THE VILLAGE OF
MATTAWAN

Mattawan Department of Public Works



Mattawan WRRF Feasibility Study

December 2018




Moore+Bruggink
Consulting Engineers
Engineering Clean Water

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Chapter 1 – Executive Summary

The Village of Mattawan currently has a treatment agreement in place with the City of Kalamazoo. Sanitary flows are collected and pass through a series of pump stations throughout the Village system before collecting in the wet well at Lift Station 1 located on 25th Street in the northwest corner of the village limits. Lift Station 1 pumps an average of 420,000 gallons per day through a 16-inch diameter forcemain approximately 6.6 miles. This forcemain is primarily located in the I-94 right-of-way, has a number of air release valves along the route, and lacks isolation valving to service the line. The air release valves are reaching the end of their design life, have had several recent failures, and replacement cost will be very high due to the dynamics of bypassing such large flows for such an extended length.

It was the high cost to service, and the eventual replacement of the existing forcemain, combined with the treatment costs from Kalamazoo, that prompted the Village to investigate altering the flows of Lift Station 1 to a new Water Resource Recovery Facility (WRRF) owned and operated by the Village. This report provides the results and recommendations of the feasibility study performed.

The report shows that a newly constructed WRRF, owned and operated by the Village, will have minimal impact to residents' current rates, and provide for a feasible, long-term solution with lower life cycle costs over a 20 year period.

Chapter 2 – Feasibility Definition

It is important to determine what criteria must be met in order to define the project as feasible. Below is the list of items that must be met for the project to be concluded as feasible.

- Must hold value over the existing condition – meaning the cost to construct, operate, and maintain a WRRF over the course of the next 20 years will provide lower life cycle cost to the Village than the cost to operate and maintain the existing forcemain and treatment at Kalamazoo in which the Village is currently engaged.
- Must have an available location for construction.
- Must have an acceptable location to discharge treated effluent according to the State, and have State discharge limits achievable by a treatment technology used in the analysis.
- The cost effect on the user rates must be within Village tolerances to accept.
- The Village must be able to retire, or otherwise work within, the current treatment agreements in place with Kalamazoo.
- Funding for the project is available to the Village.

Chapter 3 – Background and Initial Analysis

Moore+Bruggink collected and analyzed information provided by the Village on their existing collection system, lift stations, and current sewer rates. A sampling plan was also developed in order to determine current industry contributions, typical domestic wastewater strength, and design loadings for any WRRF projects. The collection system information is included in Appendix A, and the sampling results are included in Appendix B.

Through kickoff discussions with the Village, the preferred plant location was south of I-94 on property currently owned by the Village near the east limit, with a second option located on the property shared by Lift Station 1. Two initial outfall locations were discussed as “Mattawan Creek” and the “North Tributary to the East Branch of the Paw Paw River.”

The MDEQ Water Resources Division was contacted to request Effluent Limit Only (ELO) information regarding the proposed discharge locations. The results of this request showed both potential outfalls passed through Maple Lake to the west of the Village of Mattawan before entering the Paw Paw River. Maple Lake is highly regulated due to eutrophication, with three current permit-limited facilities allocated the entirety of the total phosphorus available during the summer season. This means that any facility from Mattawan providing outfall phosphorus would be unable to discharge from May to October, and effectively rendered them infeasible, removing these outfalls from consideration. Email conversations from the MDEQ are included in Appendix C.

Discussions with Tom Anthony (Village of Mattawan Department of Public Works Superintendent), as well as investigation of watersheds in the area, provided an alternate outfall location and another siting location to continue the study.

The newly proposed outfall location was north of the Village into Hayden Creek. Again, an ELO was requested for the new location with restrictive, but more positive results. The feasibility study now includes Hayden Creek as the outfall location for any potential WRRF improvements.

Along with the new outfall location, Mr. Anthony also provided two potential new locations closer to the outfall location. The first property is located at 23492 Red Arrow Highway, and the second on 25th Street, adjacent to the north of Lift Station 1. It was decided to evaluate the property north of the existing lift station as it is located within the village limits and the tie-in to Lift Station 1 would be closer, and therefore less expensive and less disruptive to the Village. Examination of the parcel that includes Lift Station 1 shows that it holds a Village well house, and does not have the acreage to support the separation distance necessary for a WRRF on that site.

Therefore, this feasibility study only considers the site location at 25th Street just north of Lift Station 1 with the outfall location at Hayden Creek.

Chapter 4 – Existing Condition

In order to determine if any project holds value over the existing condition, an analysis of the full cost to operate and maintain the forcemain to Kalamazoo was performed. This provides a cost point to know if continuing with the current situation is the best course of action for the Village. Below is the estimated costs developed for this option.

Table 1 – 20 Year Life Cycle Costs for Existing Forcemain

Description	*Quantity*	*Unit Price*	*Units*	*Cost*
Full Air Release Replacement Set	1.00	$1,536,000.00	LS	$1,536,000.00
Full Check Valve Replacement Set	1.00	$1,032,000.00	LS	$1,032,000.00
Full Forcemain Cleaning	1.00	$1,600,000.00	LS	$1,600,000.00
16" FM replacement within 20 years	6.60	$1,500,000.00	Mi	$9,900,000.00
Kzoo Treatment Costs	20.00	$250,000.00	Yr	$5,000,000.00
Contractor OH&P (10%)	1.00	$566,800.00	Sft	$566,800.00
Legal (2%)	1.00	$113,360.00	Ft	$113,360.00
Engineering (15%)	1.00	$1,955,220.00	Ea	$1,955,220.00
Contingency (20%)	1.00	$1,710,676.00	Ea	$1,710,676.00
Subtotal				*$23,415,000.00*

The total operational costs for the existing forcemain over a 20-year period is $23.4M. This is the value used as a comparison for determining if any WRRF construction would provide cost savings over the existing conditions.

Chapter 5 – Collection System Logistics

Evaluation began with collection system augmentation to provide sanitary flow to the 25th Street site. Figure 1 below shows the shortest routing available.

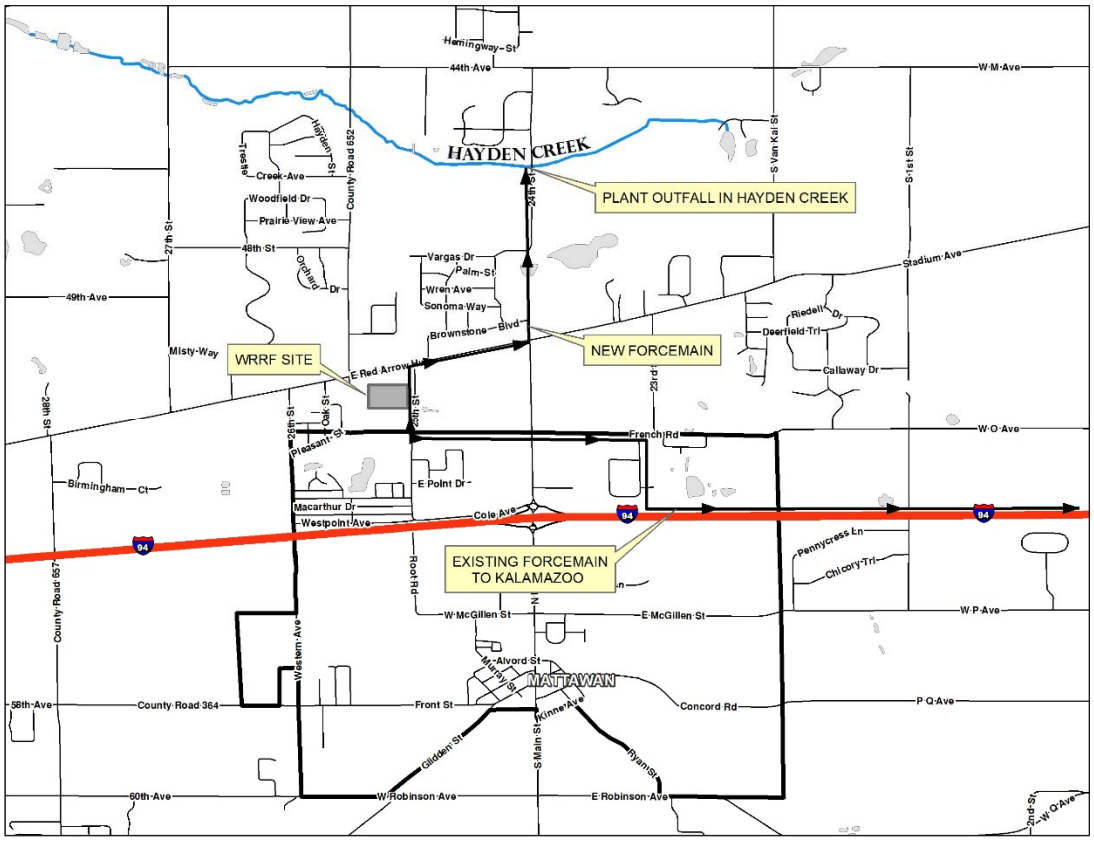

Figure 1 – Collection System Augmentation

The new forcemain to the plant would connect into the 16-foot diameter pipe north of Lift Station 1 where it turns into the easement heading east. The new 16-inch forcemain extension would follow 25th Street to the north onto the proposed WRRF property.

Below are the conceptual costs used in the evaluation for collection system augmentation.

Table 2 – Collection System Improvements Conceptual Estimate

Description	*Quantity*	*Unit Price*	*Unit*	*Cost*
16" Dia Influent Forcemain LS#1 to WWRF	1300.00	$200.00	Ft	$260,000.00
Subtotal				*$260,000.00*

Chapter 6 – Location Site Work

Moore+Bruggink, pulled GIS data from Van Buren County to evaluate the conditions and estimate site grading requirements. Below are some pictures and an example of site contours showing the existing conditions and topography.

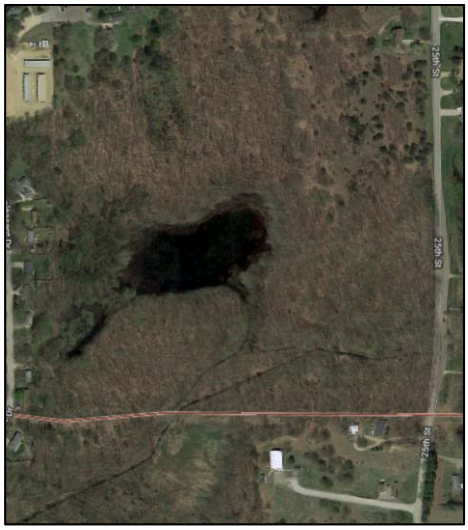

Figure 2 – Existing Conditions & Topography

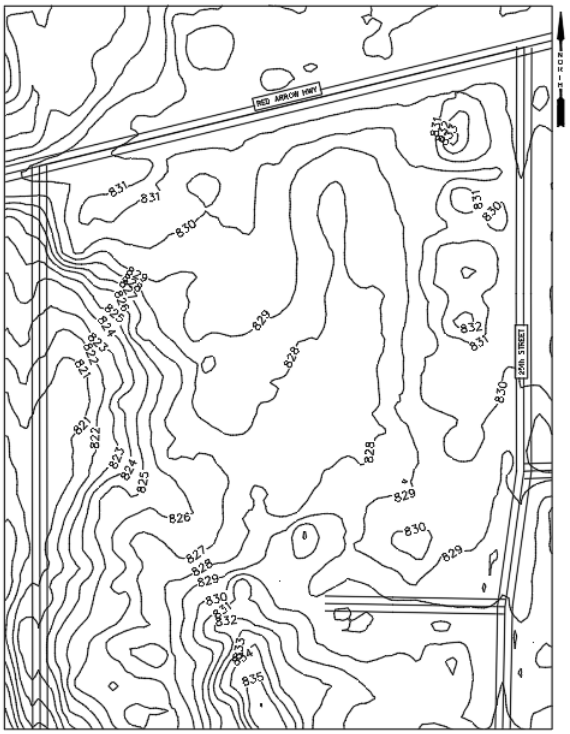

Figure 3 – Site Topography

The site is undeveloped and does not include any buildings or obvious conditions requiring demolition or cleanup efforts.

The site topography and vegetation condition works well for improvements as there is a sizeable area of little trees and forest near the north end of the property. Grades generally slope to the south.

The cost of obtaining the property has been estimated at $400,000, and acquisition fees have been included for procurement.

In order to reach the outfall location, a plant effluent pump station will need to be constructed with a 10-inch effluent forcemain running north up 25th Street to Red Arrow Highway, then turning east to the Main Street intersection, then north again to the outfall location at Hayden Creek. Given the length of the forcemain, the outfall will likely require an aeration cascade to add dissolved oxygen.

Some costs for air release valves, manholes, and bypass valving have been included in the conceptual costs for the site development portion of this evaluation. Below is the completed conceptual estimate for making the property "construction ready" for the WWRF improvements.

Table 3 – Site Improvements Conceptual Estimate

Description	*Quantity*	*Unit Price*	*Units*	*Cost*
Land Acquisition	1.00	$275,000.00	Lsum	$390,000.00
Administration and Legal (4%)	1.00	$11,000.00	Lsum	$11,000.00
Effluent Forcemain HDD	7680.00	$100.00	Ft	$768,000.00
Air Release MHs	2.00	$8,000.00	Ea	$16,000.00
Effluent Lift Station	1.00	$500,000.00	Ea	$500,000.00
Site Grading	5.00	$10,000.00	Ac	$50,000.00
Subtotal				*$1,735,000.00*

Chapter 7 – WRRF Process Analysis

To provide an educated analysis, samples were collected at Lift Station 1 to predict the influent concentrations required for any plant improvements. Samples were also taken on a small residential-only area off French Street to show typical domestic characteristics within the Village system. Tom Anthony also provided four months of past flow data from Lift Station 1 to show average daily and peak daily flows experienced. It was from this data that the following parameters were developed and presented to wastewater treatment process vendors for equipment budgets and process reliability.

Table 4 – Conceptual Design Criteria

iADF	420,000	gpd
dADF	840,000	gpd
dPDF	1,680,000	gpd

	iA. Conc. (mg/L)	iA. Mass (lbs./d)	dA Des. Conc. (mg/L)	dA. Mass (lbs./d)	dP Des. Conc. (mg/L)	dP. Mass (lbs./d)
TSS	218	765	262	1837	360	5044
VSS	188	660	226	1585	283	3965
BOD_5	315	1102	377	2644	514	7202
COD	454	1591	545	3818	484	6781
N, Ammonia	26	92	32	221	33	461
Phosphorus	9	30	10	72	17	233
TKN	43	150	51	360	64	890
$sBOD_5$ (Soluble)	104	366	125	878	128	1793

iADF = initial average daily flows
dADF = design average daily flows
dPDF = design peak daily flows

iA Conc. = initial average concentration
iA Mass = initial average mass loading
dA Conc. = design average concentration
dA Mass = design average mass loading
dP Conc. = design peak concentration
dP Mass = design peak mass loading

To provide the vendors the treatment requirements, the MDEQ-approved ELO limits were provided as well. These target treatment values are provided in Table 5 below.

A general process flow diagram was developed to communicate the anticipated treatment progression. As budget costs from vendors were obtained, each process section was refined until a complete budget for the conceptual plant could be created.

Table 5 – Effluent Limit Only – Hayden Creek Outfall

Parameter	*Months*	*Conc. (mg/l)*	*Load (lb/d)*	*Basis*	*Rationale*
$CBOD_5$	May-September	10	42	Daily Maximum	DO Standard
	October-November	45	188	Daily Maximum	DO Standard
NH3-N	May-September	2	8.3	Daily Maximum	DO Standard
		3.9	16	30 Day Average	Chronic Toxicity
	October-November	16	67	Daily Maximum	DO Standard
		9	38	30 Day Average	Chronic Toxicity
	December-March	18.2	76	30 Day Average	Chronic Toxicity
	April	12.9	54	30 Day Average	Chronic Toxicity
DO	May-September	7	—	Minimum	DO Standard
	October-November	4	—	Minimum	DO Standard
	December-April	4	—	Minimum	Acute DO Toxicity
Effluent Flow	Year Round	-	—	Report Daily	—
pH	Year Round	6.5-9	—	Daily Maximum	—
Chlorine	Year Round	0.38	—	Daily Maximum	—
Phosphorus	May-September	0.4	1.4	24-hr Composite	—
	October-November	1	4.2	24-hr Composite	—

The process flow diagram was created to show how the treatment process would meet the effluent limits set by the MDEQ. This diagram is shown below in

Figure 4.

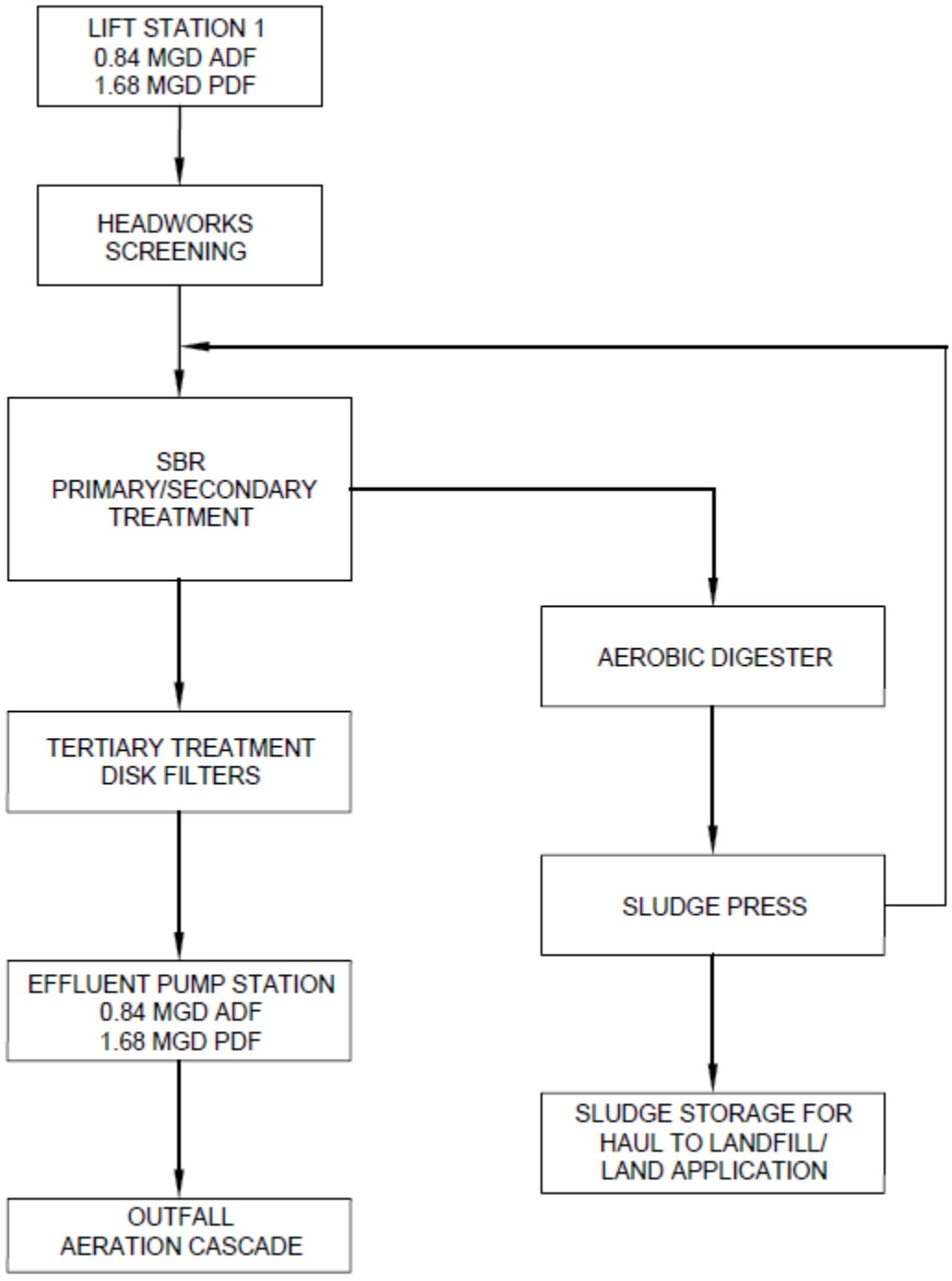

Figure 4 – Process Flow Diagram

Chapter 8 – Project Concept Cost

Using the MDEQ estimated limits provided and the sampling results, Moore+Bruggink contacted a number of vendors to discuss treatment technologies and begin to develop conceptual costs. Through this process, the option to construct a new Sequencing Batch Reactor plant was selected as best able to treat the wastewater efficiently. A sequencing batch reactor (SBR) sees two treatment basins working in sequence to treat batches of wastewater through the activated sludge process. As one batch is being treated in one tank, the other is being filled and prepared for treatment. A layout of the building and tanks was created, and the costs to construct the plant collected to total $7M, as shown below.

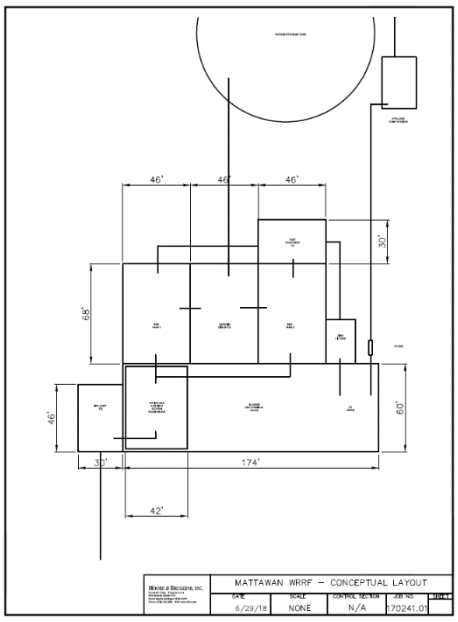

Figure 5 – Building Layout

Table 6 – Conceptual Estimate

Description	*Quantity*	*Unit Price*	*Units*	*Cost*
Main Building	7680.00	$150.00	sft	$1,152,000.00
Screens and influent pumps	1.00	$175,000.00	Ea	$175,000.00
Lakeside SBR	1.00	$750,000.00	Ea	$750,000.00
Chemical Systems	1.00	$50,000.00	Ea	$50,000.00
Concrete Tankage	2980.00	$500.00	cyd	$1,490,000.00
UV Disinfection	1.00	$260,000.00	Ea	$260,000.00
Sludge Storage	2.00	$350,000.00	Ea	$700,000.00
Aerobic Digester	1.00	$808,200.00	Ea	$808,200.00
Sludge Thickening/Dewatering	1.00	$300,000.00	Ea	$300,000.00
Site Electrical and instrumentation	1.00	$259,320.00	Ea	$259,320.00
Site Mechanical	1.00	$259,320.00	Ea	$259,320.00
Cloth Disk Filter	1.00	$420,000.00	Ea	$420,000.00
Odor Control	1.00	$130,000.00	Ea	$130,000.00
Site Access and Parking	2800.00	$75.00	syd	$210,000.00
Subtotal				*$6,964,000.00*

Combining all conceptual costs with contractor overhead/profit, legal fees, engineering, and appropriate contingency for current phase produces a $13.5M total for improvements. Table 7 below reflects values included in the conceptual estimate. In an effort to determine feasibility of a project of this scale, the existing conditions and net costs of the changes must be considered.

Table 7 – Complete Conceptual Estimate

Description	*Quantity*	*Unit Price*	*Units*	*Cost*
25th St. Site	1.00	$1,735,000.00	Lsum	$1,735,000.00
Influent Forcemain	1.00	$260,000.00	Lsum	$260,000.00
WWRF	1.00	$6,964,000.00	Lsum	$6,964,000.00
Contractor OH&P (10%)	1.00	$896,000.00	Sft	$896,000.00
Legal (2%)	1.00	$198,000.00	Ft	$198,000.00
Engineering (15%)	1.00	$1,479,000.00	Ea	$1,479,000.00
Contingency (20%)	1.00	$1,971,000.00	Ea	$1,971,000.00
Subtotal				*$13,503,000.00*

To further compare this option to the existing condition developed in Chapter 4, an operation and maintenance budget for the next 20 years was completed and added to the total as well. This number estimates the costs for sludge disposal, electrical service, and a contract operator at $350,000 annually.

Table 8 – Operation & Maintenance Budget

Operating Budget	20.00	$350,000.00	Yrs	$7,000,000.00
				$20,503,000.00

With a total value of the WRRF life cycle costs for the next 20 years estimated at $20.5M, and the life cycle costs of the existing forcemain and treatment contract to Kalamazoo estimated at $23.4M, building its own treatment facility becomes a preferred option for the Village, with considerable value of nearly $3M in savings.

Chapter 9 – Rate Analysis

The current rate structure in the Village includes a readiness-to-serve fee or base rate, and a commodity fee based on usage. Through discussions with the DEQ, the Village has decided to change this structure to an all commodity rate following recent system-wide upgrades to the water metering system. The current rate structure is shown below:

Water:

Commodity (1,000 Gallons)	Flat Rate
$3.97	$2.80

Sewer

Commodity (1,000 Gallons)	Flat Rate
$5.68	$13.70

The new commodity-only rate for water is anticipated to be $3.76/1,000 gallons. In order to evaluate feasibility of the project, an $18 million bond was used in the analysis of the wastewater commodity-only rate. Calculations for the wastewater commodity charge (with the loan payment included) will be $8.58/1,000 gallons.

To compare the typical bills of a homeowner under these conditions,

			User Costs						
	Base Rate	Commodity Charge (per 1000 gal)	4000 gal/mo	5000 gal/mo	6000 gal/mo	7000 gal/mo	8000 gal/mo	9000 gal/mo	10,000 gal/mo
Current Water	$2.80	$3.97	$18.68	$22.65	$26.62	$30.59	$34.56	$38.53	$42.50
Current Wastewater	$13.70	$5.67	$36.38	$42.05	$47.72	$53.39	$59.06	$64.73	$70.40
			$55.06	**$64.70**	**$74.34**	**$83.98**	**$93.62**	**$103.26**	**$112.90**
Future Water	$0.00	$3.76	$15.04	$18.80	$22.56	$26.32	$30.08	$33.84	$37.60
Future Wastewater	$0.00	$8.58	$34.32	$42.90	$51.48	$60.06	$68.64	$77.22	$85.80
			$49.36	**$61.70**	**$74.04**	**$86.38**	**$98.72**	**$111.06**	**$123.40**
		Change in Bill	-$5.70	-$3.00	-$0.30	$2.40	$5.10	$7.80	$10.50

Note: Future Wastewater Rate includes payments for an $18M loan for the WRRF

Table 9 – was created and shows the effects created by the loan on the typical user across various quantities of use.

	Base Rate	Commodity Charge (per 1000 gal)	User Costs 4000 gal/mo	5000 gal/mo	6000 gal/mo	7000 gal/mo	8000 gal/mo	9000 gal/mo	10,000 gal/mo
Current Water	$2.80	$3.97	$18.68	$22.65	$26.62	$30.59	$34.56	$38.53	$42.50
Current Wastewater	$13.70	$5.67	$36.38	$42.05	$47.72	$53.39	$59.06	$64.73	$70.40
			$55.06	**$64.70**	**$74.34**	**$83.98**	**$93.62**	**$103.26**	**$112.90**
Future Water	$0.00	$3.76	$15.04	$18.80	$22.56	$26.32	$30.08	$33.84	$37.60
Future Wastewater	$0.00	$8.58	$34.32	$42.90	$51.48	$60.06	$68.64	$77.22	$85.80
			$49.36	**$61.70**	**$74.04**	**$86.38**	**$98.72**	**$111.06**	**$123.40**
		Change in Bill	-$5.70	-$3.00	-$0.30	$2.40	$5.10	$7.80	$10.50

Note: Future Wastewater Rate includes payments for an $18M loan for the WRRF

Table 9 – Monthly Changes in Billing based on Commodity

As shown, any users below 6,000 gallons per month will see a decrease in their water and sewer bill, while those above will see increases. In discussions with the Village, this change is acceptable as most users in a single household fall below 7,000 gal/mo., and supports the feasibility of the project.

Chapter 10 – Funding Options

There are several options for funding wastewater system improvement projects, each with its own benefits and challenges.

USDA- Rural Economic Development Funding

The USDA-RD provides competitive loan rates that extend payments out to 40 years, and the potential for up to 40% grant following application evaluation if qualified. The application process requires the creation of Preliminary Engineering Report (PER). Another major benefit is the lack of prevailing wage requirements, which results in lower project costs.

The Clean Water State Revolving Fund (CWSRF)

Provides federal funding and low interest, 20 year, loans to municipalities to assist with treatment system improvements. The federal loans require a 20% funding match through a State grant. The SRF process requires that a project be nominated with submission of a project plan (PER) and includes prevailing wages. Nominated projects are added to a Project Priority List (PPL), with projects being selected from the PPL for SRF funding. Submission deadline for inclusion in the annual PPL is July 1st. SRF funding can have additional design requirements demanding additional effort, and should be considered as soon as project plans are completed.

Green Project Reserve (GPR) grants

This program, administered through SRF, grants funds for projects falling into one of four categories: Green Infrastructure, Water Efficiency, Energy Efficiency, and Environmentally Innovative. Given that the impacts of the existing forcemain are very low, it is not believed this project will be qualified.

Municipal bonding

The municipality may wish to engage in issuing bonds to cover the cost of the project, which would require payback of the loan in 20 years, and would not include prevailing wages. Bonds can be rolled into future bonding endeavors with combined payments to add flexibility to funding projects as well. Bond interest rates are subject to market flexibility and the credit rating of the municipality, however, which may lead other funding sources to be more beneficial.

In Mattawan's case, the USDA-RD funding program is recommended, as the payments can be outlayed 40 years, providing fiscal security. There is no penalty for early pay-off through the RD program, so the Village could retain incoming revenue to make additional payments as available.

Chapter 11 – Feasibility Conclusion and Recommendation

To provide a conclusion on feasibility, the option to disconnect from the Kalamazoo discharge and treatment agreements and construct a new Wastewater Resource Recovery Facility (WRRF) to treat the sanitary flows for the Village of Mattawan need to meet the following criteria:

- Must hold value over the existing condition – meaning the cost to construct, operate, and maintain a WRRF over the course of the next 20 years will provide less cost to the Village than the cost to operate and maintain the forcemain and treatment costs in which the Village is currently engaged.
- Must have an available location for construction.
- Must have an acceptable location to discharge treated effluent according to the State, and have State discharge limits achievable by a treatment technology used in the analysis.
- The cost effect on the user rates must be within Village tolerances to accept.
- The Village must be able to retire, or otherwise work within, the current treatment agreements in place with Kalamazoo.
- Funding for the project is available to the Village.

Through this analysis and development of a conceptual WRRF that fits all criteria above, Moore+Bruggink finds this option to be feasible for the Village of Mattawan to pursue. We recommend moving forward with engineering design of the facility.