Study on pH Adjustment Systems and Recommendations for Design and Operational Guidelines
Task 7 Study Report

Report

Submitted to:

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ES 1. EXECUTIVE SUMMARY

ES 1.1 Introduction

AMEC Earth & Environmental, a Division of AMEC Americas Limited (AMEC), in association with XCG Consultants Ltd (XCG), was retained by the Department of Environment and Conservation (ENVC) to conduct a study on pH adjustment systems in drinking water systems in Newfoundland and Labrador.

The objectives of the study were to document the operation and effectiveness of pH adjustment processes currently used in drinking water systems in the Province, and to conduct a review of existing provincial design guidelines, standards and regulations relating to pH adjustment systems. A work plan was developed to address the study objectives and included the following seven (7) tasks:

1. Project Initiation and Project Management
2. Collection of Design Information and Background Data
3. Assessment of Effectiveness of pH Adjustment Systems
4. Identification of Problems and Issues with Ineffective pH Adjustment Systems
5. Recommendations for Design Guidelines
6. Evaluation of Ryznar and Langelier Saturation Indices
7. Preparation of Study Report

The following Task Summary Reports were previously submitted to summarize the information collected during Task 2, 3, 4, 5 and 6:

- Task 2 Summary Report summarized the design information and background data that was collected during the site visits;
- Task 3 & 4 Summary Report was prepared to document the findings of the evaluation of effectiveness (Task 3) and problems and issues with ineffective pH adjustment systems (Task 4);
- Task 5 Summary Report presented the findings of a literature review of existing guidance for the design and operation of pH adjustment systems as well as recommendations for the design and operation of pH adjustment systems, specific to Newfoundland and Labrador drinking water systems, based on the information collected during Tasks 2, 3 and 4; and
- Task 6 presented the findings of a literature review of both the Langelier Saturation Index (LI) and the Ryznar Saturation Index (RSI), and compared the two corrosion indices, their application and use in other jurisdictions, and their limitations.

The purpose of this Task 7 Study Report is to provide an overview of the purpose and methodology followed in the Study, present the findings and provide recommendations for each of the tasks completed.

ES 1.2 Discussion of Findings

ES 1.2.1 Assessment of Effectiveness of pH Adjustment Systems

The results of the water quality review of data provided by the ENVC and information gathered as part of the site visits indicated that:

- The implementation of pH adjustment did not appear to have an impact on disinfection by-products (DBP) formation. In general, the presence of elevated levels of natural organic matter (NOM) in the water at the point of disinfectant application appears to be the main factor contributing to trihalomethane (THM) and haloacetic acid (HAA) formation;
- Based on the water quality data reviewed as part of this study, changes in treated water pH as a result of pH adjustment do not appear to have an effect on dissolved organic carbon (DOC) concentrations. Most of the systems included in this study have no treatment other than chlorine disinfection and pH adjustment, and as such, have no capacity for NOM removal; and
- The concentrations of aluminum, copper, iron, lead and zinc were generally found to be within acceptable levels. It appears that the treated water pH has a greater effect on metals concentrations in the system than on DBP or DOC concentrations.

The performance of pH adjustment systems was assessed based on the established criteria in Section 4.1, and it was determined that:

- Approximately seventeen (17) systems are performing effectively (38 percent);
- Approximately seven (7) systems are currently not operational (15 percent); and
- The remaining twenty-one (21) systems are not operating effectively (47 percent).

A list of performance limiting factors was developed based on the evaluation. The most common performance limiting factors identified included:

- The use of chlorine gas for primary disinfection because of its pH lowering effect;
- The lack of routine maintenance;
- A lack of redundancy for key process equipment;
- A lack of automatic monitoring and/or control of pH adjustment systems; and
- Operating objectives for treated water pH that are too low for effective corrosion control (less than 7.0).

ES 1.2.2 Langelier Saturation Index and Ryznar Saturation Index

The LI is the most common of the $CaCO_3$ saturation indices used to predict corrosion in drinking water systems. Another common index based on $CaCO_3$ saturation is the RSI. There are several limitations to the use of corrosion indices and typically they are not recommended as the primary method for determining the corrosivity of water.

ES 1.3 Recommendations

Recommendations for the operation and maintenance of pH adjustment systems to improve a system's effectiveness are summarized below:

- Preventive maintenance programs should be developed for existing pH adjustment systems;
- Spare parts for key components of the pH adjustment system should be maintained on site;
- In some cases a servicing agreement with the equipment supplier or an outside contractor for routine maintenance may be a cost effective procedure for maintaining the pH system;
- Municipalities and water treatment operations personnel are encouraged to establish treated water pH targets that are equal to or greater than 7.2. A target treated water pH of less than 7.0, although within the operational guideline for pH under the Guidelines for Canadian Drinking Water Quality (GCDWQ) of 6.5 to 8.5 is probably too low for effective corrosion control given the very low alkalinity (typically less than 5 mg/L as $CaCO_3$) of most of the raw water sources for the systems included in the study;
- The optimum treated water pH objective should be determined on a site specific basis, using an approach similar to that described in the *Guidance Manual for Preparing Corrosion Control Plans* (MOE, 2009), the *Guideline Technical Document on Corrosion Control in Drinking Water Systems* (Health Canada, 2007) or in the *Revised Guidance Manual for Selecting Lead and Copper Control Strategies* (USEPA, 2003); and
- The Province should move away from the use of corrosion indicators, such as the Langelier and Ryznar Indices, as predictors for the effectiveness of corrosion control measures. Instead the Province should adopt an approach similar to that used by Ontario, Health Canada and the USEPA which recommends the development of site specific corrosion control plans.

It is recommended that future updates or revisions to the Newfoundland and Labrador *Guidelines for the Design, Construction, and Operation of Water and Sewage Systems* (Design Guidelines) address the following issues:

- Section 3.3.4.8.5 - Corrosion Control should be rewritten as a separate section in Chapter 3 of the document, with a focus specifically on addressing internal corrosion, rather than as a consideration only for waters treated by aeration;

- Section 3.2.5 - the Langelier Index should be deleted, and a new subsection created under "Internal Corrosion Control" (as described in the previous bullet), recommending the adoption of a site specific corrosion control plan, based on an approach similar to that provided in the *Guidance Document for Preparing Corrosion Control Plans* (MOE, 2009), the *Guideline Technical Document on Corrosion Control in Drinking Water Systems* (Health Canada, 2007) or the *Revised Guidance Manual for Selecting Lead and Copper Control Strategies* (USEPA, 2003);

- Section 3.2.6 - pH Adjustment should also be moved to the new "Internal Corrosion Control" section, and include additional guidance on the selection and design of pH adjustment systems similar to that provided in the Atlantic Canada and Ontario Design Guidelines. The wording in this section should also be strengthened to discourage the use of chlorine gas for primary disinfection of surface waters with very low alkalinity, unless it is the only practical option;

- Section 3.3.11 - The discussion on Automated/Unattended Operation of Surface Water Treatment Plants is virtually identical to the Policy Statement included in the Recommended Standards for Waterworks or "Ten States Standards" (Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2007). This policy paper is mainly directed at the operation of surface water treatment plants where the main concern is particulate removal and microbiological contamination. Most of the systems included in this study draw water from surface water supplies; however, many are not equipped with particulate removal processes (e.g. conventional or direct filtration, or membranes), and therefore most of the criteria in this policy statement are not applicable. It is recommended that a new section on "Automated/Unattended Operation of Small Water Treatment Plants" be prepared and included in future versions of the Guidelines to encourage plants that are normally unattended to be designed to allow for automated and/or remote operation. While adequate precautions would need to be included in the design (e.g. high and low level alarms, automatic shutdowns during process upsets, provisions for manual operation, etc.), it is anticipated that some degree of automation will improve the overall performance of the pH adjustment systems. In addition, a consistent treated water and distribution system pH is needed for effective corrosion control, and the current mode of operation (where timely responses to changes in flow or raw water conditions are not being made because there is generally no operator on site) does not allow for optimum performance; and

- Section 6.1.1 - The Measurement List should be revised to recommend the provision of on-line pH monitors for all systems, rather than just those with a capacity greater than 1 ML/d.

It is also recommended that future upgrades or expansions to existing systems include the following:

- Provision of stand-by or spare chemical feed equipment, in conformance with Section 3.3.9.2 of the existing Guidelines;

- A change from chlorine gas to sodium hypochlorite, where feasible and appropriate;
- Installation of raw and treated water on-line pH analyzers, with low and high level alarms for treated water pH;
- Provision of some degree of automated control (i.e. flow-paced chemical addition) where adequate instrumentation is already in place (i.e. flow and pH meters), in conformance with Section 6.1.6.1.2 of the existing Guidelines; and
- The design of upgrades to, or construction of, new water treatment facilities should allow for easy access to chemical feed equipment. The design for chemical feed systems in future facilities should be above ground. During upgrades, where chemical feed pumps are located below grade, stairways should be provided rather than ladders to facilitate safe carrying of parts, tools, etc.
- pH adjustment systems should be installed downstream of treatment system, including disinfection.

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1.0 INTRODUCTION

AMEC Earth & Environmental, a Division of AMEC Americas Limited (AMEC), in association with XCG Consultants Ltd (XCG), was retained by the Department of Environment and Conservation (ENVC) to conduct a study on pH adjustment systems in drinking water systems of 45 communities in Newfoundland and Labrador.

The main objectives of the study were to:

- Identify the design and filter media/chemicals used in each pH adjustment system;
- Determine which pH adjustment systems are working effectively;
- Evaluate the effects of pH adjustment on trihalomethane (THM), haloacetic acid (HAA), metals and dissolved organic carbon (DOC) concentrations;
- Identify the reason why the pH adjustment systems are not meeting objectives;
- Identify what problems or issues have been experienced with these systems;
- Make recommendations for guidelines for the design and construction of pH adjustment systems, including but not limited to the location of the chemical injection point in the distribution system in relation to disinfection and other treatment components;
- Make recommendations on the optimization of pH adjustment systems for water treatment systems that utilize coagulation and flocculation processes;
- Review the pH adjustment discussion in the *Guidelines for the Design, Construction and Operation of Water and Sewage Systems* (Design Guidelines) and provide recommendations for changes or additions to the Guidelines;
- Make recommendations for the operation and maintenance of pH adjustment systems; and
- Evaluate the Langelier Saturation Index (LI) and the Ryznar Saturation Index (RSI) and provide recommendations as to the suitability of these indices for corrosion control.

A work plan was developed to address the study objectives and included the following seven (7) tasks:

1. Project Initiation and Project Management
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1.1 Background Information

Newfoundland and Labrador surface water pH is naturally low due to the biophysical environment of the province. The Guidelines for Canadian Drinking Water Quality recommends a pH between 6.5 and 8.5 be maintained in drinking water. A number of communities in the province have implemented pH adjustment systems in their treatment process to raise the pH to the recommended level.

pH is measured as the negative logarithm of the concentration of hydrogen ions:

$$pH = -\log(H^+).$$

The pH of water is a measure of the acid-base equilibrium and is controlled by the carbon dioxide-bicarbonate-carbonate equilibrium. The pH scale is logarithmic and as a result, each whole pH value is either ten times more acidic or ten times more alkaline then the next value.

pH is of major importance when determining the corrosivity of water. The principal objective in controlling pH is to produce a water that is neither corrosive nor produces incrustation. In general, the lower the pH, the higher the level of corrosion. At pH levels below 6.5, corrosion of drinking water pipes and fittings may cause leaching of contaminants such as metals that could be a health concern. The most influential properties of drinking water when it comes to the corrosion and leaching of distribution system materials are pH and alkalinity. Water with low alkalinity may tend to accelerate natural corrosion leading to colored water problems while high alkalinity waters may produce scale incrustations on pipes. Mineral incrustation and bitter tastes, and a decrease in the efficiency of chlorine disinfection and alum coagulation can occur with a pH above 8.5.

Of the known chlorination by-products. The primary by-products of concern are THMs and HAAs. In general, THM formation increases at high pH (above pH 9.4) and decreases at low pH (below pH 5.0), whereas the formation of HAAs decreases at high pH and increases at low pH (USEPA, 1999).

2.0 TASK 2: COLLECTION OF DESIGN INFORMATION AND BACKGROUND DATA

2.1 Collection of Design Information for Existing Systems

As part of Task 2, site visits were conducted for all 45 drinking water systems in the Province using pH adjustment systems. A list of the communities included in the study is provided in Table 2.1. Site visit records for each water treatment plant are provided in Appendix A. As shown in the site visit records, information was gathered to document the design of the pH adjustment systems, their performance and any operational issues relating to pH adjustment. Process flow schematics were also prepared for each site and are provided in the site visit records in Appendix A.

The design information that was collected for each site included:

- Point of application of pH adjustment chemicals;
- Point of application of disinfectant chemicals;
- Type of pH adjustment system used;
- Chemical or filter media used;
- Solution tank volume or filter capacity;
- Feed pump capacity; and
- On-line pH monitor and location.

A summary of the design information for each site is presented in Appendix A and Task 2 Summary Report. The monitoring of pH using a handheld meter was performed at each site at the following locations, where possible:

- Raw water (intake before any treatment);
- Before and after pH adjustment; and
- Before and after disinfection.

It should be noted that in many cases, sample taps were not available between the point of pH adjustment and the point of disinfectant application due to the configuration of the treatment system. A summary of all on-site pH measurement results is provided in Task 2 Summary Report. A summary of raw and treated water pH measurement results is provided in Table 2.1.

Finally, discussions and interviews with operations staff were conducted to assess operating conditions and identify operational challenges at each water treatment facility. A review of operating conditions and issues was completed as part of Tasks 3 and 4.

2.2 Results of On-Site pH Measurement

As discussed in Section 2.1, on-site pH measurements were made in each of the 45 water treatment facilities. Wherever possible, samples were collected from the raw water, before and after the application of the disinfectant, and before and after pH adjustment.

The pH tests were conducted by AMEC staff using a field-calibrated, handheld pH meter. A summary of the on-site pH testing results is provided in Task 2 Summary Report and the raw and treated water pH testing results are presented in Table 2.1.

The results indicated that the finished water pH (after disinfection and pH adjustment) is often relatively low (i.e. less than 7). This may be a result of one or several operating conditions. For example, many of the communities included in the study currently use chlorine gas for disinfection. The application of chlorine gas can lower the pH of water, while the use of sodium hypochlorite (liquid chlorine) will generally increase the pH of water. As noted in the site visit records, the target pH in the treated water for several systems is relatively low (e.g. between 6.5 and 7.0). A more detailed assessment of the causes of low treated water pH was conducted as part of Tasks 3 and 4 of this study.

Table 2.1 Communities with pH Adjustment Systems

Community	Source Water	Operational Status[1]	Type of Disinfectant	Type of pH adjustment	On-line pH Monitor Location	On site pH Measurement	
						Raw Water	After pH Adjustment
Avondale	Lee's Pond	Not Operating	Sodium hypochlorite	None	n/a	6.5	-
Bonavista	Long Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	None	6.1	10.2
Brigus	Long Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) pH analyzer, with sample line drawn off treated water line (post pH adjustment and chlorine addition)	6.6	6.3[1]
Burgeo	Long Pond	Operational	Ozone and Chlorine gas	Sodium hydroxide (caustic soda)	Three (3) on-line analyzers: raw water, post-ozonation, finished water	5.6	6.7[1]
Burnt Islands	Long Lake	Operational	Chlorine gas	Calcium hydroxide (lime)	None	4.4	5.4
Cape Freels North	Long Pond	Not Operating	Sodium hypochlorite	Sodium carbonate (soda ash)	None	5.6	10.4[1]
Cartwright	Burdett's Pond	Not Operating	Calcium hypochlorite	Sodium carbonate (soda ash)	None	5.1	5.8[1]
Centreville-Wareham-Trinity[2]	Northwest Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer, with sample line drawn off treated water line) post pH adjustment and chlorine addition)	6.7	-
Centreville-Wareham-Trinity	Southwest Feeder Pond	Not Operating	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer, with sample line drawn off treated water line post pH adjustment and chlorine addition)	5.7	4.4[1]
Channel-Port aux Basques	Gull Pond & Wilcox Pond	Operational	Chlorine gas	Calcium hydroxide (lime)	Three (3) on-line analyzers: raw water, rapid mix (coagulation pH), finished water	5.3	6.6[1]
Clarenville	Shoal Harbour River	Operational	Chlorine gas	Sodium carbonate (soda ash)	Two (2) on-line pH analyzers: one (1) downstream of coagulant and lime addition (at flocculation tanks) and one (1) finished water	7.0	7.1[1]
Come By Chance	Butchers Brook	Not Operating	Sodium hypochlorite	Sodium carbonate (soda ash)	None	7.1	7.1[1]
Eastport	Groundwater	Operational	Sodium hypochlorite	Sodium carbonate (soda ash)	One (1) on-line analyzer located downstream of pH adjustment and upstream of chlorine injection	7.2	7.0[1]
Fogo[2]	Freeman's Pond	Not Operating	Chlorine gas	Sodium carbonate (soda ash)	None	5.8	-
Gander	Gander Lake	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer for finished water	6.9	6.9[1]
Glovertown	Northwest Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer for finished water	6.9	6.8[1]
Grand Falls-Windsor	Northern Arm Lake	Operational	Chlorine gas	Calcium hydroxide (lime)	Two (2) on-line pH analyzers: one (1) downstream of coagulant and lime addition (at flocculation tanks) and one (1) finished water	6.6	7.5[1]
Happy Valley-Goose Bay	Groundwater	Operational	Chlorine gas	Calcium hydroxide (lime)	Two (2) on-line pH analyzers: one (1) downstream of coagulant and lime addition (at flocculation tanks) and one (1) finished water	6.5	6.2
Hare Bay	Hare Bay Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer for finished water	6.0	6.8[1]
Hermitage	Granfer's Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer for finished water	5.6	6.4[1]
Isle Aux Morts	Burnt Ground Pond	Operational	Chlorine gas	Calcium hydroxide (lime)	None	5.3	6.5
Lamaline	Upper Hodges Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer for finished water	6.5	6.5[1]
Lewisporte	Stanhope Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer for finished water	6.7	6.2[1]
Long Harbour-Mount Arlington Heights	Shingle Pond and/or Trout Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	None	6.4	6.2
Lumsden	Gull Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	None	5.6	6.4[1]
Musgrave Harbour	Rocky Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer for finished water	5.7	4.2[1]
New-Wes-Valley	Carter's Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer for finished water	4.8	5.2[1]
New-Wes-Valley	Little Northwest Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer for finished water	6.2	8.3[1]

Table 2.1 Communities with pH Adjustment Systems

Community	Source Water	Operational Status[1]	Type of Disinfectant	Type of pH adjustment	On-line pH Monitor Location	On site pH Measurement	
						Raw Water	After pH Adjustment
Petty Harbour-Maddox Cove	Western Barrens Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer for finished water	5.5	6.8[1]
Placentia	Wyses Pond	Operational	Ozonation and chloramiation (chlorine gas and ammonia)	Sodium carbonate (soda ash)	One (1) on-line analyzer for finished water	6.9	6.5[1]
Port Blandford	Noseworthy's Pond	Operational	Chlorine gas (sodium hypochlorite for booster chlorination)	Sodium carbonate (soda ash)	None	6.8	6.4[1]
Pouch Cove	North Three Island Pond	Operational	Chlorine gas (sodium hypochlorite for booster chlorination)	Sodium carbonate (soda ash)	One (1) data logger located at the Town Hall automatically records pH and free chlorine residual	6.4	6.9[1]
Ramea	Northwest Pond	Operational	Chlorine gas	Sodium hydroxide (caustic soda)	One (1) on-line analyzer for finished water	6.8	8.6[1]
Seldom-Little Seldom	Bullock Cove Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer for finished water	6.7	8.7
Spaniard's Bay	Kelly's Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line analyzer drawing sample from main treatment header downstream of pH adjustment and upstream of chlorination	6.1	6.5
St. John's	Bay Bulls Big Pond	Operational	Ozonation and chloramiation (chlorine gas and ammonia)	Calcium hydroxide (lime)	Five (5) on-line pH analyzers; raw water, ozone effluent, East clearwell, West clearwell and plant effluent	6.4	6.5[1]
St. John's	Windsor Lake	Operational	UV and chlorine gas	Calcium hydroxide (lime) and carbon dioxide (CO2)	Four (4) on-line pH analyzers; raw water, pH adjustment, after disinfection, and finished water	6.2	6.7
Summerford	Rushy Cove Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line pH analyzer located immediately downstream of system pumps, downstream of pH adjustment, upstream of chlorine addition	7.3	7.1
Torbay	North Pond	Operational	Chlorine gas (sodium hypochlorite for booster chlorination)	Calcium hydroxide (lime)	None	6.1	6.2
Trepassey	Miller's Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	None	6.8	6.8[1]
Trinity	Indian Pond	Operational	Sodium hypochlorite	Sodium carbonate (soda ash)	One (1) on-line pH analyzer drawing sample downstream of pH adjustment and upstream of chlorine addition	6.3	8.0[1]
Trinity Bay North	Whirl Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line pH analyzer for finished water	-	6.0[1]
Victoria	Rocky Pond	Operational	Chlorine gas	Sodium carbonate (soda ash)	One (1) on-line pH analyzer for finished water	6.6	6.7[1]
West St. Modeste	Ground water	Not Operating	Sodium hypochlorite	No pH adjustment	None	6.8	6.6[1]
Whitbourne	Hodges River	Operational	Chlorine gas	Sodium carbonate (soda ash)	None	6.6	7.8[1]

Notes:

1. Sample collected after disinfection and after pH adjustment.
2. No treatment being provided at time of site visit.

3.0 TASK 3: ASSESSMENT OF EFFECTIVENESS OF PH ADJUSTMENT SYSTEMS

3.1 Assessment of Effectives of pH Adjustment Systems

The ENVC has indicated that many of the pH adjustment systems currently in use in the Province's drinking water systems are not performing as desired. As such, the objective of Task 3 was to conduct an evaluation of the effectiveness of the pH adjustment systems based on existing water quality data provided by the ENVC, as well as information gathered during the site visits.

During Task 2, discussions were held with operations staff during the site visits to gather additional information on the operation and maintenance of the pH adjustment systems, including:

- Current and/or typical pH adjustment chemical and disinfectant dosage;
- Frequency and method used for measurement of pH;
- Changes in operating strategy as a result of changes to raw water quality and/or flows;
- Changes in operational settings and the rationale for the changes;
- Maintenance practices for pH adjustment systems;
- Records of discoloured water complaints and/or service leaks; and
- Operators' views on what improvements could be made to improve the performance of the pH adjustment system.

A water quality review for each community was also performed to evaluate the effects of pH adjustment on disinfection by-products (DBPs), metals and DOC concentrations and assess if changes in these parameters have occurred as a result of the implementation of pH adjustment. A one-page summary was prepared for each of the 45 communities included in the study to present:

- An overview of available historical water quality data, with a focus on DBPs (THMs and HAAs), raw and treated water pH, DOC and metals concentrations;
- A discussion of the effectiveness of the pH adjustment system, based on the raw and treated water pH, and the system's ability to provide treated water at a pH within the range noted in the Guidelines for Canadian Drinking Water Quality (GCDWQ); and
- A list of performance limiting factors, related to the design, operation and/or maintenance of the system, based on information gathered as part of the site visits.

The one-page summary sheets are included in Appendix B.

3.2 Water Quality Data Review

Historical raw and treated water quality data were provided by the ENVC for each of the 45 communities included in the study. As part of this task, a data review was conducted to determine the effect of pH adjustment on the concentration of:

- DBPs, including THMs and HAAs;
- DOC; and
- Metals, including aluminum, copper, iron, lead and zinc.

Where sufficient data were available, an analysis of the impact of changes in treated water pH on the concentration of these parameters was undertaken. For most of the drinking water systems reviewed, the pH adjustment is not having an impact on the concentrations of DBPs or DOC in the distribution system. In general, metals concentrations tend to increase as pH decreases.

As discussed in Appendix B, there were several systems for which there were insufficient data to verify a link between pH and these parameters. A discussion of the potential effects of pH adjustment on the formation of DBPs, and on DOC and metals concentrations is provided in the following subsections.

3.3 Effects of pH on Disinfection By-Product Formation

Chlorine is the most commonly used disinfectant chemical in the drinking water systems that were included in this study. Of the known chlorination by-products, the primary by-products of concern are THMs and HAAs. The current Maximum Acceptable Concentrations (MACs) for THMs and HAAs under the GCDWQ are 0.100 mg/L and 0.080 mg/L, respectively (or 100 µg/L and 80 µg/L), expressed as a locational running annual average of quarterly samples.

THMs and HAAs are formed when chlorine reacts with natural organic matter (NOM) present in the water. Ideal conditions for THM formation are different from the ideal conditions for HAA formation, and the pH of the water when chlorine is applied will enhance either the formation of THMs or HAAs. In general, THM formation increases at high pH (above pH 9.4) and decreases at low pH (below pH 5.0), whereas the formation of HAAs decreases at high pH and increases at low pH (USEPA, 1999). Therefore, some remedial measures applied to minimize THM formation could potentially increase the formation of other DBPs.

Of the 45 systems included in the study, the data provided by the ENVC indicates that approximately 32 systems (approximately 70 percent of the total) have running annual average total THM concentrations that exceed the GCDWQ MAC of 100 µg/L, and that there are 35 systems (approximately 78 percent) that exceed the GCDWQ MAC of 80 µg/L for HAAs.

Given that the treated water pH for most of the systems reviewed as part of this study was relatively neutral (i.e. between pH 6 and 7), it is unlikely that pH adjustment is affecting the formation of DBPs. Based on the data provided, it appears that the elevated levels of DBPs observed in many of these drinking water systems are due to elevated concentrations of DOC in the raw and treated water supplies. DOC concentrations in the treated water are essentially the same as those in the raw water.

3.4 Effects of pH on Dissolved Organic Carbon Concentrations

NOM is the term used to describe the combination of organic chemicals originating from natural sources that are present in all water bodies (MWH, 2005). In drinking water supplies, NOM is most commonly measured using total organic carbon (TOC) or DOC as a surrogate measure.

The presence of NOM affects many other water quality parameters as well as water treatment processes. For example, colour in surface water sources is predominantly associated with NOM (Health Canada, 1979a). The main health related concern associated with NOM is its ability to react with chlorine to form DBPs.

While there are currently no guidelines for TOC or DOC in the GCDWQ, the aesthetic objective (AO) for colour under the GCDWQ (15 TCU) considers the link between the presence of NOM and potential health effects, based on the relationship between colour and DBP formation. Other jurisdictions, such as Ontario, have established an AO for DOC (5 mg/L) on the basis of the aesthetic characteristics of the water, as well as the potential formation of DBPs (MOE, 2006).

The treatment techniques available for the removal of NOM include enhanced coagulation, activated carbon adsorption, ion exchange and high-pressure membrane filtration (such as nanofiltration and reverse osmosis).

Approximately 30 of the 45 systems included in this study have no treatment other than chlorine disinfection and pH adjustment and, as such, have no capacity for NOM removal. For these systems, DOC concentrations in the treated water are essentially the same as those in the raw water.

Approximately 28 of the 45 systems included in this study have average treated water DOC concentrations that are greater than 5 mg/L. The data provided suggest that elevated levels of DBPs in the province's drinking water systems are attributable to the elevated concentrations of NOM in both the raw water sources and treated water supplies.

3.4.1 Effects of pH on Metals Concentrations

pH is a key parameter affecting the solubility of metals used in water distribution systems, such as iron, lead, copper and zinc. The addition of pH adjustment chemicals may also increase alkalinity, which has the side effect of enhancing the formation of carbonate scales (MWH, 2005). A summary of critical pH values for minimizing corrosion of iron, copper and lead piping is presented in Table 3.1.

Table 3.1 Relationship of pH to Corrosion and Incrustation for Select Piping Materials (Adapted from Health Canada, 1979b)

Material	Target pH for Corrosion Control	Comments
Steel/cast iron	7.5 - 9.0	Within this pH range, there is a tendency for the corrosion products to adhere in a hard, crusty deposit. At lower pH, "red water" complaints are more common.
Copper	> 7.0	In most waters, the critical pH value is about 7.0. For soft waters containing organic acids the targeted pH may be higher.
Lead	> 7.0	Few waters are aggressive to lead if the pH is above 7.0.
Zinc	< 10.5	Waters with pH above approximately 10.5 can be aggressive to zinc and will often remove galvanized coatings.

4.0 TASK 4: IDENTIFICATION OF PROBLEMS AND ISSUES WITH INEFFECTIVE PH ADJUSTMENT SYSTEMS

4.1 Identification of Problems and Issues with Ineffective pH Adjustment Systems

As discussed in Section 3.1, the information gathered during each of the site visits was previously presented in the Task 2 Summary Report and has been summarized in a one-page information sheet included in Appendix B of this report. For each system, a review of water quality data, as well as operation and maintenance practices, was undertaken to assess the effectiveness of the pH adjustment system.

The effectiveness of the system was assessed on the basis of:

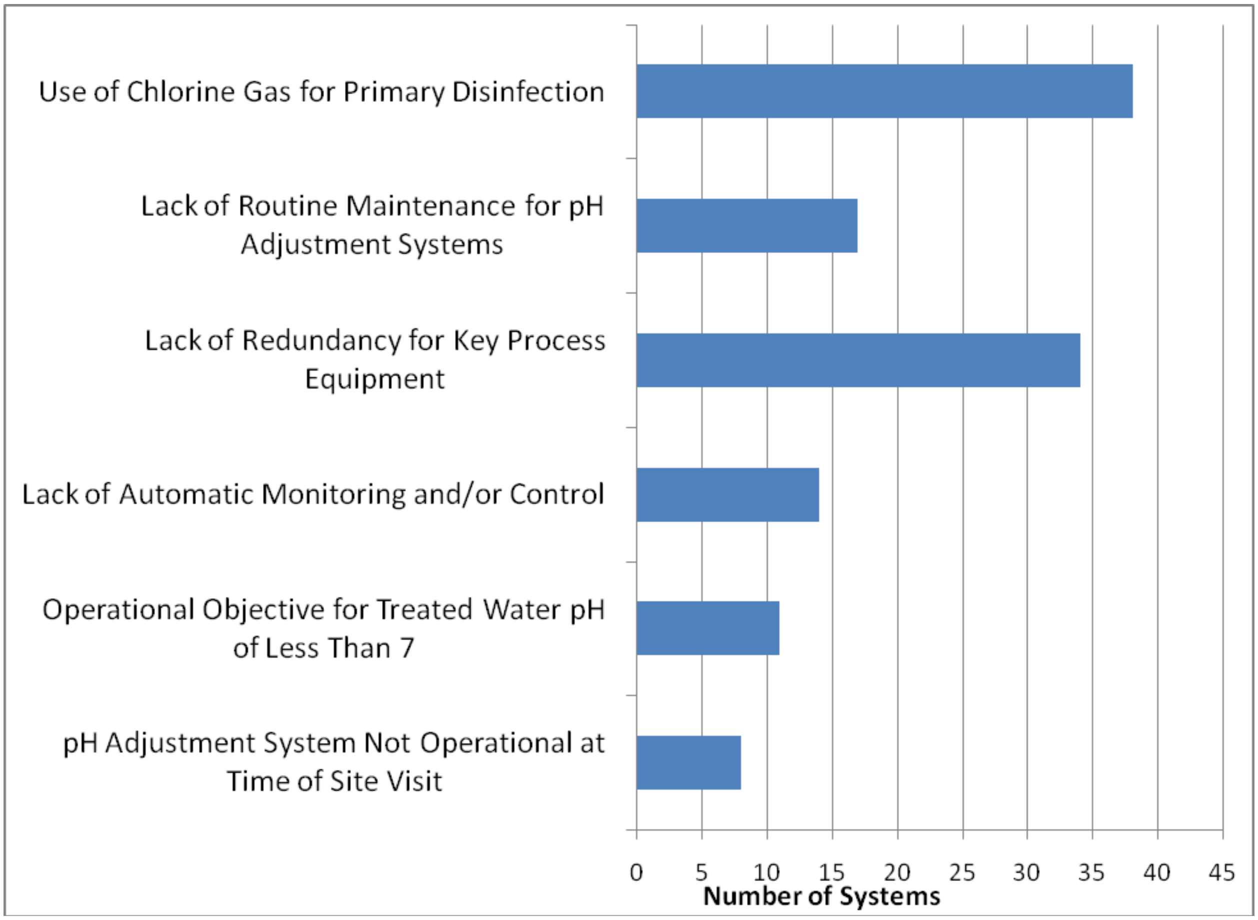
- Ability to maintain a treated water pH in the recommended range of 6.5 of 8.5 established in the GCDWQ;
- Ability to provide a treated water with a pH that is consistently greater than the raw water pH;
- Effect on other distribution system metals concentrations, such as iron, copper, lead and zinc; and
- Occurrence of watermain and/or service leaks, discoloured water complaints, or other indicators of system corrosion.

Based on these criteria, it was determined that seventeen (17) of the 45 systems evaluated (38 percent) are operating effectively. The summary sheets presented in Appendix B provide a brief assessment of the effectiveness of the system, as well as a list of performance limiting factors where satisfactory performance is not being achieved.

Based on the data provided by the ENVC and on information gathered during the site visits, it was determined that approximately twenty-one (21) of the pH systems reviewed as part of this study are not performing as desired. In addition, there were approximately seven (7) systems in which the pH adjustment system was not operational at the time of the site visits.

Figure 4.1 presents a summary of the performance limiting factors identified during the review and the number of systems at which each was encountered. The most frequently encountered factors are discussed in greater detail in the following subsections.

Figure 4.1 Occurrence of Performance Limiting Factors



4.2 Review of Performance Limiting Factors

4.2.1 Use of Chlorine Gas for Primary Disinfection

Chlorine is the most commonly used disinfectant in water treatment in Canada and throughout the world. The most common chlorine chemicals used for drinking water disinfection are chlorine gas (Cl_2), sodium hypochlorite (NaOCl) and calcium hypochlorite ($Ca(OCl)_2$).

The different chlorine chemicals have different effects on alkalinity, and therefore pH. For example, on a stoichiometric basis, the application of 1 mg of chlorine gas theoretically will result in a decrease of 1.4 mg in alkalinity as $CaCO_3$ (White, 1999). Given the low levels of alkalinity naturally present in the raw waters of the systems included in the study, the addition of chlorine gas for disinfection can have a significant negative impact on the pH of the treated water. Conversely, the application of sodium hypochlorite provides an increase in alkalinity of

0.67 mg/L as $CaCO_3$, which results in an increase in the treated water pH. pH adjustment systems should also be located downstream of chlorination processes to ensure that the pH is actually adjusted to levels within the GCDWQ OG recommended of 6.5 and 8.5.

Based on the information provided by the ENVC (WTP Inventory) and the information gathered during the site visits, the vast majority of the systems included in the study (38 out of 45 systems) use chlorine gas for primary disinfection. Of these systems, approximately 17 systems have an average treated water pH that is lower than the raw water pH. In general, the depressed pH appears to be due to an insufficient dosage of the pH adjustment chemical, either preceding or following chlorine addition. Based on the data collected as part of Task 2, in general the equipment provided as part of the pH adjustment systems appears to be adequate to maintain higher optimum dosages, as none of the processes are currently operating near their design capacities. Furthermore, for situations where the chemical feed pumps are operating near their peak capacities, it would be possible to increase the solution strength when mixing batches of soda ash solution or lime slurry, rather than increase the chemical feed rate through pumping. It should be noted that mixing of soda ash is usually to saturation and increasing solution strength may not be an option and should be assessed based on each specific community.

Alternatively, a change from chlorine gas to sodium hypochlorite could be considered to provide a positive change in alkalinity and pH during disinfection. In addition, health and safety issues associated with the use of chlorine gas could be eliminated. The main health and safety issues with chlorine gas are primarily related to the transport and handling of chlorine gas cylinders, and the potential of a toxic gas leak.

4.2.2 Lack of Routine Maintenance for pH Adjustment Systems

During the interviews with operations staff conducted as part of the site visits, it was noted that 17 systems (approximately 38 percent of the total) had no preventive maintenance program for pH adjustment systems. At the time of the site visits, eight (8) systems were not operational. Many of these process shutdowns are due to pump failures or other problems associated with process equipment. Given the number of systems that are currently not operational and/or that are not operating as intended, improvements in system maintenance could increase the reliability of process equipment and provide for more consistent treated water pH and alkalinity.

4.2.3 Lack of Redundancy for Key Process Equipment

The lack of redundancy for key process equipment was identified as a performance limiting factor for systems where only one chemical feed pump was installed for the pH adjustment system. During the site visits, it was also noted that very few systems maintain spare pumps and/or parts for these chemical addition systems. As such, it is likely that the lack of back-up equipment is contributing to process failures and/or inconsistent performance of the pH adjustment systems.

For future installations, a minimum of two chemical feed pumps should be provided. Shelf spares, particularly for mechanical equipment and key process components (such as mixers, valves, etc.), should be provided and appropriate training made available to operations staff to ensure they are able to install back up equipment when needed. It should be noted that training available through the Operators Education, Training and Certification (OECT) includes replacement of equipment. A central inventory location, for sites in close proximity to each other, may be implemented to reduce costs associated with storing of back up equipment.

4.2.4 Lack of Automatic Monitoring or Control

Many of the systems included in the study, particularly the smaller systems where only disinfection and pH adjustment are provided, are unattended facilities (i.e. the operator may only visit the site daily or weekly). In addition, these stations typically are not equipped with means for automated monitoring or control. The result is that changes in flow or raw water quality are often unnoticed and changes in the pH adjustment chemical dosage are not made in response to these changes. As a result, there may be significant fluctuations in the treated water pH, which can result in inconsistent distribution system water quality.

At a minimum, chemical dosing equipment should be provided with means for automatic pH control. It is also recommended that all of the treatment facilities be equipped with automatic/remote monitoring equipment for both flow and pH measurement.

4.2.5 Operational Objective for Treated Water pH of Less than 7.0

The operating range noted for pH under the GCDWQ is 6.5 to 8.5, which is based on providing a balance between the greater effectiveness of chlorine at lower pH with the provision of a less aggressive water at higher pH.

The information gathered during the site visits indicated that 11 of the systems reviewed had a target treated water pH of less than 7.0. While this value may be within the operating range, it is likely too low for effective corrosion control given the very low alkalinity (typically less than 5 mg/L as CaCO3) of most of the raw water sources for the systems included in the study.

It should also be noted that the LI, which is a measure of the degree of saturation with respect to calcium carbonate ($CaCO_3$), was found to be negative in samples of treated water from all of the systems included in the study based on data provided by the ENVC. A LI of less than zero indicates that the water is undersaturated with $CaCO_3$, which suggests that it will have a tendency to dissolve carbonate scale rather than precipitate protective material on the pipe surface. For most of the systems reviewed as part of the study, this is likely due to very low levels of alkalinity in the raw water (i.e. less than 5 mg/L $CaCO_3$). In many cases, a pH greater than 10.0 would be required to achieve a saturation index that is near neutral or slightly positive, and therefore likely to deposit scale.

Most of the systems deemed to be effective as part of this evaluation have a treated water pH objective ranging from 7.0 to 7.8. Although the optimum pH for distribution system stability is site specific and should be determined through on-site testing, as an interim measure, a minimum treated water pH objective of 7.2 is recommended. The USEPA recommends the use of corrosion inhibitor generally only where the treated water pH is between 7.2 and 7.8 (USEPA, 2003).

5.0 TASK 5: RECOMMENDATIONS FOR DESIGN GUIDELINES

5.1 Design Issues

Of the 38 pH adjustment systems that were operational at the time of the site visits, twenty-eight (28) used sodium carbonate (soda ash), two (2) used sodium hydroxide (caustic soda), seven (7) used calcium hydroxide (lime), and one (1) used calcium hydroxide (lime) and carbon dioxide (CO_2).

Of the systems that were deemed to be effective, the majority used soda ash, and the remaining used lime and caustic soda. A discussion of other available technologies for pH adjustment is presented in Section 5.2.

For the seven (7) systems that were not operational at the time of the site visits, several of the shutdowns were due to a failure of the primary chemical feed pump, where no back-up or spare pumps were available.

For systems that were operational but not performing as desired, the design of the pH adjustment system, in terms of the type or capacity of the equipment provided, was not the main performance limiting factor. Rather, it was determined that poor performance could generally be attributed to an insufficient dosage of the pH adjustment chemical. Based on the data collected as part of Task 2, the equipment provided as part of the pH adjustment systems was adequate to maintain higher dosages, as none of the processes were operating near their design capacities. Furthermore, for situations where the chemical feed pumps were operating near their peak capacities, it would be possible to increase the solution strength when mixing batches of soda ash solution or lime slurry, rather than increase the chemical feed rate through pumping.

It should be noted, however, that several systems were designed such that the pH adjustment equipment is located below grade and is only accessible by means of an access hatch and ladder. This design was more common in older and/or smaller systems. While this layout may permit gravity feed of raw water into the treatment plant, it limits operator access to the equipment, which may discourage routine maintenance and operation activities (e.g. minor repairs, calibration, etc.).

Another factor contributing to the ineffectiveness of the pH adjustment systems was the use of chlorine gas for primary disinfection. As noted in the Task 3 and 4 Summary Report, the application of chlorine gas tends to decrease alkalinity and therefore pH, whereas the use of sodium or calcium hypochlorite tends to increase alkalinity and pH. Although not directly related to the design of pH adjustment systems, the choice of disinfectant and its impact on treated water quality is an important consideration and should be evaluated as part of upgrades to existing systems and in the design of new systems.

Many of the systems included in the study, particularly the smaller systems where only disinfection and pH adjustment are provided, are generally unattended facilities (i.e. the operator may only visit the site daily or weekly). These stations typically are not equipped with a means for automated monitoring or control. Several of the smaller plants are not equipped with on-line pH or flow monitoring equipment. As a result, changes in flow or raw water quality are often unnoticed and changes in the pH adjustment chemical dosage are not made in response to these changes. This causes significant fluctuations in the treated water pH, which can result in inconsistent distribution system water quality.

Recommendations for improving the design of pH adjustment systems are provided in Section 8 of this report.

5.2 Technologies for pH Adjustment

5.2.1 Approaches for Internal Corrosion Control

The primary approaches to internal corrosion control in drinking water systems are to modify the water chemistry to make it less corrosive and to encourage formation of less soluble compounds (passivation). This is typically accomplished through pH and/or alkalinity adjustment, or through the addition of a corrosion inhibitor.

pH and/or alkalinity adjustment can be accomplished via chemical addition or non-chemical means. Chemicals commonly used for pH and/or alkalinity adjustment include:

- Sodium hydroxide, $NaOH$ (caustic soda);
- Potassium hydroxide, KOH (caustic potash);
- Calcium hydroxide, $Ca(OH)_2$ (lime);
- Sodium carbonate, Na_2CO_3 (soda ash);
- Potassium carbonate, K_2CO_3 (potash);
- Sodium bicarbonate, $NaHCO_3$; and
- Non-chemical addition methods include limestone contactors and aeration.

The use of corrosion inhibitors (blended phosphates or polyphosphates) is generally only recommended where the treated water pH is between 7.2 and 7.8 (USEPA, 2003). For most of the systems included in this study, passivation would require pH adjustment in addition to the application of the inhibitor; therefore, these processes are not considered further.

A brief discussion of available methods of pH and/or alkalinity adjustment, as well as their advantages and disadvantages, is presented below.

5.2.2 Evaluation of pH and/or Alkalinity Adjustment Methods

Caustic soda, a liquid chemical, is very hazardous if not handled carefully. It can cause severe burns and damage the eyes. It is generally not recommended for very small systems (USEPA, 2003). While caustic traditionally means "sodium hydroxide" solution, potassium hydroxide can be substituted for sodium hydroxide if sodium concentrations are of concern. pH control can be difficult for systems using caustic soda, particularly for waters with low levels of alkalinity, because of the large changes in pH that can occur as the result of a small change in dosage (MOE, 2009).

Lime is available as hydrated or slaked lime ($Ca(OH)_2$), and quicklime (CaO), and can be used to increase both the pH and alkalinity of the water. It is inexpensive, but can be difficult to handle and the pH of the treated water generally changes slowly when the dosage changes. Lime is slurry fed and slurry make-up can be operations and maintenance intensive. Quicklime, when added to water, produces an exothermic reaction that generates considerable heat. Lime also adds aluminum and turbidity, often present as impurities to the water.

While more expensive, sodium carbonate (soda ash) and potassium carbonate (potash) are dry compounds that are relatively safe to handle compared to caustic soda. These carbonate chemicals will not cause skin irritation. They dissolve more easily than lime. When soda ash or potassium carbonate is added to water, there is an increase in alkalinity as well as pH. Because soda ash and potassium carbonate are safe to handle, they are strongly recommended as the pH adjustment chemical for smaller systems, such as schools, condominiums, or any facility where technical resources are limited (USEPA, 2003).

Sodium bicarbonate is a dry chemical that substantially increases alkalinity while providing a very minimal increase in pH. It is relatively expensive (MOE, 2009). Because it is a dry chemical, it must be dissolved in water for feeding. It is very safe to handle and will not increase the pH above 8.3. Some utilities use both soda ash or caustic soda and sodium bicarbonate together if a significant increase in pH and alkalinity are needed.

Limestone contactors use crushed limestone in a contact chamber through which water passes. As water passes through the contact chamber, limestone dissolves causing an increase in pH, alkalinity and calcium levels. Limestone contactors are typically used in small systems as they are relatively easy to operate (MOE, 2009). A limestone contactor should be sized to provide adequate contact time over the range of flow rates and temperatures encountered during plant operation.

Aeration is a non-chemical method used to increase the pH of groundwater systems or stratified surface water systems by removing over-saturated carbon dioxide (CO_2). In addition to its use for corrosion control by increasing pH, aeration systems can be designed to simultaneously manage other constituents of concern, such as manganese, radon, volatile organic compounds (VOCs) and hydrogen sulphide. One of the disadvantages associated with aeration is that re-pumping of the water is required. For simple aeration systems, it may be difficult to control the aeration process to achieve a consistent pH, which is necessary for corrosion control. Aeration alone is therefore generally not used for corrosion control.

5.2.3 Summary of Preferred Methods for Internal Corrosion Control

As noted in Section 5.1 the majority of the pH adjustment systems in use in the Province use either soda ash or lime. Both types of systems were found to be effective when operated appropriately.

In general, the use of sodium hydroxide (caustic soda) is not recommended for systems in Newfoundland and Labrador, particularly for smaller and/or unattended facilities. Given the low levels of alkalinity naturally present in the raw water, consistent control of the dosage and resulting treated water pH may be difficult to achieve using sodium hydroxide without advanced monitoring and control equipment. The use of sodium hydroxide may be appropriate for larger systems or water supplies with adequate buffering capacity, and should be evaluated on a site specific basis.

The design and operation of systems using sodium bicarbonate for pH adjustment is similar to those using sodium carbonate (soda ash) or potassium carbonate (potash). Given that sodium bicarbonate is typically more expensive than soda ash or potash, it is likely that soda ash will be more cost effective for pH adjustment.

Limestone contactors are very easy to operate and require very little maintenance; however, they provide less operating flexibility, as the treated water pH is a function of the contact time in the contactor and will vary with flow rate. Many small systems in the Province experience a wide range of flows, particularly those communities with fish plants or other large water users. In such instances, limestone contactors are not appropriate for pH adjustment where significant variations in flow occur.

Finally, while aeration systems are relatively simple to operate and construct, and may provide for other water quality improvements, they are only effective for pH adjustment where the raw water pH is depressed due to elevated levels of carbon dioxide. Given that the majority of the systems in the Province with pH adjustment processes are surface water supplies, high concentrations of CO_2 in the raw water would not be expected. Aeration would therefore not be recommended for pH adjustment for most of the systems reviewed as part of this study. The use of aeration may be justified for some groundwater systems, but extensive raw water and pilot testing would be recommended.

Based on the above, the preferred technologies for pH adjustment in the drinking water systems in Newfoundland and Labrador are soda ash or lime addition. In general, soda ash would be preferred to lime because it is easier to handle and does not impart turbidity to the finished water. Nonetheless, a site specific evaluation of alternate chemicals, and associated costs, should be undertaken as part of the design of any pH adjustment system.

5.3 pH and Alkalinity Adjustment for Coagulation

Aluminum and iron salts are the inorganic coagulants most commonly used in water treatment. The solubility of these salts is dependent on pH. pH is important in water treatment as it directly influences the dosages of chemicals added to coagulate particles. The desired operating range for coagulation pH is based on the point of minimum solubility of the coagulant, as this promotes precipitation (floc formation).

Jar testing is recommended to determine the optimum coagulation chemical and pH for each system, as these are dependent on water quality and other site specific conditions.

In most water treatment applications for removal of turbidity, TOC and colour, the pH during coagulation ranges between 6 and 8. The lower limit is imposed to prevent accelerated corrosion rates that occur at pH valves below pH 6. The operating region for alum coagulation is in a pH range of 5.5 to about 7.7, with the minimum solubility occurring at a pH of about 6.2 at 25°C (MWH, 2005). The operating range for alum in cold water conditions (0.5°C) is approximately pH 6.0 to 8.0. For iron precipitation, the desired operating range is from pH 5.0 to 8.5, with minimum solubility occurring at a pH of 8.0 (MWH, 2005). The point of minimum solubility for alum shifts with temperature, which has a significant impact on the operation of water treatment plants where alum is used as the coagulant.

The reactions that occur during the coagulation process consume alkalinity. For example, one mg of aluminum sulphate (alum) consumes approximately 0.5 mg of alkalinity (as $CaCO_3$). For waters with naturally low levels of alkalinity, it may be necessary to add alkalinity to the water, using lime or soda ash, to prevent excessive changes in pH and for effective coagulation.

Where the coagulation pH is not maintained within the desired operating range, soluble aluminum or iron may pass through the treatment process, which can result in floc formation in downstream processes or in the distribution system if subsequent changes in pH occur.

As noted in the Task 2 Summary Report, there are four (4) systems using pH/alkalinity adjustment for coagulation, including:

- Clarenville (lime);
- Grand Falls-Windsor (lime);
- Lumsden (soda ash); and
- Ramea (lime).

These four systems are designed with two separate pH adjustment chemical injection points: one located at the headworks of the plant (typically the raw water header or low lift wet well) and the other for treated water pH adjustment (downstream of treatment but prior to discharge to the distribution system).

An assessment of the effect of the pH/alkalinity adjustment systems on the performance of the coagulation and flocculation processes was not conducted as part of this study. It should be noted, however, that all four systems were among the nine deemed to be effective for pH control in the evaluation conducted as part of Tasks 3 and 4.

5.4 Review of Design Guidance

The current guidance document for the design and construction of drinking water systems in Newfoundland and Labrador, the Design Guidelines, was published by ENVC in 2005. As part of Task 5, a review of relevant sections of the Design Guidelines relating to pH adjustment systems was undertaken.

A literature review of drinking water quality standards and design and operational guidelines from other jurisdictions across Canada and internationally was also conducted in order to make recommendations for new or updated content to be included in the guidelines.

5.4.1 Current Newfoundland and Labrador Guidelines

The existing document does not have a specific section addressing the design and construction of the various types of pH adjustment systems. A summary of the relevant sections is provided in Table 5.1.

Corrosion control is also addressed as part of the sections addressing softening and aeration, as the treated water from these processes may require further stabilization to prevent deposition or corrosion in the distribution system. Specifically, Section 3.3.4.8.5 (currently a subsection under the General Design of Aeration Systems) provides an overview of, and recommendations for, the design and implementation of a corrosion control program.

In addition, there are several sections addressing the use of corrosion resistant materials in chemical feed equipment, distribution system piping and storage facilities. These are not addressed as part of this Task, as they are not directly related to pH adjustment systems.

5.4.2 Jurisdictional Review

The jurisdictional review conducted as part of this task included the following documents:

- Guidelines for Canadian Drinking Water Quality Summary Table and Technical Documents (Health Canada, 2008);
- Atlantic Canada Guidelines for the Supply, Treatment, Storage, Distribution and Operation of Drinking Water Supply Systems (ACCWA, 2004);
- Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (Ontario Ministry of the Environment, 2006);
- Ontario Design Guidelines for Drinking Water Systems (Ontario MOE, 2008);
- Regulation Respecting the Quality of Drinking Water (Développement Durable, Environnement et Parcs, Québec, 2005);
- Manitoba Drinking Water Quality Standards Regulation (Manitoba Water Stewardship, 2007);

- Saskatchewan Drinking Water Quality Standards and Objectives (Saskatchewan Environment, 2006);
- British Columbia Drinking Water Quality Guidelines (BC Ministry of the Environment, 1998);
- Recommended Standards for Water Works (Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2007);
- World Health Organization Guidelines for Drinking Water Quality (WHO, 2008); and
- USEPA List of Drinking Water Contaminants (USEPA, 2009).

Table 5.1 Summary of Relevant Sections in the Guidelines for the Design, Construction and Operation of Water and Sewage Systems (ENVC, 2005)

Section Number	Section Heading	Comments/Content
3.2.5	Langelier Index	This section provides a brief description of the Langelier Index (LI). Recommends that a LI value of one (1) be maintained to prolong the life of the distribution system.
3.2.6	pH Adjustment	This section recommends that the raw water pH and LI be determined. Indicates that the use of chlorine gas with low alkalinity source waters may cause a significant reduction in pH and increase potential for corrosion. Indicates that for groundwater supplies, the use of sodium hypochlorite may increase the pH to unacceptable levels, and that a decrease in pH may be required for effective disinfection.
3.3.9.2	Chemical Feed Devices	Recommends that at least one standby unit be provided for chemical feed equipment.
3.3.11	Automated/ Unattended Operation of Surface Water Treatment Plants	Encourages measures, "including automation, which assist operators in improving plant operations and surveillance functions". Outlines the requirements of design and approval of automation systems.
3.4.6.1	Acids and Caustics	Provides recommendations for the safe handling and storage of acidic and alkaline chemicals.
3.7.2.4	Corrosion Prevention/ Reduction	Recommends the implementation of pH adjustment using either lime or soda ash for systems with known corrosion problems or a LI of -2 or below.
6.1.1	Measurement List	Recommends the use of on-line pH monitors for systems with a capacity of 1 ML/d or greater; allows for the use of bench testing for smaller systems.
6.1.3	Alarms and Status Indication	Recommends low and high level alarms for raw and treated water pH where on-line instruments are provided.
6.1.6.1.2	Finished Water Pumping	This section recommends that the discharge flow rate be monitored continuously, and that the flow rate will be used to control the feed rate for corrosion control chemicals, and pH control chemicals, where applicable.

A summary of relevant drinking water quality regulations, standards and guidelines related to pH adjustment or pH control is provided in Table 5.2.

Table 5.2 Summary of Relevant Water Quality Standards and Guidelines

Document	Value	Type of Standard	Comments/Content
Health Canada - Guidelines for Canadian Drinking Water Quality	6.5-8.5	Operational Guideline	The acceptable range for pH is based on providing a water that is neither corrosive or likely to produce incrustation. It also accounts for decreasing effectiveness of free chlorine for disinfection at pH greater than 8.5.
Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines	6.5-8.5	Operational Guideline	The recommended range for pH is based on providing a water that is neither corrosive or likely to produce incrustation. It also accounts for decreasing effectiveness of free chlorine for disinfection at pH greater than 8.5.
Québec Regulation Respecting the Quality of Drinking Water	6.5-8.5	Maximum concentration	
Manitoba Drinking Water Quality Standards Regulation	none	n/a	Refers to the Guidelines for Canadian Drinking Water Quality.
Alberta Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems	none	n/a	Refers to the Guidelines for Canadian Drinking Water Quality.
Saskatchewan Drinking Water Quality Standards and Objectives	6.5-9.0	Aesthetic Objective	
British Columbia Drinking Water Quality Standards	6.5-8.5	Aesthetic Objective	Based on Guidelines for Canadian Drinking Water Quality.
World Health Organization Guidelines for Drinking Water Quality	6.5-9.5	Operational Guideline	
USEPA Drinking Water Contaminants List	6.5-8.5	National Secondary Drinking Water Regulation	Non-enforceable guideline

A summary of the review of relevant drinking water system design guidelines, with a particular focus on recommendations for the design and operation of pH adjustment systems, is provided in Table 5.3.

Table 5.3 Summary of Relevant Drinking Water System Design Standards or Guidance Documents

Document	Comments/Content
Atlantic Canada Guidelines for the Supply, Treatment, Storage, Distribution and Operation of Drinking Water Supply Systems	The requirements for the design of chemical feed equipment are similar to those in the existing NL guidelines. The recommendations for remote operation of facilities are also similar to the existing NL guidelines. Specific recommendations for the design of pH adjustment systems are provided; however, no information is given regarding process selection. A treated water Langelier Saturation Index of 0 or slightly positive is recommended. Operations and Maintenance requirements for drinking water systems are identified.
Ontario Design Guidelines for Drinking Water Systems	Recommends against the use of the Langelier Saturation Index as a predictor of corrosion. Instead, an approach similar to that used in the USEPA Lead and Copper Rule or the MOE Guidance Document for Preparing Corrosion Control Plans is recommended. Provides specific recommendations for the design of pH adjustment systems, with some guidance regarding the selection of the pH adjustment process. The requirements for the design of chemical feed equipment are similar to those in the existing NL guidelines.
Alberta Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems	Recommends that water systems produce water that is non-corrosive with respect to lead and copper. Recommends corrosion control studies to compare the effectiveness of pH and alkalinity adjustment, calcium adjustment, and addition of a phosphate or silica-based corrosion inhibitor. Does not provide specific recommendations for the design of pH adjustment systems or feed equipment.
Recommended Standards for Water Works ("Ten States Standards")	Encourages any measures, including automation, which assist operators in improving plant operations and surveillance functions. States that "water that is unstable due either to natural causes or to subsequent treatment shall be stabilized". Specific recommendations for the design of pH adjustment systems are provided; however, no information is given regarding process selection. The requirements for the design of chemical feed equipment are similar to those in the existing NL guidelines.

6.0 TASK 6: EVALUATION OF LANGELIER SATURATION INDEX AND RYZNAR SATURATION INDEX

6.1 Overview of Common Corrosion Indices

As discussed in the previous Task Summary Reports, the primary approaches to internal corrosion control in drinking water systems are to:

- Modify the water chemistry to make it less corrosive; and
- Encourage the formation of less soluble compounds (passivation).

This is typically accomplished through pH and/or alkalinity adjustment, or through the addition of a corrosion inhibitor. pH is an important water quality factor affecting corrosion and corrosion control for several common plumbing materials. For example, pH is often increased to reduce the concentration of metals in drinking water because of the effect of low (acidic) pH on the solubility of metal pipe materials (AWWA, 1996).

Natural scales form on the surface of all metals used for water conduits. In addition to the natural scales, water treatment processes are used to manage the development of other scales, particularly calcium carbonate ($CaCO_3$) (MWH, 2005). During the first half of the twentieth century it was thought that achieving $CaCO_3$ saturation was the principal means for controlling corrosion of iron distribution system piping. If the water was supersaturated with $CaCO_3$, a protective $CaCO_3$ layer would develop on the inside of the pipe protecting it from the corrosion process.

In 1936, Langelier developed a $CaCO_3$ saturation index termed the Langelier Saturation Index (LI), which was used to control corrosion in distribution piping during most of the 20th century. Since Langelier's research, others have proposed alternative indices based on $CaCO_3$ saturation. These indices include the RSI, the Driving Force Index (DFI), the Aggressiveness Index (AI), the Momentary Excess (ME) and the Calcium Carbonate Precipitation Potential (CCPP). Most of the indices developed are based on the assumption that water will be less corrosive if it has a tendency to deposit a $CaCO_3$ scale on metal surfaces (WHO, 2008).

A brief discussion and comparison of the LI and RSI is provided in the following subsections. The other indices mentioned above were all derived in a manner similar to the LI and RSI, and are therefore not discussed in this report.

6.2 Langelier Saturation Index

The LI is the most common of the $CaCO_3$ saturation indices used to predict corrosion control. The concentration of calcium and carbonate in water limits the pH change that can be made without causing excessive amounts of $CaCO_3$ to precipitate. The LI is a measure of a water's pH relative to its pH at saturation with $CaCO_3$. The LI reflects the equilibrium pH of a water with respect to calcium and alkalinity. This index has traditionally been used in many countries to evaluate the stability of water to control both corrosion and the deposition of scale.

The LI is derived from the reaction between calcium ions (Ca^{2+}) and bicarbonate ions (HCO_3^-), which results in the precipitation of calcium carbonate ($CaCO_3$) and the release of hydrogen ions (H^+), as shown in Equation [1]:

[1] $Ca^{2+} + HCO_3^- \leftrightarrow CaCO_{3(s)} + H^+$

The LI is calculated using Equation [2]:

[2] $LI = pH_a – pH_s$

In which:

pH_a = measured pH of water
pH_s = pH at which the water would be saturated with $CaCO_3$

Calculation of pH_s is determined using Equation [3]:

[3] $pH_s = pK - \log [Ca^{2+}] - \log [HCO_3^-] - \log \gamma_{Ca}^{2+} - \log \gamma_{HCO3^-}$

Which means that pH_s is a function of the rate of formation of $CaCO_3$ precipitate and the concentrations of calcium and bicarbonate ions in the water.

The state of saturation with respect to $CaCO_3$ depends on the LI value:

- LI < 0: solution is undersaturated with $CaCO_3$ (will dissolve $CaCO_3$ and indicates a corrosive water)
- LI = 0: solution at equilibrium with $CaCO_3$
- LI > 0: solution is oversaturated with $CaCO_3$ (will precipitate $CaCO_3$ and indicates a non-corrosive water)

6.3 Ryznar Saturation Index

The RSI is another commonly used index related to the tendency of $CaCO_3$ to precipitate. This index is based on the LI and incorporates an empirical correlation between $CaCO_3$ build up and water chemistry which have been observed in municipal water systems.

The RSI is calculated using Equation [4]:

[4] $RI = 2pH_s - pH_a$

In which:

pH_a = measured pH of water
pH_s = pH at which the water is saturated with $CaCO_3$

The results of the experiments conducted by Ryznar showed that $CaCO_3$ had a tendency to deposit at water RSI values below 7. Waters with RSI values above 7 did not deposit $CaCO_3$, therefore these waters were deemed undersaturated and considered to be corrosive.

6.4 Limitations of Corrosion Indices

Although the LI is the most commonly used index to predict corrosivity of water, there are limitations in using it as a corrosion potential indicator. In the past, LI was used as the sole indicator of a water's corrosivity toward iron; however because of evidence contradicting the presumed connection between LI and corrosion, it was recommended that this practice be abandoned (AWWA, 1996). The limitations of the LI as a corrosion index include the following:

- There is difficulty in making accurate calculations of LI: careful measurement of pH, alkalinity, calcium, temperature and estimation of ionic strength is required;
- Reactions between calcium (Ca^{2+}) and bicarbonate (HCO_3^-) with inorganic and organic substances is generally not accounted for in the calculation of the LI, although it is possible to do so if specific analytical data are available;
- The LI provides little insight into the rate of scale precipitation or dissolution; and
- An LI value may not accurately predict whether the $CaCO_3$ deposit will form a protective film, how much will form, or how protective the deposit may be.

In general, the higher the pH, alkalinity and calcium (water quality parameters typically associated with a more positive LI value) the less corrosive a water will be. However, a positive LI value is not always necessary to protect against corrosion. In some systems, maintaining a water with a positive LI has led to excessive deposition of $CaCO_3$, which can reduce the capacity of distribution system pipes. In high-hardness and high-alkalinity water, the LI values can be used to avoid excessive $CaCO_3$ deposition.

The saturation pH, referred to as pH_s, is determined predominately by the calcium concentration and alkalinity. Alkalinity is the measure of bicarbonate and carbonate ions responsible for the acid-neutralizing capacity of water (MWH, 2005). Water with low levels of Ca^{2+} and alkalinity, which are characteristics typical of surface water supplies in Newfoundland and Labrador, will have high pH_s. Therefore, under normal operating conditions, the LI would indicate that the water would have a tendency to be corrosive in nature and undersaturated with $CaCO_3$.

The RSI, as shown in Section 6.3, is based on the same water quality parameters as the LI (i.e. is mainly determined based on the relationships between pH, alkalinity, calcium and carbonate). The difference between the two indices is the manner in which the index is calculated and the interpretation of the index and how it relates to the potential for deposition of a carbonate scale. Given that the limitations that apply to the LI also apply to the RSI, the RSI should also be applied appropriately (e.g. as one of the preliminary indicators of corrosion potential).

Corrosion indices should be used only as one method in an overall corrosion control strategy to indicate a water's corrosive potential. Field observations of pipe condition, analytical data on dissolved or particulate corrosion products, and pipe loop or coupon studies should supplement data obtained from corrosion indices values (AWWA, 1996).

6.5 Jurisdictional Review of the Use of Corrosion Indices

A literature review of provincial, federal and international water quality standards, regulations and guidelines was undertaken as part of this task. A summary of relevant findings regarding the use of corrosion indices in drinking water systems is provided below.

Newfoundland and Labrador Department of the Environment and Conservation - Guidelines for the Design, Construction and Operation of Water and Sewage Systems (ENVC, 2005)

The current version of this document recommends that a LI value of one (1) be maintained to prolong the life of the distribution system and recommends the implementation of pH adjustment using either lime or soda ash for systems with known corrosion problems or a LI of -2 or below.

Atlantic Canada Guidelines for the Supply, Treatment, Storage, Distribution and Operation of Drinking Water Supply Systems (ACCWA, 2004)

The guidelines recommend that where pH or alkalinity adjustment is provided, the system should provide for a treated water with an LI of zero (0) or slightly positive.

Ontario Ministry of Environment - Guidance Document for Preparing Corrosion Control Plans for Drinking Water Systems (MOE, 2009)

This document states that the use of LI values as an indicator of a water's corrosivity is an ineffective indicator because it is based on inhibition solely by carbonate species (carbonate, bicarbonate, and hydroxide ions) and calcium, and the measure of all dissolved carbonate-containing species, which is incorrect. It also states that the LI value of a water may not indicate the corrosivity of the water because other compounds such as phosphates and silicates can complex with other metals.

Health Canada - Guidance on Controlling Corrosion in Drinking Water Distribution Systems (Health Canada, 2009)

The document recommends against the use of corrosion indices to assess the effectiveness of corrosion control programs, as they provide only an indication of the tendency of $CaCO_3$ to dissolve or precipitate. Corrosion indices are based on the premise that corrosion is controlled by the formation of a thin layer of $CaCO_3$ on the surface of metallic pipe. A deposit of $CaCO_3$ does not necessarily form an adherent protective layer on the metal surface. It has been shown that under specific conditions, the use of corrosion indices may increase the release of corrosion by-products (Health Canada, 2009).

World Health Organization - Guidelines for Drinking Water Quality (WHO, 2008)

This report states that most corrosion potential indices have been developed based on the assumption that water will be less corrosive if it has a tendency to deposit a $CaCO_3$ scale on metals surfaces. The report suggest that parameters related to $CaCO_3$ saturation status are indicators of the tendency to deposit or dissolve $CaCO_3$ scale, and are not indicators of the corrosivity of a water. There are many waters with a positive LI that are corrosive and many with a negative LI that are non-corrosive (WHO, 2008).

7.0 DISCUSSION OF FINDINGS

7.1 Assessment of Effectiveness of pH Adjustment Systems

Based on the review of available background information, including data provided by the ENVC and information gathered as part of the site visits conducted during Task 2, an evaluation of the effectiveness of the pH adjustment systems was undertaken, and performance limiting factors were identified during Task 3 and 4.

The results of the water quality review indicated that:

- The implementation of pH adjustment did not have an impact on DBP formation. In general, the presence of elevated levels of NOM in the water at the point of disinfectant application appears to be the main factor contributing to THM and HAA formation;
- Based on the water quality data reviewed as part of this study changes in treated water pH as a result of pH adjustment do not have an effect on DOC concentrations. Most of the systems included in this study have no treatment other than chlorine disinfection and pH adjustment, and as such, have no capacity for NOM removal; and
- The concentrations of aluminum, copper, iron, lead and zinc were generally found to be within acceptable levels in the distribution system. It appears that the treated water pH has a greater effect on metals concentrations than on DBP or DOC concentrations.

The performance of pH adjustment systems was assessed based on the criteria presented in Section 4.1, and it was determined that:

- Approximately seventeen (17) systems are performing effectively (38 percent);
- Approximately seven (7) systems are currently not operational (15 percent); and
- The remaining twenty-one (21) systems are not operating effectively (47 percent).

Based on this evaluation, a list of performance limiting factors was developed. The most common performance limiting factors identified included:

- The use of chlorine gas for primary disinfection;
- The lack of routine maintenance;

- A lack of redundancy for key process equipment;
- A lack of automatic monitoring and/or control of pH adjustment systems; and
- Operating objectives for treated water pH of less than 7.0.

7.2 Operation and Maintenance of pH Adjustment Systems

As discussed in the Task 3 and 4 Summary Report, two operational issues were identified as performance limiting factors for pH adjustment systems in the Province:

- The lack of routine or preventive maintenance programs; and
- Establishing treated water pH objectives that are too low for effective corrosion control.

The existing Design Guidelines (ENVC, 2005) require that an Operations Manual be prepared, and that it identify "specific criteria for satisfactory operation and the identification of potential operational problems" for the system.

Although a review of operations and maintenance manuals was not undertaken as part of the site visits, operators were asked about existing maintenance practices and procedures during the interviews. The results indicated that almost 40 percent of the systems included in the study do not have formal maintenance programs. In several systems, pH adjustment equipment was out of service due to failure of the chemical feed pumps.

Many factors may be contributing to a lack of routine or preventive maintenance for pH adjustment systems, including:

- Lack of spare parts or equipment;
- Chemical feed equipment installed in a location that is difficult to access;
- Lack of operator awareness regarding the importance of maintenance or lack of required skills/training; and
- Lack of available resources to implement a preventive maintenance program.

7.3 Design of pH Adjustment Systems

As discussed in Section 4.1 of this report and in the Task 3 and 4 Summary Report, three design issues were identified as performance limiting factors for pH adjustment systems in the Province:

- The use of chlorine gas for primary disinfection;
- A lack of redundancy for key process equipment; and
- A lack of automatic monitoring and/or control of pH adjustment systems.

Many of the systems included in this study are surface water supplies with very low levels of alkalinity. As such, the application of chlorine gas for primary disinfection in these systems results in a considerable depression of the pH. The location of the pH adjustment system was also not consistent, with some facilities designed such that pH adjustment occurs upstream of disinfection, and others designed with pH adjustment downstream of disinfection. The design of future installations, including upgrades or expansions, should provide for pH adjustment downstream of treatment (including disinfection). Where pH or alkalinity adjustment is required for other processes (e.g. coagulation), multiple chemical addition points may be needed.

In general, it does not appear that the overall design of the pH adjustment systems, in terms of process selection or equipment sizing, is contributing to poor performance. The main issue associated with the design of the processes is a lack of reliability and redundancy, particularly for systems where only one chemical feed pump has been provided, where the facility is typically unattended, and/or where the equipment is not adequately maintained. As discussed in Section 7.2, there are many systems where the facility design discourages routine checks and maintenance, as access to the equipment may be limited (e.g. by ladder instead of stairs).

Only the largest systems were equipped with means for fully-automated control of pH adjustment. Some smaller systems were equipped with chemical dosing systems that were paced-to-flow. While most systems (approximately 67 percent) were found to have on-line pH analyzers, very few were provided with remote monitoring or control systems, such as a supervisory control and data acquisition (SCADA) system. In general, smaller systems were more likely to have no on-line monitoring or control equipment; these systems were also more likely to be unattended facilities.

Most of the above noted issues are addressed in the current Design Guidelines (ENVC, 2005): the selection of chlorination chemicals and its impact on pH is discussed in Section 3.2.6; redundancy for chemical feed equipment is discussed in Section 3.3.9.2; and on-line monitoring, control and alarms are addressed in Section 6.1. However, given that many of the treatment facilities were constructed prior to 2005, the design of many of the systems included in the study does not conform to the recommendations and/or best practices included in the current design guidelines.

7.4 Langelier Saturation Index and Ryznar Saturation Index

The key findings of the literature review of the LI and RSI, their application and use in other jurisdictions, and their limitations are summarized below:

- The LI is the most common of the $CaCO_3$ saturation indices used to predict corrosion in drinking water systems. Other indices based on $CaCO_3$ saturation included the RSI, the DFI, the AI, the ME, and the CCPP;
- The corrosion indices mentioned above are all based on the assumption that water will be less corrosive if it has a tendency to deposit a $CaCO_3$ scale on metal surfaces;

- There are several limitations to the use of corrosion indices and typically they are not recommended as the primary method for determining the corrosivity of water. In general, corrosion indices provide little insight into the rate of scale formation or dissolution. The indices may not accurately predict whether $CaCO_3$ deposit will form a protective film, how much will form, or how protective the deposit may be; and
- The precipitation of $CaCO_3$ is affected by pH, alkalinity, calcium and carbonate concentrations and many other water quality parameters. In general, low levels of hardness and alkalinity indicate that a water will be undersaturated with $CaCO_3$, and it is unlikely that a protective layer will form on the pipe wall.

8.0 RECOMMENDATIONS

8.1 Operation and Maintenance Recommendations

It is recommended that system owners and operators be encouraged to maintain a supply of spare parts for key components of the pH adjustment system. In addition, it is recommended that preventive maintenance programs be developed for existing pH adjustment systems.

Where it is not practical or cost effective to maintain inventories of spare parts or equipment, and/or where operators do not have the required skills, knowledge or time to complete needed repairs, consideration should be given to entering into a servicing agreement with the equipment supplier or an outside contractor for routine maintenance.

The information gathered during the site visits indicated that 11 of the systems reviewed had a target treated water pH of less than 7.0. While this value may be within the operating range noted for pH under the GCDWQ of 6.5 to 8.5, it is probably too low for effective corrosion control given the very low alkalinity (typically less than 5 mg/L as CaCO3) of most of the raw water sources for the systems included in the study. It is also recommended that municipalities and water treatment operations personnel be encouraged to establish treated water pH targets that are equal to or greater than 7.2. OETC has identified this as an issue in the past and Operator Trainers have been developing an on-site hand-on training session for operators of pH adjustment systems.

As noted in Section 5.4, the existing Design Guidelines (ENVC, 2005) recommend that a LI value of 1 be maintained in the treated water to prolong the life of the distribution system. None of the systems examined during this study meet this objective. It should be noted that water quality data reviewed as part of this study indicate that very high treated water pH levels (e.g. greater than 10) would be required to achieve a LI value of 0 for most systems. Rather than using LI and an indicator of corrosion, treated water pH and metal concentrations should be used as a tool to determine corrosivity of water.

It is recommended that the optimum treated water pH objective be determined on a site specific basis, using an approach similar to that described in the *Guidance Manual for Preparing Corrosion Control Plans* (MOE, 2009), the *Guideline Technical Document on Corrosion Control* *in Drinking Water Systems* (Health Canada, 2007) or in the *Revised Guidance Manual for Selecting Lead and Copper Control Strategies* (USEPA, 2003).

8.1.1 Corrosion Control Strategy

The corrosion control plans are developed using trial-and-error methodology, that could be used to complement the existing sampling and monitoring currently conducted by the ENVC, and would involve the following steps:

- Analyze the potential for metals (such as lead, copper, iron and zinc) and/or other corrosion by-products leaching into water as a result of corrosion that occurs in the system's distribution system or in plumbing that is connected to the system's distribution system;
- List and analyze possible measures to reduce the potential for the dissolution of metals;
- Identify the preferred measure or measures;
- Set out an implementation schedule;
- Include a program for monitoring the effectiveness of the preferred measure or measures; and
- Revise implemented measure as needed.

The first step in developing a corrosion control program is to conduct a monitoring program to assess if and to what degree corrosion may be occurring in a system and to take corrective action when needed. Conducting monitoring of metals such as lead, copper, and iron at the consumer's tap is the best tool to assess corrosion and reflect population exposure. A monitoring program will also provide information that is needed to determine the corrective measures that should be undertaken. The key corrosion parameters in drinking water are pH and alkalinity. In addition to pH and alkalinity, additional water quality parameters of interest are temperature, calcium, free chlorine residual, chloride, sulphate, NOM, turbidity, colour, total dissolved solids, chloride, metals (lead, iron, manganese, copper, aluminum, zinc etc) microbiological parameters..

All water systems that have exceeded metal levels, such as lead and copper should recommend a corrosion control treatment method that will minimize metals levels at users' taps. Pilot studies should be conducted to determine the effectiveness of the corrosion control method chosen.

Assessing the effectiveness of the corrosion control after implementation is critical to ensuring that the desired reduction in the potential for internal corrosion have been achieved and maintained in the system without adversely affecting other drinking water parameters. A water quality monitoring program to evaluate corrosion control effectiveness should provide information on water quality through the system Monitoring of point-of-entry water will provide information on the consistency of treated water quality and forms a basis for comparison with distribution system water. Distribution system monitoring can provide background data on the existing corrosion within the distribution system for comparison to pre-treatment conditions and identify specific areas that may have corrosive conditions or are experience adverse secondary impacts

8.2 Design Recommendations

It is recommended that future updates or revisions to the Design Guidelines [ENVC, 2005]) address the following issues:

- Section 3.3.4.8.5 - Corrosion Control should be rewritten as a separate section in Chapter 3 of the document, with a focus specifically on addressing internal corrosion, rather than as a consideration only for waters treated by aeration;
- Section 3.2.5 - Langelier Index should be deleted, and a new subsection created under "Internal Corrosion Control" (as described in the previous bullet), recommending the adoption of a site specific corrosion control plan, based on an approach similar to that provided in the *Guidance Document for Preparing Corrosion Control Plans* (MOE, 2009), the *Guideline Technical Document on Corrosion Control in Drinking Water Systems* (Health Canada, 2007) or the *Revised Guidance Manual for Selecting Lead and Copper Control Strategies* (USEPA, 2003);
- Section 3.2.6 - pH Adjustment should also be moved to the new "Internal Corrosion Control" section, and include additional guidance on the selection and design of pH adjustment systems similar to that provided in the Atlantic Canada and Ontario Design Guidelines. The wording in this section should also be strengthened to discourage the use of chlorine gas for primary disinfection of surface waters with very low alkalinity, unless it is the only practical option;
- Section 3.3.11 - Automated/Unattended Operation of Surface Water Treatment Plants is virtually identical to the Policy Statement included in the Recommended Standards for Waterworks or "Ten States Standards" (Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2007). This policy paper is mainly directed at the operation of surface water treatment plants where the main concern is particulate removal and microbiological contamination. Most of the systems included in this study draw water from surface water supplies; however, many are not equipped with particulate removal processes (e.g. conventional or direct filtration or membranes), and therefore most of the criteria in this policy statement are not applicable. It is recommended that a new section on "Automated/Unattended Operation of Small Water Treatment Plants" be prepared and included in future versions of the Guidelines to encourage plants that are normally unattended to be designed to allow for automated and/or remote operation. While adequate precautions would need to be included in the design (e.g. high and low level alarms, automatic shutdowns during process upsets, provisions for manual operation, etc.), it is anticipated that some degree of automation will improve the overall performance of the pH adjustment systems. In addition, a consistent treated water and distribution system pH is needed for effective corrosion control, and the current mode of operation (where timely responses to changes in flow or raw water conditions are not being made because there is generally no operator on site) does not allow for optimum performance; and
- Section 6.1.1 Measurement List should be revised to recommend the provision on-line pH monitors for all systems, rather than just those with a capacity greater than 1 ML/d.

It is also recommended that future upgrades or expansions to existing systems include the following:

- Provision of stand-by or spare chemical feed equipment, in conformance with Section 3.3.9.2 of the existing Guidelines;
- Change from chlorine gas to sodium hypochlorite, where feasible and appropriate;
- Installation of raw and treated water on-line pH analyzers, with low and high level alarms for treated water pH; and
- Provision of some degree of automated control (i.e. flow-paced chemical addition) where adequate instrumentation is already in place (i.e. flow and pH meters), in conformance with Section 6.1.6.1.2 of the existing Guidelines.
- The design of upgrades to, or construction of, new water treatment facilities should allow for easy access to chemical feed equipment. The design for chemical feed systems in future facilities should be above ground. During upgrades, where chemical feed pumps are located below grade, stairways should be provided rather than ladders to facilitate safe carrying of parts, tools, etc.
- pH adjustment systems should be installed downstream of treatment system, including disinfection.

A summary of performance limiting factors identified is shown in Table 8.1. It is recommended that the issues identified be addressed to ensure adequate performance of the pH adjustment system.

Table 8.1 – Summary of Performance Limiting Factors Identified

Community	Recommendation
Avondale	Not applicable
Bonavista	Lack of automatic monitoring or control. Lack of redundancy for key process equipment.
Brigus	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Operational objective for treated water pH is too low. Lack of automatic control.
Burgeo	The use of ozonation and chlorine gas at the WTP may be resulting in lower treated water pH levels. WTP is still in commissioning phase (at time of site visit).
Burnt Islands	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of automatic monitoring and control. Lack of redundancy for key process equipment.
Cape Freels North	pH treatment system not operational. Lack of automatic monitoring and control.

Table 8.1 – Summary of Performance Limiting Factors Identified

Community	Recommendation
Cartwright	Lack of automatic monitoring. Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system. Operational objective for treated water pH is too low.
Centreville-Wareham-Trinity (Northwest Pond)	pH treatment system not operational. The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system.
Centreville-Wareham-Trinity (Northwest Pond)	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. pH treatment system not operational. Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system.
Channel-Port aux Basques	Lack of redundancy for key process equipment. The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
Clarenville	None
Come By Chance	Lack of redundancy for key process equipment. Lack of automatic monitoring or control. Operational objective for treated water pH is too low.
Eastport	Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system. Operational objective for treated water pH is too low.
Fogo	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of automatic monitoring or control.
Gander	Lack of redundancy for key process equipment.
Glovertown	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system.
Grand Falls-Windsor	Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system.
Happy Valley-Goose Bay	Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system.
Hare Bay	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment.

Table 8.1 – Summary of Performance Limiting Factors Identified

Community	Recommendation
Hermitage	The use of chlorine gas as a disinfectant which can lower the pH of the treated water. Lack of redundancy for key process equipment.
Isle Aux Morts	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of automatic monitoring or control.
Lamaline	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system.
Lewisporte	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system. Operational objective for treated water pH is too low.
Long Harbour-Mount Arlington Heights	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of automatic monitoring or control. Lack of routine maintenance for pH adjustment system.
Lumsden	Lack of automatic monitoring and control.
Musgrave Harbour	Lack of redundancy for key process equipment.
New-Wes-Valley (Carter’s Pond)	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system.
New-Wes-Valley (Little Northwest Pond)	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system.
Petty Harbour-Maddox Cove	Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system.
Placentia	Lack of redundancy for key process equipment. Operational objective for treated water pH is too low.
Port Blandford	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of automatic monitoring or control. Lack of routine maintenance for pH adjustment system
Pouch Cove	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of automatic control.

Table 8.1 – Summary of Performance Limiting Factors Identified

Community	Recommendation
Ramea	None
Seldom-Little Seldom	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system.
Spaniard's Bay	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment.
St. John's (Bay Bulls Big Pond)	None
St. John's (Windsor Lake)	None
Summerford	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of routine maintenance for pH adjustment system.
Torbay	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of automatic monitoring or control. Operational objective for treated water pH is too low.
Trepassey	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Lack of automatic monitoring or control. Operational objective for treated water pH is too low.
Trinity (Indian Pond)	Lack of redundancy for key process equipment.
Trinity Bay North (Whirl Pond)	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of redundancy for key process equipment. Operational objective for treated water pH is too low.
Victoria	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Operational objective for treated water pH is too low. Lack of redundancy for key process equipment.
West St. Modeste	Lack of automatic monitoring or control. Lack of routine maintenance for pH adjustment system.
Whitbourne	The use of chlorine gas at the WTP may be resulting in lower treated water pH levels. Lack of automatic monitoring or control. Lack of redundancy for key process equipment. Operational objective for treated water pH is too low.

8.3 Langelier Saturation Index and Ryznar Saturation Index

Based on the findings of Task 6, it is recommended that the Province move away from the use of corrosion indicators, such as the Langelier and Ryznar Indices, as predictors for the effectiveness of corrosion control measures and instead adopt an approach similar to that used by Health Canada, Ontario and the USEPA. Both of these bodies have recommended the development of site specific corrosion control plans.

A site specific corrosion control plan should be developed that includes the steps outlined in Section 8.1.

As discussed in the Task 5 Summary Report, detailed information on the development of corrosion control plans is available in the following documents:

- *Guideline Technical Document on Corrosion Control in Drinking Water Systems* (Health Canada, 2007);
- *Revised Guidance Manual for Selecting Lead and Copper Control Strategies* (USEPA, 2003); and
- *Guidance Manual for Preparing Corrosion Control Plans* (MOE, 2009).

9.0 CLOSURE

This report is intended for the exclusive use of ENVC for specific application to the project sites. The scope of work was based on correspondence with the client. Any use which a third party makes of this report, or any reliance on or decisions to be made based on this report, is the responsibility of such third party. AMEC Earth & Environmental accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. The limitations of this work are expressed in Appendix C.

Respectfully submitted,
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APPENDIX A
Site Visit Records

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Avondale

Source Name: Lees Pond

Source Type: Pond | Water Supply No. :

Service Area(s):

Service Area No. : | Service Population: 50-60 Houses.

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: gravity feed to low-lift wet well
Cl injection · 2 submersible pumps w/ VFDs maintain
into 12" header distribution system pressure @ 75 psi

Operational Status: operational - 24/7

Type of Disinfectant: liquid Chlorine 3mnths Ago Cl gas before
Javex 12 Clorox 5L JUGS.

Point of Disinfectant Application:
end of header before connection to distribution system

Type of pH Adjustment System: N/A

Point of pH Adjustment: N/A

Chemical or Filter Media Used for pH adjustment: N/A. (Soda ash - previously)

Supplier: Brenntag

Concentration: —

Solid/Liquid: dry (25 kg bags)

MSDS (Y/N):

Feed Pump Capacity: n/a

Filter Capacity: n/a

Solution/Day Tank Volume: "

Bulk Storage Volume: "

On-line Monitoring of pH: Y [✓ N] | Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer:
N/A.

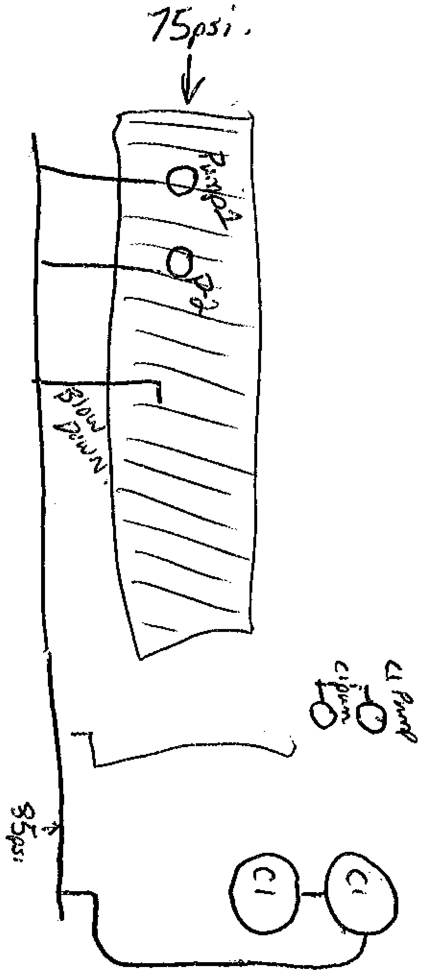
Location(s) for Collection of Grab Samples: N/A

Other Treatment Processes: N/A.

Site Visit Template - Page 2

PROCESS FLOW DIAGRAM

15-30 g/min.



← 9.5L/hr max @ 75%

9:1 Cl mix, 12% Sodium Hypochlori

Site Visit Template - Page 3

On-Site pH Measurement Results

Raw Water pH (before any treatment): 6.5 Blow off near raw water pump.

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 6.71 Sink DS of Cl injection.

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: N/A.

Current and/or typical average daily flow: 15 USgal/min

Frequency of delivery of pH adjustment chemical: N/A.

Frequency of media replacement for pH adjustment system: N/A

Frequency and method used for measurement of pH:

Adjustments to process in response to water quality changes:

Describe routine maintenance practices for pH adjustment system: N/A.

History of discoloured water complaints and/or service leaks: Complaints of dirty water when using Cl gas.

Other operational issues (making of stock solutions, mixing problems, etc.):

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Bonavista.

Source Name: Long Pond.

Source Type: Surface

Water Supply No. : WS-S-0073

Service Area(s): Bonavista.

Service Area No. : SA-0074

Service Population: 4021

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: 14" line. Cl up by Pond ~1Km+.
gravity feed. to Soda Ash plant.
2 main pumps to tower at Town (splits) what does go to town goes to tower
Cast iron & Ductile occasional leak. due to installation mostly. settle/rocks)

Operational Status: 24 hr/day. Intake out 40-50' in pond ~7-8' deep.

Type of Disinfectant: Cl gas.

Point of Disinfectant Application: ~1Km. from pond. Cl gas. ~60lbs/day
used to use 100lb/day for plant

Point of pH Adjustment: ~1Km DS of Cl injection before water tower.

Chemical or Filter Media Used for pH adjustment: Soda Ash. Brenntag.

Supplier: Eastern Chem.

Concentration: 25Kg bag.

Solid/Liquid: dry powder

Feed Pump Capacity: 77 GPH US Filter 80% on knob. (different pulleys)

Filter Capacity:

Solution/Day Tank Volume: 24 x 26 x 18" high.

Bulk Storage Volume: 2-3 pallet 40 per pallet.

On-line Monitoring of pH: Y [✓ N]

Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer:

Location(s) for Collection of Grab Samples: at pump house. and around town

Other Treatment Processes: Steel mesh screen up at pond.

Site Visit Template - Page 2

On-Site pH Measurement Results

Bonavista

Raw Water pH (before any treatment): 6.13 @ Pond.

Before pH adjustment: After Cl. 5.30 pH.

After pH adjustment:

Before Disinfection:

After Disinfection: 10.2 pH. my meter. 10.87 pH their meter

Describe sample locations, if needed: Sink in pump house

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: Large sylo. take 2 palets of S.A. Wallace and Tiernan control. manual feed rate set @ 100 Series 32-055

Current and/or typical average daily flow: ~ 390 g/min. for tower. 1200 gal/min from Cl plant. to fish plant + town.

Frequency of delivery of pH adjustment chemical: ~6 week. 1-2 lifts

Frequency of media replacement for pH adjustment system: ~~~6 week. A2 lifts~~

Target or Setpoint for pH in treated water: 10.9-11 pH. then its good around town ~7 pH

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
Trouble with flow meter. has set to manual, normally flow paced.

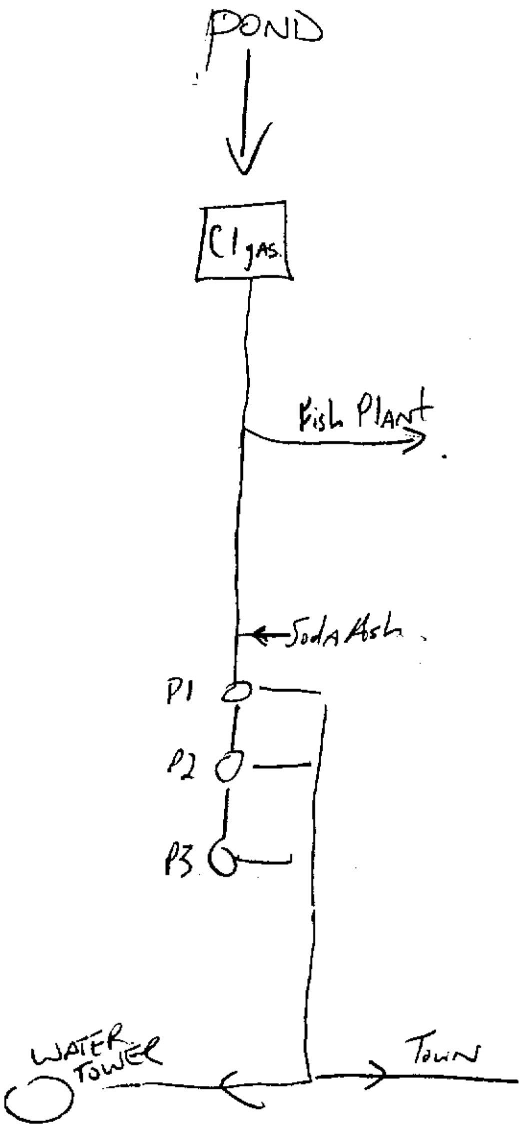
Describe routine maintenance practices for pH adjustment system:
NO.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
flow meter. off and on. work good.
lots of trouble. when they had lime. <1yr then switch to SodaAsh
not sure on dates ~12yr ago
USED TO HAVE ~100 leaks/year. on copper line.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Bonavista.



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Brigus

Source Name: Long Pond.

Source Type:

Water Supply No. :

Service Area(s):

Service Area No. :

Service Population: ~ 50 families

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: plant with gas chlorination and pH adjustment system built in '96-'97.

Operational Status: operational - 24/7

Type of Disinfectant: gas chlorination - flow paced

Point of Disinfectant Application: into main header ~ 4 m downstream of ~~pH~~ soda ash injection point. Cl 17lbs/day

Type of pH Adjustment System: soda ash. Dense 58% 25Kg Bag.

Point of pH Adjustment: into raw water header upstream of disinfection 1Kg Soda Ash in 500L water

Chemical or Filter Media Used for pH adjustment: soda ash

Supplier: Eastern Chemical

Concentration: 58% dense soda ash

Solid/Liquid: dry

MSDS (Y/N):

Feed Pump Capacity: 78.85 L/hr x 2

Filter Capacity: n/a

Solution/Day Tank Volume: 2 x 500L

Bulk Storage Volume: ~ 10 bags (25 kg)

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer: off treated water line (post-pH and chlorine)

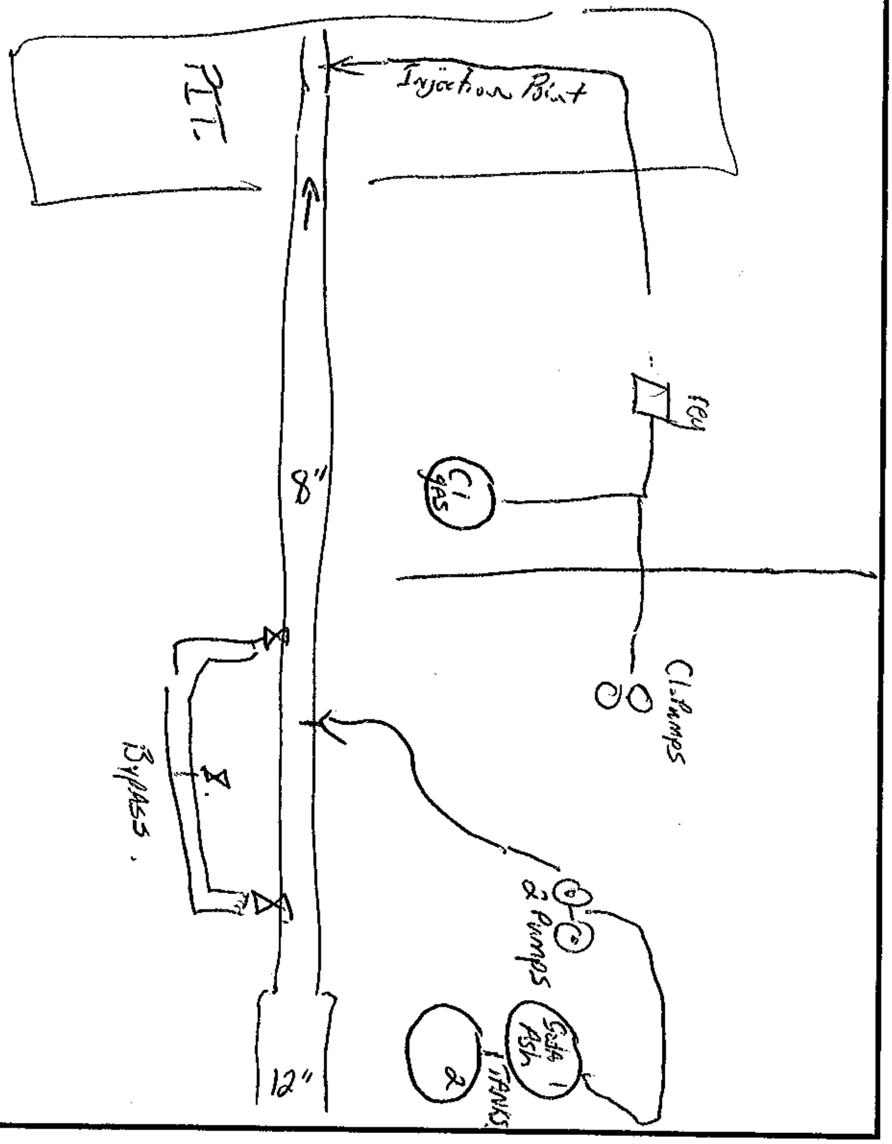
Location(s) for Collection of Grab Samples: sample tap in plant (soda ash room).

Other Treatment Processes: monitoring system linked to computer @ Town Hall to monitor cl residuals, pH, flow, etc. remotely.

Site Visit Template - Page 2

PROCESS FLOW DIAGRAM

135 US gal/min.



Site Visit Template - Page 3

On-Site pH Measurement Results

① Raw Water pH (before any treatment): 6.55

Before pH adjustment:

After pH adjustment:

Before Disinfection:

② After pH and After Disinfection: 6.25

Describe sample locations, if needed:

① Raw water - soda ash feed water line

② After pH adjustment and chlorination (sample tap in plant)

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage:
speed of dosing pump set @ 20% see extra calculation sheets.

Current and/or typical average daily flow: ~133 USgal/min

Frequency of delivery of pH adjustment chemical:
pick up bags ~2 years

Frequency of media replacement for pH adjustment system:
n/a

Frequency and method used for measurement of pH:
on-line and grab samples 3 times per week at plant

Adjustments to process in response to water quality changes:
~~n/a~~ → feed system (soda ash) is manual operation only, operators will adjust speed of pump to achieve target pH of 7.

Describe routine maintenance practices for pH adjustment system:
n/a

History of discoloured water complaints and/or service leaks:
n/a

Other operational issues (making of stock solutions, mixing problems, etc.):
n/a

UNIVAR → Soda Ash

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Burgeo

Source Name: Long

Source Type: Surface water

Water Supply No. :

Service Area(s): Burgeo

Service Area No. :

Service Population: 1400 People

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process:

→ Ozoneation 3 stage

→ has Scada

Operational Status: currently being commisioned

→ Plant under maintance → PH values MAY not be typical

Type of Disinfectant: ozone and Cl_2

Point of Disinfectant Application:

Ozone After sand filtration

Ozone Residue ~ .36 ppm

Point of pH Adjustment: After ozone treatmen

Chemical or Filter Media Used for pH adjustment: 50% liquid custic

Supplier: univar

Concentration: 50%

Solid/Liquid: liquid

Feed Pump Capacity: 24 GPD Soleand metering pump

Filter Capacity:

Solution/Day Tank Volume: N/A

Bulk Storage Volume: 3 x 1000m3

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: Y N

Location of On-Line Analyzer:

Raw ~~After~~ 4.27

~~[illegible] FAT~~ Finished 5.58

} have not Been calibrated

Location(s) for Collection of Grab Samples:

TAP @ Plant

Other Treatment Processes:

ozone gas

FAY environmental
Andy O'Connell
763-4488

Town of Burgeo
Micheal Ellard
886-2250

Kaufman → Ozone supplier (Germany)

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment):	~~4.37~~ / 5.55
After ozone Before pH adjustment:	4.46
After pH adjustment:	
Before Disinfection:	
After Disinfection:	6.7 pH final

Describe sample locations, if needed:

@ Taps all sample ports

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage:

Dose 8.4 gal/Day @ 50% → 350 gpm

Current and/or typical average daily flow:

350 gpm

Frequency of delivery of pH adjustment chemical:

6-8 month

Frequency of media replacement for pH adjustment system:

Target or Setpoint for pH in treated water:

7.0-7.5

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

Adjusts based on flow

Describe routine maintenance practices for pH adjustment system:

→ clean up basically → caustic soda → works well

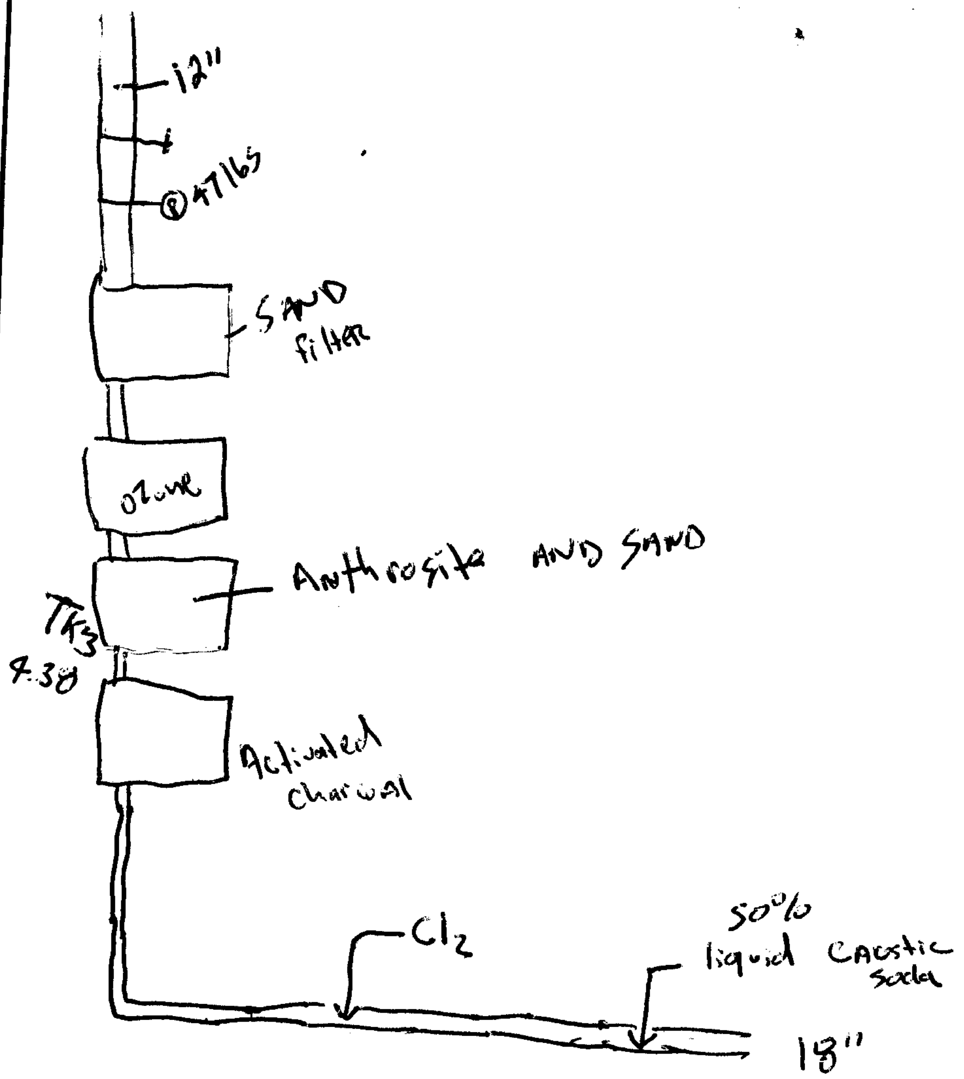
Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

→ Plant just getting operational

Supplier : univer

1m3 = 1000 liters

PROCESS FLOW DIAGRAM



Stainless in plant

Ductile iron → outside plant

5.35pH

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name:	Burnt Islands		
Source Name:			
Source Type:	Surface water	Water Supply No. :	
Service Area(s):			
Service Area No. :		Service Population:	

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process:
½ km from pump house to pond
→ 60' out in pond
→ 25' deep (20 ft from bottom)

Operational Status:
Running

Type of Disinfectant: Chlorine gas

Point of Disinfectant Application:
After Reservoir

Point of pH Adjustment: → @ pump house Before heading to Cl_2 Building

Chemical or Filter Media Used for pH adjustment: Lime

Supplier:	Call Rossetta
Concentration:	Calcium Hydroxide
Solid/Liquid:	Powder
Feed Pump Capacity:	7 GPH (Not sure what pump is Running)
Filter Capacity:	N/A
Solution/Day Tank Volume:	24" x 24" X 18"
Bulk Storage Volume:	Approx 8 bags @ time of visit

On-line Monitoring of pH: Y [✓ N] Grab Sample for pH: [✓ Y] N

ChemTube PPS
Model [illegible]88-SA1
Serial # P3044207
↓
Appears To Be set on 2.0

Location of On-Line Analyzer:
None

Location(s) for Collection of Grab Samples:
2 samples @ Chlorine sled

Other Treatment Processes:
Augering and Lime @ solution tank is automatic
operator not sure of Rate of Auger or water or
feed pump setting (MAX is 7 GPH)

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment):
Before pH adjustment:
① After pH adjustment: 5.35 @ Cl^2 Shed
② Before Disinfection: 4.35 @ Pond
③ After Disinfection: 4.4 @ Sink in Cl^2 Shed

Describe sample locations, if needed:

① Sample point on line in chlorine Shed
② probe placed in Pond
③ @ sink in chlorine shed after chlorine added.

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage:
1 bag every 5 days

Current and/or typical average daily flow:
330 GPM (Plant Running) → half when plant not

Frequency of delivery of pH adjustment chemical:
Not Sure

Frequency of media replacement for pH adjustment system:

Target or Setpoint for pH in treated water:
None

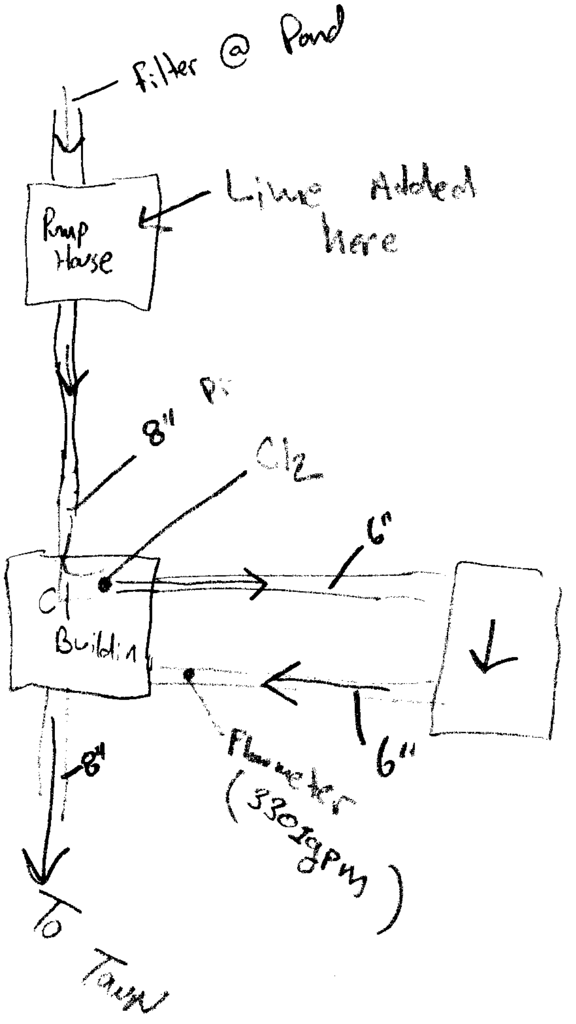
Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
No control modes for pH

Describe routine maintenance practices for pH adjustment system:
→ Not Routine

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
→ operator does not understand how system works.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



June – Oct (Plant Running)

~~300~~ 330 Igpm (Plant Running)

only 1/2 when plant not Running

when plant Running use Aprox. change Cl2 tank every 3 wks (68 kg)

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Cape Freels North

Source Name: Long Pond

Source Type: Surface. **Water Supply No. :** WS-S-0119

Service Area(s): Cape Freels North.

Service Area No. : SA-0121 **Service Population:** 150

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity feed to wet well
2 5hp pumps. through 2 particulate filters Cl (liquid) + S.Ash.
at end of line. 6" apart (Flow meter not working.)
Soda Ash system not in use since last fall due to allergy to S.A and very little copper pipes.

Operational Status: 24hr/day. All plastic.
3" Main. Plastic.

Type of Disinfectant: liquid Cl. Javex 12. 1x5L per ~1000gal/week.

Point of Disinfectant Application: Wet well. for supplament. and. pump.
Just before leaving. building. (Just put Javex12 in Wet well.

Point of pH Adjustment: 6" DS of Cl

Chemical or Filter Media Used for pH adjustment: N/A

Supplier:

Concentration:

Solid/Liquid:

Feed Pump Capacity:

Filter Capacity:

Solution/Day Tank Volume: 200 L

Bulk Storage Volume: 0

On-line Monitoring of pH: Y [✓ N] **Grab Sample for pH:** Y [✓ N]

Location of On-Line Analyzer:

Location(s) for Collection of Grab Samples:

Other Treatment Processes: 2 Particulate filters

Site Visit Template - Page 2

On-Site pH Measurement Results

Cape Freels N

Raw Water pH (before any treatment): 5.62 from Pond
Before pH adjustment:
After pH adjustment:
Before Disinfection:
—— After Disinfection: 10.37 from [illegible] tap in pumphouse.

Describe sample locations, if needed: 5.5 in town @ shop (store)

Cl OPERATIONAL ISSUES

Current and/or typical [illegible] adjustment chemical dosage:
4gal Cl per 200 Litros water Premia 75 Pump. 3.78 LPH Knob on 60

Current and/or typical average daily flow: ~ 16-17 gpm.
flow meter not working

Frequency of delivery of pH adjustment chemical: N/A -

Frequency of media replacement for pH adjustment system:

Target or Setpoint for pH in treated water:

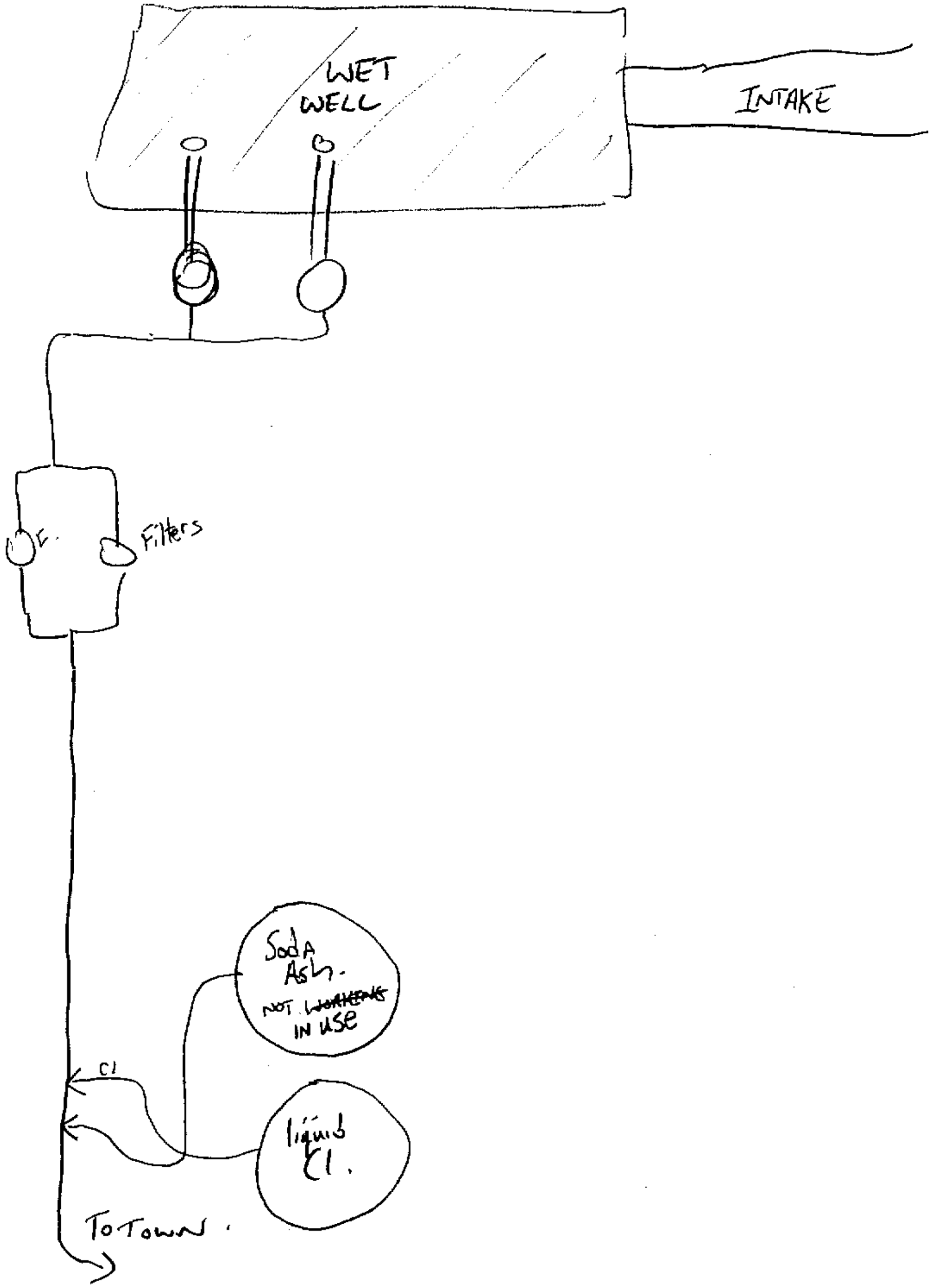
Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
flow paced.

Describe routine maintenance practices for pH adjustment system: N/A.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
*Backsystem not working.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM Cape Freels North



Shi

Site Visit Template - Page 1

August 4, 2010

GENERAL SITE INFORMATION

Community Name: Cartwright

Source Name: ~~Bu~~ Burdette Pond

Source Type: surface | **Water Supply No. :**

Service Area(s): cartwright

Service Area No. : | **Service Population:** 600 People

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process:

14" from Pond to wet well (screening well)

8" from well to chlonation

8" from treatment → high density poly (HDPE)

50-60' INTAKE

10' Pond Deep

5' deep Intake

Operational Status: PH Adjustment not working

Type of Disinfectant: Clorine granules calcium hypochlrite @ 65%

Point of Disinfectant Application:

Before leaving Plant

Point of pH Adjustment:

Befor leaving treatment Bilding (next to Chlorine)

Chemical or Filter Media Used for pH adjustment:

Supplier: Rock water distributing

Concentration: Soda ash 25 kg Bags

Solid/Liquid: solid → Powder

Feed Pump Capacity: 4 GPH

Filter Capacity:

Solution/Day Tank Volume: 45 US gallons @ 700 grams

Bulk Storage Volume: 45 US Gallons

On-line Monitoring of pH: Y [✓ N] | **Grab Sample for pH:** Y N

Location of On-Line Analyzer:

N.A

Location(s) for Collection of Grab Samples:

Other Treatment Processes:

Chlorine ⌋ 45 gal Drum

20 cups @ 700grams each

Fill Tank Once a day when plant not running

Twice a day when plant Running

Fish Plant usally Runs 6 wks June to mid July

Talk to Shirley on shipments

About 40 bags per order

1 in spring

1 during summer

And 1 in fall

→ flow changes a lot when fish Plant Running

Site Visit Template - Page 2

On-Site pH Measurement Results

① Raw Water pH (before any treatment):	5.1
Before pH adjustment:	
After pH adjustment:	
Before Disinfection:	
After Disinfection:	5-80

Describe sample locations, if needed:

① @ Pond close to shore
② @ Town office

(Ph Adjustment not working @ Time of visit.
PH pump not working)

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage:

Current and/or typical average daily flow:

Frequency of delivery of pH adjustment chemical:

Frequency of media replacement for pH adjustment system:
1 time a day when Plant not Running

Target or Setpoint for pH in treated water:
Target 6.8

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

→ when pH system working is pumping Based on flow

Describe routine maintenance practices for pH adjustment system:

→ not really routine → has to be continous

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

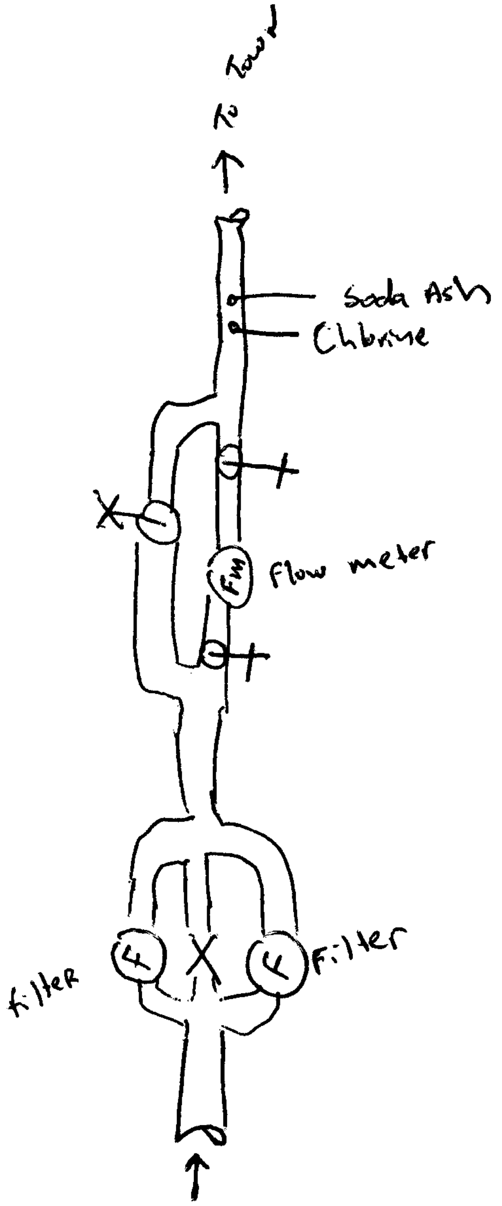
→ Lot of Problems with pH Pump

Normally 120 - 130 gal/min
on Aug. 4th → 160 → Plant
350 - 400 g/min when Plant Running

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Pwi Chate
Flow Tech



Normally @
Ph checked daily
6.7 - 6.8

Cl Pump
@ 50 % stroke
28 beats/Min
Max 4.0 GPH
PSi 100.00

Soda Ash
down for month and half
going for a week
and down now for
4 days
normally @ 50 %

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Centreville - Wareham - Trinity

Source Name: Northwest Pond

Source Type: Surface

Water Supply No. : WS-S-0138

Service Area(s): Centreville - Wareham .

Service Area No. : SA-0140

Service Population: 777

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity feed from pond to wet well then pumped (3 pumps) Cl + Soda Ash injection then out to main, 6-8-10" main.

Intake ~50' out 8' deep-

Operational Status: No treatment @ all in Centerville--Wareham.

April 2009 Soda Ash Pump down + Cl booster pump down.

Type of Disinfectant: None righ now. normally Cl gas. new system coming in Aug.

Point of Disinfectant Application: 3' US of soda Ash,

normally ~6lbs/day

Point of pH Adjustment: just before it leaves building

Chemical or Filter Media Used for pH adjustment: Soda Ash Brenntag.

Supplier: East Chem .

Concentration: 25Kg bags -

Solid/Liquid: dry powder .

Feed Pump Capacity: 6.62 LPH .

Filter Capacity: N/A .

Solution/Day Tank Volume: 450 Litres

Bulk Storage Volume: 9 bags

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: [✓ Y] N when running.

Location of On-Line Analyzer: Fully treated. when system is running

Location(s) for Collection of Grab Samples: beginning middle and end.

Other Treatment Processes: Steel Mesh screens in Wet Well.

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment): 6.71 pH from Pond.
Before pH adjustment:
After pH adjustment:
Before Disinfection:
After Disinfection:

Describe sample locations, if needed:

Boil order on.

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: Pump was on 100 (Knob)
2L soda ash per 50 Liters of water

Current and/or typical average daily flow: ~ 80 gal/min.

Frequency of delivery of pH adjustment chemical: ~ 10 bags. every 6 months.
not exactly sure. New operators. ~1.5yrs.

Frequency of media replacement for pH adjustment system:

Target or Setpoint for pH in treated water: 7 pH.

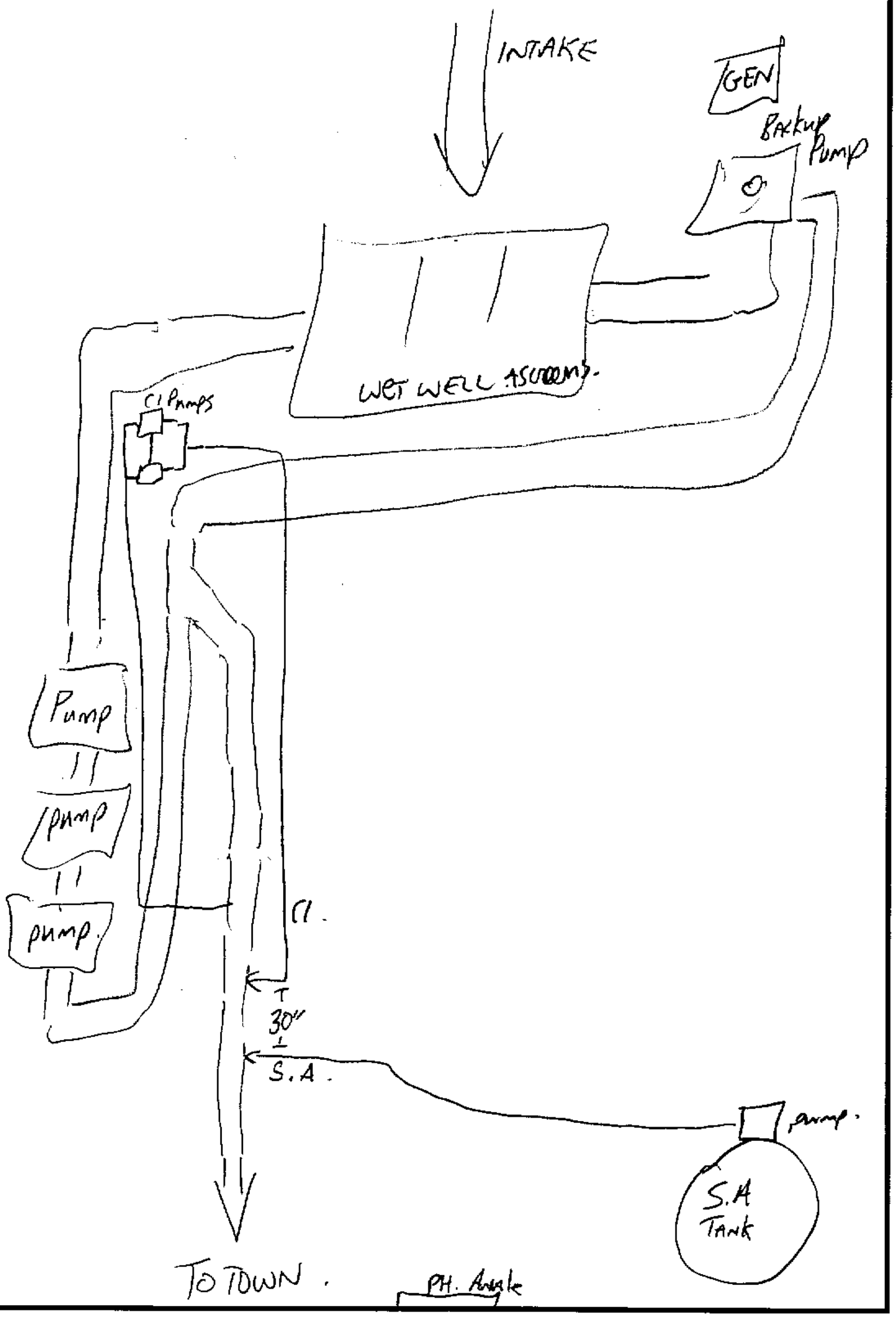
Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
manual adjustment

Describe routine maintenance practices for pH adjustment system:
NO Maintenance (need new pump -

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
-8 leaks this year on copper flare lines.
- Complaints about dirty water (staining laundry).
- No trouble with system except pump went down.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Trinity (Centerville).

Source Name: Southwest Feeder Pond

Source Type: Surface

Water Supply No. : WS-S-0139

Service Area(s): Trinity

Service Area No. : SA-0141

Service Population: 369

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity Feed to Wet Well. (40psi) 2 filters. Soda Ash + Cl gas. 12" DS of S.A.

Operational Status: 24hr/day. Soda Ash system down. N/yr.

Type of Disinfectant: Cl gas. flow paced. ~ 3lbs/day

Point of Disinfectant Application: Just before it leaves building

Point of pH Adjustment: 12" US of Cl gas.

1.8L Soda Ash. per 50L water.

Chemical or Filter Media Used for pH adjustment: Soda Ash

Supplier: East Chem.

Concentration: 25kg bag

Solid/Liquid: dry powder

Feed Pump Capacity: 6.62 LPH Pulsatron NOT RUNNING

Filter Capacity:

Solution/Day Tank Volume: 300 Liters.

Bulk Storage Volume: 2 bags.

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: Y N

Location of On-Line Analyzer: service line (treated.

Location(s) for Collection of Grab Samples: Beginning - Middle - End

Other Treatment Processes: 2 particulate filters.

Site Visit Template - Page 2

On-Site pH Measurement Results

Trinity Centerville

Raw Water pH (before any treatment): 5.66 After filters
Before pH adjustment:
After pH adjustment:
Before Disinfection:
After Disinfection: 4.41 After Cl

Describe sample locations, if needed:

All Ductile lines. Copper service lines

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 1.8L per 50 Liters of water.

Current and/or typical average daily flow: ~30 gpm.

Frequency of delivery of pH adjustment chemical: system down -

Frequency of media replacement for pH adjustment system: N/A.

Target or Setpoint for pH in treated water: 7pH.

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

Manual adjustments on pump or mix.

Describe routine maintenance practices for pH adjustment system:

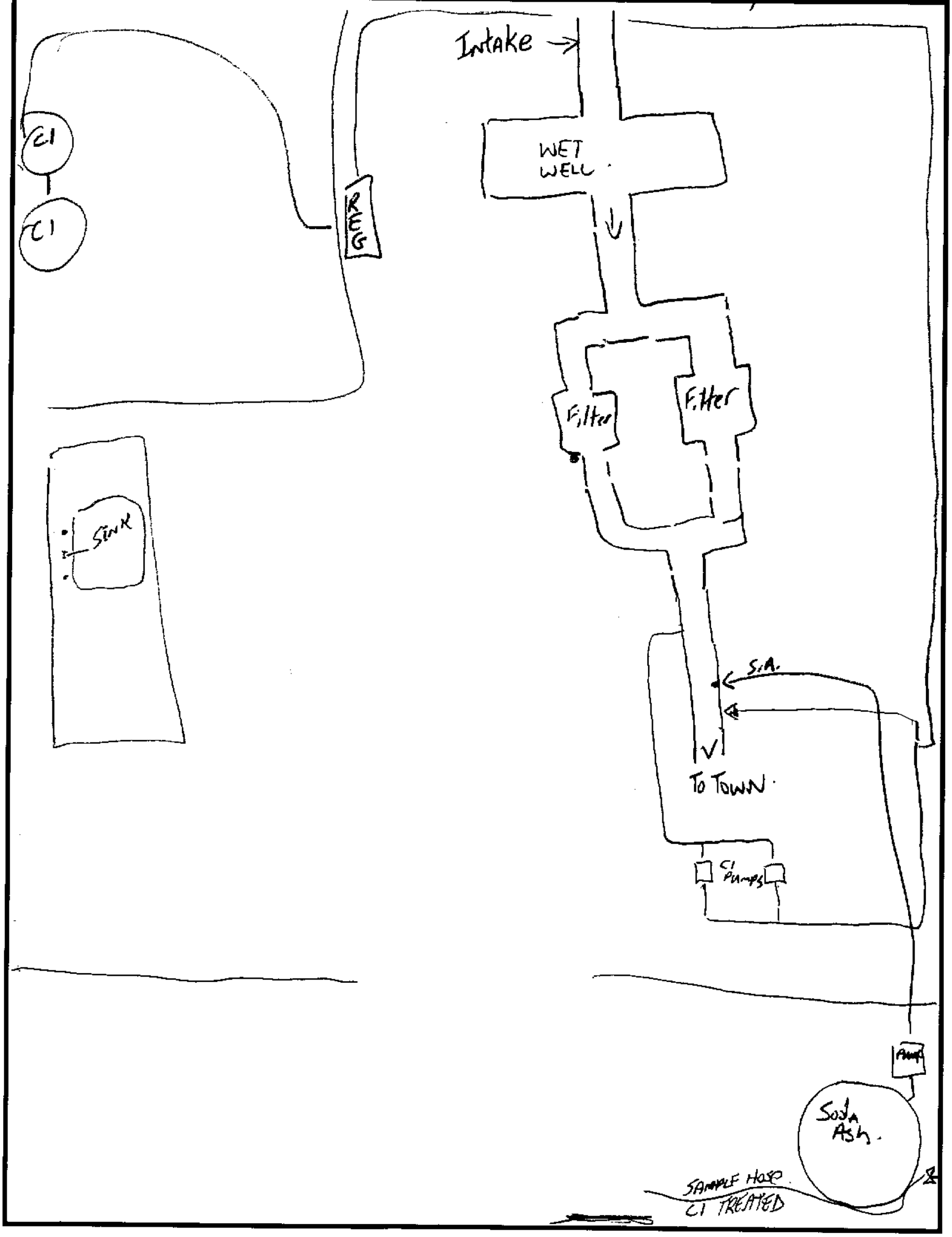
NO.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

pump down.
- Not many leaks

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM Trinity Centerville



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Port-Aux-Basque

Source Name: Main Resovoir DAM

Source Type: Surface / Bog

Water Supply No. :

Service Area(s):

Service Area No. :

Service Population: 4000 People

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process:

→ Surface water → filtered → Dergmont filter
18" Intake → mostly gravity feed except for Pumping
To Rapid mix

Operational Status: → Running → Manual mode (Cl is being adjusted manually → currently being Repaired)

Type of Disinfectant: Chlorine gas

Point of Disinfectant Application:
→ @ clear well in Chlorine Retention tank
Cl_2 tank in Clear well

Point of pH Adjustment: 2 places
@ Rapid mix
@ Clear well

Chemical or Filter Media Used for pH adjustment: Lime (Powder)

Supplier: Burges Contracting LTD, Petitcodiac, NB

Concentration:

Solid/Liquid: Powder

Feed Pump Capacity: 500 gpD

Filter Capacity: N/A

Solution/Day Tank Volume:

Bulk Storage Volume:

On-line Monitoring of pH: [✓ Y] N — Rapid Mix

Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer: ~~Raw~~
- Rapid Mix
- Raw water
- Clear well

Location(s) for Collection of Grab Samples:

Other Treatment Processes: → Degremont Infilco

Polymer → Brent Blizzard
102 Horsepine Rd
Fredericktown, NB

Site Visit Template - Page 2

On-Site pH Measurement Results

T RAW well

Raw Water pH (before any treatment):	
✓ Before pH adjustment:	
Rapid mix Tank ~~After pH adjustment:~~	5.39 from Tank
Before Disinfection:	
clear well After Disinfection:	6.60

Describe sample locations, if needed:

Raw water @ Tap

After Disinfection

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: when Running taking 16 gpm of water
? ← Lime feeder @ 45 %

Current and/or typical average daily flow:
@ Visit = 34 lps 2500 m³ per day = 2500,000 l

Frequency of delivery of pH adjustment chemical: April 1st → 24 Tonne 35 tonne silo on Roof.
once a YEAR

Frequency of media replacement for pH adjustment system:
Done Automatically — Silo on Roof feeds Solution / Slurry Tank

Target or Setpoint for pH in treated water: Rapid mix Low: 4.55 , High 6.3 (Alarms)
~~5.55~~

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
→ normally on flow control (not manual)
→ If not @ set point

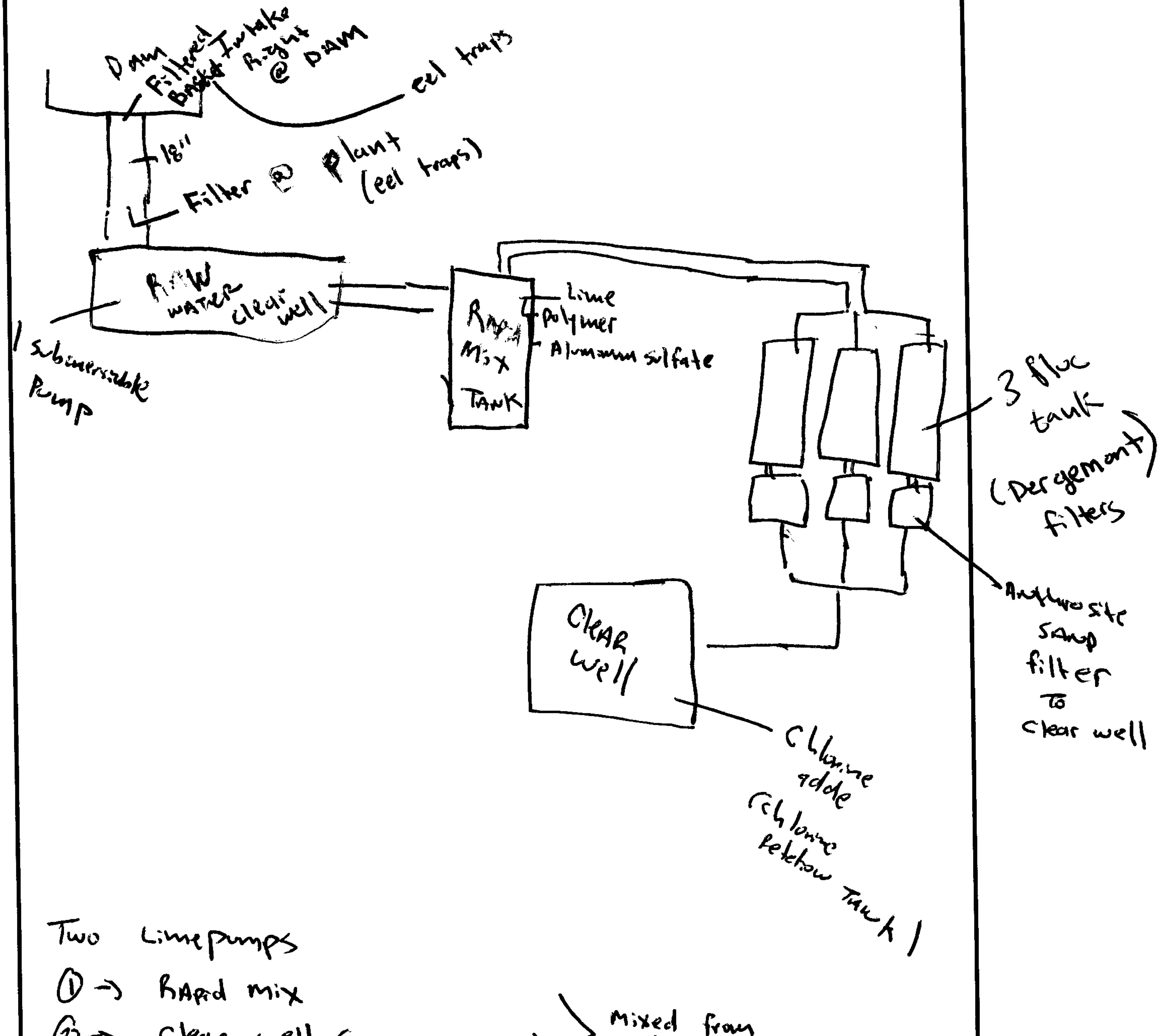
Describe routine maintenance practices for pH adjustment system:
every Friday → Lime pumps slurry cleaned
→ Put screens on section lines

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
→ Lime pumps → slurry
→ sometimes lime feed may stick (have diluted mix)

RAW water pH = 5.26 5.10
Rapid mix = 5.36
clear well = 6.9 - 7.5 (6.94)

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

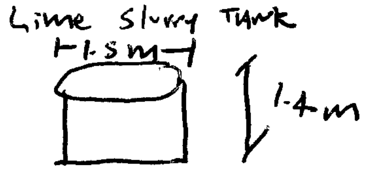


Two Limepumps

① → Rapid mix

② → clear well (corrosion control) } Mixed from silo AND feeder

Cl → Two – Two tonne clyinders



#4

Lime pumps

wAllace & ~~[illegible]~~ TierNAN

↱ Stroke @ 75% → Pre of 500 gPD @ 42% of speed

↳ Strok @ 90% → Post

MAx output = 500 U.S GPD

~~Serial~~ Serres: 44-313

Serial - ~~LRD~~ LDP 8274

wallace & TierNAN

PeNNWALT

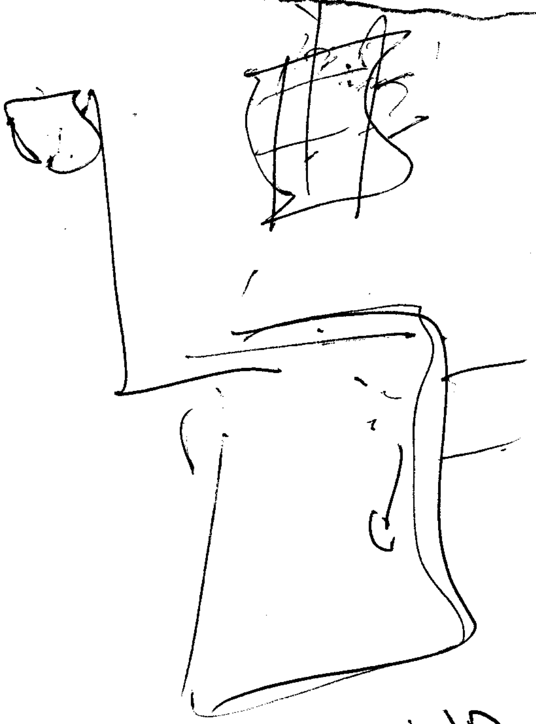
Feeder

wallace & TierNAN

Serial LDF 20387

Type 32055

#5



@ 24 hr/p/D

Max speed

500
42%
1000
2000
210.00 gas
21

210
75 (pre)
1050
1470 gpD
157.5

@ set flow

Same

#6

Lime Delivered Per Year

July 16 /08 — 25 tonne
May 20/09 - 24 tonne

Avarge 24 tonne per/year

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Clarenville (Shoal Harbour)

Source Name: Shoal Harbour River

Source Type: Surface **Water Supply No. :** WS-S-0168

Service Area(s): Clarenville

Service Area No. : SA - 0170 **Service Population:** 1168

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: New system in 2007. Alum sulfate added then lime, then into Flock tanks, then 3-4 layer filters then chlorine, and Soda Ash just before going into clear water chamber then to water tower.

Operational Status: 24 hr/day

Type of Disinfectant: Cl gas 37.5% 2.22 ppm in clear water well

Point of Disinfectant Application: right after filters

Point of pH Adjustment: just before going into clear water

Chemical or Filter Media Used for pH adjustment: lime and Soda Ash

Supplier: Newfoundland Eco tech Inc, Dover

Concentration: 50lb bags

Solid/Liquid: dry powder

Feed Pump Capacity: 46 GPH Set @ 30 stroke 2 pumps just using 1

Filter Capacity: N/A

Solution/Day Tank Volume: 61" high 56" diameter MIXTANK 48" high 42" diameter

Bulk Storage Volume: 56 bags

On-line Monitoring of pH: [✓ Y] N **Grab Sample for pH:** [✓ Y] N

Location of On-Line Analyzer:
5.44 pH from flock tank. 7.48 pH Finished water

Location(s) for Collection of Grab Samples: Homes, Hotel, not on a regular basis

Other Treatment Processes: Alum sulfate, Filters

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment): 7.02 pH sample sink

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 7.13 pH fully treated. sample tap.

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: Soda Ash 10.75 mg/L normally 7-8 mg/L
Lime 8.5 mg/L

Current and/or typical average daily flow: 1.1 - 1.4 million gal/day
1030 gal/min

Frequency of delivery of pH adjustment chemical: 725 bags last year
5 bags every 24-36 hrs 50 bags every 2-3 weeks. (30 metric tonnes of lime/per year

Frequency of media replacement for pH adjustment system: N/A

Target or Setpoint for pH in treated water: 7.8 pH

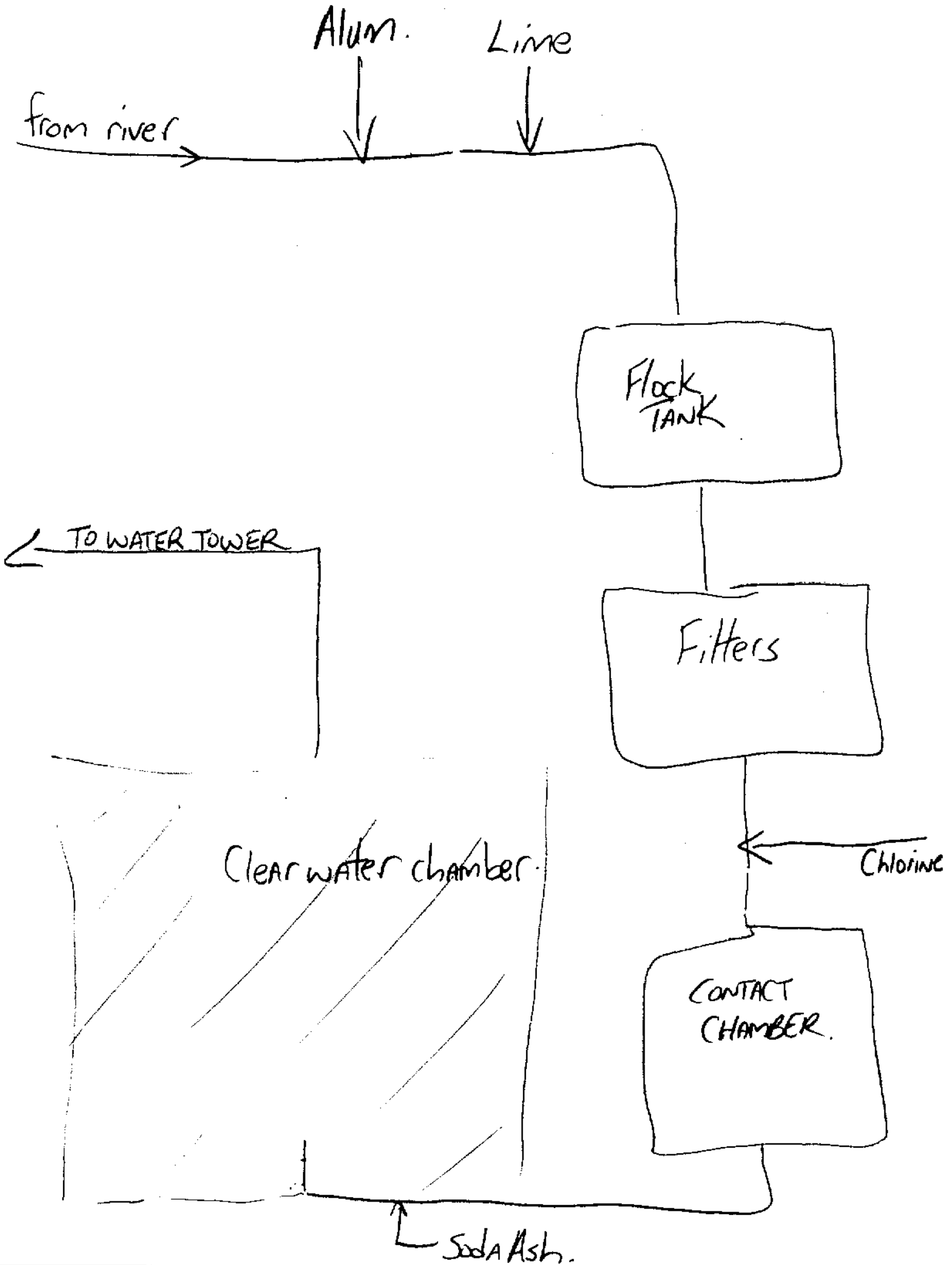
Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
flow paced. , some adjustments made on computer.

Describe routine maintenance practices for pH adjustment system:
Cleaning of Soda Ash strainer, lime tanks (buildup)
Changing soda ash quill.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
- Complaints of color issues during flushing program.
- Some corrosion issues. 35-40 yr old cast iron.
- No major operational issues

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name:	Come by Chance .		
Source Name:	Butcher's Brook		
Source Type:	surface	Water Supply No. :	WS-S-0184
Service Area(s):	Come by Chance		
Service Area No. :	SA-0186	Service Population:	265

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity feed to wet well. 2 submersible pumps. Soda Ash not being since last year because pH was good. and corrosion control wasn't the best. Chlorine solution then out to system 4" line in working Pumphouse. Main is 8" Iron. to water tower or town

Operational Status: 24hr/day . 7000 gal in wet well

Type of Disinfectant: [illegible] . injected in wet well . MIOX .

Point of Disinfectant Application: bottom of wet well .

Point of pH Adjustment: Not in use. (pipe taken out)

Chemical or Filter Media Used for pH adjustment: Soda Ash .

Supplier:	N/A
Concentration:	N/A
Solid/Liquid:	Dry Powder
Feed Pump Capacity:	9.54 L/H GAMMA/5 ProMinent fluid controls
Filter Capacity:	N/A . set@ 60
Solution/Day Tank Volume:	50 US GAL
Bulk Storage Volume:	N/A .

On-line Monitoring of pH: Y [✓ N]

Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer:

Location(s) for Collection of Grab Samples: Sample valve before main leaves building

Other Treatment Processes: MIOX. Treatment system. for disinfection
- 2 water softeners .
- 3 particulate filters

Site Visit Template - Page 2

On-Site pH Measurement Results

come by chance

Raw Water pH (before any treatment): 7.05 pH. Reservoir behind pumphouse.
Before pH adjustment:
After pH adjustment:
Before Disinfection:
After Disinfection: 7.11 pH just before - leaves pumphouse.

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: N/A.

Current and/or typical average daily flow: 25,000 US Gal/Day.

Frequency of delivery of pH adjustment chemical:

Frequency of media replacement for pH adjustment system:

Target or Setpoint for pH in treated water: 6.5-7.5

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

N/A.

Describe routine maintenance practices for pH adjustment system:

N/A -

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

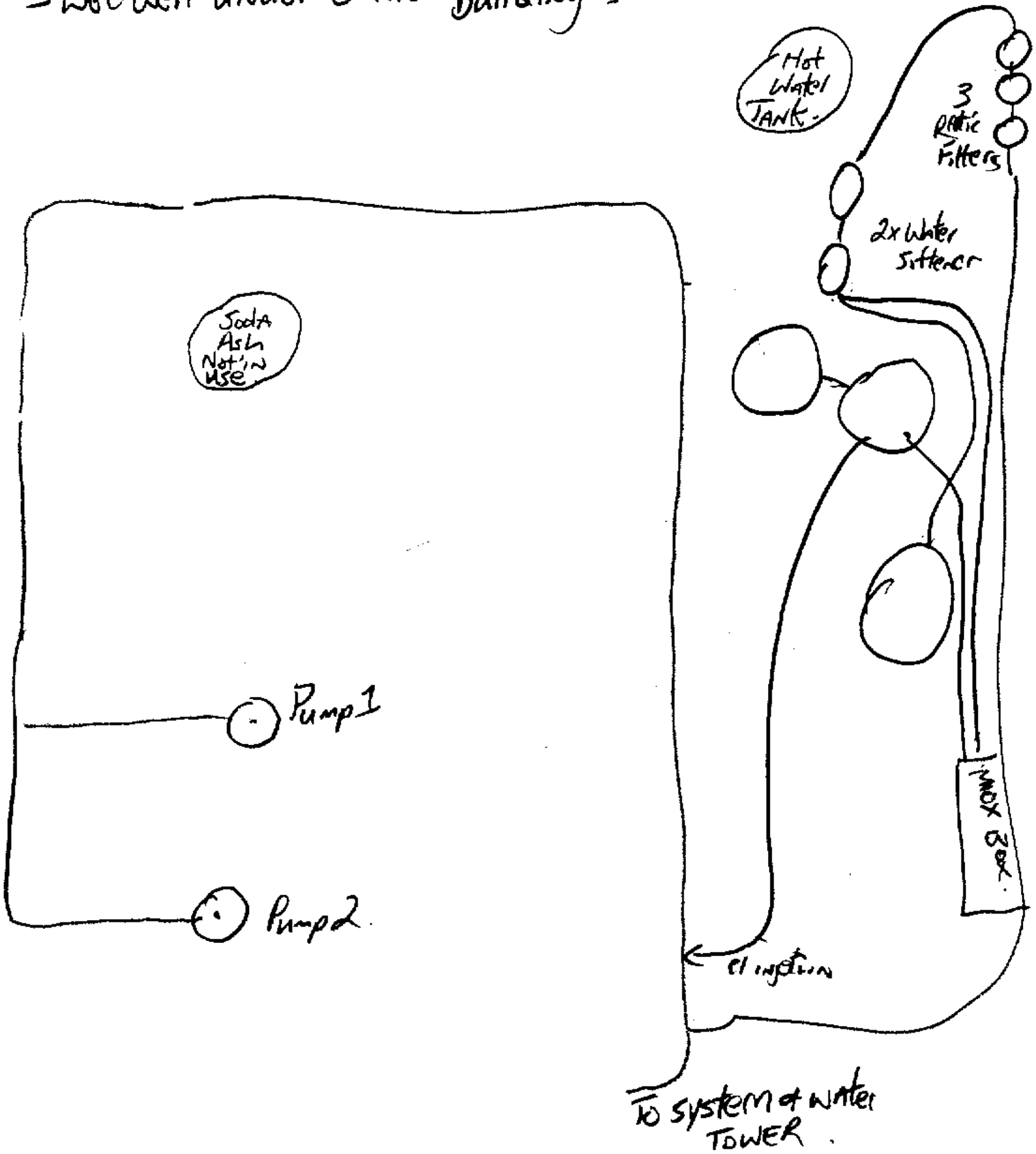
- NO leaks. PVC MAIN, some copper + plastic. service lines
- stained clothes usally in Aug, Sept.
- Ocassional boil order if systems down., Flushing lines.
-

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Come by Chance.

- wet well under entire building -



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Eastport

Source Name:

Source Type: Well

Water Supply No. :

Service Area(s):

Service Area No. :

Service Population:

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Water from well goes through two particulate filters, gets Soda Ash - gets pumped to town or water tower. Cl liquid solution added just before it leaves the pumphouse.

Operational Status: 24 hr/day.

Type of Disinfectant: liquid Cl

Point of Disinfectant Application: Just before it leaves the building

Point of pH Adjustment: Just as it comes into the building after the two particulate filters

Chemical or Filter Media Used for pH adjustment: Soda Ash. Brenntag.

Supplier: East Chem.

Concentration: 25Kg bags

Solid/Liquid: dry powder

Feed Pump Capacity: MAX 5 GPH Premia 75 Model P75MP19XAVHC3BXE

~~Filter Capacity~~: 4-20 ratio 78% Flow= 14.4 GPD set at 32 on gauge

Solution/Day Tank Volume: Mix TANK 53" dia x 72" high Solution tank 36" dia x 48" high.

Bulk Storage Volume: 9 bag.

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer: In between Soda Ash and Cl.
6.94 pH

Location(s) for Collection of Grab Samples:

Other Treatment Processes:

Site Visit Template - Page 2

On-Site pH Measurement Results

Eastport

Raw Water pH (before any treatment): 7.24 pH from spring runoff outside.

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 7.02 pH treated water from hose

Describe sample locations, if needed:

~ 8M seperation from Soda Ash + Cl injection

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 10.77 GPD

200 L water and 5L Javex 12 Clorox Cl pump shut down with main pump -

Current and/or typical average daily flow: 85-90 gpm in summer

40-45 gpm in winter

Frequency of delivery of pH adjustment chemical:

20-25 bags 2-3 times year

Frequency of media replacement for pH adjustment system: N/A

Target or Setpoint for pH in treated water: 6.67 - 8.10 pH

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

~~Flow paced~~, based-on pH readings on Analyzer flucuates from 6.67 to 8.10 pH constantly.

Describe routine maintenance practices for pH adjustment system:

No maintenance, system running good.

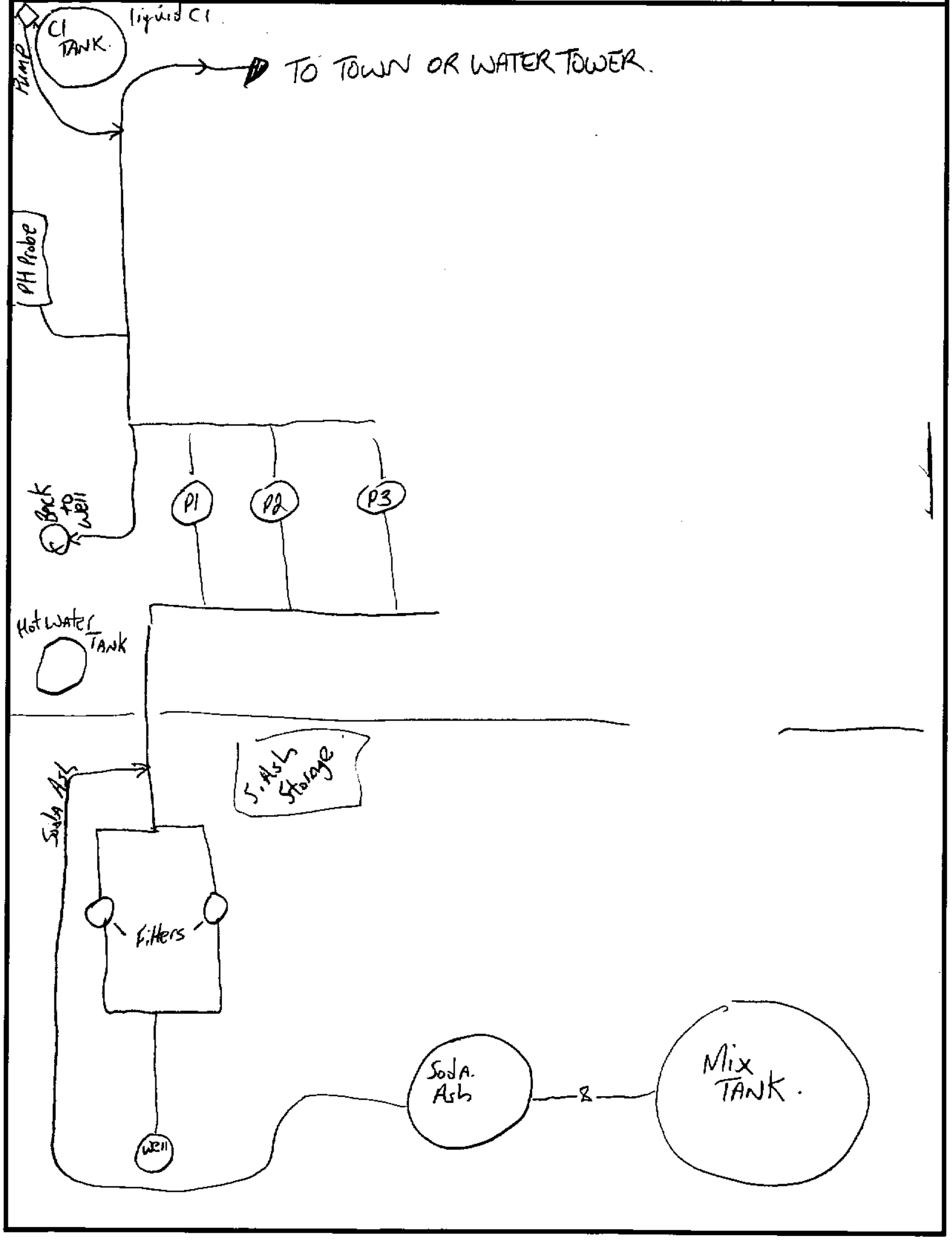
Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

Used to be 20-30 leaks per year on copper lines, since new system installed alot less.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Eastport.



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Fogo

Source Name: Freeman's Pond

Source Type: Surface | Water Supply No. : WS-S-0248

Service Area(s): Fogo

Service Area No. : SA - 0254 | Service Population: 803

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Boil order since last fall
- 17 Oct 09 Chlorine went down.
- pH system put in ~8-9yrs ago. not working now

Gravity feed system.

Operational Status: NO Treatment.

Type of Disinfectant: Used to be Cl gas.

Point of Disinfectant Application: N/A

Point of pH Adjustment: N/A.

Chemical or Filter Media Used for pH adjustment: WAS Soda, Ash.

Supplier: Eco Tech. in Dover.

Concentration: 25Kg. bag.

Solid/Liquid: Dry Powder.

Feed Pump Capacity: LMI 4.5 GPH.

Filter Capacity: N/A.

Solution/Day Tank Volume: 80 gallons.

Bulk Storage Volume: 4 bags

On-line Monitoring of pH: Y [✓ N] | Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer: N/A.

Location(s) for Collection of Grab Samples: N/A.

Other Treatment Processes: Steel mesh screens

Site Visit Template - Page 2

On-Site pH Measurement Results

Fogo

Raw Water pH (before any treatment): 5.84 pH in Pond near Treatment Plant.

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection:

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: NONE

Current and/or typical average daily flow: Don't know flow meter not working.

Frequency of delivery of pH adjustment chemical: N/A

Frequency of media replacement for pH adjustment system: N/A.

Target or Setpoint for pH in treated water: ~7yrs.

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

Was flow paced.

Describe routine maintenance practices for pH adjustment system:

general cleaning.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

~50-70% of copper system showing leaks.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Fogo

NO SYSTEM
IN OPERATION

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Gander

Source Name: Gander lake.

Source Type: Surface **Water Supply No. :** WS-S-0268

Service Area(s): Gander

Service Area No. : SA-0274 **Service Population:** 9651

TREATMENT SYSTEM INFORMATION 4

General Description of Treatment Process: Pump up. from lake. TK1. sand filter. TK2 ozone contact. TK3 Sand & anthracite. TK4 carbon. then Cl gas. then Soda. Ash.

were using Hydrofluosilicic Acid. but stopped ~82 g/Nm3. O3.

Operational Status: 20-21 hr/day. once reservoir is full

Type of Disinfectant: Cl gas. 907Kg. tanks.

Point of Disinfectant Application: After last filter. ~75lb/day.

~15' inbetween Cl + S.A.

Point of pH Adjustment: ~15' DS of Cl gas injection

Auger set 65%. 4gal/min.

Chemical or Filter Media Used for pH adjustment: Soda Ash

Supplier: East Chem.

Concentration: 1000 Kg bags

Solid/Liquid: Dry powder.

Feed Pump Capacity: Encore 700 US Filter 180 GPH set@ 96.

Filter Capacity: N/A.

Solution/Day Tank Volume: 24 x 25 x 18" high

Bulk Storage Volume: 4 bags.

On-line Monitoring of pH: [✓ Y] N **Grab Sample for pH:** [✓ Y] N

Location of On-Line Analyzer: Treated water 7.23. just before it leaves building
Another one in reservoir
some grabs around town. 4-5 locations.

Location(s) for Collection of Grab Samples: Res, Plant, Hospital, Needs, college.

Other Treatment Processes: Filters. + Ozone

Site Visit Template - Page 2

On-Site pH Measurement Results

Gander

Raw Water pH (before any treatment): 6.850 pH from raw tap. (Backwash in process)

Before pH adjustment: a S.A

After pH adjustment:

Before Disinfection: 5.79 after filters + O^3.

After Disinfection: 6.98 just before leaves plant.

Describe sample locations, if needed: 6.85 from reservoir.

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 4 gal/min

Current and/or typical average daily flow: 285 m3/hr 69 psi

Frequency of delivery of pH adjustment chemical: 12 bags
7-9 days./bag.

Frequency of media replacement for pH adjustment system:

Target or Setpoint for pH in treated water: 7 pH.

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

Flow paced.

Describe routine maintenance practices for pH adjustment system:

- cleaning auger for S. Ash. calibrating meter.

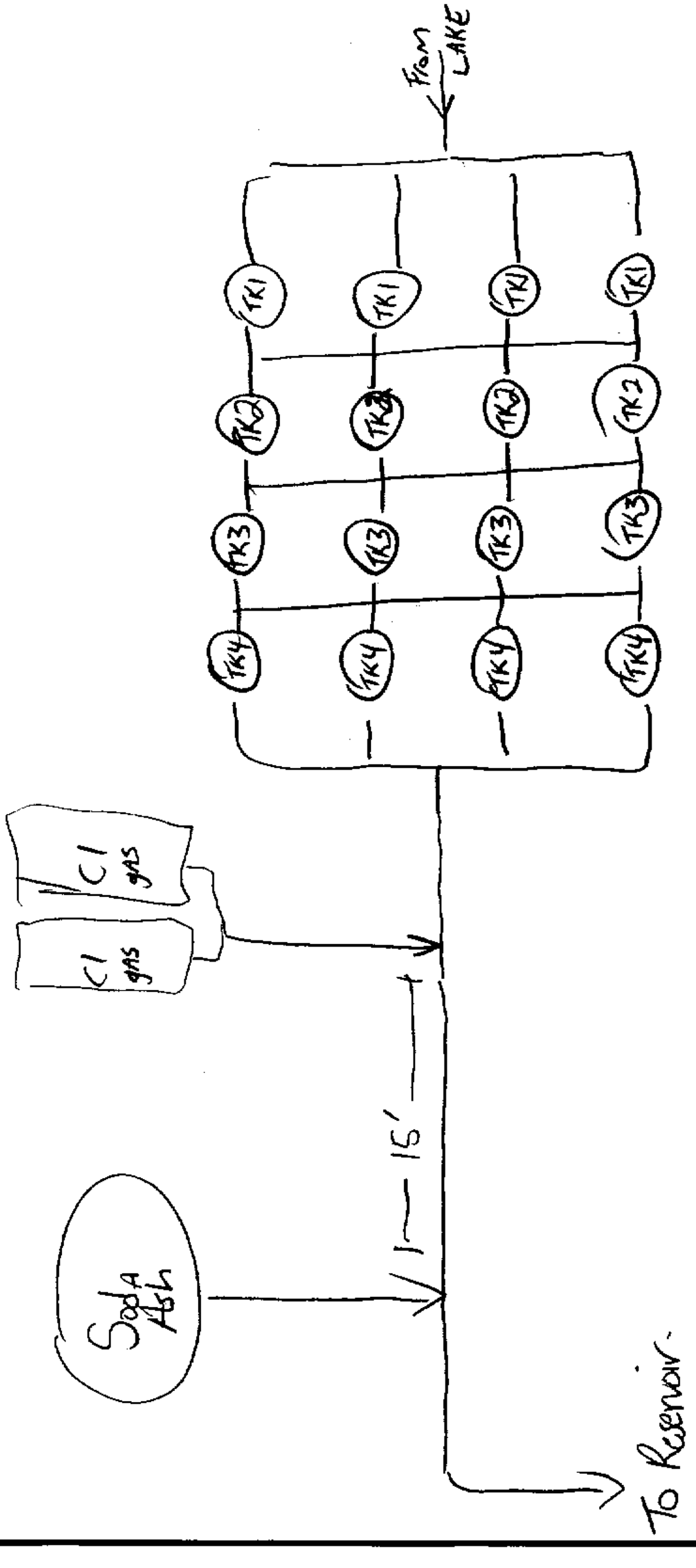
Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

just regular maintence.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Gander



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name:	Glover town.		
Source Name:	Northwest Pond		
Source Type:	Surface	Water Supply No. :	WS-S-0283
Service Area(s):	Glovertown		
Service Area No. :	SA-0290	Service Population:	2163

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity feed to most of town 1 pumphouse. to reach. far end of town (uphill). Soda Ash. then Cl gas. treatment.

Operational Status: 24 hr/day

Type of Disinfectant: Cl gas ~25lb/day

Point of Disinfectant Application: Just before it leaves the pumphouse

Point of pH Adjustment: ~5' US of the Cl injection

Chemical or Filter Media Used for pH adjustment: Soda Ash (Heavy) Anhydrous sise ram

Supplier: NL Ecotech Inc

Concentration: 25Kg bags.

Solid/Liquid: dry powder

Feed Pump Capacity: 18.9 LPH -set @ 90.1 GPD (flucuating)

Filter ~~Capacity~~: Sig/Rate 15.9/73

Solution/Day Tank Volume: 30" dia x 53" high

Bulk Storage Volume: ~50 bags.

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer: In line near sink fully treated water 6.18 pH

Location(s) for Collection of Grab Samples:

Other Treatment Processes: Steel mesh screens

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment): 6.89 pH @ pond.

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 6.75 pH @ sink fully treated.

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 1800L /per 2 bags.
18.9 LPH - set at 90.1 GPD (flucuating) Sig/rate 15.9 /73

Current and/or typical average daily flow: 880 gal/min with the fish plant operating
AVG ~600 gal/min.

Frequency of delivery of pH adjustment chemical:
50 bags every 10 weeks. on average. Using ~5 bag per week

Frequency of media replacement for pH adjustment system: N/A -

Target or Setpoint for pH in treated water: 7 pH

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

Flow paced

Describe routine maintenance practices for pH adjustment system:

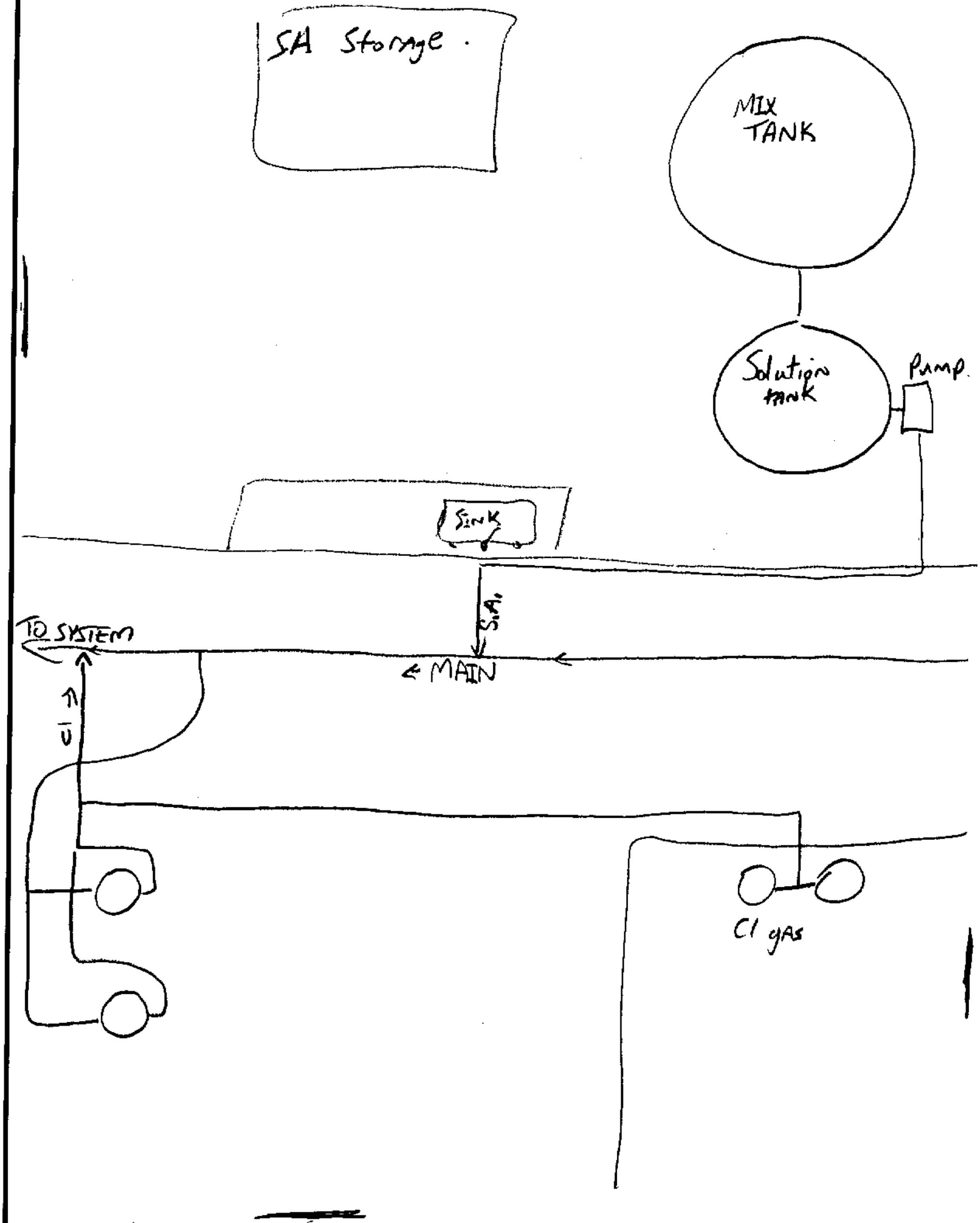
NO maintenance

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

~50-75 leak on copper line service lines at flarings
12" main 2 breaks. (settling) this year.
- NO operational issues with system.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Grand Falls

Source Name: Northern Arm Lake

Source Type: Surface | **Water Supply No. :** WS-S-0291

Service Area(s): Wooddale, Grand Fall Winsor, Botwood, Bishop falls, + Peterview

Service Area No. : SA-0298 | **Service Population:** 13,340

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity feed screen spray if need, then lime stone, flock tanks. settle. tanks, 4 layer filters. lime, then chlorine. then to water towers.

3 water towers. 24" main 4 filters..

Operational Status: 24hr/day.

~14 yrs old

Type of Disinfectant: Cl gas - 1.61 mg/L

Point of Disinfectant Application: Just before its leaves building in basement

Point of pH Adjustment: Hydrated Lime - 11.35mg/L. 191L/sec.

- 17.5mg/L Alum.

→* After filters

- 9-11 mg/L Lime stone (10.65mg/L) 191L/sec. ,45% 21.60 ML/day after Auto screen.

Chemical or Filter Media Used for pH adjustment: Lime stone. + Hydrated lime.

Supplier: ?

Concentration: Transport truck (lime).

Solid/Liquid: dry powder.

Feed Pump Capacity: ?

Filter Capacity:

Solution/Day Tank Volume: 3x3x2' high

Bulk Storage Volume: 13 x 40bags.

On-line Monitoring of pH: [✓ Y] N | **Grab Sample for pH:** [✓ Y] N

Location of On-Line Analyzer: Pre treat with limestone 6.77pH

Finished with hydrated lime 7.59

Location(s) for Collection of Grab Samples: Check pretreat + Finish daily. grab samples all over plant once a week.

Other Treatment Processes: Alum flock. + 4 layer filters.

*polymer if needed

Site Visit Template - Page 2

On-Site pH Measurement Results

Grand Falls.

Raw Water pH (before any treatment): 6.58 from tap

pretreat ~~Before~~ pH adjustment: 6.41 from tap. 6.81 on inline meter

After pH adjustment:

Before Disinfection:

After Disinfection: 7.53 from tap. 7.66 on inline meter

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: Hydrated lime 11.35 mg/L
Limestone 10.65 mg/L

Current and/or typical average daily flow: AVG ~ 200 Litres/sec

Frequency of delivery of pH adjustment chemical: ~ once a month for limestone
?

Frequency of media replacement for pH adjustment system: N/A -

Target or Setpoint for pH in treated water: 6.2 - 6.4 for pretreat.
7-7.5 for finished

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

Flow paced - All adjustments made from PLC (computer).

Describe routine maintenance practices for pH adjustment system:

NO. yearly full maintenance on pumps, feeder

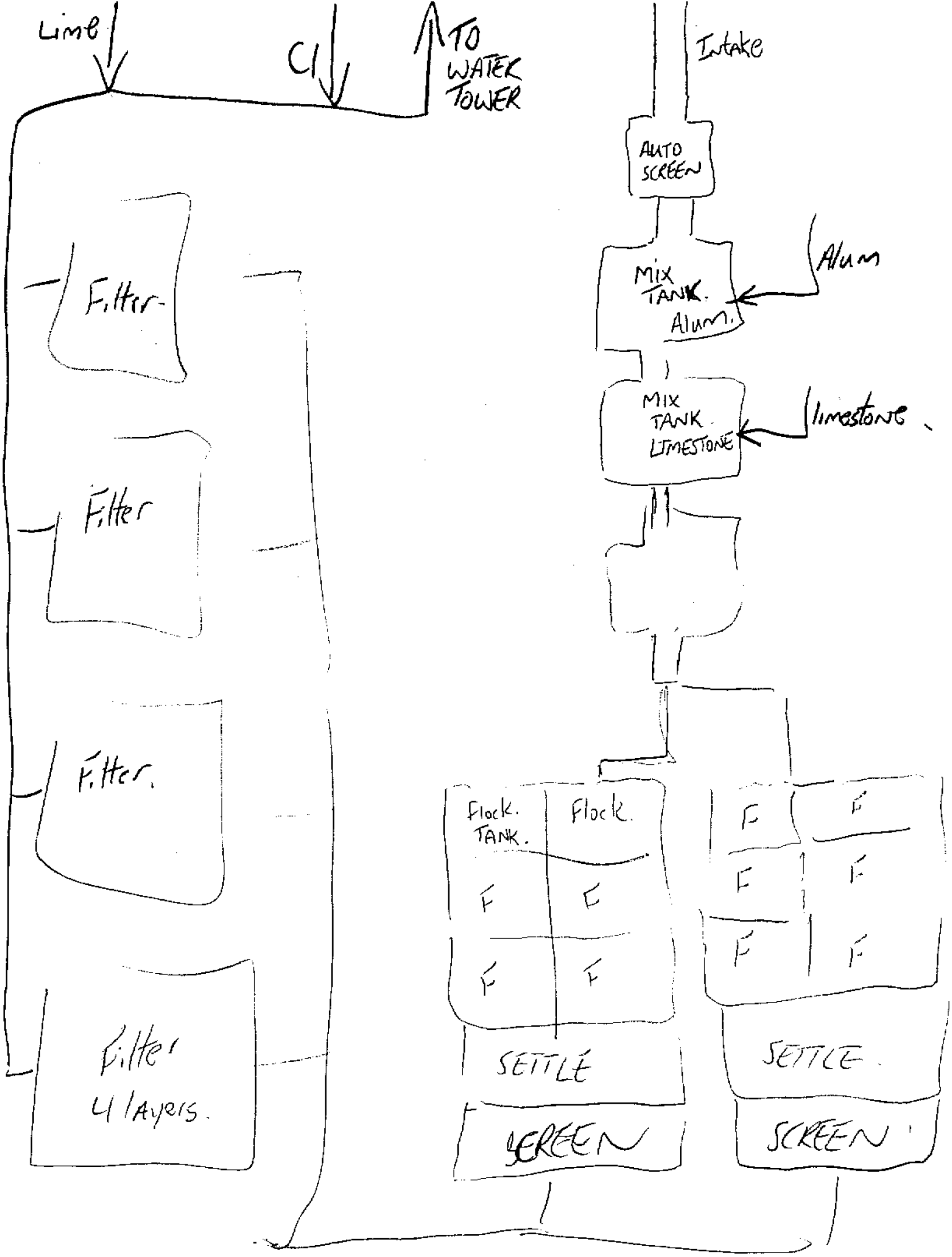
Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

No major issues. (new operator. 3 mnths)

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Grand Falls



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Happy Valley Goose Bay

Source Name:

Source Type: Drilled wells | Water Supply No. :

Service Area(s): Happy Valley

Service Area No. : | Service Population: 4000-4500 People

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process:

5 drilled wells → 136' to 164' 14" Diameter

Alum, Chlorine

Multimedia And Green SAnd

wells to plant → Ductile iron

plant Sandhill → 24" (HDPE)

Keith Pye

896 - 1470 (cell)

Operational Status: operational

Type of Disinfectant: Chlorine gas → works on flow Pace

Point of Disinfectant Application:

As Raw water enters Plant

Point of pH Adjustment:

Before clear well

Chemical or Filter Media Used for pH adjustment: Lime

Supplier: EAST Chem

Concentration:

Solid/Liquid: Powder

Feed Pump Capacity: 4-28 lpm (Running @ 12 lpm) → measured

Filter Capacity:

Solution/Day Tank Volume: 24" x 24" x 16"

Bulk Storage Volume:

On-line Monitoring of pH: [✓ Y] 6.7 N | Grab Sample for pH: Y N

Location of On-Line Analyzer:

Located in Lab (6.7

Location(s) for Collection of Grab Samples:

~~Raw~~ wells 3, 4 & 5 combined (Raw)
well #2
well #1

After filtration from Two filters #1 + 2

Other Treatment Processes:

→ Floride treatment

Cl_2 → 96 lbs a day

14 tonne of Cl_2 @ Year

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment):
Before pH adjustment:
After pH adjustment:
Before Disinfection:
After Disinfection:

Describe sample locations, if needed:

Raw #3 (3,4,5) → 6.44
Raw #2 → 6.47
Raw #1 → 6.51
@ Sink in Lab

Currently
195 m³/h

After filtration — 6.11
After filtration — 6.14
AT TAP = 6.16

* Analyzer 6.72
operator pH meter = 8.23

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage:
3200 m3 per 2 bags

Current and/or typical average daily flow:
2600 m³ / Aug. 2800 m³

Avg?
[illegible]
26 m³

Frequency of delivery of pH adjustment chemical:
2 bag per 24 hours Raw 3200 m³,

3,200,000 l
per 2 bags

Frequency of media replacement for pH adjustment system:
1 time per week

Target or Setpoint for pH in treated water:
7.3

Describe available control modes for pH adjustment system ([✓ manual], flow paced) and how adjustments are made to pH adjustment chemical dosage:

Based on hand held meter
Low - speed up pump
→ Never to high

set up but factor is not ~~so~~

the dosage high enough (10 mg/l)
@ Aprox 15 mg/l

Describe routine maintenance practices for pH adjustment system:

- 6 wks — Clean tank, float Replaced Twice a year
- cleaning @ injection point
- cleaning @ Lime discharge in slurry tank

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

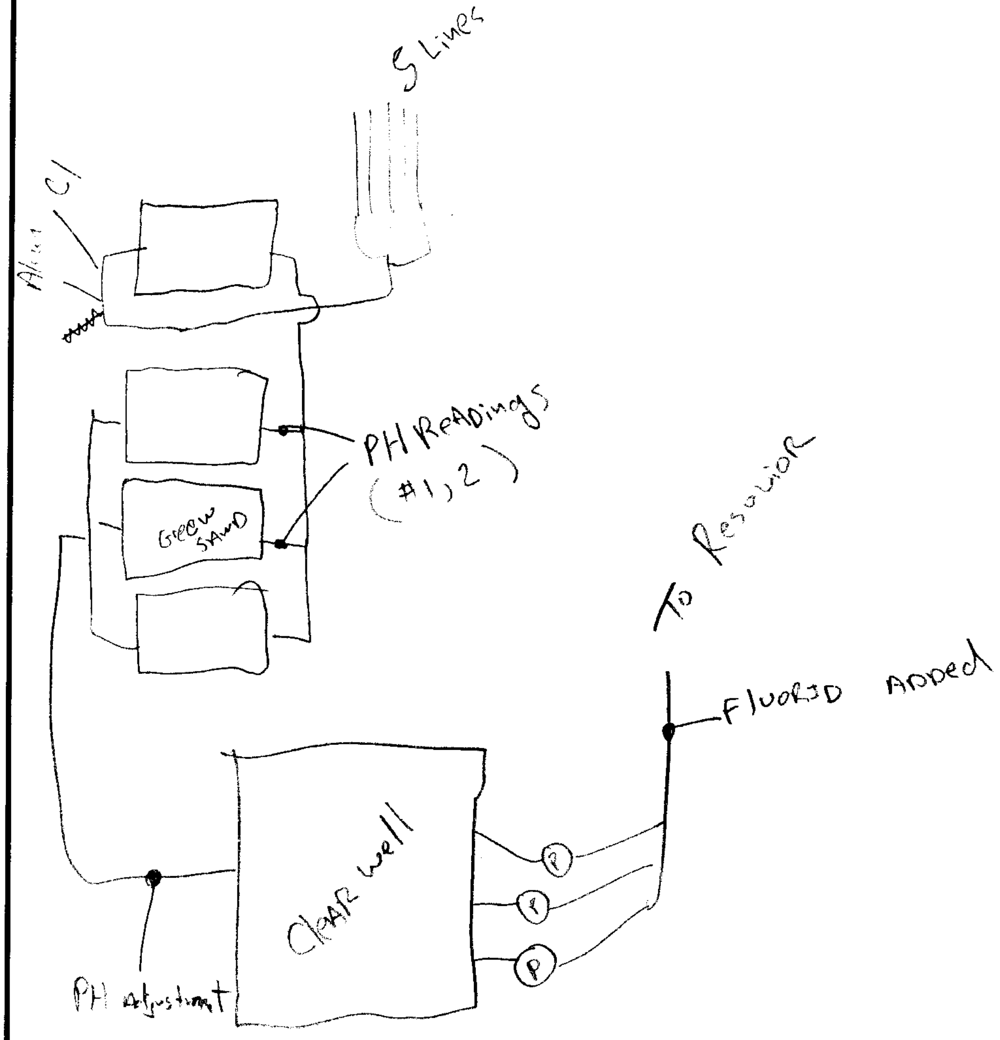
→ Can't get ~~up to 8~~ it consistant

2 bags a day (50lb bag) / 24 hr

@ time of visit → feeder not working @ time of visit
motor gone

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



3 High lift pumps

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Hare Bay.

Source Name: Hare Bay Pond

Source Type: Surface

Water Supply No. : WS-S-0338

Service Area(s): Hare Bay + Dover

Service Area No. : SA-0345

Service Population: 1065 +730?

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity Feed New ~ 3yrs ago.
~110psi 10-8-6" main plastic.
Intake. ~10' out. ~12-14' deep.

Operational Status: 24hr/day.

Type of Disinfectant: Cl gas. ~20lbs/day.

Point of Disinfectant Application: [illegible] before it leaves building.
14'

Point of pH Adjustment: 6' before it leaves. building.

~1 bag/day.

Chemical or Filter Media Used for pH adjustment: Soda Ash.

Supplier: Wayne Parson's.

Concentration: 25kg/bags.

Solid/Liquid: Dry Powder.

Feed Pump Capacity: 15.9 gph. Grundfos. Pump. DME 60-10 AR PP/E/K-F-21 A3A5B.

Filter Capacity: N/A

Solution/Day Tank Volume: 2× 120gal. tanks. ~3'dia - 48"high. 1bag per 2' water.

Bulk Storage Volume: 5 bags. Usall

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer: 6.8pH.
Just before main leaves building

Location(s) for Collection of Grab Samples:

Other Treatment Processes: Onival Filters. chang media 1/yr.

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment): 6.03 from pond surface.

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 6.76. @ sink

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage:

Current and/or typical average daily flow: 450 - 500 with Plant, GPM.
220 - 280 · without Plant

Frequency of delivery of pH adjustment chemical:

Frequency of media replacement for pH adjustment system: 25 bays / month

Target or Setpoint for pH in treated water:

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

flow paced. pumping 20.3 l/hr

Describe routine maintenance practices for pH adjustment system:

NO.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

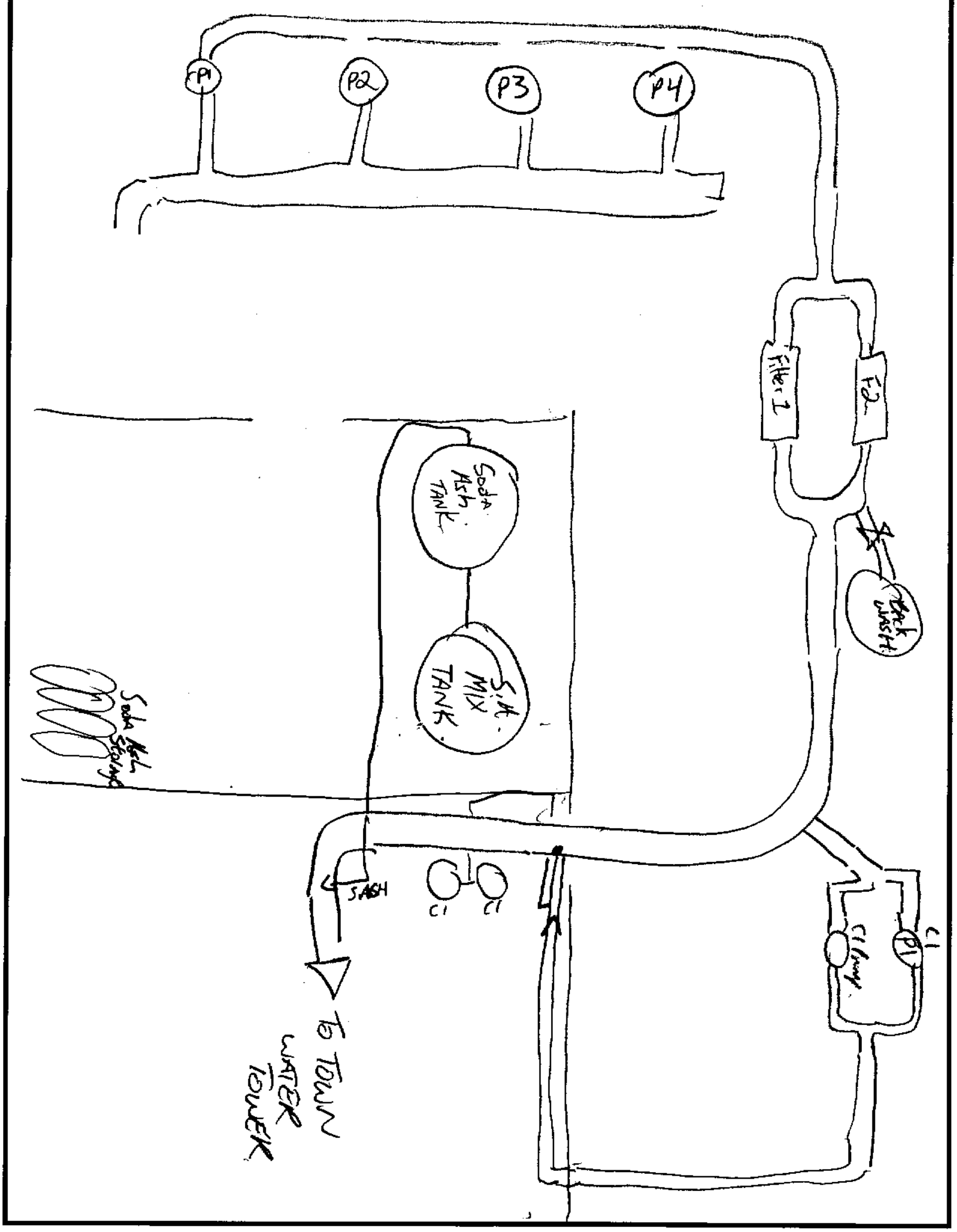
~100 leaks /years. on copper service lines, flares, now 3-4 this year.

-color complaints in spring

-laundry complaints. without Soda. Ash.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Hermitage-Sandyville

Source Name:

Source Type: Surface water

Water Supply No. :

Service Area(s):

Service Area No. :

Service Population: 500 People

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: → Cl & Soda ash

→ Phil Harris → Pond 800 kms from cl shed

Dam broke 93/94 Roy Anderson (883-7743) → outlet 20'

→ 10" Into Building

Operational Status: 24/7 operating

Type of Disinfectant: GAS (Chlorine gas)

Point of Disinfectant Application: GAS ADDed to TANK / Clear well

Point of pH Adjustment: ~~Gas~~ Soda Ash added to TANK / clear well

Chemical or Filter Media Used for pH adjustment: Soda Ash

Supplier:

Concentration:

Solid/Liquid: Powder 25 kg bags

Feed Pump Capacity:

Filter Capacity:

Solution/Day Tank Volume:

Bulk Storage Volume:

On-line Monitoring of pH: [✓ Y] 6.38 N

Grab Sample for pH: Y N

Location of On-Line Analyzer: Two flow meters 6" and 3" Line
meter on 6" line working
" " 3" line not working

Location(s) for Collection of Grab Samples: 2 Grab samps

Other Treatment Processes:

192 GPD

Plastic Drum 70 x 1.10m

45 l per Drum add

Pump is set @
Stroke length @ 40% @
25-30% speed / frequence

Site Visit Template - Page 2

Hermitage

On-Site pH Measurement Results

②Raw Water pH (before any treatment):	5.6
Before pH adjustment:	
After pH adjustment:	
Before Disinfection:	
① After Disinfection:	6.38

Describe sample locations, if needed:

① sink @ town Hall

② @ valve @ Inlet

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: ? 2 meters → 1 not working

Current and/or typical average daily flow:

Frequency of delivery of pH adjustment chemical:
~~12 Bags~~ 12 BAGS every 3 weeks

Frequency of media replacement for pH adjustment system:
PH Check @ shed after (sensor After

Target or Setpoint for pH in treated water:
N/A

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
Manual

Describe routine maintenance practices for pH adjustment system:
Clean Diaphram (6 month) and Barrell (3 months)

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
→ Biggest concern → nothing marked → no plans of system

Frequency of sampling everyday @ sink @ Town Hall

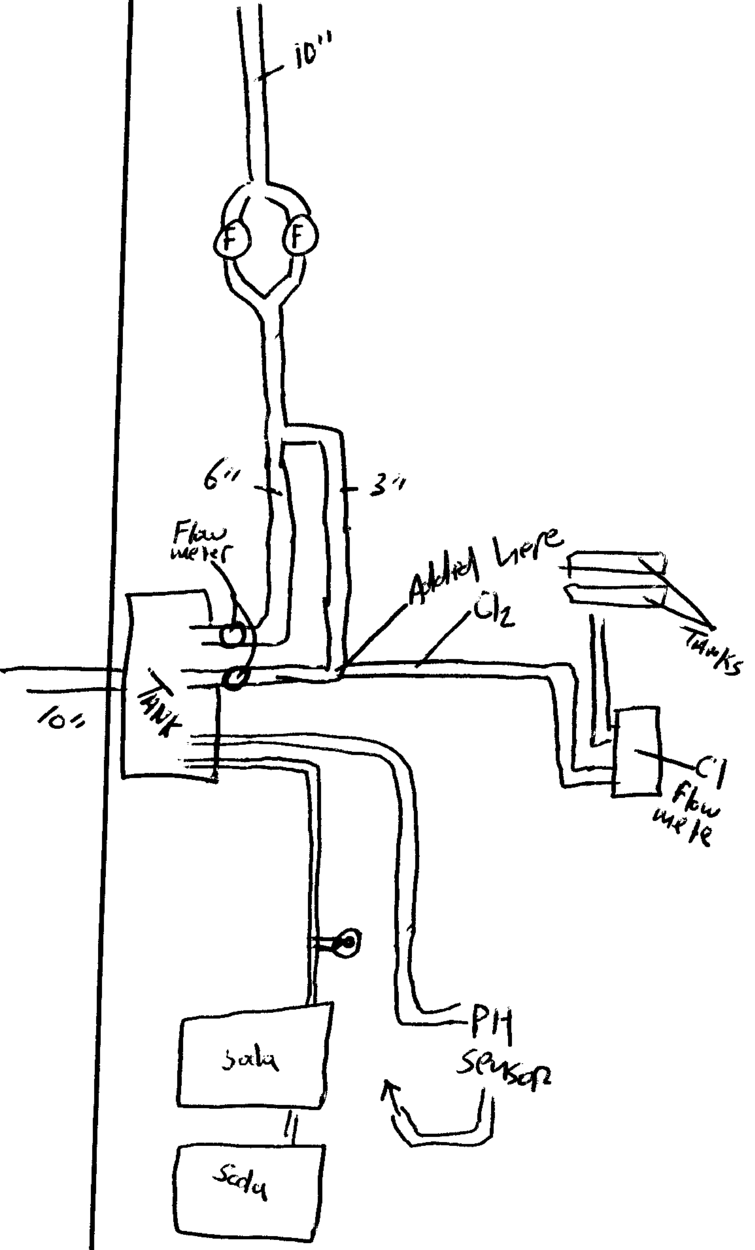
Site Visit Template - Page 3

Hermitage

PROCESS FLOW DIAGRAM

Dany Hynes

Atlantc



Filters HAYWARD model No 52
Serial 21449

Hermitage
Sandyville

11:30 to 2:00

26.5 hrs dropped Approx. 20 cm

Cl_2 gas set @ 14 lbs per 24 hrs

winter @ 7-8 lbs per 24 hrs

Ductile Iron in Town

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Isle-Aux-Mort

Source Name: Burnt Pond

Source Type: surface water | Water Supply No. :

Service Area(s):

Service Area No. : | Service Population: 700

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process:

→ CARBON Filter
→ Chlorine gas

Operational Status: operational

Type of Disinfectant: Chlorine gas

Point of Disinfectant Application: @ Chlorine shed after treatment

In winter @ 5 ppb

(17ppb) In summer 150 lb / 2 wks which is triple winter RATE.

Point of pH Adjustment:
Right After CARBON filter

Chemical or Filter Media Used for pH adjustment: Lime

Supplier: EAST Chem

Concentration:

Solid/Liquid: Powder

Feed Pump Capacity: 175 g/p/h Chemtube PPS model # 120304-SA1

Filter Capacity: Serial # P1043937

Solution/Day Tank Volume: 24" x 24" x 18" high

Bulk Storage Volume: 1 bag in hoppler

On-line Monitoring of pH: Y [✓ N] | Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer:
No

Location(s) for Collection of Grab Samples:
See next PAGE

Other Treatment Processes:
→ In winter going through more water but less cl and do not need more lime

→ Lime added MAnually To Hopper → dosage determined by flow → In winter speed of Hopper slowed by 50%
→ water flow almost double

Site Visit Template - Page 2

On-Site pH Measurement Results

①Raw Water pH (before any treatment): 5.3

Before pH adjustment:

After pH adjustment:

Before Disinfection: 6.45

After Disinfection: 4.55

Describe sample locations, if needed:

① @ Raw water in plant 5.30

② @ Chlorination sled before Cl_2 injection = 6.45

③ @ Garage (very Big lines → Slurry may not be there yet)

No where to take pH ~~between~~ pH adjustment and Cl_2

Was shut down for two days
Running for 3 hr when I ARRived

ig
nes
because of
rmer
fish
plant

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage:
Automatic

Current and/or typical average daily flow:
160-180 gpm → In winter up to 300 gpm

Frequency of delivery of pH adjustment chemical:
3 times a YEAR (50 bags 3 times a year)
50 lb Bags

Frequency of media replacement for pH adjustment system:
1 bag every 3 days

Target or Setpoint for pH in treated water:
Target is 6.8 - 7.0 (Preferably 7)

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

→ Manual → pH @ Town Garage

→ sometimes may not get it checked for a couple of days

Describe routine maintenance practices for pH adjustment system:

→ Backwash filters weekly

→ every two months Slurry TANK cleaned

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

→ Injection goes out 6-8 months ($1000.00 to Replace)

→ Lime plugs up

Pump @ 37-38 Hz Flow is 180 gpm (Aprox)

Pump will not Run greater than 60 Hz

Pump Rate determined by Hz (Related to flow)

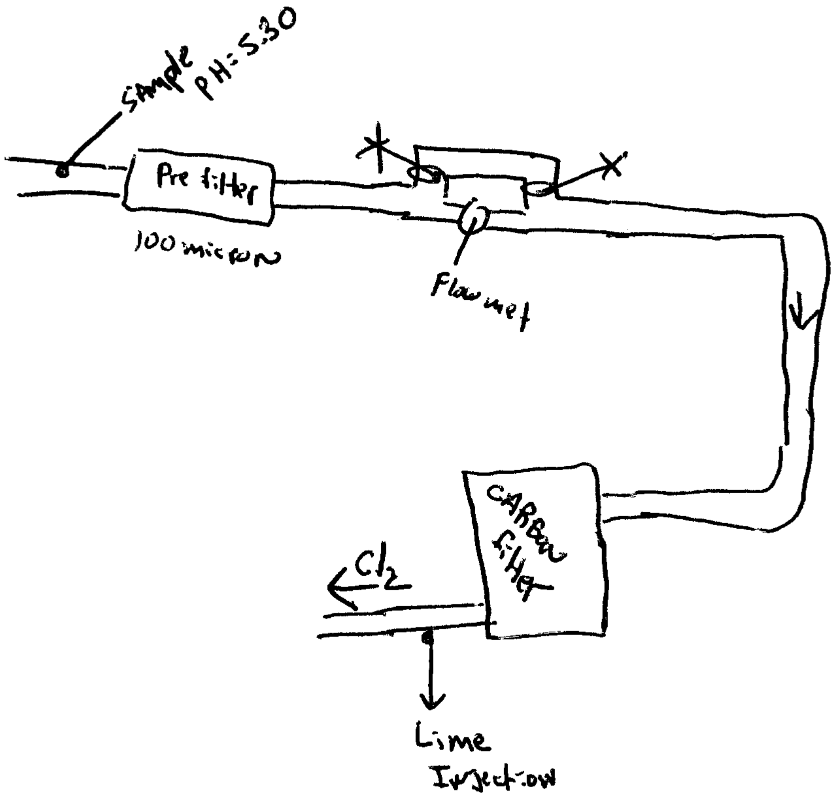
Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

12" @ Intake

6" @ Plant

12" @ chlorination



→ In winter → filters stopped

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Lamaline.

Source Name:

Source Type: Water Supply No. :

Service Area(s):

Service Area No. : Service Population:

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity feed.

System in since 1992. 30psi

Operational Status: 24hr/day

-13.5

Type of Disinfectant: Cl gas 12lbs/day, 60%.

Point of Disinfectant Application: ~4' US of Soda.Ash.

Point of pH Adjustment: Just before it leaves building.

Chemical or Filter Media Used for pH adjustment: Soda Ash. Brenntag.

Supplier: Eastern Chemical.

Concentration: 25Kg bags.

Solid/Liquid: dry powder.

Feed Pump Capacity: 1.75 GPH MAX Premia 75 Model P75MPH7XAVHC1BXX

Filter Capacity:

Solution/Day Tank Volume: 300 Litres.

Bulk Storage Volume: 10 bags

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer: Treated water line off MAIN. reading 6.5pH.

Location(s) for Collection of Grab Samples: N/A.

Other Treatment Processes: Steel mesh screen at pond., ~2-3Km. North. ~200 out in pond. ~2-3 feet deep.

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment): 6.52 @ valve - were main comes in

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 6.5 pH Treated from analyzer line

Describe sample locations, if needed:

Boil Order ON ~2month since electrical storm -

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage:
½ bag - per 250 liters ..

Current and/or typical average daily flow: 135 GPM. with bleed line open.
4-20 Ratio 100% Knob set on 50

Frequency of delivery of pH adjustment chemical: 12 bags. every 2 months -

Frequency of media replacement for pH adjustment system: N/A -

Target or Setpoint for pH in treated water: 7 pH.

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
flow paced. , NO manual adjustment.

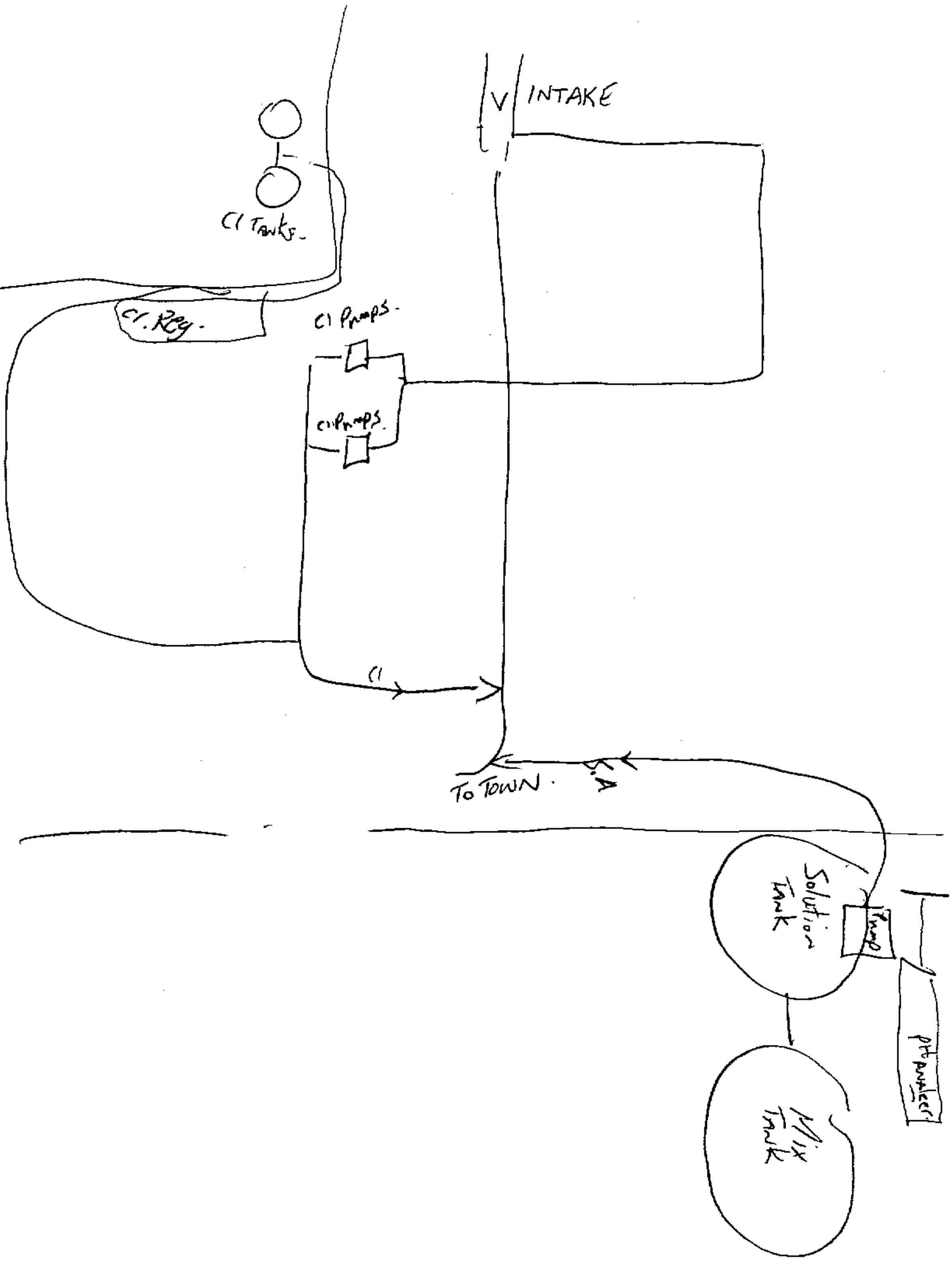
Describe routine maintenance practices for pH adjustment system:
NO maintenance.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
-Some COMPLAINTS about color . in spring.

NO ISSUES WITH CORROSION -

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Lewisporte

Source Name: Stanhope Pond

Source Type: Surface

Water Supply No. : WS-S-0411

Service Area(s): Lewisporte

Service Area No. : SA - 0421

Service Population: 3300

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Water comes into wet wells the 1-3 pumps pump into 2 filters the Cl injection then S.A. then butter solution injected.

Main is ~6" , Intake. 200' out in pond ~30' below -

Operational Status: 24 hr/day

80' head in tower

Type of Disinfectant: Cl gas.

Point of Disinfectant Application: After filters

Point of pH Adjustment: After Cl injection ~4' DS.

Chemical or Filter Media Used for pH adjustment: Soda Ash. Brenntag.

Supplier: East Chem -

Concentration: 25 Kg.

Solid/Liquid: dry powder

Feed Pump Capacity: Pro Minent Fluidcontrols. Gamma/L ? Manally set @ 60%

Filter Capacity: 1.1gph MAX Showing 100 Freq on digital display.

Solution/Day Tank Volume: 100gal. mix + 100gal. solution tank.

Bulk Storage Volume: 4 bags -

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer: ~5' DS of S.A injection 6.8pH

Location(s) for Collection of Grab Samples:

Other Treatment Processes: Buttner solution injected ~4' DS of soda Ash to bring pH up.

Site Visit Template - Page 2

On-Site pH Measurement Results

Lewisporte

Raw Water pH (before any treatment): 6.65pH @ pond.

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 6.22 pH.

Describe sample locations, if needed: Plant since 1992.

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: ~25Kg per 70gal water mix 1.1gph set @ 60%. 100 Frequency on digital display.

Current and/or typical average daily flow: 500,000 gal/day

Frequency of delivery of pH adjustment chemical: 8 bags. every month. - month/hal

Frequency of media replacement for pH adjustment system: N/A.

Target or Setpoint for pH in treated water: 6.8 - 6.9

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

flow paced

Mix ~25Kg per ~70gal. water

Describe routine maintenance practices for pH adjustment system:

NO.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

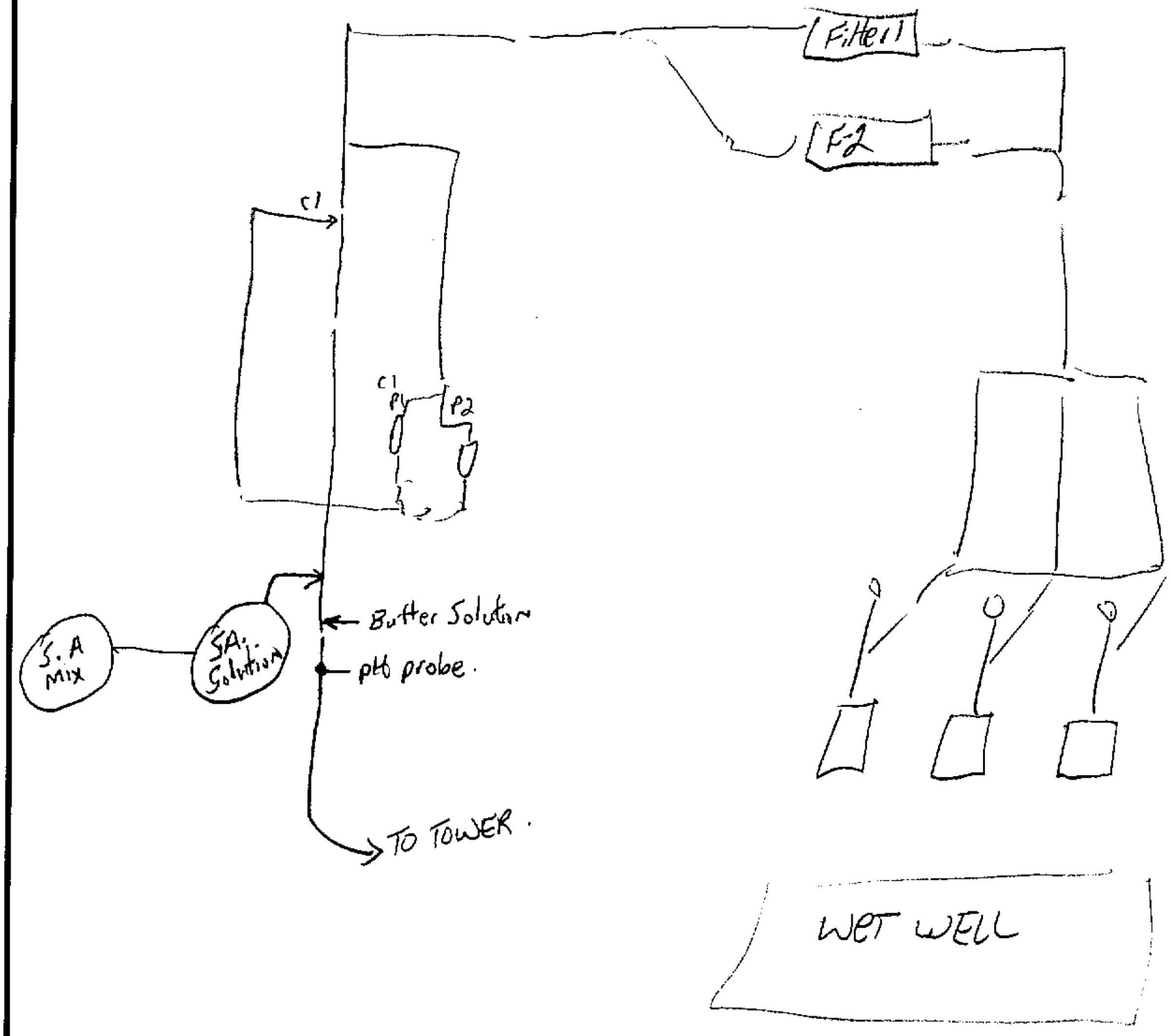
NO ISSUES - NO COMPLAINTS

~12 leaks/y. on copper flares.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Lewisporte



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Long Harbour.

Source Name: Trout Pond. + Shingle Pond 8" Main Line.

Source Type: Surface **Water Supply No. :** WS-S-0427

Service Area(s): Long Harbour - Mount Arlington Heights

Service Area No. : SA-0439 **Service Population:** 238

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Cl gas + Soda Ash + 3 media (sand) filters.
- pond ~2km away (gravity feed).
intake depth ~6' in troutpond + 8-10' in shingle pond
70-80' out. ~100' out new system in 97
steel screen in wet wells @ pond.

Operational Status: 24 hr/day 3 screens in a well x2 wells

Type of Disinfectant: Chlorine Gas. 150lb cylinder.

Point of Disinfectant Application: injected ~10' DS of where main comes in
2 x 75hp pumps. (Baldor) switch pumps every 2nd Day. Small filter on Cl raw water feed

Point of pH Adjustment: ~1' DS of Cl injection.

Chemical or Filter Media Used for pH adjustment: Soda Ash. BRENTAG. 25Kg.

Supplier: Eastern Chemical.

Concentration: 25Kg bags.

Solid/Liquid: Dry. Powder.

Feed Pump Capacity: 4 GPH. Pressure control @ 40 Stroke @ 40

Filter Capacity:

Solution/Day Tank Volume: 45 gal

Bulk Storage Volume: 6 bags

On-line Monitoring of pH: Y [✓ N] **Grab Sample for pH:** [✓ Y] N

Location of On-Line Analyzer: N/A.

Location(s) for Collection of Grab Samples: 1 @ pump house. and 1 @ end of system daily. pH color meter

Other Treatment Processes: 2 x 2000 gal. Cl contact tanks.
3 x ___ gal sand filters.
6' high. ~3' wide.

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment): 6.42 pH before Cl feed pumps.

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: Treated 6.15 pH. Sink in Plant.

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 500ml Soda Ash per 5 gallons water

Current and/or typical average daily flow: 60-70 gal/min.

Frequency of delivery of pH adjustment chemical:
6 bags every 6 months. ~1 bag/month

Frequency of media replacement for pH adjustment system: N/A.

Target or Setpoint for pH in treated water: pH 7.

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
adjust pump speed and increase or decrease soda ash mix.

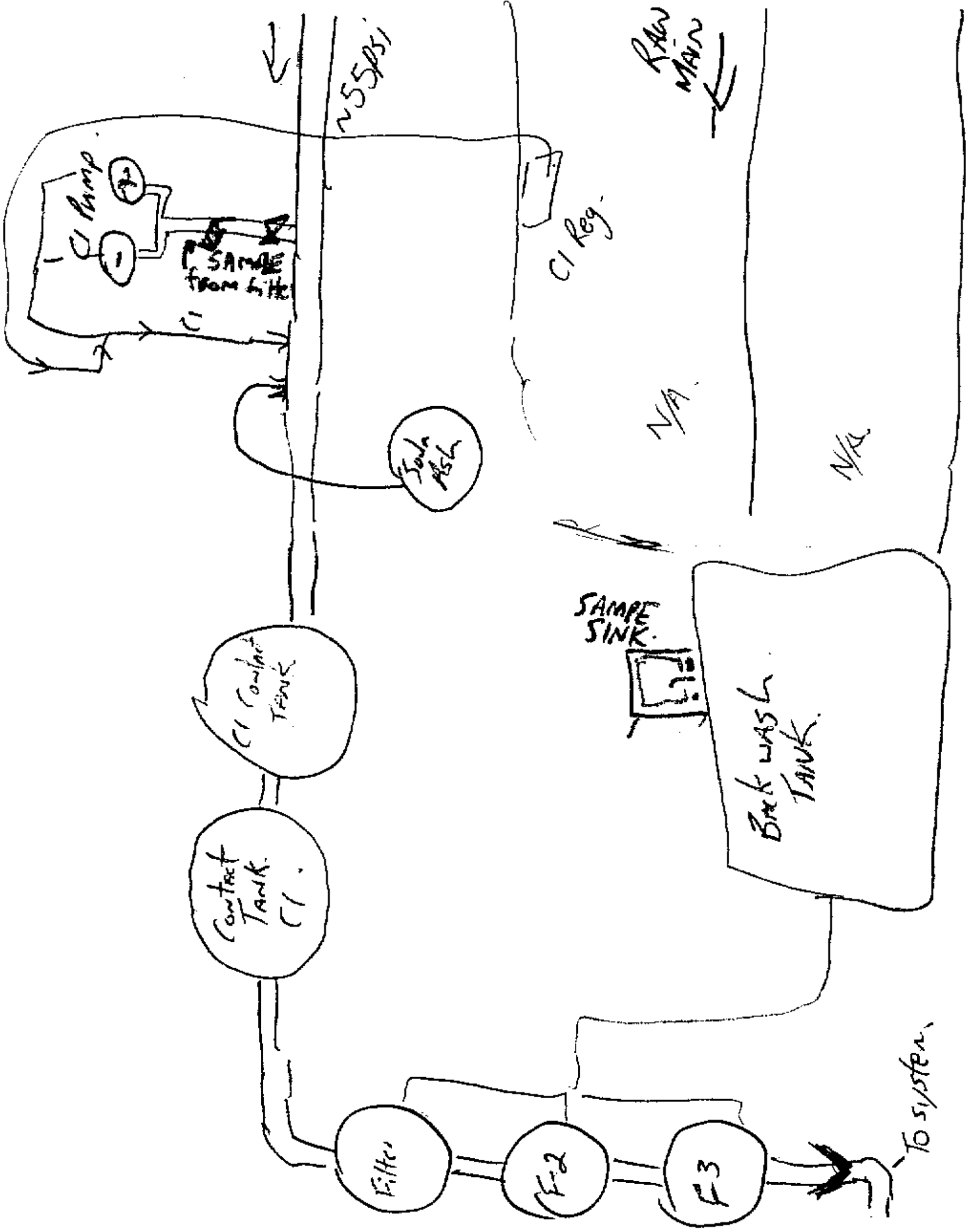
Describe routine maintenance practices for pH adjustment system:
general cleaning of tank / pump every couple of week.
Cl raw water feed filter.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
- Complaints from resident. about boggy/trout. odour. brown colour
- Seems to be leaks flow rate doesn't drop late @ night.

Some corrison on copper pipes
- pH flucuates frequently,

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Lumsden.

Source Name: Gull Pond

Source Type: Surface **Water Supply No. :** WS-S-0434

Service Area(s): Lumsden

Service Area No. : SA-0447 **Service Population:** 622

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Main come in gravity feed. gets Soda Ash & Alum. goes into flock tank. comes out of flocktank. gets poly. goes into large filter come out gets more Soda. Ash then chlorine - then goes to clear water chamber., then pumped to town or tower
Started new system Nov 09 still working on it.

Operational Status: 7am - 5pm. daily (water tower)
*Having to turn water pump on manually.

Type of Disinfectant: Cl gas. 1.25 - 2lb Cl/day.

Point of Disinfectant Application: After all treatment before water enters clear water tank.

Point of pH Adjustment: ~10' DS of where main comes in, Alum. 6" DS of Soda Ash. 2nd S.A dosage ~40" DS of Cl before clear water tank.

Chemical or Filter Media Used for pH adjustment: Soda Ash.

Supplier: Eco tech. Dover.

Concentration: 25Kg bag

Solid/Liquid: dry powder.

Feed Pump Capacity: 30 GPH MAX. Neptune Proportioning Pump 547-D-N3-TE1

~~Filter Capacity~~: 2 Knobs set on 15 and 4.

Solution/Day Tank Volume: 36" Dia x 43" high.

Bulk Storage Volume: 45-50 bags.

On-line Monitoring of pH: Y [✓ N] **Grab Sample for pH:** [✓ Y] N

Location of On-Line Analyzer:

Location(s) for Collection of Grab Samples: 2-3 times / week
Plant - Town Hall - some other houses around town.

Other Treatment Processes: Alum - Poly. - filter (Anthracite - sand 7 layers). Gravel.

Site Visit Template - Page 2

On-Site pH Measurement Results

Lumsden

Raw Water pH (before any treatment): 5.63 at POND.
Before pH adjustment:
After pH adjustment: +Alum + Poly 5.64 pH from top of filter
Before Disinfection:
Fully treated – After Disinfection: 6.44 from sink

Describe sample locations, if needed:

Very few leaks.
Plastic MAIN + Ducttile. mostly copper service lines some plastic.

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage:
2 bags per tank. 2 Knobs set @ 15 and 4

Current and/or typical average daily flow: 139 gpm to water tower.
63 psi.

Frequency of delivery of pH adjustment chemical: 4 bags / week 16 month.
50 bags every 3-4 month.

Frequency of media replacement for pH adjustment system: N/A.

Target or Setpoint for pH in treated water: 7.2 pH

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
MANUAL Adjustments on pump.

2 bags per tank of water

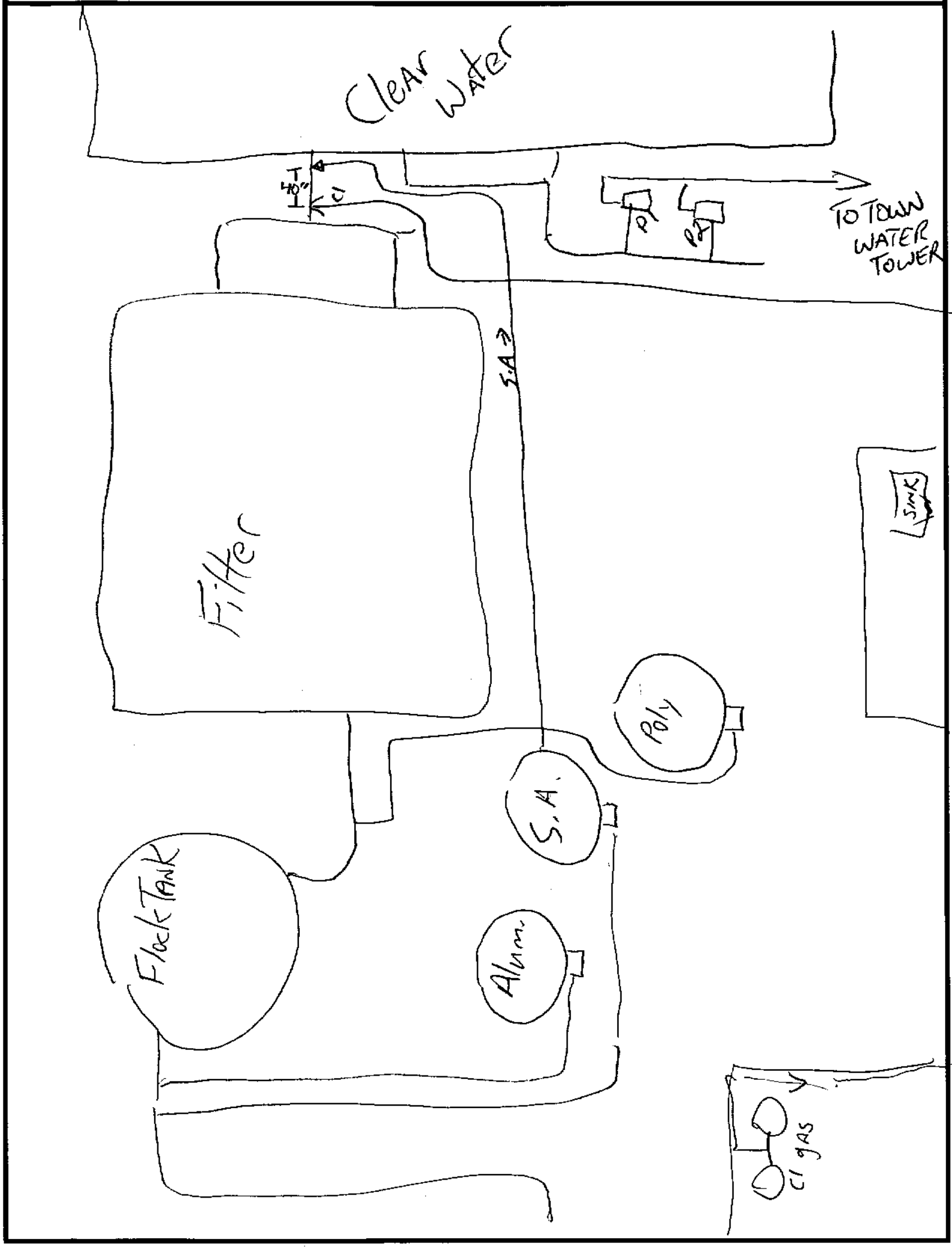
Describe routine maintenance practices for pH adjustment system:
NO

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
NO Issues
NO COMPLAINTS. about quality.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Lumsden



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Musgrave Harbour

Source Name: Rocky Pond

Source Type: Surface. Water Supply No. : WS-S-0473

Service Area(s): SA-0490 Musgrave Harbour.

Service Area No. : SA-0490 Service Population: 1286

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity feed from reservior, inline filter then lime, Alum, Poly, 2 large filters (Anthracite + sand), then to clear well where Cl gas is injected, Main pumps (3) pump water to town and water tower. Soda Ash injected just before water leaves building. (system 10 yrs Old)

Operational Status: 24hr/day

Type of Disinfectant: Cl gas. ~10-12lbs/day Reg set @ 70%

Point of Disinfectant Application: In clear well.

Point of pH Adjustment: just before water leaves pump house/treatment plant

Chemical or Filter Media Used for pH adjustment: Soda Ash.

Supplier: Ecotech Dover.

Concentration: 25 Kg bags.

Solid/Liquid: dry powder

Feed Pump Capacity:

Filter Capacity: 6.94 LPH - Pulsatron LPH4A-VTC1-R20. Not running.

Solution/Day Tank Volume: 2 x 125 gal.

Bulk Storage Volume: 35 bags.

On-line Monitoring of pH: [✓ Y] N Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer: On service line - off main.

Location(s) for Collection of Grab Samples:

Other Treatment Processes: Lime Feed rate set @ 60 Wallace + Teirnan feed pump solution @ 42 max capacity 12 GPH.
Alum feed rate set @ 80 Solution pump set @ 75 Encore 700

Polymer Solution pump Encore 700 set @ 16 5.8 USGPH

Site Visit Template - Page 2

On-Site pH Measurement Results

Musgrave

Raw Water pH (before any treatment): 5.74 pH sample TAP -

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 4.20 pH. sample tap.

Describe sample locations, if needed: Gravity feed topumphouse. then get gets pumped to town + water tower.

5.08pH after filters

10" Ducttile Iron main with copper service lines.

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 68½ lbs per 125 gal tank

Current and/or typical average daily flow: ~140 gal/min -

Frequency of delivery of pH adjustment chemical: 45 bags month

Frequency of media replacement for pH adjustment system:

Target or Setpoint for pH in treated water: 7.8 pH.

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
pump has been down about a week. waiting on replacement.
Was flow paced with some manual adjustment.

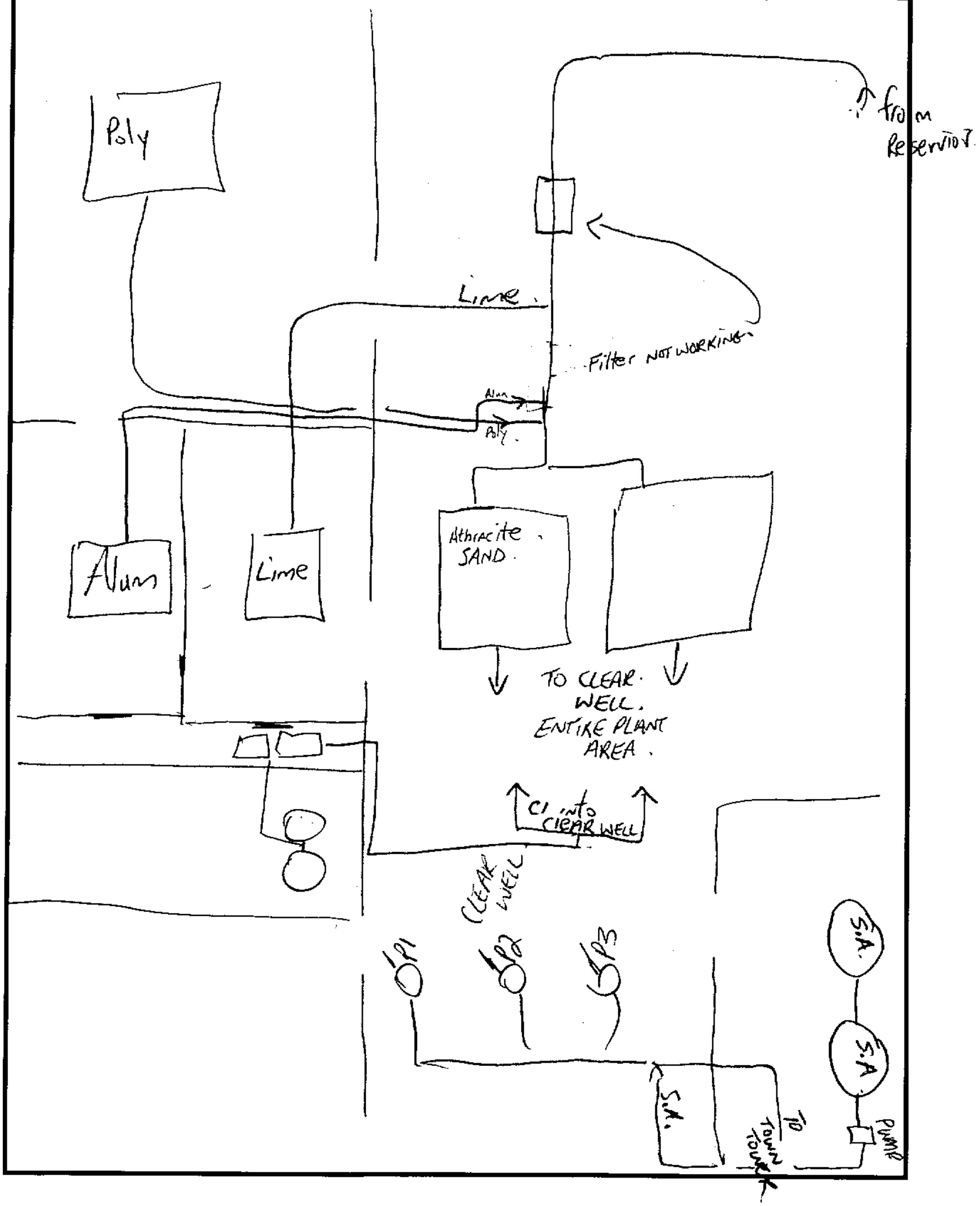
Describe routine maintenance practices for pH adjustment system:
regular cleaning of tanks and lines
- NO COMPLAINTS WATER IS BEST ITS BEEN.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
pumps have been breaking down. (new pumps)
lots of leaks before they adjusted the pH with S.A.
now very few

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Musgrave H



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: New-Wes-Valley

Source Name: Little Northwest Pond

Source Type: Surface

Water Supply No. : WS-S-0485

Service Area(s): Westleyville-Badgers Quay, Pools Island, Brookfield - Poundcove

Service Area No. : SA-0503

Service Population: 2332

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Water from pond to wet well. Automatic screen. 4 pumps. Chlorine and Soda Ash treatment.

New system last year. S.A. Feed Rate on screw on 80

Operational Status: 24hr/day.

Type of Disinfectant: Cl gas ~ 50lb/day

Point of Disinfectant Application: ~ 14" US of Soda. Ash.

Point of pH Adjustment: Just before it leaves the pumphouse -

Chemical or Filter Media Used for pH adjustment: Soda Ash.

Supplier: Ecotech in Dover

Concentration: 25Kg bags

Solid/Liquid: dry powder

Feed Pump Capacity: Siemens Wallace+Tiernan - Encore 700. 77USGPH MAX Set on full (100)

~~Filter Capacity~~: Model E7DR2XG AAU1

Solution/Day Tank Volume: 24x25 x18" high

Bulk Storage Volume: 24 bags.

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer: 6.57pH after treatment Cl & S.A.

Location(s) for Collection of Grab Samples: every morning @ pumphouse.

Other Treatment Processes: N/A.

Site Visit Template - Page 2

On-Site pH Measurement Results

New Wes Valley

Raw Water pH (before any treatment):	6.2pH from Pond.
Before pH adjustment:	
After pH adjustment:	
Before Disinfection:	
After Disinfection:	8.26pH treated.

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 3 bag per day, Pump set at full

Current and/or typical average daily flow: 700 gal/min.

Frequency of delivery of pH adjustment chemical: 100 bags every 3 wks - month.

Frequency of media replacement for pH adjustment system: N/A.

Target or Setpoint for pH in treated water: 7 pH.

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

Some manual adjustments.

Describe routine maintenance practices for pH adjustment system:

NO

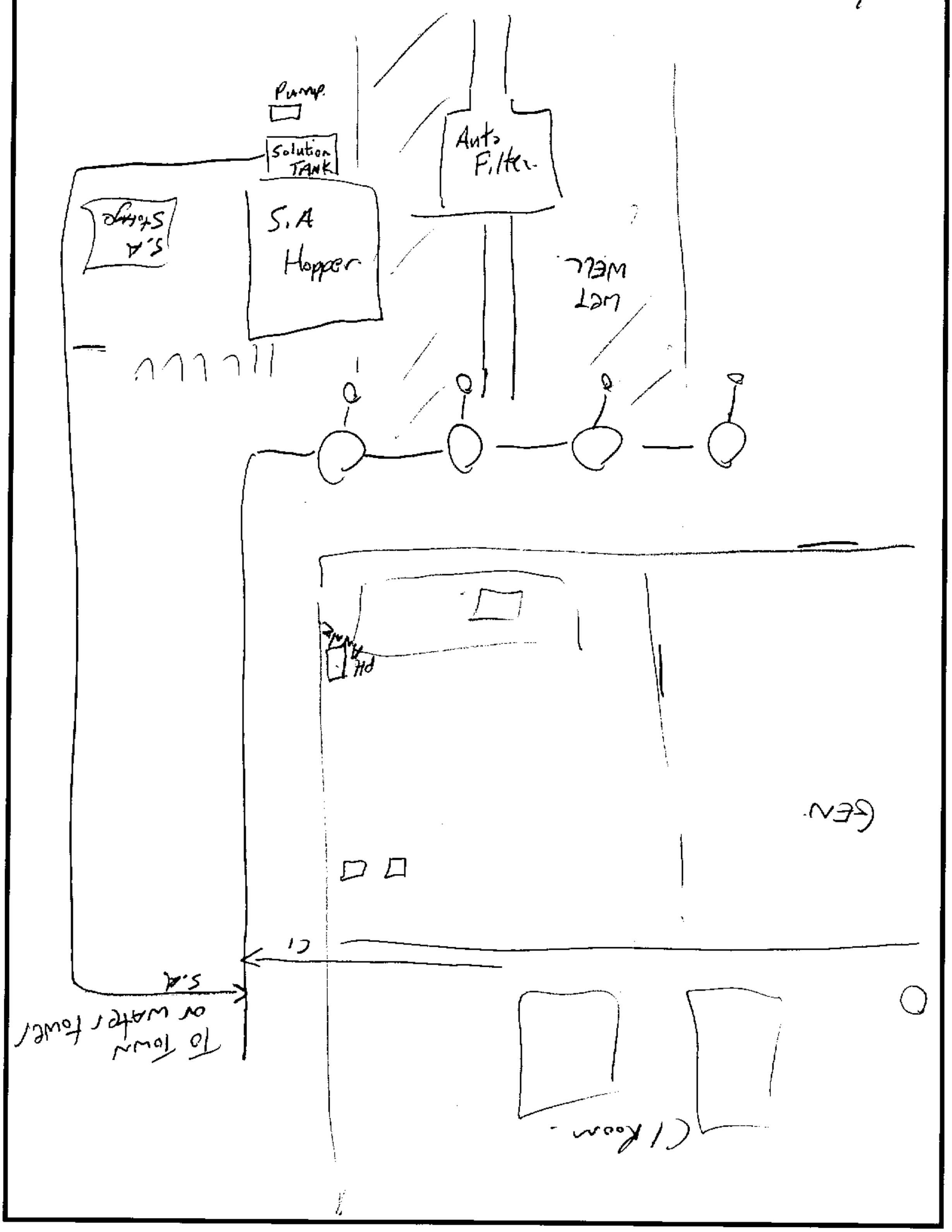
Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

NO

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

New Wes Vally.



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Newtown - Templeton New-WES-VALLEY

Source Name: Carters Pond

Source Type: Surface

Water Supply No. : WS-S-0484

Service Area(s): SA-0502

Service Area No. : SA-0502

Service Population: 500

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Steel mesh screen into wet well. 2 Pumps through filter, then Soda Ash, then Chlorine. then to water tower.

Operational Status: 24hr/day

Type of Disinfectant: Cl gas. ~6lb day summer less in winter set 15lb/day now on manual

Point of Disinfectant Application: ~3' before it leaves building goes to pump house.

Point of pH Adjustment: ~8' US of Cl gas injection.

Chemical or Filter Media Used for pH adjustment: Soda Ash.

Supplier: 1

Concentration: 25Kg bags.

Solid/Liquid: dry powder

Feed Pump Capacity: 4.89 gph. Grundfos DME19-6A-PP/V/C-F-2155B. pumping @ 6 l/h

Filter Capacity: N/A.

Solution/Day Tank Volume: 2x 125 gal.

Bulk Storage Volume: 3 bags.

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer: treated water. 6.26pH.

Location(s) for Collection of Grab Samples:

Other Treatment Processes: Particulate filter

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment): 4.81 from hose near wet well

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 5.24. Treated @ sensor tap.

Describe sample locations, if needed:

INTAKE

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 6 L/h ~~TypicAl~~. ~~[illegible]~~t.

Current and/or typical average daily flow: 130 gpm.

Frequency of delivery of pH adjustment chemical: SAme shipment As New WesValley

Frequency of media replacement for pH adjustment system: N/A.

Target or Setpoint for pH in treated water: 7pH.

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

flow paced.

2gal of SodA Ash. per 60gal water

Describe routine maintenance practices for pH adjustment system:

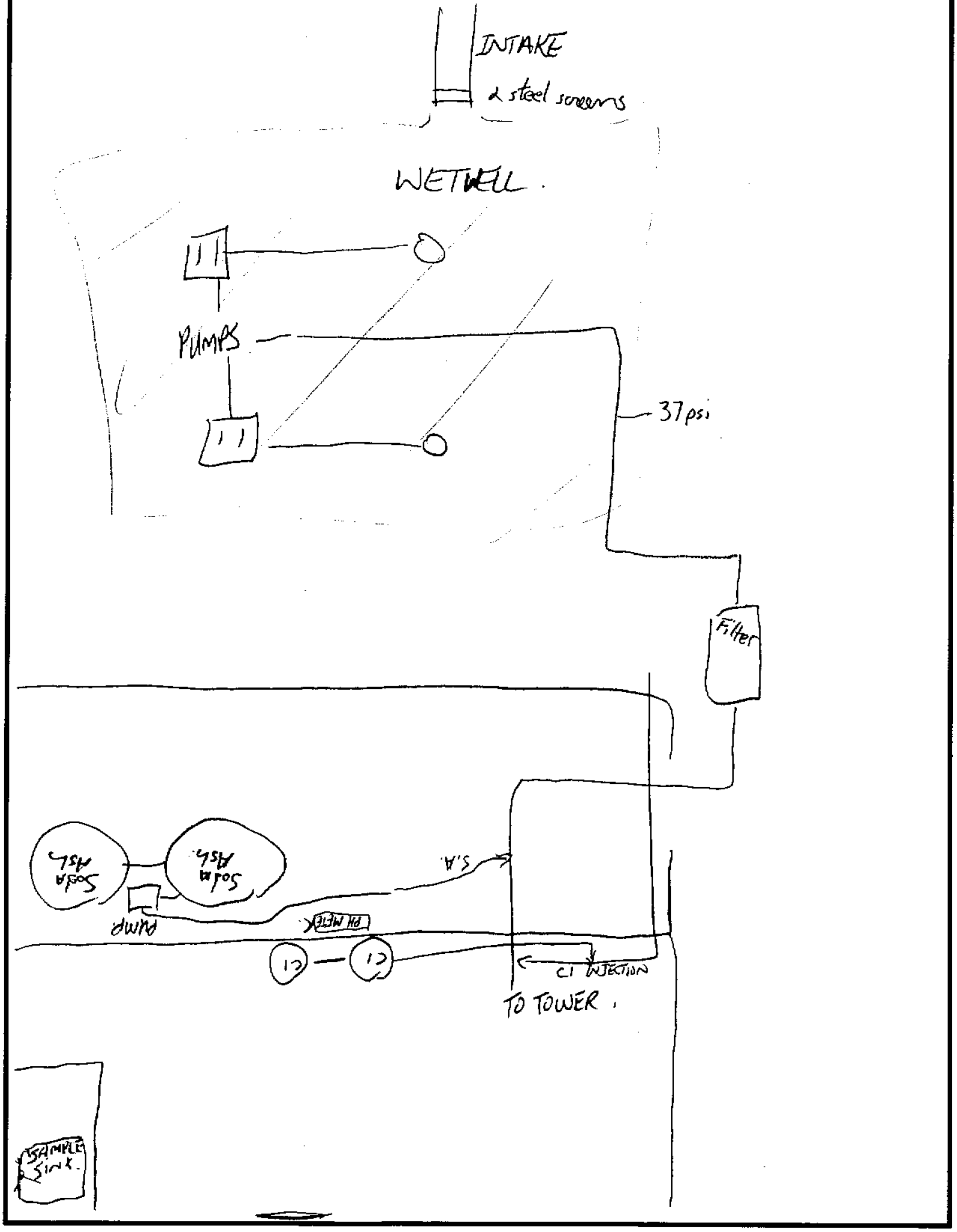
NO -

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

~~NO~~ occasional complaint about color, staining laundry.
very little leaks. mostly plastic.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Petty Harbour - Maddox Cove

Source Name: Western Barrens Pond

Source Type: Surface | Water Supply No. : WS-S-0867

Service Area(s): Petty Harbour - Maddox Cove

Service Area No. : SA-0903 | Service Population: 949

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity Feed. to treatment plant
2 filters.

8" Ducttile Iron Main, splits off to 6+4" @ town.

Operational Status: 24 hr/day.

Type of Disinfectant: Cl gas. ~5-7 lbs/day 24hr.

Point of Disinfectant Application: Just before main goes under floor.

Point of pH Adjustment: ~10' DS of Cl injection.

Chemical or Filter Media Used for pH adjustment: Soda Ash.

Supplier: Brenntag. (Old East Chem).

Concentration: 25Kg bags.

Solid/Liquid: dry powder.

Feed Pump Capacity: 2.50 GPH LMI MiltonRoy

Filter Capacity:

Solution/Day Tank Volume: 4'2" high x 2'10" dia x2 tank.

Bulk Storage Volume: 6 bags + Rubbermaid container.

On-line Monitoring of pH: [✓ Y] N | Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer: not working new one on order.

Location(s) for Collection of Grab Samples: 6 in Petty Harbour & 7 in Maddox Cove.
for pH + Chlorine.

Other Treatment Processes: 2 particulate filter.

Site Visit Template - Page 2

On-Site pH Measurement Results

Petty Harbor

Raw Water pH (before any treatment): 5.5 @ Pond.

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 6.84 pH system went down overnight hose came off.

Describe sample locations, if needed:

Pond intake ~ 250' out in pond. ~10' deep.

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: Pump set @ 85 stroke
Speed set @ 90 1L of S.A. per 1" of water. ~3 bags a week.

Current and/or typical average daily flow: 150 - 200 GPM

Frequency of delivery of pH adjustment chemical: Pick up ~20 bags every 1.5 months

Frequency of media replacement for pH adjustment system: N/A

Target or Setpoint for pH in treated water: 7 - 7.5

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

All manual adjustments on pump + S.A. Mix.

Describe routine maintenance practices for pH adjustment system:

Clean S.A tanks once a year

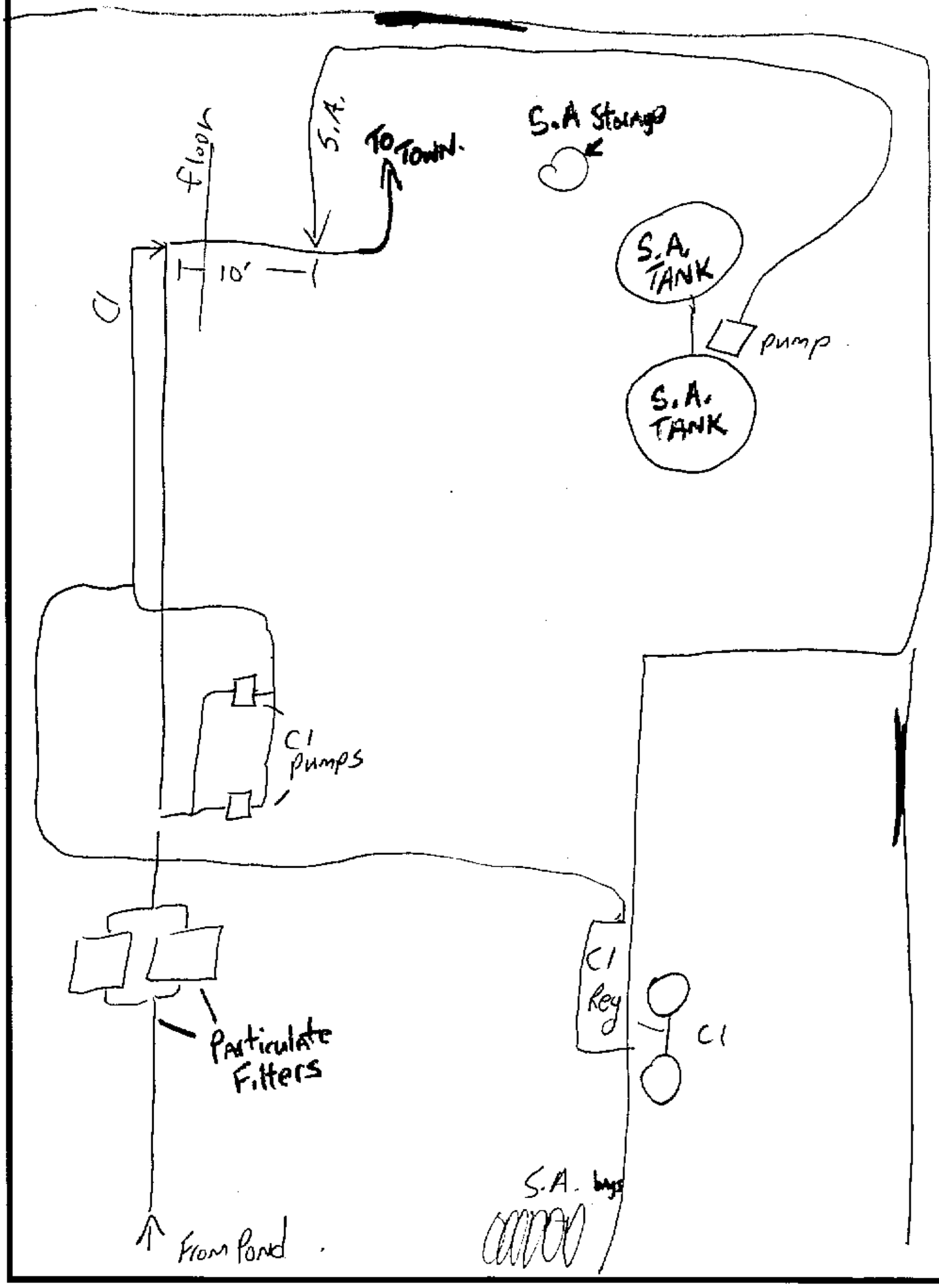
Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

3-4 leaks per year on old copper flares.
May need new pump every few years

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Petty Harbour



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Placentia

Source Name: Wyses Pond. ~12-15 off shore 8' deep.

Source Type: Surface

Water Supply No. : WS-S-0548

Service Area(s): Dunville

Service Area No. : SA-0568

Service Population: 1300

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity Feed to wet well Gets pumped through Ozone chamber then through filters Seaquest gets injected then Cl & NH3. then Soda-Ash.

Operational Status: 24 hr/day.

Type of Disinfectant: Cl gas + Ammonia gas.

Point of Disinfectant Application: After media filter

Point of pH Adjustment:
10lb soda Ash. per 20gal water.
6lb [illegible] per 20L water. SeaQuest.

Chemical or Filter Media Used for pH adjustment: Soda Ash. (Used to use lime) 3yrs ago + Seaquest

Supplier: Brentag. East Chem.

Concentration: 25Kg bags. Dense 58%.

Solid/Liquid: dry powder. 35 bags. 1bag every 3days. ~3months.

Feed Pump Capacity: 0.47 gal/hr set @ 20% speed. Seaquest mix.

Filter Capacity: change filter media every 3 years.

Solution/Day Tank Volume: 36" dia x 48" high.

Bulk Storage Volume: 35 bags

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: [✓ Y] N on occassion.

Location of On-Line Analyzer: In clear water chamber below floor. 6.98 pH.

Location(s) for Collection of Grab Samples: From clear water chamber

Other Treatment Processes: Sea Quest (blend phospates) Iron inhibition preventative. 5gal buck
powder.

Site Visit Template - Page 2

Placentia

On-Site pH Measurement Results

Raw Water pH (before any treatment): 6.88. Wet Well

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 6.49 Inline meter 6.97.

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 15lb/day Cl
2lb/day NH4

Current and/or typical average daily flow: 200gal/min

Frequency of delivery of pH adjustment chemical: 3months. 35 bags 2x20L pails

Frequency of media replacement for pH adjustment system:

Target or Setpoint for pH in treated water: 6.5 pH

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
just got a new pump Friday. old one has been down for 2 month.
Liquipro Model # C111-362S1. 2.5 gal/min. (was set @ 30)

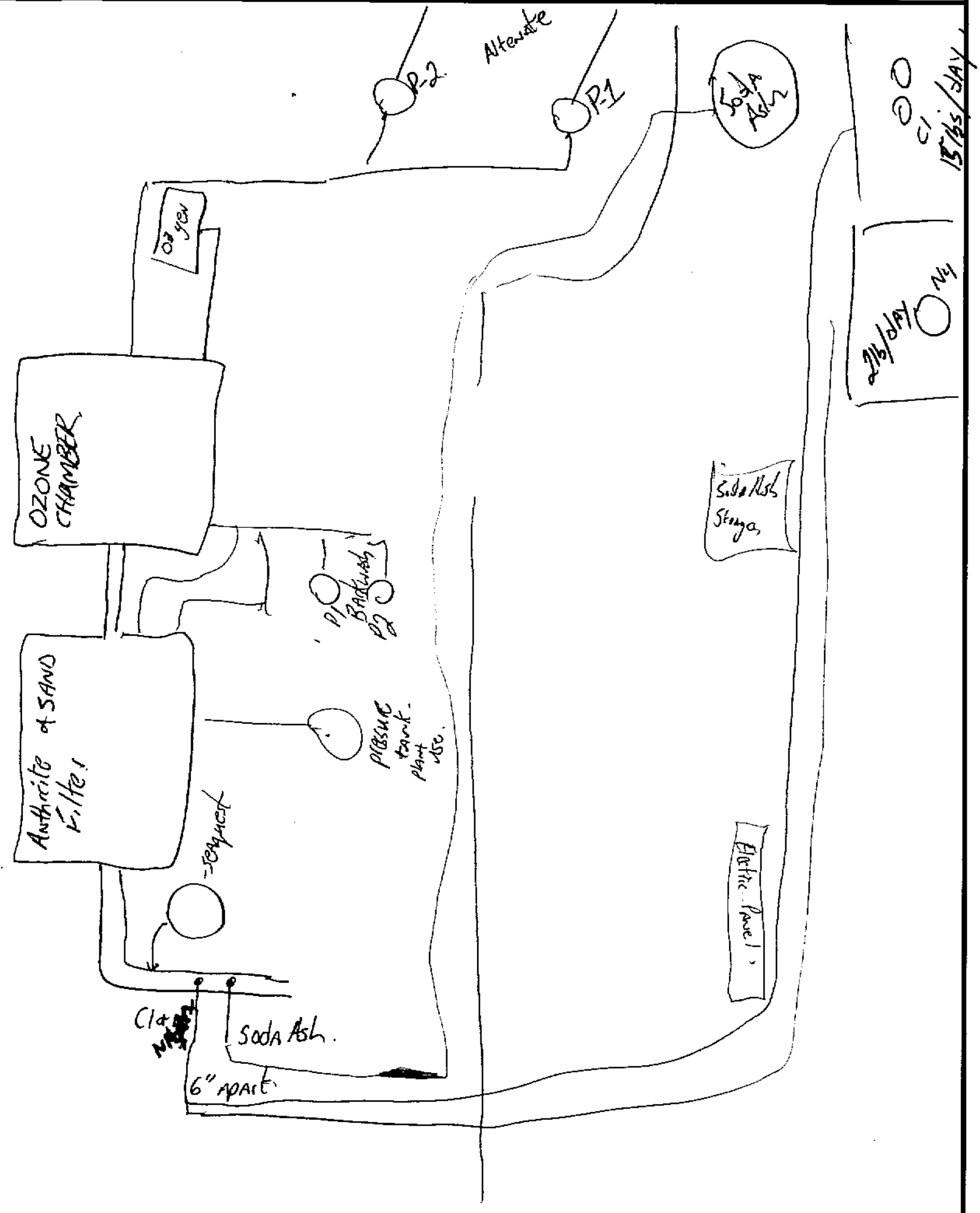
Describe routine maintenance practices for pH adjustment system:
Cleaning of equipment. general cleaning. new pump.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
Steady. no big issues only rain events.
Lots of complaints., boggy odour., colour issues sometimes.
Avg 1/week. on services. some leaks on main. lots of corrosive.

Site Visit Template - Page 3

Placentia

PROCESS FLOW DIAGRAM



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name:	Port Blandford		
Source Name:	Nosworthy's Pond.		
Source Type:	Surface	Water Supply No. :	WS-S-0577
Service Area(s):	Port Blandford		
Service Area No. :	SA-0597	Service Population:	551

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity feeb to pumphouse. 2 particulate filters. then to 3 pump. soda ash injection then Cl 2.5'DS. then to town + water. tower.

New Addition for Soda Ash in 2007.

Operational Status: 24 hr/day.

Type of Disinfectant: Cl gas. @ pump house Cl liquid @ water tower.

Point of Disinfectant Application: JUST After [illegible]A Ash.

using ~ 2.5lb [illegible] @ pumphouse.

Point of pH Adjustment: just after pump. –

Chemical or Filter Media Used for pH adjustment: Soda Ash. Brenntag.

Supplier: East Chem.

Concentration: 25 Kg bags.

Solid/Liquid: dry powder

Feed Pump Capacity: 15.85 gal/hr Grundfos All DOS. DDI 60-10

Filter Capacity: N/A.

Solution/Day Tank Volume: 3x 120 gal tank.

Bulk Storage Volume: 14 bags.

On-line Monitoring of pH: Y [✓ N]

Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer: –

Location(s) for Collection of Grab Samples: Town office. operators house.

5 days/week.

Other Treatment Processes:

Site Visit Template - Page 2

Port Blandford

On-Site pH Measurement Results

Raw Water pH (before any treatment): 6.78 tap where MAIN comes in.

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 6.44 treated @ town office

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 5Kg S.A. / 25 gal water

using ~10Kg/dAY.

Current and/or typical average daily flow: 50 gal/min

Frequency of delivery of pH adjustment chemical: 12-15 bAys.

Frequency of media replacement for pH adjustment system: N/A

Target or Setpoint for pH in treated water: 7 pH.

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage: set @ 8.25 L/hr. flow paced.

adjustment on pump.

based on. flow.

Describe routine maintenance practices for pH adjustment system:

NO.

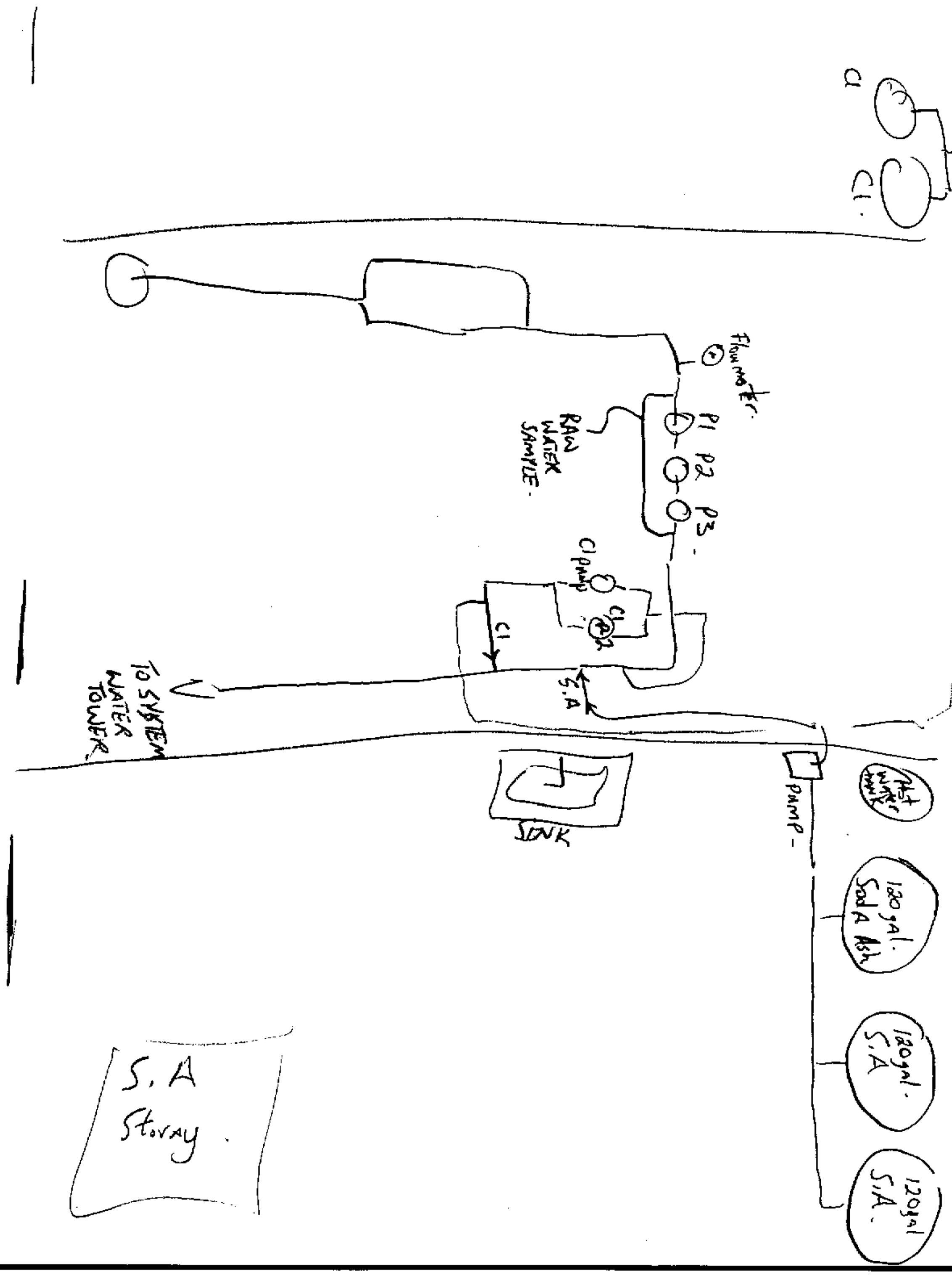
Other operational issues (making of stock solutions, feed rate, mixing problems, etc.): VAlve..

Feed pumps. cloggs @ VAlve.. Used to be 20-30 leaks. on copper service. Now 2-3 leaks/year. No issues. on main 85% PVC. 10-15% Ductile. 6" MAin some 2-4"

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

port blanford



Note: follow up re: chlorine dose

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Pouch Cove

Source Name: North Three Island Pond

Source Type: Surface water

Water Supply No. : WS-S-0598

Service Area(s): Pouch Cove

Service Area No. : SA-0619

Service Population: 1669

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Intake from pond is ~ 1000 ft (14") soda ash injected into raw water header immediately upstream of static mixer. Cl_2 is injected 22 ft downstream of lime.

Operational Status: operational - 24/7.
(pH system installed in Jan. 2004)

Type of Disinfectant: chlorine gas

Point of Disinfectant Application: raw water header d/s of soda ash injection and mixing

Type of pH Adjustment System: soda ash.

Point of pH Adjustment: raw water header upstream of disinfection

Chemical or Filter Media Used for pH adjustment: Soda ash.

Supplier: East Chem

Concentration: —

Solid/Liquid: dry (25 kg bags)

MSDS (Y/N): —

Feed Pump Capacity: small pump 9 gph large pump 36 gph.

Filter Capacity: n/a

Solution/Day Tank Volume: 26 x 24 x 18 " (solution tank).

Bulk Storage Volume:

On-line Monitoring of pH: [✓ Y] ~~N~~

Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer: Town Hall has data logger for pH and Cl_2 residual. Daily grab samples are also taken at Town Hall.

Location(s) for Collection of Grab Samples: ↗

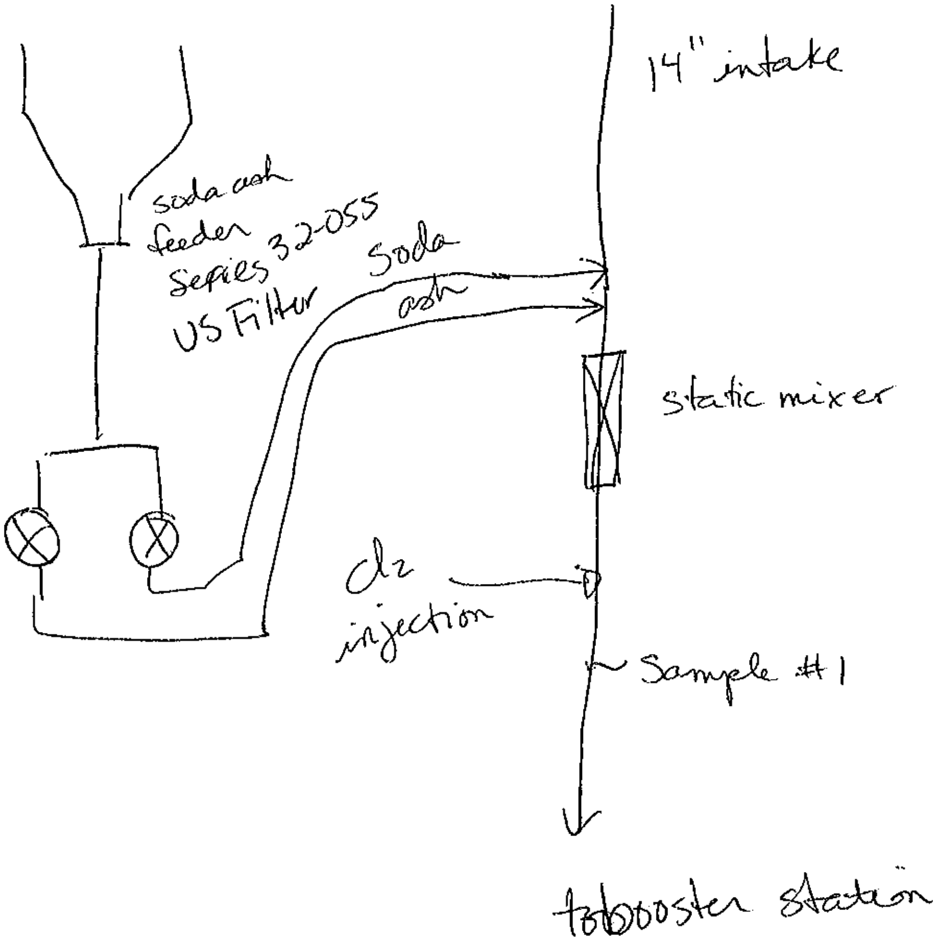
Other Treatment Processes:

static mixer design pressure 125 psi
model no. series 600, 10" diameter.

Statiflo motionless mixer.

Site Visit Template - Page 2

PROCESS FLOW DIAGRAM



Site Visit Template - Page 3

On-Site pH Measurement Results

② Raw Water pH (before any treatment): 6.43

Before pH adjustment:

① After pH adjustment: 6.96

Before Disinfection:

After Disinfection:

Describe sample locations, if needed:

① downstream of chlorination and pH adjustment
(no sample point available for water after pH adj. and before disinfection)

② service water line (before pH adj.)

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 49 mg/L design feed rate is 73% (soda ash).
Soda ash is flow paced (~~po~~ see extra sheets).

Current and/or typical average daily flow: (fire flow designed for 1500GPM).
250-300 GPM

Frequency of delivery of pH adjustment chemical:
pick up 40 bags about every 3 weeks.

Frequency of media replacement for pH adjustment system:
n/a.

Frequency and method used for measurement of pH:
pH and Chlorine are measured on-line at Town Hall (not WTP)

Adjustments to process in response to water quality changes:
- target pH of 7
- adjustments made based on pH measurement at Town Hall

Describe routine maintenance practices for pH adjustment system:

History of discoloured water complaints and/or service leaks:

Other operational issues (making of stock solutions, mixing problems, etc.):
- use about 1.5 bags per day
- ~~pH is higher in winter than in summer (raw water)~~
- pH of the pond is higher in summer than in winter
- feed rate is maintained constant but concentration of slurry can be adjusted (changes based on raw water pH)

→ pH is measured using hand-held meter every day at the Town Hall.

- design is 4 USgal water per pound of soda ash.

3/4" Saw High Speed | 0.24 cuft/hr

Pulley 3 | 98% = 0.22 $\frac{ft^3}{hr}$

98% of fullrate

VFD 17.88 Hz $\boxed{0.3}$ 30% = 10.7 GPH

5 x 60

$$\text{density} = 1000 \frac{kg}{m^3} \times 2.2 \frac{lb}{kg} = 2200 \frac{lb}{m^3} \times \cancel{\frac{27 ft^3}{3 \cdot 27 ft \cdot 3 \cdot 27}} \quad \frac{1 m^3}{27 ft^3}$$

$$27 \overline{)2200}$$

$$\text{density} = 81.5 \frac{lb}{ft^3}$$

flow = 10.7 gph solution

$$\text{feeder rate} = 0.22 \frac{ft^3}{hr} \text{ soda ash.}$$

$$\text{feed rate} = 0.22 \frac{\cancel{ft^3}}{hr} \times 81.5 \frac{lb}{\cancel{ft^3}}$$

$$= 17.9 \frac{lb}{hr} \text{ soda ash.}$$

$$\frac{17.9 \frac{lb}{hr} \text{ soda ash}}{30 \frac{gal}{hr} \text{ water}} = \boxed{0.60 \frac{lb \text{ soda}}{gal \text{ water}}} \text{ solution strength.}$$

$$10.7 \frac{\cancel{gal}}{hr} \cdot 0.60 \frac{lb}{\cancel{gal}} = 260 \frac{\cancel{gph}}{min} \circ$$

~~0.64~~

$$\text{dosage} = 6.4 \frac{lb}{hr} \text{ into } 260 \frac{gal}{min} \Big\} \text{ bulk flow}$$

$$6.4 \frac{\cancel{lb}}{\cancel{hr}} \cdot \frac{1 \cancel{hr}}{60 min} \cdot \frac{1 \cancel{kg}}{2.2 \cancel{lbs}} \cdot \frac{1000 \cancel{g}}{\cancel{kg}} \cdot \frac{1000 mg}{\cancel{g}} = 48\,485 \frac{mg}{min} \quad \text{dosage} = \frac{48485 \frac{mg}{min}}{984.1 \frac{L}{min}}$$

$$260 \frac{gal}{min} \cdot 3.785 \frac{L}{gal} = 984.1 \frac{L}{min}$$

$$\boxed{\text{dosage} = 49 \frac{mg}{L}}$$

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Ramea

Source Name: North West

Source Type: Surface water | Water Supply No. :

Service Area(s): Ramea

Service Area No. : | Service Population: 330 Houses, 550 People

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process:

→ water Ran through SAND filter to clear well where it is treated with chlorine AND caustic soda

Operational Status: Operational → Cl Pump was Replaced upon ARRIVAL

Type of Disinfectant: / Chlorination Media SAND Filter → Andersite

Point of Disinfectant Application:

@ entry to clear well

Point of pH Adjustment:

@ entry to clear well

Chemical or Filter Media Used for pH adjustment: caustic soda 50%

Supplier: Brenn Tag / EAST Chem

Concentration: 50%

Solid/Liquid: liquid

Feed Pump Capacity:

Filter Capacity:

Solution/Day Tank Volume: N/A

Bulk Storage Volume:

On-line Monitoring of pH: [✓ Y] N | Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer:

treated H_2O 8.95 pH

Location(s) for Collection of Grab Samples:

Other Treatment Processes:

lime → on timer every 40min

1" Am/hr

Alum → every 20m

drained 11" in Two days

Polymer → Time Run of Plant ← Pump @ 11% 12 GPH

lime 72g per min 50% of 12GPH

Alum 90.2g per min 62% 12GPH

Site Visit Template - Page 2

On-Site pH Measurement Results

① Raw Water pH (before any treatment): 6.80

② Before pH adjustment: 6.26

After pH adjustment:

Before Disinfection:

After Disinfection: 8.63

Describe sample locations, if needed:

① Raw water entering Plant

② After sand filtration

③ final treated water

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage:

Current and/or typical average daily flow:

Frequency of delivery of pH adjustment chemical:

Frequency of media replacement for pH adjustment system:

} see notes on Dosage

Target or Setpoint for pH in treated water:

8.0 – 8.5

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

→ Keep adjusting caustic if PH to low or to high set @ 24-28 drops per min.

Describe routine maintenance practices for pH adjustment system:

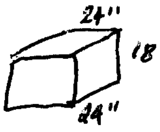
→ Caustic Soda does not Require a lot of maintenance

→ have to clean lime @ Hopper if it gets clogged

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

No problems other than occasional clogging

Polymer tank – 1.15m x .60m



} Alum & Lime Solution TANKS

Site Visit Template - Page 3

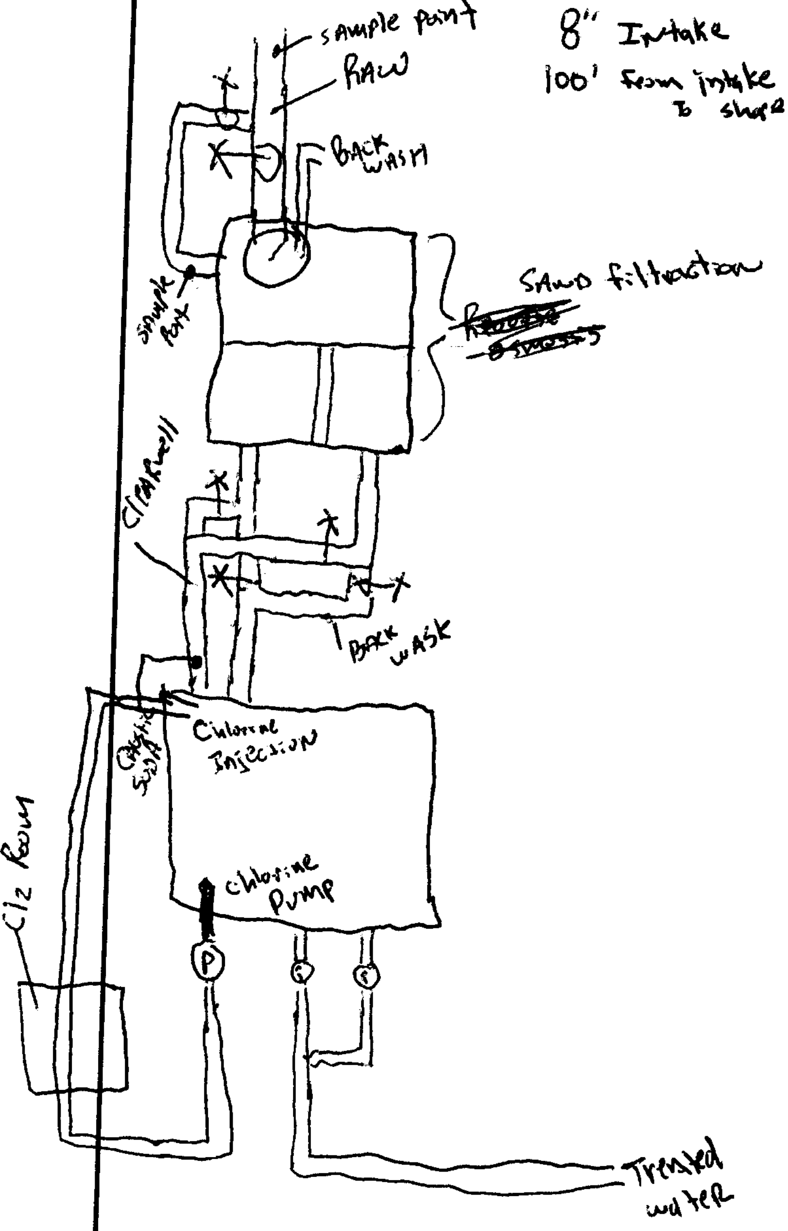
PROCESS FLOW DIAGRAM

5-600 YARDS

8" Intake

100' from intake to shore

on VBT running @ 102 gpm



→ Before filitration

- Lime added
- alum added

→ polymer ADDed

once a week Clorine added to filter tank for 1/2-1 hr

Avg 1 lb of Cl2 a day

70 lb tank 65-80 DAY depending on weather etc

Avg = 60,000 - 80,000 gpd

6 caustic soda per year

~~from~~ for 2009

-> used total of 126 Bags of Lime

→ 352 Bags of alum

→ 1 bag of Polymer] Castchem

-> 6 Barrell caustic]

-> 5 cholrine cylinders (68 lbs)

SAME?

Brenn Tag → supplies Alum, Lime, Cl2

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Seldom.

Community Name: Seldom.
Source Name: Bullish Cove.
Source Type:
Water Supply No. :
Service Area(s):
Service Area No. :
Service Population:

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: 24" MAin ~30' out ~18' deep. Gravity into wet well. 3 pumps 1 7hp 2x 15hp.

NEW SYSTEM JAN 2009.

Operational Status: 24hr/day. 10" in pumphouse 12" Ductile.

Type of Disinfectant: Cl gas. 16lbs/day.

Point of Disinfectant Application: ~3' before. MAin leaves building

Point of pH Adjustment: ~4' DS of last pump.

Chemical or Filter Media Used for pH adjustment: Soda. Ash. Brenntag.
Supplier: East Chem.
Concentration: 25Kg
Solid/Liquid: dry POWDER.
Feed Pump Capacity: 4.89 GPH Grundfos AllDOS Type DME19-6 A-PP/E/C-F-2155B.
Filter Capacity: set @ 9.4 l/h. flucuating.
Solution/Day Tank Volume: 2 x ~200gal tank 36" dia x 48" high.
Bulk Storage Volume: 10 bags

On-line Monitoring of pH: [✓ Y] N
Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer: At sink.

Location(s) for Collection of Grab Samples:

Other Treatment Processes: 2 screens steel mesh.

Site Visit Template - Page 2

On-Site pH Measurement Results

Seldom

Raw Water pH (before any treatment): 6.73 pH from. pond.

Before pH adjustment:

After pH adjustment: 8.67pH just soda Ash.

Before Disinfection:

After Disinfection: 6.82 pH from sink with sensor.

Describe sample locations, if needed: finished water sample. comes. ~ 16" US. upstream of were Cl is injected

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 2 bag per tank. 36" dia x 48" high. ~200gal. ~ 1bag/day

Current and/or typical average daily flow: 780 GPM. with fish plant. 50-100

Frequency of delivery of pH adjustment chemical: 40 bags. ~ 1.5 months.

Frequency of media replacement for pH adjustment system: N/A

Target or Setpoint for pH in treated water: 7pH.

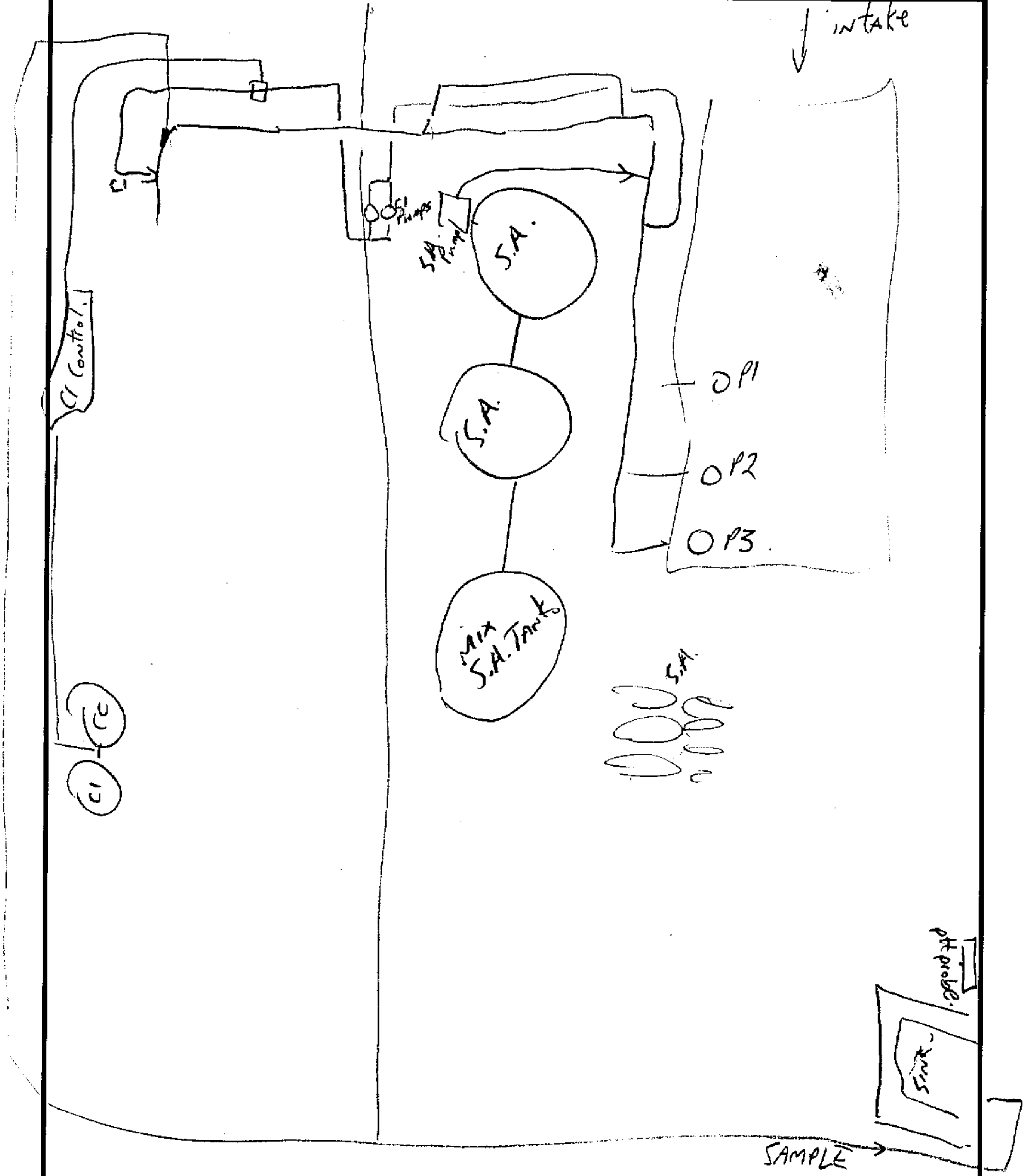
Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
flow paced. some manuall. adjustments on max dosage. setting differenent time of year (rainfall).

Describe routine maintenance practices for pH adjustment system:
-NO MAINTENANCE.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
- Some complaints. of staining of laundry.
- fairly new supply system no leaks.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Spaniards Bay.

Source Name: Kelly's Pond (Spider Pond)

Source Type: Surface

Water Supply No. : WS-S-0673

Service Area(s): Spaniards Bay (+ Upper Island Cove)

Service Area No. : SA-0698

Service Population: 2600

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity Feed system. Soda Ash + Chlorine treatment.

Operational Status: 24 hr/day

Type of Disinfectant: Cl gas. ~3m seperation from S.A

Point of Disinfectant Application: 30lbs/day. ~3m. DS of S.Ash Just before it leaves pit.

Point of pH Adjustment: On main ~3m US of Cl gas.

Chemical or Filter Media Used for pH adjustment: Soda Ash. Brenntay.

Supplier: Bronntay.

Concentration: 25kg bags

Solid/Liquid: dry powder

Feed Pump Capacity: 4 GPH MAX LMI Milton Roy Model C921-362SI

Filter Capacity: N/A set on 50 on Knob. 35 pumps/min

Solution/Day Tank Volume: 2700L Mix. Tank. ~350L solution tank.

Bulk Storage Volume: 56 Bags.

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer: Inbetween. Soda Ash + Cl gas. 7.04 pH

Location(s) for Collection of Grab Samples: Town Hall. by Provincial Guy

Other Treatment Processes:

Site Visit Template - Page 2

On-Site pH Measurement Results

Spaniards Bay

Raw Water pH (before any treatment):	6.07
Before pH adjustment:	
After pH adjustment:	6.46pH. probe. sample tube.
Before Disinfection:	
After Disinfection:	5.81 @ Town Hall

Describe sample locations, if needed:

System in place ~4yrs.

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 6-7 bags per 2700L 35 pumps/min

Current and/or typical average daily flow: ~700gal/min.

Frequency of delivery of pH adjustment chemical: once every 10-11 months.

Frequency of media replacement for pH adjustment system: N/A.

Target or Setpoint for pH in treated water: ~7pH

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

manual adjustment on pump.

Describe routine maintenance practices for pH adjustment system:

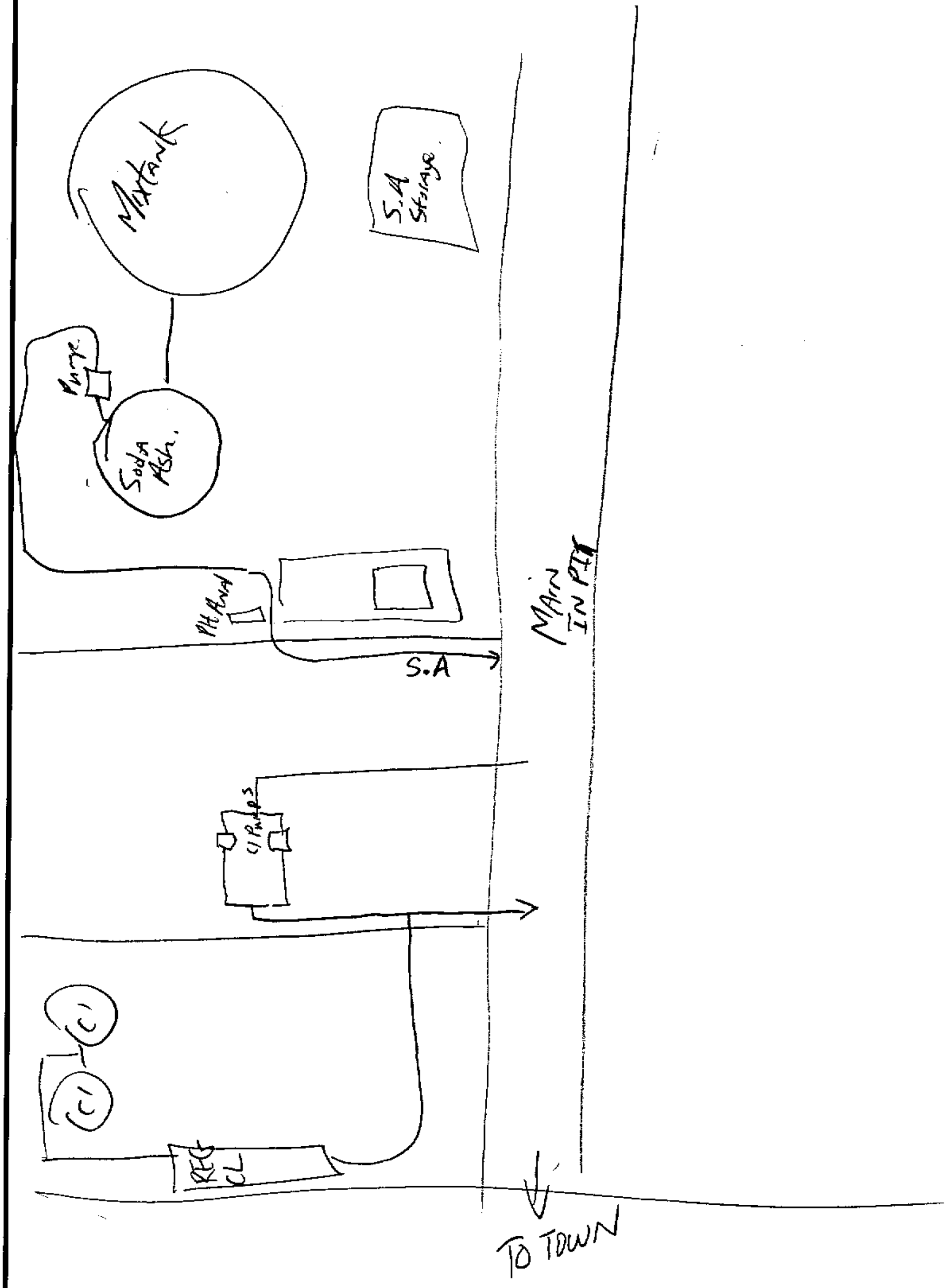
Clean Tank once/month

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

Faulty valves from mix to solution tank.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM Spaniards Bay.



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: St. John's

Source Name: Bay Bulls Big Pond

Source Type: Surface

Water Supply No. : WS-S-0691

Service Area(s): St. John's, Mt. Pearl, Paradise, Portugal Cove, St. Phillips, CBS

Service Area No. : SA-0716

Service Population: 81,517

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process:
380 Ft from low lift pump house (Depth = 36 ft')
48' Diameter, Automatic travelling screens

Operational Status: Operational

Type of Disinfectant: ozone / Cholamination

Point of Disinfectant Application: and dosage:
ozone contact chambe header (4)
Choline added @East/west clear well @ same location @AS lime

Type of pH Adjustment System: Lime UPGRADED 2003-04 date installe

Point of pH Adjustment:
Two injection points - East clear well + west clear well

Chemical or Filter Media Used for pH adjustment: Lime

Supplier: EAST chemical

Concentration:

Solid/Liquid: Powder (DRY)

MSDS ([✓ Y]/N):

Feed Pump Capacity: See pump curve

Filter Capacity: N/A

Solution/Day Tank Volume: 54" x 54" x 48"

Bulk Storage Volume: 50 tonne silo (every 1½-2 months) — 29 tonnes

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer:
Rawater line = 6.09 @ 14.6°C
ozone effluent PH = 5.60 @ 15.1°C
east clearwell - 7.39 @ 15.2
west clearwell - 7.41 @ 2.20 mg/l of free Cl.
Plant effluent → 7.59 @ 15°C

Location(s) for Collection of Grab Samples:
See Pg. 3

Other Treatment Processes:
emergency Cl injection @ Raw water (gas)
ozonation, Filtration, chloramination, Sodium Bisulfite for ozone quenching

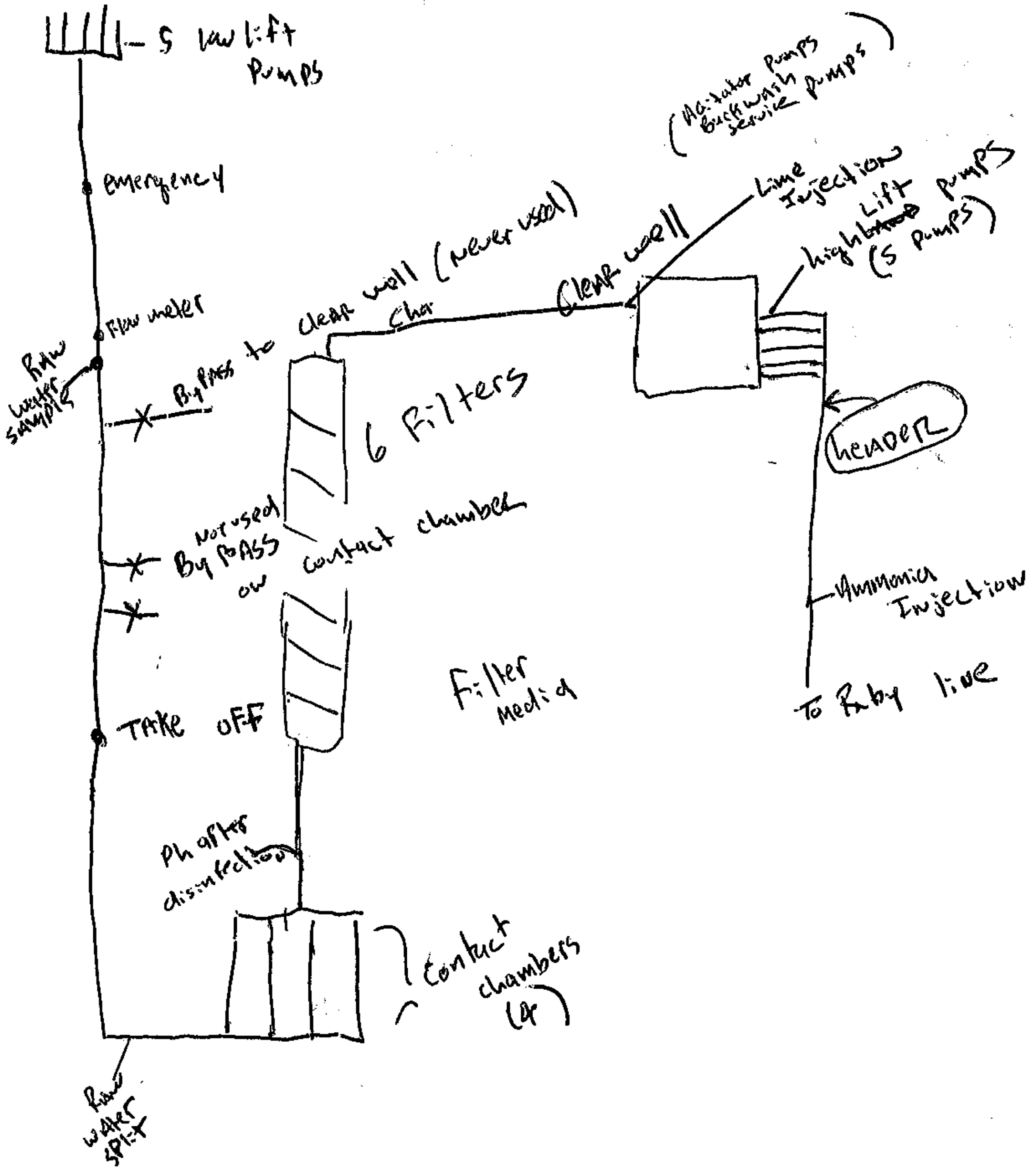
2003 - UPGRADE
108 MD @ 67
to 122

5 pumps - low lift and high lift

54" x 54" x 46" → lime

Site Visit Template - Page 2

PROCESS FLOW DIAGRAM



→ Backwash Right now @ 12 hrs

Site Visit Template - Page 3

On-Site pH Measurement Results

#1 Raw Water pH (before any treatment): 6.43

~~#4~~ Before pH adjustment:

pH 7.42 #3 After pH adjustment: 6.49 *

Before Disinfection:

#2 After Disinfection: ~~outlet @ o~~ 5.93

Describe sample locations, if needed:

#1 Raw water header → Before ozone

#2 After ozone → outlet @ ozone contactor, After Sodium Biosulfate

#3 After PH Adjustment → After cholorine addition, East clear well sample tap.

#4 Plant finish ~~@~~ after ammonia addition → potable tap @ lab = 6.54

LAB = 7.56

Buffer 668@ 10

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: TARGET PH @ clearwell 7.5

Current and/or typical average daily flow: Rated @ 108 ml. avg = 67.

Frequency of delivery of pH adjustment chemical:
See pg. 1

Frequency of media replacement for pH adjustment system:
N/A

Frequency and method used for measurement of pH:
on line AND Daily sampling

Adjustments to process in response to water quality changes:

→ Calculated through PLC

→ operators will adjust set point as needed to maintain 7.5 target In clear w

Describe routine maintenance practices for pH adjustment system:

→ P.M. Program IN place

History of discoloured water complaints and/or service leaks:

→ Colour → not many complaints

→ corrosion → challanges in ~~corrosi~~ distribution system – high pre. con / ductile iron

Other operational issues (making of stock solutions, mixing problems, etc.):

Problems → Intial system → air tibrator → heater was not big enough

→ ~~or~~ Air prep system for ozone generator

Ammonia dosage = 94.2% #A

HAve 3 ~~t~~ime slurry Pumps.

July 6th @ 12:15 p.m

Plant flow

65 m^3 /min Influent Raw

Effluent

17.05 m^3 / min

~~Cl~~ Lime

EAST dos 6.3 (.81 m^3/hr)
west dos 6.8 (1.0 m^3/hr)
~~Total Residual 2.29~~

Pump 1	37.7 %
2	0.1%
3	47.3 %

3 clorinators
#1 207 kg/D west
#2 194 kg/D EAST
#3 174 kg/D (off line) RAW water + B/W water

Cl

EAST dos = 4.7 mg/l
WEST dos = 4.9 mg/l
Total Cl Residual = 2.29

ammonia
dosage = 0.6 mg/l
cl: ~~N~~ NH_3 = 3.7

ozone dosage NOTE → one of generators down
Set point → 2.2 mg/l → ~~Auto~~ Actual = 1.36 mg/l
Flow to contact chamber reduce

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: St. John's

Source Name: Winsor Lake.

Source Type: Surface **Water Supply No. :** WS-S-0693

Service Area(s): St. John's

Service Area No. : SA-0718 **Service Population:** 81,517

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Lime + Co_2. pH 6.98.
5 main. pumps - 3 secondary. for backwash. water,
5 low lift pumps @ station.
Chlorine, Membrane system, UV (Intake 500' out 22' deep. 1200mm)

Operational Status: 24 hr/day

Type of Disinfectant: Cl gas. UV.

Point of Disinfectant Application: 2.6 mg/L

CO_2 - 32 ~~mg/~~ Kg/hr 26.7 mg/L

Point of pH Adjustment: At low lift - lime + Co_2, As soon As water comes in building
15 mg/L

Chemical or Filter Media Used for pH adjustment: lime

Supplier: Greymont. NB.

Concentration:

Solid/Liquid: powder. dry.

Feed Pump Capacity: 10,000 L/hr 4-5000 needs cleaning 100 gal/min

~~Filter Capacity:~~ new 2nd pump on the way parstaltic.

Solution/Day Tank Volume: ~~6' high~~. 2300L

Bulk Storage Volume: 50 tones

On-line Monitoring of pH: [✓ Y] N **Grab Sample for pH:** [✓ Y] N

Location of On-Line Analyzer: Various locations throughout plant.
(7.31 finishes)

Location(s) for Collection of Grab Samples: 20 locations throughout city.

Other Treatment Processes: 2 traveling screens, UV, CO_2.

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment): 6.24 pH

Before pH adjustment:

Lime + CO2. After pH adjustment: 6.74 pH

Going into Reservior ~~Before Disinfection~~: 6.62. pH

Domestic line. ~~After Disinfection~~: 6.56 pH.

Describe sample locations, if needed:
Sample sink in Lab

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 15 mg/L Lime.

Current and/or typical average daily flow: 65.1 mill Litres
62-63 million litres/day

Frequency of delivery of pH adjustment chemical: 1 - 4wks. 32 tonnes.

Frequency of media replacement for pH adjustment system: N/A.

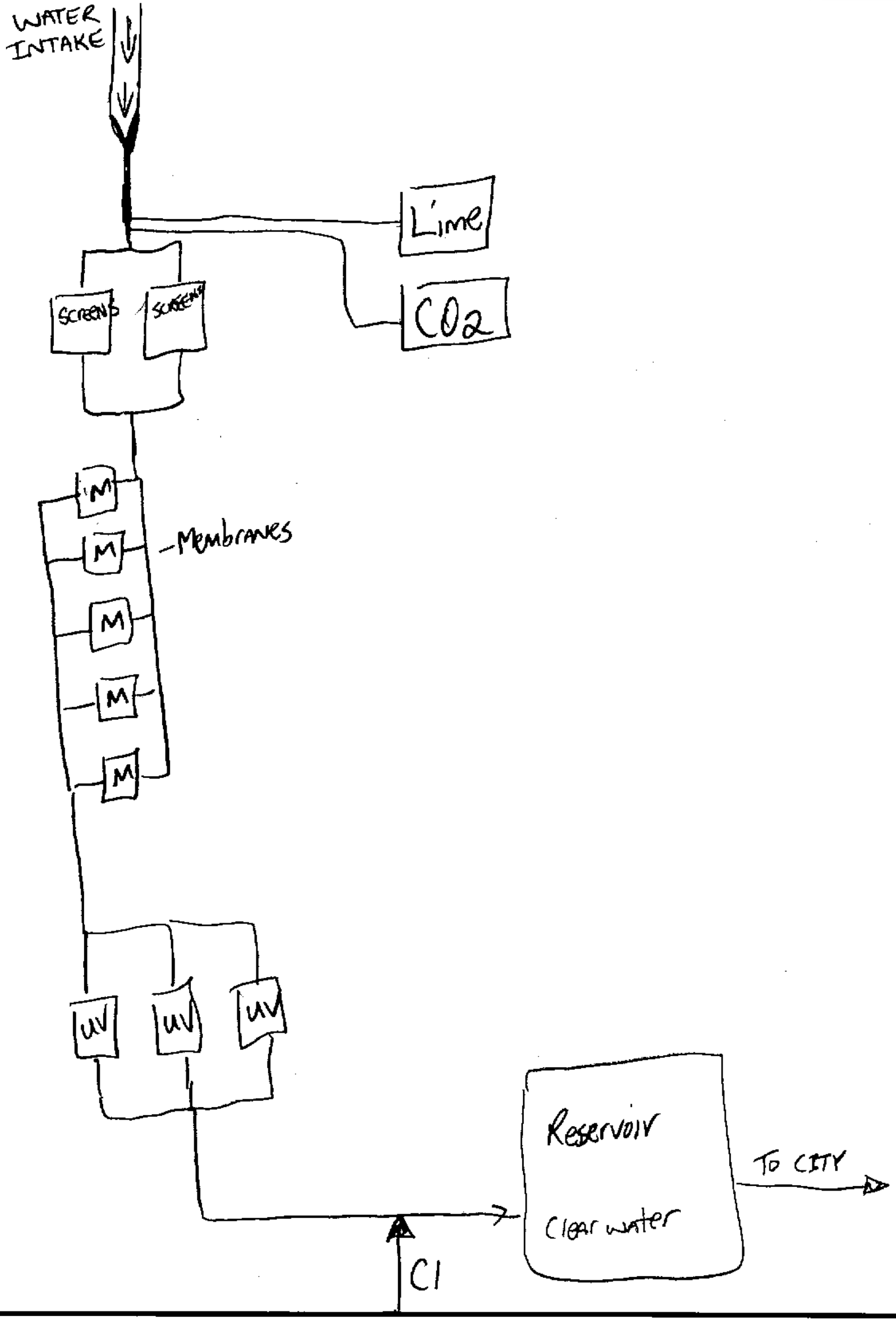
Target or Setpoint for pH in treated water: 7 - 7.2.

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage: 40 tonne sylo.
- flow paced., any adjustments are made from computer system.

Describe routine maintenance practices for pH adjustment system:
- Mix Tank cleaning twice / yr
- Lime pump cleaning monthly
- Lime line cleaning quarterly

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
Had trouble with feed system., ratholeing, vibrator / Air.
Tank caking 2-year, pump cleaning monthly, mixer ~~cake~~ -, line cleaning quarterly.

PROCESS FLOW DIAGRAM



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Summerford.

Source Name: Rushy Cove Pond

Source Type: Surface | **Water Supply No. :** WS-S-0721

Service Area(s): SA-0746 Summerford (+ Cottlesville)

Service Area No. : SA-0746. | **Service Population:**

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Intake ~ 100' out ~16' deep in wet well.
2 sets of steel mesh screens.
Soda Ash injected into wet well., then Cl gas before it leaves pumphouse.
New SYSTEM INSTALLED ~5 years. 10" Main 25% Ductile. 75% Plastic.

Operational Status: 24hr/day.

Type of Disinfectant: Cl gas. ~ AVG 12lbs/day depending on fish plant.

Point of Disinfectant Application: just before in leaves the pumphouse.
reg @55% + flucuatory

Point of pH Adjustment: put into the wet well.

Chemical or Filter Media Used for pH adjustment: Soda Ash.

Supplier: [illegible]er East Chem.

Concentration: 25Kg bag.

Solid/Liquid: Dry Powder.

Feed Pump Capacity: ProMinent Fluid Controls Ltd 144 L/H Model VAMB0412 0NP10U0D110

Filter Capacity: Set on 5 on knob. ProMinent Vario

Solution/Day Tank Volume: 2x 36"dia x 48" high 1 MIX 1 FEED.

Bulk Storage Volume: ~ 5 Kg

On-line Monitoring of pH: [✓ Y] N | **Grab Sample for pH:** [✓ Y] N

Location of On-Line Analyzer: Sensor right after pump., pH adjustment before Cl
reading 7.18 pH.

Location(s) for Collection of Grab Samples: Seniors Home 1-2 times month.

Other Treatment Processes:

Site Visit Template - Page 2

On-Site pH Measurement Results

Summerford

Raw Water pH (before any treatment): 7.32pH In Pond

Before pH adjustment:

After pH adjustment: 7.13 pH in wet well.

Before Disinfection:

After Disinfection: 6.75 pH @ seniors home ~3Km DS.

Describe sample locations, if needed:

Cl gas injected ~30' DS of wett well.

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 1 gal of Soda Ash per tank of water.

Current and/or typical average daily flow: 130gal/min. 230-300gal/min with plant (fish)

Frequency of delivery of pH adjustment chemical: 1 bag. every 2 years

Frequency of media replacement for pH adjustment system: N/A

Target or Setpoint for pH in treated water: ~7pH

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

manually set and flow paced

Describe routine maintenance practices for pH adjustment system:

NO. regular cleaning -

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

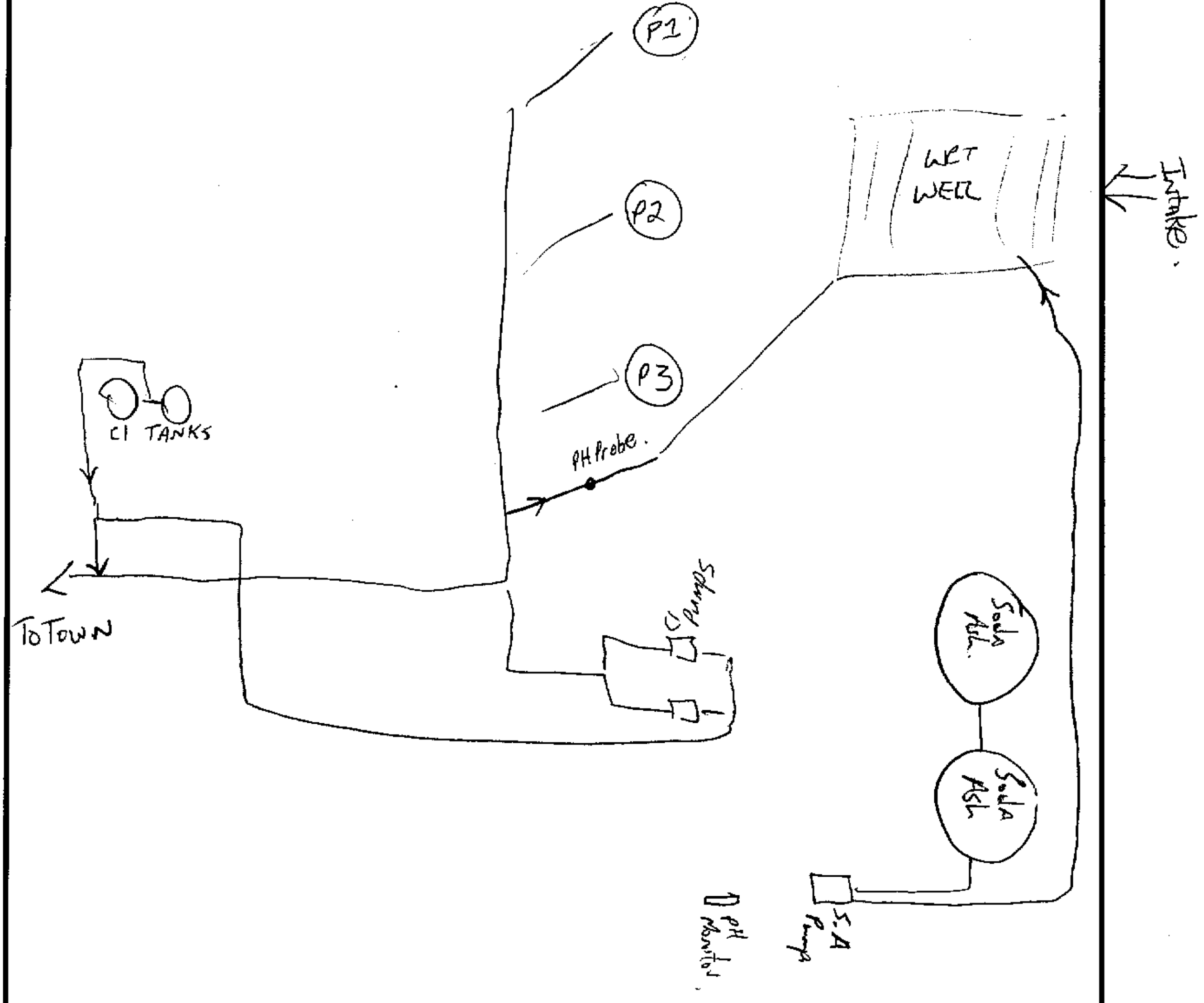
NO ISSUES

~2 leak in ductile corrosion from outside in. lots of new PVC pipe within last couple years.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Summerford



Note: follow up re- date of installation of pH adj. system

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Torbay

Source Name: North Pond

Source Type: surface water

Water Supply No. : WS-S-0740

Service Area(s): Torbay

Service Area No. : SA-0766

Service Population: 5230 (1996)

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: ~~24 hrs~~ [no flow meter]

Intake is ~16 ft deep ~ 50 feet off shore when pond is full

no screens on intake

all gravity feed to booster stations

Operational Status: operational ~24 hrs/d.

Type of Disinfectant: @ WTP Chlorine gas (hypo @ booster stations)

Point of Disinfectant Application:

gas applied ~~at~~ into raw water intake. (16" pipe)

Type of pH Adjustment System: lime

Point of pH Adjustment: lime injected 4' DS of Chlorine injection

16" Pipe 1" ID Injection pipe

Chemical or Filter Media Used for pH adjustment: hydrated lime

Supplier: Eastern Chemical

Concentration: (25 kg bags)

Solid/Liquid: dry

MSDS (Y/N):

Feed Pump Capacity: Motor (Electrol Model No. 22250000) 77gal/hr

Filter Capacity: n/a

Solution/Day Tank Volume: 20/27/24 in slurry tank vol.

Bulk Storage Volume: stored in bags on site. (~10 bags)

On-line Monitoring of pH: Y [✓ N]

Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer:

n/a

Location(s) for Collection of Grab Samples:

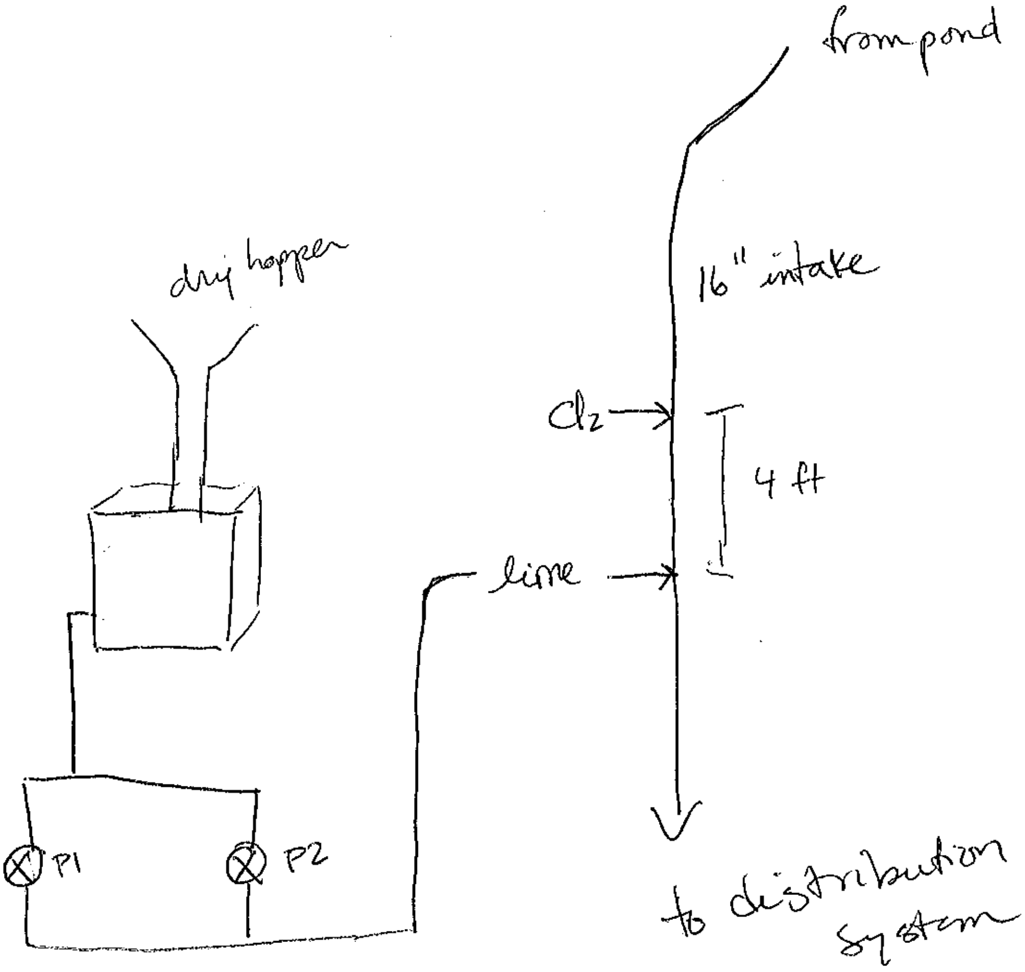
n/a

Other Treatment Processes:

n/a

Site Visit Template - Page 2

PROCESS FLOW DIAGRAM



Site Visit Template - Page 3

On-Site pH Measurement Results

② Raw Water pH (before any treatment): 6.12
① Before pH adjustment: 6.43
③ After pH adjustment: 6.15
Before Disinfection: X
After Disinfection: X

Describe sample locations, if needed:
① after disinfection, before pH adjustment (eye wash station)
② from pond (directly)
③ 30 Tynedale (~ 1 km downstream of WTP)
13th house on system

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage:
Duty pump is usually set @ 75% (set @ control panel)

Current and/or typical average daily flow: n/a

Frequency of delivery of pH adjustment chemical:
~ pick up 10 bags about every 8 weeks (25 kg bags)

Frequency of media replacement for pH adjustment system:
n/a

Frequency and method used for measurement of pH:
hand-held meter used every day @ garage kitchen and at one other location in system. (Needs)

Adjustments to process in response to water quality changes:
Aim for pH of 6.5 to 8. Speed of pumps is adjusted to maintain pH in distribution system in this range

Describe routine maintenance practices for pH adjustment system:
maintenance conducted on solenoid valves, diaphragms etc. as a result of aggressiveness of water

History of discoloured water complaints and/or service leaks:
not in relation to corrosion

Other operational issues (making of stock solutions, mixing problems, etc.):
- hopper is refilled (1 bag) ~ every 5 days.
- pump duty is rotated automatically every 24 hrs regardless of whether pump is fit
- not possible to measure water flow to solution tank.

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Trepassey

Source Name: Miller's Pond

Source Type: Surface | Water Supply No. : WS-S-0743

Service Area(s): Trepassey

Service Area No. : SA-0769 | Service Population: 1,176

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Raw water from river gets screen before entering underground pit Chlorine gas + Soda Ash Application

2 main pumps with small particulate filters.

Operational Status: 24 hr/day

Type of Disinfectant: Cl gas 8-10 lbs/day

Point of Disinfectant Application: ~6-8 DS of pump

Point of pH Adjustment: Unknown, solution goes into floor ~20' from Cl injection

Chemical or Filter Media Used for pH adjustment: Soda Ash, Brentag

Supplier: Eastern Chemical

Concentration: 25kg bags

Solid/Liquid: dry powder

Feed Pump Capacity: 17 gal/hr

Filter Capacity: N/A

Solution/Day Tank Volume: 500 L

Bulk Storage Volume: 24 bags

On-line Monitoring of pH: Y [✓ N] | Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer: pH check 1-2 times/week @ sink

Location(s) for Collection of Grab Samples:

Other Treatment Processes: N/A.

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment): 6.78 pH at river near intake
Before pH adjustment:
After pH adjustment:
Before Disinfection:
After Disinfection: 6.83 pH Hose at sink

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 12.5 Kg per 500 litres
U.S. Filter Model Chem-Ad C set @ 39 on gauge 2nd pump broke.

Current and/or typical average daily flow: 230 gal/min

Frequency of delivery of pH adjustment chemical: pickup 40 bags every 4 months

Frequency of media replacement for pH adjustment system: N/A

Target or Setpoint for pH in treated water: 4-7

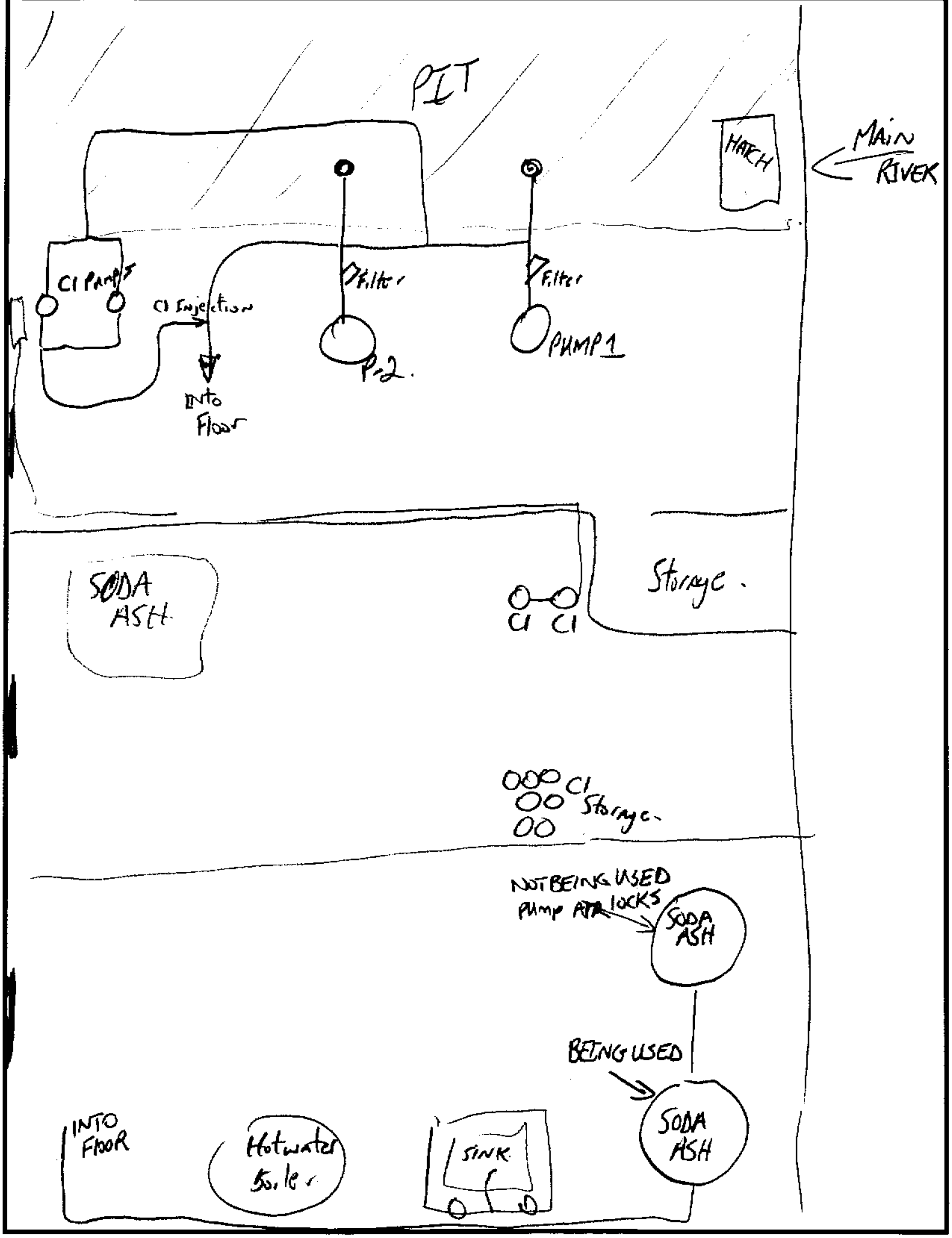
Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
pump is adjusted to increase or decrease flow rate.

Describe routine maintenance practices for pH adjustment system:

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
- Water boil in effect last 30 years
- boost Cl in winter
- 7-10 leaks/year on copper lines, 8" MAIN plastic

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



Glenn

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Trinity

Source Name: Indian Pond

Source Type: Surface | Water Supply No. : WS-S-0866

Service Area(s): SA-0902 Trinity T.B.

Service Area No. : SA-0902 | Service Population: 60

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity Feed Pump house 5yrs old.
165psi
Soda Ash solution and liquid Cl. injection.

Operational Status: 24 hr/day.

Type of Disinfectant: liquid Sodium Hypochlorite. LAVO "12"

Point of Disinfectant Application: on 4" line coming in.

(15L Soda Ash per 50 gallons water.)

Point of pH Adjustment: on 4" line coming in. Soda Ash first 74" US of Cl

Chemical or Filter Media Used for pH adjustment: Soda Ash. Brentag.

Supplier: O.M.B

Concentration: 25kg.

Solid/Liquid: Dry Powder.

Feed Pump Capacity: 2.50 GPH MAX Set@60

Filter Capacity: N/A.

Solution/Day Tank Volume: 50 gal Mix Tank. + 50 gal supply.

Bulk Storage Volume: 1 bag.

On-line Monitoring of pH: [✓ Y] N | Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer: 6" US of Cl injection

Location(s) for Collection of Grab Samples: Cl grabs. in town. various locations.

Other Treatment Processes:

Site Visit Template - Page 2

On-Site pH Measurement Results

Trinity

Raw Water pH (before any treatment): 6.25 valve @ intake in pumphouse.

Before pH adjustment: N/A.

After pH adjustment: N/A

Before Disinfection: N/A

After Disinfection: 8.01pH. (final). Sink before leaves pumphouse.

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 15L of Soda Ash per 50gal

Current and/or typical average daily flow: AVG 50gal/min.

Frequency of delivery of pH adjustment chemical: 2 bags at a time from Clarenville ~every month.
½ bag per 7-10 days.

Frequency of media replacement for pH adjustment system: N/A

Target or Setpoint for pH in treated water: 6.5

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
flow paced based on pH meter. pump set @ 60. (29 p/min).

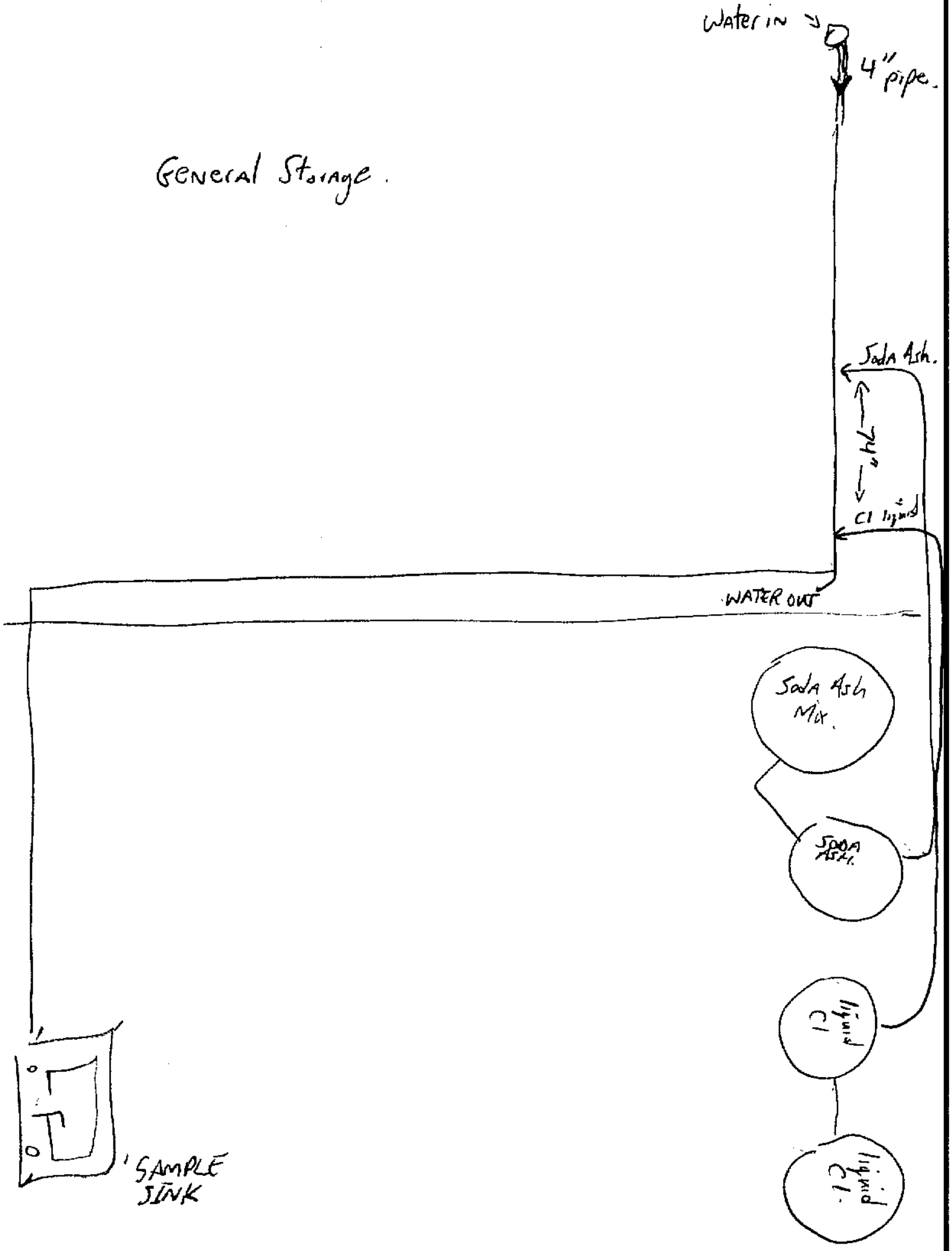
Describe routine maintenance practices for pH adjustment system:
Clean pumps ~ once/month.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
- Entire system is plastic. redone 5 yrs ago.
- No complaints about quality

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Trinity



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Trinity North.

Source Name: Whirl Pond

Source Type: Surface

Water Supply No. : WS-S-032

Service Area(s): SA-0894 Port Union, Catalina + Little Catalina.

Service Area No. : SA-0894

Service Population: 1,481

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process:
105psi Ductile. 6-14". copper service.

Operational Status: 24hr/day.

Type of Disinfectant: Cl gas. 130lb/day.

Point of Disinfectant Application: ~2Km upstream.

Point of pH Adjustment: 2 bags/day. 2 bags per 250gal tank.

Chemical or Filter Media Used for pH adjustment: Soda Ash.

Supplier: NL Ecotech. (Hare Bay.)

Concentration: 25Kg

Solid/Liquid: dry powder.

Feed Pump Capacity: 2x 77 GPH @ 30% on gauge. Encore 700 diaphraym. metering pump.

Filter Capacity:

Solution/Day Tank Volume: 2x 250gal.

Bulk Storage Volume: 27 bags on hand.

On-line Monitoring of pH: [✓ Y] N

Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer: just before. it leaves plant 5.51pH.

Location(s) for Collection of Grab Samples:

Other Treatment Processes:

Site Visit Template - Page 2

On-Site pH Measurement Results Trinity North

Raw Water pH (before any treatment):

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 6.00 pH taken from. analyser sample valve.

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 130 lb/day

Current and/or typical average daily flow: 1900 gal/min. with plant

Frequency of delivery of pH adjustment chemical: 60 bags/month when plant is running.

Frequency of media replacement for pH adjustment system: N/A

Target or Setpoint for pH in treated water: 6.5-7 pH.

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
small adjustments on pump manually. and. adjustments on soda ash mix.

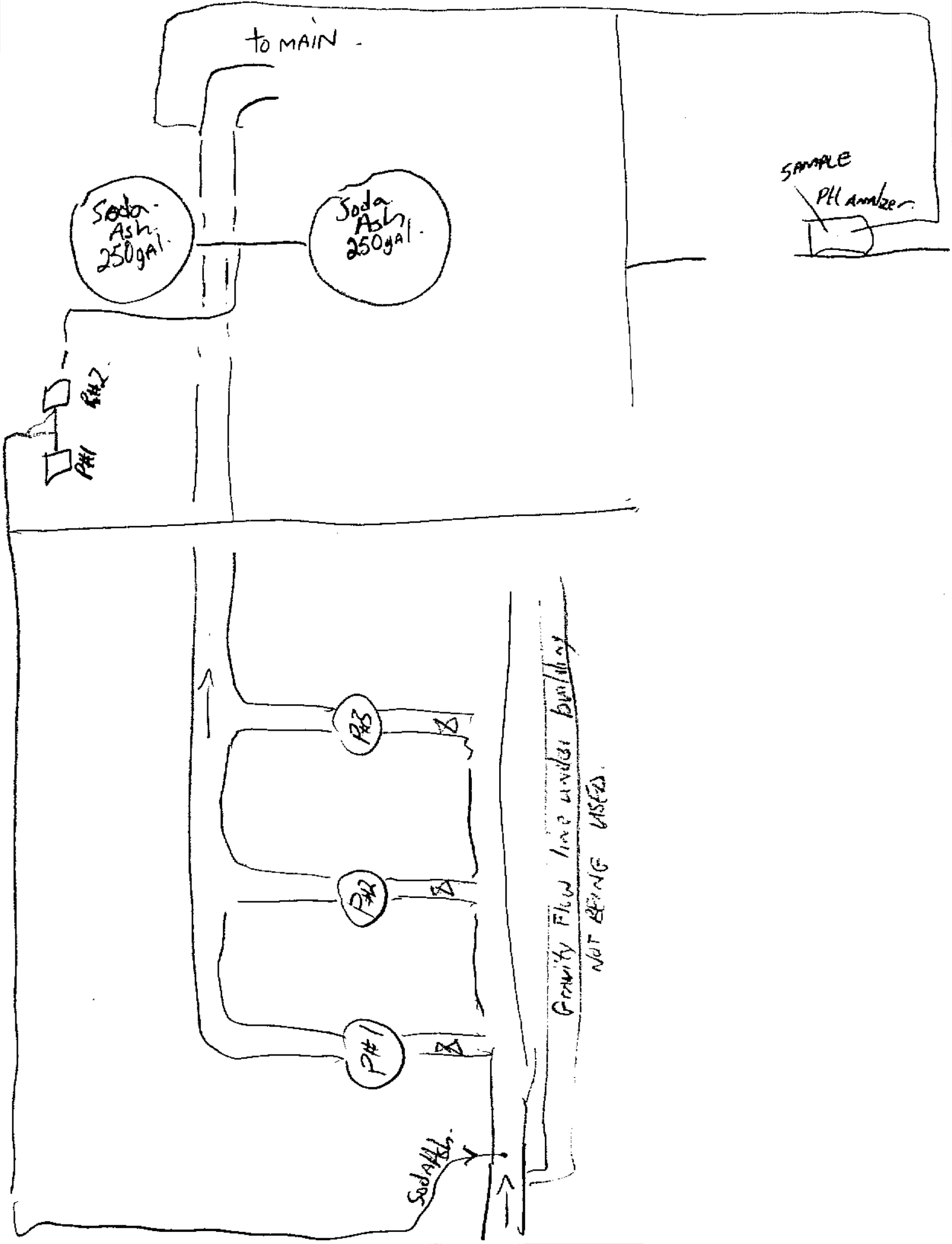
Describe routine maintenance practices for pH adjustment system:
Cleaning of Soda Ash tank., minor maintence. on pumps cleaning filters /greasing.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
- Leaks on copper flares. estimates. ~650-800. without plant. 60% leaks.
- Complaints on color, staining on bathtubs.
- Soda Ash. mix tanks. very dirty lots of organics.

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM

Trinity North



Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Victoria

Source Name: Rocky Pond

Source Type: Surface | Water Supply No. : WS-S-0761

Service Area(s): Victoria + Salmon Cove

Service Area No. : SA-0788 | Service Population: 2117

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Gravity feed system. Soda Ash + Chlorine gas Application
14" Intake 200-300' out ~25-30' deep. 10" coming to plant 8" MAIN

Operational Status: 24 hr/day

Type of Disinfectant: Cl gas

Point of Disinfectant Application: Assuming its after soda ash. just before main leaves building

Point of pH Adjustment: Unknown, Soda Ash line goes into floor near supply tanks.

Chemical or Filter Media Used for pH adjustment: Soda Ash.

Supplier: Eastern Chemical

Concentration: 25Kg

Solid/Liquid: dry powder

Feed Pump Capacity: MAX 4 GPH

Filter Capacity: N/A

Solution/Day Tank Volume: 2 x 140 gal tank. Seperate 140gal tank for mixing

Bulk Storage Volume: 5 bags on hand

On-line Monitoring of pH: [✓ Y] N | Grab Sample for pH: Y [✓ N]

Location of On-Line Analyzer: Inline with wate feed to sink. Reading 7.9 pH

Location(s) for Collection of Grab Samples: N/A.

Other Treatment Processes: Cl gas 5.8 lbs/day 55% dose 17"Hg

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment): 6.60pH hose on main

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection: 6.71pH @ sink

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: 1-25kg bag per 140gal lasts about 7 days Pump manually set at 60 strokes out of 100 (20 pumps/min)

Current and/or typical average daily flow: 430 GPM

Frequency of delivery of pH adjustment chemical: Every 12 weeks / 12 bags

Frequency of media replacement for pH adjustment system: N/A

Target or Setpoint for pH in treated water: 6.5 - 8

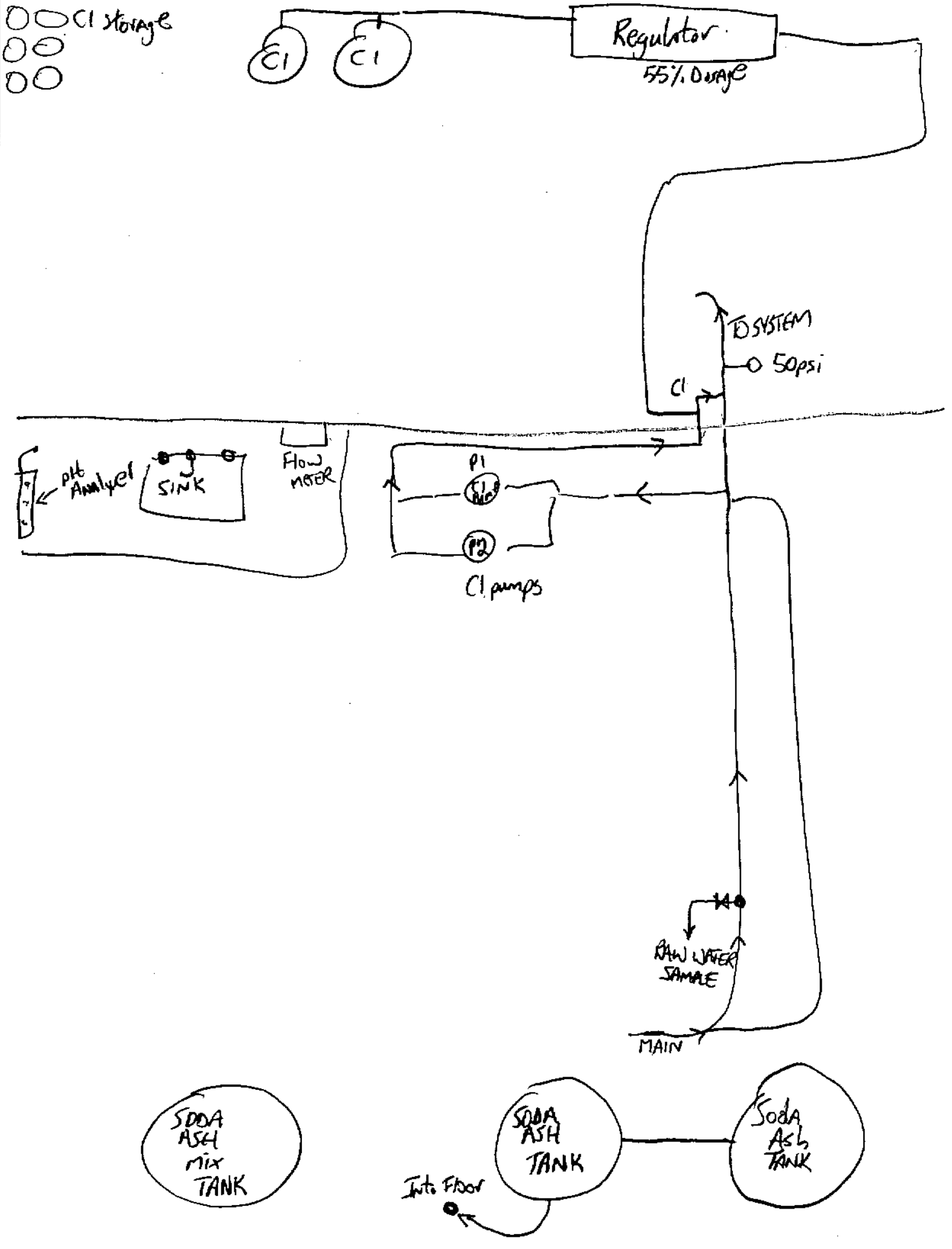
Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
Adjust pump manually to increase or decrease dosage.

Describe routine maintenance practices for pH adjustment system:
General Cleaning of pump & tanks on occasion

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
Occasional complaints about odour once or twice a year
60-70 leaks/year in copper pipes before pH adjustment system.
15-20 leaks/year in copper since pH system installed >7yrs ago

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



Alunzo CABot
927-5563 → 5641

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: West St. Modest

Source Name: wells #1 #3

Source Type: ground water

Water Supply No. : WS-G-0776

Service Area(s): west St. Modest

Service Area No. :

Service Population: 64 hook-ups

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process:

→ Javax 12 for PVC 1½ #3

1¼ #1

Approx 12,000 gal / 24 hr

Town Ductile Iron

Operational Status:

→ Running

Type of Disinfectant: Javex

Point of Disinfectant Application:

Before filtration

Point of pH Adjustment:

No Adjustment

Chemical or Filter Media Used for pH adjustment: N/A → no pH Adjustment

Supplier:

Concentration:

Solid/Liquid:

Feed Pump Capacity:

Filter Capacity:

Solution/Day Tank Volume:

Bulk Storage Volume:

On-line Monitoring of pH: Y [✓ N]

Grab Sample for pH: [✓ Y] N

Location of On-Line Analyzer:

No

Location(s) for Collection of Grab Samples:

→ Raw

→ After filtration and chlorine

Other Treatment Processes:

→ Sand filtration Green sand

80 liters per /180 for 2½ weeks

2 to 2½ weeks

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment):

Before pH adjustment:

After pH adjustment:

Before Disinfection:

After Disinfection:

Describe sample locations, if needed:

→ Ph @ Raw: ~~4~~ 6.75

→ After treatment: 6.60

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage:

N/A

Current and/or typical average daily flow:

12,000 l per 24 hrs

Frequency of delivery of pH adjustment chemical:

N/A

Frequency of media replacement for pH adjustment system:

N/A

Target or Setpoint for pH in treated water:

N/A

Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:

None

Describe routine maintenance practices for pH adjustment system:

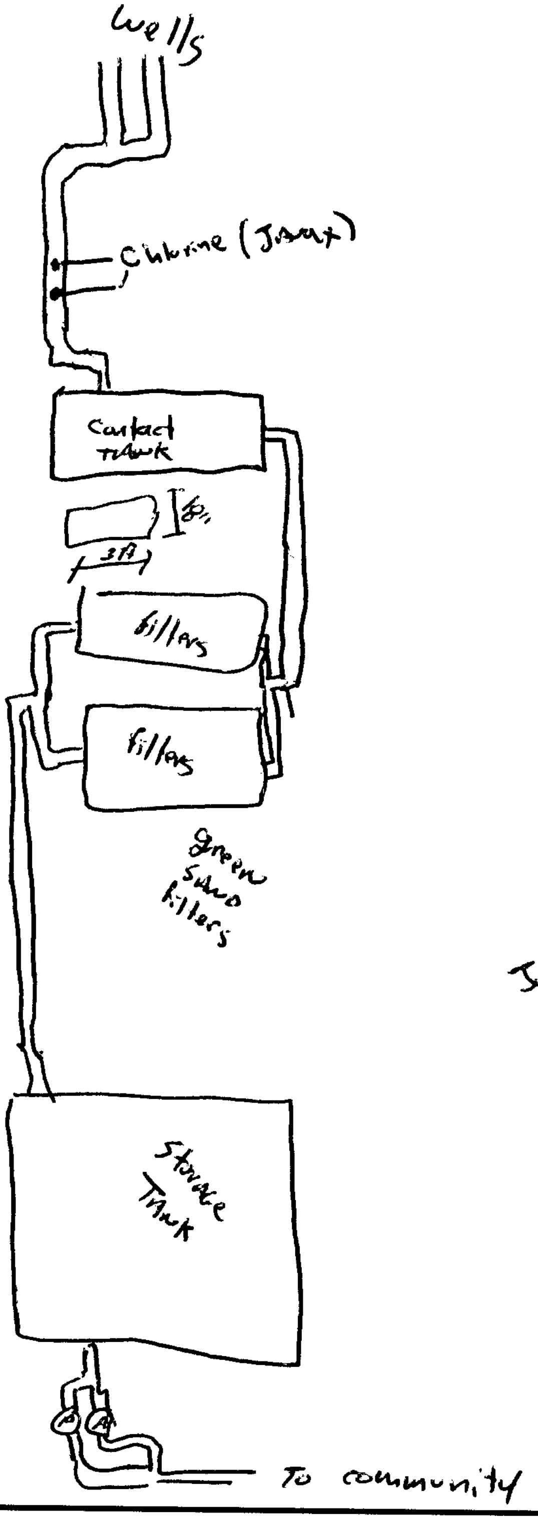
none

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):

Service leak or water colour Problems ?

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



→ Potassium Permngnganate
→ used to clean filters during BACKWASH

2 days a week

each filter backwash every second nigh
Alternate between 1 to the other

Javax
Two Diaphrom Pumps
MAX → Rated for gph
→ 110 psi

set at 40 %

Site Visit Template - Page 1

GENERAL SITE INFORMATION

Community Name: Whitbourne

Source Name: Hodges River

Source Type: Surface water

Water Supply No. : WS-S-0779

Service Area(s): Whitbourne

Service Area No. : SA-0807

Service Population: 847

TREATMENT SYSTEM INFORMATION

General Description of Treatment Process: Source water comes from river ~150' upstream of plant Intak ~12' deep in dug out hole. Water comes into pit under plant, goes through mesh scream. Cl + Soda Ash injected somewhere into pit (N/A) then pumped to water tower,

Operational Status: 24 hr/day

Type of Disinfectant: Chlorine gas

Point of Disinfectant Application: In pit below treatment plant
8-12 lb/day Cl gas

Point of pH Adjustment: In pit below treatment plant

Chemical or Filter Media Used for pH adjustment: Soda Ash. Brentag Dense Soda Ash.

Supplier: Eastern Chemical

Concentration: 25 Kg bag.

Solid/Liquid: dry powder

Feed Pump Capacity: 5.5 gal/hr MAX set @ 30% stroke length IWAKI metering pump

Filter Capacity: N/A

Solution/Day Tank Volume: 300 L tank.

Bulk Storage Volume: 9 bags on hand 40 bags every 1-2 months

On-line Monitoring of pH: Y [✓ N]

Grab Sample for pH: [✓ Y] N when required

Location of On-Line Analyzer: N/A
Provincial water guy checks pH once a week.

Location(s) for Collection of Grab Samples: Hose just before treated water leaves building

Other Treatment Processes: They were using lime solution up until 1 month ago with Soda Ash. (Regulator stopped working).
* fine mesh screen as raw water enters pit.

Site Visit Template - Page 2

On-Site pH Measurement Results

Raw Water pH (before any treatment):	6.59 pH taken @ river
Before pH adjustment:	
After pH adjustment:	
Before Disinfection:	
After Disinfection:	7.80 pH hose before leaving pumphouse

Describe sample locations, if needed:

OPERATIONAL ISSUES

Current and/or typical pH adjustment chemical dosage: Pump set @ 30%
~2gal of soda Ash per 100L of water

Current and/or typical average daily flow: NO METER.
3 pumps each pump pumps 60 gal/min to feed water tower

Frequency of delivery of pH adjustment chemical: 40 bags every 1-2 months

Frequency of media replacement for pH adjustment system:
N/A

Target or Setpoint for pH in treated water: 6.5-8

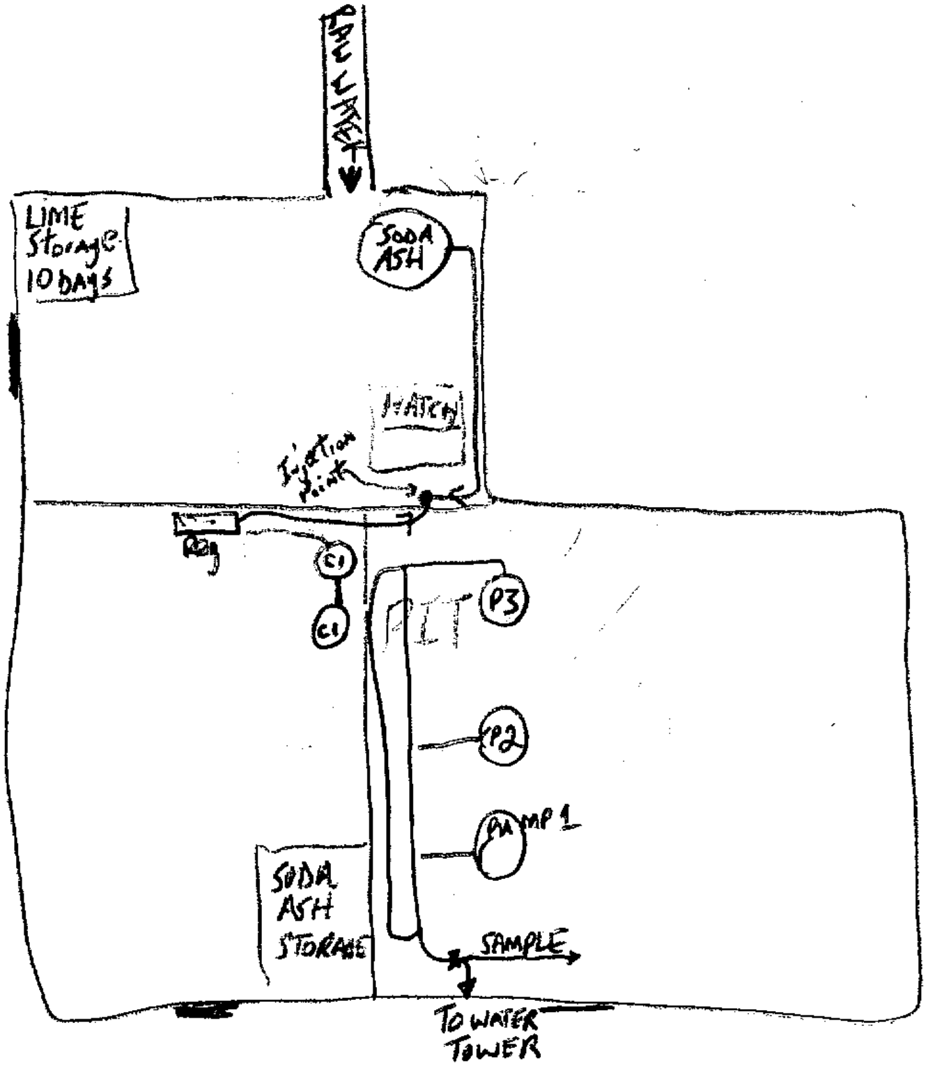
Describe available control modes for pH adjustment system (manual, flow paced) and how adjustments are made to pH adjustment chemical dosage:
pH is adjusted by increasing or decreasing pump speed.

Describe routine maintenance practices for pH adjustment system:
General cleaning of pump & mix tank.

Other operational issues (making of stock solutions, feed rate, mixing problems, etc.):
- lots of leaks in copper service lines on flares
- complaints of staining on

Site Visit Template - Page 3

PROCESS FLOW DIAGRAM



APPENDIX B
Task 3 Summary Sheets

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LIST OF FIGURES

1.0 AVONDALE

Water Supply Source: Lee's Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total trihalomethanes (THMs) in the treated water of 142 µg/L exceeds the Guidelines for Canadian Drinking Water Quality (GCDWQ) Maximum Acceptable Concentration (MAC) of 100 µg/L.
- The running annual average for total haloacetic acids (HAAs) in the treated water of 87 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 2004 to 2009, the raw water pH ranged from 6.4 to 7.7 with an average of 6.7. The treated water pH during the same period ranged from 6.4 to 9.0 with an average of 7.6. In general, the treated water pH is within the GCDWQ operational guideline (OG) of 6.5 to 8.5.
- The average dissolved organic carbon (DOC) concentration in the treated water for the period of 2004 to 2009 was approximately 4 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc were all found to be within acceptable levels.
- Treated water average Langelier Index (LI) for the period of 2004 to 2009 was reported as -2.4.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on disinfection by-product (DBP), DOC and metals concentrations.

Assessment of Effectiveness

- No pH adjustment process installed. Previously soda ash was used for pH adjustment at this facility.
- Not applicable. Treated water pH is typically within GCDWQ recommended range of 6.5 to 8.5.

Performance Limiting Factors

- Not applicable

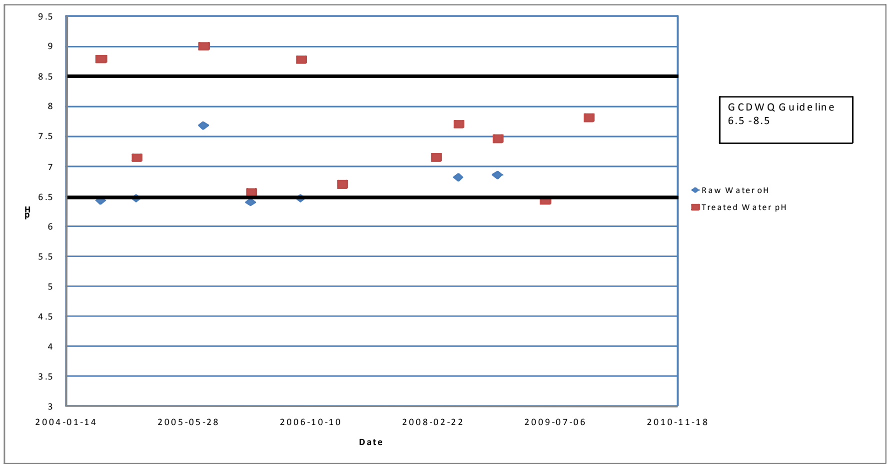

Figure B.1 Avondale Raw and Treated Water pH

2.0 BONAVISTA

Water Supply Source: Long Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 299 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 339 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1986 to 1999, prior to pH adjustment, the raw water pH ranged from 5.1 to 6.3 with an average of 6.0. After pH adjustment the raw water pH ranged from 4.7 to 6.3 with an average of 5.9 while the treated water pH ranged from 6.0 to 8.0 with an average of 6.9. The treated water pH is generally within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2000 to 2009 was approximately 5 mg/L.
- Iron concentrations above the GCDWQ AO of 0.3 mg/L have been observed in the treated water. The concentrations of aluminum, copper, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period of 2001 to 2009 was reported as -3.6.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP and DOC concentrations. In general, it appears that increases in treated water pH have a tendency to decrease iron levels in the distribution system.

Assessment of Effectiveness

- Based on the data provided, the pH treatment system appears to be effective. Treated water pH is typically within GCDWQ recommended range of 6.5 to 8.5.

Performance Limiting Factors

- Lack of automatic monitoring or control.
- Lack of redundancy for key process equipment.

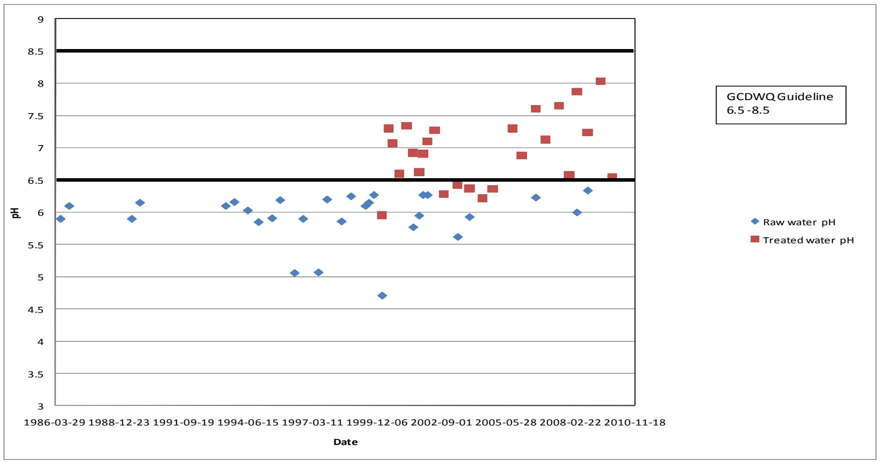

Figure B.2 **Bonavista Raw and Treated Water pH**

3.0 BRIGUS

Water Supply Source: Brigus Long Pond (to Brigus)

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 92 µg/L is below the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 143 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1987 to 2006, prior to pH adjustment, the raw water pH ranged from 5.9 to 6.9 with an average of 6.4. The treated water pH for this period ranged from 4.8 to 6.4 with an average of 5.4. After pH adjustment, the raw water pH ranged from 6.6 to 6.7 with an average of 6.6 while the treated water pH ranged from 5.4 to 6.7 with an average of 5.9. In general, the treated water pH is not within the GCDWQ OG of 6.5 to 8.5.
- The average DOC concentration in the treated water before and after the installation of the pH adjustment system was approximately 5 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before pH adjustment was -5.8 and after pH adjustment was -5.2.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5. In addition, the treated water pH is typically lower than raw water pH.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Operational objective for treated water pH is too low.
- Lack of automatic control.

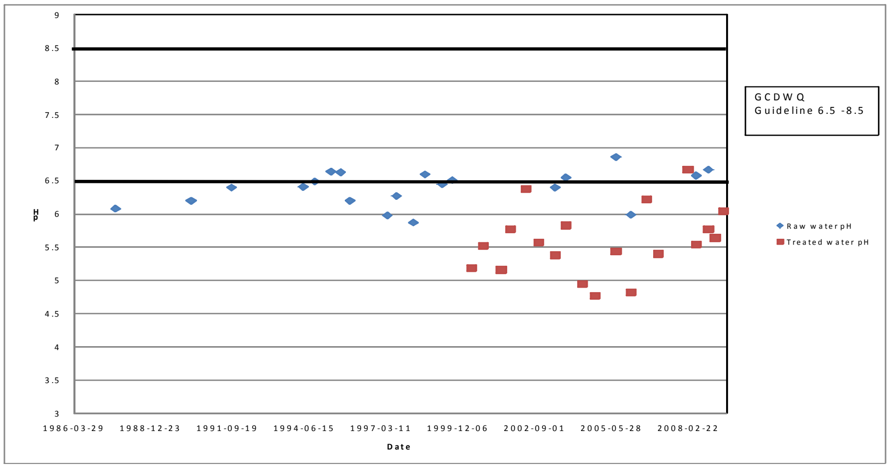

Figure B.3 Brigus Raw and Treated Water pH

4.0 BURGEO

Water Supply Source: Long Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 576 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 596 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1988 to 2009, prior to pH adjustment, the raw water pH ranged from 4.4 to 5.9 with an average of 5.0. The treated water pH for the period ranged from 4.5 to 7.0 with an average of 5.8. After the installation of the pH adjustment system, the raw water pH ranged from 5.0 to 5.9 with an average of 5.4 while the treated water pH ranged from 6.1 to 6.9 with an average of 6.6. The treated water pH is generally within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before and after pH adjustment was approximately 11 mg/L.
- Iron concentrations above the GCDWQ AO of 0.3 mg/L have been observed in the treated water. Copper, lead and zinc concentrations were found to be within acceptable levels. Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L, which is likely a result of the use of aluminum-based coagulants at the WTP.
- Treated water average LI for the period before pH adjustment was reported as -4.4 and after pH adjustment was reported as -3.2..

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP and DOC concentrations. There appears to be a relationship between lower treated water pH levels and increases in metals concentrations in the distribution system.

Assessment of Effectiveness

- The pH adjustment system at this location does appear to be effective in maintaining a treated water pH within the GCDWQ OG of 6.5 to 8.5. GCDWQ.

Performance Limiting Factors

- The use of ozonation and chlorine gas at the WTP may be resulting in lower treated water pH levels.
- WTP is still in commissioning phase (at time of site visit).

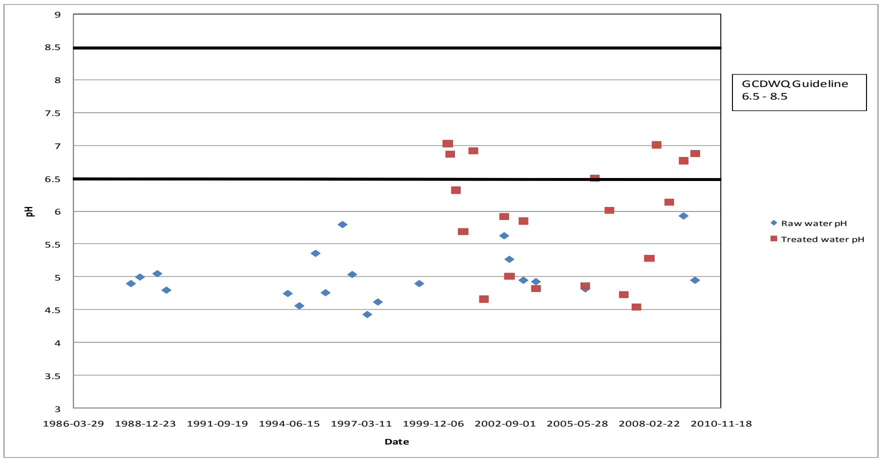

Figure B.4 Burgeo Raw and Treated Water pH

5.0 BURNT ISLANDS

Water Supply Source: Long Lake

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 16 µg/L is below the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 50 µg/L is below the GCDWQ MAC of 80 µg/L.
- For the period of 1994 to 2004, prior to the installation of pH adjustment, the raw water pH ranged from 4.6 to 5.6 with an average of 5.0. The treated water pH for the period ranged from 3.9 to 6.4 with an average of 4.8. After pH adjusted, the raw water pH ranged from 4.7 to 5.2 with an average of 5.0 and the treated water pH ranged from 4.2 to 5.4 with an average of 4.6 In general, the treated water pH is not within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before pH adjustment was approximately 5 mg/L and after pH adjustment was approximately 7 mg/L. The average raw water DOC was 5 mg/L, before pH adjustment and 9 mg/L after pH adjustment.
- The data indicate that the concentrations of copper, iron, lead and zinc are generally within acceptable levels. Aluminum concentrations are typically found at levels above the GCDWQ OG of 0.2 mg/L.
- Treated water average LI for the period before pH adjustment was reported as -6.4 and after pH adjustment was reported as -6.8.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on the DBP and DOC concentrations. In general, it appears that increases in treated water pH have a tendency to decrease metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH adjustment system at this location does not appear to be effective in maintaining a treated water pH within the GCDWQ OG of 6.5 to 8.5. Treated water pH was typically lower than raw water pH.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of automatic monitoring and control.
- Lack of redundancy for key process equipment.

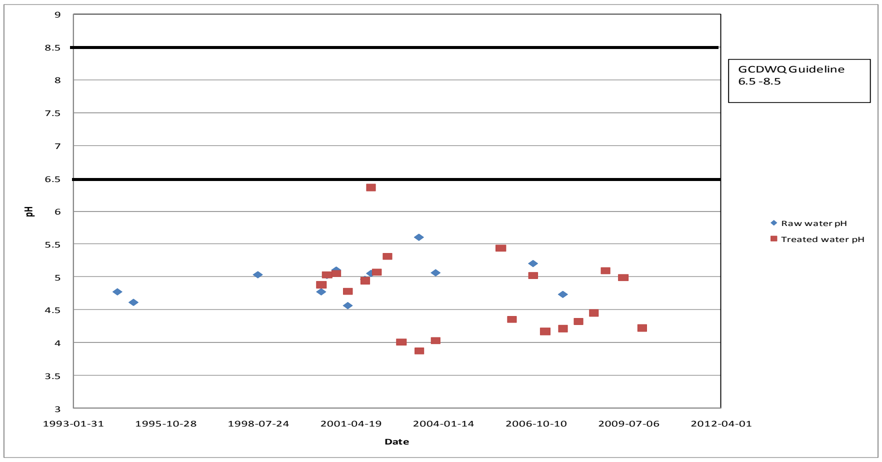

Figure B.5 **Burnt Islands Raw and Treated Water pH**

6.0 CAPE FREELS NORTH

Water Supply Source: Long Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The most recent data provided indicate that the running annual average for total THMs in the treated water of 318 µg/L exceeds the GCDWQ MAC.
- No data was provided for HAAs.
- For the period of 1992 to 2003, prior to pH adjustment, the raw water pH ranged from 5.0 to 5.4 with an average of 5.1. The treated water pH for the period ranged from 5.2 to 6.7 with an average of 5.4. After pH adjustment, the raw water pH ranged from 4.9 to 8.2 with an average of 5.7 and the treated water pH ranged from 5.2 to 6.7 with an average of 5.7. In general, the treated water pH is not within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water was approximately 6 mg/L, before pH adjustment and 10 mg/L, after pH adjustment. The raw water DOC was 5 mg/L, before pH adjustment and 10 mg/L, after pH adjustment,
- Treated water iron concentrations exceed the GCDWQ AO of 0.3 mg/L for the review period. Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as – 6.0 and after pH adjustment was reported as -5.6.

Based on the data provided, the implementation of pH adjustment at this facility does not appear to have had an influence on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- System not operational since Fall 2009.
- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5.

Performance Limiting Factors

- pH treatment system not operational.
- Lack of automatic monitoring and control.

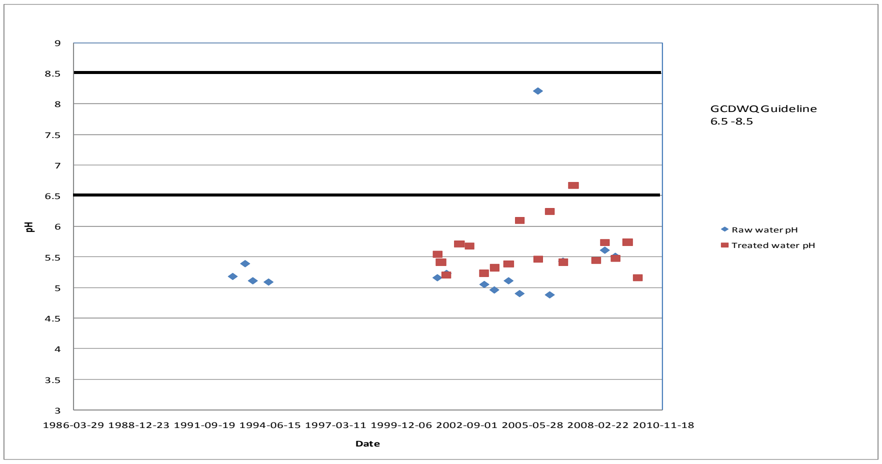

Figure B.6 Cape Freels North Raw and Treated Water pH

7.0 CARTWRIGHT

Water Supply Source: Burdett's Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 297 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 382 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1992 to 2004, prior to pH adjustment, the raw water pH ranged from 5.4 to 6.2 with an average of 5.7. The treated water pH for the period ranged from 5.7 to 6.4 with an average of 6.1. After pH adjustment, the raw water pH ranged from 4.6 to 6.2 with an average of 5.5 and the treated water pH ranged from 5.6 to 6.8 with an average of 6.4. After pH adjustment the treated water pH was occasionally within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period prior to pH adjustment was approximately 10 mg/L and after pH adjustment was 11 mg/L. The raw water DOC average prior to pH adjustment was 8 mg/L and after pH adjustment was 11 mg.L.
- Treated water iron concentrations exceed the GCDWQ AO of 0.3 mg/L for the review period. Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period prior to pH adjustment was reported as -4.5 and after pH adjustment was reported as -4.2.

Based on the data provided, the implementation of pH adjustment at this facility does not appear to have had an influence on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- The pH treatment system was not operational at the time of the site visit.
- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5.

Performance Limiting Factors

- Lack of automatic monitoring.
- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.
- Operational objective for treated water pH is too low.

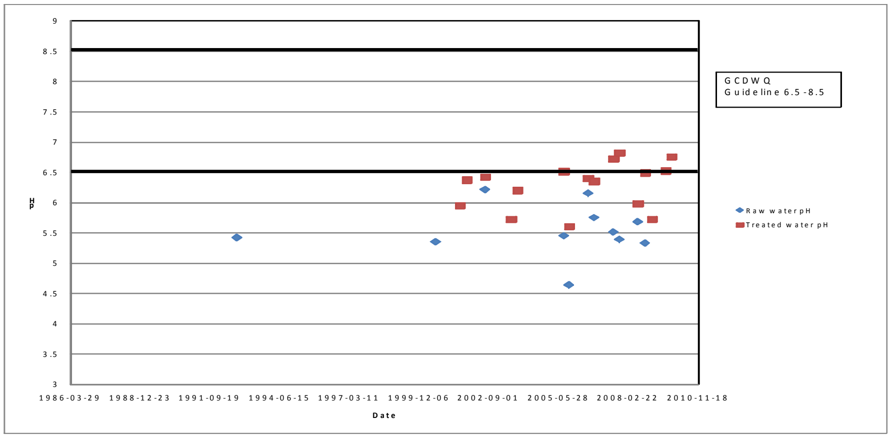

Figure B.7 Cartwright Raw and Treated Water pH

8.0 CENTREVILLE-WAREHAM-TRINITY (NORTHWEST POND)

Water Supply Source: Northwest Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 106 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 186 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1988 to 2005, prior to pH adjustment, the raw water pH ranged from 5.8 to 6.7 with an average of 6.3. The treated water pH for the period ranged from 4.8 to 5.8 with an average of 5.3. After pH adjustment, the raw water pH ranged from 6.2 to 6.7 with an average of 6.4 and the treated water pH ranged from 4.6 to 6.6 with an average of 5.4. In general, the treated water pH is not within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before and after pH adjustment was approximately 6 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before and after pH adjustment was reported as -5.7.

Based on the data provided, it appears that the implementation pH adjustment at this facility has not had a significant effect on DBP and DOC concentrations. Treated water metals concentrations appear to decrease as pH increases.

Assessment of Effectiveness

- System not operational at the time of the site visit.
- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5. In addition, the treated water pH is typically lower than raw water pH.

Performance Limiting Factors

- pH treatment system not operational.
- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.

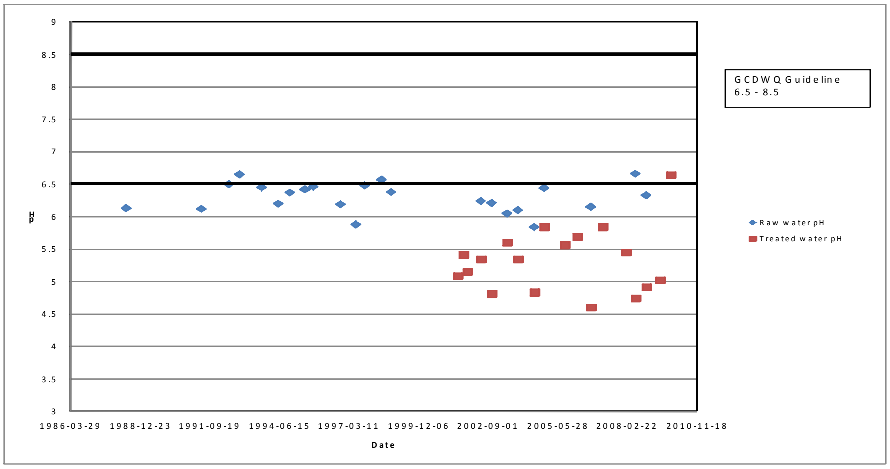

Figure B.8 **Centreville-Wareham-Trinity (Northwest Pond) Raw and Treated Water pH**

9.0 CENTREVILLE-WAREHAM-TRINITY (SOUTHWEST POND)

Water Supply Source: Southwest Feeder Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 221 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 286 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1986 to 2005,prior to pH adjustment, the raw water pH ranged from 5.4 to 6.2 with an average of 5.8. The treated water pH for the period ranged from 4.3 to 5.6 with an average of 4.7. After pH adjustment, the raw water pH ranged from 5.6 to 6.0 with an average of 5.8 and the treated water pH ranged from 4.6 to 6.4 with an average of 5.5. In general, the treated water pH is not within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before pH adjustment and after pH adjustment was approximately 7 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as -6.5 and after pH adjustment was reported as -5.8.

Based on the data provided, it appears that the implementation of pH adjustment at this facility has not had a significant effect on the DBP, DOC and metals concentrations.

Assessment of Effectiveness

- System not operational at the time of the site visit since Fall 2009.
- Based on the data provided the pH treatment system is not effective. Treated water pH was typically lower than raw water pH. The treated water did not meet the GCDWQ guideline range of 6.5 to 8.5.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- pH treatment system not operational.
- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.

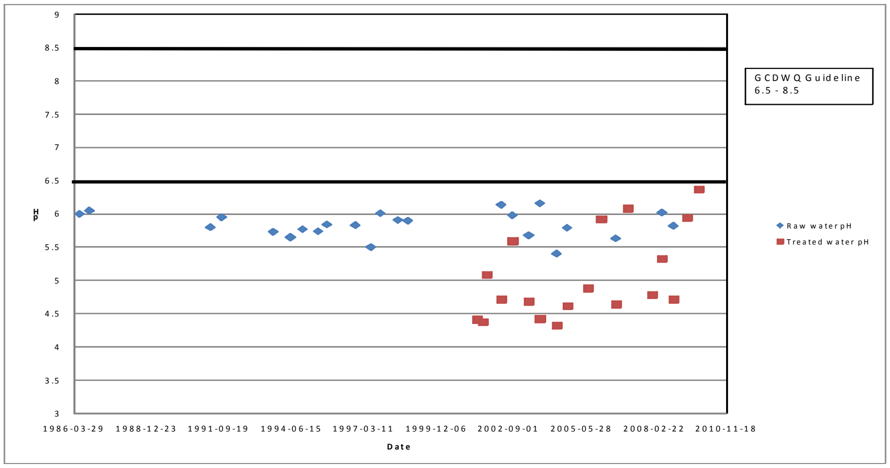

Figure B.9 **Centreville-Wareham-Trinity (Southwest Pond) Raw and Treated Water pH**

10.0 CHANNEL-PORT AUX BASQUES

Water Supply Source: Gull Pond & Wilcox Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 80 µg/L is below the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 105 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1988 to 2009, the raw water pH ranged from 4.6 to 6.5 with an average of 5.3. The treated water pH for the period of 2001 to 2009 ranged from 4.5 to 6.7 with an average of 5.8. The treated water pH is generally not within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2001 to 2009 was approximately 2 mg/L.
- Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, iron, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period of 2001 to 2009 was reported as - 4.6.

Based on the data provided, it appears that the implementation of pH adjustment at this facility has not had a significant effect on the DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5. In addition, the treated water pH is typically lower than raw water pH. This may be a result of the use of chlorine gas as the primary disinfectant at this facility, which can depress the pH of the water.

Performance Limiting Factors

- Lack of redundancy for key process equipment.
- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.

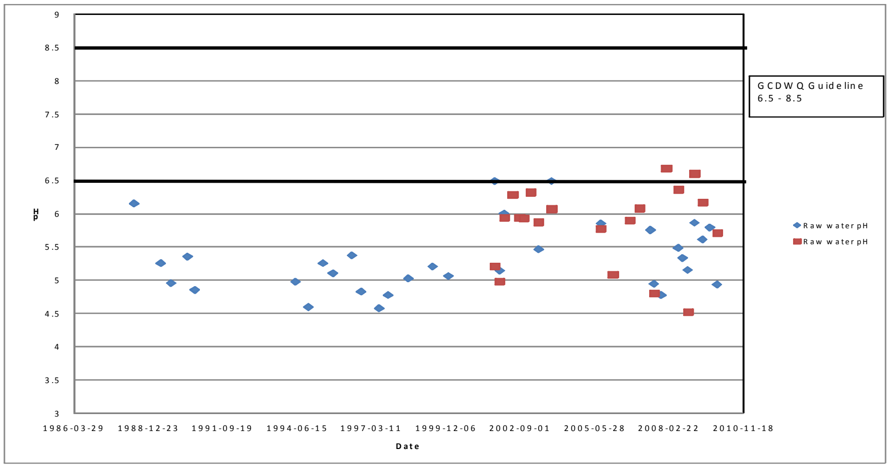

Figure B.10 Channel-Port Aux Basques Raw and Treated Water pH

11.0 CLARENVILLE

Water Supply Source: Shoal Harbour River

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 55 µg/L is below the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 58 µg/L is below the GCDWQ MAC of 80 µg/L.
- For the period of 1987 to 2009, the raw water pH ranged from 5.6 to 6.9 with an average of 6.5. The treated water pH for the period of 2008 to 2009 ranged from 6.7 to 7.3 with an average of 7.1. In general, the treated water pH is within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2001 to 2009 was approximately 2 mg/L.
- Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, iron, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period of 2008 to 2009 was reported as - 2.5.

Based on the data provided, it appears that the implementation of pH adjustment at this facility has not had a significant effect on the DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided, the pH treatment system appears to be effective. Treated water pH is typically within GCDWQ recommended range of 6.5 to 8.5.

Performance Limiting Factors

- None.

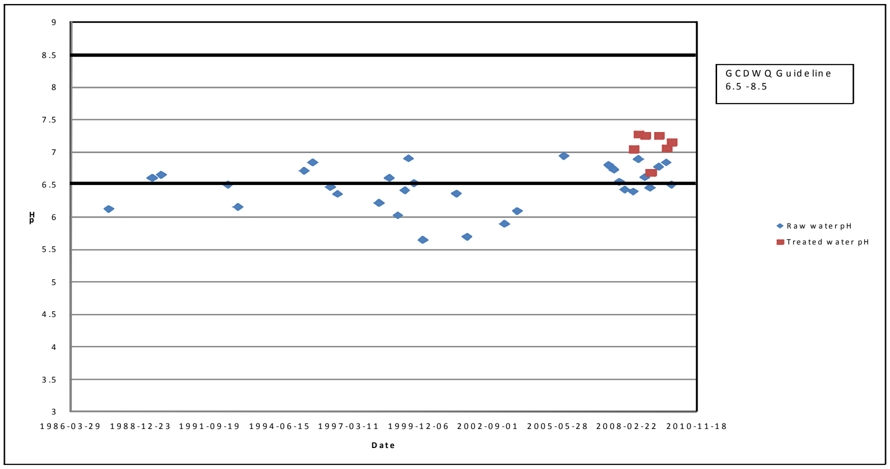

Figure B.11 Clarenville Raw and Treated Water pH

12.0 COME BY CHANCE

Water Supply Source: Butchers Brook

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 180 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 135 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1987 to 2003, prior to pH adjustment, the raw water pH ranged from 6.0 to 7.1 with an average of 6.6. The treated water pH for the period ranged from 6.0 to 7.2 with an average of 6.7. After pH adjustment, the raw water pH ranged from 6.7 to 7.2 with an average of 6.9 and the treated water pH ranged from 6.5 to 7.3 with an average of 6.9. The treated water pH is generally within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before pH adjustment and after pH adjustment was approximately 6 mg/L.
- Treated water iron concentrations exceed the GCDWQ AO of 0.3 mg/L for the review period. The concentrations of aluminum, copper, lead and zinc are generally within acceptable levels.
- Treated water average LI was reported as - 3.5, for the period before pH adjustment and as -3.4 for the period after pH adjustment.

Based on the data provided, it appears that the implementation of pH adjustment at this facility has not had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- System not operational at the time of the site visit since 2009.
- Based on the data provided raw water pH and treated water pH were similar regardless of the operational status of the pH adjustment system. There is information available is insufficient to make a determination of the effectiveness of the system.

Performance Limiting Factors

- Lack of redundancy for key process equipment.
- Lack of automatic monitoring or control.
- Operational objective for treated water pH is too low.

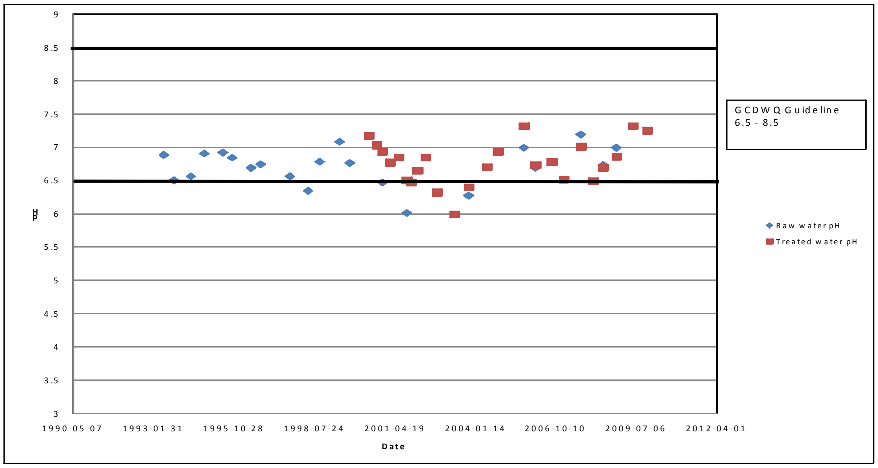

Figure B.12 Come By Chance Raw and Treated Water pH

13.0 EASTPORT

Water Supply Source: Dug

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- Limited data was provided for total THMs and HAAs, however, the results reviewed indicate that both of these parameters were detected at levels below the GCDWQ MAC.
- For the period of 1987 to 2008, prior to pH adjustment, the raw water pH ranged from 6.2 to 6.9 with an average of 6.5. The treated water pH during the same period ranged from 6.1 to 7.0 with an average of 6.4. After pH adjustment, the treated water pH ranged from 6.5 to 7.3 with an average of 6.9. After pH adjustment treated water pH levels within the GCDWQ guideline of 6.5 to 8.5 have been observed.
- The average DOC concentration in the treated water for the period of 2001 to 2009 was approximately 0.2 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as - 3.2 and after pH adjustment was reported as -2.7.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP and DOC concentrations.

Assessment of Effectiveness

- The pH adjustment system is designed and can be operated such that it is effective in providing treated water that meets the GCDWQ OG.

Performance Limiting Factors

- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.
- Operational objective for treated water pH is too low.

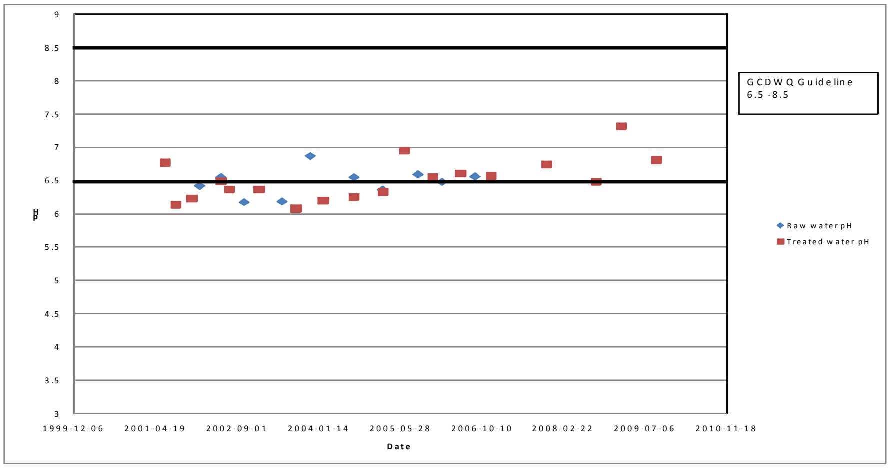

Figure B.13 Eastport Raw and Treated Water pH

14.0 FOGO

Water Supply Source: Freeman's Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 121 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 246 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1989 to 2001, prior to pH adjustment, the raw water pH ranged from 5.4 to 6.5 with an average of 5.9. The treated water pH for the same period ranged from 6.1 to 6.4 with an average of 6.3. After pH adjustment, the raw water pH ranged from 5.3 to 6.1 with an average of 5.8 and the treated water pH ranged from 3.1 to 6.2 with an average of 4.6. In general, the treated water pH is not within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before pH adjustment was approximately 12 mg/L and after pH adjustment was 14 mg/L. The average raw water pH was 10 mg/L, before pH adjustment and 12 mg/L, after ph adjustment.
- Treated water iron and aluminum concentrations exceed the GCDWQ AO of 0.3 mg/L and OG of 0.2 mg/L, respectively, for the review period. The concentrations of copper, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as – 4.7 and after adjustment was reported as -6.4.

Based on the data provided, it appears that the implementation of pH adjustment at this facility has not had a significant effect on the DBP, DOC and metals concentrations.

Assessment of Effectiveness

- System not operational at the time of the site visit since October 2009.
- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5. In addition, the treated water pH is typically lower than raw water pH.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of automatic monitoring or control.

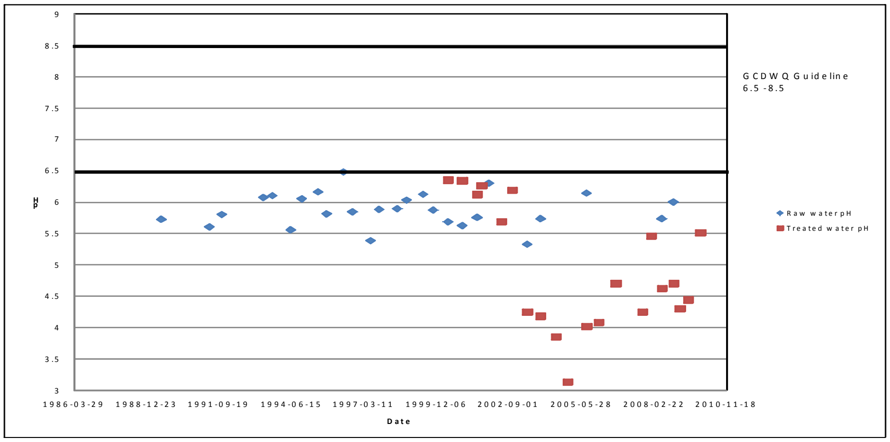

Figure B.14 Fogo Raw and Treated Water pH

15.0 GANDER

Water Supply Source: Gander Lake

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 121 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 88 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1993 to 2005, prior to pH adjustment, the raw water pH ranged from 5.9 to 6.9 with an average of 6.4. The treated water pH for the same period ranged from 5.4 to 6.9 with an average of 6.3. After pH adjustment, the raw water pH ranged 6.2 to 6.9 with an average of 6.5 and the treated water pH ranged from 6.1 to 7.2 with an average of 6.7. Treated water pH levels below the GCDWQ guideline of 6.5 to 8.5 have been observed on occasion.
- The average DOC concentration in the treated water for the period before pH adjustment and after pH adjustment was approximately 6 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as – 4.0 and after pH adjustment was reported as -3.8.

Based on the data provided, it appears that the implementation of pH adjustment at this facility has not had a significant effect on the DBP, DOC and metals concentrations.

Assessment of Effectiveness

- The pH adjustment system is designed and can be operated such that it is effective in providing treated water that meets the GCDWQ OG.

Performance Limiting Factors

- Lack of redundancy for key process equipment.

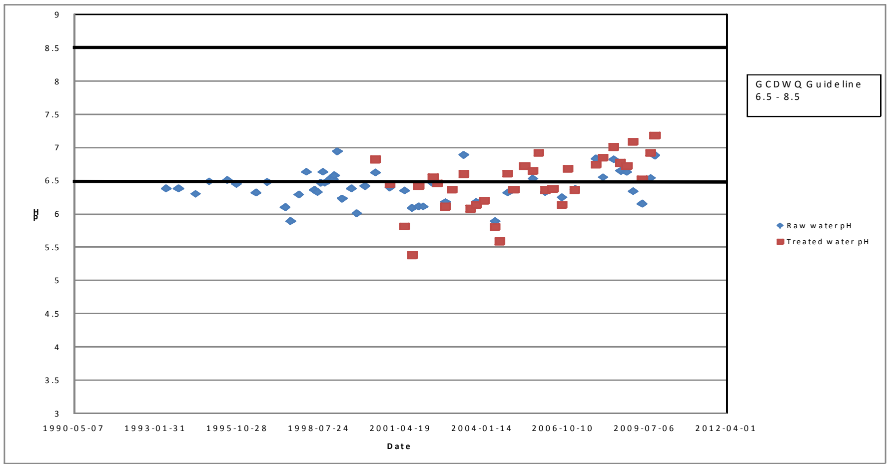

Figure B.15 Gander Raw and Treated Water pH

16.0 GLOVERTOWN

Water Supply Source: Northwest Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 113 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 135 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1987 to 2007, prior to pH adjustment, the raw water pH ranged from 4.2 to 6.7 with an average of 6.2. The treated water pH for the same period ranged from 4.7 to 6.3 with an average of 5.1. After pH adjustment, the raw water pH ranged from 6.4 to 6.5 with an average of 6.4 and the treated water pH ranged from 5.3 to 6.3 with an average of 5.9. In general, the treated water pH is not within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before and after pH adjustmet was approximately 7 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI of was reported as – 6.1 for the period before pH adjustment and as -5.2 for the period after pH adjustment.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5. In addition, the treated water pH is typically lower than raw water pH.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.

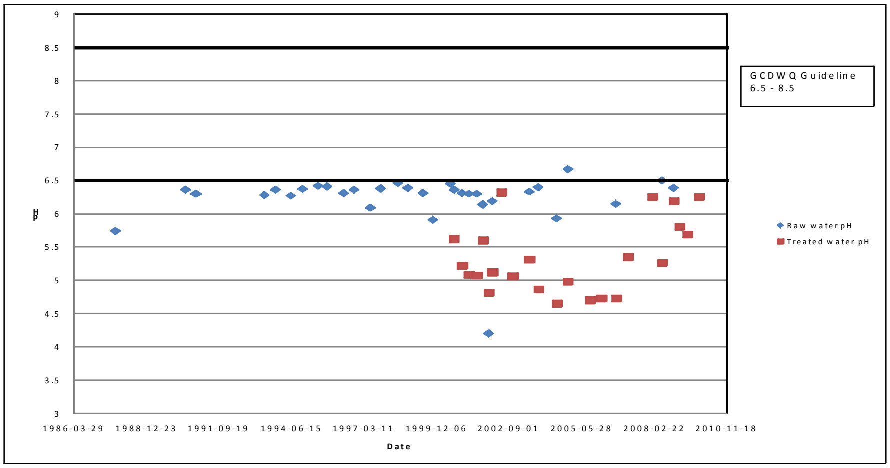

Figure B.16 Glovertown Raw and Treated Water pH

17.0 GRAND FALLS - WINDSOR

Water Supply Source: North Arm Lake

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 122 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 131 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1987 to 2009, the raw water pH ranged from 5.9 to 7.4 with an average of 6.4. The treated water pH for the period of 2000 to 2009 ranged from 6.2 to 7.4 with an average of 6.8. The treated water pH is generally within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2001 to 2009 was approximately 3 mg/L.
- Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period of 2000 to 2009 was reported as - 3.0.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided, the pH treatment system appears to be effective. Treated water pH is typically within GCDWQ recommended range of 6.5 to 8.5.

Performance Limiting Factors

- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.

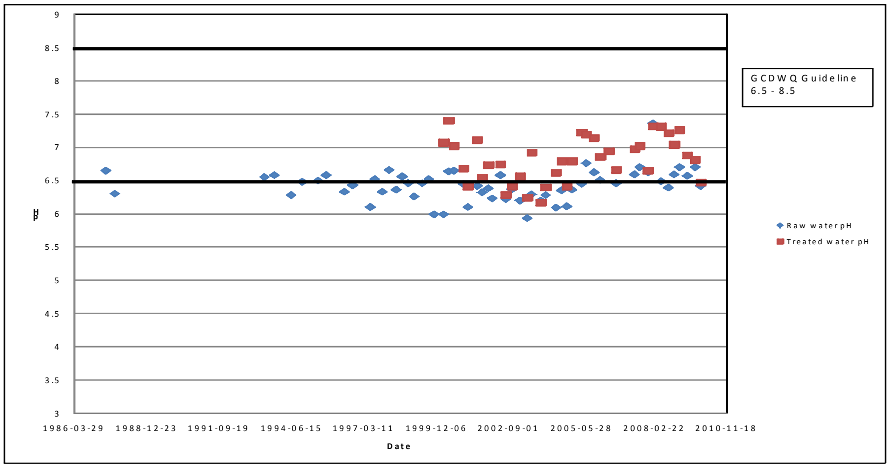

Figure B.17 Grand Falls-Windsor Raw and Treated Water pH

18.0 HAPPY VALLEY-GOOSE BAY

Water Supply Source: Well Field

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 65 µg/L is below the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 38 µg/L is below the GCDWQ MAC of 80 µg/L.
- For the period of 2001 to 2009, the raw water pH ranged from 6.5 to 7.3 with an average of 7.0. The treated water pH for the period of 2002 to 2009 ranged from 6.3 to 7.8 with an average of 7.1. The treated water pH is generally within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2001 to 2009 was approximately <1 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period of 2005 to 2009 was reported as - 1.9.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided, the pH treatment system appears to be effective. Treated water pH is typically within GCDWQ recommended range of 6.5 to 8.5.

Performance Limiting Factors

- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.

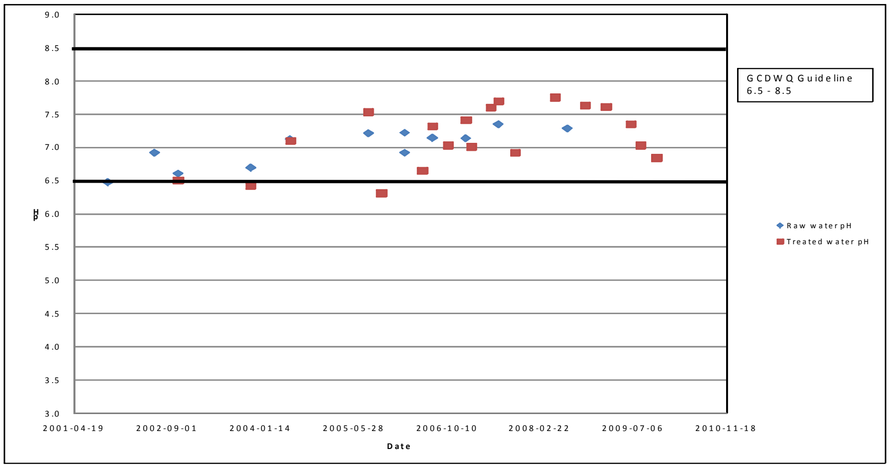

Figure B.18 Happy Valley Goose Bay Raw and Treated Water pH

19.0 HARE BAY

Water Supply Source: Hare Bay Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 149 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 178 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1988 to 2007, prior to pH adjustment, the raw water pH ranged from 5.3 to 6.6 with an average of 5.8. The treated water pH for the same period ranged from 4.2 to 6.7 with an average of 5.1. After pH adjustment, the raw water pH ranged from 5.6 to 5.8 with an average of 5.7 and the treated water pH ranged from 5.9 to 6.8 with an average of 6.4. In general, after pH adjustment the treated water pH was occasionally within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before and after pH adjustment was approximately 9 mg/L.
- Treated water iron concentrations exceed the CDWQ AO of 0.3 mg/L for the review period. Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as – 6.3 and after pH adjustment was reported as – 4.6.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided the pH treatment system is not effective. The treated water pH was typically lower than raw water pH. The treated water did not meet the GCDWQ guideline range of 6.5 to 8.5.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.

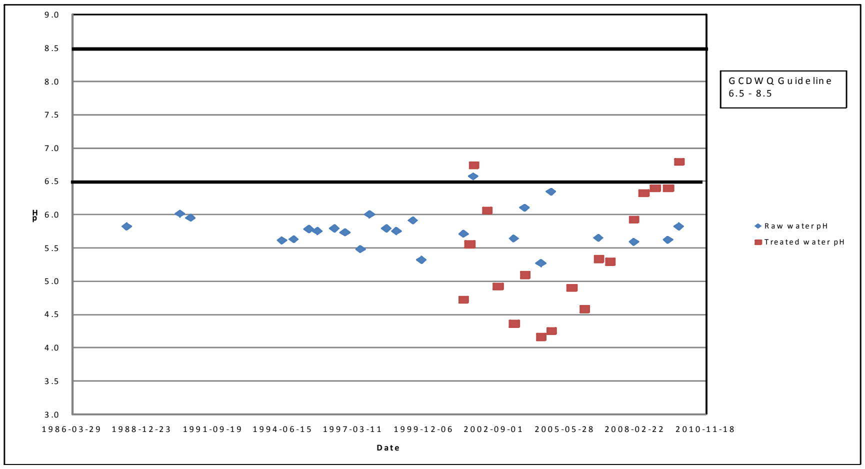

Figure B.19 Hare Bay Raw and Treated Water pH

20.0 HERMITAGE

Water Supply Source: Granfer's Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 268 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 538 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1987 to 2009, the raw water pH ranged from 5.1 to 6.7 with an average of 5.6. The treated water pH for the period of 2001 to 2009 ranged from 4.2 to 6.9 with an average of 5.3. In general, the treated water pH is not within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2001 to 2009 was approximately 9 mg/L.
- Treated water iron concentrations exceed the CDWQ AO of 0.3 mg/L for the review period. Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period of 2001 to 2009 was reported as - 5.8.

Based on the data provided, it appears that the implementation of pH adjustment at this facility has not had a significant effect on the DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5. In addition, the treated water pH is typically lower than raw water pH. This may be a result of the use of chlorine gas as the primary disinfectant at this facility, which can depress the pH of the water.

Performance Limiting Factors

- The use of chlorine gas as a disinfectant which can lower the pH of the treated water.
- Lack of redundancy for key process equipment.

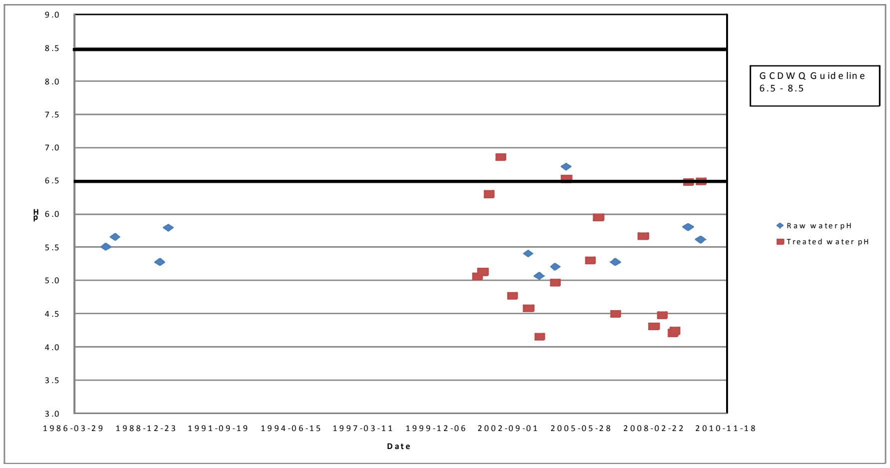

Figure B.20 Hermitage Raw and Treated Water pH

21.0 ISLE-AUX-MORTS

Water Supply Source: Burnt Ground Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 274 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 283 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1994 to 2002, prior to pH adjustment the raw water pH ranged from 4.6 to 5.1 with an average of 5.2. The treated water pH for the same period ranged from 3.6 to 4.0 with an average of 4.1. After pH adjustment, the raw water pH ranged from 5.0 to 6.7 with an average of 5.8 and the treated water pH ranged from 3.6 to 5.9 with an average of 4.5. In general, the treated water pH is not within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before and after pH adjustment was approximately 8 mg/L.
- Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as – 7.0 and after pH adjustment was reported as – 6.6.

Based on the data provided, it appears that the implementation of pH adjustment at this facility has not had a significant effect on the DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is below the GCDWQ OG of 6.5 to 8.5. In addition, the treated water pH is typically lower than raw water pH.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of automatic monitoring or control.

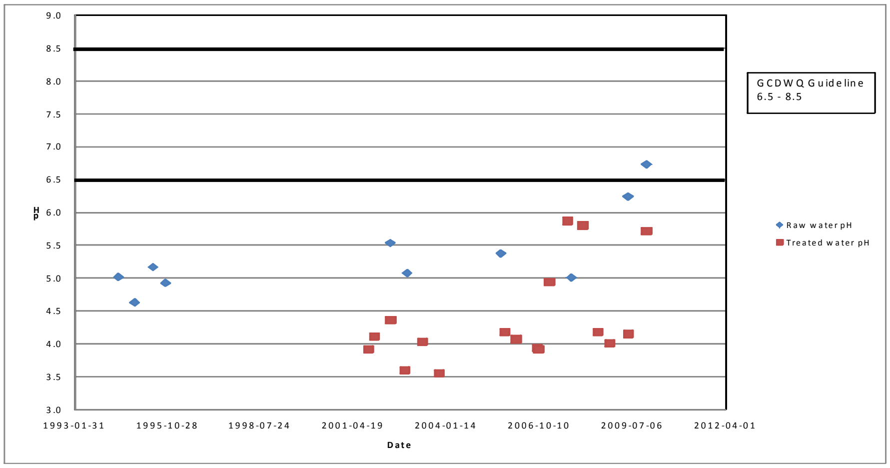

Figure B.21 Isle-Aux-Morts Raw and Treated Water pH

22.0 LAMALINE

Water Supply Source: Upper Hodge's Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 129 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 151 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1996 to 2005, prior to pH adjustment, the raw water pH ranged from 4.7 to 7.1 with an average of 6.4. The treated water pH for the same period ranged from 4.3 to 7.1 with an average of 6.2. After pH adjustment, the raw water pH ranged 6.3 to 6.9 with an average of 6.6 and the treated water pH ranged from 4.4 to 6.7 with an average of 6.0. After pH adjustment treated water pH levels below the GCDWQ guideline of 6.5 to 8.5 have been observed.
- The average DOC concentration in the treated water for the period before and after pH adjustment was approximately 7 mg/L.
- Treated water iron concentrations exceed the CDWQ AO of 0.3 mg/L for the review period. The concentrations of aluminum, copper, lead and zinc are generally within acceptable levels.
- Treated water average LI was reported as - 4.4, for the period before pH adjustment and as -4.8, for the period after pH adjustment.

Based on the data provided, the implementation of pH adjustment at this facility does not appear to have had a significant effect on DBP and DOC concentrations. There appears to be a relationship between increases in pH and decreases in treated water metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5. In addition, the treated water pH is typically lower than raw water pH.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.

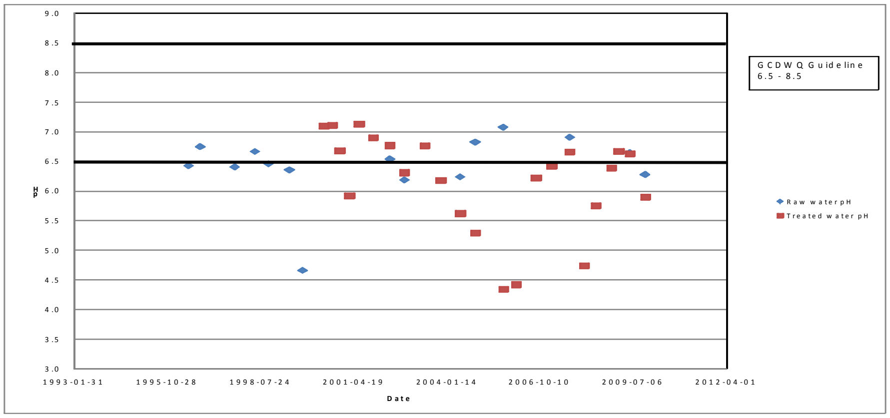

Figure B.22 Lamaline Raw and Treated Water pH

23.0 LEWISPORTE

Water Supply Source: Stanhope Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 158 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 104 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1986 to 2009, the raw water pH ranged from 5.5 to 7.3 with an average of 6.9. The treated water pH for the period of 2001 to 2009 ranged from 6.0 to 7.0 with an average of 6.5. Treated water pH levels below the GCDWQ guideline of 6.5 to 8.5 have been observed on occasion.
- The average DOC concentration in the treated water for the period of 2001 to 2009 was approximately 6 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period of 2001 to 2009 was reported as - 3.4.

Based on the data provided, given the degree of variability in the treated water pH data, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5. In addition, the treated water pH is typically lower than raw water pH.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.
- Operational objective for treated water pH is too low.

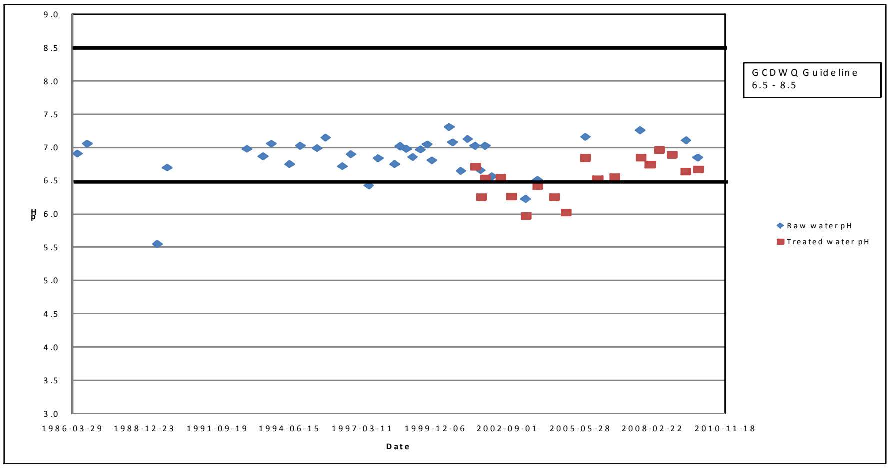

Figure B.23 Lewisporte Raw and Treated Water pH

24.0 LONG HARBOUR-MOUNT ARLINGTON HEIGHTS

Water Supply Source: Shingle Pond and/or Trout Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 48 µg/L is below the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 82 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1986 to 1997, prior to pH adjustment, the raw water pH ranged from 6.1 to 6.5 with an average of 6.3. After pH adjustment, the raw water pH ranged from 5.4 to 6.5 with an average of 5.9 and the treated water pH ranged from 4.4 to 7.2 with an average of 5.5. In general, the treated water pH is not within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2001 to 2009 was approximately 7 mg/L.
- Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, iron, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period before and after pH adjustment was reported as - 5.7.

Based on the data provided, the implementation of pH adjustment at this facility does not appear to have had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5. In addition, the treated water pH is typically lower than raw water pH.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of automatic monitoring or control.
- Lack of routine maintenance for pH adjustment system.

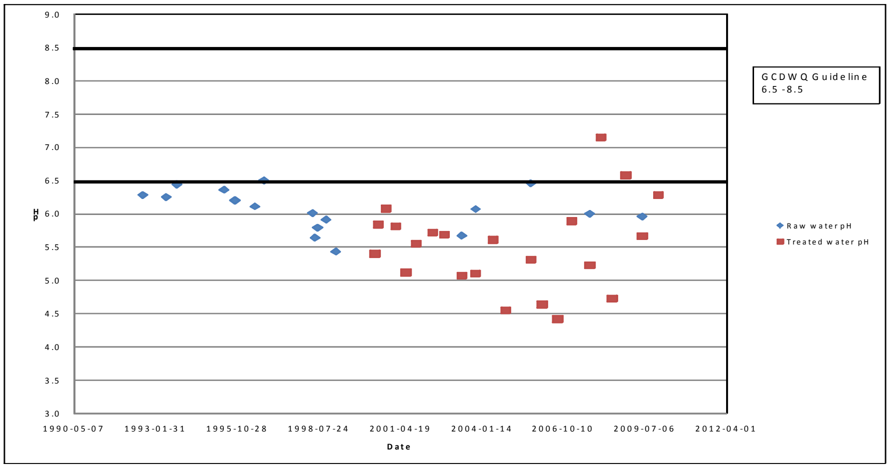

Figure B.24 Long Harbour-Mount Arlington Heights Raw and Treated Water pH

25.0 LUMSDEN

Water Supply Source: Gull Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 118 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 104 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1988 to 2009, the raw water pH ranged from 4.8 to 6.6 with an average of 5.4. The treated water pH for the period of 2000 to 2009 ranged from 5.0 to 7.6 with an average of 6.9. In general, the treated water pH is within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2001 to 2009 was approximately 4 mg/L.
- Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, iron, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period of 2001 to 2009 was reported as - 3.7.

Based on the data provided, it does not appear that the implementation of pH adjustment at this facility has had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided, the pH treatment system appears to be effective. Treated water pH is typically within GCDWQ recommended range of 6.5 to 8.5.

Performance Limiting Factors

- Lack of automatic monitoring and control.

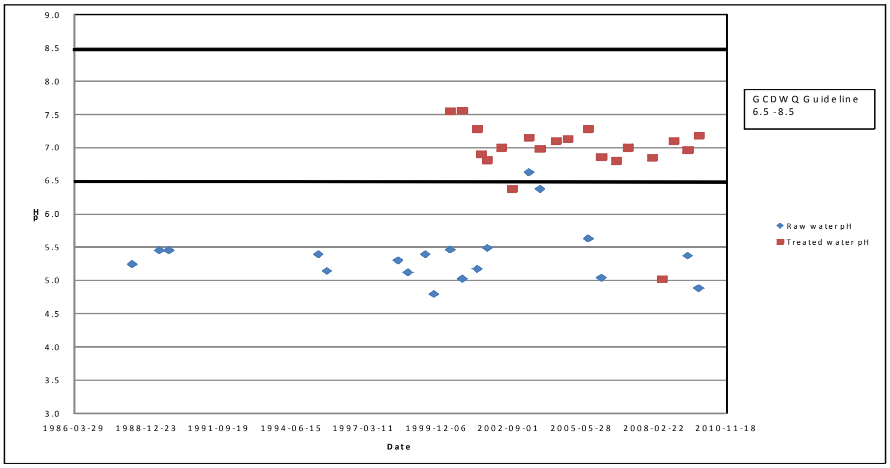

Figure B.25 Lumsden Raw and Treated Water pH

26.0 MUSGRAVE HARBOUR

Water Supply Source: Rocky Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 158 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 253 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1988 to 2009, the raw water pH ranged from 5.4 to 6.8 with an average of 5.9. The treated water pH for the period of 2000 to 2009 ranged from 4.7 to 7.2 with an average of 6.5. The treated water pH is generally within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2001 to 2009 was approximately 4 mg/L.
- Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, iron, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period of 2000 to 2009 was reported as - 3.6.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided, the pH treatment system appears to be effective. Treated water pH is typically within GCDWQ recommended range of 6.5 to 8.5.

Performance Limiting Factors

- Lack of redundancy for key process equipment.

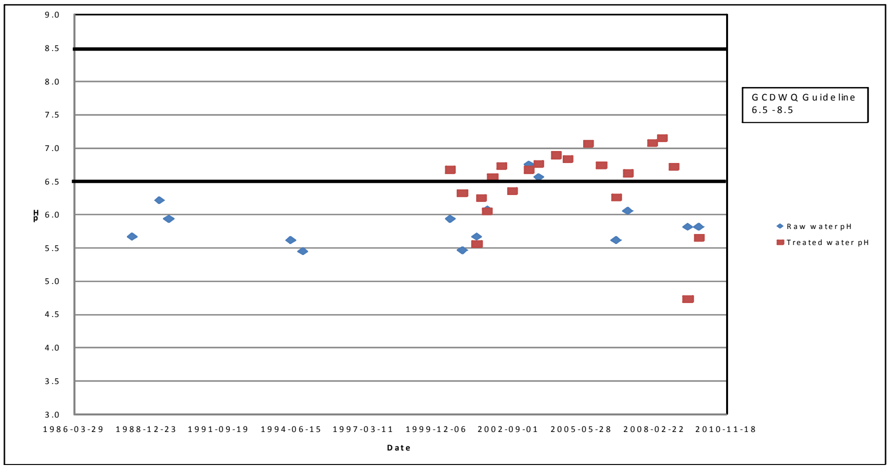

Figure B.26 Musgrave Harbour Raw and Treated Water pH

27.0 NEW-WES-VALLEY (CARTERS POND)

Water Supply Source: Carter's Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 268 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 674 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1986 to 2005, prior to pH adjustment, the raw water pH ranged from 4.1 to 5.4 with an average of 4.6. The treated water pH for the same period ranged from 3.7 to 6.3 with an average of 4.5. After pH adjustment, the raw water pH ranged from 4.6 to 5.5 with an average of 4.8 and the treated water pH ranged from4.0 to 6.2 with an average of 4.6. In general, the treated water pH is not within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the raw and treated water for the period before pH adjustment was approximately 9 mg/L and 10 mg/L, respectively. The average DOC concentration in the raw and treated water for the period after pH adjustment was approximately 14 mg/L.
- Treated water iron concentrations exceed the CDWQ AO of 0.3 mg/L for the review period. Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as - 7.2 and after pH adjustment was reported as -7.1.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5. In addition, the treated water pH is typically lower than raw water pH.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.

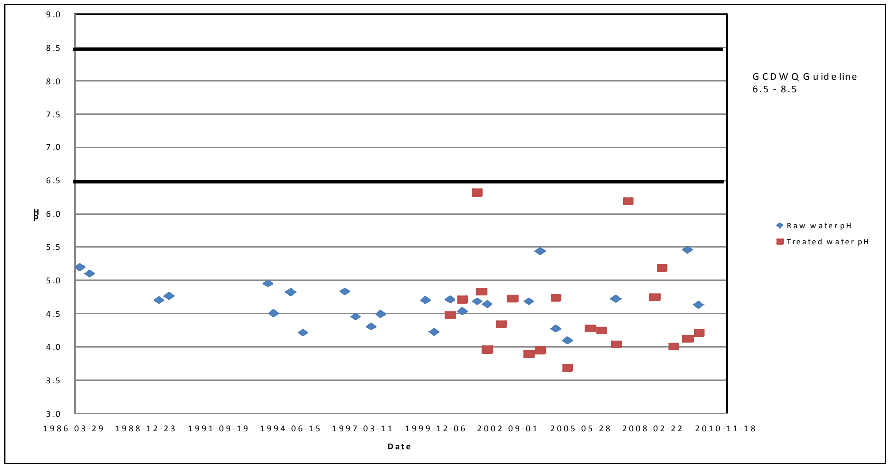

Figure B.27 New-Wes-Valley (Carters Pond) Raw and Treated Water pH

28.0 NEW-WES-VALLEY (LITTLE NORTHWEST POND)

Water Supply Source: Little Northwest Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 318 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 480 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1987 to 2008, prior to pH adjustment, the raw water pH ranged from 4.4 to 6.0 with an average of 5.3. The treated water pH for the same period ranged from 4.1 to 6.9 with an average of 5.6. After pH adjustment, the raw water pH ranged from 5.3 to 5.5 with an average of 5.4 and the treated water pH ranged from 4.4 to 6.8 with an average of 5.6. The treated water pH is generally not within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before and after pH adjustment was approximately 8 mg/L.
- Treated water iron concentrations exceed the CDWQ AO of 0.3 mg/L for the review period. Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before and after pH adjustment was reported as - 5.5.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP, and DOC concentrations. There appears to be a relationship between increases in pH and decreases in treated water metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.

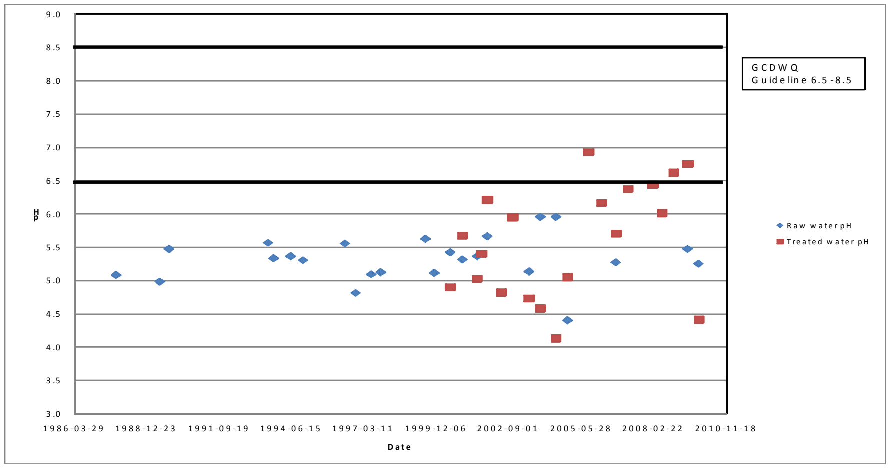

Figure B.28 New-Wes-Valley (Little Northwest Pond) Raw and Treated Water pH

29.0 PETTY HARBOUR- MADDOX COVE

Water Supply Source: Western Barrens Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 130 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 106 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 2006 to 2009, the raw water pH ranged from 5.3 to 65.8 with an average of 5.6. The treated water pH during the same period ranged from 5.0 to 7.7 with an average of 6.0. The treated water pH is generally within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2006 to 2009 was approximately 3 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period of 2006 to 2009 was reported as - 4.2.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided, the pH adjustment system was effective in maintaining a treated water pH that within the GCDWQ guideline of 6.5 to 8.5. It should be noted that only limited raw water and treated water pH data are available for this facility, which may limit the validity of this assessment.

Performance Limiting Factors

- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.

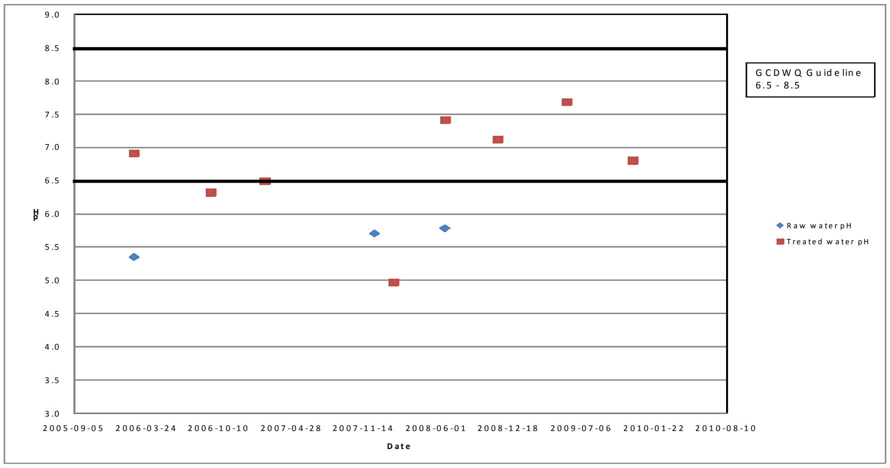

Figure B.29 Petty Harbour-Maddox Cove Raw and Treated Water pH

30.0 PLACENTIA

Water Supply Source: Wyses Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 35 µg/L is below the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 10 µg/L is below the GCDWQ MAC of 80 µg/L.
- For the period of 1985 to 1991, prior to pH adjustment, the raw water pH ranged from 5.8 to 6.3 with an average of 6.0. After pH adjustment, the raw water pH ranged 5.3 to 6.7 with an average of 6.0 and the treated water pH ranged from 5.8 to 7.0 with an average of 6.5. Treated water pH levels below the GCDWQ guideline of 6.5 to 8.5 have been observed on occasion.
- The average DOC concentration in the treated water for the period of 2000 to 2009 was approximately 8 mg/L.
- Treated water iron concentrations exceed the CDWQ AO of 0.3 mg/L for the review period. The concentrations of aluminum, copper, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before and after pH adjustment was reported as - 3.9.

Based on the data provided, it appears that the implementation of pH adjustment at this facility has not had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided treated water pH is effective in maintaining a consistent treated water pH within the GCDWQ recommended range.

Performance Limiting Factors

- Lack of redundancy for key process equipment.
- Operational objective for treated water pH is too low.

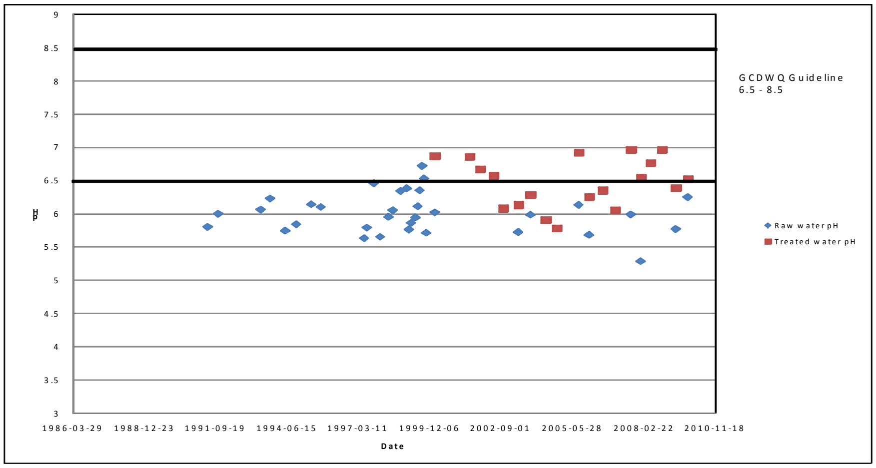

Figure B.30 Placentia Raw and Treated Water pH

31.0 PORT BLANDFORD

Water Supply Source: Noseworthy's Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 222 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 222 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1988 to 2006, prior to pH adjustment, the raw water pH ranged from 5.4 to 6.6 with an average of 6.1. The treated water pH for the same period ranged from 4.2 to 6.2 with an average of 5.5. After pH adjustment, the raw water pH ranged from 6.3 to 6.6 with an average of 6.5 and the treated water pH ranged from 4.4 to 7.8 with an average of 6.2. The treated water pH is occasionally within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before and after pH adjustment was approximately 6 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as - 5.4 and after pH adjustment was reported as -4.4.

Based on the data provided, the implementation of pH adjustment at this facility does not appear to have had an effect on DBP and DOC concentrations. The data indicate that metals concentrations tend to be lower during periods of higher treated water pH.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of automatic monitoring or control.
- Lack of routine maintenance for pH adjustment system.

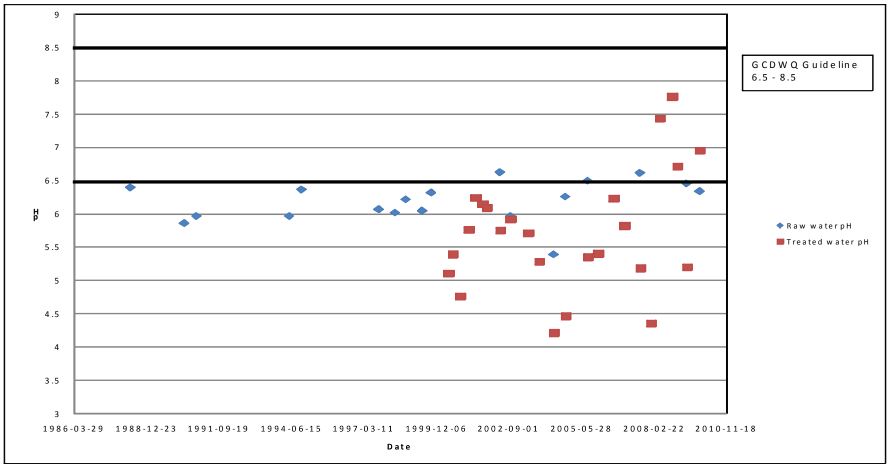

Figure B.31 Port Blandford Raw and Treated Water pH

32.0 POUCH COVE

Water Supply Source: North Three Island Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 342 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 429 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1989 to 2003, prior to pH adjustment, the raw water pH ranged from 5.5 to 7.1 with an average of 6.4. The treated water pH for the same period ranged from 4.0 to 6.5 with an average of 5.3. After pH adjustment, the raw water pH ranged from 6.5 to 6.9 with an average of 6.7 and the treated water pH ranged from 4.7 to 8.7 with an average of 6.6. The treated water pH is generally within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before and after pH adjustment was approximately 8 mg/L.
- Treated water iron concentrations generally exceed the GCDWQ AO of 0.3 mg/L for the review period. The concentrations of aluminum, copper, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as – 5.8 and after pH adjustment was reported as - 3.8.

Based on the data provided, the implementation of pH adjustment at this facility does not appear to have had a significant effect on DBP and DOC concentrations. There appears to be a relationship between higher pH levels and lower treated water metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally within the GCDWQ OG of 6.5 to 8.5.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of automatic control.

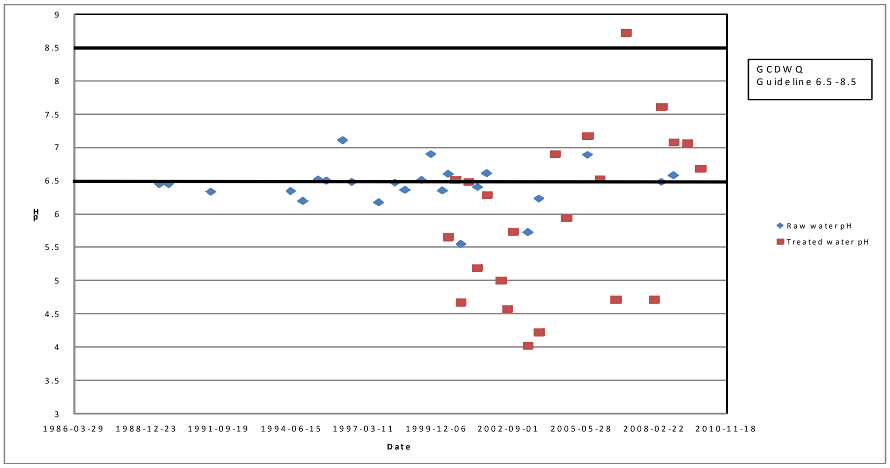

Figure B.32 Pouch Cove Raw and Treated Water pH

33.0 RAMEA

Water Supply Source: Northwest Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 143 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 43 µg/L is belows the GCDWQ MAC of 80 µg/L.
- For the period of 1988 to 2009, the raw water pH ranged from 4.8 to 7.5 with an average of 5.6. The treated water pH for the period of 2000 to 2009 ranged from 6.0 to 7.3 with an average of 6.7. The treated water pH is generally within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2000 to 2009 was approximately 2 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period of 2000 to 2009 was reported as - 3.0.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided, the pH treatment system appears to be effective. Treated water pH is typically within GCDWQ recommended range of 6.5 to 8.5.

Performance Limiting Factors

- None.

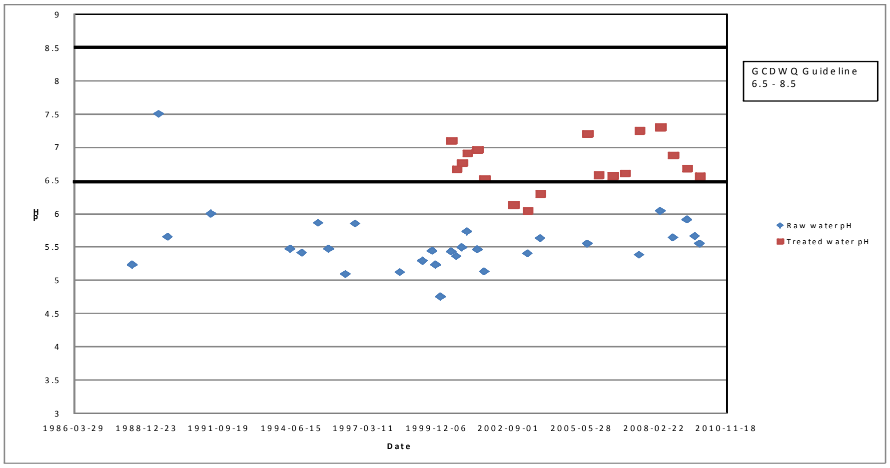

Figure B.33 Ramea Raw and Treated Water pH

34.0 SELDOM-LITTLE SELDOM

Water Supply Source: Bullock Cove Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 157 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 94 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1993 to 2008, prior to pH adjustment, the raw water pH ranged from 5.0 to 6.0 with an average of 5.6. The treated water pH for the same period ranged from 4.1 to 6.9 with an average of 5.3 and the treated water pH ranged from 6.4 to 7.1 with an average of 6.8. The treated water pH is generally within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before and after pH adjustment was approximately 12 mg/L.
- Treated water iron concentrations exceed the CDWQ AO of 0.3 mg/L for the review period. Aluminum concentrations exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as - 5.7 and after pH adjustment was reported as - 3.8.

Based on the data provided, the implementation of pH adjustment at this facility does not appear to have had a significant effect on DBP and DOC concentrations. There appears to be a relationship between increases in pH and decreases in treated water metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally within the GCDWQ OG of 6.5 to 8.5.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.

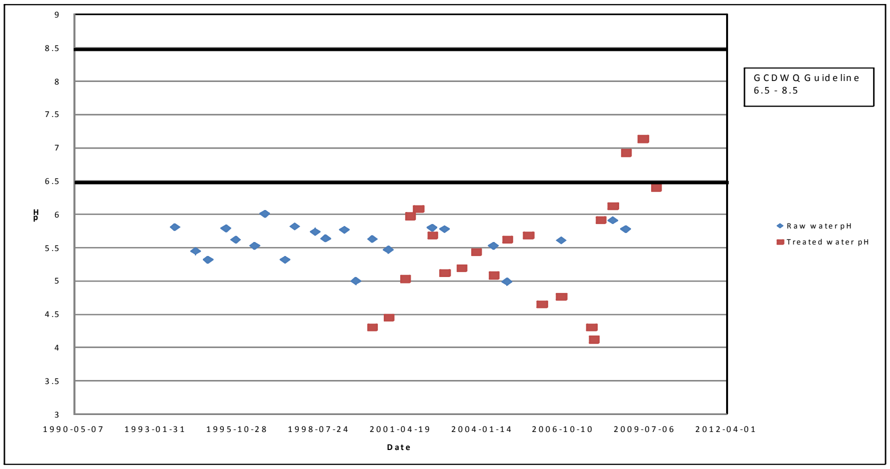

Figure B.34 Seldom-Little Seldom Raw and Treated Water pH

35.0 SPANIARD'S BAY

Water Supply Source: Kelly's Pond (Spider Pond)

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 80 µg/L is below the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 112 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1993 to 2005, prior to pH adjustment, the raw water pH ranged from 5.9 to 7.0 with an average of 6.2. The treated water pH for the same period ranged from 4.7 to 6.3 with an average of 5.5. After pH adjustment, the raw water pH ranged from 6.2 to 6.3 with an average of 6.2 and the treated water pH ranged from 4.9 to 6.1 with an average of 5.4. In general, the treated water pH is not within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before and after pH adjustment was approximately 4 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as - 5.5 and after pH adjustment was reported as – 5.4.

Based on the data provided, the implementation of pH adjustment at this facility does not appear to have had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5. In addition, the treated water pH is typically lower than raw water pH.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.

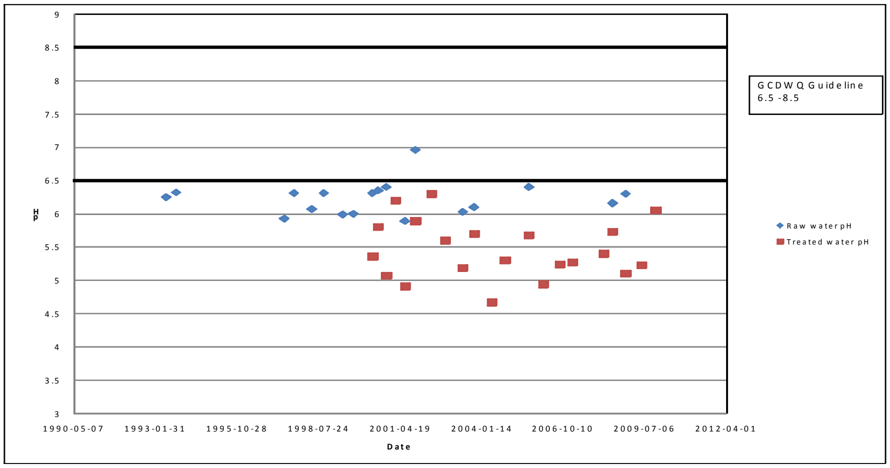

Figure B.35 Spaniard's Bay Raw and Treated Water pH

36.0 ST. JOHN'S (BAY BULLS BIG POND)

Water Supply Source: Bay Bulls Big Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 64 µg/L is below the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 61 µg/L is below the GCDWQ MAC of 80 µg/L.
- For the period of 1988 to 2009, the raw water pH ranged from 5.4 to 7.0 with an average of 6.1. The treated water pH for the period of 2002 to 2009 ranged from 6.1 to 7.7 with an average of 6.6. The treated water pH is generally within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2000 to 2009 was approximately 3 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period of 2001 to 2009 was reported as - 3.8.

Based on the data provided, the implementation of pH adjustment at this facility has not had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided, the pH treatment system appears to be effective. It should be noted that treated water pH levels below the GCDWQ guideline of 6.5 to 8.5 have been observed on occasion.

Performance Limiting Factors

- None

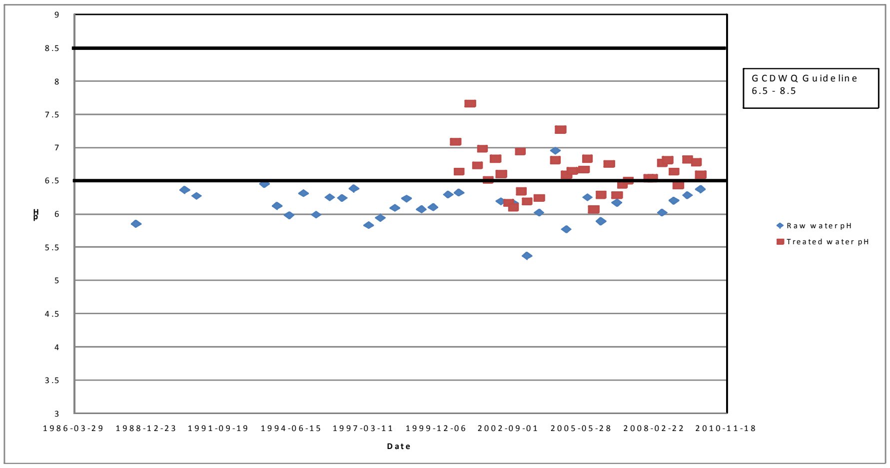

Figure B.36 St. John's (Bay Bulls Big Pond) Raw and Treated Water pH

37.0 ST. JOHN'S (WINDSOR LAKE)

Water Supply Source: Windsor Lake

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 66 µg/L is below the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 48 µg/L is below the GCDWQ MAC of 80 µg/L.
- For the period of 1995 to 2004, prior to pH adjustment, the raw water pH ranged from 5.7 to 6.4 with an average of 6.1. The treated water pH for the same period ranged from 5.0 to 7.2 with an average of 6.3. After pH adjustment, the raw water pH ranged from 6.0 to 6.3 with an average of 6.2 and the treated water pH ranged from 5.5 to 7.7 with an average of 6.7. Treated water pH levels below the GCDWQ guideline of 6.5 to 8.5 have been observed on occasion.
- The average DOC concentration in the treated water for the period before and after pH adjustment was approximately 3 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as – 4.6 and after pH adjustment was reported as - 3.3.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had an effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided, the pH adjustment system was generally effective in maintaining a treated water pH that within the GCDWQ guideline of 6.5 to 8.5. It should be noted that only limited raw water and treated water pH data are available for this facility, which may limit the validity of this assessment.

Performance Limiting Factors

- None

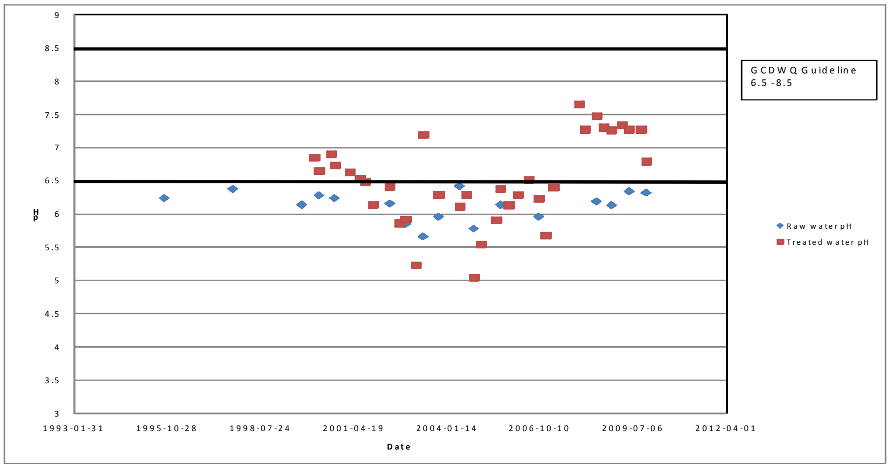

Figure B.37 St. John's (Windsor Lake) Raw and Treated Water pH

38.0 SUMMERFORD

Water Supply Source: Rushy Cove Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 322 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 277 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1988 to 2004, prior to pH adjustment, the raw water pH ranged from 6.8 to 8.0 with an average of 7.5. The treated water pH for the same period ranged from 6.5 to 7.2 with an average of 6.8. After pH adjustment, the raw water pH ranged from 7.3 to 7.7 with an average of 7.5 and the treated water pH ranged from 6.9 to 7.8 with an average of 7.3. In general, the treated water pH is within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before and after pH adjustment was approximately 9 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as – 2.0 and after pH adjustment was reported as - 1.6.

Based on the data provided, there is insufficient data to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided, it appears the pH adjustment system is operated effectively, as the treated water pH was within the GCDWQ recommended range. It should be noted however, that the treated water pH is generally lower than the raw water pH.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of routine maintenance for pH adjustment system.

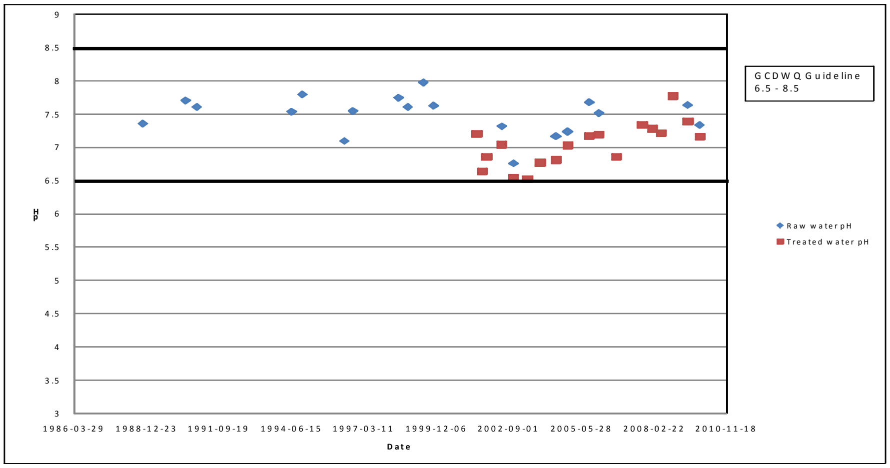

Figure B.38 Summerford Raw and Treated Water pH

39.0 TORBAY

Water Supply Source: North Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 107 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 140 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1988 to 2009, the raw water pH ranged from 5.9 to 7.1 with an average of 6.3. The treated water pH for the period of 2000 to 2009 ranged from 4.5 to 6.9 with an average of 6.0. The treated water pH is generally not within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2000 to 2009 was approximately 3 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period of 2001 to 2009 was reported as - 4.9.

Based on the data provided, the implementation of pH adjustment at this facility does not appear to have had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided the pH treatment system is not operated effectively, as the treated water pH was typically lower than raw water pH. The treated water pH is generally below the GCDWQ recommended range.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of automatic monitoring or control.
- Operational objective for treated water pH is too low.

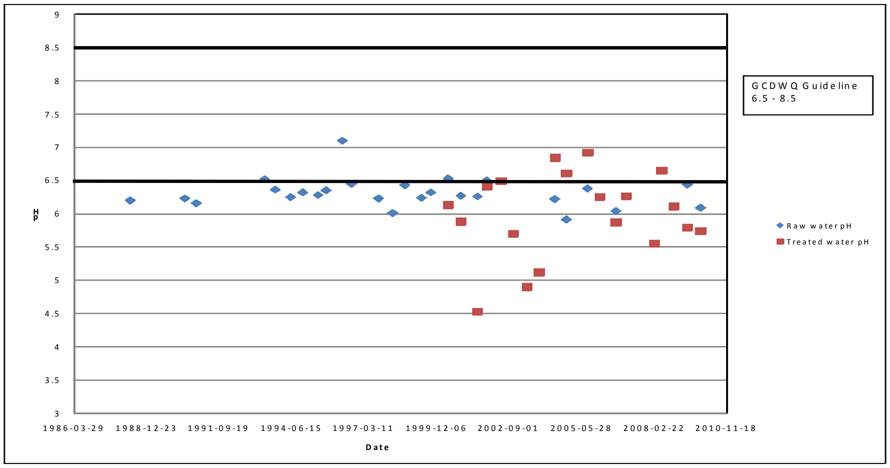

Figure B.39 Torbay Raw and Treated Water pH

40.0 TREPASSEY

Water Supply Source: Miller's Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 108 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 131 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1985 to 2009, the raw water pH ranged from 5.3 to 7.0 with an average of 6.2. The treated water pH for the period of 2001 to 2009 ranged from 4.2 to 6.9 with an average of 5.4. The treated water pH is generally not within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2000 to 2009 was approximately 7 mg/L.
- Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. Copper, iron, lead and zinc concentrations are generally found to be within acceptable levels.
- Treated water average LI for the period of 2001 to 2009 was reported as - 5.8.

Based on the data provided, the implementation of pH adjustment at this facility does not appear to have had an effect on DBP and DOC concentrations. It is not possible to determine if there is a relationship between pH changes and treated water metals concentrations.

Assessment of Effectiveness

- Based on the data provided, it appears that the pH adjustment system is not operated effectively, as the treated water pH was typically lower than raw water pH. The treated water pH is generally below the GCDWQ recommended range.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Lack of automatic monitoring or control.
- Operational objective for treated water pH is too low.

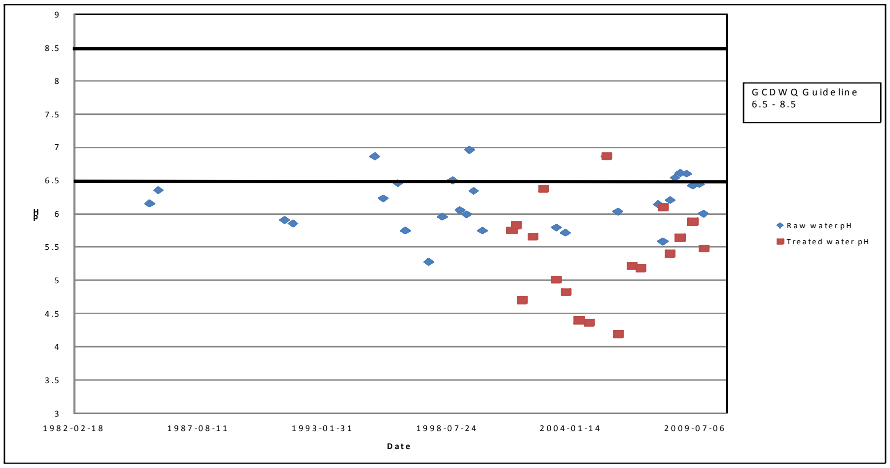

Figure B.40 Trepassey Raw and Treated Water pH

41.0 TRINITY (INDIAN POND)

Water Supply Source: **Indian Pond**

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 268 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 267 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 2006 to 2009, the raw water pH ranged from 5.4 to 5.9 with an average of 65.6. The treated water pH during the same period ranged from 6.0 to 7.5 with an average of 6.7. The treated water pH is generally within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2006 to 2009 was approximately 6 mg/L.
- Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, iron, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period of 2006 to 2009 was reported as - 4.7.

Based on the data provided, it appears that the implementation of pH adjustment at this facility has not had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided the pH treatment system is effective. The treated water pH was typically within the GCDWQ established range of 6.5 to 8.5. It should be noted that this assessment is based on limited water quality data.

Performance Limiting Factors

- Lack of redundancy for key process equipment.

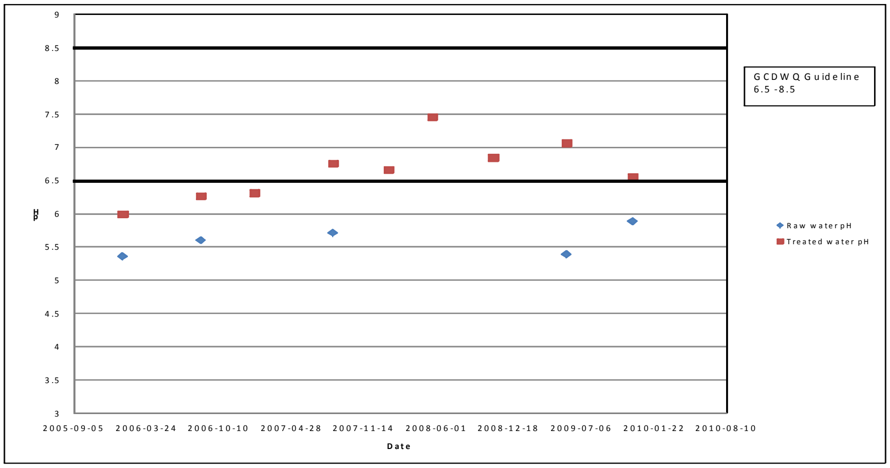

Figure B.41 Trinity (Indian Pond) Raw and Treated Water pH

42.0 TRINITY BAY NORTH (WHIRL POND)

Water Supply Source: Whirl Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 159 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 160 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 2006 to 2009, the raw water pH ranged from 4.6 to 6.8 with an average of 5.7. The treated water pH for the period of 2001 to 2009ranged from 3.8 to 6.4 with an average of 5.4. In general, the treated water pH is not within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2006 to 2009 was approximately 8 mg/L.
- Treated water iron concentrations exceed the GCDWQ AO of 0.3 mg/L for the review period. Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period of 2006 to 2009 was reported as - 5.9.

Based on the data provided, the implementation of pH adjustment at this facility has not had a significant effect on DBP, and DOC concentrations. There appears to be a relationship between decreases in pH and increases in treated water metals concentrations.

Assessment of Effectiveness

- Based on the data provided the pH treatment system is not operated effectively, as the treated water pH was typically lower than raw water pH. The treated water pH is below the GCDWQ recommended range.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of redundancy for key process equipment.
- Operational objective for treated water pH is too low.

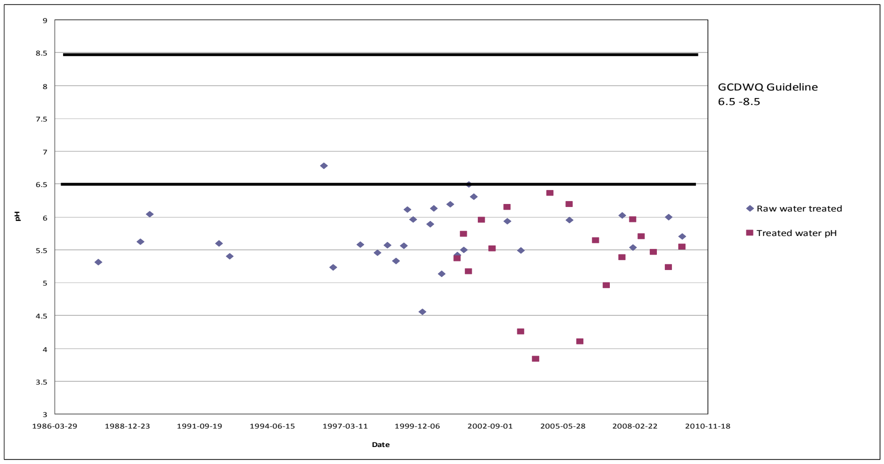

Figure B.42 Trinity Bay North (Whirl Pond) Raw and Treated Water pH

43.0 VICTORIA

Water Supply Source: Rocky Pond

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 54 µg/L is below the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 66 µg/L is below the GCDWQ MAC of 80 µg/L.
- For the period of 1987 to 2003, prior to pH adjustment, the raw water pH ranged from 5.6 to 6.9 with an average of 6.3. The treated water pH for the same period ranged from 4.4 to 6.5 with an average of 5.2. After pH adjustment, the raw water pH ranged from 6.3 to 6.4 with an average of 6.3 and the treated water pH ranged from 5.5 to 6.6 with an average of 6.1. The treated water pH is generally not within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period before and after pH adjustment was approximately 3 mg/L.
- Treated water iron concentrations generally exceed the CDWQ AO of 0.3 mg/L for the review period. Aluminum concentrations generally exceed the GCDWQ OG of 0.2 mg/L. The concentrations of copper, lead and zinc were all found to be within acceptable levels.
- Treated water average LI for the period before ph adjustment was reported as – 6.0 and after pH adjustment was reported as - 5.3.

Based on the data provided, the implementation of pH adjustment at this facility does not appear to have had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided the pH treatment system is not operated effectively, as the treated water pH was typically lower than raw water pH.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Operational objective for treated water pH is too low.
- Lack of redundancy for key process equipment.

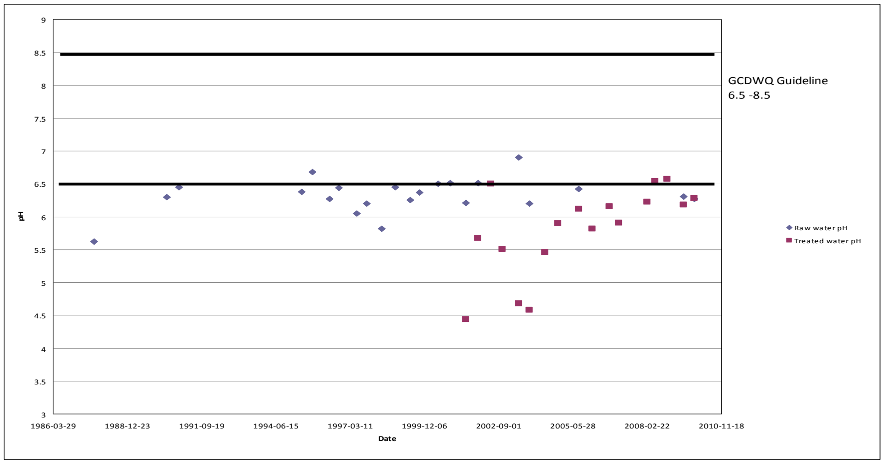

Figure B.43 Victoria Raw and Treated Water pH

44.0 WEST ST. MODESTE

Water Supply Source: Well Field

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 142 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 103 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 2001 to 2009, the raw water pH ranged from 6.8 to 7.4 with an average of 7.1. The treated water pH during the same period ranged from 6.6 to 7.6 with an average of 7.3. In general, the treated water pH is within the GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the treated water for the period of 2001 to 2009 was approximately 4 mg/L.
- Treated water iron concentrations exceed the CDWQ AO of 0.3 mg/L for the review period. The concentrations of aluminum, copper, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period of 2001 to 2009 was reported as - 1.7.

Based on the data provided, it is not possible to determine if the implementation of pH adjustment at this facility has had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data provided, the pH adjustment system was effective in maintaining a treated water pH that within the GCDWQ guideline of 6.5 to 8.5. It should be noted that only limited raw water and treated water pH data are available for this facility, which may limit the validity of this assessment.

Performance Limiting Factors

- Lack of automatic monitoring or control.
- Lack of routine maintenance for pH adjustment system.

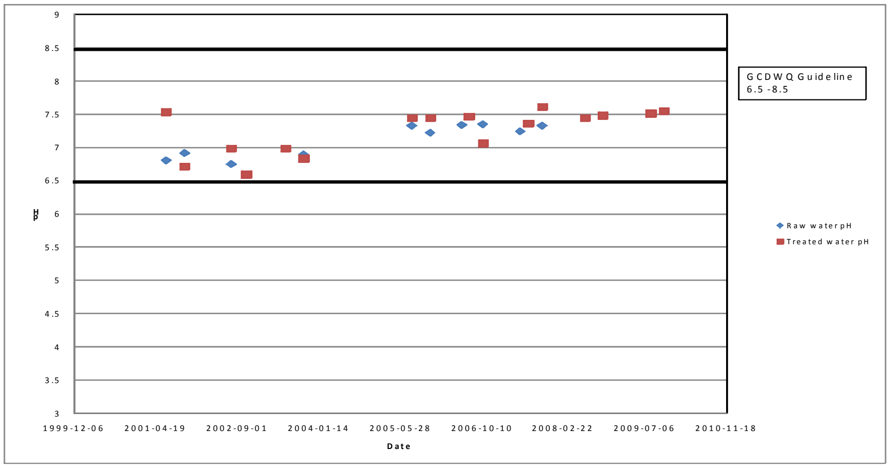

Figure B.44 West St. Modeste Raw and Treated Water pH

45.0 WHITBOURNE

Water Supply Source: Hodges River

Water Quality Summary

A review of available water quality data provided by the ENVC indicates that:

- The running annual average for total THMs in the treated water of 110 µg/L exceeds the GCDWQ MAC of 100 µg/L.
- The running annual average for total HAAs in the treated water of 184 µg/L exceeds the GCDWQ MAC of 80 µg/L.
- For the period of 1987 to 2001, prior to pH adjustment, the raw water pH ranged from 6.2 to 6.8 with an average of 6.5. The treated water pH for the same period ranged from 4.6 to 6.9 with an average of 5.7. After pH adjustment, the raw water pH ranged from 6.2 to 6.8 with an average of 6.6 and the treated water pH ranged from 4.7 to 7.4 with an average of 5.7. The treated water pH is generally not within GCDWQ OG range of 6.5 to 8.5.
- The average DOC concentration in the raw and treated water for period before pH adjustment was approximately 4 mg/L. The average DOC concentration in the raw and treated water for period after pH adjustment was approximately 5 mg/L.
- The concentrations of aluminum, copper, iron, lead and zinc are generally within acceptable levels.
- Treated water average LI for the period before pH adjustment was reported as – 6.4 and after pH adjustment was reported as - 5.2.

Based on the data provided, the implementation of pH adjustment at this facility does not appear to have had a significant effect on DBP, DOC and metals concentrations.

Assessment of Effectiveness

- Based on the data reviewed, the pH treatment system does not appear to be adequate to maintain acceptable pH levels in the system, as the treated water pH is generally below the GCDWQ OG of 6.5 to 8.5. In addition, the treated water pH is typically lower than raw water pH.

Performance Limiting Factors

- The use of chlorine gas at the WTP may be resulting in lower treated water pH levels.
- Lack of automatic monitoring or control.
- Lack of redundancy for key process equipment.
- Operational objective for treated water pH is too low.

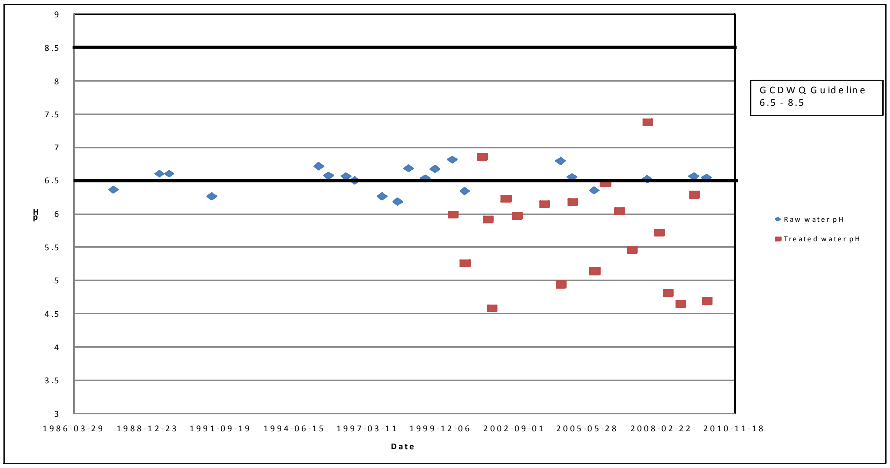

Figure B.45 Whitbourne Raw and Treated Water pH

APPENDIX C
Limitations

LIMITATIONS

1. The work performed in this report was carried out in accordance with the Standard Terms of Conditions made part of our contract. The conclusions presented herein are based solely upon the scope of services and time and budgetary limitations described in our contract.
2. The report was prepared in accordance with generally accepted environmental study and/or engineering practices for the exclusive use of ENVC. No other warranties, either expressed or implied, are made as to the professional services provided under the terms of our contract and included in this report.
3. Third party information reviewed and used to develop the opinions and conclusions contained in this report is assumed to be complete and correct. This information was used in good faith and AMEC does not accept any responsibility for deficiencies, misinterpretation or incompleteness of the information contained in documents prepared by third parties.
4. The services performed and outlined in this report were based, in part, upon visual observations of the site and attendant structures. Our opinion cannot be extended to portions of the site which were unavailable for direct observation, reasonably beyond our control.
5. The objective of this report was to assess environmental conditions at the sites, within the context of our contract and existing environmental regulations within the applicable jurisdiction. Evaluating compliance of past or future owners with applicable local, provincial and federal government laws and regulations was not included in our contract for services.
6. Our observations relating to the condition of environmental media at the sites are described in this report. It should be noted that compounds or materials other than those described could be present in the site environment.
7. The findings and conclusions presented in this report are based exclusively on the field parameters measured at specific locations. It should be recognized that conditions between and beyond the sample locations may vary. AMEC cannot expressly guarantee that conditions between and beyond the sample locations do not vary from the results determined at the sample locations. Notwithstanding these limitations, this report is believed to provide a reasonable representation of site conditions at the date of issue.
8. The contents of this report are based on the information collected during a review of available background information, interviews, site inspection and investigation activities, our understanding of the actual site conditions, and our professional opinion according to the information available at the time of preparation of this report. This report gives a professional opinion and, by consequence, no guarantee is attached to the conclusions or expert advice depicted in this report. This report does not provide a legal opinion in regards to Regulations and applicable Laws.
9. Any use of this report by a third party and any decision made based on the information contained in this report by the third party is the sole responsibility of the third party. AMEC will not accept any responsibility for damages resulting from a decision or an action made by a third party based on the information contained in this report.