Minute No. 314
Report - Standing Policy Committee on Public Works - March 8, 2005

Item No. 2 **Water Treatment Program - Mitigation of risks - Chlorine Gas and long duration Power failure**
File No. WS-7

COUNCIL DECISION:

Council concurred in the recommendations of the Standing Policy Committee on Public Works and adopted the following:

1. That the Water Treatment Program approved by Council as part of the Five Year Capital Forecast be amended to include:

   A. On-site generation of sodium hypochlorite for disinfection instead of chlorine gas, at an estimated capital cost of $7.3 Million, in order to reduce the risk associated with operation of the Water Treatment Plant.

   B. A standby power system to allow operation of one "train" of the Water Treatment Plant to produce 200 ML/d of treated water during power outages, in order to ensure a minimum supply of potable water during protracted power outages, at an estimated cost of $6.0 Million.

2. That the Proper Officers of the City be authorized to do all things necessary to implement the intent of the foregoing.

Report - Standing Policy Committee on Public Works - March 8, 2005

DECISION MAKING HISTORY:

Moved by Councillor Eadie,

That the recommendation of the Standing Policy Committee on Public Works be adopted by consent.

Carried

EXECUTIVE POLICY COMMITTEE RECOMMENDATION:

On March 16, 2005, the Executive Policy Committee concurred in the recommendations of the Standing Policy Committee on Public Works and Standing Committee on Fiscal Issues and submitted the matter to Council:

STANDING COMMITTEE RECOMMENDATION:

On March 8, 2005, the Standing Policy Committee on Public Works concurred in the administrative recommendation and submitted its recommendation to the Executive Policy Committee and Council.

On March 8, 2005, the Standing Committee on Fiscal Issues concurred in the administrative recommendation and submitted the matter to the Executive Policy Committee.

RE: Water Treatment Program – Mitigation of risks - Chlorine Gas and long duration Power failure

FOR SUBMISSION TO: The Standing Policy Committee on Public Works and
The Standing Committee on Fiscal Issues

ORIGINAL REPORT SIGNED BY: Barry D. MacBride, P. Eng., Director
Water and Waste Department

REPORT DATE: March 2, 2005

RECOMMENDATION(S): It is recommended that:

1. The Standing Policy Committee on Public Works recommend to City Council that:

    a. Water Treatment Program approved by Council as part of the Five Year Capital Forecast be amended to include on-site generation of sodium hypochlorite for disinfection instead of chlorine gas, at an estimated capital cost of $7.3 Million, in order to reduce the risk associated with operation of the Water Treatment Plant.

    b. The Water Treatment Program approved by Council as part of the Five Year Capital Forecast be amended to include a standby power system to allow operation of one "train" of the Water Treatment Plant to produce 200 ML/d of treated water during power outages, in order to ensure a minimum supply of potable water during protracted power outages, at an estimated cost of $6.0 Million.

2. The Standing Committee on Fiscal Issues consider the above and submit its recommendation to the Executive Policy Committee.

REPORT SUMMARY

KEY ISSUES:

- Council approval is required to amend the Water Treatment Program.
- Decisions are required on whether the City is prepared to accept the risks relating to use of chlorine gas and long duration power outages, or make investments to reduce these risks.

IMPLICATIONS OF THE RECOMMENDATION(S):

General Implications

	None
	For the organization overall and/or for other departments
X	For the community and/or organizations external to the City of Winnipeg
	Involves a multi-year contract

Comment(s):

1. Risk analysis indicates that the probability of an accident which results in a catastrophic release of chlorine gas from a rail tank car is very unlikely, but the consequences are disastrous and may include injury or death to City personnel and the general public. Based upon risk analysis this is a critical risk and it has been recommended that the risk be eliminated.

2. Risk analysis indicates that the probability of a long duration power failure which would cause depletion of potable water storage and result in the need to supply untreated water is very unlikely, but the consequences are severe and include the need to boil water to ensure health safety during the power outage. Based upon the risk analysis this is a severe risk and it has been recommended that this risk be eliminated or reduced.

Policy Implications

X	No
	Yes – Comment(s):

Environmental Implications

X	None
	Yes – Comment(s):

Human Resources Implications

X	No
	Yes – Comment(s):

Financial Implications

	Within approved current and/or capital budget
X	Current and/or capital budget adjustment required

Comments: Additional capital funding of $7.3 million is required for on-site sodium hypochlorite generation, and operating costs will increase by $74,000 per year. Additional capital funding of $6.0 million is required for increased standby generation capacity, and operating costs will increase by $90,000 per year.

REPORT

REASON FOR THE REPORT:

Council must approve the proposed changes to the Water Treatment Program.

HISTORY:

1993 Council approved the creation of the Water Treatment Reserve Fund to cash finance a portion of the cost of a water treatment plant.

2000 On November 22, Council adopted the Water Treatment Program.

2002 On July 17, Council amended the Water Treatment Program to include ultra violet (UV) light disinfection and modified the schedule so that the water treatment plant would be operational in 2007.

2003 On June 25, Council adopted a recommendation that the "construction management" project delivery strategy be utilized for design and construction of the water treatment plant, and that City forces operate the facility.

2004 On June 8, the Standing Committee on Fiscal Issues received "Water Treatment Program Financial Status Report No. 1" as information.

2004 On July 21, Council adopted a recommendation to reduce the water treatment plant (WTP) design capacity from 515 ML/d to 400 million litres/day (ML/d).

2004 On October 12, the Standing Committee on Fiscal Issues received "Water Treatment Program Financial Status Report No. 2" as information.

2004 On October 27, Council adopted a recommendation to amend the implementation schedule for the water treatment program approved by Council to defer the Chloramination Facility from 2005 to 2007 and commission it concurrent with the balance of the water treatment plant.

2004 December 13, Council adopted the 2005 Capital Budget that included $84 million for the Water Treatment Plant project.

2005 On February 8, the Standing Committee on Fiscal Issues received "Water Treatment Program Financial Status Report No. 3" as information.

DISCUSSION:

Current Status of the Water Treatment Plant:

Preliminary engineering of the WTP has been completed and the draft preliminary design report has been submitted for City review.

The overall completion of the Water Treatment Program is scheduled such that the WTP will be operational in 2007, pursuant to the Council approved plan. A very aggressive design and construction schedule is being pursued in order to meet this completion date. Detailed design of certain components of the facility has already begun and approximately $24 million in goods and materials for the Water Treatment Program will be tendered by June, 2005.

Risks and Risk Mitigation:

A comprehensive risk management process has been implemented, pursuant to Council direction and administrative policy for projects which exceed $10 million, to mitigate risk and ensure proper oversight and implementation of the Water Treatment Program,. A risk management seminar was facilitated by a risk consultant on January 6/7, 2005. This seminar identified 44 project risks and 33 design issues. All risks will require mitigation and monitoring. Of the risks identified, about a dozen could be considered serious or critical. Mitigative strategies for all risks that have been identified are under development.

Mitigation of two of the risks identified (chlorine gas discharge and long-term power outage) will require capital investments which are outside the base project scope. These investments are not included in the project budget or capital estimates. A discussion of these risks follows.

Chlorine Gas Discharge

The City of Winnipeg presently uses chlorine gas for disinfection of the potable water supply at three stages in the "supply chain". It is added at the Shoal Lake Intake, the Deacon Booster Pumping Station and each of the three Regional Pumping Stations located in Winnipeg. The chlorine is transported to the Intake facilities and to the Deacon Booster Pumping Station (the future site of the WTP) by rail tank car. It is transported to the Regional Pumping Stations in tonne cylinders by semi trailer. The chlorine gas is transported as a liquid under pressure. If the pressure is relieved by opening a valve on the tank or an accident causing tank rupture, chlorine gas will be discharged. Chlorine gas is a poisonous gas which is heavier than air.

The Department's track record in safe handling of chlorine gas is extremely good. Chlorine gas has been used at the Deacon site since 1978 without incident. Personnel are well-trained in safe procedures and are also trained to respond to chlorine gas emergencies. An emergency response plan is in place and the plan is exercised on a regular basis. It has been judged that a major chlorine gas discharge is very unlikely and has a probability of less than 1 percent. However, the consequences of such an event have been judged as disastrous. Preliminary computer dispersion

analysis indicates that depending upon wind conditions, a discharge of this nature could affect people within five miles of the event. A potential cause of the major rupture is a collision between the train tank car and a large vehicle such as a semi trailer. The Department operates a shortline railway and on several occasions vehicles ranging from pickup trucks to large tandem dump trucks have been in collision with trains. This type of accident is almost impossible to mitigate, and could result in a disaster of the scale of that recently experienced in North Carolina, which resulted in several fatalities and major disruption to communities.

Many cities in the United States are presently converting from chlorine gas to safer forms of chlorine such as liquid sodium hypochlorite. As a result of an accidental discharge, the city of Calgary is presently converting from chlorine gas to on-site generation of liquid sodium hypochlorite. Based upon the outcome of our risk analysis, it would be prudent for Winnipeg to consider disinfection alternatives which do not use chlorine gas for the new WTP.

The consultants have identified two alternatives to chlorine gas for the WTP. These are the use of liquid sodium hypochlorite delivered by truck or rail tank car, or on-site generation of liquid sodium hypochlorite from high-grade salt shipped by truck or rail car. Each of these alternatives would eliminate the hazards associated with the discharge of gas during transit or in plant. Both alternatives used liquid sodium hypochlorite as a source of chlorine for disinfection. The chlorine is in aqueous solution and any liquid which is spilled has characteristics similar to bleach. Standard practice is to provide structures around storage tanks so that spills are contained.

The capital and operating costs of these options are compared to the cost of improvements required to the existing chlorine gas system and operation using chlorine gas in the table below.

Parameter	**Chlorine Gas (Existing system) Not Recommended**	**Alternative 1- Delivery of Bulk Liquid Sodium Hypochlorite**	**Alternative 2 - On-site Generation of Liquid Sodium Hypochlorite**
Capital Cost	$500,000(1)	$2,755,000	$7,285,000
Annual O&M Cost	$170,000	$620,000	$244,000
NPV	$2,619,000	$10,482,000	$10,326,000

(1) Improvements to the existing chlorine gas system are required in any event to ensure reliable operation until the WTP is commissioned. Accordingly, this capital expenditure is not saved if Alternative 1 or 2 is implemented.

The capital cost of Alternative 2 - On-site Generation is much higher than Alternative 1- Delivery of Bulk Liquid Sodium Hypochlorite due to the cost of process equipment needed to generate liquid sodium hypochlorite from salt. The operating cost of Alternative 1 is much higher due to the large volume solution which must be shipped.

The net present value (NPV) of the options has been calculated, using a twenty-year project life and a 5% discount rate. The NPV is a measure of the aggregate value of the initial capital cost and the future operating costs of the alternatives in present dollars. Considering the precision of the cost estimates, the overall cost of ownership of the two alternatives is essentially the same.

Alternative 2 has some operating advantages relative to Alternative 1:

- Liquid sodium hypochlorite that is generated on site has a lower chlorine concentration than bulk delivered sodium hypochlorite, and therefore is less hazardous to personnel.
- The strength of bulk delivered liquid sodium hypochlorite will degrade overtime while the product is in storage. Consequently, an increasing quantity of liquid is required to maintain the same dose, which increases operating complexity and may increase operating costs. The liquid sodium hypochlorite which is generated on site is more stable due to the lower concentration.
- Bulk delivered liquid sodium hypochlorite will tend to produce off gases in pipelines which may result in vapor locks in the feed system that will require additional operations and maintenance attention.
- Rail tank cars of bulk delivered sodium hypochlorite will freeze if left standing in cold weather. This can create significant operational and logistical issues during winter months. The on-site generation of liquid sodium hypochlorite requires delivery of food grade salt, which is not subject to freezing.

Accordingly Alternative 2 is recommended.

Once the WTP has been built and commissioned, the secondary disinfection used in the distribution system will be changed from chlorine to chloramines. After it has been demonstrated that the WTP and ancillaries are operating reliably, it will be possible to decommission the chlorine facilities at the regional pumping stations and eliminate the risk associated with chlorine gas at these facilities.

Proposals to decommission the chlorine facilities at the three regional pumping stations and to eliminate the use of chlorine gas at the Shoal Lake Intake will be developed and submitted for Council's consideration as part of future Capital Estimates, such that these projects can proceed as early as possible after the WTP is completed.

Standby Power

The present design of the WTP provides nominal standby power using engine driven generators to ensure that essential building services and control systems continue operating during and after a power failure occurs. This ensures that systems are shut down in a safe and orderly fashion when the power fails, and that personnel safety is preserved. However, there is insufficient standby generation capacity to operate the plant process units to produce treated water. This is a common design approach that has been used throughout North America. We are aware of only two water treatment plants in Canada (Ottawa and Halifax) that have the capacity to treat water

during a power outage. However, recent events such as ice storms and power grid failures in eastern Canada demonstrate that long duration power outages can and do occur. Depending on water demand conditions immediately before and during a power failure, potable water storage reservoirs could be depleted and it would be necessary to supply untreated water to satisfy basic sanitary needs and ensure fire protection. At average day and maximum day water demand rates, it is projected that the reservoirs would be depleted, except for emergency fire storage, in about 1.9 days to 1.2 days respectively. Untreated water can be supplied by gravity from Deacon Reservoir to the three regional pumping stations, and there is adequate engine driven pump capacity within the stations to ensure an emergency supply, although water rationing would be required.

Risk analysis indicates that the probability of a long duration power failure which would cause depletion of potable water storage and result in the need to supply untreated water is very unlikely (less than 1 percent), but the consequences are severe and include the need to boil water to ensure health safety during the power outage. Not all customers would to have the ability and resources to boil water during a power outage. A boil water order would place severe hardship on hospitals, nursing homes, the ill and elderly. Based upon the risk analysis this is a severe risk and it has been recommended that this risk be eliminated or reduced.

Fifty percent of the capacity of the WTP or 200 ML/d would be an adequate potable water supply during a protracted power outage, with water rationing in effect. The capital cost to construct standby power generation capacity at the WTP which is adequate to power 50% of the production capacity of the WTP and produce 200 ML/d of treated water is estimated at $6.0 million. The annual operating cost of the installation is estimated at $90,000. It is recommended that this standby power system be constructed as part of the WTP project.

Finances:

The budget for the Water Treatment Program including engineering, contingencies, financing administration and inflation through to the 2007 completion date is $214 million. In the fourth quarter of 2004, the Construction Manager was directed to develop an updated estimate which reflects the present economic climate, as well as the outcome of the Value Engineering undertaken at the end of Concept Design. The estimate that was performed is a “Class 4” or “Conceptual” estimate. By definition, this type of estimate is based upon design information that has been developed to the conceptual level. Class 4 estimates are usually within 15% of the final cost, for a comparable scope of work under favorable and competitive market conditions. The WTP estimate reflects inflation projected at 0.5% per month in the heavy construction industry for the duration of the project, and carries a contingency allowance of 17%. The estimate indicates that the budget of $214 million for the 400 ML/d plant adopted by Council is adequate.

As of December 31, 2004 funds committed to the Water Treatment Program stood at approximately $32.6 million, and funds expended were about $11 million. The Council approved capital budget up to and including 2005 is $130.042 million. The majority of funds expended to date have been for engineering studies, pilot testing and design and construction of the UV disinfection facility. Committed expenditures to date are slightly ($1.6 million) below budget.

In 1993, council approved the creation of the Water Treatment Reserve Fund to cash finance approximately 50% of the cost of a WTP. As a result of this initiative, $117 million of the $214 million budget for the Water Treatment Program will be funded from the reserve. All expenditures to date have been funded from the reserve.

A summary of project cost categories, budgets, and actual and forecast expenditures for the program is included in Appendix 1. As noted in Appendix 1, funding for the two recommendations made herein would require that the current $214 million budget be adjusted to $227.3 million. This funding would be included in future capital estimates and would be debt financed. The increased debt and operating costs would have a nominal effect on the utility's rate plan. Appendix 2 provides an update of the financing plan with these new costs.

FINANCIAL IMPACT:

The following financial impact statement for this project has been prepared in accordance with the recommendation adopted by Council on December 13, 2000.

Financial Impact Statement

Date: February 25, 2005

Project Name: **First Year of Program** **2006**

WATER TREATMENT PROGRAM – MITIGATION OF RISKS - CHLORINE GAS AND LONG DURATION POWER FAILURE

	2006	2007	2008	2009	2010
Capital					
Capital Expenditures Required	$ 6,664,705	$ 6,635,295	$ -	$ -	$ -
Less: Existing Budgeted Costs	-	-	-	-	-
Additional Capital Budget Required	$ 6,664,705	$ 6,635,295	$ -	$ -	$ -
Funding Sources:					
Debt - Internal	$ -	$ -	$ -	$ -	$ -
Debt - External	6,664,705	6,635,295	-	-	-
Grants (Enter Description Here)	-	-	-	-	-
Reserves, Equity, Surplus	-	-	-	-	-
Other - Enter Description Here	-	-	-	-	-
Total Funding	$ 6,664,705	$ 6,635,295	$ -	$ -	$ -
Total Additional Capital Budget Required	$ 13,300,000				
Total Additional Debt Required	$ 13,300,000				
Current Expenditures/Revenues					
Direct Costs	$ 194,118	$ 831,176	$ 1,503,148	$ 1,503,148	$ 1,503,148
Less: Incremental Revenue/Recovery	194,118	164,706	-	-	-
Net Cost/(Benefit)	$ -	$ 666,471	$ 1,503,148	$ 1,503,148	$ 1,503,148
Less: Existing Budget Amounts	-	-	-	-	-
Net Budget Adjustment Required	$ -	$ 666,471	$ 1,503,148	$ 1,503,148	$ 1,503,148

Additional Comments: The Operating & Maintenance and Labour costs shown on the Current page are the incremental cost between the existing system and the recommended on-site generation system.

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Moira L. Geer C.A.
Manager of Finance & Administration

IN PREPARING THIS REPORT THERE WAS CONSULTATION WITH AND CONCURRENCE BY:

Legal Services, Corporate Services Department

THIS REPORT SUBMITTED BY:

Department: Water and Waste Department
Division: Engineering Services Division
Prepared by: Tom Pearson
File No.: 020-18-29-05-00

APPENDIX 1
WATER TREATMENT PROGRAM - MITIGATION OF RISKS - CHLORINE GAS AND LONG DURATION POWER FAILURE

REVISED CAPITAL COSTS AND CASH FLOW PROJECTIONS
WATER AND WASTE DEPARTMENT - ENGINEERING DIVISION

		COSTS				PROJECTED COSTS TO COMPLETE				TOTAL	VARIANCE	NOTE
	Components	Total Budgeted Costs	Approved [1] Budget To Date	Costs Incurred up to last report	Costs submitted this report	Total Costs Incurred to Date (per G/L) 31-Dec-04	2005	2006	2007	Total Costs Remaining to Complete	Total Project Cost	Variance from Budget (Unfavorable)	
A)	CONCEPTUAL ENGINEERING	3,700,000	3,765,300	3,737,028	28,268	3,765,297					3,765,297	(65,297)	(2)
B)	UV DISINFECTION	9,000,000	9,000,000	4,655,791	1,397,812	6,053,603	952,188			952,188	7,005,791	1,994,209	(3)
C)	CHLORAMINATION	3,000,000	3,000,000					1,500,000	1,500,000	3,000,000	3,000,000	0	
D)	PROGRAM'S PROJECT MANAGEMENT OFFICE	100,000	100,000	17,231	17,515	34,747	65,253			65,253	100,000	0	
E)	WATER TREATMENT PLANT ENGINEERING	22,700,000	22,700,000	11,309	453,599	1,173,923	14,837,386	4,000,000	3,000,000	21,837,386	23,011,309	(311,309)	(4)
F)	WATER TREATMENT PLANT CONSTRUCTION (5)	188,800,000	91,476,700				49,000,000	76,164,705	63,635,295	188,800,000	188,800,000	0	
	Total	**227,300,000**	**130,042,000**	**8,421,359**	**1,897,195**	**11,027,570**	**64,854,827**	**81,664,705**	**68,135,295**	**214,654,827**	**225,682,397**	**1,617,603**	
	Percentage Complete					5%							

1) **Council has approved a total budget of $130.042 Million for the Water Treatment Program; Distribution of costs to project activities A) to F) was done by the Water and Waste Department.**
2) **Negative variance due to additional study requirements.**
3) **Positive variance due to competitive bids received for UV equipment and installation contracts.**
4) **Negative variance due to additional engineering requirements.**
5) **Capital cost adjusted to include the works recommended in this report.**

Appendix 2
Water Treatment Plant Financing Schedule $000s
Updated to Reflect Additional Costs to Mitigate Risks
(actual to year ending December 31, 2004)

Year	Capital Expenditure	Contribution to Reserve				Balance End of Year	
		Contribution	Interest	Total	Debt	Debt	Reserve
to 2004	$ 11,027	$ 79,891	$ 15,942	$ 95,833	$ -	$ -	$ 84,806
2005	64,854	10,416	1,816	12,232	-	-	32,184
2006	78,715	10,167	468	10,635	40,000	40,000	4,104
2007	72,704	-	-	-	68,600	108,600	-
Total	**$ 227,300**	**$ 100,474**	**$ 18,226**	**$ 118,700**	**$ 108,600**		