Appendix E

TECHNICAL MEMORANDUM #4

Iron and Manganese Treatment Upgrades for the Shingletown Wells Class Environmental Assessment

Technical Memorandum #4

Develop Alternative Design Concepts- Facility Sizing and Short-Listed Locations

FINAL

Prepared for:

Region of Waterloo

RVA 184245

December 16, 2020

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December 16, 2020 RVA 184245

Region of Waterloo
Transportation and Environmental Services
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Attention: Nicole Sapeta

Dear Ms. Sapeta:

Re: Technical Memorandum #4 – Develop Alternative Design Concepts- Facility Sizing and Short- Listed Locations– FINAL
Iron and Manganese Treatment Upgrades for the Shingletown Wells Class Environmental Assessment

Please see the enclosed Technical Memorandum #4 as a submittal for the Iron and Manganese Treatment Upgrades for the Shingletown Wells Class Environmental Assessment.

Yours very truly,

R.V. ANDERSON ASSOCIATES LIMITED

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Project Manager

Encls.

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Iron and Manganese Treatment Upgrades for the Shingletown Wells Class Environmental Assessment

Technical Memorandum #4
Develop Alternative Design Concepts- Facility Sizing and Short-Listed Locations

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1.0 INTRODUCTION

The Shingletown Wells (Wells K50, K51 and K52) and the existing treatment facility are located at 2324 Bleams Road in the Township of Wilmot.

The purpose of this technical memorandum is to present the conservative assumptions used to estimate the footprint requirements for the new iron and manganese treatment facility based on the preferred treatment and residual management solutions for the Shingletown Wells from Technical Memorandum #3 Develop and Evaluate Alternative Solutions (TM#3).

Once the short-listed sites have been selected, further archeological and natural environment studies will be completed. Using the results from these studies, the short-listed sites will be evaluated in Technical Memorandum #5 Evaluation of Alternative Design Concepts- Preliminary Preferred Location (TM#5) using the criteria and scoring method outlined in Technical Memorandum #2 Evaluation Criteria (TM#2).

2.0 FACILITY LAYOUT

The recommended treatment alternative from TM#3 was oxidation and filtration using chlorine as the oxidant with catalytic media. The residual management for the facility includes a backwash equalization tank with wastewater being sent to a clarifier for further settling. Supernatant from the clarifier would be recycled to the head of the filters and the sludge would be pumped occasionally to a sludge holding tank with sludge being hauled offsite as required.

Based on the preferred treatment approach, key facility components are summarized below:

- Provision for Two (2) Raw Water Reservoirs
- Two (2) Clearwells
- Filter and Pump Room
- Two (2) Backwash Equalization Tanks
- Clarifier
- Sludge Holding Tank

- Electrical Room
- Mechanical Room
- Chemical Room
- Provision for Office/Lab

The new site should have additional space for adequate property set-backs, driveway, parking, septic holding tank and tile field, landscaping and future expansions if required.

3.0 PRELIMINARY EQUIPMENT AND TANKAGE SIZING ASSUMPTIONS

3.1 Flow Rate

Based on the existing Permit To Take Water (PTTW), a design flow rate of 157.8 L/s was assumed. It is anticipated that the wells will be capable of supplying up to the PTTW capacity as Well K52 will be brought into service for the new facility.

3.2 Tankage Depth

It was assumed the depth the excavation for the tanks is approximately 3.5 m below grade due to unknown soil conditions. With an approximate 0.5 m for the base slab and 0.5 m allowed for freeboard, the depth of water in the tankage is 2.5 m.

3.3 Raw Water Reservoir

To be conservative, space was provided for a raw water reservoir with two cells, each estimated to be 12 by 12 m holding approximately 360 m^3 each. The inclusion of the raw water reservoir is provisional and will be finalized during detailed design.

3.4 Filter and Pump Room

It is assumed there will be four low lift pumps (2 duty and 2 standby) delivering water to the filters and four high lift pumps (2 duty and 2 standby) delivering water to the distribution system. There will be two pumps (1 duty and 1 standby) for backwashing and 2 blowers (1 duty and 1 standby) for air scour. It was estimated that all the pumps and blowers would be in one room. It can be noted the low life pumps are only required if the raw water reservoir is included in the final design. Alternatively, the well pumps could be sized to deliver water through the filters. The high-lift and backwash pumps will be required for either configuration.

Pressure filters and gravity filters were both considered. Supplier correspondence based on the pressure filter pilot testing data has confirmed that the filters can operate at maximum loading rate ranging between 18 m/h to 24.4 m/h. Pressure filter sizing was selected to meet the maximum loading rate with one filter out of operation, and considered both horizontal and vertical filters. The gravity filters were sized to not exceed the recommended loading rate by the

MECP design guidelines of 11.7 m/h since pilot testing was not conducted. A summary of the filter sizing and the filter room size requirements are listed in Table 1.

For the purposes of the Class EA, it was assumed there was 2.5 m on either side and in between the filters to provide space for walking. Five (5) meters of spacing was provided on one side to account for the piping. The different filter room dimensions are outlined in Table 1.

To determine the approximate building footprint requirements, the maximum length and width requirements were used. The minimum spacing required for the filters was 27 m by 14 m. The additional space above the raw water reservoirs, the clearwells and the backwash equalization tanks was used for the pumps and piping. It was assumed that 2 m spacing was required on either side and in between the pumps and blowers to allow space for access and maintenance. On one side 4 m of spacing was provided for piping. Since the below ground tankage required more space than the pumps and piping on the ground floor, the filter and pump room was conservatively sized to be the same size as the area of tankage below.

Table 1: Summary of Pressure and Gravity Filter Sizing and Preliminary Sizing of the Filter Room

	Number of Filters	Filter Area per Filter (m^2)	Filter Loading Rate 1 Filter Down (m/h)	Preliminary Filter Room Length (m)	Preliminary Filter Room Width (m)
Tonka Vertical Filters 3.20 m D	4	8.1	23.4	25	11
Tonka Horizontal Filter, 3 Cells, 3.05 m D x 7.92 m L	2	24.2	23.4	15	14
Hungerford & Terry Vertical Filters 3.35 m D	4	8.8	21.4	26	11
Hungerford & Terry Horizontal Filters, 3 Cells 3.05 m D x 9.14 m L	2	27.8	20.4	17	14
Napier Reid Vertical Filters 3.66 m D	4	10.5	18.0	27	11
Pureflow Horizontal Filter 2.44 m D x 3.96 m L	3	11.6	24.5	17	11
Gravity Filters with GreensandPlus 5 m x 5.5 m	3	27.5	10.3	24	13

3.5 Clearwell

It was assumed the clearwell will be used for the backwash water as well as providing the appropriate contact time required by the Ministry of the Environment, Conservation and Parks (MECP).

Per the Region of Waterloo's (Region) existing municipal drinking water licence (MDWL), 4 log inactivation for virus is required for the Shingletown Wells. The minimum volume in the clearwell to achieve the required level of disinfection is 194.2 m^3 based on temperature, pH and chlorine residual. The following conditions were used in the CT calculations taken from the water quality data for the Shingletown Wells. The data was collected by the Region's Environmental Enforcement and Lab Services staff and/or Water Operations staff. The data is stored in the Region's Hydrogeology & Source Water's Water Quality Database (eWRAS in-house database):

- pH = 8.3
- Water temperature = < 5 °C
- Chlorine residual = 1.3 mg/L (The current average free residual is 1.568 mg/L after the contact piping at the Shingletown Wells. Use 1.3 mg/L to be conservative.)
- Baffle Factor = 0.3 (Single or multiple unbaffled inlets and outlets, no intra-basin baffles)
- Maximum flow = 157.8 L/s
- CT to achieve 4 Log Virus= 8 mg/L/min

The worse case scenario of the filters being backwashed back to back was assumed while the facility continues to supply water to the system. The gravity filters are the most conservative requiring the largest backwash volume of 450 m^3. Assuming the clearwell was divided in two (2) cells, the required backwash volume was divided in two plus the volume required for disinfection.

The clearwell has two (2) cells, 13 m by 13 m, sized for a volume of 420 m^3 each. It can be noted that an alternate configuration could be used for the clearwell, which would have separate tanks for the clearwell and the backwash feed. This configuration would not result in an overall increase in the footprint for the tankage. A preferred configuration is to be determined during the detailed design.

3.6 Residual Management

A conservative footprint for the residual management system for recycling the supernatant and hauling the solids include a backwash equalization tank, clarifier, and sludge holding tank.

3.6.1 Backwash Equalization Tank (BET)

The BET was sized to hold the wastewater of the backwash and filter to waste volumes for all the filters and the analyzer volumes for 5 days between backwashes. To be conservative, the largest wastewater volume produced from the filters in Table 1 for the gravity filters.

The volume for the BET of 790 m^3 was assumed to be divided into 2 cells. Each cell would be 13 m by 13 m.

3.6.2 Clarifier

The total wastewater volume would be sent from the BET to the clarifier over 24 hours with a flow rate into the clarifier estimated to be 10 L/s. The supernatant from the clarifier would be recycled to the head of the plant. The sludge would be settled by gravity and periodically blown down to the sludge holding tank. Polymer addition may be required to enhance the settling process. The estimated size of the clarifier was 4 m by 4 m to hold 40 m^3 (based on an assumed 5 m/h settling rate).

3.6.3 Sludge Holding Tank

The sludge holding tank is located below grade, beside the clarifier. An estimated sludge holding tank of 3 m by 3 m was assumed. The sludge holding tank was sized to hold a minimum of 4 weeks of sludge blown down from the clarifier at a settled solids concentration of 0.5%.

3.7 Electrical Room

The electrical room was sized to include the MCCs, transformer, switchboard, automatic transfer switch (ATS) and VFDs for pumps and blowers.

The estimated size of the electrical room was 13 m by 11 m.

3.8 Mechanical Room

The mechanical room was sized to include the diesel generator, hot water tank and other HVAC equipment. The estimated size of the mechanical room was 6 by 13 m.

It can be noted that with the generator in the new facility, the existing diesel generator building at the Shingletown Wells site would no longer be required.

3.9 Chemical Room

The current chemical room contains two, 946 L (250 gallon) tanks for sodium hypochlorite. They consume approximately 144 L per day at an average dose of approximately 2 mg/L at 100 L/s. Currently, the Shingletown Wells have sodium hypochlorite delivered once a week.

The assumption is that the new facility will dose at approximately 2 mg/L at 157.8 L/s for a sodium hypochlorite consumption of 230 L/day. For two weeks of chemical storage, two 1700 L (450 gallon) tanks will be used, approximately 1.3 m in diameter.

The existing chemical room is approximately 5 m by 5 m. The estimated size of the chemical room for the new facility was 7 m by 13 m. This allows space fore the additional sodium hypochlorite and provisional space for coagulants and chemicals if required for backwash in the future.

3.10 Office/Lab

Space is required for a sample sink and storage. Provisional space was allocated for an office/lab that would contain the sample sink, storage, small fridge and desk

The estimated size of the office/lab was 4 m by 8 m

3.11 Miscellaneous Requirements and Considerations

Additional space requirements include space for building setbacks, parking and driveway access for deliveries. Additional space has also been allocated to provide flexibility for future requirements.

The Shingletown Well facility is within an area zoned as Agricultural Zone 1. Per the Township of Wilmot's building requirements, a Region water treatment facility is classified as a utility building and doesn't have any set back requirements or building size restrictions. However, to match the surrounding area, it is recommended that the new facility meets the same set back requirements as those required for Agricultural Zone 1.

A typical building within an Agricultural Zone 1 area would have the following setbacks:

- 10 m from the front of the property
- 3 m or half of the building height from the side property lines
- 7.5 m from the back of the property

It can be noted the Township of Wilmot typically does not allow for hard surfacing within 0.6 m (2 ft) of the property line. The parking spots were estimated to be 6 m long and 3 m wide, and the driveway was assumed to be 6 m wide with additional width where turning around could be required.

A setback from the back of the property has been allocated for construction laydown area and potential future requirements.

3.12 Preliminary Site Layout

From the above requirements, the total site area is approximately 0.56 hectares with a width of 75 m and a length of 75 m. The building will be 28 m by 55 m. The preliminary site layout is shown in Figure 3.1.

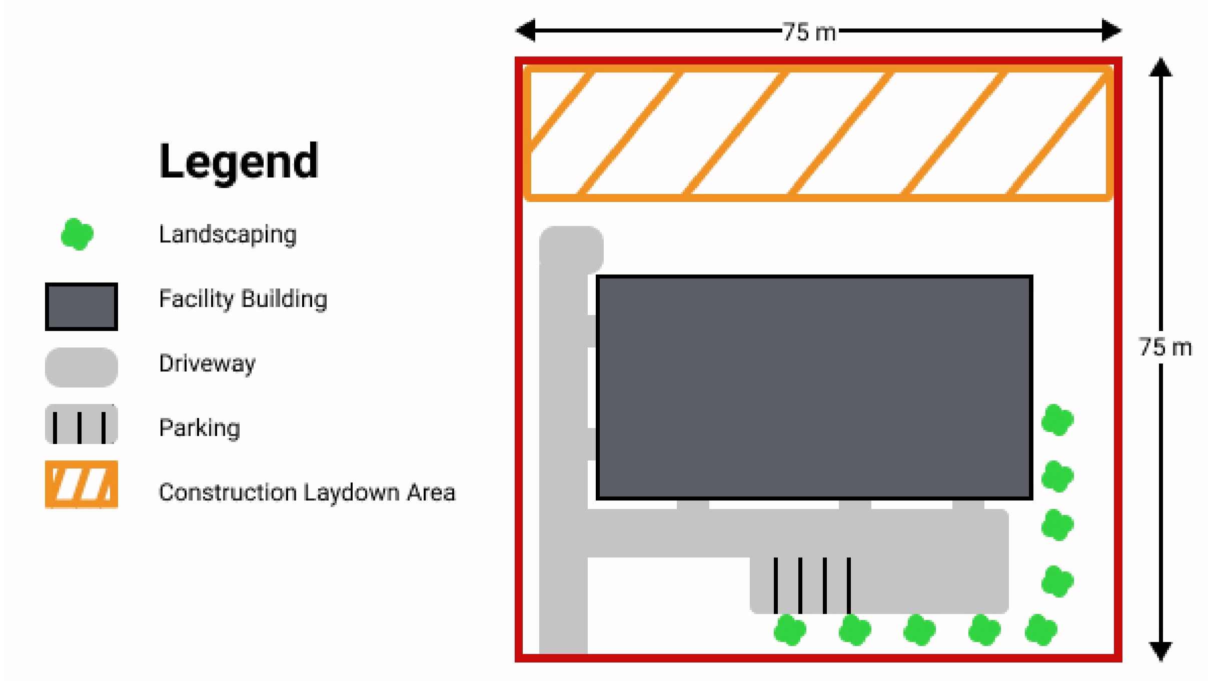

Figure 3.1: Preliminary Site Layout

4.0 DISCUSSION AND SELECTION OF FACILITY LOCATION ALTERNATIVES

4.1 Facility Location Alternatives

Three preliminary locations for the iron and manganese facility were identified and outlined in Figure 4.1. Potential sites were identified based on considerations for:

- Land size available
- Vehicle Access
- Distance to the existing Shingletown Wells and watermains
- Environmental features, culture heritage features and areas of archaeological potential
- Current and potential future land uses

Based on preliminary review, advantages and disadvantages of each site are listed in Table 2.

Figure 4.1: Preliminary Site Locations

Table 2: Advantages and Disadvantages of Potential Facility Location

Location	Advantages	Disadvantages
1	• Adjacent to Bleams Road for vehicle access	• Located furthest away from Shingletown Wells (approximately 240 m of piping required from well houses to new facility) • Agricultural field potential habitat for birds • Partially within GRCA regulated area
2	• Located close to Shingletown Wells (approximately 75 m of piping required) • Adjacent to Bleams Road for vehicle access	• Agricultural field potential habitat for birds • Construction required within roadway
3	• Located close to Shingletown Wells (approximately 50 m of piping required) • Land could be connected to existing Region property • Adjacent to Bleams Road for vehicle access	• Agricultural field potential habitat for birds

5.0 NEXT STEPS

The next step is to complete the natural environment survey for the identified facility locations.

The preliminary preferred location will be determined in TM#5 using the results from this technical memorandum (TM#4) and the natural environment survey.

Following the completion of TM#5, public consultation center #3 (PCC#3) will be conducted to present the findings from TM#5 and receive public input and feedback.

After TM#5 and PCC#3 is complete, the Environmental Study Report will be completed to document project information and the decision-making process.

Region of Waterloo Council will provide approval to file the Environmental Study Report for a 30-day review period for public comment.

APPENDIX A:

Residual Management Sizing Calculations

Shingletown Iron and Manganese Treatment Upgrades-Waterloo, ON

TM#4- Develop Alternative Design Concepts

BASIC DESIGN PARAMETERS

	L/s	m^3/h
Current Capacity (all 3 wells)	100	360
Future Capacity (all 3 wells)	157.8	568

FILTRATION

Number of filters	3		(Gravity filters)
Filter Length	5.5	m	
Filter Width	5	m	
Filter Area	27.5	m^2	
Filter Loading Rate	11.4	m/h	(For gravity filters. 18 to 24.4 m/h for pressure filters.)
Backwash Loading Rate	29.4	m/h	
Backwash Volume Rate per filter	809	m^3/h	
Backwash duration per filter	10	min	
Backwash duration per filter	0.167	h	
Backwash Volume per Filter	134.8	m^3	
Filter To Waste Loading Rate	11.7	m/h	
Filter To Waste Volume Rate	322	m^3/h	
Filter To Waste duration per filter	5	min	
Filter To Waste duration per filter	0.083	h	
Filter To Waste Volume per Filter	26.8	m^3	
Total Volume of Wastewater Produced Per Filter	162	m^3	

BACKWASH EQUALIZATION TANK

Total Volume of Wastewater Produced For All Filters	485	m^3	
Frequency of Backwash (Filter backwashed after number of days)	5	days	
Turbidity and Chlorine Analyzer Volume Produced Between Backwashes	60	m^3/day	(Turbidity + Chlorine analyzer 0.1 m3/h per analyzer. # of analyzers= # of filters + 2)
Total Volume of Tank	785.0	m^3	
Split in 2 Cells for redundancy	392.5	m^3	
Depth of water in BET	2.5	m	
Area required	157.0	m^2	
Length	13	m	
Width	13	m	

CLARIFIER

Flowrate Out of Clarifier	10	L/s	(10% of well capacity)
Flowrate Out of Clarifier	54	m^3/h	(With 1.5 safety factor)
High Rate Clarifier	5	m/h	
Area required	10.8	m^2	
Length	4	m	
Width	3	m	

SLUDGE HOLDING TANK

Percent of Solids	0.10%		
Weight of Solids/Volume of Solids	1000	mg/L	
Mn in Raw Water	0.0296	mg/L	(Average Historical Mn concentration for K51 (worse case of both wells))
Fe in Raw Water	0.024	mg/L	(Average Historical Fe concentration for K51 (worse case of both wells))

Future Capacity (all 3 wells)	157.8	L/s	
Mn + Fe removed per year	266813832	mg/year	
Volume of Solids per year	266814	L/year	
Volume of Solids per year	270	m^3/year	
Volume of Sludge per week	5.2	m^3	
Volume of Sludge per month	20.8	m^3	
Depth of water in tank	2.5	m	
Area required	8.3	m^2	
Length	3	m	
Width	3	m	