McMAHON
ENGINEERS ARCHITECTS

To: The Village President and Board of Trustees

From: Chris Dopkins, P.E. Village Engineer

Re: Phosphorous Discharge Optimization Plan – South WWTP

Date: August 14, 2022

As we have discussed, there has been concerted effort by the Federal EPA to reduce nutrients (Nitrogen, Potassium and Phosphorus) from being discharged into the environment. This is largely in response to Gulf Hypoxia and observed algae growth within rivers, lakes and streams in the Mississippi River Basin. As you will recall, during a routine review of the permit for the SWWTP, Test, Inc. noted that the permit contains two special conditions which are outlined below.

SPECIAL CONDITION 18. The Permittee shall develop and submit to the Agency a Phosphorus Discharge Optimization Plan within twenty-four months of the effective date of this permit. The plan shall include a schedule for the implementation of these optimization measures. Annual progress reports on the optimization of the existing treatment facilities shall be submitted to the Agency by March 31 of each year beginning 12 months from effective date of the permit. In developing the plan, the Permittee shall evaluate a range of measures for reducing phosphorus discharges from the treatment plant, including possible source reduction measures, operational improvements, and minor facility modifications that will optimize reductions in phosphorus discharges from the wastewater treatment facility. The Permittee's evaluation shall include, but not be limited to, an evaluation of the following optimization measures:

A. WWTF influent reduction measures.
   1. Evaluate the phosphorus reduction potential of users.
   2. Determine which sources have the greatest opportunity for reducing phosphorus (i.e., industrial, commercial, institutional, municipal and others).
      a. Determine whether known sources (i.e., restaurant and food preparation) can adopt phosphorus minimization and water conservation plans.
      b. Evaluate implementation of local limits on influent sources of excessive phosphorus.
B. WWTF effluent reduction measures.
   1. Reduce phosphorus discharges by optimizing existing treatment processes.
      a. Adjust the solids retention time for either nitrification, denitrification, or biological phosphorus removal.
      b. Adjust aeration rates to reduce dissolved oxygen and promote simultaneous nitrification-denitrification.
      c. Add baffles to existing units to improve microorganism conditions by creating divided anaerobic, anoxic, and aerobic zones.
      d. Change aeration settings in plug flow basins by turning off air or mixers at the inlet side of the basin system.
      e. Minimize impact on recycle streams by improving aeration within holding tanks.
      f. Reconfigure flow through existing basins to enhance biological nutrient removal.

SPECIAL CONDITION 19. The Permittee shall, within twenty-four months of the effective date of this permit, prepare and submit to the Agency a feasibility study that identifies the method, timeframe, and costs of reducing phosphorus levels in its discharge to a level consistently meeting a potential future effluent limit of 0.5 mg/L and 0.1 mg/L. The study shall evaluate the construction and O & M costs of the application of these limits on a monthly, seasonal and annual average basis.

After review, the Village authorized staff to proceed with the optimization plan and feasibility study in December of last year. These studies are in essence a miniature version of a facility plan where just about any feasible technology that can be used to limit the discharge of phosphorus is evaluated. I have attached a draft of the plan for review, and I will make a short presentation of the findings at the August 17th meeting. Well then allow 30 days for Trustee and Staff review, and hopefully the Village will formally adopt the study in September where it will then be sent to IEPA for Agency review and comment.

I look forward to discussing this item with the Board and in the meantime please do not hesitate to contact me at 636-9590 with any questions. Thank you.

Engineering Report

Wastewater Treatment Facility

Phosphorus Discharge Feasibility Study

Prepared for The

VILLAGE OF POPLAR GROVE

BOONE COUNTY | ILLINIOS

VILLAGE OF POPLAR GROVE A Great Place to Call Home Illinois

FOR VILLAGE REVIEW
AUGUST 2022

JULY 2022

McM. No. P0013 07-21-00148.02

McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.
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Engineering Report

Wastewater Treatment Facility

Phosphorus Discharge Feasibility Study

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JULY 2022
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Phosphorus Discharge Feasibility Study

Prepared for The

VILLAGE OF POPLAR GROVE

BOONE COUNTY | ILLINIOS

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McMAHON ASSOCIATES, INC.
MACHESNEY PARK, ILLINOIS

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I. INTRODUCTION

The Village of Poplar Grove owns and operates two (2) wastewater treatment facilities, the North and South Plants. The Village of Poplar Grove South Wastewater Treatment Plant (SWWTP) discharges treated effluent to Beaver Creek, a tributary to Meander Creek, under its National Pollution Discharge Elimination System (NPDES) Permit No. IL0071447.

The current NPDES Permit, which was issued on September 26, 2019 (effective October 1, 2019), contains an effluent limit for total phosphorus of 1.0 mg/L (monthly average), which will be followed by potential future effluent limits of 0.5 mg/L and 0.1 mg/L (monthly average).

The current NPDES Permit contains a Compliance Schedule, which requires submittal of a Feasibility Study by October 1, 2021, that identifies the method, timeframe, and costs of reducing phosphorus levels in its discharge to a level consistently meeting potential future effluent limits of 0.5 mg/L and 0.1 mg/L.

II. WASTEWATER TREATMENT FACILITY DESCRIPTION

A Process Flow Schematic of the Village of Poplar Grove South Wastewater Treatment Plant (SWWTP) is shown on Figure 1.

The Village of Poplar Grove SWWTP includes the following major unit processes:

- Influent Pumping

- Screening and Grit Removal
- Sequencing Batch Reactors (SBR)
- Post Equalization
- ABF Sand Filter
- UV Disinfection
- Aerobic Digestion
- Sludge Dryer Bed

The influent design criteria for the SWWTP are summarized below:

▪ Average Flow, mgd	1.0
▪ Maximum Flow, mgd	2.5
▪ Average BOD, ppd	Unknown – Poplar Grove Unable to Provide Data
▪ Average TSS, ppd	Unknown – Poplar Grove Unable to Provide Data
▪ Average TP, ppd	Unknown – Poplar Grove Unable to Provide Data

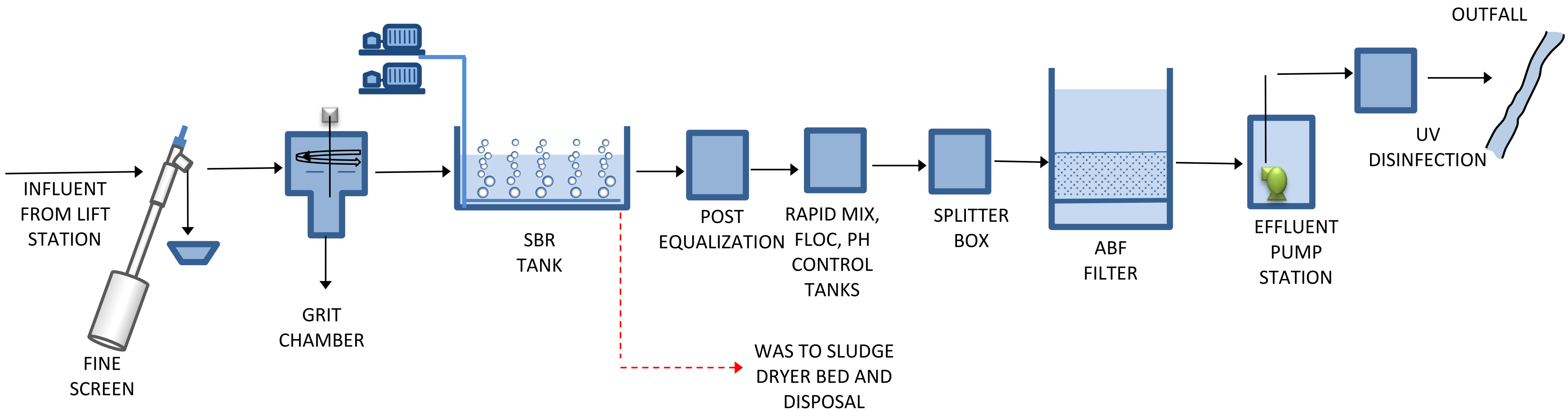

Figure 1

SOUTH WATERWATER TREATMENT PLANT

PROCESS FLOW SCHEMATIC

VILLAGE OF POPLAR GROVE, IL

McM. No. P0013 07-21-00148.02

III. WASTEWATER TREATMENT FACILITY INFLUENT FLOWS AND LOADINGS

Influent flows and loadings from January 2019 through December 2021 are summarized in Table 1, below. For the 3-year period, the average influent flow was 0.214 mgd, which is 21% of the original WWTP average design flow capacity of 1.0 mgd. The average TSS, BOD and TP loadings from January 2019 through December 2021 is 409 lbs./day, 173 lbs./day and 9 lbs./day, respectively.

Table 1
Summary of WWTP Influent Flows and Loadings
2019 through 2021

VILLAGE OF POPLAR GROVE
Wastewater Treatment Facility – Discharge Feasibility Study

Parameters	2019	2020	2021	Average	Maximum
Flow, mgd					
Average	0.313	0.200	0.128	0.214	--
Max Month	0.448	0.317	0.211	--	0.448
Max Day	0.961	0.830	0.634	--	0.961
BOD_5, lbs./day					
Average	245	131	144	173	--
Max Month	345	167	188	--	345
Max Day	1,220	633	668	--	1,220
TP, lbs./day					
Average	13*	8	6	9	--
Max Month	16*	20	10	--	20
Max Day	20*	119	52	--	119
TSS, lbs./day					
Average	741	295	191	409	--
Max Month	1,394	540	319	--	1,394
Max Day	7,887	1,432	1,446	--	7,887

*Includes November through December 2019 data only.

IV. WASTEWATER TREATMENT FACILITY PERFORMANCE

Effluent flows and loadings from January 2019 through December 2021 are summarized in Table 2, below. The monthly effluent flows and loadings and discharge concentrations are summarized in Appendix I, Table I-1, attached.

The SWWTP has been able to maintain an average effluent phosphorus concentration of 0.43 mg/L from January 2019 through to December 2021. The SWWTP has been able to consistently meet a monthly average effluent concentration below 0.5 mg/L in 2019, 2020, and 2021, with the exception of November 2020 through February 2021. The chemical pump was not functioning during this period, not allowing chemical to be delivered to the system, as needed.

Table 2

Wastewater Treatment Facility Performance – Effluent Discharge

2019 through 2021

VILLAGE OF POPLAR GROVE

Wastewater Treatment Facility – Discharge Feasibility Study

Parameters	2019	2020	2021	Average	Maximum
Flow, mgd					
Average	0.321	0.262	0.235	0.273	--
Max Month	0.439	0.357	0.359	--	0.439
Max Day	1.221	0.928	2.045	--	2.045
BOD_5, mg/L					
Average	1.50	3.43	3.07	2.67	--
Max Month	2.88	5.00	18.00	--	18.00
Max Day	6.00	5.00	18.00	--	18.00
TP, mg/L					
Average	0.25	0.55	0.48	0.43	--
Max Month	0.42	1.52	1.29	--	1.52
Max Day	1.03	2.22	2.83	--	2.83
TSS, mg/L					
Average	2.60	5.25	4.04	3.96	--
Max Month	4.69	7.07	5.83	--	7.07
Max Day	22.00	15.00	12.00	--	22.00
NH_3-N, mg/L					
Average	0.29	0.47	0.16	0.31	--
Max Month	1.44	2.45	0.39	--	2.45
Max Day	6.64	9.89	1.89	--	9.89
TKN, mg/L					
Average	0.72	1.79	0.92	1.14	--
Max Month	1.79	7.56	1.21	--	7.56
Max Day	1.79	12.20	1.33	--	12.20

V. PHOSPHORUS LOADINGS

Concentrations of phosphorus in raw municipal wastewater typically range from 4 to 15 mg/L. The usual forms of phosphorus in wastewater include Orthophosphate, Polyphosphate, and organic phosphorus, where organic phosphorus typically ranges from 25% to 33% of the total raw wastewater phosphorus and the remainder is inorganic, or a combination of Ortho and Polyphosphate.

Industrial wastes can either add, or in cases of a few phosphorus deficient discharges, dilute the total phosphorus in wastewater. Industrial wastes typically high in phosphorus include those generated from fertilizer production, meat processing, packing, milk processing, and food process wastes. It appears that there are no major industrial users contributing to the phosphorus load at the South WWTP. At this time, the phosphorus load seen in the influent SWWTP is primarily from domestic contributions only. The Village is using an orthophosphate product for water distribution system corrosion protection and is maintaining a constant dose around 0.8 to 1 mg/L.

VI. WWTP FEASIBILITY STUDY TO ACHIEVE 0.5 MG/L P

In addition to achieving biological phosphorus removal in the SBR tanks, the Village currently feeds alum to further achieve an average effluent phosphorus concentration of less than 0.5 mg/L. Approximately 27 gallons/month of alum is being dosed at the SWWTP. The current annual O&M expense for chemical addition is estimated at $37,000/year ($3,083/month).

We recommend the following additional items to enhance phosphorus removal in the SBR tanks:

- Installation of online monitoring analyzers for effluent ortho-phosphate to control the amount of alum being fed into the system.
- Modification of chemical feed location to ensure chemical is being fed to the SBR tanks at the end of the react phase.
- Conducting a complete bench scale testing of various chemical coagulants such as aluminum based and iron-based salt solution, to help determine achievable optimization P levels in the SWWTF, and to identify which coagulant provides the most efficient P removal in terms of dosing requirements and associated chemical costs.

VII. WWTP FEASIBIILTY STUDY TO ACHIEVE 0.1 MG/L P

It is very likely that the Village can reduce their effluent phosphorus discharge through optimization of their biological and chemical feed systems; however, it is unlikely that the chemical feed alone would allow the WWTP to consistently meet an effluent phosphorus limit of 0.1 mg/L. Tertiary treatment upgrades would likely be required to ensure the WWTP can consistently meet a future stringent NPDES permit effluent phosphorus limit. Therefore, the Village needs to further evaluate feasible treatment alternatives to meet a future phosphorus limit of 0.1 mg/L.

The following alternatives were evaluated for their ability to meet a future effluent phosphorus limit of 0.1 mg/L:

- Tertiary Treatment
  - Cloth Media Disk Filters
  - Continuously Backwashed Up-flow Sand filters

A. Preliminary Opinions of Cost Considerations

Preliminary Opinions of Capital and Operational Costs were developed for each treatment alternative for comparison purposes. Opinion of Capital Costs include equipment costs and construction/installation costs.

Opinion of annual costs include the costs necessary to operate the proposed tertiary treatment facilities. These costs include operation and maintenance (O&M), labor equipment parts, repairs and supply costs, chemical power, and fuel costs. The O&M costs are based upon the design criteria for each alternative and the personnel required for operating and maintaining these facilities.

It is important to note that improving solely the tertiary treatment process would be considered a small project in the way that there are not significant amounts of material involved. Small units tend to drive up unit prices, which makes it difficult to provide an accurate opinion of cost. The unit prices used in the cost estimates are what are considered conservative at the time of completing this report. Additionally, the market prices and availability are currently unstable, which adds to the difficulty of estimating project costs in advance.

The costs utilized in the analysis include the following:

- Electrical Cost — $0.08 per kW hour
- Alum — $3.69 per gallon
- Supplies and Parts — 1% of equipment costs
- Replacement Fund — 5% of equipment costs

Equipment vendor quotations were used for equipment capital costs. Mechanical, pipe and valve installation are estimated at 20% of the total equipment capital cost. Equipment installation is estimated at 40% of the total equipment capital cost. Electrical and controls are estimated at 10% of the total capital cost. General conditions are estimated at 10% of the subtotal cost. Contingency and engineering are estimated at 30% of the sum of the subtotal and general conditions cost.

B. Design Criteria

The following design criteria were used for sizing and evaluating the tertiary treatment options:

- Average Design Flow — 1 mgd
- Max Flow — 2.5 mgd
- Final Effluent TSS — 4 mg/L
- Secondary Effluent Total Phosphorus with Chemical Addition — 0.4 mg/L
- Final Effluent Total Phosphorus limit (Month Avg.) — 0.1 mg/L

C. Cloth Media Disc Filter

A Cloth Media Disk Filtration System (e.g., Aqua Aerobic Systems (AASI), AquaDisc Cloth Media Filter) is a tertiary treatment process that utilizes a cloth filter media installed on multiple rotating disks. A schematic of the AASI Cloth Media Disk Filter is shown in Figure 2, below.

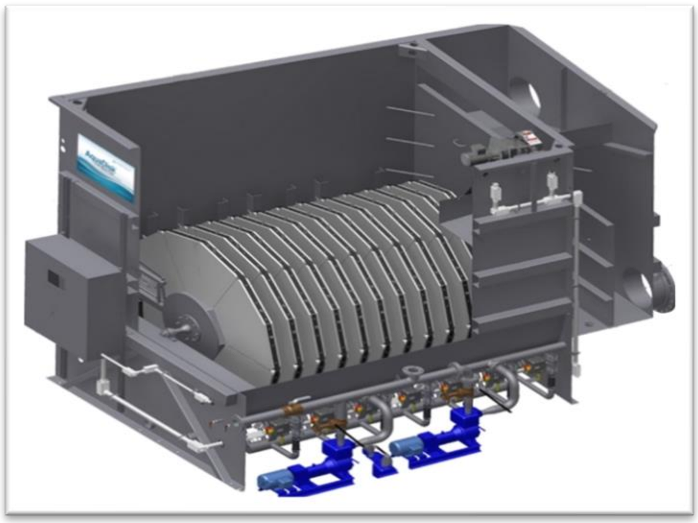

Figure 2: Aqua-Aerobic Systems AquaDisc Cloth Media Filter.

The disks can be installed in prefabricated steel or cast in place concrete tanks. During operation, chemically conditioned secondary effluent enters the filtration tank and passes through the cloth media filter, which provides a physical barrier for removing suspended solids. The filtered solids collect on the outer surface of the cloth media, forming a mat as filtrate flows through the disks. Heavier secondary effluent solids also settle to the bottom of the tank.

Flow through the disks is restricted as solids accumulate on the cloth media, causing the level in the tank to rise. At a predetermined setpoint level, a backwash cycle is initiated. During a backwash sequence, the disks rotate slowly by a chain gear drive. Backwash shoes in contact with the cloth media remove the filtered solids by vacuum pressure provided by a backwash pump. Settled solids on the bottom of the tank are removed on an intermittent basis by the backwash pump. The captured solids are returned to secondary treatment or solids handling.

Multi-point chemical addition for precipitation of phosphorus would be required to meet stringent effluent TP limits. A coagulant such as Ferric Chloride or Aluminum Sulfate (Alum), would be added to the SBR at the end of the react phase.

In this alternative, SBR effluent would flow to the post equalization basins then to the rapid mix, coagulant, and flocculation tanks were additional chemical coagulation and polymer would be dosed. Flow would then go through the disk filters and would discharge to the downstream process. A process flow schematic is shown in Figure 3, below.

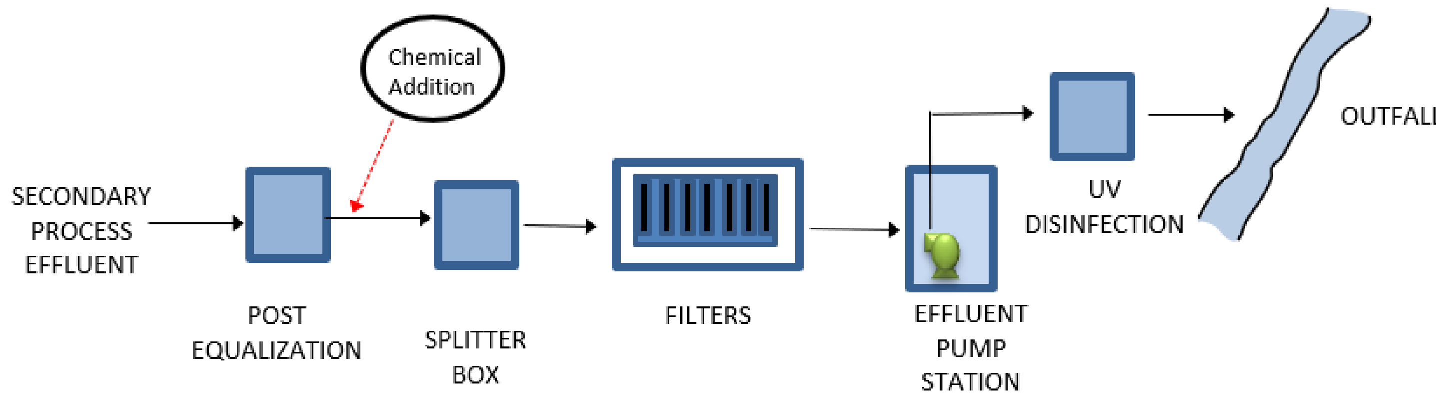

Figure 3
WATERWATER TREATMENT FACILITY
PROCESS FLOW SCHEMATIC - CLOTH MEDIA DISK FILTER
VILLAGE OF POPLAR GROVE, IL
McM. No. P0013 07-21-00148.02

McMAHON ENGINEERS ARCHITECTS

Aqua-Aerobic Systems (AASI) was contacted to evaluate the feasibility of installing the cloth media filter system at the Village of Poplar Grove SWWTP. To treat an average flow of 1.0 mgd and a maximum flow of 2.5 mgd, two (2) eight-disk AquaDisc Cloth Media Filters are recommended. Each filter disk has an area of 53.8 ft^2, with a total filtration area of 860.8 ft^2. The system has been designed with an average hydraulic loading rate of 0.81 gpm/ft^2, a maximum hydraulic loading rate of 2.02 gpm/ft^2, and a solid loading rate of 0.72 lbs. TSS/day/ft^2. The solid's loading rate is based on a maximum flow rate of 2.5 mgd and a maximum TSS of 22 mg/L.

The recommendation is based upon the provision to maintain a satisfactory hydraulic surface loading rate with one (1) unit out of service. The resultant hydraulic loading rate at the maximum design flow with one unit out of service is 4.0 gpm/ft^2.

In addition to the cloth media disc filters, rapid mix, coagulation, and flocculation tanks will be required for dosing of chemical coagulant and polymer. The existing tanks onsite can be used for chemical conditioning.

AASI provided a budgetary equipment cost for two (2) eight-disk AquaDisc Cloth Media Filters of $890,000 in prefabricated stainless-steel tanks. The cloth media filters can also be provided in cast in place concrete tanks at a budgetary equipment cost of $750,000. Ten percent was added to proposal costs to account for potential inflation between time of developing the cost estimate and when construction would be able to start.

This alternative will not require a new building to house the new cloth media filter equipment but can be installed directly in the ABF filter concrete tanks. Additional costs include piping, and all associated general mechanical and electrical work.

The Opinion of Probable Capital Costs are estimated at **$2,651,000**. The Opinion of Probable Annual Operation & Maintenance (O&M) Costs for power consumption, chemical, replacement, parts/supplies, and labor are **$105,000**. Refer to Table 3 for a breakdown of the Opinion of Probable Capital Costs.

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Table 3

Opinion of Probable Costs
Cloth Media Disk Filter System Alternative

Construction and Equipment Costs	
Demolition and Disposal	$83,000
Disk Filter Equipment *(in prefabricated stainless-steel tanks)*	$979,000
Mechanical, Pipe & Valve Installation	$196,000
Equipment Installation	$392,000
Electrical & Controls	$204,000
Subtotal	**$1,853,000**
General Conditions	$189,000
Engineering & Contingency	$612,000
Total Capital Cost	**$2,651,000**

Annual Operation and Maintenance Costs	
Labor	$9,000
Power	$5,000
Chemical	$37,000
Replacement	$45,000
Parts & Supplies	$9,000
Total Annual O & M	**$105,000**

D. Continuously Backwashed Up-Flow Sand Filters

Chemically enhanced, continuously backwash up-flow sand filtration is commonly used to meet restrictive effluent phosphorus limitations. A schematic of the process is shown in Figure 4, below.

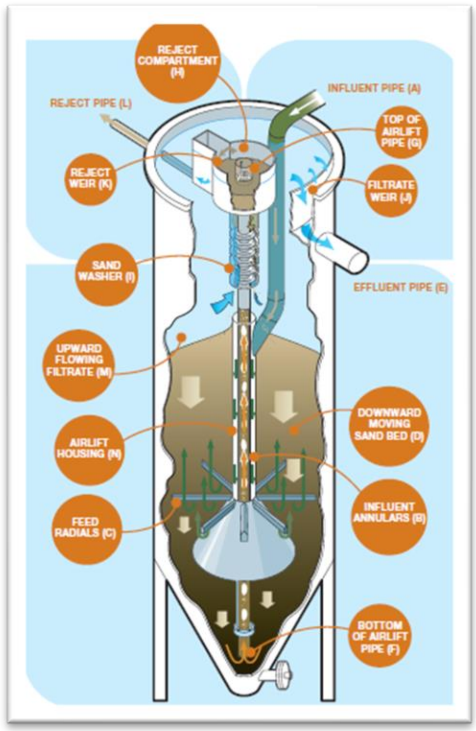

Figure 4: Continuously Backwashed Up-Flow Sand Filter.

In a continuously backwashed up-flow sand filter, the wastewater and sand travel in opposite directions. Chemically conditioned secondary effluent enters the top of the filter and flows downward through an annual section in the filter into the bottom of the sand bed through a series of slotted lateral feed radials. The radials are evenly distributed throughout the tank for an even distribution of the filter influent. Suspended solids are captured by the downward moving sand as the influent flows upward through the bed, existing at the top of the filter over a weir.

The sand bed is drawn downwards into the center of the filter and into the airlift pipe, where the sand is scoured to dislodge any attached solid particles. The sand slurry is pushed to the top of the airlift and into a reject compartment, where the heavier sand falls into the sand washer and the lighter solids are carried over the reject weir and out the reject pipe. A small amount of the polished effluent moves upwards through the sand washer carrying out the remaining reject solids as the cleaned sand is deposited back on the top of the sand bed.

Filters can be installed in series to achieve ultra-low effluent phosphorus concentrations less than 0.1 mg/L.

A process flow schematic is shown in Figure 5, below. Multi-point chemical addition for precipitation of phosphorus would be required to meet stringent effluent phosphorus limits. A coagulant such as Ferric Chloride or Aluminum Sulfate (Alum), would be added to the SBR at the end of the react phase.

SBR effluent will flow to the post equalization basin and pumped to the filters. Flow would then go through the filters and would discharge to the downstream process. Reject water and floor drains would be piped back to the head of the plant. An advantage of piping reject water back to the head of the plant is that any non-reacted chemical will react with soluble phosphorus in the raw wastewater, slightly reducing the chemical feed requirements. Upstream of the filters.

Nexom was contacted to evaluate the feasibility of installing their BluePro® filter technology at Popular Grove WWTP. To treat an average flow of 1.0 mgd and a maximum flow 2.5 mgd, eight (8) CF64-60 BluePro® filters were recommended, with a total filtration area of 512 ft^2. The system has been designed with an average hydraulic loading rate of 1.35 gpm/ft^2, a maximum hydraulic loading rate of 3.9 gpm/ft^2, and a solid loading rate of 1.3 lbs. $TSS/day/ft^2$. The solid's loading rate is based on a maximum flow rate of 2.5 mgd and a maximum TSS of 22 mg/L. The recommendation is based upon the provision to maintain a satisfactory hydraulic surface loading rate with one (1) unit out of service.

Nexom provided a budgetary equipment cost for eight (8) CF64-60 BluePro® filters for $1,197,000 in prefabricated steel. The up-flow sand filters can also be provided in cast in place concrete tanks at a budgetary equipment cost of $827,000. The equipment costs include costs associated with the chemical feed system.

This alternative will require a new 40 ft. x 25 ft. building to house the BluePro® filter technology equipment. Additional costs include piping, site restoration, a road to provide access to the building, and all associated general mechanical and electrical work.

The Opinion of Probable Capital Costs are estimated at **$5,437,000**. The Opinion of Probable Annual Operation & Maintenance (O&M) Costs for power consumption, chemical, replacement, parts/supplies, and labor are **$113,966**. A breakdown of the opinion of probable costs is provided in Table 4.

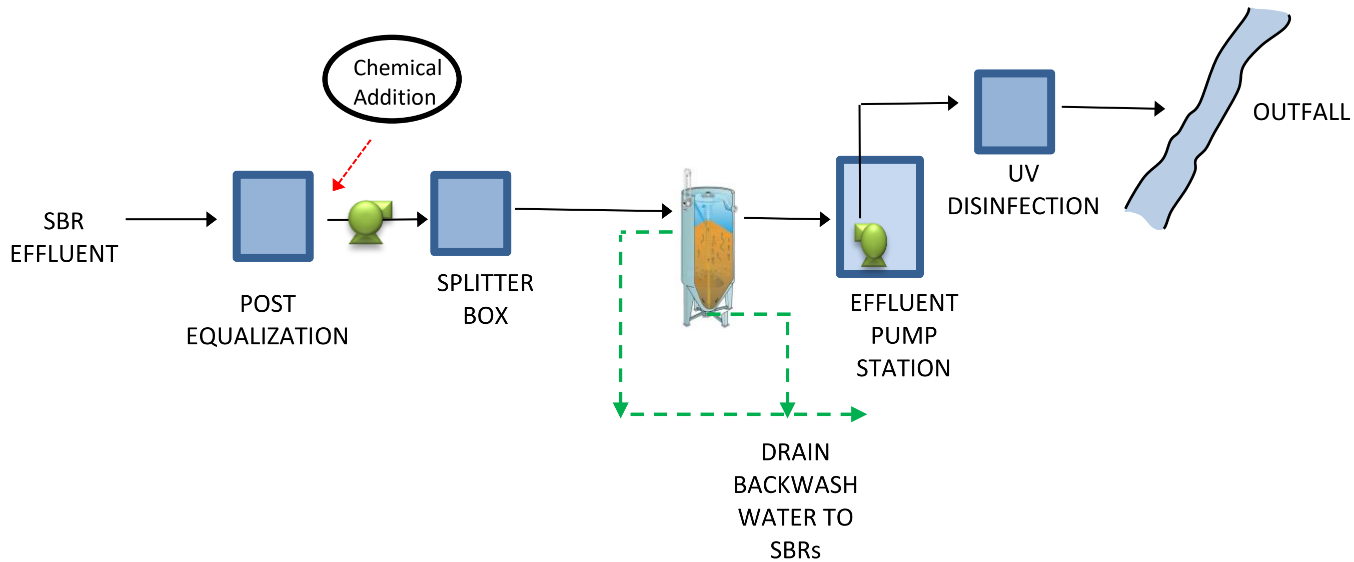

Figure 5
WATERWATER TREATMENT FACILITY
PROCESS FLOW SCHEMATIC CONTINUOUSLY
BACKWASHED UP-FLOW SAND FILTER
VILLAGE OF POPLAR GROVE, IL
McM. No. P0013 07-21-00148.02

Table 4

Opinion of Probable Costs

Continuously Backwashed Up-Flow Sand Filter System Alternative

Construction and Equipment	Cost
Site Work	$44,000
Demolition and Disposal	$50,000
New Filter Building	$440,000
Submersible Pump Station	$275,000
Filter Feed Pumps	$110,000
Sand Filter Equipment *(in prefabricated stainless-steel tanks)*	$1,317,000
Mechanical, Pipe & Valve Installation	$448,000
Equipment Installation	$895,000
Electrical & Controls	$224,000
Subtotal	**$3,803,000**
General Conditions	$380,000
Engineering & Contingency	$1,254,000
Total Capital Cost	**$5,437,000**

Annual Operation and Maintenance Costs	
Labor	$11,970
Power	$18,626
Chemical	$5,550
Replacement	$64,850
Parts & Supplies	$12,970
Total Annual O & M	**$113,966**

VIII. OVERALL SUMMARY & SELECTED ALTERNATIVE

The current NPDES Permit, which was issued on September 26, 2019 (effective October 1, 2019), contains an effluent limit for total phosphorus of 1.0 mg/L (monthly average), which maybe follow by future effluent limits of 0.5 mg/L and 0.1 mg/L (monthly average).

The SWWTP has been able to maintain an average effluent phosphorus concentration of 0.43 mg/L from January 2019 through to December 2021. The SWWTP has been able to consistently meet a monthly average effluent concentration below 0.5 mg/L in the last three years, with the exception of the four-month period between November 2020 through February 2021. Tertiary treatment upgrades would be required to ensure the WWTP could consistently meet an NPDES permit effluent phosphorus limit of 0.1 mg/L.

The following treatment compliance alternatives were evaluated for meeting the new effluent Total P limitations:

- Tertiary Filtration
  - Cloth Media Disk Filter
  - Continuously Backwashed Up-flow Sand Filters

A Preliminary Opinion of Probable Cost was completed for the two (2) treatment alternatives. The following design criteria were used for sizing and evaluating each tertiary treatment alternative:

▪ Average Design Flow	1 mgd
▪ Max Flow	2.5 mgd
▪ Final Effluent TSS	4 mg/L
▪ Secondary Effluent Total Phosphorus with Chemical Addition	0.4 mg/L
▪ Final Effluent Total Phosphorus limit (Month Avg.)	0.1 mg/L

The two (2) treatment alternatives for meeting the 0.1 mg/L Total P limit are summaries below in Table 5.

Table 5

Summary of Treatment Alternative Costs

	AquaDisk®	**BluePro®**
Total Capital Cost	$2,651,000	$5,437,000
Total Annual O & M	$185,000	$113,966

The Cloth Media Filters appear to be the most cost-effective treatment alternative for meeting future effluent phosphorus limits, assuming the existing filters can be retrofitted with the disk filter equipment eliminating the need for a new filter building. It is recommended that the Village undertake Facility Planning on the SWWTP for a comprehensive and in-depth evaluation of implementing tertiary treatment improvements. A completed Facility Plan will be required by the

Illinois Environmental Protection Agency before improvements can take place. Additionally, when the Village is required to move forward with tertiary treatment, it is recommended that the alternatives be pilot tested to verify system performance and chemical use.

* The Opinion of Probable Cost was prepared for use by the Owner in planning for future costs of the project. In providing Opinions Of Probable Cost, the Owner understands the Design Professional has no control over costs or the price of labor, equipment, or materials, or over Construction Professionals' method of pricing, and that the Opinions Of Probable Cost provided herewith are made on the basis of the Design Professional's qualifications and experience. It is not intended to reflect actual costs and is subject to change with the normal rise and fall of the local area's economy. This Opinion must be revised after every change made to the project or after every 30-day lapse in time from the original submittal by the Design Professional.

APPENDIX I
Monthly Effluent Flows and Loading
January 2019 – December 2021

Table I-1
Village of Poplar Grove
2019 Effluent Loading

Month	2019 Effluent											
	Flow		BOD		TSS		NH3-N		Total P		TKN	
	MGD		mg/L		mg/L		mg/L		mg/L		mg/L	
	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max
Jan	0.245	0.736	1.00	1.00	2.47	14.00	0.09	0.19	0.26	0.86	0.46	0.46
Feb	0.329	0.560	2.00	5.00	1.58	3.00	0.91	4.07	0.29	1.03	0.78	0.78
Mar	0.368	0.836	1.67	3.00	3.08	7.00	0.14	0.42	0.29	0.72	0.33	0.33
Apr			2.88	6.00	3.57	7.00	0.06	0.10	0.23	0.53	0.29	0.29
May	0.439	0.813	1.50	3.00	2.46	13.00	0.07	0.16	0.14	0.20	0.76	0.76
Jun	0.326	0.546	1.00	1.00	2.67	16.00	0.21	0.58	0.42	0.94	0.87	0.87
Jul	0.327	0.637	2.00	4.00	1.29	4.00	0.27	1.94	0.33	0.67	0.46	0.46
Aug	0.221	1.221	1.00	1.00	2.46	8.00	0.09	0.21	0.20	0.43	1.79	1.79
Sep	0.340	0.983	1.00	1.00	1.67	9.00	0.07	0.12	0.28	0.73	0.82	0.82
Oct	0.351	0.829			3.00	21.00	0.10	0.44	0.17	0.26	0.95	0.95
Nov	0.352	1.068	1.00	1.00	4.69	22.00	1.44	6.64	0.24	0.59	0.77	0.77
Dec	0.234	0.423			2.25	4.00	0.06	0.12	0.17	0.20	0.32	0.32
Average	0.321	--	1.50	--	2.60	--	0.29	--	0.25	--	0.72	--
Max	0.439	1.221	2.88	6.00	4.69	22.00	1.44	6.64	0.42	1.03	1.79	1.79

Table I-1 (Continued)
Village of Poplar Grove
2020 Effluent Loading

Month	2020 Effluent											
	Flow		BOD		TSS		NH3-N		Total P		TKN	
	MGD		mg/L		mg/L		mg/L		mg/L		mg/L	
	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max
Jan	0.254	0.398			3.83	7.00	0.05	0.08	0.26	0.80	6.36	12.20
Feb	0.201	0.384			4.09	8.00	0.05	0.08	0.21	0.40	1.33	1.33
Mar	0.294	0.312	3.50	3.33	7.07	7.60	2.09	2.65	0.43	0.43	7.56	7.56
Apr	0.330	0.928	3.75	4.00	6.17	15.00	2.45	9.89	0.47	0.83	0.56	0.56
May	0.327	0.509	4.00	4.00	4.73	7.00	0.26	1.03	0.55	1.47	0.93	0.93
Jun	0.357	0.916			5.86	9.00	0.06	0.10	0.51	2.22	0.61	0.61
Jul	0.277	0.420			5.77	9.00	0.07	0.09	0.37	0.75	0.71	0.71
Aug	0.243	0.399			5.67	15.00	0.29	2.41	0.28	0.41	0.48	0.48
Sep	0.236	0.850	2.33	5.00	5.29	11.00	0.06	0.08	0.30	0.33	0.99	0.99
Oct	0.207	0.304	2.00	2.00	5.33	10.00	0.10	0.31	0.36	0.54	0.91	0.91
Nov	0.199	0.288			5.60	12.00	0.06	0.12	1.35	1.84	0.29	0.29
Dec	0.215	0.378	5.00	5.00	3.60	7.00	0.07	0.11	1.52	2.15	0.77	0.77
Average	0.262	--	3.43	--	5.25	--	0.47	--	0.55	--	1.79	--
Max	0.357	0.928	5.00	5.00	7.07	15.00	2.45	9.89	1.52	2.22	7.56	12.20

Table I-1 (Continued)
Village of Poplar Grove
2021 Effluent Loading

Month	2021 Effluent											
	Flow MGD		BOD mg/L		TSS mg/L		NH3-N mg/L		Total P mg/L		TKN mg/L	
	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max
Jan	0.217	0.314	2.00	2.00	5.83	9.00	0.35	1.30	1.29	1.46	1.10	1.10
Feb	0.204	0.392	1.00	1.00	5.73	9.00	0.32	1.89	1.24	1.89	1.09	1.33
Mar	0.359	0.745	3.33	5.00	5.25	10.00	0.09	0.27	0.41	1.36	1.03	1.03
Apr	0.261	0.537	18.00	18.00	3.33	9.00	0.11	0.33	0.70	2.83	1.01	1.20
May	0.225	0.429	4.00	5.00	4.13	7.00	0.08	0.27	0.21	0.26	0.52	0.52
Jun	0.211	0.498	1.00	1.00	3.75	12.00	0.08	0.15	0.24	0.29	0.66	0.91
Jul	0.221	0.379	1.10	2.00	2.75	4.00	0.10	0.19	0.21	0.25	0.93	0.93
Aug	0.285	2.045	1.54	2.00	4.90	8.00	0.39	1.80	0.25	0.44		
Sep	0.195	0.619	1.21	2.00	4.29	8.00	0.12	0.27	0.47	1.24	1.21	1.21
Oct	0.214	0.503	1.42	2.00	2.89	6.00	0.11	0.14	0.20	0.28		
Nov	0.214	0.349	1.07	2.00	3.25	7.00	0.09	0.14	0.35	1.95	0.71	0.72
Dec	0.213	0.485	1.17	2.00	2.33	5.00	0.09	0.15	0.20	0.77		
Average	0.235	--	3.07	--	4.04	--	0.16	--	0.48	--	0.92	--
Max	0.359	2.045	18.00	18.00	5.83	12.00	0.39	1.89	1.29	2.83	1.21	1.33