Level II Anti-Degradation Review Input
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Reverse Osmosis Culinary Water Treatment Plant Reject Water

Point Source Discharge to Twelve Mile Creek at Highway 137 Bridge in Mayfield, Utah

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Introduction

The Centerfield City culinary water system presently serves approximately 500 connections. An update to the culinary water master plan was completed for the City in 2003. The updated master plan showed that the City was in violation of the minimum source capacity and storage capacity requirements of the drinking water regulations. To meet requirements at the end of the 20 year planning period, the city would need to essentially double its source and storage capacity. Some needed distribution system upgrades were also identified in the master plan.

In addition to the other needs identified in the master plan, concerns were raised by the water operator that nitrate levels in the spring had been gradually trending upward during the past several years. The operator expressed a desire to find a source that could be blended with the spring to reduce the overall nitrates if necessary.

A well siting study, completed in October of 2002 while work was progressing on the master plan, identified three potential well sites that could produce significant volumes of culinary water. Site A, near the mouth of Hayes Canyon northwest of Centerfield, had the best potential for the highest production, but it would require 11 miles of new pipeline. Site B, located 7 miles east of Centerfield and northwest of Mayfield along Twelve Mile Creek offered the least expensive alternative because it could make use of the existing spring transmission pipeline. Site C, approximately 7 miles west of Centerfield in Lone Cedar Canyon was recommended as a secondary site, because the aquifer was very deep and the projected yield was not large enough. Culinary wells cannot be drilled near Centerfield due to source protection rules. In addition, the expected output is relatively low, and water quality in wells deeper than 165 feet is poor due to geologic formations.

After the well site near Mayfield was selected, but before the test well was drilled, the Town of Mayfield approached the City of Centerfield and asked if they could purchase water from the new well to blend with water from their park well. Nitrate levels in their park well exceeded the MCL allowed by the drinking water regulations. Centerfield agreed, but before drilling the test well, all private wells in the vicinity of the proposed well site were sampled, and all showed nitrate levels at or above the MCL.

It was suggested that livestock feed lots and septic tanks, upstream of the proposed Site B in Mayfield, might be the source of nitrate contamination in wells in Mayfield and near Site B. Since this seemed plausible, a test well was drilled approximately 1.2 miles north of 12 mile creek where the nitrate concentration should be lower. This well produced a significant amount of water, but the nitrate concentration was 13 ppm, which is nearly the same as Mayfield's park well.

A second test well was then drilled at the Hayes Canyon Site A. Water quality tests revealed the nitrate in concentration at this site was 16 ppm, and there was no easy explanation for why the nitrates were there. Due to the suspected depth and limited quantity of available water and the fact that it would be difficult to provide benefit to Mayfield with a well at this site, no test well was drilled at Site C.

The City of Centerfield is planning to construct a reverse osmosis culinary water treatment plant. The plant will be located approximately 80 feet east of Highway 137 and 5,300 feet north of the Highway 137 Twelve Mile Creek Bridge, which is located in Mayfield. A discharge location map is included at the end of this report as Exhibit A. Treated water from this plant will serve as a source of nitrate free water to be blended with other available sources resulting in reduced nitrate contamination levels (below the MCL) for drinking water. Mayfield is cooperating with this plan by making their park well available as a source of water to be blended with the spring, a proposed new well, and the treatment plant output. These sources will meet the source capacity requirements for both Centerfield and Mayfield through the planning period.

RO Treatment Plant Capacity & Operation

The reverse osmosis treatment plant will initially be equipped with two treatment "trains" rated at 150 gpm permeate output each. The raw water into each train would be 200 gpm and the wastewater produced from each train will be 50 gpm. One train would be in operation while the second is in standby. If necessary both trains can be operated at the same time. Two treatment trains with a permeate output of 300 gpm will meet system needs throughout the next 20 years of projected growth.

Once the demand is such that both trains must be operated on a regular basis, an additional train will be added to ensure that there is a standby available. The plant building will be designed for up to 3 treatment trains capable of treating a maximum of 600 gpm, based on the expected available aquifer capacity. With all three trains in operation the equivalent wastewater output could reach 150 gpm.

In the reverse osmosis process water is forced through a very fine membrane capable of removing dissolved solids including nitrates. The maximum expected recovery level of purified water will be approximately 75%. The remaining 25% is discharged as wastewater. At this recovery level, the concentration of impurities in the wastewater is approximately four times the concentration found in the raw water.

The TDS level in the spring is 724 ppm. The TDS level in the existing well in Mayfield park is 850 ppm. A new well that will be constructed at a later date and used as a future source is expected to have TDS levels in the same range. Therefore, to be conservative it is assumed that the TDS concentration in the raw spring and well water that will be treated will be 900 ppm. It is further assumed that the TDS levels in the wastewater will be as high as 3,600 ppm. If the efficiency of the actual plant is lower than expected the volume of wastewater may be slightly higher, but the contaminant concentrations would be proportionally lower. During the treatment process wastewater flows ranging from 50 gpm to 150 gpm will be produced by the treatment plant. The actual wastewater flow is dependant upon the volume of pure water needed for blending to maintain nitrate levels in the drinking water below 10 ppm.

The treatment plant will not operate continuously. It will be designed to cycle as needed. The Mayfield well and the proposed future well will be equipped with variable speed pumps. The

output of the wells will be controlled so that it can be blended with the Centerfield spring, while maintaining the nitrate concentration below the 10 ppm MCL. During higher demand periods when the levels in either community's storage tanks cannot be maintained by the output of the Centerfield spring blended with reduced output from the Mayfield well (to keep nitrates below the 10 ppm MCL) the treatment plant would be brought on line and the well output increased to meet the higher drinking water demand. Initially it is expected that the treatment plant will operate one train only for short periods of time each day during the hottest periods of the summer, and as needed for maintenance. As the population increases and drinking water demands increase the treatment plant online time and output will be increased as necessary.

Proposed Discharge to Twelve Mile Creek

It is proposed that the treatment plant wastewater be discharged to Twelve Mile Creek at the Highway 137 Bridge in Mayfield. This discharge requires a Level II anti-degradation review. The advantages of this option are itemized below.

1. This option will require 5,380 feet of 4 inch discharge piping from the treatment plant to the creek. Because the discharge piping can be installed at the same time and in the same trench as the water lines to and from Mayfield, the cost will be approximately half what it would cost to construct a new separate pipeline. It is estimated that the cost for this option will be approximately $32,000. This is the least cost option for discharge.

2. The maximum wastewater output from the reverse osmosis culinary water treatment plant at the expected worst case TDS of 3,600 ppm will be 150 gpm (0.33 cfs). The minimum expected stream flow is 1792 gpm (4 cfs), and the TDS level is 280 ppm. If the treatment plant wastewater at worst case maximum flow is discharged into the creek at the minimum flow rate, the TDS level in the stream will increase to 536 ppm. This is less than half of the 1,200 ppm limit in the water quality rules.

3. There are no diversions of the creek for agricultural or other purposes between the Highway 137 Bridge and the Highland Canal diversion structure, which is located approximately 1.5 miles downstream from the bridge. The entire flow from Twelve Mile Creek is diverted into the Highland Canal at that diversion except for a few weeks during the maximum spring runoff period.

   During the maximum spring run off, the creek flow rate can exceed the capacity of the Highland Canal. This over flow passes downstream to the San Pitch River channel to the Old Field Canal Diversion where as much of the remaining water as possible is diverted into the Old Field Canal. Any remaining spring runoff water follows the San Pitch River channel downstream to the Sevier River.

4. The DWR fisheries biologist provided the following regarding this part of Twelve-Mile Creek, which is over 4 miles below the Manti-Lasal National Forest boundary. "This part of Twelve Mile Creek is classified for fishery management purposes as a Class 4 stream. Class 4 streams are typically poor in quality, with limited sport fish value. However,

Class 4 streams may support native non-sport fish populations. In this part of the Twelve-Mile Creek, cutthroat trout numbers are probably negligible and mottled sculpin numbers are probably low. Fish spawning habitat and reproductive success are both low in this part of Twelve-Mile Creek, in part due to turbidity and fine sediments." The stream below the Highland Canal diversion is cut off from the San Pitch River, and is dry for most of the year. Therefore it does not support a warm water fishery.

Anti Degradation Review Alternatives

The *State of Utah Administrative Rules for Design Requirements for Wastewater Collection, Treatment, and Disposal Systems,* rule R317-2-3.4.2.b.11.c.2 requires that for proposed UPDES permitted discharges, the following list of alternatives should be considered, evaluated and implemented to the extent feasible:

(a) Innovative or Alternative Treatment Options

Beyond distillation, which is not feasible on a municipal scale, the only other option for removal of nitrates from culinary water is through ion exchange (IX). During the planning process this option was evaluated and dismissed. Although the initial capital cost of an IX system may be slightly lower than the RO system, the O&M cost was much higher. The higher O&M is due to several factors.

For satisfactory removal of the targeted nitrates, the IX system must treat 100% of the water rather than a small amount for blending. An IX plant cannot be periodically started and stopped once it goes on line. It must operate 24 hours per day from that point forward. This means that 100% of the water in the system must be pumped through the IX system with the treatment plant in operation 24 hours per day. In the case of the RO system, only a small portion of the water would be run through the treatment plant for relatively short periods when required.

There is no convenient sewer available to discharge the very concentrated brine waste from the IX system. Manufacturer's estimates of brine production vary between 1,700 and 6,800 gallons each day.

Brine disposal would be limited to trucking it to a suitable treatment plant and paying for treatment or pumping to a zero leakage evaporation pond. Trucking expense is prohibitive over the life of the plant.

To ensure that the pond could contain the "suggested but as yet unknown" brine output under less than ideal conditions with no seepage a preliminary design pond capacity should be assumed to be 6,800 gallons per day.

Evaporation in the area of the proposed treatment plant is approximately 40 inches per year and precipitation is approximately 13.6 inches per year. Using the data to calculate a zero seepage pond shows that a 4 acre pond should contain the daily brine

output. There is insufficient suitable property available nearby for an evaporation pond.

The nearest property suitable for an evaporation pond is located approximately 3 miles west of the proposed treatment plant, and that property is not for sale.. This discharge option would cost between $400,000 and $700,000. A tighter estimate is not possible due to the many unknowns that were left after the various IX manufacturers were consulted and the uncertainty of land cost.

For this project IX is not preferable. IX would be considered as an alternative to Reverse Osmosis only if a discharge permit cannot be issued for the Reverse Osmosis Process. There are no other feasible alternatives.

(b) More Effective Treatment Options or Higher Treatment Levels

This option is primarily related to treatment of wastewater. The RO process selected for this project is the highest treatment degree possible. The effluent will be used as culinary water. The wastewater is the same as the supply, but the impurities in the inlet water are concentrated in the bypass wastewater from the RO System.

(c) Connection to Other Wastewater Treatment Facilities

The nearest sewer treatment system is the Gunnison/Centerfield Lagoon treatment plant located approximately eight miles west of the treatment plant. It would require approximately 12 miles of pipe to access the facility. In addition calculations show that the system would need to be expanded by up to 55 acres to accommodate the maximum discharge from the treatment plant. The cost of the pipeline and the lagoon expansion would amount to several million dollars, making this option not feasible.

(d) Process Changes or Product or Raw Material Substitution

This plant is treating culinary grade water. The only other potentially feasible process available, as noted in (a) above, is IX. The product being produced is culinary water, and there is no product substitution available. The raw material is the water that is produced from the culinary wells and springs that will be connected to the treatment plant. The only substitution that could be made is to supply lower quality water to the inlet from a lake, river, creek or canal.

(e/f) Seasonal or Controlled Discharge Options to Minimize Discharging During Critical Water Quality Periods

By nature of the requirements for culinary water this step is already being followed. The worst case discharge scenario assumes that the maximum discharges occur during the winter when stream flows are lowest. Actually, the minimum use of the treatment plant will occur during the winter months, which means that discharges during that

period will be at their minimum. The major periods for discharge will be during the summer period when culinary water demand is highest and the creek flows are generally higher. This means that the effect of the discharge will be lower that the worst case effect used to determine the potential impact to the stream.

(g) Pollutant Trading

Pollutant trading assumes that a process modification or other means could be used to alter the wastewater makeup so that the pollutants will be more acceptable. No pollutant trading can be accomplished using this process.

(h) Water Conservation

The IX process would create lower volumes of wastewater, but the wastewater cannot be used. All of the wastewater produced by this process will be used for irrigation except that small amount that is lost to evaporation once the water is discharged to the creek and then to the irrigation canal system.

(i) Water Recycle and Reuse

All of the wastewater produced by this process will be used for irrigation except that small amount that is lost to evaporation once the water is discharged to the creek and then to the irrigation canal system.

(j) Alternative Discharge Locations or Alternative Receiving Waters

Discharge to the Highland Canal is a potential alternative to discharge to Twelve Mile Creek. However, following the shortest possible route, this alternative would require approximately 1.75 miles of new 4 inch discharge pipeline paralleling an existing culinary water pipeline. The cost of this option would be approximately $111,000 for the pipeline alone, which represents an increase to the cost for the discharge pipeline of over 300%. This estimated cost does not include cost of additional private property easements.

The maximum wastewater output from the reverse osmosis culinary water treatment plant at the expected worst case TDS of 3,600 ppm will be 150 gpm (0.33 cfs). The canal flow rate below the Twelve Mile Creek diversion structure is maintained at a minimum of 10 cfs. Therefore, the combined canal flow rate and treatment plant discharge would be 6 cfs, which means that the minimum canal flow rate at the point where the treatment plant would be blended would be 5.67 cfs. Assuming that the TDS in the canal is 806 ppm, the resulting TDS in the canal from the discharge point to the Twelve Mile Creek diversion would be 962 ppm. This is less than the 1,200 ppm limit in the water quality rules.

(k) Land Application

Due to the TDS Level in the wastewater discharge stream (3,600 ppm maximum, it cannot be successfully used for irrigation without blending to reduce the TDS. Blending will be accomplished by discharging to the creek.

(l) Total Containment

Another alternative to discharging into Twelve Mile Creek is discharging to a total containment lagoon system. This option was evaluated and dismissed due to the fact that there is no suitable property available near the treatment plant site.

Assuming a 150 gpm discharge flow rate for 12 hours per day, 40 inches per year for evaporation, 13.6 inches per year precipitation, and zero leakage the lagoon system would need to require a minimum of 55 acres of surface area. The cost of this option including the land acquisition, easements, pipeline and lagoons will exceed $1.5 million. Note: Zero leakage was selected to prevent the relatively high nitrate concentration of 40 to 60 ppm in the discharge water from contaminating shallow private wells in the area. This is likely because the lagoon seepage would enter the shallow ground water aquifer and nitrates move rapidly through ground water aquifers. If a seepage rate of 0.25" per day was allowed as is the case for sewer lagoons, the required pond area would be 12 acres.

Property near the site has high ground water, and some of it qualifies as wet meadow and wetlands. Except for steep slopes, the nearby property is farmed, or used as pasture for horses, cattle, or elk. A significant portion is suitable for development. It is unlikely that it could be obtained for a reasonable price, even through condemnation. The nearest suitable property is located approximately 3 miles west of the site and that property is not for sale.

(m) Improved Operation and Maintenance of Existing Treatment Systems

There are no existing treatment systems. This item is not applicable.

(n) Other Appropriate Alternatives

Because nitrates cannot be removed from drinking water by any other means than those discussed herein, there are no other alternatives available.

Project Scope and Funding

The treatment plant is included in the second phase of a two phase culinary water improvement project. The first phase will include all improvements required to bring the Centerfield culinary water system into compliance with the drinking water regulations. Phase 1 improvements include distribution system improvements, a new storage tank, and a booster/blending station.

The booster/blending station will allow blending of the Mayfield park well water with the Centerfield spring, increasing source capacity for both communities. It is expected that up to 200 gpm of well water can be satisfactorily blended with the spring water while maintaining nitrate levels in the output below the 10 ppm MCL. The booster/blending station will also include all required future connections for the treatment plant. The second phase of the project will also include an additional well located near the treatment plant.

Initial project estimates, which are now over 3 years old, put the total cost of the project at about $5.7 million. Funding for the project is shown in the table below. The funding was obtained based on the State required minimum water bill of 1.75% of median adjusted gross income for culinary water.

Centerfield City (Committed and Spent)	$ 191,000
Board of Water Resources Loan (Committed)	$ 255,000
USDA-Rural Development Grant (Committed)	$ 950,000
USDA-Rural Development Loan (Committed)	$ 400,000
CIB Grant (Committed)	$ 550,000
CIB Loan (Committed)	$ 302,000
Division of Drinking Water (Committed)	$ 104,000
STAG [State and Tribal Assistance Grant (Approved)]	$ 1,434,000
STAG [State and Tribal Assistance Grant (Pending*)]	$ 1,434,000
Total Funding	$ 5,620,000

* The second STAG installment has been applied for, approved and is earmarked in the 2007 Federal budget but is currently on hold. A reapplication has been made for the next years fiscal budget in the event that the earmark is not released this year.

Summary

The proposed reverse osmosis treatment option is the best alternative for intermittent nitrate removal needed in this application. The plant will treat spring water and well water for the culinary water system. This project is the first step at regionalization between the communities of Centerfield and Mayfield and represents a major benefit to both.

The least cost point of discharge from the reverse osmosis treatment plant is into Twelve Mile Creek at the Highway 137 Bridge. There are no diversions between the requested point of discharge and the Highland Canal diversion structure. The stream is not managed as a fishery below the requested discharge point.

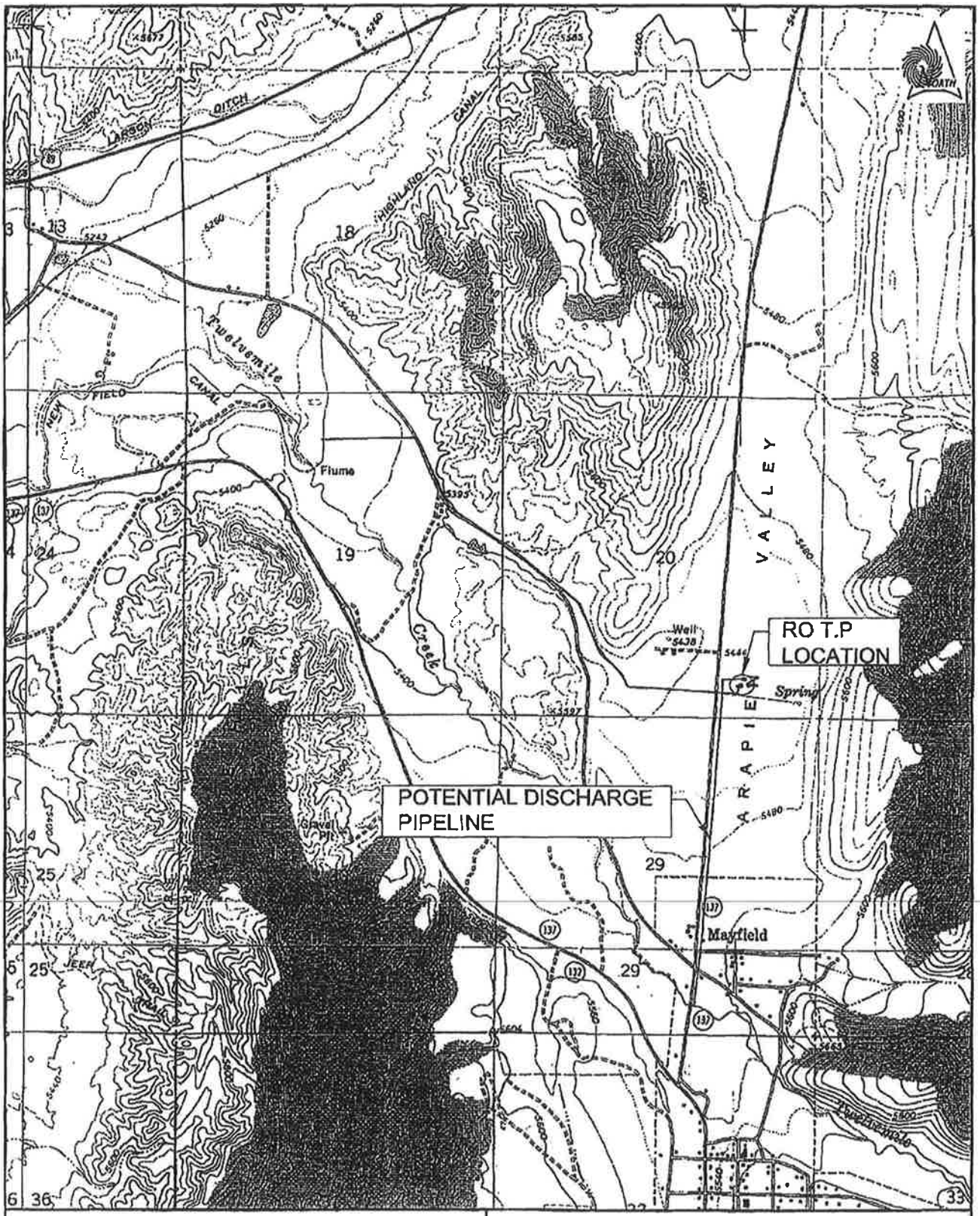
The treatment plant will operate intermittently. The initial discharge rates will be approximately 50 gpm at a maximum TDS concentration of 3,600 ppm for short periods each day, primarily during the summer. The maximum potential discharge will be 150 gpm at a maximum TDS concentration of 3,600 ppm, which would increase the TDS concentration in Twelve Mile Creek from 280 ppm to 536 ppm at the minimum expected stream flow rate. This increased level is

well below the maximum in stream TDS limit of 1,200 ppm. This maximum discharge is not expected to occur except during plant testing within the next 20 years.

The proposed discharge is the least cost alternative available to Centerfield. The monthly rate structure in place has the City at or above the 1.75% median adjusted gross income suggested for culinary water funding. At about 500 connections, the Centerfield system is very small to undertake such a major project. Small systems are incapable of generating large amounts of revenue over short periods of time without major financial hardship. It will be difficult for the community to pay for more costly options. Centerfield has already committed and expended the money that they had set aside for a new water project, and State funding sources are already deeply committed.

Exhibit A

Discharge Location Map



OPTIONFOR RO DISCHARGE TO TWEVLE MILE CREEK

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