Chapter 4 - Development and Evaluation of Wastewater Treatment Facility Improvement Alternatives

General

In this chapter, alternatives to improve the City of John Day's wastewater treatment and effluent reuse/disposal facilities are developed and evaluated to address the deficiencies identified in Chapter 3. The wastewater collection system was not evaluated as part of this Wastewater Facilities Plan (WWFP) Update. A conceptual discussion of the treatment and effluent disposal alternatives considered in this WWFP Update are presented. Feasible alternatives deserving further consideration are identified, and further discussion and evaluation of the feasible treatment alternatives and effluent disposal and reuse options are provided. Based on comparison of the feasible alternatives, a recommended improvements package is presented. Selected improvements are detailed further in Chapter 5.

Wastewater Treatment Facility Alternatives and Effluent Reuse/Disposal Options

In this section, wastewater treatment facility (WWTF) alternatives and effluent reuse/disposal options are discussed. The City's existing WWTF has served the City effectively for many years. However, as discussed in Chapter 3, the existing WWTF has many important components that have deteriorated beyond repair, surpassed their design life, lack the capacity to meet current and/or future demands, or lack the capability of meeting potential future National Pollutant Discharge Elimination System (NPDES) Permit requirements. Therefore, upgrading the existing WWTF is not considered in the discussion of WWTF alternatives. The treatment and effluent reuse alternatives deemed to be feasible are evaluated in further detail prior to outlining the recommended improvements.

In the event the Oregon Department of Environmental Quality (DEQ) requires the City to obtain an NPDES Permit or requires them to discontinue discharging to the percolation ponds due to the apparent hydraulic connection to the John Day River, the City of John Day would need to make significant changes to the WWTF. Several alternatives are available to the City to improve their discharge method and/or meet regulatory compliance with an NPDES Permit. This chapter presents, develops, and analyzes wastewater treatment alternatives and disposal improvement options for the City.

Conceptual Discussion of Wastewater Treatment Facility Alternatives

Four WWTF alternatives were considered and are conceptually evaluated in this WWFP Update:

- No Action Alternative
- Alternative A - New Wastewater Treatment Lagoon System
- Alternative B - New Mechanical WWTF
- Alternative C - New Wastewater Treatment Lagoon System and Mechanical WWTF

A brief description of each conceptual alternative follows.

No Action Alternative

Under the No Action Alternative, the City would continue to use the WWTF in its current condition and continue to discharge treated effluent into the percolation ponds. Refer to Chapter 3 for a comprehensive discussion of the existing WWTF. No work would be performed on the City's wastewater treatment system.

As discussed previously, the apparent hydraulic connection between the percolation ponds and the John Day River is a concern. In the event the DEQ requires the City to obtain an NPDES Permit, the existing WWTF process does not have the ability to meet the regulatory requirements for indirect discharge to the John Day River. Furthermore, based on the evaluation that was completed on the existing WWTF, some of the treatment units are of inadequate capacity to accommodate existing and anticipated future flows and loadings, and the majority of the components and equipment have reached or are nearing their useful design life. Consequently, the No Action Alternative is not considered to be a long-term viable option.

Alternative A - New Wastewater Treatment Lagoon System

With this alternative, the existing WWTF would be demolished and a pumping system and pipeline to a new non-discharging facultative lagoon system would be constructed to treat effluent and store the reclaimed water for reuse as irrigation of crops for non-human consumption. The new WWTF would consist of preliminary treatment (screening and grit removal), two lift stations, an 8-inch forcemain, a two-cell lagoon system, chlorine disinfection system, and irrigation area.

The water balance developed for Alternative A is shown on Figure 4-1. According to the water balance, the City would need to construct approximately 33 million gallons (MG) of storage on an approximately 30-acre site with an irrigation area of approximately 45 acres to meet the design criteria developed in Chapter 2. The lagoon system would consist of a treatment lagoon, approximately 10 acres in size, and a storage lagoon approximately 20 acres in size. The treatment and storage lagoons would both have impoundment dikes approximately 10 feet deep. The treatment lagoon would have a maximum water depth of 7 feet, leaving 3 feet for freeboard. The treatment lagoon would maintain a minimum water depth of 3 feet at all times for treatment purposes, leaving the remaining 4 feet for additional treatment and operational storage. The storage lagoon would have a maximum water depth of 7 feet. Water depths would fluctuate throughout the year. The lagoon could be lined with on-site materials if the clay content is high enough; otherwise, a mixed-blanket bentonite or a geosynthetic liner would be utilized.

The location of the lagoon system and irrigation area will affect project costs due to the distance and elevation difference between the City and a suitable site. During the development of this WWFP Update, one site was evaluated that is located on a canyon shelf north of the City. The cost estimate shown on Figure 4-2 assumes the lagoons and irrigated lands are approximately 2-1/2 miles and 900 feet up in elevation from the existing WWTF. This location has on-site clay, which should be suitable for use as a liner. To convey the maximum daily flows from the City to the proposed site, an 8-inch forcemain and two lift stations in series would need to be installed.

Alternative A would allow the City to maintain its existing Water Pollution Control Facilities (WPCF) Permit and discontinue the apparent indirect discharge to the John Day River through the percolation ponds. The main difficulty associated with Alternative A is acquiring a suitable amount of land from a landowner close to the City of John Day to construct the new WWTF and irrigation area. Preliminary discussions with local landowners have resulted in no viable sites. Due to the fact that a property has not been identified, Alternative A is not a viable alternative for treating and disposing of the City's wastewater. However, a conceptual site plan of what Alternative A could look like is shown on Figure 4-3.

Cost

The estimated project cost for Alternative A is approximately $6,015,000 and is shown on Figure 4-2. The cost estimate was prepared assuming a landowner and site were located by the City.

Advantages

The advantages to Alternative A are:

- Discontinued use of the percolation ponds and alleviates concerns surrounding the apparent hydraulic connection to the John Day River.
- Land application is a proven and accepted method of effluent disposal.
- Maintains the WPCF Permit.
- Future NPDES Permit discharge limits would not apply.
- Most cost-effective alternative.

Disadvantages

The disadvantages to Alternative A are:

- Land acquisition or condemnation is needed.
- No viable landowners have been identified.
- Facilities are located miles from the City making access and operations a challenge.
- Crop management is needed.
- Improvements cannot be phased for installation over time.
- Farming practices are limited to crops not for human consumption.
- Does not meet the City's long-term planning goals/or commercial/industrial reuse of water.

Alternative B - New Mechanical Wastewater Treatment Facility

With this alternative, a new mechanical WWTF would be constructed at a new site to allow for development of the property at the existing WWTF to meet the City's current planning efforts involving the Innovation Gateway. There is the potential the existing percolation ponds would be reused for wastewater disposal depending on permitting. Otherwise, the existing WWTF would be demolished.

The mechanical WWTF would be capable of producing Class A or B effluent. The mechanical WWTF would generally consist of a new preliminary treatment system (screening and grit removal), an influent lift station, a membrane bioreactor (MBR) package facility, disinfection system, sludge management system (aerobic digestion, sludge thickening and dewatering, and associated components), electrical, controls, and instrumentation, process and yard piping, etc.

The preliminary treatment (headworks) would consist of a fine screening to remove plastics, rags, etc., essential to protecting the treatment equipment from excessive wear and plugging. The headworks would also be equipped with a grit removal system and an influent flowmeter.

The new mechanical treatment process would require preliminary treated wastewater to be pumped into the system via an influent lift station. The lift station would be capable of handling the anticipated design peak flows with built-in redundancy and reliability.

The MBR package facility is a turn-key operation that contains all the components necessary for effluent processing including pumps, valves, blowers, mixers, flowmeters, and the membranes. The prefabricated unit would be constructed of stainless steel tanks that withstand the harsh chemical environment created in the treatment process.

As preliminary treated wastewater enters the MBR, it is cycled through an equalization basin to regulate flow and prevent overloading during peak flow events. From the equalization basin, effluent enters the anoxic (low oxygen) tank where it is mechanically mixed. Effluent is then gravity-fed into the aeration tank where oxygen is injected through air diffusers and a biological reaction occurs, breaking down the organic products.

After aeration, the effluent is filtered through the membranes. Membranes are composed of different materials and configurations, but all allow the passage of only specific components and the separating of fluid and solids. This treatment process can be easily modified if regulatory requirements become more stringent.

Sludge biosolids is a byproduct derived from the wastewater treatment process and must receive additional treatment for proper disposal. Two commonly used methods used for sludge processing is through anaerobic or aerobic digestion. Typically, the most effective and economic process utilizes aerobic digestion. To increase digester process performance and reduce digester volume, sludge thickening equipment would be utilized to thicken the City's sludge to approximately 3 to 6 percent solids prior to aerobic digestion.

Similar to wastewater classifications, sludge processing has different levels of treatment requirements (refer to Chapter 3 for more information on the regulatory requirements). To meet the criteria for Class B quality biosolids with aerobic digestion, the digesters must be sized to provide between 40 and 60 days of solids retention time depending on temperatures within the digesters. The average design solids production is estimated to be approximately 728 pounds of volatile solids per day. It is estimated that the solids would be wasted out of the MBR system at approximately 0.8 percent solids. To reduce the aerobic digester volume and demands from the blower equipment, the sludge would be processed through a polymer injection system and sludge thickening equipment to increase the solids concentration to approximately 4 percent solids. At this rate of solids production and concentration, the sludge wasting rate from the treatment process into the digestion system would be approximately 2,200 gallons per day (gpd). It can be expected that around 30 to 40 percent of the incoming solids to the digestion system would be volatile and at a minimum 30 percent reduction of the volatile solids would occur. Given these assumptions, sludge would accumulate in the tanks at a rate of approximately 2,000 gpd. Therefore, with the 60 days of solids retention time needed to meet the Part 503 regulations for Class B sludge, the amount of digester working volume that would be needed is approximately 120,000 gallons (digester working volume = 60 days x 2,000 gpd = 120,000 gallons). A minimum of two digesters would need to be constructed.

Sludge dewatering is needed to provide efficient handling of the waste digested sludge (biosolids). It is proposed to include a screw press and associated polymer feed system that would provide sludge dewatering capability to achieve dewatered sludge concentrations of 15 to 20 percent dry solids. This would allow efficient storage and transport of the solids for disposal.

Construction of a new mechanical WWTF would provide the City with the means to consistently and effectively exceed the existing WPCF Permit requirements and meet or exceed any future NPDES Permit requirements. The mechanical WWTF would be designed with the ability to biologically remove nutrients (nitrogen and phosphorus) and metals (iron, copper, and lead), which would alleviate the concerns with indirect or direct discharge into the John Day River.

In the event direct discharge to the John Day River is permitted, the DEQ would need to revise the John Day River's total maximum daily load's (TMDLs) recognizing John Day as a new discharger. Currently, the John Day River TMDLs are assigned for the City of Mt. Vernon and the City of Dayville only. A mixing zone study would need to be performed due to the City of John Day's new outfall to the John Day River. The mixing zone study would evaluate the dispersion, mixing, and dilution of the discharged effluent within the assigned mixing zone boundary.

Given the above considerations, it is evident that a new mechanical WWTF is a viable alternative available to the City. A conceptual site plan and process schematic of Alternative B is shown on Figures 4-4A and 4-4B, respectively.

Cost

The total estimated project cost for Alternative B is approximately $10,330,000 and is shown on Figure 4-5A). Disposal options for Alternative B are discussed in depth hereafter; however, additional costs will be incurred above what is proposed on Figure 4-5A if the City is permitted to dispose of treated wastewater via deep well injection. Therefore, Figure 4-5B has been prepared to reflect the costs of constructing a deep well for wastewater injection. The deep well would also be equipped with a pumping system to recover reclaimed water for beneficial use in the "purple pipe" network that is described in detail hereafter.

Advantages

The advantages to Alternative B are:

- High-quality effluent allows for multiple beneficial reuses to be utilized.
- Meets the City's long-term planning goals.
- Potential reuse of existing infrastructure for disposal (percolation ponds).

Disadvantages

The disadvantages to Alternative B are:

- High capital cost.
- High operation and maintenance (O&M) cost.
- Winter storage may be required.
- Permitting indirect or direct discharge to the John Day River may be difficult.

Alternative C - New Wastewater Treatment Lagoon System and Mechanical Wastewater Treatment Facility

With this alternative, the existing WWTF would be demolished and a new wastewater treatment system composed of similar components described in Alternative A and B would be constructed. The use of each facility would be dependent on the reuse demand for Class A or B wastewater produced by the mechanical WWTF. This would allow the City to optimize the beneficial reuse of a Class A or B effluent and provide for storage for the City's wastewater during periods when the City's wastewater production exceeds the beneficial reuse demand.

The water balance developed for Alternative C is shown on Figure 4-6. For planning purposes, the water balance assumes the City can reuse all wastewater produced during the summer months. During the winter months, the City would store wastewater and then reuse the treated wastewater when permitting allows in the spring. According to the water balance, the City would need to construct approximately 33 MG of storage on an approximately 25-acre site to meet the design criteria developed in Chapter 2. The lagoon system would consist of a single storage lagoon approximately 25 acres in area. As the demand for reuse wastewater exceeds that produced by the WWTF, the City would convey stored wastewater back through the pipe network to dedicated reuse sites, alleviating the need for crop management and maximizing water reuse capabilities.

Alternative C would allow the City to maintain its existing WPCF Permit and discontinue the apparent indirect discharge to the John Day River through the percolation ponds. Alternative C would produce a Class A or B effluent for wastewater beneficial reuse meeting the City's long-term planning goals. However, no viable sites to the sites have been identified to construct a storage lagoon. Therefore, Alternative C is not a viable option.

Cost

The estimated project cost for Alternative C is approximately $13,725,000 and is shown on Figure 4-7).

Advantages

The advantages to Alternative C are:

- High-quality effluent allows for multiple beneficial reuses to be utilized.
- Most beneficial reuse options available.

- Meets the City's long-term planning goals.
- Discontinued use of the percolation ponds and alleviates concerns surrounding the apparent hydraulic connection to the John Day River.
- Land application is a proven and accepted method of disposal.
- Maintains the WPCF Permit.
- Future NPDES Permit discharge limits would not apply.

Disadvantages

The disadvantages to Alternative C are:

- Most expensive alternative.
- High capital cost.
- High O&M cost.
- Land acquisition or condemnation is needed.
- No viable landowners have been identified.
- Improvements cannot be phased for installation over time.

Common Components Required for Each Alternative

With each alternative presented above, the new WWTF would be relocated to a new site and some or all of the structures at the existing WWTF would be demolished. Therefore, demolition costs are included in each cost estimate.

Regardless of the treatment alternative implemented, the new WWTF must include preliminary treatment to remove grit and debris. Removal of grit and debris are essential to protect treatment equipment and pumps from excessive wear and plugging. The new headworks would consist of a fine screening system to remove plastics, rags, etc., a new influent flowmeter, and a grit removal chamber. To provide protection and prevent freezing of the new headworks equipment (screening and grit dewatering equipment), a new headworks building would need to be constructed.

Conceptual Discussion of Effluent Reuse and Disposal Options

In this section, the current and potential future effluent reuse and disposal options available to the City are conceptually discussed. The associated treatment class requirements for each option are also discussed and paired with the appropriate treatment alternative previously presented. See Figure 4-8 for a map of the potential land application and beneficial reuse locations potentially available to the City. See Figure 4-9 for a detailed description of the wastewater treatment classifications, the associated treatment requirements, and the associated beneficial reuse applications for each classification.

Option 1 - Class D Land Application and Beneficial Reuse

Class D treatment capabilities could be achieved through the treatment lagoon system proposed in Alternative A. Beneficial use of Class D wastewater is limited to crops grown for non-human consumption (i.e., cattle feed and fodder) after disinfection. The irrigation area must be signed, fenced, and have a minimum of 100 feet setback from areas with public access.

Due to land application practices, irrigation of wastewater during the winter months is not permitted. Therefore, the treatment lagoon would need ample capacity to store the City's wastewater during the winter months.

No additional costs for Class D land application and beneficial reuse above what is already proposed in the Alternative A cost estimate is anticipated.

Option 2 - Class B Land Application and Beneficial Reuse

Class B treatment capabilities could be achieved through the proposed mechanical WWTF (Alternatives B and C). To summarize, the City's current and potential Class B uses consist of the following:

- Irrigation of the golf course
- Water source for landscape and restricted recreational impoundments (reclaimed water lake at the Innovation Gateway)
- Non-residential urinal and toilet flushing
- Hydroponic greenhouse heating and cooling (non-contact)
- Log deck watering at Malheur Lumber

Option 3 - Class A Land Application and Beneficial Reuse

Class A treatment capabilities can be achieved through the proposed mechanical WWTF (Alternatives B and C). The capital cost for upgrading an MBR facility from Class B to Class A is negligible. To summarize, some of the City's current and potential Class A uses consist of the following:

- Any beneficial use indicated in Option 2
- Landscape irrigation for areas open to public (parks, sports complex, greenway, etc.)
- Irrigation for any agricultural or horticultural use (hydroponic greenhouses)
- Water supply source for non-restricted recreational impoundments (fishing, boating, etc.)
- Torrefaction process water (Malheur Lumber)

One Class A beneficial reuse option has been identified at Malheur Lumber that would use the City's wastewater as torrefaction process water. Additional treatment of the City's wastewater may be necessary for this beneficial reuse. If additional treatment is requested by the consumer above Class A treatment capabilities, the associated costs would be the consumer's responsibility and not the City's. Therefore, costs associated with additional treatment above Class A for site specific beneficial reuse is not provided in this WWFP Update.

Option 4 - Class A Surface Infiltration or Subsurface Injection

The City could construct a deep well and discharge treated wastewater into a subsurface aquifer as long as the methods and water characteristics meet the requirements of OAR 340-044. For this option to be considered, the City of John Day would need to conduct water tests on the confined aquifer that is not currently being used as a drinking water source down gradient of the proposed injection site. The City would need to show that the wastewater injection process does not introduce contaminants into the groundwater that violate any primary drinking water regulation under the Safe Water Drinking Water Act, or fails to comply with groundwater protection requirements specified in Oregon Administrative Rule 340-040.

A preliminary search of well logs in the area found that the injection well would need to reach a depth of approximately 550 feet below ground surface to tap an unconfined aquifer.

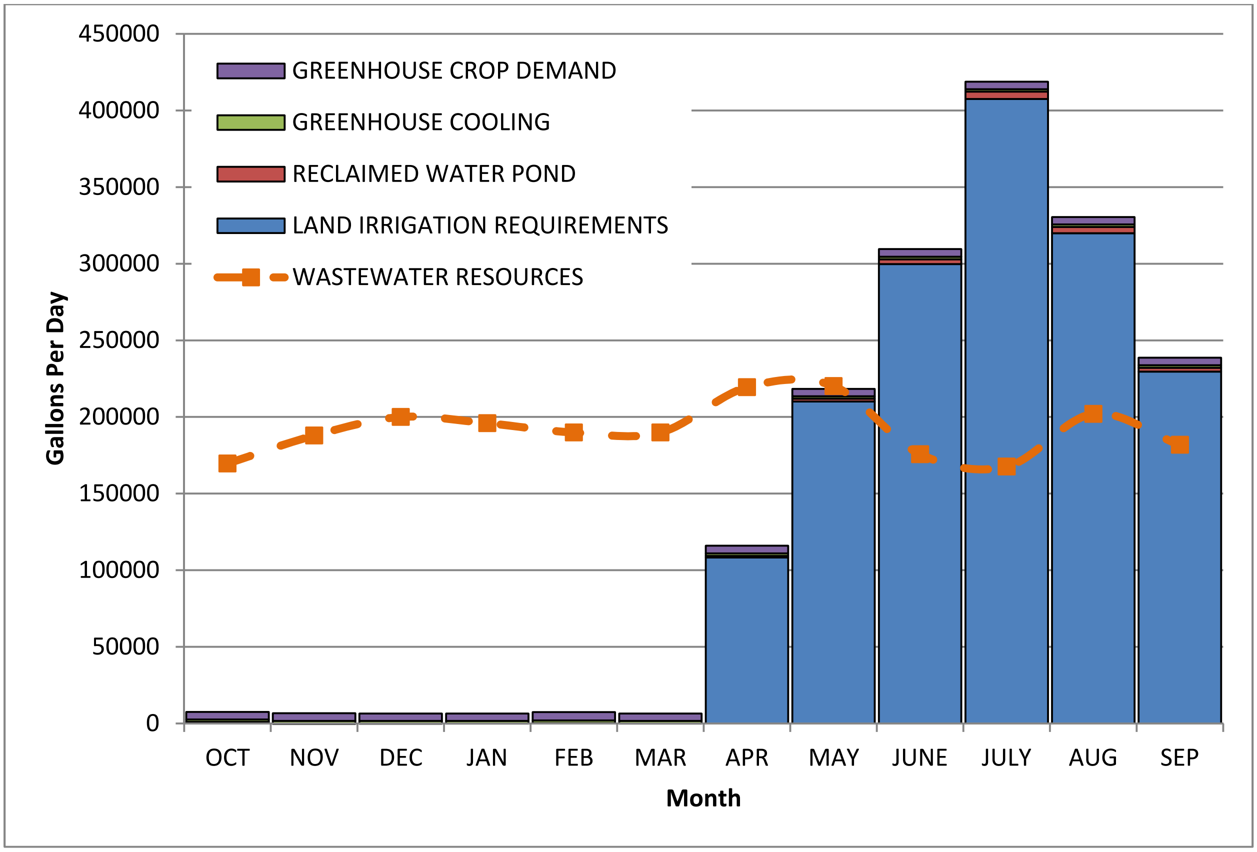
Purple Pipe System and Wastewater Reuse Demands

To convey Class A or Class B wastewater to a dedicated disposal site, a "purple pipe" system is needed. The purple pipe system would consist of a piping network and a pump station to pressurize the distribution system. The pipe network would consist of approximately 13,000 feet of 8-inch main line that originates at the proposed mechanical WWTF site and is installed east to the ballfields and west to the golf course as shown on Figure 4-8. The main line would be tapped where needed to convey treated wastewater to other identified disposal sites, such as irrigation of the greenway, reclaimed water pond, greenhouses, etc. The cost to install the 8-inch main line, pump station, and appurtenances is approximately $1,060,000. A cost estimate breakdown can be seen in Figure 4-10.

The City's potential wastewater resources from the mechanical WWTF and reuse demands were compared to determine the approximate volume of disposal available from the City's current reuse options. Assuming wastewater reuse is the only method for disposal, the City would need to identify enough reuse demand to consume on average 213,000 gpd (average daily flow between January 2012 and December 2016).

The City is currently pursuing the construction of their first greenhouse. When fully functional, the greenhouse will have an annual reuse demand of approximately 2.4 MG for heating/cooling and crop management. As the City constructs more greenhouses, that demand will increase. The reclaimed water pond at the Innovation Gateway will be approximately 1 acre in area and will dispose of wastewater via evaporation. The annual storage deficit from evaporation will be approximately 0.54 MG per year. Producing a Class A effluent from the mechanical WWTF would allow the City to irrigate approximately 25 acres between the ballfields, parks, and proposed greenway at the Innovation Gateway. Another 33 acres of irrigable land is available at the golf course. However, irrigation practices in the John Day area only allow disposal via irrigation between April and October of each year. As seen in Chart 4-1 below, a large abundance of wastewater is left over in the winter months. This is another indication why it is important for the City to have another means of disposal in the winter months whether it is direct discharge to the John Day River or deep well injection.

CHART 4-1
WASTE WATER RESOURCE VERSUS DEMAND



Summary

The WWTF alternatives and effluent disposal/reuse options discussed in this chapter were presented to the City for discussion and selection. (Selected alternative TBD)