City of Hays
Office of the City Manager

Memo

To: City Commission

From: Toby Dougherty, City Manager

Date: 2-1-16

Re: February 4, 2016 Work Session

Please find the attached agenda and supporting documentation for the February 4, 2016 Work Session. The only item on the agenda this week is the Wastewater Treatment Process Design Selection. As indicated throughout the design-build process, the City Commission will be given the opportunity to determine which process is selected. City staff and CDM Smith evaluated three options. The first two options were more of a traditional biological process, and the third option is a Membrane Bioreactor Process. All three processes would serve us very well and were evaluated simply on cost. After significant evaluation, the 5-Stage Oxidation Ditch with Final Clarifiers and Denitrification Filters is the process we are recommending that the Governing Body approve. This process costs a little more on the capital side but has much lower operating costs, and is a much simpler unit to operate. Therefore, the net present value is lower than the other two options. City staff is very happy with the recommendation. Stan Christopher of HDR and Kevin Rood of CDM Smith will be at the work session to explain the recommendation in more detail.

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CITY OF HAYS
CITY COMMISSION WORK SESSION
THURSDAY, FEBRUARY 4, 2016 – 6:30 P.M.
AGENDA

1. **ITEM FOR REVIEW: January 7, 2016 Work Session Notes** (PAGE 1)
   DEPARTMENT HEAD RESPONSIBLE: Kim Rupp, Director of Finance

2. **ITEM FOR REVIEW: Wastewater Treatment Process Design Selection** (PAGE 7)
   PERSONS RESPONSIBLE: Stan Christopher, HDR Engineering, Inc.
   Johnny O'Connor, Director of Utilities

3. **OTHER ITEMS FOR DISCUSSION**

4. **EXECUTIVE SESSION (IF REQUIRED)**

5. **ADJOURNMENT**

ANY PERSON WITH A DISABILITY NEEDING SPECIAL ACCOMMODATIONS TO ATTEND THIS MEETING SHOULD CONTACT THE CITY MANAGER'S OFFICE 48 HOURS PRIOR TO THE SCHEDULED MEETING TIME. EVERY ATTEMPT WILL BE MADE TO ACCOMMODATE ANY REQUESTS FOR ASSISTANCE.

City of Hays
City Commission
Work Session Notes
Thursday, January 7, 2016 – 6:30 p.m.

Present: Eber Phelps, Shaun Musil, James Meier, Henry Schwaller IV, Lance Jones, John Bird, Toby Dougherty and Kim Rupp

December 17, 2015 Work Session Notes

There were no corrections or additions to the minutes of the work session held on December 17, 2015; the minutes stand approved as presented.

Request by USD 489 for Sales Tax Issues

USD 489 is planning a Capital Improvement Program that could cost up to $94 million. The USD 489 School Board and staff are in the process of determining how to fund these improvements. School districts, by State law, have the ability to place questions on the ballot regarding property tax levies to fund capital improvements. By State law, school districts do not have the ability to place questions on the ballot regarding sales tax increases to fund the same type of improvements. Only cities and counties have the ability to do this.

A sales tax question may be taken to the voters of Hays in two different ways. First, the City Commission can authorize, by ordinance, that a sales tax question be placed on a ballot to be voted on by the residents of Hays. The second, a petition signed by at least 10% of the registered voters in the City of Hays, can be presented to the Ellis County Clerk. If the petition is deemed valid, the question will then be placed on a ballot at the next available election. An example of the latter is the sales tax that funded the creation of the Bickle-Schmidt Sports Complex. An example of the former is the sales tax question that funded the building of the Hays Aquatic Park.

Dean Katt, USD 489 Superintendent, presented information to the Commission regarding proposed improvements and the possible use of sales taxes to supplement bond payments for the planned facility improvements.

Commissioner Schwaller asked if maintenance is paid for through this bond issue how will that affect maintenance costs going forward and also asked if teacher's salaries could be included.

Dean Katt replied that maintenance has been delayed due to lack of funding. Under state statute, bond issues are levied for facility improvements only so it could not be used for teacher's salaries, but it would free up other funds.

Dustin Avey, Managing Director for Piper Jaffray, the Financial Advisor for USD 489, presented four funding scenarios using a combination of city sales tax and property taxes.

Dustin Avey indicated that an increase in property tax only would have a great impact on the mill levy. If financed over 20 years could result in an increase of 21 mills and 25 year financing could result in an 18.75 mill increase. Several scenarios with varying sales tax were reviewed.

Commissioner Meier asked which scenario the Board of Education (BOE) was endorsing. He stated this is their idea and it is not the City Commission's responsibility to choose which option is best.

Lance Bickle, Board of Education President, stated they like the option that would wait to increase the city tax until the county sales tax to pay for its improvements fell off, so people would continue paying the same sales tax amount.

Commissioner Musil stated this is going to be a tough sell to the community and people don't want a sales tax, but he sees the need for the improvements at the schools. He is also concerned that the State may vote to raise sales taxes.

Sarah Rankin, School Board Member, responded that the BOE doesn't know about the tax implications, so they brought options to the Commissioners to determine the best way to get this across to the voters.

Commissioner Schwaller stated in 1999 the City of Hays had similar financial problems and through the hiring of a new City Manager were able to trim over a million dollars per year off of spending and new efficiencies were found. Because of that, went to the voters and eliminated the funding mechanism of property tax that was used to fund the general operations of the city and transfer that to a sales tax and would hold property tax to 25 mills. He stated this is probably the worst time in our history, other than the 1930's and 1980's to do this so he will not support this.

Commissioner Jones stated that when someone comes from out of town to shop in Hays, the sales tax goes toward streets and public safety such as police and fire protection, they shouldn't be paying for our kids to go to school here, he feels that is our responsibility, not someone that is shopping here.

Chairperson Phelps stated as a representative of the City we are relying on sales tax and we must provide a safe community.

It was the consensus of the Commission that this agenda item not be moved on.

Update on Activities of the Ellis County Coalition for Economic Development

Aaron White, Ellis County Coalition for Economic Development Executive Director, updated the Commissioners on various activities of the Ellis County Coalition for Economic Development. He discussed succession planning to assist in connecting business owners that plan to retire or close their business with someone who may be interested in stepping into an existing business operation. He also reviewed new training initiatives they are launching under the employment training program.

The 2016 Budget for the City of Hays does not contain a direct allocation for the Ellis County Coalition for Economic Development. The allocation is for "Economic Development". Therefore, City staff will not release any 2016 funds to the Coalition until directed by the City Commission.

Commissioner Jones stated many of the questions and concerns he had have been addressed in a recent meeting and the update given at this meeting. He hopes regular meetings and updates to the Commission continue.

It was the consensus of the Commission to discuss releasing the 2016 funds to the Ellis County Coalition for Economic Development, at the January 14, 2016 Commission meeting.

Discussion on Modifications to the Economic Development Policy

During consideration of a development proposal, and subsequent economic development request by NWK Investments, the City Commission suggested that the Economic Development Policy be revised to more clearly define the role of the Ellis County Coalition for Economic Development. City staff met with Aaron White, Director of the Ellis County Coalition for Economic Development, as well as the City's Bond Counsel to develop the suggested revisions to the Economic Development Policy.

City Manager, Toby Dougherty, presented the proposed modifications to the Commissioners for their consideration. A preamble was added with the exception of job-bounty applications and applications involving non-mixed type housing developments. It states that the coalition is expected to take a role in vetting applications before they are brought before the commission. The applicant will be required to have a detailed plan of what they want to ask the commission for and what the proposal is. Anyone that is interested in utilizing a TIF, a Tax Development District, Community Improvement District, IRB or STAR bonds, must work with the Ellis County Coalition for Economic Development prior to coming before the commission. The applicant would then be required to make a non-refundable deposit to buy access to the City's bond counsel. They would meet with the City's bond counsel and get on paper what they are applying for.

This policy should provide clear direction of the requirements that must be met prior to presenting a proposal to the governing body.

Chairperson Phelps stated this policy will set parameters and will give better direction to the Coalition.

The policy will be brought back to the commission at a later date.

City Commission Reorganization/Rules of Procedure

Due to changes enacted by the Kansas State Legislature, the City Commission recently adopted an ordinance changing the date of Commission reorganization to the second regular meeting in January of each year. The current Rules of Procedure state that the Commission will reorganize in April after the Ellis County Commission has certified the election results. City Staff suggests the Commission modify the Rules of Procedure to reflect the January reorganization. Also, moving the reorganization to January is going to create a situation where a Commissioner will serve a long or short term as mayor. The current Mayor was elected in April of 2015. Reorganization at the January 28th regular meeting would result in a nine month term.

Commissioner Schwaller stated he feels the reorganization should be held on schedule and the term could be split this first year.

City Manager, Toby Dougherty, stated a motion can be made to split the terms of Mayor with the dates of each term identified in the motion.

At the January 14, 2016 Commission meeting, Commissioners will be asked to approve a resolution revising the City Commission Rules of Procedure and to determine the term lengths for the Mayor and Vice Mayor.

Other Items for Discussion

City Manager, Toby Dougherty, announced that the R-9 Ranch transfer application was filed with the State of Kansas. The regulatory process began 23 months ago and now it is up to the State of Kansas to set the hearings and go forward from here.

Commissioner Meier thanked the Hays Police Department and area law enforcement for the job they did on the recent man hunt following the robbery in Ellis.

Commissioner Musil thanked City Manager Toby Dougherty for all the work he has done on the R-9 Ranch project.

The work session was adjourned at 8:46 p.m.

Submitted by: _____

Brenda Kitchen – City Clerk

Commission Work Session Agenda Memo

From: Stan Christopher, Project Manager HDR
Johnny O'Connor, Director of Utilities

Work Session: February 4, 2016

Subject: Wastewater Treatment Process Design Selection

Person(s) Responsible: Stan Christopher, Project Manager HDR
Kevin Rood, CDM Smith
Johnny O'Connor, Director of Utilities

Summary

On December 10, 2015, the Commission authorized the City Manager to enter into a contract with CDM Smith (CDM Constructors, Inc.) for Phase 1, 90% Design and GMP Development, for the rebuilding of the wastewater treatment facility. The first step in the process is to determine which treatment process to move forward with. Three processes were considered: 1) 5-Stage Oxidation Ditch with Final Clarifiers and Traditional Tertiary Filters; 2) 5-Stage Oxidation Ditch with Final Clarifiers and Denitrification Filters; and, 3) Membrane Bioreactor Process (MBR). All three processes include biological nutrient removal to meet treatment requirements. The 5-Stage Oxidation Ditch with Final Clarifiers and Denitrication Filters (Option 2) process is being recommended based on several factors such as ease of operation, lowest present value, and its ability to meet current and anticipated future effluent limits. This option will also improve effluent quality for continued irrigation and indirect recharge reuse. Staff and HDR are recommending the Commission authorize CDM Constructors, Inc. to continue the 90% design and GMP development of the 5-Stage Oxidation Ditch Final Clarifiers and Denitrification Filters process.

Background

In late 2014, the City made a decision to proceed with the upgrade of its wastewater treatment facility using a progressive design-build procurement method. HDR was selected as the Owner's representative. During the initial evaluation phase, several treatment options were considered with two, the 5-Stage Oxidation Ditch and the Membrane Bioreactor, being included in the Facilities Plan for further consideration. On December 10, 2015, the Commission chose CDM Constructors, Inc. as the design-build team. One of the first tasks CDM Constructors, Inc. is tasked with is to develop costs for the alternate processes in order to recommend a process to the Commission. City staff, HDR, and CDM Constructors, Inc. have been working diligently to determine the process to recommend for consideration.

Discussion

A kick off meeting was held January 7 and 8, 2016, in which CDM Constructors, Inc. was given the notice to proceed with the Phase 1 Contract. The first deliverable is the Basis of Design Report. The CDM Constructors, Inc. report includes the two process options evaluated in the Facility Plan plus a third option, 5-Stage Oxidation Ditch with Final Clarifiers and Denitrification Filters. The report evaluates the technical and economical elements of the three different treatment design concepts for the City's wastewater treatment plant. All three alternatives utilize biological nutrient removal to meet treatment requirements. The first treatment alternative is the 5-Stage Oxidation Ditch with Final Clarifiers and Traditional Tertiary Filters. The second is a 5-Stage Oxidation Ditch with Final Clarifiers and Denitrification Filters. The third treatment alternative is the Membrane Bioreactor Process (MBR). The following criterion was evaluated for each process:

- Capital Cost
- Operation & Maintenance Cost
- Compliance
- Sustainability
- Reuse
- Future effluent and reuse regulations

The operation of the 5-Stage Oxidation Ditch with Final Clarifiers and Traditional Tertiary Filters and the 5-Stage Oxidation Ditch with Final Clarifiers and Denitrification Filters will be very similar to the process that the City currently operates. Both options are forgiving processes and will handle fluctuations in flow and loading. The filters following the clarifiers provide a "belt and suspenders" operation, allowing a problem with one of these processes without sacrificing the effluent quality significantly.

The operation of a Membrane Bioreactor Process will involve less treatment processes but will involve a higher level of operator attention associated with more equipment to make sure the desired results are achieved. The membranes are the only method of solids separation and must be working effectively to meet your permit conditions. Overloading the membranes, blinding the membranes, and tearing a membrane can cause the effluent limits to be exceeded. The MBR process is less capable of handling high peak flows. Fortunately, the City has not experienced high wet weather flows based on flow data and operation experience.

The performance of all three processes is excellent for reuse of effluent for irrigation and even groundwater recharge. The MBR option offers the benefit of a higher effluent quality which reduces the required UV disinfection dose. In the future if direct potable reuse becomes a reasonable option for the City, the MBR offers the advantage of providing the lower effluent turbidity. The MBR effluent would be more suitable as feed water to a reverse osmosis water treatment plant if direct potable reuse was ever adopted by the City. Current plans by the City and discussions with KDHE have not included direct potable reuse as a viable water supply option.

CDM Constructors, Inc. completed net present value comparisons of the three treatment process options. The results are as follows:

Capital Cost – 2016 $

	5- Stage Oxidation Ditch	5- Stage Oxidation Ditch with Denitrification Filters	MBR
Headworks	$150,000	$150,000	$360,000
Biological Process	4,100,000	4,100,000	6,480,000
Clarifiers	1,690,000	1,690,000	—
Filtration Rehab	1,100,000	—	—
Filtration New	—	1,650,000	—
Disinfection	—	—	—
Solids Handling	—	—	—
Total Capital Cost	$7,040,000	$7,590,000	$6,840,000

Annual Operations and Maintenance Costs – 2016 $

	5- Stage Oxidation Ditch	5- Stage Oxidation Ditch with Denitrification Filters	MBR
Power	$177,400	$ 118,000	$120,400
Staff	7,500	7,500	$ 10,000
Chemical	—	—	$ 10,000
Equipment Replacement	25,000	25,000	$ 10,000
Membrane Replacement	—	—	$ 76,400
Misc. Maintenance	5,000	$ 5,000	$ 10,000
Opinion of Annual Cost	$214,900	$155,500	$ 234,800

20 Year Net Present Cost - $

	5- Stage Oxidation Ditch	5- Stage Oxidation Ditch with Denitrification Filters	MBR
Present Worth of Future Worth O&M	$3,854,000	$2,789,000	$4,211,000
Opinion of Capital Cost	7,040,000	7,590,000	6,840,000
Opinion of Present Worth	$10,894,000	$10,379,000	$11,051,000

The MBR option represents the lowest capital cost option; however, the 5-Stage Oxidation Ditch with Final Clarifiers and Denitrification Filters represents the lowest net present value. During 30% design a 3-Stage Oxidation Ditch with Final Clarifiers and Denitrification Filters will be considered, with the potential to reduce capital costs of Option 2 by approximately $500,000. Staff is recommending the Commission authorize CDM Constructors, Inc. to continue the 90% design and GMP development of the 5-Stage Oxidation Ditch with Final Clarifiers and Denitrification Filters process. This alternative represents the lowest net present cost to the City.

CDM Constructors, Inc. will be present at the Work Session on February 4th and the regular meeting on the 11th to answer questions related to this project.

Legal Consideration

There are no known legal obstacles to proceeding with the selection of the Wastewater Treatment Process Design Selection.

Financial Consideration

The Contract Price for Phase 1, 90% Design and GMP Development is $1,811,611.00. This cost will be reimbursed to the City from the SRF loan from Kanas Department of Health & Environment. This decision does not impact the Contract Price for Phase 1.

Options

The City is required to complete improvements to its wastewater treatment plant and meet new permit limits by July 2018. The City Commission has the following options:

1. Approve the recommended treatment process as written.
2. Reject the recommended treatment process and give the City Staff and HDR instructions on how to proceed.
3. Do nothing.

Recommendation

City Staff and HDR recommend that the City Commission authorize CDM Constructors, Inc. to continue the 90% design and GMP development of the 5-Stage Oxidation Ditch with Final Clarifiers and Denitrifying Filters process. Once 90% design and the GMP have been developed, the City Commission will be asked to accept the GMP and enter into Phase II contracts for construction.

Action Requested

For Commission to authorize CDM Constructors, Inc. to continue the 90% design and GMP development of the 5-Stage Oxidation Ditch with Final Clarifiers and Denitrification Filters process.

Supporting Documentation

Process Selection Memorandum from CDM Smith

CDM Smith

Memorandum

To: *Stan Christopher, HDR*

From: *Kevin Rood, CDM Smith*

Date: *January 29, 2016*

Subject: *Hays Kansas WWTP Design Build, Phase 1 – Biological Process Evaluation Summary*

The purpose of this memorandum is to summarize the evaluation and make a recommendation for the biological process to be used for the Hays WWTP Upgrade and Expansion project. The evaluation is a comparison of capital and lifecycle costs based on budgetary pricing of equipment and preliminary material take-offs of all treatment and support facilities planned for the project to meet the current permit and Tier 1 Nutrient requirements. A secondary requirement was to meet the Tier 2 Nutrient requirements without additional basins though additional chemical feed may be needed. The process evaluation includes refinement of the process design for the following options:

- Option 1: Traditional Biological Nutrient Removal System (BNR) 5 Stage Ditch
- Option 1A: Traditional Biological Nutrient Removal System (BNR) 5 Stage Ditch with Denitrification Filters
- Option 2: Biological Nutrient Removal System using MBR Technology (MBR)

This refinement provides the information necessary to determine preliminary basin volumes and process equipment sizing needed to solicit budgetary pricing for the evaluation of capital and operations and maintenance (O&M) cost differences between options. Only costs directly associated with the process have been included; costs that are common to the options have been excluded from this evaluation and will be presented in the Basis of Design Report.

Cost differences between the options' preliminary treatment, sludge handling, tertiary treatment, equipment replacement, and chemical and power usage were identified and have been included in this evaluation.

Biological Treatment Options

Traditional Biological Nutrient Removal System (BNR) - Five Stage Oxidation Ditch

The Five Stage Oxidation Ditch process would consist of an anaerobic mixed zone, an anoxic mixed zone, an aerated mixed and oxygenated zone, an anoxic mixed zone and a final aerobic zone. The overall ditch process would be contained in two parallel basins. Mixing and oxygenation would be provided by surface aerators and submersible mixers. These basins would be followed by two final

clarifiers with associated sludge return and wasting pumps. The final clarifiers would be followed by a rehabilitated traveling bridge filter equipped with four rehabilitated transfer pumps. The primary features of this option are summarized below.

Option 1: BNR Five Stage Oxidation Ditch Features

Item No.	Description	Units
1.	Five Step Oxidation Ditch	2
2.	Final Clarifiers	2
3.	Rehab of Existing Filter	2 Trains
4.	Transfer Pumps	4
5.	Sludge return and waste pumps	Yes
6.	Tier 2 Future Chemical Feed	Possible
7.	Reuse Transfer pump	2

Traditional Biological Nutrient Removal System (BNR) - Five Stage Oxidation Ditch with Denitrification Filter

The Five Stage Oxidation Ditch would use the same equipment identified in the Five Stage option's anaerobic mixed zone, anoxic mixed zone, aerated mixed and oxygenated zone, the post anoxic and aerated zones. There would be two final clarifiers with the associated sludge return and wasting pumps. The major difference from Option 1 is that the filters would be upflow denitrification sand filters in lieu of the rehabilitated traveling bridge filters. Denitrification filters have more media depth than particulate filters and would act as a bioreactor in addition to particulate filtration. This bioreactor or denitrification filter would remove total nitrogen more effectively than a particulate filter. Total phosphorus would also be removed jointly with particulate removal. Low doses of carbon chemical feed would be required in this process. One of the benefits of this option is that the hydraulic grade line through the filters could be raised and the process could flow by gravity from the head of the plant to the outfall without intermediate pumping. The primary features of this option are summarized below.

Option 1A: BNR Five Stage Oxidation Ditch with Denitrification Filter Features

Item No.	Description	Units
1.	Three Step Oxidation Ditch	2
2.	Final Clarifiers	2
3.	Sludge return and waste pumps	Yes
4.	Rehab of Existing Filter	No
5.	Transfer Pumps	No
6.	New Denitrification Filters	2 trains
7.	Tier 2 Future Chemical Feed	Yes
8.	Reuse Transfer Pumps	2

Biological Nutrient Removal System Using MBR Technology (MBR)

The MBR option would utilize blowers with fine bubble diffused aeration equipment and submersible mixers to create an anaerobic zone, an anoxic zone, an aeration zone with a final anoxic zone in the bioreactor. The contents of the bioreactor would then be pumped to the membrane basins, allowing gravity flow of the membrane return to the bioreactor basins. This configuration facilitates using the bioreactor basin volume to equalize peak flows to the membranes thus reducing peak hourly flows and the amount of membrane equipment required. The membrane basins would serve the same function as the last aerated volume, the final clarifiers, the filters and filter return pumps in the Traditional BNR processes. The permeate pumps on the discharge side of the membrane filters would be sized to pump through the disinfection process and directly to reuse thereby eliminating the second stage reuse pumps. The primary features of this option are summarized below.

Option 2: Biological Nutrient Removal System Features

Item No.	Description	Units
1.	Four Step Biological Process	2
2.	Final Clarifiers	0
3.	Rehab of Existing Filter	No
4.	Transfer Pumps	0
5.	New Membrane Reactors	2 trains
6.	Tier 2 Future Chemical Feed	Yes
7.	Reuse Transfer Pumps	0

Additional Plant Unit Processes

Following is a brief description of the remaining plant processes and the differences evaluated in these facilities based on the requirements of the biological options.

Influent Pump Station and Coarse Screening

The influent pump station is planned to be a four submersible pump lift station installed in a divided wet well. Influent into the wet well would pass through a ¾-inch coarse screen prior to being pumped to the headworks for further processing. This pump station is common to all options.

Headworks – Grit and Fine Screening

The headworks is to be constructed as a two level structure with the fine screenings and grit removal systems elevated to allow the flows to pass through the facility to the outfall by gravity. The basic structure is the same for all the options. Also, the receiving well and grit unit are the same for all options. The fine screens change from ¼-inch openings to 2-mm openings for the membranes, which would impact the cost of the screens by a small margin.

Disinfection

Disinfection for the Traditional BNR processes would be the same. Disinfection for the MBR process would potentially reduce the capital equipment cost due to the increased performance of

membranes in removing total suspended solids (TSS), coliforms, and other particulates that would impact the performance of the UV Disinfection Equipment. The disinfection will have a greater impact on the operation and maintenance costs.

Sludge Handling

There are three basic options for sludge thickening and two options for dewatering. The thickening options are:

- Rotary drum thickener
- Decanter
- Membranes

A rotary drum thickener would be placed upstream of digestion and include polymer equipment, and additional tanks and pumps. The sludge produced by the thickener would have a solids concentration of about four percent. The decanter would be placed within the aerobic digester and would produce a sludge of roughly two percent solids. The membranes, like the decanter, would thicken sludge within the digester and produce a sludge of about four percent solids. The capital cost of the solids treatment and handling system are similar for these three options. The operations and maintenance costs vary somewhat due to the concentration of the solids, however the total pounds of solids would be similar for all three processes.

Economic Evaluation

The following tables provide a comparison of the three process options' estimated capital costs and O&M costs. These comparisons provide the differences in costs under the various categories.

Capital Cost Comparison or Difference

	Option 1 – 5 Stage BNR	Option 1A – 5 Stage BNR with Denitrification Filters	Option 2 – MBR
Headworks	$150,000	$150,000	$360,000
Biological Process	$ 4,100,000	$4,100,000	$6,480,000
Clarifiers	$1,690,000	$1,690,000	--
Filtration Rehab	$1,100,000	--	--
Filtration New	--	$1,650,000	--
Disinfection	Minor O&M Only	Minor O&M Only	Minor O&M Only
Solids Handling	Minor O&M Only	Minor O&M Only	Minor O&M Only
Capital Cost Comparison	$7,040,000	$7,590,000	$ 6,840,000

Operations and Maintenance Estimate – Yearly Average

	Option 1 – 5 Stage BNR	Option 1A – 5 Stage BNR with Denitrification Filters	Option 2 - MBR
Power	$ 177,400	$ 118,000	$120,400
Staff	$ 7,500	$ 7,500	$ 10,000
Chemical	--	--	$ 10,000
Equipment Replacement	$ 25,000	$ 25,000	$ 10,000
Membrane Replacement	--	--	$ 76,400
Misc. Maintenance	$ 5,000	$ 5,000	$ 10,000
Opinion of Annual Cost	$ 214,900	$155,500	$ 234,800

Power costs were estimated based upon the varying number of equipment being operated at average conditions and $0.09 /KWH. Chemical usage was developed from manufacturer information. Membrane replacement was provided by the manufacturer as follows:

- Total Membrane Replacement Cost of $913,900 based upon the cost of $34/sq. ft. of Membrane based upon OVIVO
- No Replacement during the first Ten Years
- 20% of Membranes in Year 11 (2028)
- 20% of Membranes in Year 12 (2029)
- 20% of Membranes in Year 13 (2030)
- 20% of Membranes in Year 14 (2031)
- 20% of Membranes in Year 15 (2032)

20-Year Present Worth Evaluation

	Option 1 – 5 Stage BNR	Option 1A – 5 Stage BNR with Denitrification Filters	Option 2 - MBR
Present Worth of Future Worth O&M	~~$3,8754,000~~ 3,854,000	$2,789,000	$4,211,000
Opinion of Capital Cost	$7,040,000	$7,590,000	$6,840,000
Opinion of Present Worth (20 Years)	$10,894,000	$10,379,000	$11,051,000

The present worth evaluation was performed based on:

- Inflation 1.9%
- Discount Rate 3.1%
- Period 20 years

Summary and Recommendation

The evaluation of the biological process was completed at maximum flow design conditions. Though the process options have not been optimized through extended simulation modeling, the costs and information are relative and are adequate for process comparison and selection. Capital cost estimates favor the MBR process by approximately 2.8 percent though the annual O&M cost is higher than other options by about 9.3 percent. Option 1A, Five Stage BNR with Denitrification Filters provides the lowest present worth cost by about 4.7 percent. Given the preliminary nature of the project at this time, cost estimates have been developed with an accuracy of +/- 15 percent.