.

c. The Department may require the applicant to install ground water monitoring wells to measure changes in ground water quality.

C. Determination of Significance

The MGWPCS Permit No. G2000 will allow a permittee to discharge wastewater, from the backwashing of water treatment facility filters and from bypass of raw water, to ground water. The wastewater must be discharged in compliance with the stipulations in the permit and be treated as outlined in the letter of authorization. The permit prohibits the degradation of ground water beyond the boundary of the mixing zone.

The review of the activities allowed under MGWPCS Permit No. G2000 for significance was conducted using the criteria from Section 75-5-301 MCA. Although the determination of significance is ultimately the burden of the developer, the Department has made the following determination using the guidelines provided under Section 75-5-301(5)(c)(i,ii,iii,iv), MCA, for determining whether a proposed activity or class of activities will result in significant changes in water quality for any parameter:

i. Equate significance with the potential for harm to human health or the environment.

Review: The activities allowed under this general permit are designed to prohibit degradation of ground water and protect human health. A mixing zone will not be granted if beneficial uses would be impaired by the discharge.

ii. Considers both the quantity and the strength of the pollutant:

Review: Although the pollutants of concern are harmful they are not toxic or carcinogenic. The quantity and strength of the pollutant(s) of concern may change from case to case and will be evaluated as part of the authorization process.

iii. Considers the length of time the degradation will occur;

Review: Degradation may only occur within the mixing zone during the life of the facility. The activities allowed under this general permit are designed to shorten the time degradation will occur by permitting treatment and control of the pollutant(s).

iv. Considers the character of the pollutant so that greater significance is associated with carcinogens and toxins that bioaccumulate or biomagnify and lesser significance is associated with substances that are less harmful or less persistent;

Review: The pollutant(s) of concern are harmful but they are not toxic or carcinogenic. Concentration levels will be reduced through treatment by settling, attenuation in the unsaturated zone and dilution with ground water in mixing zone.

CONCLUSION: Changes in water quality resulting from discharge of treated wastewater in accordance with effluent limitations in this permit, is determined to be nonsignificant. Wastewater quality improves with treatment in a lagoon system or through land application and percolation through the unsaturated zone. Mixing of discharged water with receiving ground water will likely result in nonsignificant changes in ground water quality in the immediate vicinity of the lagoon(s).

Prepared by: Carolyn V. DeMartino, June 1994

DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES
Cogswell Building, Helena, Montana 59620
(406)444-3948

ENVIRONMENTAL ASSESSMENT (EA)

Division/Bureau: Water Quality Division

Project or Application: Potable Water Treatment Plant General Discharge Permit

Description of Project: This permit will authorize a permittee to discharge treated wastewater to ground water. Wastewater will be generated from the backwashing of water treatment plant filters or from bypass of raw water. These wastewaters will receive treatment by settling in lagoons or infiltration ponds prior to land application into trenches, irrigation ditches, or sprinkler systems. A mixing zone will be established from the perimeter of the lagoon system down into the top 15 feet of the saturated portion of an unconfined aquifer and 500 feet in the downgradient direction, from the furthest downgradient side, in accordance with 75-5-301, (4), MCA. Limitations will be based on the nondegradation portion of the Montana Water Quality Act (75-5-303 MCA). The parameters of concern potentially include: TDS, chloride, aluminum, copper, iron, and manganese. An increase of 15 percent of the standard will be allowed as long as beneficial uses of ground water are not impaired.

Benefits and Purpose of Proposal: This permit will allow authorization to be issued for discharges resulting from backwashing treatment plant filters and water that bypasses the treatment plant and enters a lagoon system. Permit authorization can be issued without requiring a 30 day public notice. A General Permit is allowed since discharges from such facilities are similar.

Description and analysis of reasonable alternatives whenever alternatives are reasonably available and prudent to consider: Treated wastewater can be beneficially reused by land application systems.

A listing and appropriate evaluation of mitigation, stipulations and other controls enforceable by the agency or another government agency: MGWPCS Permit limitations, Water Quality Standards, Nondegradation portion of the Montana Water Quality Act, Clean Water Act.

Recommendation: Approval with stipulations.

If an EIS is needed, and if appropriate, explain the reasons for preparing the EA: None

If an EIS is not required, explain why the EA is an appropriate level of analysis: Adverse impacts should not occur from this type of discharge. Although pollutants of concern are harmful they are not toxic. Permit limits will be met because: 1) wastewater will receive treatment in a lagoon system or through land application, 2) wastewater will receive treatment as it percolates through the unsaturated zone, and 3) mixing of discharges

with receiving ground water will likely result in nonsignificant changes in ground water quality in the immediate vicinity of the lagoon(s), 4) the Department believes that complete mixing will occur within 500 feet, and 5) this is the smallest practicable mixing zone that will result in a smallest practicable effect on water uses.

Other groups or agencies contacted or which may have overlapping jurisdiction: None

Individuals or groups contributing to this EA: Water Quality Division personnel

POTENTIAL IMPACTS ON PHYSICAL ENVIRONMENT

		Major	Moderate	Minor	None	Unknown	Att Pages
1.	Terrestrial and aquatic life and habits				x		
2.	Water quality, quantity, and distribution				x		
3	Geology and soil quality, stability, and moisture				x		
4.	Vegetation cover, quantity, and quality				x		
5.	Aesthetics				x		
6.	Air quality				x		
7.	Unique endangered, fragile, or limited environmental resource				x		
8.	Demands on environmental resource of water, air, and energy				x		
9.	Historical and archaeological sites				x		

Cumulative and Secondary Impacts: None

POTENTIAL IMPACTS ON HUMAN ENVIRONMENT

		Major	Moderate	Minor	None	Unknown	Att Pages
1	Social structures and more				x		
2.	Cultural uniqueness and diversity				x		
3.	Local and state tax base and tax revenue				x		
4.	Agricultural or industrial production				x		
5.	Human health				x		
6.	Access to and quality of recreational and wilderness activities				x		
7.	Quantity and distribution of employment				x		
8.	Distribution of population				x		
9.	Demands for governmental services				x		
10.	Industrial and commercial activity				x		
11.	Locally adopted environmental plans and goals				x		

Cumulative and secondary impacts: None

EA prepared by: Carolyn V. DeMartino Date: June 1994

DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER QUALITY DIVISION

MARC RACICOT, GOVERNOR

COGSWELL BUILDING
1400 BROADWAY

STATE OF MONTANA

(406)444-2406
FAX (406) 444-1374

PO BOX 200901
HELENA, MONTANA 59620-0901

January 16, 1996

Leonard Willett
City Of Helena Ten-Mile
Water Treatment Plant
1115 Rimini Road
Helena, MT 59601

RE: Ten-Mile Water Treatment Plant Montana Ground Water Pollution Control System Permit G-2001/ Montana Ground Water Pollution Control System General Permit G-2000

Dear Mr. Willett:

Please thank Jim Lentz for sending another copy of the September 1995, monitoring results for Ten-Mile Water Treatment Plant Montana Ground Water Pollution Control System Permit G-2001. During review of these analytical results I noted that the water samples had been analyzed for magnesium instead of manganese. Not analyzing the water samples for manganese, in accordance with the General Permit To Discharge Wastewater From Potable Water Treatment Facilities - MGWPCS Permit 2000, is a violation. In the future, please have whoever collects the water samples for the semi-annual monitoring and submits them to the laboratory for analysis reread Section B "Effluent Limitations and Monitoring Requirements" of the permit.

Enclosed with this letter is a modified Page 6 of 9 for MGWPCS General Permit 2000. The address has been changed to reflect the new department name. Please insert the modified page into your copy of the general permit. Analytical results should be sent Attention: John Arrigo. If you have any questions please contact me at 444-5343.

Sincerely,

Carolyn V. DeMartino

Carolyn V. DeMartino
Water Quality Specialist
Water Quality Division
CD/612

Enclosure

Montana Department of Environmental Quality
Water Quality Division
PO Box 200901
Helena, Montana 59620-0901
Phone: (406) 444-2406

D. TEST PROCEDURES

Unless otherwise stated, test procedures for the analysis of pollutants shall conform to regulations published in, or subsequent revisions to, Part 136, Title 40 of the Code of Federal Regulations. Sample collection and preservation shall be in accordance with EPA methods. (The Department's Treatment and Preservation Guide should be consulted for acceptable sample collection and preservation techniques.)

E. RECORDING OF RESULTS

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

1. Description of sampling site (Township, Range, Section 1/4 Section, and Site Name or street address), date, and time of sampling;
2. The dates the analyses were performed;
3. The person(s) or laboratory who performed the analyses;
4. The analytical techniques or methods used; and
5. The results of all required analyses, and copies of laboratory analytical reports.

F. ADDITIONAL MONITORING BY PERMITTEE

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the monitoring report. Such increased frequency shall also be indicated.

G. RECORDS RETENTION

All records and information resulting from the monitoring activities required by this permit, including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation, shall be retained for a minimum of three (3) years, or longer if requested by the Department.

Montana Department of
ENVIRONMENTAL QUALITY
Judy Martz, Governor
P.O. Box 200901 • Helena, MT 59620-0901 • (406) 444-2544 • Website: www.deq.state.mt.us

January 31, 2002

Jack L. Williams
City of Helena-Ten Mile Treatment Plant
1115 Rimini Road
Helena, MT 59601

RE: Montana Ground Water Pollution Control System Discharge Permit MGWPCSG-2001

Dear Mr. Williams:

The Department of Environmental Quality received your analytical data submitted August 13, 2001 concerning monitoring of the potable wastewater effluent at the Ten Mile Water Treatment Plant. The City of Helena is authorized under a MGWPC General Discharge Permit, regulating discharges to ground water.

The City of Helena's authorization under the ground water discharge permit MGWPCSG-2001 expired December 1, 1999. The Department has yet to receive your application for permit renewal. The City of Helena's MGWPCSG-2001 was administratively extended awaiting submittal of the required application information and fee. Failure to submit your application for renewal may result in a violation of the Montana Water Quality Act.

I have enclosed an application form; a copy of the Administrative Rules of Montana (ARM) 17.30.1023, specifying the application requirements for renewal of MGWPCSG-2001 permit; and a copy of permit fee rules [ARM 17.30.201] valid until February 15, 2002. Application submitted after February 15, 2002 are required to submit an application fee of $700.

Please complete the application and remit the required application fee of $250 by February 15, 2001 (or $700 after February 15, 2002) by **March 1, 2002**. If you have any questions or require assistance, please contact me at (406) 444-1454.

Sincerely,

Kari Smith

Kari S. Smith
Water Quality Specialist
Water Quality Discharge Permit Section
E-mail karsmith@state.mt.us
Fax (406) 444-1374 Phone (406)444-1454

Enclosures

For Agency Use		
APPLICATION NUMBER		
DATE RECEIVED		
Year	Month	Day

MONTANA GROUND WATER POLLUTION CONTROL SYSTEM APPLICATION FOR PERMIT

RETURN TO: Department of Environmental Quality
Water Protection Bureau
Metcalf Building
PO Box 200901
Helena MT 59620-0901

Questions? Call (406) 444-3080

Please Print or Type

1. Name, address and telephone number of the individual or company which will have responsibility for the operation:

   A. Name: City of Helena, Ten Mile Treatment Plant

   B. Mailing Address

   (1) Street Address: 1115 Rimini Rd.

   (2) City: Helena (3) State: MT

   (4) Zip: 59601 (5) Telephone Number: 447-1520

2. Give the exact location of the proposed operation.

   A. Quarter: SE B. Section: 34 C. Township: 10N

   D. Range: 5W E. County: Lewis & Clark

3. Check any of the following circumstances which may apply to your operation.

   A. Lined retention pond containing waste or process chemicals ☐

   B. Unlined retention pond containing waste or process chemicals ☑

   C. Land application of liquid or solid waste ☑

   D. Stock pile of potential polluting material on land ☐

   E. Other (description)

4. Describe the general nature of the waste or process chemicals to be maintained on the site.

Aluminum Sulfate Sludge

5. The operation is expected to begin on or about Aug (Month) 14 (Day) 1990 (Year).

6. Briefly list any other agencies that will be reviewing this operation.

7. Provide a sketch map, if appropriate, and brief description of your proposed operation.

Water goes to lagoon, land discharge to farm from last lagoon

I certify under penalty of law that I personally examined and am familiar with the information submitted in the attached document; and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Jack L. Williams
Printed Name of Person Signing

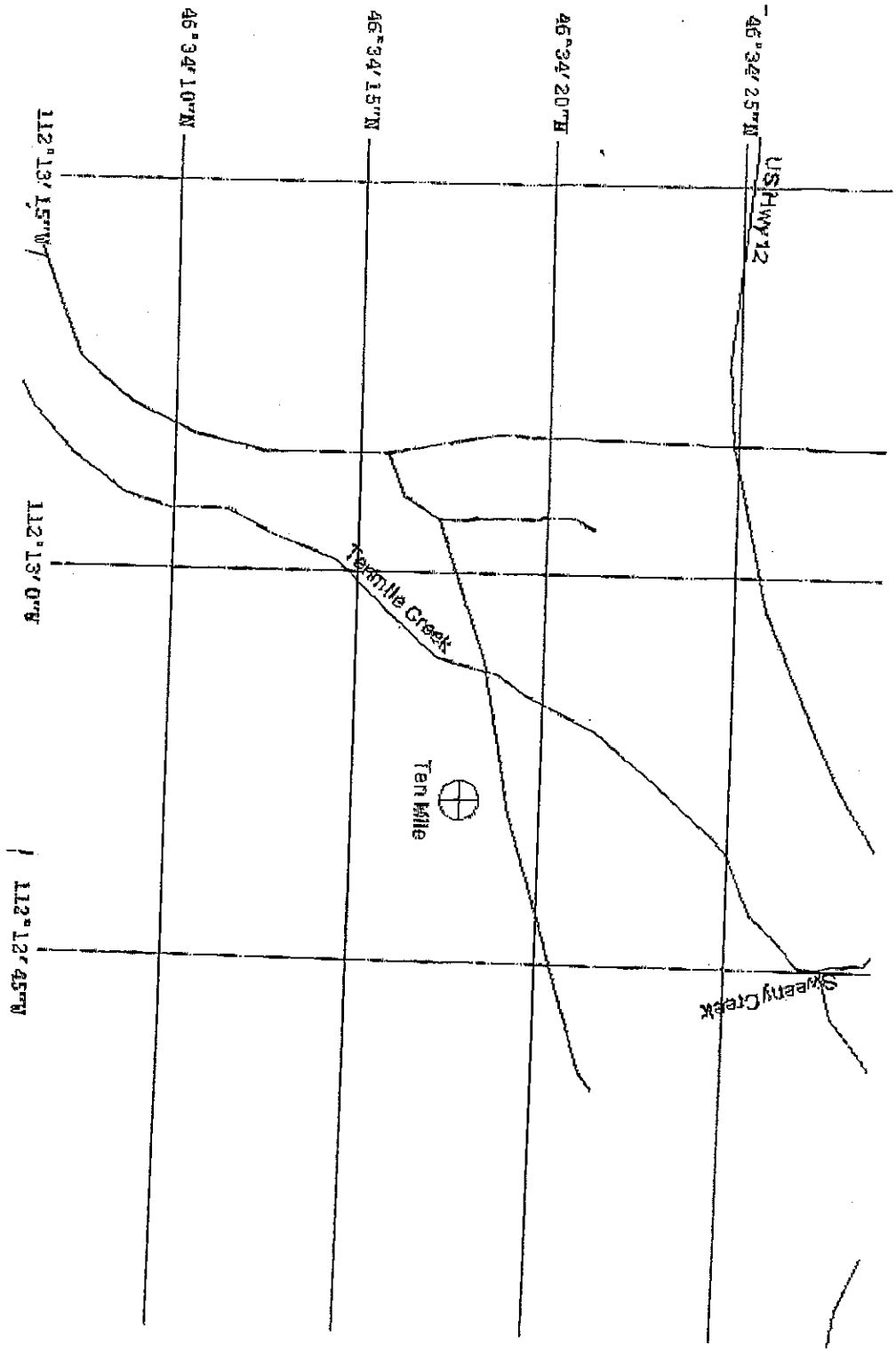
Water Production Supervisor
Title

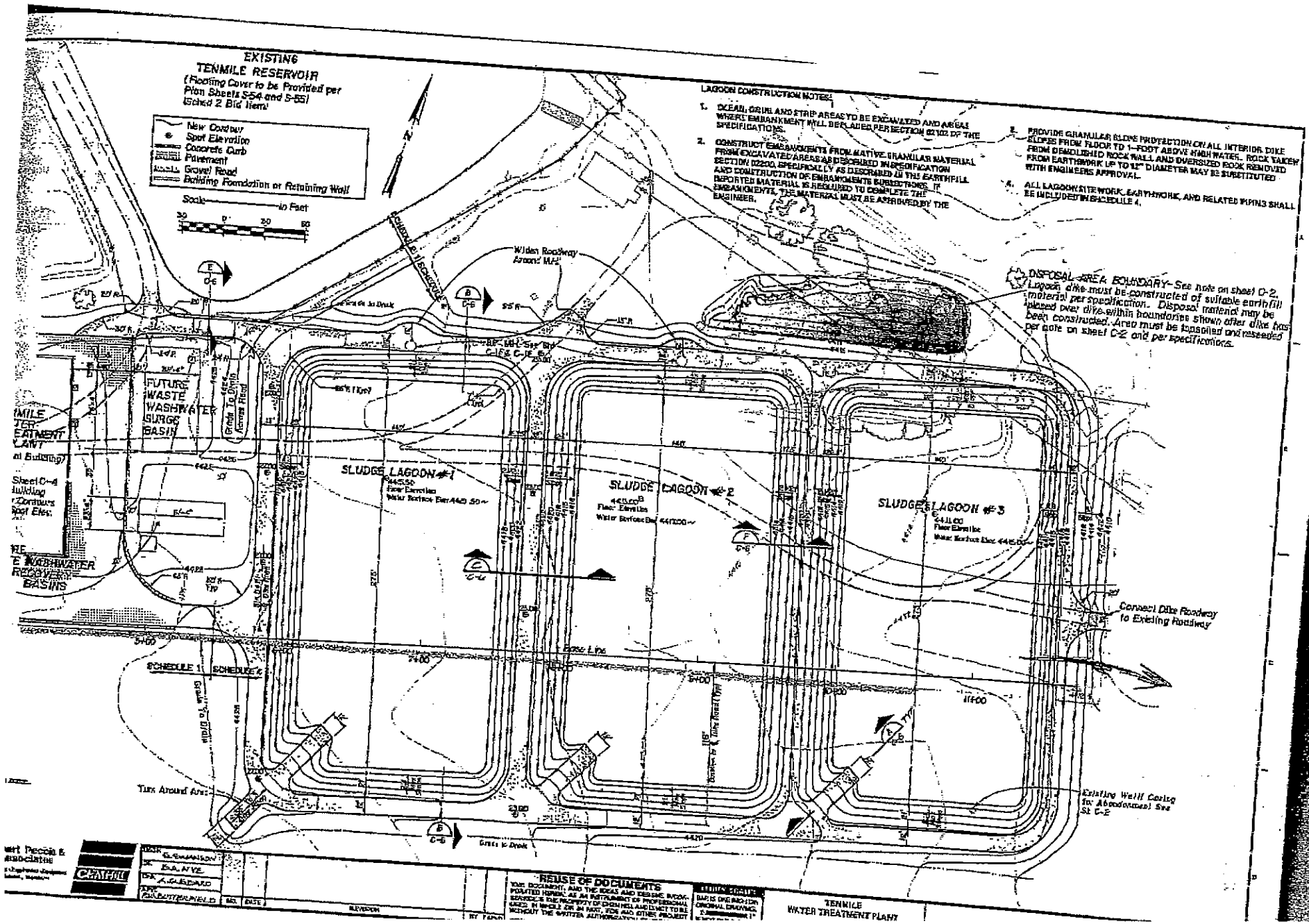
1 Feb 02
Date Application Signed

Jack L. Williams
Signature of Applicant

Section 75-5-633 provides that any person who knowingly makes a false statement, representation, or certification on this application shall, upon conviction, be subject to a fine of not more than $10,000 or by imprisonment for not more than six (6) months, or both.

DEQ estimates processing time for this application to be 180 days. (Only 30 days for general permits.)


46°34'25"N
46°34'20"N
46°34'15"N
46°34'10"N
US Hwy 12
Tenmile Creek
Ten Mile
Sweeny Creek
112°13'15"W
112°13'0"W
112°12'45"W


EXISTING
TENMILE RESERVOIR
(Floating Cover to be Provided per Plan Sheets S-54 and S-55) (Sched 2 Bid Item)
New Contour
Spot Elevation
Concrete Curb
Pavement
Gravel Road
Building Foundation or Retaining Wall
Scale
Feet
LAGOON CONSTRUCTION NOTES:
1. CLEAR, GRUB AND STRIP AREAS TO BE EXCAVATED AND AREAS WHERE EMBANKMENT WILL BE LAID PER SECTION 02100 OF THE SPECIFICATIONS.
2. CONSTRUCT EMBANKMENTS FROM NATIVE GRANULAR MATERIAL FROM EXCAVATED AREAS AS DESCRIBED IN SPECIFICATION SECTION 02200, SPECIFICALLY AS DESCRIBED IN THE EARTHFILL AND CONSTRUCTION OF EMBANKMENTS SUBSECTIONS. IF IMPORTED MATERIAL IS REQUIRED TO COMPLETE THE EMBANKMENTS, THE MATERIAL MUST BE APPROVED BY THE ENGINEER.
3. PROVIDE GRANULAR SLOPE PROTECTION ON ALL INTERIOR DIKE SLOPES FROM FLOOR TO 1-FOOT ABOVE HIGH WATER. ROCK TAKEN FROM DEMOLISHED ROCK WALL AND OVERSIZED ROCK REMOVED FROM EARTHWORK UP TO 12" DIAMETER MAY BE SUBSTITUTED WITH ENGINEERS APPROVAL.
4. ALL LAGOON SITE WORK, EARTHWORK, AND RELATED PIPING SHALL BE INCLUDED IN SCHEDULE 1.
DISPOSAL AREA BOUNDARY - See note on sheet C-2. Lagoon dike must be constructed of suitable earthfill material per specification. Disposal material may be placed over dike within boundaries shown after dike has been constructed. Area must be topsoiled and reseeded per note on sheet C-2 and per specifications.
Widen Roadway Around Hill
FUTURE WASTE WASHWATER SURGE BASIN
SLUDGE LAGOON #1
SLUDGE LAGOON #2
SLUDGE LAGOON #3
Connect Dike Roadway to Existing Roadway
Turn Around Area
Existing Well Casing to Abandoned See St C-2
SCHEDULE 1
SCHEDULE 2
Base Line
REUSE OF DOCUMENTS
TENMILE WATER TREATMENT PLANT
CH2MHILL

PERMITTEE NAME/ADDRESS (Include Facility Name/Location if Different)
NAME CITY OF HELENA
ADDRESS 316 NORTH PARK
HELENA MT 59623

FACILITY LOCATION TENMILE WATER TREATMENT
HELENA MT 59601
ATTN: WATER SUPERINTENDENT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved.
OMB No. 2040-0004

MT0028720 — PERMIT NUMBER
001 E — DISCHARGE NUMBER

MINOR
F - FINAL
TENMILE WTP

MONITORING PERIOD	YEAR	MO	DAY		YEAR	MO	DAY
FROM	04	12	01	TO	04	12	31

*** NO DISCHARGE [X] ***

NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
FLOW RATE	SAMPLE MEASUREMENT		******	(76)	******	******	******				
00058 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT			GPM				MGD *****			
TURBIDITY	SAMPLE MEASUREMENT	******	******		******		******	(43)			
00070 5 0 0 UPSTREAM MONITORING	PERMIT REQUIREMENT			*** ****				NTU			
TURBIDITY	SAMPLE MEASUREMENT	******	******		******		******	(43)			
00070 6 0 0 DOWNSTREAM MONITOR	PERMIT REQUIREMENT			*** ****				NTU			
COPPER TOTAL RECOVERABLE	SAMPLE MEASUREMENT	******	******		******		******	(19)			
01119 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT			*** ****				UG/L			
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
John Schwartz
Water Production Supervisor
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE AREA CODE	NUMBER	DATE YEAR	MO	DAY
406	447-1520	05	06	03

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

IF KNNO4 TREATMENT OCCURS DURING THE MONTH, REPORT THE TEST RESULTS ON THIS FORM. IF NO TRTMT OCCURS DURING THE MONTH, REPORT "NO DISCHARGE" ON THIS REPORT FORM.

EPA Form 3320-1 (Rev. 3/99) Previous editions may be used.

This is a 4 part form

PAGE 24 TENMILE 4064471521 01/31/2005 15:06

Appendix 6-D Pretreatment Estimated Detailed Costs

Actiflo Cost Estimate

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Building	1714	SF	$ 200	$ 342,720
Concrete Walls	271	CY	$ 550	$ 149,188
Concrete Trough Slab	19	CY	$ 650	$ 12,285
Concrete Top Slab	63	CY	$ 650	$ 40,950
Concrete Bottom Slab	63	CY	$ 450	$ 28,350
Equipment	1	LS	$ 1,312,500	$ 1,312,500
Installation of Equipment (50%)	1	LS	$ 656,250	$ 656,250
Electrical and Instrumentation (35%)	1	LS	$ 660,000	$ 660,000
HVAC (10%)	1	LS	$ 189,000	$ 189,000
Piping and Valves (20%)	1	LS	$ 377,000	$ 377,000
Demolition (10%)	1	LS	$ 188,599	$ 188,599
Subtotal				$ 3,956,842
Engineering			15%	$ 593,526
Contingencies			30%	$ 1,187,053
Total Estimated Construction Cost				**$ 5,737,421**

O&M Costs

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Electrical Power	421,741	kw-hrs	$ 0.05	$ 21,087
Sand Replacement	57,920	lb	$ 0.14	$ 8,109
Labor	520	Hr	$ 20.00	$ 10,400
Total Estimated O&M Costs				**$ 39,596**
Total Estimated 20-Year PW Costs				**$6,126,179**

DAF Cost Estimate

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
New Concrete Walls	490	CY	$ 550	$ 269,487
Concrete Top Slab	156	CY	$ 600	$ 93,870
New Concrete Floor	214	CY	$ 500	$ 107,100
Equipment	1	LS	$ 918,750	$ 918,750
Installation of Equipment (50%)	1	LS	$ 459,375	$ 459,375
Electrical and Instrumentation (35%)	1	LS	$ 417,000	$ 417,000
HVAC (10%)	1	LS	$ 139,000	$ 139,000
Piping and Valves (20%)	1	LS	$ 278,000	$ 278,000
Demolition (10%)	1	LS	$ 138,921	$ 138,921
Subtotal				$ 2,821,503
Engineering			15%	$ 423,225
Contingencies			30%	$ 846,451
Total Estimated Construction Cost				**$ 4,091,179**

O&M Costs

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Electrical Power	581,491	kw-hrs	$ 0.05	$ 29,075
Labor	520	Hr	$ 20.00	$ 10,400
Total Estimated O&M Costs				**$ 39,475**
Total Estimated 20-Year PW Costs				**$4,478,746**

Plate Settler Cost Estimate

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Flocculation and Rapid Mix Building	473	SF	$ 200	$ 94,500
Building Addition for Cover	1820	SF	$ 200	$ 364,000
Installed Concrete	542	CY	$ 550	$ 297,990
Floc and Rapid Mix Concrete	176	CY	$ 550	$ 96,619
Equipment	1	LS	$ 659,400	$ 659,400
Flocculation and Rapid Mix Equipment	1	LS	$ 105,000	$ 105,000
Installation of Equipment (50%)	1	LS	$ 382,200.0	$ 382,200
Electrical and Instrumentation (35%)	1	LS	$ 566,000	$ 566,000
HVAC (10%)	1	LS	$ 162,000	$ 162,000
Piping and Valves (20%)	1	LS	$ 324,000	$ 324,000
Demolition (10%)	1	LS	$ 161,751	$ 161,751
Subtotal				$ 3,213,460
Engineering			15%	$ 482,019
Contingencies			30%	$ 964,038
Total Estimated Construction Cost				**$ 4,659,517**

O&M Costs

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Electrical Power	575,101	kw-hrs	$ 0.05	$ 28,755
Labor	520	Hr	$ 20.00	$ 10,400
Total Estimated O&M Costs				**$ 39,155**
Total Estimated 20-Year PW Costs				**$5,043,947**

Appendix 6-E Taste and Odor Estimated Detailed Costs

UV/H2O2 - Taste and Odor Only

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Equipment	1	EA	$ 538,000	$ 538,000
Installation and Equipment (50%)	1	LS	$ 269,000	$ 269,000
Electrical and Instrumentation (35%)	1	LS	$ 188,300	$ 188,300
Piping and Valves (10%)	1	LS	$ 53,800	$ 53,800
		Subtotal		$ 1,049,100
		Engineering	15%	$ 157,365
		Contingencies	30%	$ 314,730
Total Estimated Construction Cost				$ 1,521,195

O&M Costs for UV/H2O2 Taste and Odor Only

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Electrical Power	-	kw-hrs	-	$ 46,000
h2o2	-	lb	-	$ 27,000
Labor	100	Hr	$ 20.00	$ 2,000
Lamp Replacement				$ 6,000
Total Estimated O&M Costs				**$ 54,000**
20-Year Present Worth of O&M				**$ 530,180**
Total 20-Year Present Worth				**$ 2,100,000**

Powder Activated Carbon (PAC) - Taste and Odor

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
PAC	1	LS	$ 1,000,000	$ 1,000,000
Installation and Equipment (50%)	0	LS	$ 500,000	$ -
Electrical and Instrumentation (35%)	0	LS	$ 300,000	$ -
HVAC (10%)	0	LS	$ 100,000	$ -
Piping and Valves (20%)	0	LS	$ 200,000	$ -
Demolition (10%)	0	LS	$ 100,000	$ -
Subtotal				$ 1,000,000
Engineering			15%	$ 150,000
Contingencies			30%	$ 300,000.00
Total Estimated Construction Cost				**$ 1,450,000**

O&M Costs

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Electrical Power		kw-hrs	$ 0.05	$ -
PAC	79,147	lb	$ 0.50	$ 39,573
Labor	100	Hr	$ 20.00	$ 2,000
Total Estimated O&M Costs				**$ 41,573**
20-Year Present Worth of O&M				**$ 408,173**
Total 20-Year Present Worth				**$ 1,900,000**

UV/H2O2 - Disinfection and Taste and Odor

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Equipment	1	EA	$ 700,000	$ 700,000
Building	350	SF	$ 200	$ 70,000
Installation and Equipment (50%)	1	LS	$ 350,000	$ 350,000
Electrical and Instrumentation (35%)	1	LS	$ 269,500	$ 269,500
HVAC (10%)	1	LS	$ 77,000	$ 77,000
Piping and Valves (20%)	1	LS	$ 154,000	$ 154,000
Demolition (10%)	1	LS	$ 77,000	$ 77,000
Subtotal				$ 1,697,500
Engineering			15%	$ 254,625
Contingencies			30%	$ 509,250
Total Estimated Construction Cost				**$ 2,461,375**

O&M Costs

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Electrical Power	-	kw-hrs	-	$ 46,000
h2o2	-	lb	-	$ 27,000
Labor	100	Hr	$ 20.00	$ 2,000
Lamp Replacement				$ 6,000
Total Estimated O&M Costs				**$ 81,000**
20-Year Present Worth of O&M				**$ 795,270**
Total 20-Year Present Worth				**$ 3,300,000**

PAC & Chlorine Dioxide - Disinfection and Taste and Odor

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Chlorine Dioxide Generator	1	LS	$ 100,000	$ 100,000
PAC	1	LS	$ 1,000,000	$ 1,000,000
Installation and Equipment (50%)	1	LS	$ 50,000	$ 50,000
Electrical and Instrumentation (35%)	1	LS	$ 35,000	$ 35,000
HVAC (10%)	1	LS	$ 10,000	$ 10,000
Piping and Valves (20%)	1	LS	$ 20,000	$ 20,000
Demolition (10%)	1	LS	$ 10,000	$ 10,000
Subtotal				$ 1,225,000
Engineering			15%	$ 183,750
Contingencies			30%	$ 367,500.00
Total Estimated Construction Cost				**$ 1,776,250**

O&M Costs

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Electrical Power		kw-hrs	$ 0.05	$ -
PAC	79,147	lb	$ 0.50	$ 39,573
Labor	100	Hr	$ 20.00	$ 2,000
Chemical for ClO2				$ 20,000.00
Total Estimated O&M Costs				**$ 61,573**
20-Year Present Worth of O&M				**$ 604,536**
Total 20-Year Present Worth				**$ 2,400,000**

Appendix 6-F Disinfection Estimated Detailed Costs

Tenmile
Chlorine Cost Estimate

Description	Unit	Unit Price ($/unit)	Free Chlorine Quantity	Free Chlorine Total ($)	Sodium Hypochlorite Quantity	Sodium Hypochlorite Total ($)	On-site Generation Quantity	On-site Generation Total ($)
Mechanical								
Tanks	LS	$ 27,900	0	$ -	1	$ 27,900	0	$ -
Pumps	LS	$ 14,400	0	$ -	1	$ 14,400	0	$ -
Hypochlorite Generator	LS	$ 98,000	0	--	0	--	1	$ 98,000 *
Chlorine Containment System***	LS	$ 85,000	1	$ 85,000	0	--	0	--
Sprinkler System	LS	$ 1,800	1	$ 1,800	0	--	0	--
Containment	LS	$ 4,500	3	$ 13,500	1	$ 4,500	0	--
Chlorinators**	NA	--	0	--	0	--	0	--
Double Door for Tank Installation	LS	$ 5,000	0	$ -	1	$ 5,000	0	$ -
Double Door Construction	LS	$ 5,000	0	$ -	1	$ 5,000	0	$ -
Installation of Equipment (50%)	LS	50%	1	$ 50,150	1	$ 28,400	1	$ 49,000
Electrical and Instrumentation (35%)	LS	35%	1	$ 35,105	1	$ 19,880	1	$ 34,300
HVAC (10%)	LS	10%	1	$ 10,030	1	$ 5,680	1	$ 9,800
Piping and Valves (20%)	LS	20%	1	$ 20,060	1	$ 11,360	1	$ 19,600
Demolition (10%)	LS	10%	1	$ 10,030	1	$ 5,680	1	$ 9,800
Subtotal				$ 225,675		$ 127,800		$ 220,500
Engineering		15%		$ 33,851		$ 19,170		$ 33,075
Contingencies		30%		$ 67,703		$ 38,340		$ 66,150
Total Estimated Construction Cost				**$ 327,229**		**$ 185,310**		**$ 319,725**

* Based on estimated from Rory Schmiat at Industrial Systems 2/2/05
** Existing chlorinators would be used.
***Based on quote from TGO Technologies 7/5/05

O&M Costs

Description	Unit	Unit Price ($/unit)	Free Chlorine[1] Quantity	Free Chlorine Total ($)	Sodium Hypochlorite[2] Quantity	Sodium Hypochlorite Total ($)	On-site Generation Quantity	On-site Generation Total ($)
Chemical Cost				$ 4,900.00		$ 17,500		$ 2,600
Power Cost	kwh	$ 0.045	--	$ -	7884	$ 400	79113.75	$ 3,900
Labor	hr	$ 40.00	365	$ 14,600.00	365	$ 14,600	730	$ 29,200
Estimate Misc. Maintenance				$ 9,000.00		$ 2,250		$ 12,600
Total Estimated O&M Costs				**$ 28,500**		**$ 34,750**		**$ 48,300**
Total Estimated 20-Year PW Costs				**$ 607,046**		**$ 526,491**		**$ 793,942**

[1] Based on email from John Schwartz
[2] Based on estimate from local chemical distributor 2/24/05

Missouri River
Chlorine Cost Estimate

Description	Unit	Unit Price ($/unit)	Free Chlorine[1] Quantity	Free Chlorine[1] Total ($)	Sodium Hypochlorite[2] Quantity	Sodium Hypochlorite[2] Total ($)	On-site Generation Quantity	On-site Generation Total ($)
Building	CY	$ 200	400	$ 80,000	400	$ 80,000	750	$ 150,000
Mechanical								
Tanks	LS	$ 31,000	0	$ -	1	$ 31,000	0	$ -
Pumps	LS	$ 16,000	0	$ -	1	$ 16,000	0	$ -
Hypochlorite Generator	LS	$ 150,000	0	$ -	0	$ -	1	$ 150,000
Piping/Valves	LS	$ 5,000	1	$ 5,000	4	$ 20,000	1	$ 5,000
Chlorine Containment System	LS	$ 85,000	1	$ 85,000	0	$ -	0	$ -
Sprinkler System	LS	$ 2,000	1	$ 2,000	0	$ -	0	$ -
Containment	LS	$ 5,000	3	$ 15,000	1	$ 5,000	0	$ -
Chlorinators	LS	$ 123,000	1	$ 123,000	0	$ -	0	$ -
Installation of Equipment (50%)	LS	50%	1	$ 115,000	1	$ 36,000	1	$ 77,500
Electrical and Instrumentation (30%)	LS	30%	1	$ 69,000	1	$ 21,600	1	$ 46,500
HVAC (10%)	LS	10%	1	$ 23,000	1	$ 7,200	1	$ 15,500
Piping and Valves (20%)	LS	20%	1	$ 46,000	1	$ 14,400	1	$ 31,000
Demolition (10%)	LS	10%	1	$ 23,000	1		1	$ 15,500
Subtotal				$ 586,000		$ 231,200		$ 491,000
Engineering		15%		$ 87,900		$ 34,680		$ 73,650
Contingencies		30%		$ 175,800		$ 69,360		$ 147,300
Total Estimated Construction Cost				**$ 849,700**		**$ 335,240**		**$ 711,950**

O&M Costs

Description	Unit	Unit Price ($/unit)	Free Chlorine[1] Quantity	Free Chlorine[1] Total ($)	Sodium Hypochlorite[2] Quantity	Sodium Hypochlorite[2] Total ($)	On-site Generation Quantity	On-site Generation Total ($)
Chemical Cost				$ 5,300.00		$ 19,100		$ 2,900
Power Cost	kwh	$ 0.045	--	$ -	8760	$ 400	85775	$ 3,900
Labor	hr	$ 40.00	365	$ 14,600.00	365	$ 14,600	730	$ 29,200
Estimate Misc. Maintenance				$ 10,000.00		$ 2,500		$ 14,000
Total Estimated O&M Costs				**$ 29,900**		**$ 36,600**		**$ 50,000**
Total Estimated 20-Year PW Costs				**$ 1,143,263**		**$ 694,584**		**$ 1,202,857**

[1] Based on email from John Schwartz
[2] Based on estimate from local chemical distributor 2/24/05

UV - Disinfection Only

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Equipment	2	EA	$ 162,000	$ 324,000
Building	350	SF	$ 200	$ 70,000
Installation and Equipment (50%)	1	LS	$ 162,000	$ 162,000
Electrical and Instrumentation (35%)	1	LS	$ 118,200	$ 118,200
HVAC (10%)	1	LS	$ 39,400	$ 39,400
Piping and Valves (20%)	1	LS	$ 78,800	$ 78,800
Demolition (10%)	1	LS	$ 39,400	$ 39,400
Subtotal				$ 831,800
Engineering			15%	$ 124,770
Contingencies			30%	$ 249,540
Total Estimated Construction Cost				**$ 1,206,110**

O&M Costs

Description	Quantity	Unit	Unit Price ($/unit)	Total ($)
Electrical Power	-	kw-hrs	-	$ 22,000
Labor	100	Hr	$ 20.00	$ 2,000
Lamp Replacement				$ 3,000
Total Estimated O&M Costs				**$ 27,000**
20-Year Present Worth of O&M				**$ 265,090**
Total 20-Year Present Worth				**$ 1,500,000**

Appendix 6-G MRTP Discharge Permit to Prickly Pear Creek

Public
Minor Industrial
No Bio-monitoring
Permit No.: MT-0000949

MONTANA DEPARTMENT OF HEALTH
AND
ENVIRONMENTAL SCIENCES

AUTHORIZATION TO DISCHARGE UNDER THE

MONTANA POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with Section 75-5-101 et seq., MCA, and ARM 16.20.1301 et seq., and 16.20.601 et seq.,

Helena Municipal Water Treatment Plant
316 North Park Avenue
Helena, Montana 59623

is authorized to discharge from Missouri River Water Treatment Plant

to receiving waters named Prickly Pear Creek,

in accordance with discharge point(s), effluent limitations, monitoring requirements and other conditions set forth herein. Authorization for discharge is limited to those outfalls specifically listed in the permit.

This permit shall become effective on the date of issuance.

This permit and the authorization to discharge shall expire at midnight, September 30, 1996.

FOR THE MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

Frederick C. Shewman, P. E.
Supervisor, Permits Section
Water Quality Bureau
Environmental Sciences Division

Dated this 1st day of November 1991

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I. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

A. Definitions.

1. The "30-day (and monthly) average," other than for fecal coliform bacteria, is the arithmetic average of all samples collected during a consecutive 30-day period or calendar month, whichever is applicable. Geometric means shall be calculated for fecal coliform bacteria. The calendar month shall be used for purposes of reporting self-monitoring data on discharge monitoring report forms.

2. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

3. "Daily Maximum" ("Daily Max.") is the maximum value allowable in any single sample or instantaneous measurement.

4. "Department" means the Montana Department of Health and Environmental Sciences.

5. A "grab" sample, for monitoring requirements, is defined as a single "dip and take" sample collected at a representative point in the discharge stream.

6. An "instantaneous" measurement, for monitoring requirements, is defined as a single reading, observation, or measurement.

7. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

8. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

B. Description of Discharge Points

The authorization to discharge provided under this permit is limited to those outfalls specifically designated below as discharge locations. Discharges at any location not authorized under an MPDES permit is a violation of the Montana Water Quality Act and could subject the person(s) responsible for such discharge to penalties under the Act. Knowingly discharging from an unauthorized location or failing to report an unauthorized discharge within a reasonable time from first learning of an unauthorized discharge could subject such person to criminal penalties as provided under Section 75-5-632 of the Montana Water Quality Act.

Outfall Serial Number	Description of Discharge Point
001	Discharge from potable water supply treatment plant. Sampling shall be performed at the treatment lagoon discharge and prior to entering Prickly Pear Creek

C. Specific Limitations and Self-Monitoring Requirements

1. Effluent Limitations

(a) Effective immediately and lasting through September 30, 1996, the quality of effluent discharged by the facility shall, as a minimum, meet the limitations as set forth below:

Effluent Characteristics	Effluent Limitations 30-Day a/ Average	Daily Maximum
TSS, mg/l	30	45
Total Dissolved Aluminum mg/l	1.0	1.5

The Total Residual Chlorine concentration shall not exceed 0.019 mg/l in any grab sample.

The pH shall not be less than 6.5 standard units nor greater than 9.5 standard units and shall be monitored semi-annually by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

2. Self-Monitoring Requirements

(a) Wastewater Discharge Monitoring

As a minimum, upon the effective date of this permit, the following constituents shall be monitored at the frequency and with the type of measurement indicated; samples or measurements shall be representative of the volume and nature of the monitored discharge. If no discharge occurs during the entire monitoring period, it shall be stated on the Discharge Monitoring Report Form (EPA No. 3320-1) that no discharge or overflow occurred.

Effluent Characteristic	Frequency	Sample Type a/
Flow	Monthly	Instantaneous
Total Dissolved Aluminum	Monthly	Grab
Total Suspended Solids	Monthly	Grab
Total Residual Chlorine	Daily	Grab
pH	Monthly	Grab
Turbidity	Monthly	Grab

II. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling. Samples taken in compliance with the monitoring requirements established under Part I shall be collected from the effluent stream prior to discharge into the receiving waters. Samples and measurements shall be representative of the volume and nature of the monitored discharge.

B. Monitoring Procedures. Monitoring must be conducted according to test procedures approved under Part 136, Title 40 of the Code of Federal Regulations, unless other test procedures have been specified in this permit. All flow-measuring and flow-recording devices used in obtaining data submitted in self-monitoring reports must indicate values within 10 percent of the actual flow being measured.

C. Penalties for Tampering. The Montana Water Quality Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than six months, or by both.

D. Reporting of Monitoring Results. If no discharge occurs for an entire year, a yearly report shall be submitted on a Discharge Monitoring Report Form (EPA No. 3320-1). If a discharge occurs during any quarter of a year, the permittee is required to submit a quarterly report for the quarter in which the discharge occurred. The yearly or quarterly reports shall be postmarked no later than the 28th day of the month following the completed reporting period. Legible copies of these, and all other reports required herein, shall be signed and certified in accordance with the Signatory Requirements (see Part IV), and submitted to the Department at the following addresses:

Montana Department of Health and Environmental Sciences
Water Quality Bureau
Cogswell Building, Room A-206
Helena, Montana 59620-0909
Phone: (406) 444-2406

E. Compliance Schedules. Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any Compliance Schedule of this permit shall be submitted no later than 14 days following each schedule date.

F. Additional Monitoring by the Permittee. If the permittee monitors any pollutant more frequently than required by this permit, using approved analytical methods as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report. Such increased frequency shall also be indicated.

#8 12/24/91

II. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling. Samples taken in compliance with the monitoring requirements established under Part I shall be collected from the effluent stream prior to discharge into the receiving waters. Samples and measurements shall be representative of the volume and nature of the monitored discharge.

B. Monitoring Procedures. Monitoring must be conducted according to test procedures approved under Part 136, Title 40 of the Code of Federal Regulations, unless other test procedures have been specified in this permit. All flow-measuring and flow-recording devices used in obtaining data submitted in self-monitoring reports must indicate values within 10 percent of the actual flow being measured.

C. Penalties for Tampering. The Montana Water Quality Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than six months, or by both.

D. Reporting of Monitoring Results. Effluent monitoring results obtained during the previous month(s) shall be summarized for each month and reported on a Discharge Monitoring Report Form (EPA No. 3320-1), postmarked no later than the 28th day of the month following the completed reporting period. If no discharge occurs during the reporting period, "no discharge" shall be reported. Legible copies of these, and all other reports required herein, shall be signed and certified in accordance with the Signatory Requirements (see Part IV), and submitted to the Department at the following addresses:

Montana Department of Health and Environmental Sciences
Water Quality Bureau
Cogswell Building, Room A-206
Helena, Montana 59620-0909
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E. Compliance Schedules. Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any Compliance Schedule of this permit shall be submitted no later than 14 days following each schedule date.

F. Additional Monitoring by the Permittee. If the permittee monitors any pollutant more frequently than required by this permit, using approved analytical methods as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report. Such increased frequency shall also be indicated.

G. Records Contents. Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements;

2. The initials or name(s) of the individual(s) who performed the sampling or measurements;

3. The date(s) analyses were performed;

4. The time analyses was initiated;

5. The initials or name(s) of individual(s) who performed the analyses;

6. References and written procedures, when available, for the analytical techniques or methods used; and,

7. The results of such analyses, including the bench sheets, instrument readouts, computer disks or tapes, etc., used to determine these results.

H. Retention of Records. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time. Data collected on site, copies of Discharge Monitoring Reports, and a copy of this MPDES permit must be maintained on site during the duration of activity at the permitted location.

I. Twenty-four Hour Notice of Noncompliance Reporting.

1. The permittee shall report any noncompliance which may seriously endanger health or the environment as soon as possible, but no later than twenty-four (24) hours from the time the permittee first became aware of the circumstances. The report shall be made to the Water Quality Bureau at (406) 444-2406.

2. The following occurrences of noncompliance shall be reported by telephone to the Water Quality Bureau at (406) 444-2406 by the first workday (8:00 a.m. - 4:30 p.m. Mountain Time) following the day the permittee became aware of the circumstances:

   a. Any unanticipated bypass which exceeds any effluent limitation in the permit (See Part III.G., Bypass of Treatment Facilities.);

   b. Any upset which exceeds any effluent limitation in the permit (See Part III.H., Upset Conditions.); or,

   c. Violation of a maximum daily discharge limitation for any of the pollutants listed in the permit to be reported within 24 hours.

3. A written submission shall also be provided within five days of the time that the permittee becomes aware of the circumstances. The written submission shall contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times;

   c. The estimated time noncompliance is expected to continue if it has not been corrected; and,

   d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

4. The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the Water Quality Bureau, by phone, (406) 444-2406.

5. Reports shall be submitted to the addresses in Part II.D., Reporting of Monitoring Results.

J. Other Noncompliance Reporting. Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for Part II.D. are submitted. The reports shall contain the information listed in Part II.I.3.

K. Inspection and Entry. The permittee shall allow the head of the Department or the Regional Administrator, or authorized representative thereof, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,

4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance, any substances or parameters at any location.

III. COMPLIANCE RESPONSIBILITIES

PART III

A. Duty to Comply. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The permittee shall give the Department advance notice of any planned changes at the permitted facility or of an activity which may result in permit noncompliance.

B. Penalties for Violations of Permit Conditions. The Montana Water Quality Act provides that any person who violates a permit condition of the Act is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions of the Act is subject to a fine of not more than $50,000 per day of violation, or by imprisonment for not more than 2 years, or both. Except as provided in permit conditions on Part III.G., Bypass of Treatment Facilities and Part III.H., Upset Conditions, nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to Mitigate. The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper Operation and Maintenance. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit. However, the permittee shall operate, as a minimum, one complete set of each main line unit treatment process whether or not this process is needed to achieve permit effluent compliance.

F. Removed Substances. Collected screenings, grit, solids, sludges, or other pollutants removed in the course of treatment shall be buried or disposed of in such a manner so as to prevent any pollutant from entering any waters of the state or creating a health hazard.

G. Bypass of Treatment Facilities:

1. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs 2. and 3. of this section.

2. Notice:

a. Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least 60 days before the date of the bypass.

b. Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required under Part II.I., Twenty-four Hour Reporting.

3. Prohibition of bypass.

a. Bypass is prohibited and the Department may take enforcement action against a permittee for a bypass, unless:

(1) The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and,

(3) The permittee submitted notices as required under paragraph 2. of this section.

b. The Department may approve an anticipated bypass, after considering its adverse effects, if the Department determines that it will meet the three conditions listed above in paragraph 3.a. of this section.

H. Upset Conditions.

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with technology based permit effluent limitations if the requirements of paragraph 2. of this section are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review (i.e., Permittees will have the opportunity for a judicial determination on any claim of upset only in an enforcement action brought for noncompliance with technology-based permit effluent limitations).

2. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

a. An upset occurred and that the permittee can identify the cause(s) of the upset;

b. The permitted facility was at the time being properly operated;

c. The permittee submitted notice of the upset as required under Part III.I., Twenty-four Hour Notice of Noncompliance Reporting; and,

d. The permittee complied with any remedial measures required under Part III.D., Duty to Mitigate.

3. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

I. Toxic Pollutants. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

J. Changes in Discharge of Toxic Substances. Notification shall be provided to the Department as soon as the permittee knows of, or has reason to believe:

1. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

   a. One hundred micrograms per liter (100 μg/L);

   b. Two hundred micrograms per liter (200 μg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 μg/L) for 2,4-dinitrophenol and for 2-methyl-4, 6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;

   c. Five (5) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7); or,

   d. The level established by the Department in accordance with 40 CFR 122.44(f).

2. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

   a. Five hundred micrograms per liter (500 μg/L);

   b. One milligram per liter (1 mg/L) for antimony;

   c. Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7); or,

   d. The level established by the Department in accordance with 40 CFR 122.44(f).

IV. GENERAL REQUIREMENTS

A. Planned Changes. The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when the alteration or addition could significantly change the nature or increase the quantity of pollutant discharged. This notification applies to pollutants which are not subject to effluent limitations in the permit.

B. Anticipated Noncompliance. The permittee shall give advance notice to the Department of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

C. Permit Actions. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

D. Duty to Reapply. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The application should be submitted at least 180 days before the expiration date of this permit.

E. Duty to Provide Information. The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by this permit.

F. Other Information. When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Department, it shall promptly submit such facts or information.

G. Signatory Requirements. All applications, reports or information submitted to the Department shall be signed and certified.

1. All permit applications shall be signed as follows:

   a. For a corporation: by a responsible corporate officer;

   b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively;

   c. For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Department shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to the Department, and,

   b. The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3. Changes to authorization. If an authorization under paragraph IV.G.2. is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph IV.G.2. must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this section shall make the following certification:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. Penalties for Falsification of Reports. The Montana Water Quality Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years per violation, or by both.

I. Availability of Reports. Except for data determined to be confidential under 40 CFR Part 2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. As required by the Clean Water Act, permit applications, permits and effluent data shall not be considered confidential.

J. Oil and Hazardous Substance Liability. Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Clean Water Act.

K. Property Rights. The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

L. Severability. The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

M. Transfers. This permit may be automatically transferred to a new permittee if:

1. The current permittee notifies the Department at least 30 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them; and,

3. The Department does not notify the existing permittee and the proposed new permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph 2. above.

N. Reopener Provision. This permit may be reopened and modified (following proper administrative procedures) to include the appropriate effluent limitations (and compliance schedule, if necessary), or other appropriate requirements if one or more of the following events occurs:

1. Water Quality Standards: The water quality standards of the receiving water(s) to which the permittee discharges are modified in such a manner as to require different effluent limits than contained in this permit.

2. Wasteload Allocation: A wasteload allocation is developed and approved by the Department and/or EPA for incorporation in this permit.

3. Water Quality Management Plan: A revision to the current water quality management plan is approved and adopted which calls for different effluent limitations than contained in this permit.

4. Toxic Pollutants: A toxic standard or prohibition is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit.

ADDRESS 1-COURT ADAIR BLDG.
318 E. PARK
HELENA MT 59623

FACILITY MISSOURI RIVER WATER PLANT
LOCATION HELENA MT 59601

ATTN: MARK PRODUCTER SUPERVISOR

PERMIT NUMBER

DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	97	01	01	TO	97	12	31

OMB No. 2040-0004

FINAL

FECAL COLI 432

NO DISCHARGE ☒ SIZE

NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX.	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
FLOW RATE	SAMPLE MEASUREMENT		********	(MGD)	********	********	********				
	PERMIT REQUIREMENT										
00556 1 0 0 DISSOLVED GROSS ALPHA	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
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	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

John Sedlmeier
Water Production Supervisor

TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE: AREA CODE / NUMBER

DATE: YEAR / MO / DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

IF NO DISCHARGE OCCURS DURING THE TRIAL, REPORT "NO DISCHARGE" ON THIS REPORT FORM. IF A DISCHARGE OCCURS, MONTHLY MONITORING AND QUARTERLY REPORTING IS REQUIRED.

EPA Form 3320-1 (Rev. 3/99) Previous editions may be used.

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