Notice
City Commission Study Session

7:00 PM
Monday, January 12, 2015
Governmental Center, Commission Chambers, 400 Boardman Avenue
Traverse City, MI 49684
Posted and Published: 01-09-2015

The meeting informational packet is available for public inspection at the Traverse Area District Library, Law Enforcement Center, City Manager's Office, and City Clerk's Office.

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At the request of City Manager Jered Ottenwess, City Clerk Benjamin Marentette has called this Study Session.

City Commission:
c/o Benjamin C. Marentette, CMC, City Clerk
(231) 922-4480
Email: tcclerk@traversecitymi.gov
Web: www.traversecitymi.gov
400 Boardman Avenue
Traverse City, MI 49684

The mission of the Traverse City City Commission is to guide the preservation and development of the City's infrastructure, services, and planning based on extensive participation by its citizens coupled with the expertise of the city's staff. The Commission will both lead and serve Traverse City in developing a vision for sustainability and the future that is rooted in the hopes and input of its citizens and organizations, as well as cooperation from surrounding units of government.

Welcome to the Traverse City Study Session!

Any interested person or group may address the City Commission on any agenda item when recognized by the presiding officer or upon request of any commissioner. Also, any interested person or group may address the City Commission on any matter of City concern not on the Agenda during the agenda item designated Public comment. The comment of any member of the public or any special interest group may be limited in time. Such limitation shall not be less than five minutes unless otherwise explained by the presiding officer, subject to appeal by the Commission.

Agenda

Pledge of Allegiance

Roll Call

1. Presentation of the Fiscal Year 2013/2014 Audit. (Jered Ottenwess, William Twietmeyer)

2. Discussion regarding Wastewater Treatment Plant membrane replacement. (Jered Ottenwess)

3. Presentation and discussion regarding the Water System Reliability Study. (Jered Ottenwess, Dave Green)

4. Announcements from the Deputy City Clerk. (Katie Stroven)

5. Public comment.

6. Adjournment.

The City of Traverse City

Communication to the City Commission

FOR THE CITY COMMISSION STUDY SESSION OF JANUARY 12, 2015

DATE: JANUARY 9, 2015

FROM: JO JERED OTTENWESS, CITY MANAGER

SUBJECT: JANUARY 12 STUDY SESSION

1. ***Presentation of the Fiscal Year 2013/2014 Audit***
   Packet: no items; audit report provided to City Commission at January 5th regular meeting (available on City website at http://www.traversecitymi.gov/budget.asp)

Representatives from Abraham and Gaffney, the professional audit firm that performed the annual audit for Fiscal Year 2013/2014 will be in attendance Monday evening to present the audit and answer any questions. Formal acceptance of the audit by the City Commission is scheduled for the January 20th Regular Meeting.

2. ***Discussion regarding Waste Water Treatment Plant membrane replacement***
   Packet: City Manager Memorandum dated 12-31-14 with attachments

I provided a follow-up memo on December 31, 2014 to prepare for and facilitate discussion at the January 12th study session, which is attached. CH2MHILL representatives will be in attendance Monday evening and available for questions and discussion. No presentation is planned.

In order to prepare for action in the near future, I ask that the City Commission vet any questions or concerns that you may still have. Recall that the lead time between approval and installation of membranes in 2014 was approximately eight months.

3. ***Presentation and discussion regarding the Water System Reliability Study***
   Packet: DPS Memorandum dated 1-7-14

The Water System Reliability Study (192-page document) is available on the City's website at: http://www.traversecitymi.gov/downloads/rep_20140404_wsrsfinal.pdf

The Water System Reliability Study is intended to evaluate and determine the reliability of the City's potable water system; the ability of the system to treat and distribute a sufficient quantity of quality water to meet the residential, commercial, and fire protection demands of all customers. The Michigan Department of Environmental Quality requires that the study is updated every five years. The DEQ approved the City's most recent update in April 2014. The general purpose of the discussion planned for the study session is to review the capital projects identified in the study, relate those to the City's Six-Year Capital Improvement Plan, and solicit feedback from the City Commission so you are familiar with the projects and identify any specific issues or concerns you may have.

Overall, the City's system is deemed reliable and sufficient to meet current demands. Planned projects for the period 2014-2021 include Water Treatment Plant, transmission and distribution, and storage upgrades. The City must continue to work closely with township customers (Elmwood and Garfield) on future needs including a secondary raw water source. However, at this time, major capital investments (totaling $8 million) that include low service pump and high service pump upgrades at the WTP and construction of a second raw water intake are planned for the 2029-2034 timeframe and are not identified as near-term improvements

Projects included in the Six-Year CIP total $6.85 million. Spread over that timeframe the City's current rate structure and budget are expected to accommodate their cost. In other words, these projects should not have a significant impact on rates.

E-copy: William Twietmeyer, City Treasurer/Finance Director
John Divozzo, Director, Grand Traverse County DPW
Elizabeth Hart, WWTP Operator, CH2MHILL
Dave Green, DPS Director

The City of Traverse City

Communication to the City Commission

FOR THE CITY COMMISSION STUDY SESSION OF JANUARY 12, 2015

DATE: DECEMBER 31, 2014

FROM: JERED OTTENWESS, CITY MANAGER

SUBJECT: WASTE WATER TREATMENT PLANT MEMBRANE REPLACEMENT – JANUARY 12 STUDY SESSION

At the December 8, 2014 study session and subsequent to the meeting City Commissioners raised multiple concerns related to replacement of membranes at the WWTP as recommended by CH2MHILL, the plant's operator:

- Description of membrane permeability, including the impact this has on the risk of failure;
- Risk analysis of replacing fewer trains over longer period of time as opposed to the recommendation to replace four trains in 2015 and remaining three in 2016;
- Cost difference between membrane replacement using 500C versus 500Ds modules; and
- Impact on ratepayers.

This memorandum serves as follow-up to address these specific concerns and provide a recommendation for discussion in order to schedule action at an upcoming regular meeting.

DESCRIPTION OF MEMBRANE PERMEABILITY, INCLUDING THE IMPACT THIS HAS ON THE RISK OF FAILURE

CH2MHILL has prepared an addendum (attached) to their December 4, 2014 Technical Memorandum that provides a different analytical approach to address this issue than in the original memorandum. Table 2 in the addendum demonstrates the current peak flow capacity as a result of decreased permeability in the original membranes. Note that with one new train installed peak flow capacity stands at 6.4 million gallons per day (mgd). As described in the December 4, 2014 Technical Memorandum, in 2014 there were two occasions on which the plant experienced peak flow of 10 mgd. In order to avoid spills into Boardman Lake and River, intensive manual operation was necessary.

Elizabeth Hart, WWTP Operator, CH2MHILL, describes intensive manual operation at the plant as requiring that operators manually manipulate the software program that runs the membrane trains, using computers to adjust flows, shut trains on and off, turn blowers on and off, back pulse, and to do this at the speed at which the software program typically would. The variables involved in making these adjustments and getting the desired result are multiple. Equipment has to operate perfectly; gates have to open and close without tripping out; software must run smoothly, without errors or interruptions. In short, the margin for error either with equipment or operation is very small.

Replacing additional trains increases permeability and therefore the peak flow capacity of the plant, as shown in Table 2. Table 2 demonstrates that in order to achieve a functional peak flow capacity of 10.1 mgd, at least two additional trains will need to be replaced in 2015. This would most likely avoid the need for intensive manual operations during peak flow events of 10 mgd or greater, as experienced in 2014. Keep in mind that this does not take into account the impact of biological process upsets, which likely will recur and reduces the permeability and peak flow capacity of the plant.

RISK ANALYSIS OF REPLACING FEWER TRAINS OVER LONGER PERIOD OF TIME AS OPPOSED TO THE RECOMMENDATION TO REPLACE FOUR TRAINS IN 2015 AND REMAINING THREE IN 2016

Table 2 also serves to address this issue, demonstrating the peak flow capacities that can be expected by replacing varying number of trains over the next two years. The risk associated with replacing any number of trains depends on two key factors: (1) predictability of weather events that exacerbate peak flow conditions and (2) confidence in the ability to manually operate the system. Weather is obviously impossible to predict, but a growing body of scientific research indicates that severe weather events, e.g. spring snow melts combined with rain events, are likely to increase in frequency and severity in the Great Lakes Basin as climate change continues.[1]

While CH2MHILL has been able to manually operate the plant successfully during recent high peak flow events, as permeability continues to decrease, manual operation becomes more difficult. In addition, recent peak flow events have not occurred during periods of biological process upset, which would make manual operation that much more difficult. Both key factors – weather and ability to manually operate – will likely continue to increase the risk of failure.

Failure of the membrane treatment process means that waste water that has not been fully treated is being discharged to the lake and river at roughly the same rate it enters the plant. This would result in violations from the State of Michigan Department of

[1] National Oceanic and Atmospheric Administration's *Great Lakes Coastal Resilience Planning Guide*

Environmental Quality, including fines of up to $25,000 per day per violation and consent orders requiring the City to take certain remedial actions. Perhaps more significantly, failure would most likely result in precautionary beach closures, which could last for an extended duration depending on levels of contaminants discharged from the plant such as E. coli bacteria.

COST DIFFERENCE BETWEEN MEMBRANE REPLACEMENT USING 500C VERSUS 500DS MODULES

Additional information provided in CH2MHILL's addendum (see Table 1 and associated discussion) has concluded that the cost to replace with 500C modules now exceeds the cost to replace with 500Ds modules. The sole-source supplier of the membranes used at the WWTP, GE/Zenon, indicates that 500C manufacturing costs have increased as production demand decreases and GE moves to less automated production. CH2MHILL now estimates the cost for 500C membrane modules at $725,000 – the primary components of the membrane trains – compared to $465,000 in the fall of 2013 (note that these costs do not include other component units, such as fasteners, and installation costs).

In addition, as noted in the addendum, non-cost factors relating to membrane operation and maintenance also favor using 500Ds. 500Ds modules withdraw permeate more efficiently by withdrawing from both the top and bottom of the membrane fibers and are easier to remove and maintain. 500Ds cassettes have fewer fasteners, simpler air connections, and no module spacers.

IMPACT ON RATEPAYERS

Based on the analysis presented by the City Treasurer during discussion in early 2014 related to the purchase of one train of new membranes, the rate structure for sewer charges was estimated to increase as a result from $34.00 per the first 600 cubic feet (4,488 gallons) and $40.00 per 1,000 additional cubic feet (7,481 gallons) of usage, to $37.00 per the first 600 cubic feet and $43.50 per thousand additional cubic feet. However, mitigating factors – including additional revenue and/or capital expenditures – modified this cost when the actual rate analysis was performed as part of the budget process later in the year and there was no rate increase in FY14-15.

The cost of replacing four additional trains in 2015 is estimated to be $3.3 million. That cost is shared with townships which are a party to the Master Sewer Agreement with the City, whereby the total cost to the City would be approximately 50% or $1.65 million. The City Treasurer and I recommend utilizing interfund transfers between City funds so that the full $1.65 million cost would be spread out over a five-year period to the Sewer Fund. Depending on other factors involved in determining rates, I anticipate a negligible impact on FY15-16 rates as a result of purchasing four additional trains in 2015, no more than what was anticipated in 2014.

CONCLUSION

The membrane bioreactor technology chosen when the WWTP was upgraded in 2004 requires membrane replacement through time. There is no question that the original membranes must be replaced at some point. The question is when and how they will be replaced. The data that have been collected and analyzed and the operational experience from CH2MHILL lead to the conclusion that additional membranes should be replaced immediately, albeit in a staged approach. Considering the risk associated with replacing fewer trains (less than four in 2015) over a longer period of time (more than two years), relative to the cost of replacement, I concur with CH2MHILL's recommendation to replace four trains in 2015.

I have provided this memorandum in advance of the January 12, 2015 study session, where this is scheduled for discussion in order to provide sufficient time for your review and consideration. Please provide any additional comments, questions, requests for further information, or anything else as soon as practical so that we can prepare for the study session discussion as well as possible.

Enclosures: CH2MHILL Technical Memorandum dated December 4, 2014
CH2MHILL Technical Memorandum – Addendum dated December 29, 2014

Traverse City Regional Wastewater Treatment Plant Membrane Replacement

PREPARED FOR: Traverse City, Michigan

PREPARED BY: Scott Levesque

REVIEWED BY: John Bowman, Liz Hart

DATE: December 4, 2014

PROJECT NUMBER: 439201

Executive Summary

This technical memorandum discusses membrane replacement at the Traverse City Regional Wastewater Treatment Plant (TCRWWTP). It updates a memo on this topic that was issued in November 2013.

In October 2014, new membranes were installed in one of eight trains. The new membranes were purchased from GE using a negotiated cost that was based on a competitive bid elsewhere. This non-binding pricing uses an economic index to escalate costs, which will allow pricing to be applied to the remaining trains.

Over the past year, the original membranes (installed in 2004) have shown signs that they are approaching end of life. Permeate quality continues to be exceptional, but membrane productivity is worsening, and there is significant risk that the plant will not be able to process peak flows during a rain event. It is urgent to plan for the replacement of all original membranes.

CH2M HILL recommends that the City install new membranes in four additional trains in 2015 and the final three trains in 2016. The cost of membrane replacement is estimated to be $3.3 million in 2015 and $2.5 million in 2016 (expressed in November 2014 dollars). Depending on financing approach, all seven trains of membranes could be purchased and installed in 2015. However, there exists the possibility that for new membranes, fewer than 13 cassettes per train will be needed. It will take 6 months to a year to determine this, and it would not be possible to take advantage of this possibility if all of the remaining original membranes were ordered and replaced in 2015.

Background

TCRWWTP has eight membrane tanks. In mid-2014, in preparation for installation of new membranes in Train 1, 13 existing membrane cassettes in Train 1 were relocated to empty spaces in Trains 2 through 7. (None of the cassettes were relocated to Train 8 because it has a different pipe spool configuration than the others.) By relocating existing cassettes to other trains, membrane area in those trains has been increased, partially offsetting decreasing performance of the aging membranes. Each original cassette has 32 GE 500C membrane modules, and each module has 220 square feet (sf) of membrane area (7,040 sf of membrane area per space; 91,500 sf per train).

New membranes for Train 1 were procured by negotiating price with GE based on a recent competitive procurement in Temecula, California. There is a standing, though non-binding, offer from GE to provide subsequent membranes, with cost to be escalated using an agreed upon economic index. It is our understanding that GE will honor this commitment.

In October 2014, new membranes were installed in Train 1. In each of the 13 spaces, two cassettes were installed, one with 16 modules, the other with 8 modules, effectively forming a 24-module "cassette." The new modules are GE 500Ds, each of which has 300 sf of membrane area (7,200 sf of membrane area per space; 93,600 sf per train). The new membranes have nominally more area per space, and the membrane material itself has been improved relative to the original membranes. On an equal-area basis, the new

membranes have the potential to perform better than the original membranes when they were new. However, it will take 6 months to a year of operating experience to make this determination.

Recent Membrane Performance

Over the past year, a number of factors suggest that the existing membranes are approaching end of life. While permeate (filtered water) quality continues to be exceptional, membrane permeability has deteriorated.[1] The following discussion applies to the original membranes, not the new membranes that were recently installed.

There were two episodes in 2014, one in April and one in September, when rain events produced peak flows to the plant that the membranes could barely process. Without intensive manual operation of the membrane process, there would have been wastewater spillage from the plant. During these high-flow events, membrane permeability decreased. Although normal permeability returned after the high-flow event, high-flow events are when normal permeability is needed the most.

The April 2014 event occurred before the Train 1 cassettes were redistributed. Peak flow was approximately 10 million gallons per day (mgd), and process temperature was approximately 10 degrees Celsius (°C). The September 2014 event occurred after the Train 1 cassettes were redistributed. Again, peak flow was approximately 10 mgd, but process temperature was approximately 21°C. These events did not coincide with biological process upsets such as those reported to have impaired permeability in the past. It is important to note that higher peak flows could be experienced in any particular year. Design peak flow for the plant is 17 mgd, and this flow has been exceeded.

Figure 1 illustrates risk of the membrane process being unable to handle current flows The membranes usually could accommodate impairment to less than 20 to 30 percent of normal permeability. However, on days with the highest flows, impairment to less than 40 percent of normal permeability would cause spillage from the plant. Impairment to 50 percent of normal has been observed during high flow events, and the situation would be worse if high flows were to coincide with a gram positive bacteria event. The current risk of spillage from the plant is significant, and membranes in additional trains need to be replaced to mitigate this risk.

Two types of cleaning are performed to maintain/restore membrane permeability: maintenance cleaning and recovery cleaning.[2] In the past year, membrane permeability has declined quickly between maintenance cleanings, and it has become necessary to perform maintenance cleaning once per week rather than once every two weeks. While historically, membranes were recovery cleaned annually, certain trains have required recovery cleaning after six months. In 2014, train 8 had to be recovery cleaned twice in succession because its performance was not restored by the first cleaning. Inability to restore permeability by cleaning and the need to clean more frequently are evidence that the membranes are nearing end of life.

Three months following a recovery clean, a membrane train is flow tested. During this 16-hour test, the train is operated at a series of permeate flow rates, including design peak flow rate of 1,725 gallons per minute (gpm) for one hour. Turbidity and transmembrane pressure (TMP) are recorded during the test. The test fails if at any time the train enters into "TMP mode" of flow control. "TMP mode" is triggered by a TMP of -7.5 pounds per square inch (psi). Prior to 2014 no train had failed a flow test, but in 2014, Train 7 failed a flow test. It is not expected that more frequent recovery cleaning can completely mitigate the risk described above.

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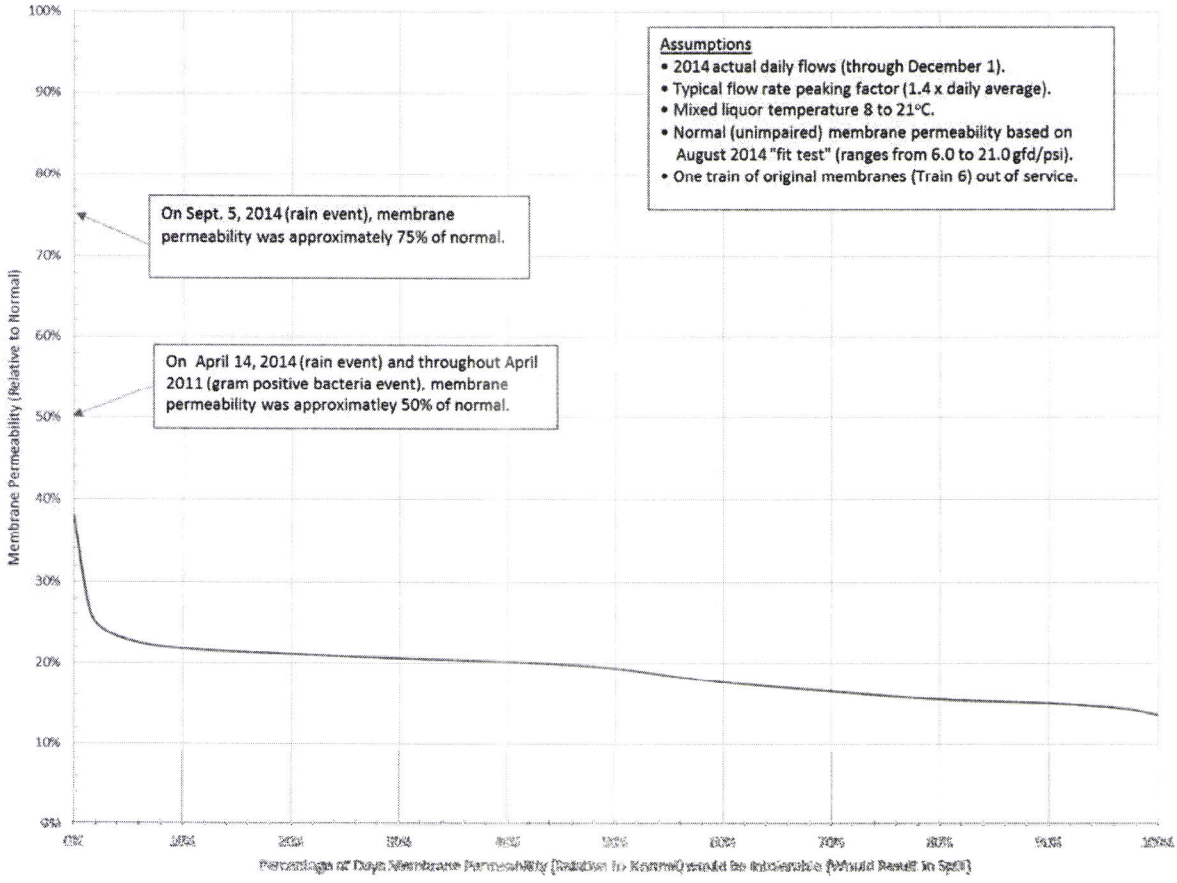
[1] Permeability represents the ability of the membranes to produce permeate (filtered water) at the required rate with available pressure (vacuum in this case). It is calculated using permeate flow rate, membrane area, and transmembrane pressure, and it is expressed in units of gallons per day per square foot per pounds per square inch, essentially flux per pressure (gfd/psi).

[2] Maintenance cleaning is performed at short intervals (approximately weekly), and recovery cleaning is performed at longer intervals (approximately annually). Recovery cleaning uses higher chemical concentrations and longer exposure than maintenance cleaning. The purpose of maintenance cleaning is to extend the time between recovery cleaning.

Figure 1 - Traverse City Regional WWTP Risk of Impaired Permeability



In October 2014, plant staff began to conduct a monthly "fit test" of each train. In this test, a train is operated at design peak flow for one hour. As with the flow test, a train fails a fit test if at any time it enters into "TMP mode" of flow control. In October, all trains passed this test, but by varying margins. Compared to the new membranes in Train 1, permeability of the best original membranes (Train 6) was approximately 40 percent, while permeability of the worst original membranes (Trains 3 and 7) was approximately 30 percent.

Recommendations

The original membranes are showing signs that they are approaching end of life, and this is unrelated to the biological upsets (reported previously) that have impacted permeability in the past.

Even with one train of new membranes, there is risk that the membrane process as a whole could be unable to process peak flows arriving at the plant. Therefore, CH2M HILL recommends that the City install new membranes in four additional trains in 2015 and the final three trains in 2016. (This matches CH2M HILL's 2013 recommendation to budget for replacement of the remaining membranes, half in 2015 and half in 2016.)

Depending on financing approach, all seven trains of membranes could be purchased and installed in 2015. However, there is an advantage to replacement in two steps. The new membranes in Train 1 may demonstrate that less membrane area is needed per train. By purchasing membranes in two steps, it would be possible to make an adjustment at the second step, relocating some cassettes from Trains 1 through 5 into Trains 6 through 8 and purchasing fewer additional cassettes for Trains 6 through 8.

Membrane Replacement Cost

The basis for membrane cost is the same as last year, with costs escalated from October 2012 (the Temecula, California bid date), using the most recently published value for the U.S. Consumer Price Index – All Urban Users (CPI-U). The table below has been revised to add a column corresponding to the September 2014 value of US CPI-U, which is the most recently published at time of this writing.

When the original membrane were removed from Train 1 this year, it was noted that the membrane tank chemically-resistant coating was flaking off the concrete. A line item for membrane tank repair and recoating has been added to the revised table.

In addition, a line item for permeate and air valves has been added to reflect an unanticipated cost for the first train. However, this line will not apply to membranes installed in the remaining trains.

For membrane replacement in the first train, CH2M HILL underestimated expenses (labor, equipment, and supplies). This line item has been increased to reflect actual installation expenses for the first train.

Traverse City RWWTP Membrane Replacement Cost (per train)

Parameter	Oct. 2012	Aug. 2013	Sep. 2014
US CPI-U (basis for cost escalation)	231.317	233.877	238.031
Cassette spaces per train (13 of 16 spaces filled)	13	13	13
Modules per space (16+8)	24	24	24
Membrane area per 500Ds module (square feet)	300	300	300
Membrane area per train (square feet)	93,600	93,600	93,600
Cost per square foot of cassettes and modules (shipped to plant, LEAP)	$6.66	$6.74	$6.86
Cost of cassettes and modules (shipped to plant, LEAP)	$623,779	$630,682	$641,884
Deduct for cyclic aeration instead of LEAP	($75,000)	($75,830)	($77,177)
Cassettes and modules (shipped to plant, cyclic aeration)	$548,779	$554,852	$564,707
Membrane warranty (2 years, full replacement)	$9,360	$9,464	$9,632
GE design (first train only)	$23,100	$23,356	$0
Saddle-type anchors (qty. 68)	$32,643	$33,004	$33,590
Hanger arms & split collars (qty. 8)	$55,770	$56,387	$57,389
Permeate hoses, aeration hoses, fittings & spools	$30,030	$30,362	$30,902
GE services	$60,000	$60,664	$25,000
SUBTOTAL (paid to GE/ZENON)	$759,682	$768,090	$721,220
Local sales tax (at 6%)	---	$46,085	$43,273
Membrane tank repair and recoating	---	$27,000	$27,480
Permeate and air valves (for cassette relocation only)	---	$8,700	$0
CH2M HILL services (labor, equipment, supplies)	---	$30,000	$30,533
TOTAL (rounded)	---	$880,000	$823,000

The cost to replace membranes in four trains in 2015 is estimated to be $3.3 million. The cost to replace membranes in the remaining three trains in 2016 is estimated to be $2.5 million. These costs are expressed in November 2014 dollars.

Traverse City Regional Wastewater Treatment Plant Membrane Replacement - Addendum

PREPARED FOR:	Traverse City, Michigan
PREPARED BY:	Scott Levesque
REVIEWED BY:	John Bowman, Liz Hart
DATE:	December 29, 2014
PROJECT NUMBER:	439201

This addendum to the December 4, 2014 memorandum about Traverse City Regional Wastewater Treatment Plant (TCRWWTP) membrane replacement compares membrane replacement using new GE 500Ds modules and cassettes (recommended) or new GE 500C modules installed in the original cassettes. It also provides justification for CH2M HILL's recommendation for the number of trains to be upgraded in 2015 (four trains) and 2016 (three trains).

Membrane Replacement Using GE 500Ds or 500C Membranes

The original membrane cassettes and modules are GE 500C, whereas the membrane cassettes and modules recently installed in Train 1 are the latest GE membrane product, 500Ds. (The "s" in "500Ds" represents shorter fiber length and therefore less membrane area than GE's standard 500D module. Shorter fiber length is needed at TCRWWTP due to membrane tank depth.)

The original 500C cassettes can accommodate replacement 500C modules, which have greater membrane area (250 square feet) than the original modules (220 square feet). However, the original 500C cassettes cannot accommodate 500Ds modules. To use 500Ds modules, new cassettes are required.

The membrane material and fibers used for replacement 500C and 500Ds modules are the same; therefore either choice benefits from GE's membrane product development, specifically durability and permeability.

For 500Ds and 500C cassettes, there are differences in terms of module design and how modules are incorporated into a cassette. 500C modules withdraw permeate from the top, while 500Ds modules withdraw permeate from the top and bottom. GE made this design change because it reduces pressure drop within the membrane fibers, increasing capacity slightly for a given vacuum in the permeate header. GE was asked to quantify this difference in capacity – under TCRWWTP design conditions, a train with 96,000 square feet of 500C membranes (384 modules) is considered equivalent to a train with 93,600 square feet of 500Ds membranes (312 modules).

In a 500C cassette, maintenance of a single module requires removal of all modules between the module requiring maintenance and the edge of the cassette. For example, one must remove modules 1 through 7 to access module 8. In a 500Ds cassette, one can remove any module without removing any others. This saves time and reduces the risk of damaging modules by reducing handling.

500Ds cassettes also are better designed from a maintenance point of view (half the number of fasteners, simpler permeate and air connections, and no module spacers). At TCRWWTP, some of the 500C cassettes have needed repairs, and CH2M HILL expects that more repairs will be needed the longer these cassettes are used.

The labor cost to install new, loose 500C modules in existing cassettes is much higher than the cost to install new 500Ds cassettes shipped with new modules already installed. Whereas it takes about a day to install new, loose modules in an existing cassette, it takes about an hour to install a cassette that was shipped with modules already in place.

In 2013, it was acknowledged that it would cost less to replace a train of original 500C modules with new 500C modules (in existing cassettes) rather than new 500Ds modules (in new cassettes). However, it was recommended to do the latter because this strategy allowed original 500C cassettes and membranes to be distributed to other trains rather than being disposed of. Increasing overall membrane area in the process was/is beneficial to mitigate the risk of unanticipated short-term permeability impairment due to process biology.

GE indicated recently that it expects to stop high-volume manufacture of 500C modules between 2015 and 2017. GE notes that 500C manufacturing costs have increased and will continue to increase into the future as production demand decreases and GE moves to less automated production.

Table 1 presents costs to replace membranes in one train either with new 500Ds modules and cassettes or new 500C modules in existing cassettes. The 500C membrane area is based on GE's suggested equivalent area to a 500Ds train. The 500C cost is based on a recent budget estimate from GE (that reflects current manufacturing cost) and reflects greater effort by CH2M HILL to install individual modules.

TABLE 1
Membrane Replacement Cost (per train) – Using September 2014 Cost Indices
Traverse City Regional Wastewater Treatment Plant Membrane Replacement

Parameter	500Ds modules, new cassettes	500C modules, existing cassettes
Cassette spaces used per train (of 15 usable)	13	12
Modules per cassette space	24	32
Membrane area per module (square feet)	300	250
Membrane area per train (square feet)	93,600	96,000
Cassettes (500Ds only) and modules (shipped to plant)	$564,707	$725,000
Membrane warranty (2 years, full replacement)	$9,632	Included
Saddle-type anchors (qty. 68)	$33,590	Not Applicable
Hanger arms & split collars (qty. 8)	$57,389	Not Applicable
Permeate hoses, aeration hoses, fittings & spools	$30,902	$30,902
GE services	$25,000	Included
US customs duties (3.9 percent of membrane cost)	Included	Included
Merchandise processing fee (0.3464 percent of invoice)	Included	Included
SUBTOTAL (paid to GE/ZENON)	$721,220	$755,902
Local sales tax (at 6%)	$43,273	$45,354
Membrane tank repair and recoating	$27,500	$27,500
CH2M HILL services (labor, equipment, supplies)	$30,500	$100,000
TOTAL (rounded)	$823,000	$929,000

Membrane replacement using new 500Ds cassettes and modules will cost less than replacement using 500C (existing cassettes). Non-cost factors relating to membrane operation and maintenance also favor upgrade to 500Ds. CH2M HILL recommends installing 500Ds membranes in the remaining trains.

Number of Membrane Trains to Replace in 2015 and 2016

CH2M HILL has been asked to illustrate the consequences of replacing membranes in fewer than four trains in 2015. The analysis presented in Figure 1 of the draft memorandum did not address this; therefore, a different analytical approach is presented here.

Assumptions include:

- One new membrane train out of service (matching original design basis)
- Permeate production in any given train limited by its permeate pump
- Mixed liquor temperature 10 degrees Celsius (as experienced)
- Membrane permeability impairment to 25 percent of normal (as experienced)
- Baseline normal permeability of new and existing membranes as measured in October 2014
- No decrease in normal permeability of new membranes (through 2016)
- Normal permeability of existing membranes decreasing by 0.5 gfd/psi in 2015 and by an additional 0.5 gfd/psi in 2016 (based on long-term permeability decline in train 7)

Table 2 summarizes results of the analysis - peak flow capacity for the plant, as limited by the membrane filtration process. One train of new 500Ds membranes has already been installed. Installation of additional trains of new membranes (500Ds or 500C) would incrementally increase capacity.

In 2014, the plant experienced a peak flow of 10 million gallons per day (mgd) on two occasions, and slightly higher peak flow has been experienced previously. It is important to note that higher peak flows could be experienced in any particular year, depending on severity of rain events. Design peak flow for the plant is 17 mgd.

Current average and peak flows are less than design capacity. Therefore, it may possible to de-rate the plant to lower capacity, allowing fewer than 8 membrane trains to be outfitted with new membranes. De-rating the plant has regulatory implications and would need to consider future flow projections, which is beyond the scope of the present analysis.

CH2M HILL recommends installing new membranes in four additional trains in 2015, which would increase plant peak flow capacity from 6.4 to 13.1 mgd under design conditions. Risk of spill could be further reduced by installing new membranes in additional trains; however, deferring membrane replacement in the final three trains until 2016, opens the possibility of demonstrating that fewer cassettes per train are needed, which would mean fewer cassettes could be purchased in 2016.

After installing new membranes in the final three trains, the plant's design peak flow capacity will have been restored. When permeability of the replacement membranes decreases to approximately half of their permeability when new, it will be time for the next replacement. For long-range financial planning, it is recommended to assume membrane life of 10 years. As the membranes age, this assumption would be revisited and potentially adjusted.

Table 2

Membrane Process Peak Flow Capacity

Traverse City Regional Wastewater Treatment Plant Membrane Replacement

Number of New Membrane Trains Installed	2015	2016
1	6.4 mgd	6.0 mgd
2	8.5 mgd	8.0 mgd
3	10.1 mgd	9.7 mgd
4	11.6 mgd	11.3 mgd
5	**13.1 mgd**	12.8 mgd
6	14.4 mgd	14.3 mgd
7	15.8 mgd	15.7 mgd
8	17.0 mgd	**17.0 mgd**

Memorandum

The City of Traverse City

To: Jered Ottenwess, City Manager
From: William E. Twietmeyer, City Treasurer/Finance Director W.E.T.
Subject: Wastewater Treatment Plant Membrane Replacement
Date: January 5, 2015

Per your direction, I have looked at the plant membrane replacement costs to determine how the City can accomplish this project given its limited resources.

This transaction will be a little more complicated than the recent purchase of one membrane. First of all, there is a cash flow problem in that the City cannot upfront the total cost and wait for the townships to provide their share at a later date. Discussions will need to take place with our township partners to determine if they have sufficient funds and when those funds would be available. Second, the City does not have $1.65 million in its Sewer Fund to cover its share of the membrane cost. Normally, the City performs a rate study in the spring in conjunction with the budget process to determine if the rate structure is sufficient for the upcoming year. An additional element that needs to be factored in is the townships' recent communication ending their 8% capacity lease from the City. This will result in higher costs to the City for paying of the 2002 debt service on the wastewater treatment plant expansion and upgrade.

Nevertheless, we will be looking at recommending some type of a rate increase that will be affordable, measured, and cognizant of the fact that more membranes may need to be replaced the following year. I expect that we will pursue some type of inter-fund loan over a five or ten year time frame to help moderate any rate increase that is needed.

Memorandum

The City of Traverse City
Department of Public Services

TO: Jered Ottenwess, City Manager

FROM: Dave Green, DPS Director
Art Krueger, WTP Superintendent

DATE: January 5, 2015

SUBJECT: 2014 Water System Reliability Study Overview

The Michigan Department of Environmental Quality requires that Level 1 water systems conduct a Reliability Study every five years. The City and the surrounding Townships are all Level 1 systems, and therefore each is required to perform a reliability study. The most recent study was completed in April 2014 by our Engineering Consultant, Prein & Newhof. It focused not only on the City water distribution system, but also on the City Water Treatment Plant. In simple terms, a Reliability Study is intended to show proof that the water system owner has the capability to treat and distribute a sufficient quantity of quality water to meet the residential, commercial, and fire protection demands of all customers on the system for the next 20 years or at least has a plan in place to do so. Therefore, the recommendations in this study determine the course for the water system in the form of prioritizing Capital Improvement Projects (CIP's) as well as potential operational changes and/or adjustments.

In summary, Cost Opinions for Recommended Improvements in the Water System Reliability Study lists fifteen (15) CIP's in order of priority along with a cost estimate and a recommended time frame for completion. We want to focus on the first nine projects which we list in our Six Year CIP. The first project P-1, is the Plant Monitoring and Controls Improvements (SCADA) project which is currently out for bids and scheduled to be completed in two phases between February 2015 and March 2016. This project includes replacement of some key controls and mechanical devices at the Water Plant that are original from 1965. Project P-2, Filter 1, 2 & 3 Media Replacement and Surface Wash Upgrades will replace original filter media and the surface wash system which is critical to our filtering operations. Project P-3, The Midtown Water Transmission Main includes installing a 24-inch cross-town water main in conjunction with the Eighth Street Improvement Project. This will improve the pumping capacity to the west side of town including the Wayne Hill reservoir. Another key project listed is P-4, the Barlow Reservoir Rehabilitation. This above ground 4-million gallon steel water storage tank was built in 1972 and needs interior structural roof repairs and the coatings removed and replaced both inside and out. Project P-5, The Electrical Gear Upgrades Project at the WTP and Low Service Pump Station will replace

old electrical equipment that is beyond its service life. Definite energy savings and utility cost reductions will be realized as well. P-6, The Hannah Avenue Water Main Upgrade Project will replace approximately 1900 feet of 6 inch diameter water main with 12 inch diameter water main thereby improving distribution pumping efficiencies. P-7, The Chemical Systems Upgrade Project will address the need to maintain satisfactory storage and chemical application capabilities. P-8, Filters 1, 2 & 3 Valve Replacement Project will replace existing, original equipment. Lastly, P-9, The East-West Transmission Main Upgrade Project will improve our cross town pumping capacity as well as giving us a redundant option in case of emergencies.

The following table will show the Study Project list and how they cross reference with the City Six Year CIP:

Reliability Study Improvement Project	City Six Year CIP Project	Opinion of Probable Project Cost	Project Implementation Time Frame
P-1 Plant Monitoring and Controls Improvements	CIP-103 Plant-SCADA	$1,100,000	2014-2016
P-2 Filter 1, 2 & 3 Media Replacement & Surface Wash Upgrades	CIP-114 Plant Filters 1, 2 & 3	$350,000	2017-2018*
P-3 Construct 11,000 feet of 24" Transmission Main Across the City (Phase 1)	CIP-115 Midtown Water Transmission Line	$1,500,000	2018-2019
P-4 Rehabilitate Barlow Reservoir	CIP-113 Barlow Reservoir Rehabilitation/Reconstruction	$1,000,000	2015-2016
P-5 Electrical Gear Upgrades at WTP and Low Lift Station	CIP-930 Electrical Gear Upgrades at WTP & Low Service	$850,000	2016-2017
P-6 Replace 1,900 feet of aging 6" main on Hannah Avenue with 12" main from Bates Street to South Garfield Avenue.	CIP-932 Hannah Ave Water Main Upgrade	$310,000	2017-2018
P-7 Chemical System Upgrades (Alum, Chlorine, and Fluoride)	CIP-933 Chemical System Upgrades (Alum, Chlorine, and Fluoride)	$250,000	2019-2020
P-8 Filter 1, 2 & 3 Valve Replacement	CIP-934 Filter 1, 2 & 3 Valve Replacement	$400,000	2019-2020
P-9 Construct 5,800 feet of 24" and 16" Transmission Main Across the City (Phase 2)	CIP-935 East -West Transmission Main Upgrade	$1,090,000	2020-2021

*Per approval by MDEQ this project can be deferred until 2017-2018 fiscal year.

We concur with the prioritized project list and look forward to our continued progress as we strive to get the Water Treatment Plant back to the cutting edge plant it was when first constructed back in 1965. By completing the WTP SCADA Project, the Filter 1, 2 & 3 Media Replacement & Surface Wash Upgrade Project and the Electrical Upgrades Project at the plant within the next 3 years we will be where we need to be to realize this goal. Additionally, after completing the Barlow Reservoir Rehabilitation Project in the spring of 2016 and installing a 24" transmission main in conjunction with the Eighth Street Improvement Project during the 2018/2019 fiscal year our distribution system will be much improved.

One of the first recommendations on the operational side deals with unaccounted water issues. Staff has been investigating sources of unbilled water and believes one of the major contributors to the discrepancy between billed and unbilled water is the accuracy of the master meters at the plant. Our recent purchase and installation of the ultrasonic flow meters partially confirmed our belief. Project P-1 includes the installation of new master meters on both raw and finished water lines that will give us final accurate data to determine the actual percentage of loss. This number should typically be in the 10-15% range and we will continue to work on our system wide management strategy until we get there. Our current meter change-out program is part of this strategy and we are looking to bolster our efforts here.

Additional recommendations include replacing older deteriorating water mains in conjunction with street and utility projects, valve exercising program, water main flushing program and looping dead end mains. We currently replace water mains as part of street reconstruction projects and will continue to do so. We plan on accelerating our valve exercising and flushing programs as recommended. It should be noted that additional manpower may be required to adequately perform these recommended activities.

Overall, the 2014 Reliability Study shows that although we need to plan for some key short term improvements, once completed, our Water Treatment Plant and distribution/transmission system will continue to serve us well now and into the next decade.