GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY

Temporary and Mobile Water/Wastewater Treatment Systems for Successful Environmental Remediation – A Contractor's Perspective

Nishil Mohammed Ph.D.
Project Manager – Technologies Division
Ground Force Environmental Corp. (GFEC)
nishilmohammed@gflenv.com +1-519-591-7057

PRESENTATION OUTLINE

Intro to GFEC

Water/Wastewater Treatment Systems

Technologies Available

Case Study

Contractor Perspectives

GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY

GFEC → SERVICES OFFERED

GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY

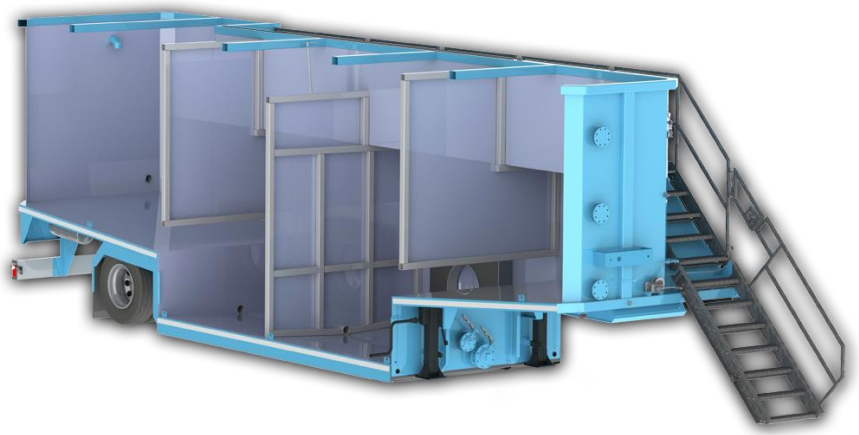
Bulk Excavation, Remediation & Restoration	Mass Excavation & Shoring	Interior/Industrial Site Remediation
Stormwater Management Pond Cleanouts & Creek Restoration	Bulk Materials Screening, Grinding & Crushes	Fuel Station Decommissioning
Underground Storage Tank Removals	Cutoff walls, slurry walls & Permeable Reactive Barriers	Facility Demolition & Decommissioning
In-Situ/Ex-Situ Remediation Services (Including Drilling)	**Water/Wastewater Treatment Systems**	Sub-Slab Vapour Intrusion Mitigation System Installation

GFEC → WATER/WASTEWATER TREATMENT

- Experienced **water treatment contractors** in Canada.
- A fleet of **mobile water treatment systems** that are ready to be **setup and commissioned** at to your project site within a very short timeframe.
- Possesses mobile **environmental compliance approvals (ECAs)**
  - Allows water/wastewater treatment and discharge to natural environment or city sanitary/sewers.
  - Capability to treat various contaminants at flow rates up to 1,000 GPM.
- Clients have relied upon our systems for the following applications:
  - **Excavation dewatering**
  - **Emergency spill response**
  - **Pump-and-treat**
  - **Pump, treat, and re-inject**
  - **Automated chemical dosing/injection**

GROUNDFORCE ENVIRONMENTAL • A GFL COMPANY

TECHNOLOGIES AVAILABLE



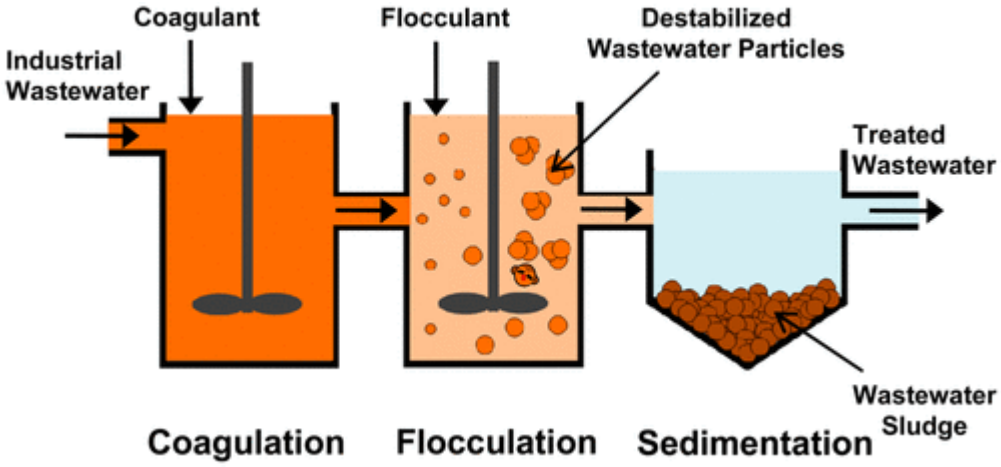
1

2

Settling and **Multi-Media Filtration** for removal of total suspended solids (TSS).

GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY

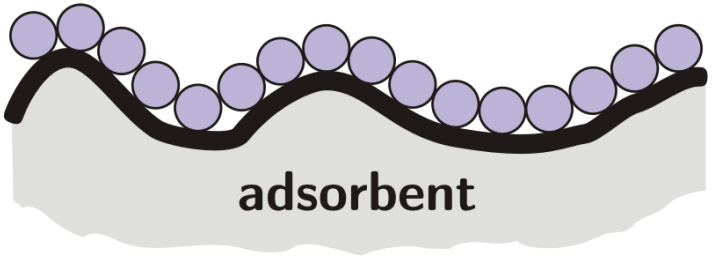
TECHNOLOGIES AVAILABLE



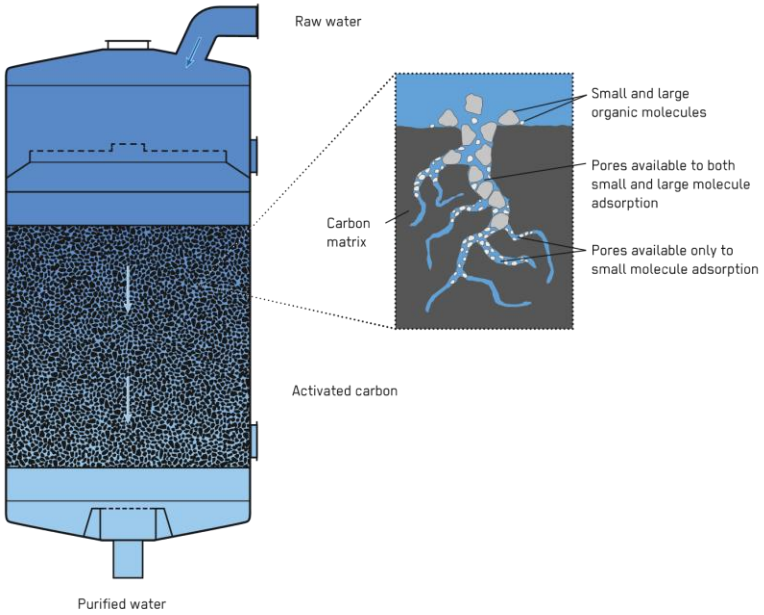
Coagulation, **Flocculation** followed by **Sediment Filtration** for removal of TSS and metals.

GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY

TECHNOLOGIES AVAILABLE



4

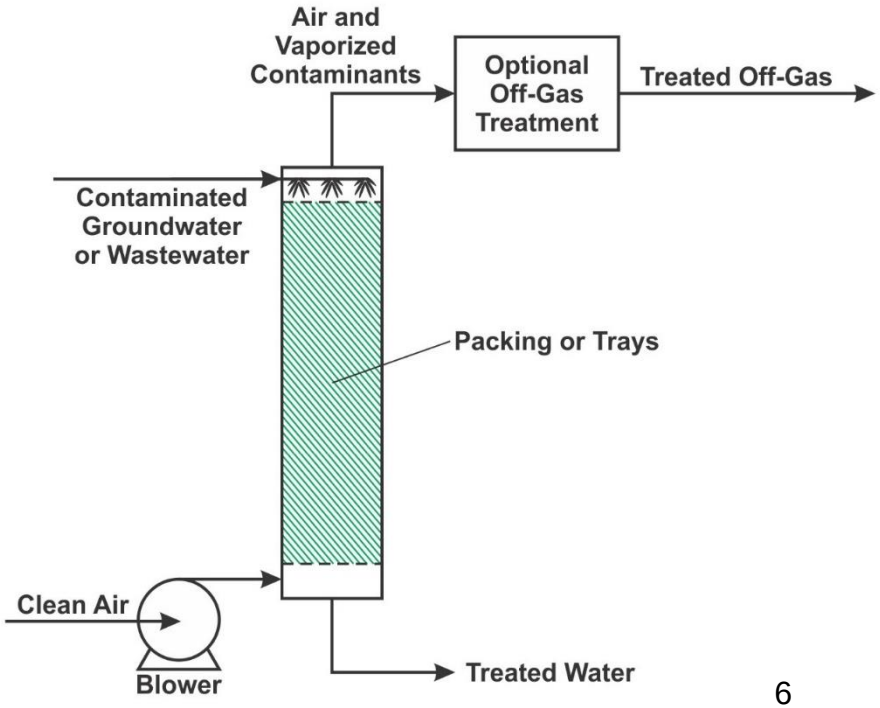


5

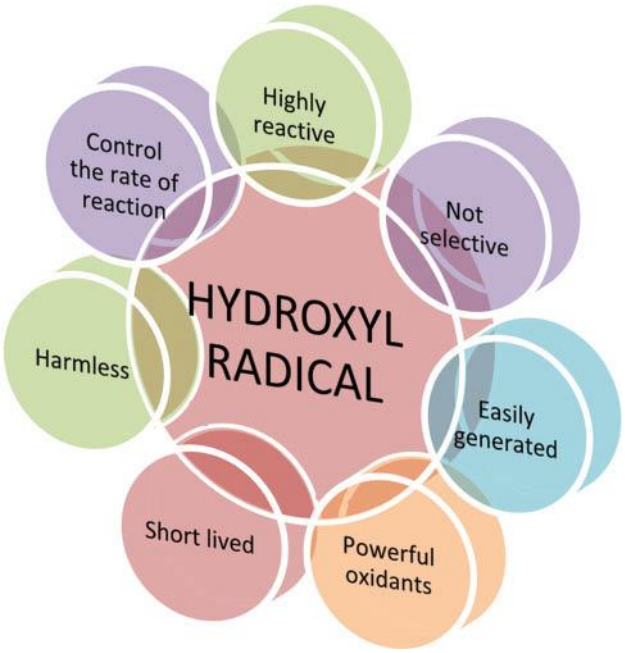
Adsorptive filtration for removal of dissolved phase contaminants using various filter media such as granular activated carbon (GAC), organoclay, zeolite, or apatite.

GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY

TECHNOLOGIES AVAILABLE



6

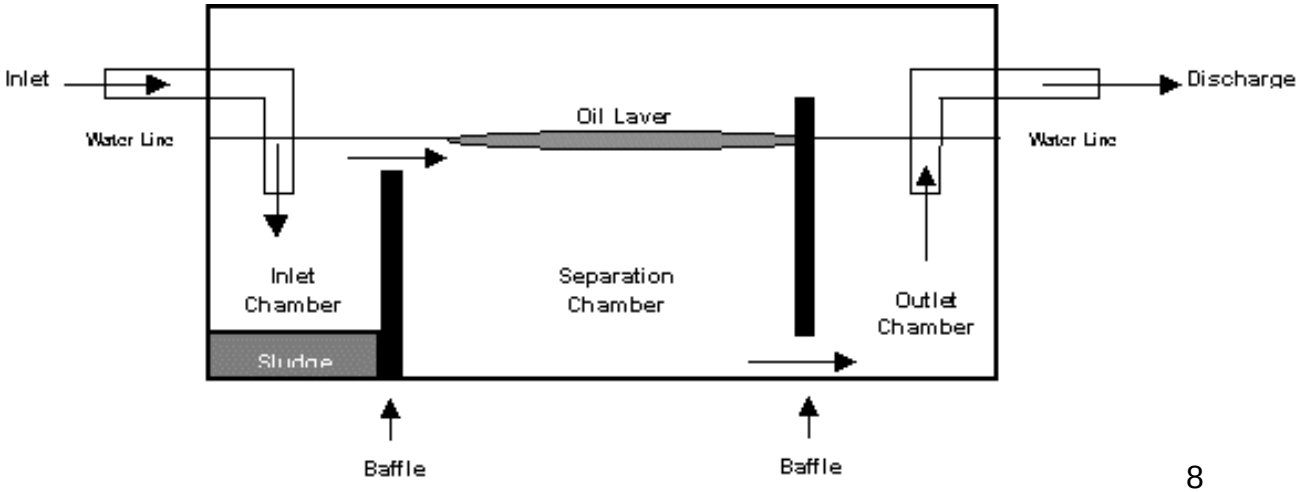


7

Air stripping or **advanced oxidation processes** for removal of dissolved-phase contaminants.

GROUND FORCE ENVIRONMENTAL • A GFL COMPANY

TECHNOLOGIES AVAILABLE



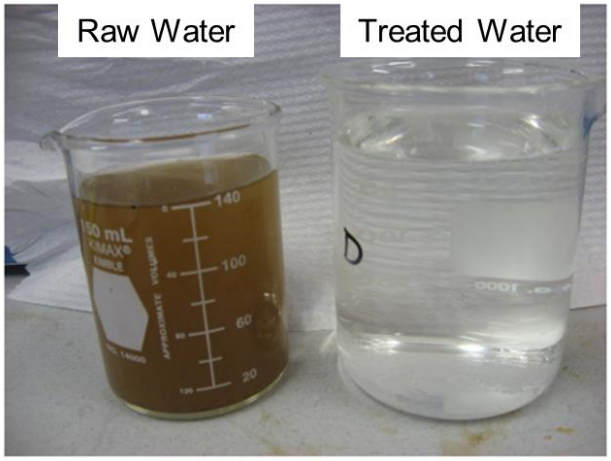
8

Free-phase product recovery and **separation** using specialized extraction pumps and oil water separators.

GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY

TECHNOLOGIES AVAILABLE

- **Membrane processes** such as microfiltration, nanofiltration and reverse osmosis.
- Addition of **chemical reagents**, **bio-stimulation compounds**, or **bioaugmentation cultures** to re-circulated groundwater to promote in-situ remediation of the contaminant plume.
- **Multi-phase extraction**, **air sparging**, **bio-sparging**, and **direct injection** options.



GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY

CASE STUDY – REMEDIATION PROJECT

LOCATION: Remote Eastern Ontario

CLIENT: Confidential

GOAL: Water treatment system to pump, treat and discharge more than **250,000 m^3** of dissolved metals impacted water in a wetland caused by a historical mining ore spill.

Contaminants of Concern (COCs): TSS, Copper, Zinc and Polyaromatic Hydrocarbons (PAHs).

Parameter	Units	Treated Water Objective
TSS	mg/L	< 25
pH	-	6.0 to 9.5
Copper	mg/L	< 0.0075
Zinc	mg/L	< 0.024

TREATMENT PROCESS

- Partnered with a leading equipment/technology provider Veolia Water Technologies Canada Inc. (**VEOLIA**) for treatability testing, process design and system commissioning.
- **Chemically Enhanced Process**: The metals are precipitated at high pH and separated from the water with the aid of coagulant, polymer and microsand.
- **Equipment Sizing:**
  - All the equipment on the **water treatment chain** is designed for the maximum hydraulic flow of 227.3 m^3/hour.
  - All the equipment on the **sludge dewatering chain** is designed for the maximum hydraulic flow of 24 m^3/hour.

TREATABILITY TESTING

- Objective was **to test the feasibility of chemical enhanced process** to treat the dissolved metals impacted water from the site.
- **Treatability Testing Procedure:**

Step 1: Sample Collection
20 liters of contaminated raw water from the site was collected via grab sampling from the site.

Step 2: Screening
The raw water was screened through a 1 mm screen to remove vegetation and coarse solids prior to testing.

TREATABILITY TESTING

Step 3: Actiflo® Clarification Testing

The procedure uses a standard Phipps & Bird jar tester and 1 L cylindrical beakers. The RPMs, time sequence of chemical/actisand and settling time are optimized for the desired full-scale operation.

Chemicals	Formula	Purpose
Alkali blend	Hydrex™ 9501	pH adjustment
Iron based coagulant	Hydrex™ 6253	Coagulation
Alum based coagulant	Hydrex™ 6240	Coagulation
Anionic polymer	Hydrex™ 6105	Flocculation
Actisand	HydrexTM	Ballast
Sulfuric Acid	H2SO4	pH neutralization

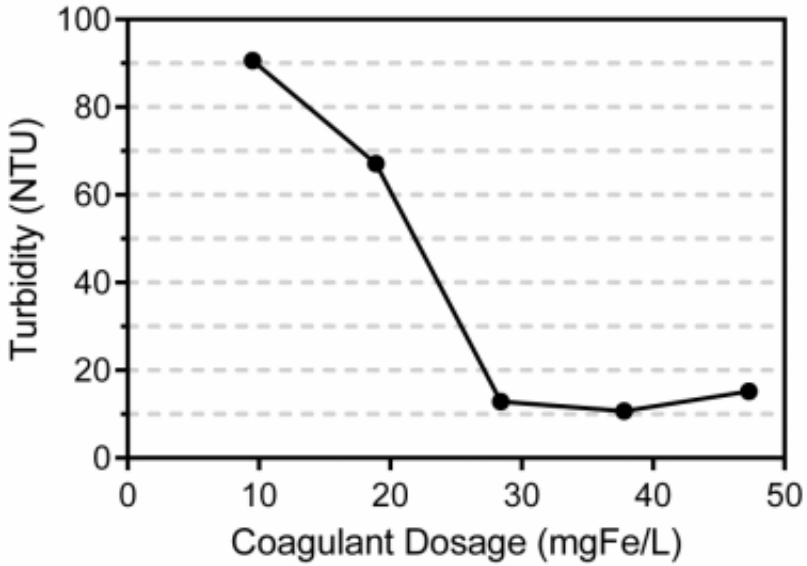
Step 4: Hydrotech Filtration
Water is filtered through the column at a set pressure head and water is collected at specified time points. The collected water is used for downstream analysis and the volume of water is calculated for up-scaling calculations.

Step 5: Granular Activated Filtration
Hydrotech filtered water was done on a filtration column, designed to closely reproduce a GAC filtration unit.

GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY

TREATABILITY TESTING

- **Course screening** may be required if high levels of vegetation are expected in the raw water during the remediation process.
- The **Iron based coagulant**, Hydrex™ 6353, was capable of achieving the objectives.
- A **coagulant** dosage of 37 mg/L is optimal to achieve the TSS, copper and zinc removal.
- **Anionic polymer** Hydrex™ 6105 demonstrated excellent performance for TSS and metal precipitate removal. The recommended dosage is 1.0 mg/L.
- The **Hydrotech Discfilter** polished the clarified water and did not experience significant clogging of the filter cloth.
- The **GAC** removed the organic matter, copper complexes and produced a high-quality final effluent.
- Low dosage of **sulfuric acid** can be applied to neutralize the pH.

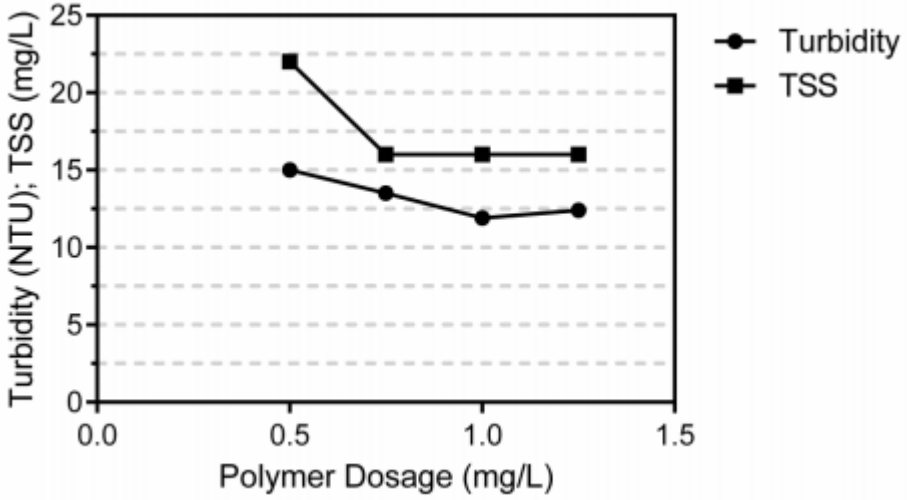


Coagulant Dosage Optimization

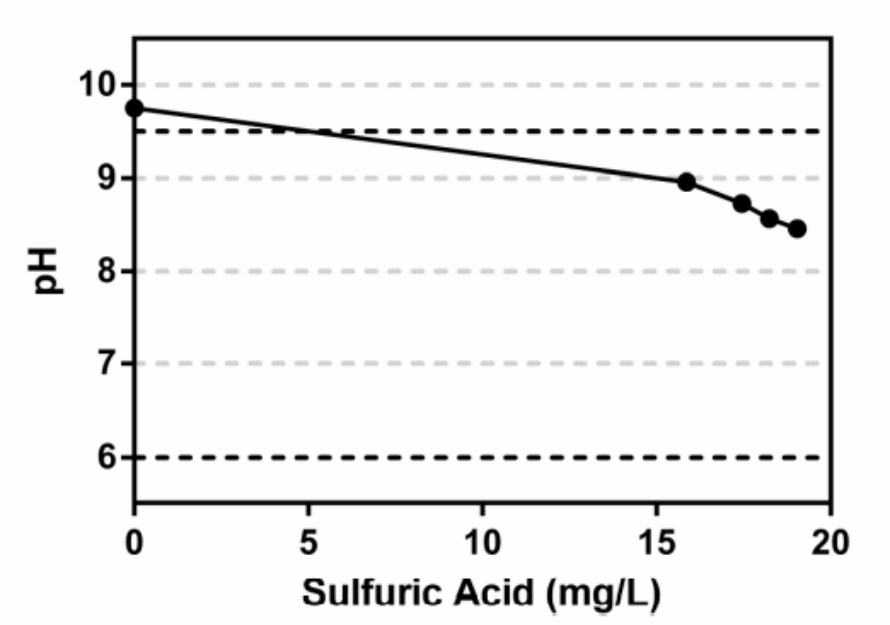
Best performance of coagulant was achieved at a dosage of **37 mg/L**.

Polymer Dosage Optimization

Best performance of coagulant was achieved at a dosage of **1 mg/L**.



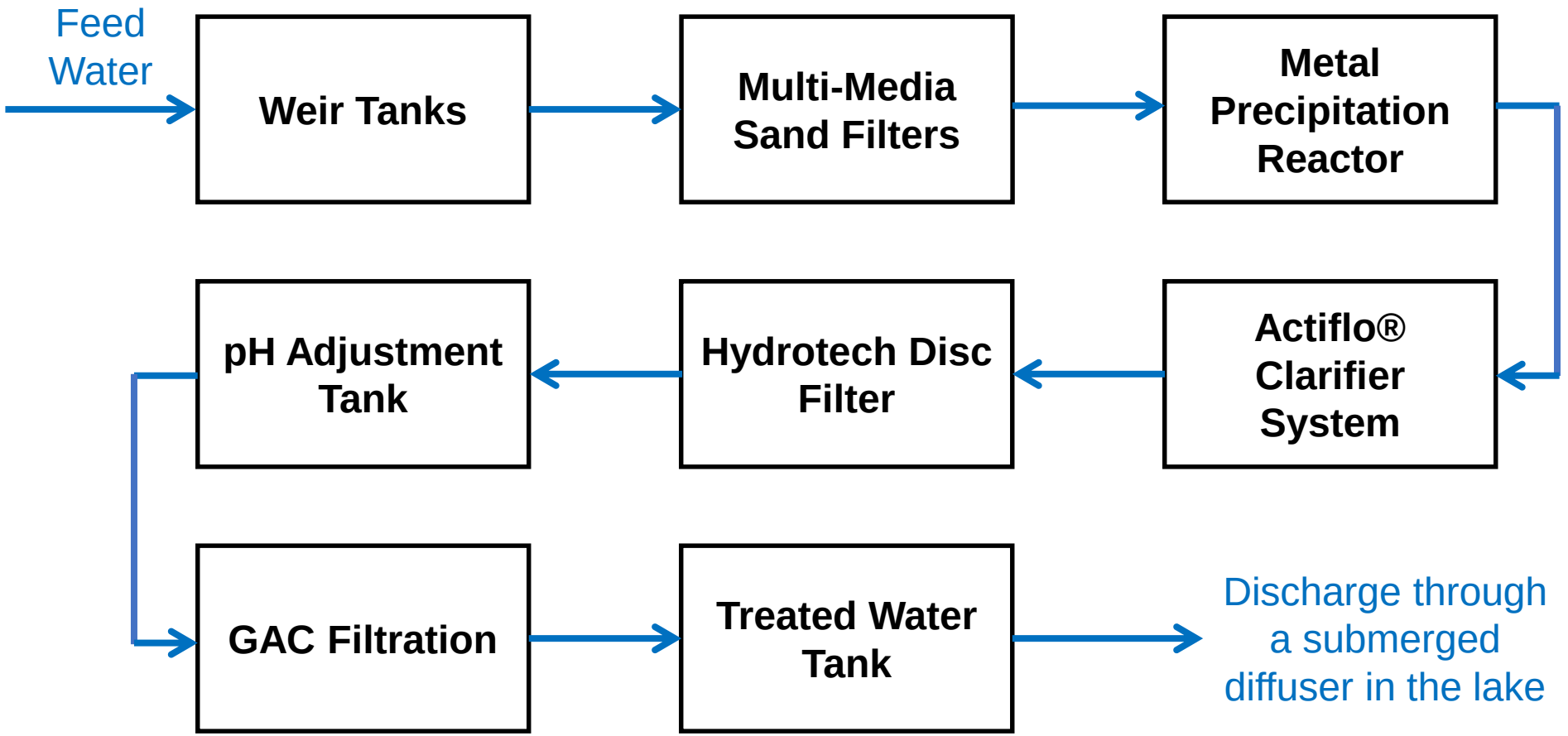
GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY



pH Neutralization

Acid was added from a starting point pH of 9.75 to a final pH of 8.46. The addition of **17.4 mg/L** of sulfuric acid decreased the pH to 8.73

TREATMENT PROCESS

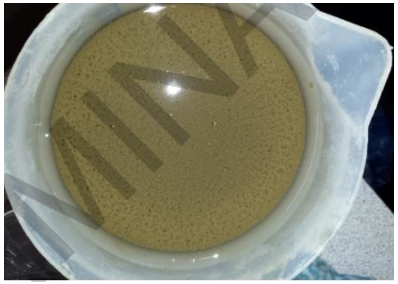


GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY

TREATMENT PROCESS

Sludge Dewatering Chain:

1. Sludge splitter box after the clarifier system.
2. Dewatering using Geotube.
3. Dewatered sludge → Slurry pit → Solidified → Offsite disposal.



GROUND FORCE ENVIRONMENTAL • A GFL COMPANY

TREATMENT PROCESS

- GFEC provided **contracting support** to mobilize, install, and commission the water treatment system and all associated pumps and hoses.
- Due to **site access restrictions** and **limited space** in the heavily wooded area of the site, the system had to be located more than 500 metres away from the dredging area.
- GFEC operated this system **24 x 7** at this remote site location.
- GFEC was responsible for the **strict operational timelines**.
- The treatment system was operated **successfully** to meet the required water quality guidelines and the **treated** water was discharged to a **pristine cold lake**.

PROJECT TIMELINE

2016

2017

2018

2018

GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY

ON-SITE TREATMENT SYSTEM

GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY

CONTRACTOR'S PERSPECTIVE

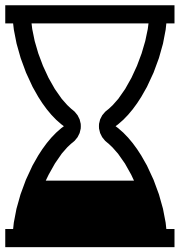
- Pre-qualify your contractor
  - Limit your risk.
  - Work with experienced contractors to level playing field.
  - Less potential for unexpected change orders.

- Communicate impacts of the project with existing tenants.

- Work with sub-trades. i.e., Plumber, electrical, granular, concrete:
  - To ensure utilities are identified and supply is accessible.
  - To ensure fittings and materials that meets the specifications and guidelines are used.

- Technical engagement at the early stage
  - Understand site-specific water chemistry.
  - Management of water treatment residuals.

- On-site testing is key and only trained and experienced field professionals can carry out this.



- Strategic planning to deal with unexpected delays and supply chain issues.

REFERENCES

1. https://www.rainforrent.co.uk/products/60m3-weir-tank/
2. https://www.bluewaterbio.com/filterclear/
3. Teh, Chee Yang, et al. "Recent advancement of coagulation–flocculation and its application in wastewater treatment." Industrial & Engineering Chemistry Research 55.16 (2016): 4363-4389.
4. https://simple.wikipedia.org/wiki/Adsorption
5. https://www.emergency-wash.org/water/en/technologies/technology/granular-activated-carbon-gac
6. https://frtr.gov/matrix/Air-Stripping-Ex-Situ/
7. Buthiyappan, Archina, Abdul Raman Abdul Aziz, and Wan Mohd Ashri Wan Daud. "Recent advances and prospects of catalytic advanced oxidation process in treating textile effluents." Reviews in Chemical Engineering 32.1 (2016): 1-47.
8. https://p2infohouse.org/ref/07/06019.htm
9. https://www.youtube.com/watch?v=VoyrHzpENHg&ab_channel=SidneySecklerFerreiraFilho

GROUND FORCE
ENVIRONMENTAL • A GFL COMPANY

remediation

Questions & Comments ???

Contact Us

Nishil Mohammed, Ph.D.

Project Manager – Technologies

Ground Force Environmental Corp. - A GFL Company

✉ nishilmohammed@gflenv.com

+1-519-591-7057

We'll See You On-Site!