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VEGETABLE PACKING FACILITY WATER USE ASSESSMENT REPORT FOR:

Holland Marsh Growers' Association

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HMGA-02-P01

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Executive Summary

Enviro-Stewards worked with Holland Marsh Growers' Association to conduct site specific projects that will be used to develop a sector template for future assessments based on cost-benefit principles. This water use assessment identifies site-specific opportunities to reduce water use.

Enviro-Stewards conducted the water use assessment from October 14 to October 22, 2021, at a vegetable washing and packing facility located in the Holland Marsh, Ontario. The assessment included on-site visits and data logging of key equipment. In addition to the water use assessment, a high level review of the current waste water treatment system was undertaken to determine whether improvements could be made cost-effectively to that system.

Major Findings

- Upgrading the roller de-dirter with a soft durometer finger de-dirter with cleaning system will yield the greatest water reduction opportunity. Additional benefits include:
    - Increased product packed per hour due to improved washer throughput because less time is required to wash the product;
    - The improved dirt removal associated with the finger de-dirter may allow the removal or significantly reduced use of the pre-wash dribble bar.
- An inspection of a leaking back flow preventer (BFP) by a licensed inspector is recommended to identify & repair the issue or replace the BFP. This recommendation will yield some water savings, but the greatest benefits are safety (slips, trips & falls) and floor cleaning convenience.
- 1” & ¾” open hoses without a spray gun nozzle are used to wash down floors and equipment. It is recommended:
    - To do a dry clean-up (scrape or sweep) of the production area floor in order to reduce the duration of washdown with the sanitation hoses;
    - To investigate efficient spray gun nozzles to limit water flow from the hoses. Consult with a supplier of sanitation spray gun nozzles to determine an appropriate product & its cost. NOTE: the success of these nozzles is very dependent on matching the nozzle to the end use, & educating staff on why they are being used.
- Install more efficient spray nozzles on the pre-wash dribble bar & the sorting table spray bar.

A water balance is presented for the current end uses in the following table.

The potential water & greenhouse gas savings, cost, & payback of the recommendation are provided in the final table.

Water Balance: Existing End Uses

Water Balance	Summer Consumption	Winter Consumption	% of Total	Water Consumed	Notes
	m^3/wk	m^3/wk		m^3/yr	
Annual Consumption (2020)	394.4	835.7	+7%	35,954	Utility Bills
Main	NA	784.0	**100%**		Flowmeter on water main
Production	**354.5**	**708.9**		30,838	Baseline (any equipment running more than 10 min)
Intake Pre-Wetting Dribble Bar	12.6	25.2	3%	1,096	
Root washer	339.0	678.0	86%	29,494	
Sizing spray	2.9	5.7	1%	248	
Sanitation		23.3		1,163	
1" Sanitation Hose	2.9	5.8	1%	250	
3/4" Sanitation Hose	8.8	17.6	2%	913	
Other		60.5		12	
Backflow Preventer Leak	0.2	0.2	0%	12	
Domestic		8.8		393	
Toilet (Plant)	3.90	7.2	1%	319	
Toilet (Front Office)	0.26	0.5	0%	25	
Single Hand Wash Sink (Front Office	0.04	0.1	0%	4	
2 Hand Wash Sinks (Plant)	0.55	1.0	0%	45	
Unaccounted		42.7	5%	3,548	

Recommended Opportunities: Estimated Savings & Payback

		WATER			TOTAL SAVINGS	GHG (CO_2e)	ESTIMATED PROJECT COST	PAYBACK
	Recommended Opportunities	m^3/yr	%	$/yr	$/yr	tonnes/yr	$	Years
	Resource Unit Cost (above 200m^3): $4.51 Present Consumption (2020): 35,954			$162,153		0.9		
	Water							
4.1	Eliminate leak on backflow preventer	12	0.0%	$54	$54	0.0003	$175	3.2
4.2	Roller de-dirter upgrade	7,374	25.0%	$33,254	$33,254	0.1902	$11,000	0.3
4.3	Install spray nozzles on intake pre-wetting dribble bar	914	2.5%	$4,120	$4,120	0.02	$100	0.02
4.4	More efficient nozzles on the sorting table spray bar	157	0.4%	$706	$706	0.004	$100	0.1
4.5	Reuse sorting table discharge water in vegetable washer	91	0.3%	$412	$412	0.002	$2,000	4.9
4.6	Install spray guns on the open sanitation hoses for cleaning	291	0.8%	$1,311	$1,311	0.007	$500	0.4
4.7	Adjust sensors to reduce time that sinks are running	25	0.1%	$112	$112	0.0	$200	1.8
	TOTAL	**8,862**	**29.1%**	**$39,970**	**$39,970**	**0.23**	**$14,075**	**0.4**

Vegetable Packing Facility Water Use Assessment

1. Background

Enviro-Stewards worked with Holland Marsh Growers' Association to conduct site specific projects that will be used to develop a sector template for future assessments based on cost-benefit principles. This water use assessment identifies site-specific opportunities to reduce water use without impacting the end-product.

Between October 14 and October 22, 2021, Enviro-Stewards conducted a water use assessment at a vegetable wash and packing facility located in the Holland Marsh, Ontario.

The main objectives of the investigation were to:

- Identify sources of water consumption throughout the facility including the packing area and offices;
- Identify opportunities to reduce water use and potentially wastewater generation & present the business case for those opportunities;
- Undertake a high level wastewater assessment to evaluate the potential for a wastewater treatment system.

2. Facility Background Information

The facility washes and packs carrots, parsnips and beets typically 5 days a week from August to July. The facility has two production cycles:

Summer: 5 hours/day from May to July typical;

Winter: 10 hours/day from August to April typical.

Vegetables in pallet bins are loaded into a hopper from which they are conveyed onto a roller brush de-dirter and then into the Wyma polisher. From the polisher, the vegetables are conveyed to a sorting table, then to the packing area.

The facility is on municipal water and sewer services. The majority of the water used by the facility is for washing vegetables. A minimal amount of municipal water is for domestic use (hand wash stations, washrooms, and kitchen). The domestic wastewater is completely separated from the wash water stream. A settling tank system provides removal of some of the solids from the wash water prior to discharging to the municipal sewer system. The settling tank is pumped out once a month.

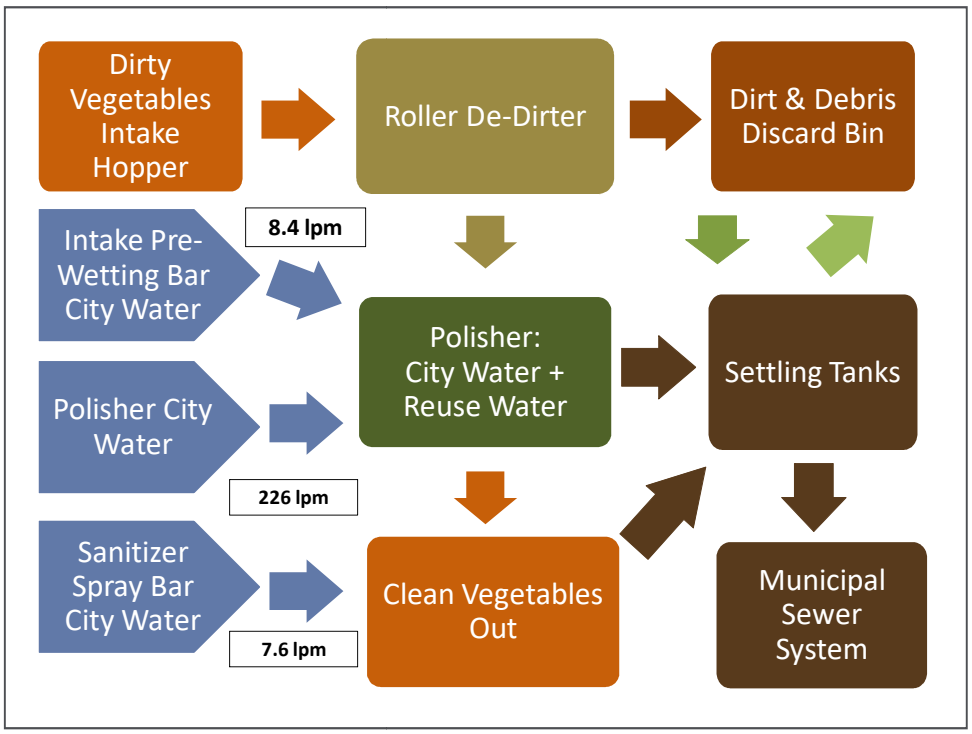
Two sources of water are used in the wash process, municipal (fresh) and reuse water. Water is used at three points along the wash line. A dribble bar pre-wets the vegetables with fresh water as they enter the polisher, where the vegetables are washed with recirculated water and fresh water. As clean vegetables discharge from the polisher, the polisher operator often uses a sanitation hose to wash off any residual debris with fresh water. Upon entry to the sorter, a spray bar applies a preservative carried by fresh water to the vegetables.

Water that has been in contact with the vegetables from the dribble bar and the polisher is collected in a tank under the washer and reused in the initial wash of the dirty vegetables. Two separate fixed pipes extend the length near the top of the polisher's interior. Holes are drilled in about the first 2/3's of the pipe to wash the dirty product entering the polisher. The back 1/3 of the second pipe provides the final

fresh water rinse. Ball valves are manually adjusted to control the supply and mix of fresh and reused water to the initial wash pipe. The choice of water source used in the first section of the washer depends on the amount of dirt on the product and how clean it is upon discharge from the washer. The amount of dirt on a vegetable depends on the soil moisture (seasonal variation), soil type, and the type of vegetable. Vegetables tend to be dirtier in wet harvest seasons and if they were grown in heavier clay soil.

The collection tank under the polisher drum is emptied periodically into a floor trench. The excess water from the sanitizer spray nozzles also discharges into this trench, which flows to a settling tank system before discharging to the municipal sewer system. A schematic of the dirt removal process is presented in Figure 1.

Figure 1:Schematic of the Dirt Removal Process



Water and wastewater consumption fees are presented in Table 1.

For the purpose of this report, ***$4.51/m³*** will be used to calculate costs and savings, based on the water and wastewater fees for consumption >200m³.

Table 1: 2020 Water & Wastewater Consumption Fee Schedule

Fee Category	Water ($/m³)	Wastewater ($/m³)
Up to 200 m³	$ 1.88	$ 3.73
>200 m³	$ 1.51	$ 3.00
Fixed Fee	$ 96.00	$ 84.00

The facility's 2020 water consumption and sewer surcharges are presented in Table 2. The sewer surcharges are based on high TSS and BOD levels in the wastewater.

Table 2: 2020 Water Consumption & Sewer Surcharges

Water-Wastewater Consumption			Sewer Surcharges	
Billing Period	**m^3**	**$**	**Billing Period**	***Total ($)**
Jan1-Feb29	7,196	$ 11,035.96	Jan-Mar	$ 10,570.63
Mar1-Apr30	6,660	$ 10,226.60	Apr-June	$ 1,320.14
May1-June30	3,827	$ 5,948.77	July-Sept	$ 1,553.15
July1-Aug31	2,877	$ 4,514.27	Oct-Dec	$ 7,796.63
Sept1-Oct31	7,571	$ 11,602.21	***Total***	***$ 21,240.55***
Nov1-Dec31	7,823	$ 11,982.73	* Includes lab fee & HST	
Total	***35,954***	***$ 55,310.54***	* Based on TSS & BOD only	

3. Water Use Assessment

The following main activities were carried out by Enviro-Stewards:

- Identify all water supply sources to the facility (packing plant and offices);
- Overview of process flow within the packing area;
- Monitor the water main supplying the facility with a data logger;
- Identify all water consuming activities in the facility;
- Identify the type of water supply (fresh, reuse, or a mix) to the end use;
- Data log or take timed samples of water consumption by select end uses;
- Identify sources of wastewater (processing vs. domestic) by end use;
- Collect a sample of wastewater discharge from the polisher for analysis;
- Utility bill analysis of water and wastewater consumption charges, and sewer surcharges;
- Identify water use optimization and reuse opportunities; and
- Analyse potential wastewater treatment options;
- Present business case for the opportunities where appropriate.

3.1 Water Supply Main Monitoring

A data logger was installed from October 15 to 22, 2021 on the facility's water main supplying the offices and packing area (Figure 2). The logger was installed after the backflow preventer.

The logged data are presented in Figure 3. From 0:00 October 15 to 23:00 October 21, the facility's total water use was 787.6 m^3. Maximum flow was 541.02 lpm on October 19, 12:46.

The weekend's water use profile is presented in Figure 4. It appears that something was left running after operations shut down on October 16. Average water consumption from shutdown on October 16 to 23:59 Oct 17 was 1.92 lpm.

Figure 2: Main Water Supply Data Logger Location

Figure 3: Main Water Supply Logged Data - Oct14-22, 2021

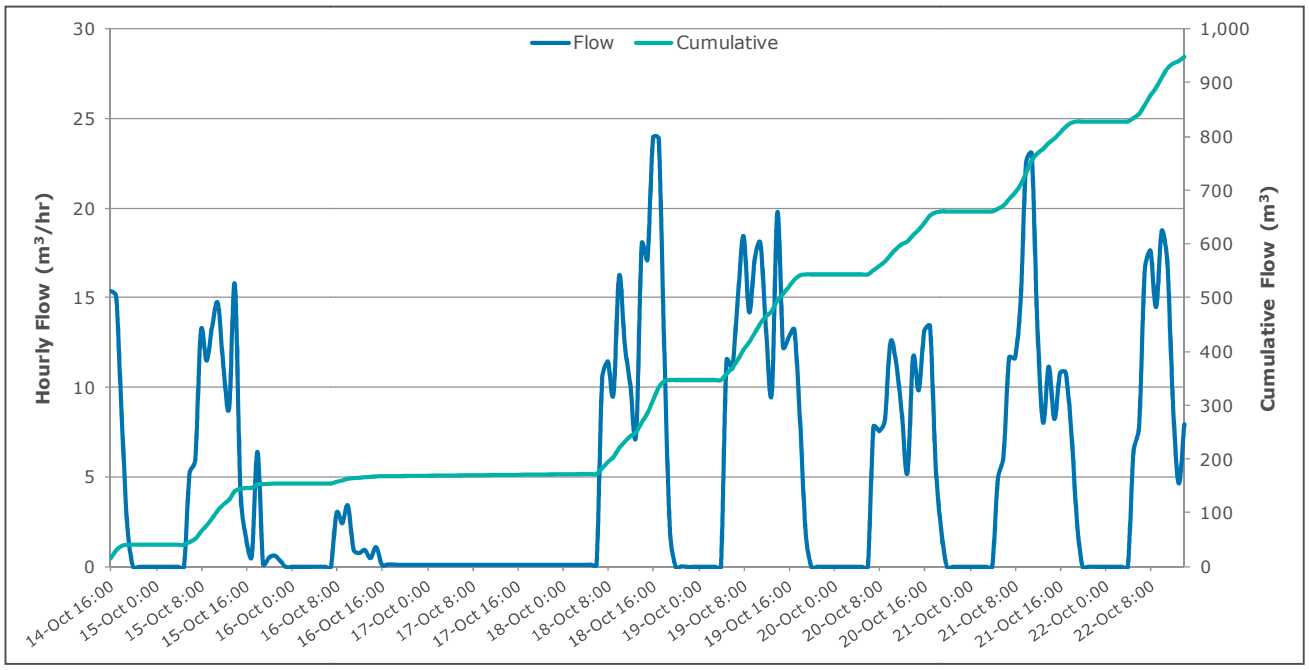
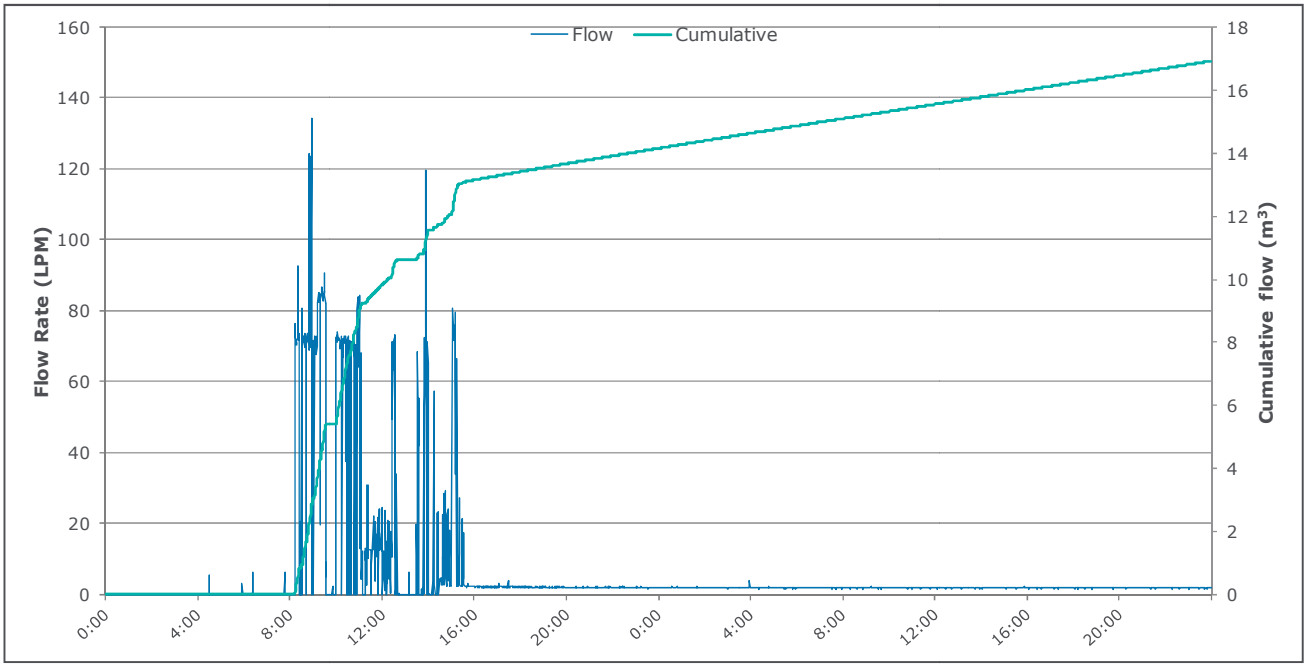


Figure 4: Weekend Facility Water Use - October 16 - 17, 2021



4. Opportunities

The following sections outline the results of the investigation.

4.1 Eliminate Leak on Backflow Preventer

A reduced pressure backflow preventer (BFP) is installed on the water supply to the facility after the meter (Figure 5, Figure 6). The BFP is dripping at a rate of 0.023 lpm based on a timed grab sample. According to facility staff, the BFP leaks 24/7/365. A collection system (Figure 7) directs the dripping water to a floor drain that is connected to the settling tanks before discharging to the municipal sewer system.

Figure 5: Backflow Preventer (Top View)

Figure 6: Backflow Preventer (Side View)

Figure 7: Backflow Preventer Drip Collector

Potential Issues:

1. Excessive Pressure on Plant Side of BFP:
   - Directing the plant supply line up to the ceiling of the production area may result in an elevated pressure exceeding the pressure setpoint of the BFP.
2. Debris in Relief Valve;
3. Relief Valve is Failing;
4. Test Cock Leak:
   a. Valve has failed;
   b. Debris has damaged ball;
   c. Plastic casing inside has failed.
5. Freeze Protection Device is Worn Out;
6. Pressure Relief Valve is Worn Out.

Savings:

- Approximately 12.1 m^3;
- Approximately $54/yr.

Recommendation:

- An inspection of the BFP by a licensed BFP inspector to identify & repair the issue or replace the BFP;
- The BFP should be inspected annually to address any issues that might arise.

Cost:

- Approximately $175 to troubleshoot the issue;
- Plus cost of repairs or replacement.

Payback:

- TBD based on inspection.

Additional Benefits:

- Safety: to prevent slips, trips and falls associated with a wet floor in the event the drip collection system is dislodged from the floor drain or from under the BFP;
- Improved ease of floor cleaning: with removal of the drip collection system after dripping stops.

4.2 Roller De-Dirter Upgrade

The first stage of in-plant dirt removal involves a 27" wide x 75" long roller de-dirter (Figure 8). Dirt that is mechanically rubbed off the vegetables is collected in a bin under the rollers (Figure 9). Shields are in place to direct dirt into the bin (Figure 10). The vegetables tend to roll around on top of the rollers. To prevent product from falling through, the spacing between the rollers is tighter than some other dirt removal systems (Figure 11).

Recommendation:

- Replace the roller de-dirter with a soft durometer finger de-dirter (Figure 12) with a finger cleaning system.
- NOTE: Vegetables tend to bounce as they move through a finger de-dirter, resulting in improved dirt removal compared to a roller system. Dirt builds up between the finger disks. The dirt can be removed during operation by installing a cleaning system underneath the dedirter. Metal blades positioned between the finger disks scrape off the dirt that builds up on the disks (Figure 13).

Savings:

- Approximately 7,374 m^3/yr of fresh wash water;
- Approximately $33,250/yr.
- NOTE: work done by OMAFRA indicates that upgrading to a finger de-dirter with cleaning system will reduce vegetable washer water use by approximately 25%.

Cost:

- Approximately $11,000: For a 30" wide x 48" long finger de-dirter plus finger cleaning system.
- NOTE: A 27' wide x 75" long de-dirter will be replaced by a 30" wide x 48" long system. The new system is shorter, which could potentially free up some space in the product cleaning area.

Estimated Payback:

- Approximately 0.3 yrs.
- NOTE: Other benefits that will yield additional cost savings and revenue include:
    - Reduced settling tank pump out charges due to dirt being removed from the wastewater stream;
    - More product packed per hour due improved washer throughput. Typically, the washer is the bottleneck in the entire system from loading dirty product into the intake hopper to packaging finished product. The more dirt that can be removed

either in the field or pre-wash in the packing facility, the less time required to wash the product.

Other Considerations:

- The number of bins of dirt collected will approximately double because the finger de-dirter will remove approximately 50% of the dirt prior to washing based on work done by OMAFRA.

Figure 8: Roller De-Dirter from Beneath

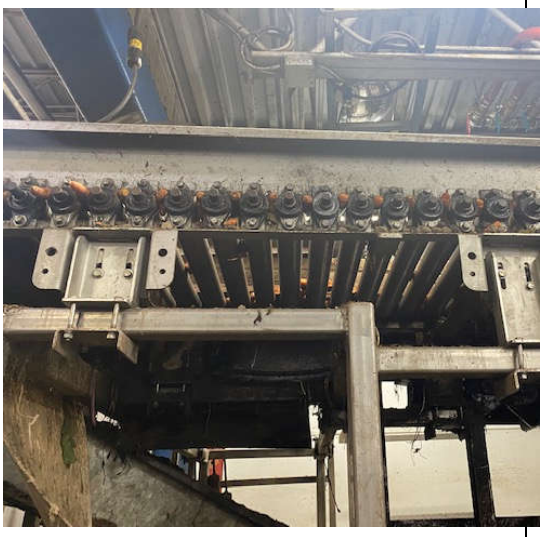


Figure 9: Dirt Collection Bin Under De-Dirter

Figure 10: Dirt Shields on De-Dirter

Figure 11: Roller De-Dirter Top View

Figure 12: Soft Durometer Finger De-Dirter

Figure 13: Finger De-Dirter Cleaning System

4.3 Install Spray Nozzles on Intake Pre-Wetting Dribble Bar

A dribble bar pre-wets the vegetables as they enter the washer (Figure 14). The dribble bar supplies 8.4 lpm based on a timed grab sample. The excess water is collected in the collection tank for reuse in the washer.

Figure 14: Intake Pre-Wetting Dribble Bar

Recommendation:

- Replace the dribble bar with a spray nozzle system that delivers 0.7 lpm per nozzle. Based on the length of the current spray bar, one to 2 nozzles should be adequate depending on the mounting height and spray pattern.

- NOTE: If a finger style de-dirter is installed, it is entirely possible that the pre-wetting bar may only be required very rarely or not at all due to improved dirt removal.

Savings:

- Approx 900 m^3/yr;
- Approx $4,120/yr.

Cost:

- Approximately <$100;
- Assume metal bar fabrication @ $50/hr, 2 - 0.7 lpm nozzles @ $10 CDN/nozzle.

Payback:

- Maximum 0.02 yrs or < 1 month.

4.4 More Efficient Nozzles on Sorting Table Spray Bar

Figure 15: Sorting Table Spray Bar

The amount of water discharging from the 4 nozzles on the sorting table spray bar (Figure 15) has been assumed due to a data logger failure. Each nozzle is assumed to discharge 1.9 lpm, which is based on a grab sample from a similar type of nozzle at another site.

Recommendation:

- Replace the existing spray nozzles with more efficient nozzles that deliver 0.7 lpm per nozzle.

Savings:

- Approximately 150 m^3/yr;
- Approximately $700 /yr.

Cost:

- Approximately <$100;
- Assume $10 CDN / 0.7 lpm nozzle.

Payback:

- Approximately 0.1 yrs or < 2 months.

4.5 Reuse Sorting Table Spray Bar Discharge Water

The excess water from the spray bar (Figure 15) at the intake end of the sorting table is directed to the floor drain.

Recommendation:

- Pump the sorting table discharge water to the collection tank under the polisher for reuse to wash dirty vegetables entering the washer.
    - It is assumed that more efficient 0.7 lpm spray nozzles have been installed on the spray bar, replacing the existing nozzles.
    - The excess sorting table water is relatively clean, but will need a filter to remove debris such as vegetable tops and roots.

Savings:

- Approximately 91 m^3/yr (assume 0.7 lpm nozzles);
- Approximately $400/yr.

Cost:

- Approximately $2,000 (discharge water collection system, filter, pump, pipe work to polisher).

Payback:

- Approximately 4.9 yrs.

4.6 Sanitation Hoses – Consider Installing Spray Gun Nozzles

¾" and 1" sanitation hoses are used in the facility to wash away dirt, debris, and vegetables from equipment and the floor. These are open hoses without a spray gun nozzle installed to limit the flow. The existing hoses use between 20 – 23 lpm as measured with a bucket and stopwatch. Without control of the flow, excess water is often used.

Recommendation:

- Encourage staff to scrape or sweep vegetables, dirt, and other dry waste from the floor before washing down with sanitation hoses. A dry clean-up of the production area can reduce the duration of washdown with the sanitation hoses. Water should not be used to remove solid material;
- Consider using a spray gun nozzle with restricted flow only to clean the remaining dirt from surfaces. By using a restricting nozzle, the flowrate can be reduced.

Savings:

- Speak with a supplier to properly size a cleaning spray gun for your application. For every 5 lpm reduction in flow, an estimated $1,300 will be saved annually.

4.7 Hand Wash Stations

The hand wash stations in the production area run for 13 seconds once activated. It continues to run for the full 13 seconds, even if the user removed their hands. This means that water will run unnecessarily for 26 seconds if the water is activated to lather, and again to rinse off.

Recommendation:

- Adjust the timer on the motion activated faucets. Ideally the settings would be changed so that the faucet turns off whenever the user removed their hands. The maximum run time should be reduced to 10 seconds. It is expected that a user would wet their hands for 3 seconds before lathering. The rinse would then take the full 10 seconds. The total runtime would be 13 seconds.

Savings:

- Approximately 50% water savings;

Approximately $112 per year.

Cost:

- Facility staff can adjust the settings using the operating manual. (An example is provided in a Youtube video https://www.youtube.com/watch?v=g9z5FI49ccs).
- Assume $200 for labour.

Payback:

- Approximately 1.8 yrs.

5. Other Systems Evaluated

5.1 Toilets

The toilets are rated at reasonable water flow rates.

Recommendations:

- Occasionally check for leaks;
- When it is time to replace the toilets, consider low flow options.

5.2 Rain Water Harvesting

A rain water harvesting system collects and stores rain water, in this case, from roof surfaces. The water could be used to wash dirty vegetables in the first section of the Wyma washer. It would also be suitable for use in toilets.

This recommendation was not presented due to space required for a storage tank, and the system's cost.

An 8m^3 storage tank, pump and pipework would cost about $7,600 with an estimated payback of 7.9 yrs.

6. Wastewater Treatment

The facility currently uses a settling tank system to pre-treat the water before discharging to the City sewer system. A review of the facility's 2020 sewer surcharges was undertaken to determine whether

additional treatment would be feasible. The facility's sewer surcharges are based on TSS and BOD only. A summary of the 2020 sewer surcharges is presented in Table 3.

Recommendation:

The assessment determined that supplemental treatment cannot be justified based on current surcharges. Should the quality of the wastewater change or surcharges increase significantly, or the City requires additional treatment before discharging into the sewer system, then additional sampling of the wastewater should be undertaken. Collect a split sample. Place a portion in a sample bottle. Let the remainder of the sample sit for one hour, and then draw a sample of the supernatant into a second sample bottle. The results of both samples will help determine the design of a polishing (settling) treatment system if it is deemed appropriate.

Table 3: 2020 Quarterly Sewer Surcharge & Lab Fees

Quarter	*Sewer Surcharge	Lab Fee	HST	Total
Jan-Mar 2020	$ 10,031.62	$477.00	$62.01	$10,570.63
Apr-June 2020	$ 781.13	$477.00	$62.01	$ 1,320.14
July-Sept 2020	$ 1,014.14	$477.00	$62.01	$ 1,553.15
Oct-Dec 2020	$ 7,317.51	$424.00	$55.12	$ 7,796.63
Total				***$21,240.55***
*Note: Sewer surcharge is for TSS & BOD only & is a % of Parameter $				