

Introduction:

In the early 90's, a number of municipalities in south central Manitoba joined to form the Pembina Valley Water Cooperative Inc. (PVWC). The purpose was to develop a regional approach to supplying potable water in an area which lacked wide distribution of good, plentiful water resources, but which also exhibited the highest rate of economic growth of any region in Manitoba. Municipalities that are currently members of the cooperative include:

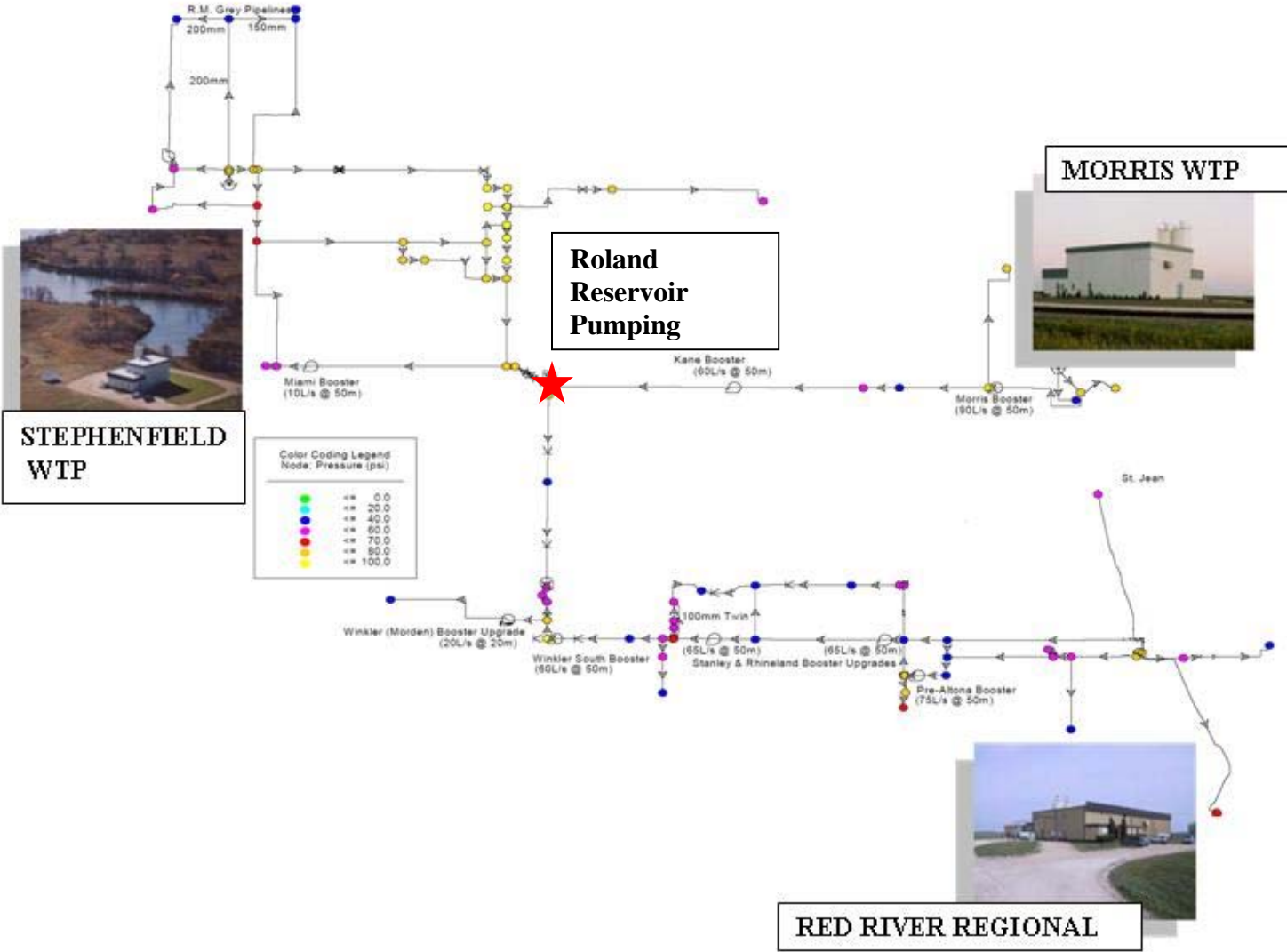
Town of Altona	R.M. of Dufferin
Town of Carman	R.M. of Franklin
Town of Emerson	R.M. of Grey
Town of Gretna	R.M. of Montcalm
Town of Morden	R.M. of Morris
Town of Morris	R.M. of Rhineland
Town of Plum Coulee	R.M. of Roland
Village of St. Claude	R.M. of Stanley
City of Winkler	R.M. of Thompson

The mandate of the PVWC is to provide treated/potable water that meets all of the Canadian drinking water standards to its municipal members. It is governed by a board of 18 members, one representative from each municipal member.

The PVWC is a wholesaler of water which it distributes through its pipelines to its municipal customers. The municipalities then sell this water to the end user, their customers, delivered through their own distribution system. The service area covers 3500 square miles with a population base of approx. 45,000. The existing water supply system is shown on Figure 1.

Figure 1 (not to scale) is a model of the PVWC distribution system, including the three water treatment plants.

Figure 1 – PVWC Distribution System



Existing Water Supply

The water treatment plant at Morris withdraws water from the Red River and pumps it into a large holding pond. It has the capacity to produce up to 67 litres per second (lps) of treated water. The commission of the Morris plant in Feb 2010 increased the capacity to 67 lps. From there, treated water is provided to the Town of Morris, the R.M.s of Morris, Montcalm, Roland, Thompson, and Dufferin and a partial supply to the City of Winkler and the R.M. of Stanley. The remainder of the supply to Winkler and Stanley comes from the Letellier water treatment plant.

The Letellier water treatment plant also withdraws water from the Red River and has the ability to produce up to 100 lps of treated water. From there, treated water is provided to Towns of Emerson, Altona, Gretna, Plum Coulee and Morden and to the City of Winkler. Treated water is also provided from this plant to the R.M.s of Franklin, Montcalm, Rhineland, Stanley, and the Roseau River First Nation.

The Stephenfield water treatment plant withdraws water from the Stephenfield Reservoir and has a capacity to produce up to 25 lps of treated water. This plant provides water to St. Claude and Haywood and to the R.M.s of Dufferin, Grey, Thompson and a partial supply to the R.M.s of Roland, Morris and the Town of Carman

By the licensing requirements of the existing system and as a matter of best management practice, all of the regions existing supplies are utilized to their sustainable yield with the exception of the newly expanded water treatment plant in Morris. The expansion will allow for growth and drought resistance in the future. The Town of Morden receives only 10% of their water supply from the PVWC with the remainder coming from Lake Minnewasta. The City of Winkler receives approximately 35% of their supply from the PVWC and the remainder is withdrawn from the Winkler Aquifer. The Town of Carman receives 25% of their water supply from the PVWC and the rest of their supply comes from the Boyne River.

The PVWC is a user-pay water supply system. The price includes the cost of production, operation and maintenance, principal and interest. There is no decreasing scale or other discounting in the pricing system. The price charged to deliver the water to the municipal system in 2010 was \$6.40 per thousand gallons.

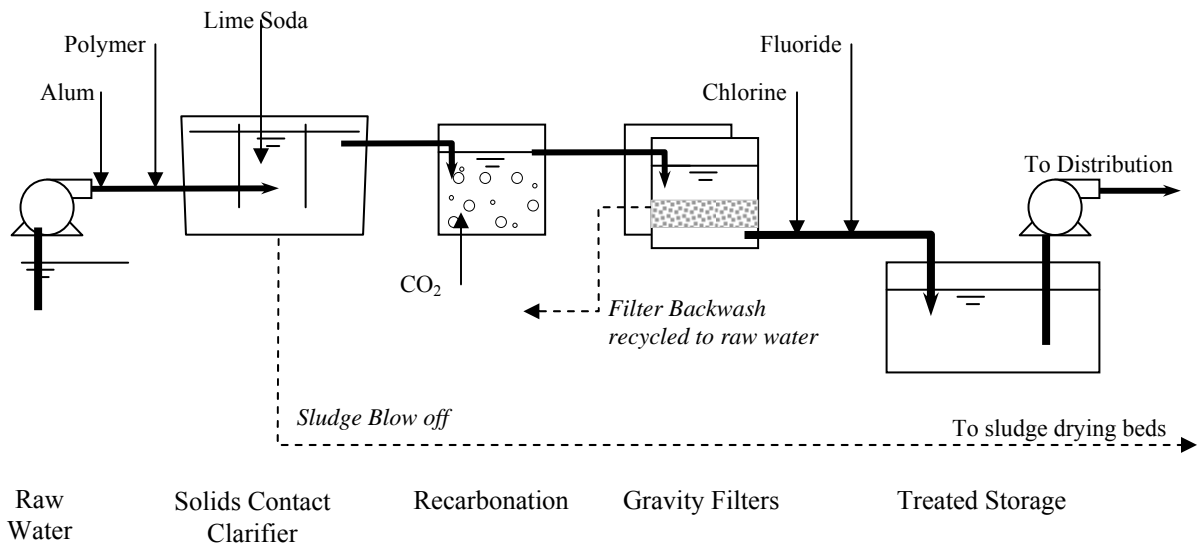
Red River Regional Water Treatment Plant - Letellier

- Red River used as water source
- Rated for 96 litres per second
- Storage capacity 2,450,000 litres or 540,000 gallons
- Senior plant operator- Kirt Henry
- Drinking Water Officer- Marc Balcaen/Jared McNabb



The following is a description of the major treatment processes for the Red River Regional Water Treatment Plant:

This lime softening plant, which is typical of those commonly found throughout the Manitoba prairies, is used to treat the water from the Red River. Figure 4.1 is a schematic of



the existing process.

Figure 4.1

The current process consists of a screened raw water intake located off the Red River that pumps to an off stream storage reservoir beside the plant which is then pumped directly to the solids contact clarifier. The cold lime softening clarifier then reduces hardness and turbidity. The subsequent recarbonation step stabilizes the clarifier effluent and the gravity filters polish the water for final turbidity and pathogen reduction.

The filtered water is then dosed with chlorine for disinfection and fluoride for dental maintenance. The fluoridation program is monitored by Manitoba Health and Living.

Disinfection Monitoring and Reporting

The treated water leaving the water plant is tested continuously for a level of chlorine that is high enough for proper disinfection in the distribution system.

	Requirement	Performance
Free chlorine residual entering the distribution system (A)	≥ 0.5 mg/l	100%
Free chlorine residual in the distribution system (B)	≥ 0.1 mg/l	<100%*
Frequency of testing (A)	Continuous	100%
Frequency of testing (B)	Weekly	100%
Report submissions	Monthly	100%

* Free chlorine at the end of a distribution system is dependent on the initial chlorine injected at the source, the rate of flow in the distribution system and the time spent in the distribution system. Changes in any of these factors can result in lower chlorine residuals. Corrective action forms were submitted to meet regulations.

Bacteriological Monitoring and Reporting

The raw and treated water is tested on a weekly basis for the presence of total coliform and E. coli bacteria. If these bacteria are present in the water it is an indication that disease causing organisms may also be present.

	Requirement	Performance
Number of treated water samples	52	100%
Total Coliform present in treated water samples	0 per 100ml	100%
E-Coli present in treated water samples	0 per 100ml	100%

A copy of the water test results are kept at the water treatment plant and at the main office in Altona.

Turbidity Monitoring and Reporting

Turbidity is a measurement of the clarity of water. Turbidity is used to tell us if the treatment process and filtration is working to remove particles and other contaminants from the water.

A high turbidity can cause the water to look cloudy and affect the disinfection process. Turbidity is continuously tested after the filtering process and before disinfection.

Turbidity, which is measured and reported in nephelometric turbidity units (NTU), is an optical measurement of water's ability to scatter and absorb light rather than transmit it in straight lines.

	Requirement	Performance
Chemically assisted, rapid gravity filtration process for water treatment	≤ 0.3 NTU in at least 95% of the samples taken per month	100%
	Not to exceed 0.3 NTU for more than 12 continuous hours	100%
	Not to exceed 1.0 NTU at any time	100%
Frequency of testing	Continuous	100%
Report submissions	Monthly	100%

Disinfection By-products Monitoring and Reporting

Trihalomethane (THM's) are formed when chlorine reacts with naturally occurring organic matter in the water. Studies have shown a link between high levels of THM's and cancer. The province has set a standard for THM's of 100 micrograms per litre of water. The THM standard is based on an average of four samples per year. Our water from the Letellier plant is tested at four locations in the distribution system, Emerson, St.Jean Baptiste, Gretna and Morden.

Trihalomethane quarterly sampling

Locations	Requirement	Test Results
Emerson	Less than or equal to 100 µg/L as an annual average of quarterly samples	121.5 µg/L
St Jean Baptiste		119.4 µg/L
Gretna		122.7 µg/L
Morden		126.2 µg/L

One factor in the increase in THM's is the new requirement to maintain greater than 0.1 mg/l of chlorine residual in the water distribution system. This has made it necessary to increase the chlorine concentration leaving the water treatment plant which has the direct result of

increasing the THM's. New treatment methods and operational methods are being investigated to reduce the disinfection by-products created by chlorine.

Analysis of Raw & Treated Water Samples Red River Water Treatment Plant

Parameter		Raw Water	Treated Water	Aesthetic Objective	Units
Total Dissolved Solids		497	363	500	mg/l
Dissolved Chloride	Cl	26.5	29	250	mg/l
Dissolved Sulphate	SO ₄	138	132	500	mg/l
pH		8.58	7.81	6.5-8.5	pH units
Total Alkalinity	CaO ₃	212	91.5	-	mg/l
Bicarbonate Alkalinity	HCO ₃	240	112	-	mg/l
Carbonate Alkalinity	CO ₃	9.17	<0.6	-	mg/l
Hydroxide Alkalinity	OH	<0.4	<0.4	-	mg/l
Copper	Cu	0.00488	0.0142	1.0	mg/l
Iron	Fe	0.67	<.020	0.3	mg/l
Manganese	Mn	0.461	0.00186	0.05	mg/l
Sodium	Na	36.4	71.7	200	mg/l
Zinc	Zn	0.0088	0.054	5	mg/l
Hardness	CaCO ₃	299	109	-	mg/l
Dissolved Fluoride	F	0.22	1.25	1.5	mg/l
Nitrate and Nitrite	N	<0.050	0.114	10	mg/l
Dissolved Sulphate	SO ₄	138	132	-	mg/l
Ammonia Nitrogen	N	<0.05	<0.050	-	mg/l
Conductivity		685	572	-	uS/cm
Aluminum	Al	0.499	<0.0050	-	mg/l
Antimony	Sb	0.00044	0.00041	0.006	mg/l
Arsenic	As	0.0121	0.00160	0.010	mg/l
Barium	Ba	0.0720	0.0216	1.0	mg/l
Boron	B	0.0081	0.053	5	mg/l
Cadmium	Cd	0.000082	<0.00001	0.005	mg/l
Calcium	Ca	67.1	40.2	-	mg/l
Chromium	Cr	<0.0010	<0.0010	0.05	mg/l
Lead	Pb	0.000846	0.000278	0.01	mg/l

Parameter		Raw Water	Treated Water	Max Acceptable Concentration	Units
Magnesium	Mg	32.0	2.03	-	mg/l
Potassium	K	7.20	7.02	-	mg/l
Selenium	Se	<0.0010	<0.0010	0.01	mg/l
Silver	Ag	<0.00010	<0.00010	-	mg/l
Uranium	U	0.00306	<0.0001	0.02	mg/l

Parameter	Raw Water	Treated Water	Detection Limit	Units
Total Organic Carbon	20.5	5.8	.0002	mg/l
Total Inorganic Carbon	47.6	22.6	1	mg/l
Total Carbon	68.1	28.4	1	mg/l

Major Expenses for Red River Regional Water Treatment Plant in 2010

The 8” pipeline diversion along highway 201 due to the reconstruction was completed. Also the modification to the north sludge ponds has been completed.

Future Expenses for the Red River Water Treatment Plant

No major expenses are planned for the next year ongoing maintenance will have some higher costs.

Water Breaks

One major water main break occurred on Sept 20 south of Winkler when a directional boring machine hit the pipeline. This line affected the Boundary trails hospital and forced the hospital to use the backup tanker system for their water supply. The pipeline was fixed, flushed, and then put back into service several hours later.

Morris Regional Water Treatment Plant

- Red River used as water source
- Rated for 67 litres per second
- Storage capacity 2,800,000 litres or 616,000 gallons
- Senior plant operator- Byron Klassen
- Drinking Water Officer- Greg Wojcikowski/Jared McNabb



The following is a description of the major treatment processes for the Morris Regional Water Treatment Plant which was commissioned on March 17:

The plant is a new state of the art micro filtration and membrane plant. Figure 4.2 is a schematic of the new process. The cold lime process was used in January and February.

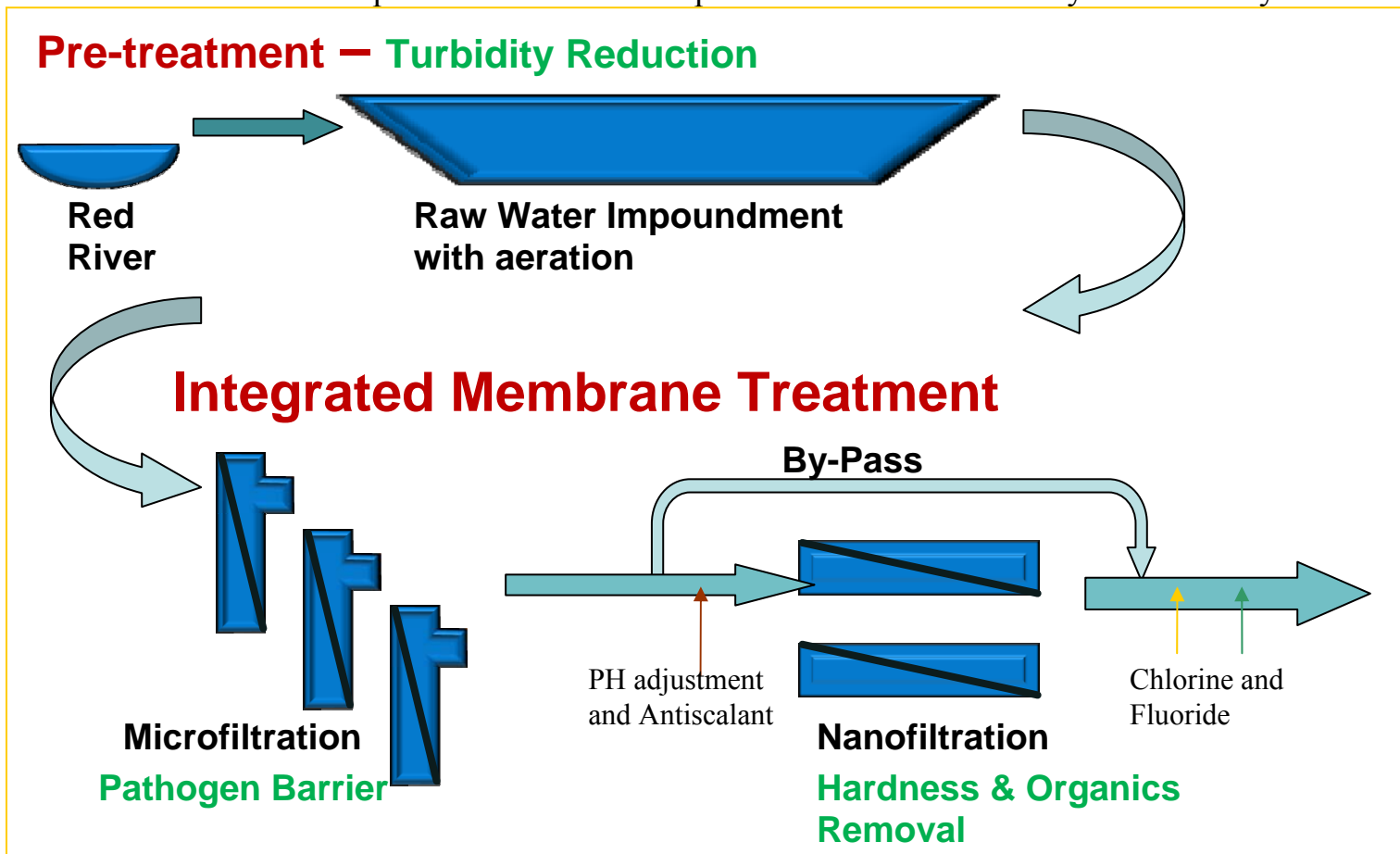


Figure 4.2

The new process consists of a screened raw water intake located off of the Red River that pumps into a raw water impound for off stream storage and settling. The Microfiltration removes the pathogens and reduces the turbidity to a point where it is potable. A partial percentage of the water is bypassed and put in to the distribution system. The subsequent nanomembrane step removes the hardness and the organics so that when the water is blended the water exceeds all of the Manitoba Drinking waters guidelines. The blended water is then dosed with chlorine for disinfection and fluoride for dental maintenance. The fluoridation program is monitored by Manitoba Health and Living.

Disinfection Monitoring and Reporting

The treated water leaving the water plant is tested continuously for a level of chlorine that is high enough for proper disinfection in the distribution system.

	Requirement	Performance
Free chlorine residual entering the distribution system (A)	≥ 0.5 mg/l	100%
Free chlorine residual in the distribution system (B)	≥ 0.1 mg/l	100%
Frequency of testing (A)	Daily	100%
Report submissions	Monthly	100%

Bacteriological Monitoring and Reporting

The raw and treated water is tested on a weekly basis for the presence of Total Coliform and E. coli bacteria. If these bacteria are present in the water it is an indication that disease causing organisms may also be present.

	Requirement	Performance
Number of raw/incoming water samples	52	100%
Number of treated water samples	52	100%
Frequency of testing	Weekly	100%
Total Coliform present in treated water samples	0 per 100ml	100%
E-Coli present in treated water samples	0 per 100ml	100%

A copy of the water test results are kept at the water treatment plant and at the main office in Altona.

Turbidity Monitoring and Reporting

Turbidity is a measurement of the clarity of water. Turbidity is used to tell us if the treatment process and filtration is working to remove particles and other contaminants from the water. A high turbidity can cause the water to look cloudy and affect the disinfection process. Turbidity is continuously tested after the microfiltration process and before disinfection. Turbidity, which is measured and reported in nephelometric turbidity units (NTU), is an optical measurement of water's ability to scatter and absorb light rather than transmit it in straight lines.

	Requirement	Performance
Continuous sampling of the effluent from each of the microfiltration skids.	≤ 0.1 NTU in at least 99% of the samples taken per month	100%
	Not to exceed 0.3 NTU for any continuous time	100%
	Not to exceed 1.0 NTU at any time	100%
Frequency of testing	Continuous	100%
Report submissions	Monthly	100%

Disinfection By-products Monitoring and Reporting

Trihalomethane (THM's) are formed when chlorine reacts with naturally occurring organic matter in the water. Studies have shown a link between high levels of THM's and cancer. The province has set a standard for THM's of 100 micrograms per litre of water. The THM standard is based on an average of four samples per year. Our water is tested at two locations in the distribution system, Miami and Rosenort.

	Requirement	Performance
Trihalomethane sampling requirements	2 sample locations 4 times a year	100%
Miami	<100 $\mu\text{g/L}$ as an annual average of quarterly samples	67.3 $\mu\text{g/L}$
Rosenort		54.8 $\mu\text{g/L}$

The new treatment method and operational methods is effective for decreasing the by-products created by chlorine.

**Analysis of Raw & Treated Water Samples
Morris Water Treatment Plant**

Parameter		Raw Water	Treated Water	Aesthetic Objective	Units
Total Dissolved Solids		550	134	500	mg/l
Dissolved Chloride	Cl	26.6	9.29	250	mg/l
Dissolved Sulphate	SO4	155	37.3	500	mg/l
pH		8.56	7.68	6.5-8.5	pH units
Total Alkalinity	CaO3	218	51.1	-	mg/l
Bicarbonate Alkalinity	HCO3	251	62.3	-	mg/l
Carbonate Alkalinity	CO3	7.72	<0.6	-	mg/l
Hydroxide Alkalinity	OH	<0.4	<0.4	-	mg/l
Copper	Cu	0.00775	0.0377	1.0	mg/l
Iron	Fe	1.82	<0.020	0.3	mg/l
Manganese	Mn	0.0434	0.000543	0.05	mg/l
Sodium	Na	35.4	10.4	200	mg/l
Zinc	Zn	0.0117	0.01	5	mg/l
Hardness	CaCO3	346	78.3	-	mg/l
Dissolved Fluoride	F	0.138	0.877	1.5	mg/l
Nitrate and Nitrite	N	0.13	<0.050	10	mg/l
Dissolved Sulphate	SO4	155	37.3	-	mg/l
Ammonia Nitrogen	N	0.028	0.010	-	mg/l
Conductivity		761	218	-	uS/cm
Aluminum	Al	1.84	<0.0050	-	mg/l
Antimony	Sb	0.00025	<0.00020	0.006	mg/l
Arsenic	As	0.00488	0.000113	0.010	mg/l
Barium	Ba	0.0651	0.0113	1.0	mg/l
Boron	B	0.074	0.061	5	mg/l
Cadmium	Cd	0.000049	<0.00001	0.005	mg/l
Calcium	Ca	67.5	16.3	-	mg/l
Chromium	Cr	0.0026	<0.000010	0.05	mg/l
Lead	Pb	0.000990	0.000546	0.01	mg/l
Magnesium	Mg	43.1	9.14	-	mg/l
Potassium	K	7.19	1.74	-	mg/l
Selenium	Se	<0.001	<0.001	0.01	mg/l
Silver	Ag	<0.0001	<0.00010	-	mg/l
Uranium	U	0.00394	0.00087	0.02	mg/l

Parameter	Raw Water	Treated Water	Detection Limit	Units
Total Organic Carbon	10.0	2.8	1	mg/l
Total Inorganic Carbon	48.6	13.0	1	mg/l
Total Carbon	58.6	15.8	1	mg/l

Major Expenses for Morris Water Treatment Plant in 2010

The plant was expanded to 67 litres per second. Also a new off stream storage facility with a new river intake and pumping station was built that will store enough water to run the new plant for up to 300 days without needing water from the Red River. The cost of this total project was \$15,000,000.

Future Expenses for the Morris Treatment Plant

No major expenses at the Morris treatment plant

Other events

In July flushing was done near Morris due to the new chemistry of water that had the effect of cleaning pipelines which resulted in yellowish water. On top of that the iron and manganese in the water source also affected the water quality. Both of these issues did not pose a health risk to the consumers but it affected the aesthetics of the water. After flushing the pipelines and adding a sequestering agent the problem was resolved.

Stephenfield Regional Water Treatment Plant

- Stephenfield Lake used as water source
- Rated for 20 litres per second
- Storage capacity 950,000 litres or 209,000 gallons
- Senior plant operator- Paul Termeer
- Drinking Water Officer- Marc Balcaen/ Jared McNabb



The following is a description of the major treatment processes for the Stephenfield Regional Water Treatment Plant:

The existing plant is a typical lime softening plant found throughout the Manitoba prairies.

Figure 4.3 is a schematic of the existing process.

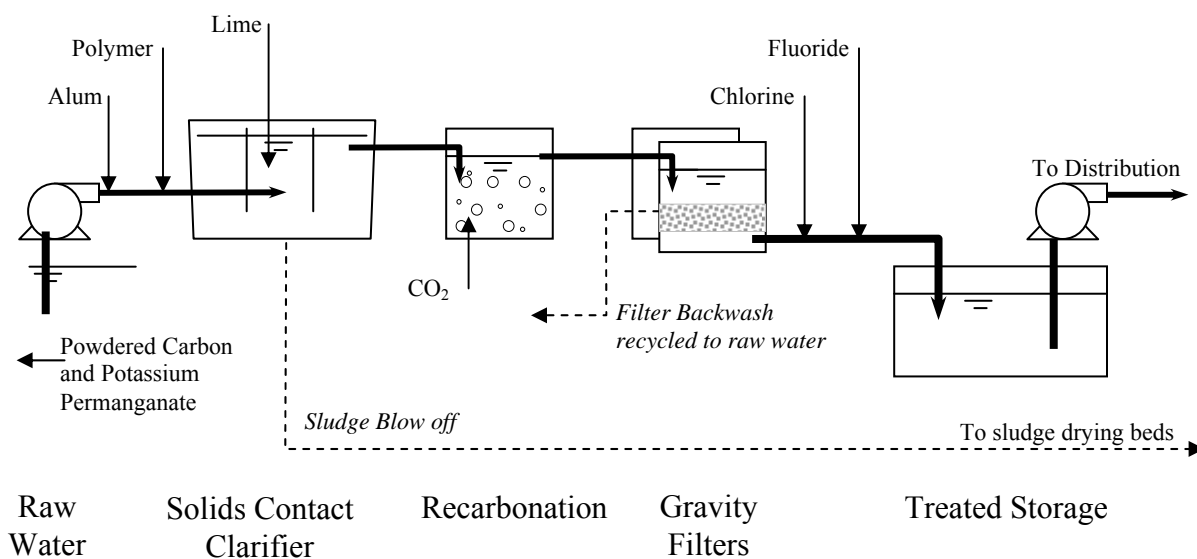


Figure 4.3

The current process consists of a screened raw water intake located in Stephenfield Lake that feeds water directly to pumps in the water plant that supplies water to the solids contact clarifier. The cold lime softening clarifier then reduces hardness and turbidity. The subsequent recarbonation step stabilizes the clarifier effluent and the gravity filters polish the water for final turbidity and pathogen reduction.

The filtered water is then dosed with chlorine for disinfection and fluoride for dental maintenance. The fluoridation program is monitored by Manitoba Health and Living.

Disinfection Monitoring and Reporting

The treated water leaving the water plant is tested continuously for a level of chlorine that is high enough for proper disinfection in the distribution system.

	Requirement	Performance
Free chlorine residual entering the distribution system (A)	≥ 0.5 mg/l	100%
Free chlorine residual in the distribution system (B)	≥ 0.1 mg/l	100%*
Frequency of testing (A)	Continuous	100%
Frequency of testing (B)	Weekly	100%
Report submissions	Monthly	100%

* PVWC met the regulatory requirement for 2010. Corrective action forms were received for all days of non-compliance.

Bacteriological Monitoring and Reporting

The raw and treated water is tested on a weekly basis for the presence of Total Coliform and E. coli bacteria. If these bacteria are present in the water it is an indication that disease causing organisms may also be present.

	Requirement	Performance
Number of raw/incoming water samples	26	100%
Number of treated water samples	26	100%
Frequency of testing	Bi-Weekly	100%
Total Coliform present in treated water samples	0 per 100ml	100%
E-Coli present in treated water samples	0 per 100ml	100%

A copy of the water test results are kept at the water treatment plant and at the main office in Altona.

Turbidity Monitoring and Reporting

Turbidity is a measurement of the clarity of water. Turbidity is used to tell us if the treatment process and filtration is working to remove particles and other contaminants from the water. A high turbidity can cause the water to look cloudy and affect the disinfection process.

Turbidity is continuously tested after the filters and before disinfection.

Turbidity, which is measured and reported in nephelometric turbidity units (NTU), is an optical measurement of water's ability to scatter and absorb light rather than transmit it in straight lines.

	Requirement	Performance
Chemically assisted, rapid gravity filtration process for water treatment	≤ 0.3 NTU in at least 95% of the samples taken per month	100%*
	Not to exceed 1.0 NTU at any time	100%
Frequency of testing	Continuous	100%
Report submissions	Monthly	100%

*Corrective action forms were received for all days of non-compliance.

Disinfection By-products Monitoring and Reporting

Trihalomethane (THM's) are formed when chlorine reacts with naturally occurring organic matter in the water. Studies have shown a link between high levels of THM's and cancer. The province has set a standard for THM's of 100 micrograms per litre of water. The THM standard is based on an average of four samples per year. Our water is tested at two locations in the distribution system, St. Claude and Sperling.

	Requirement	Performance
Trihalomethane sampling requirements	2 sample locations 4 times a year	100%
Location		
St. Claude	≤100 µg/L as annual average of quarterly samples	122.8µg/L
Sperling		194.3µg/L

Meeting the standard in the Stephenfield distribution system will be a challenge. The need to keep the required chlorine residual at the distribution ends forces a high chlorine injection at the plant site. A Re-chlorination station has been installed north of Carman which will take time to see the results. PVWC is continually looking at any new process systems that could be added in the future to remedy this problem.

**Analysis of Raw & Treated Water Samples
Stephenfield Water Treatment Plant**

Parameter		Raw Water	Treated Water	Aesthetic Objective	Units
Total Dissolved Solids		544	273	500	mg/l
Dissolved Chloride	Cl	19.2	23.8	250	mg/l
Dissolved Sulphate	SO ₄	72.3	83.9	500	mg/l
pH		8.35	7.45	6.5-8.5	pH units
Total Alkalinity	CaO3	348	42.1	-	mg/l
Bicarbonate Alkalinity	HCO ₃	416	51.3	-	mg/l
Carbonate Alkalinity	CO ₃	4.25	<0.6	-	mg/l
Hydroxide Alkalinity	OH	<0.4	<0.4	-	mg/l
Copper	Cu	.00118	.024	1.0	mg/l
Iron	Fe	0.058	<0.020	0.3	mg/l
Manganese	Mn	1.98	0.00386	0.05	mg/l
Sodium	Na	26.9	31.1	200	mg/l
Zinc	Zn	<0.0050	<0.050	5	mg/l

Parameter		Raw Water	Treated Water	Max Acceptable Concentration	Units
Hardness	CaCO ₃	345	42.1	-	mg/l
Dissolved Fluoride	F	0.32	0.75	1.5	mg/l
Nitrate and Nitrite	N	0.214	0.366	10	mg/l
Dissolved Sulphate	SO ₄	72.3	83.9	-	mg/l
Ammonia Nitrogen	N	0.296	<0.050	-	mg/l
Conductivity		745	355	-	uS/cm
Aluminum	Al	0.0536	0.0242	-	mg/l
Antimony	Sb	0.00034	0.00040	0.006	mg/l
Arsenic	As	0.0117	0.00157	0.010	mg/l
Barium	Ba	0.0701	0.00812	1.0	mg/l
Boron	B	0.104	0.069	5	mg/l
Cadmium	Cd	0.000013	<0.00001	0.005	mg/l

Parameter		Raw Water	Treated Water	Max Acceptable Concentration	Units
Calcium	Ca	85.5	19.3	-	mg/l
Chromium	Cr	<0.0010	<0.0010	0.05	mg/l
Lead	Pb	<0.00009	0.000355	0.01	mg/l
Magnesium	Mg	32.0	9.14	-	mg/l
Potassium	K	9.22	8.92	-	mg/l
Selenium	Se	<0.0010	<0.0010	0.01	mg/l
Silver	Ag	<0.00010	<0.00010	-	mg/l
Uranium	U	0.00516	<0.00010	0.02	mg/l

Parameter		Raw Water	Treated Water	Detection Limit	Units
Total Organic Carbon		15.7	8.1	1	mg/l
Total Inorganic Carbon		77.7	10.1	1	mg/l
Total Carbon		93.4	18.2	1	mg/l

Major Expenses for Stephenfield Water Treatment Plant in 2010

There were no major projects undertaken at the Stephenfield Water Treatment Plant.

Future Expenses for the Stephenfield Treatment Plant

There are no extra projects planned for the Stephenfield plant in the next two years.