Alexco Resource Canada Corp.

Bellekeno Underground Development
Flow Monitoring Plan

Water Use Licence QZ07-078

October 2008

Prepared by:

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1.0 INTRODUCTION

1.1 *Purpose of Plan*

This plan is submitted to fulfill the condition set out in Part D Section 26 of Water Licence QZ07-078 issued to Alexco Resource Canada Corp on October 3, 2008:

> *"The Licensee shall, within 30 days of the effective date of this licence, submit a plan for monitoring flows at monitoring stations described in this licence, which require flow measurement. At a minimum, the plan shall indicate the methodology to be used at each monitoring station."*

This plan outlines the flow monitoring methodology that will be used during the advanced exploration and preliminary development activities at the Bellekeno Mine on the Keno Hill property.

2.0 MINE LOCATION AND DESCRIPTION

The Bellekeno mine area is located approximately 3 km east of Keno City within the Keno Hill Silver District. The Keno Hill Silver District is located in central Yukon Territory, 354 km (by air) due north of Whitehorse.

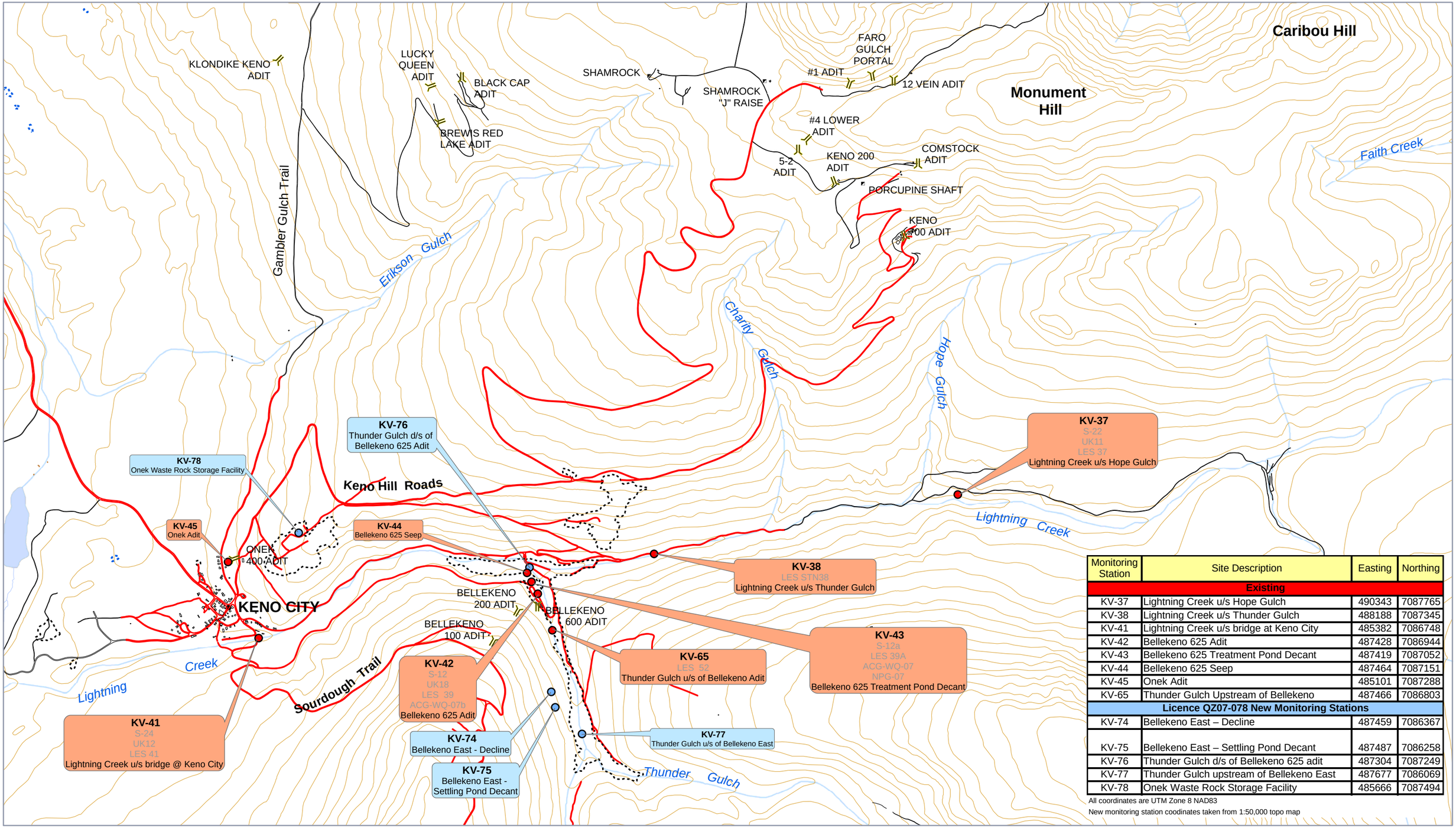
The portal at Bellekeno East is located on a steep slope above Thunder Gulch, a narrow tributary of Lightening Creek.

3.0 MONITORING STATION LOCATIONS

Schedule A, Part I of the Water Licence QZ07-078 identifies 13 specific water monitoring stations required for flow monitoring. Eight locations are being monitored for Water Quality under the Care & Maintenance Water Licence QZ07-074 (as denoted by an asterisk [*] on Table 1). Table 1 provides the site designations, descriptions and locations. Figure 1 illustrates the existing and new flow monitoring locations. (Please note that GPS Coordinates are approximate).

Table 1 Existing and New Flow Monitoring Locations under Water Licence QZ07-078

Monitoring Station	Site Description	Easting	Northing
Existing			
KV-37*	Lightning Creek u/s Hope Gulch	490343	7087765
KV-38*	Lightning Creek u/s Thunder Gulch	488188	7087345
KV-41*	Lightning Creek u/s bridge at Keno City	485382	7086748
KV-42*	Bellekeno 625 Adit	487428	7086944
KV-43*	Bellekeno 625 Treatment Pond Decant	487419	7087052
KV-44*	Bellekeno 625 Seep	487464	7087151
KV-45*	Onek Adit	485101	7087288
KV-65*	Thunder Gulch Upstream of Bellekeno	487466	7086803
Licence QZ07-078 New Monitoring Stations			
KV-74	Bellekeno East – Decline	487459	7086367
KV-75	Bellekeno East – Settling Pond Decant	487487	7086258
KV-76	Thunder Gulch d/s of Bellekeno 625 adit	487304	7087249
KV-77	Thunder Gulch upstream of Bellekeno East	487677	7086069
KV-78	Onek Waste Rock Storage Facility	485666	7087494



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All coordinates are UTM Zone 8 NAD83

New monitoring station coodinates taken from 1:50,000 topo map

N

1:25,000
(when plotted on 11x17 inch sheet)

0 250 500 1,000 1,500 2,000 m

Legend

Water Quality
- Station Name / Site Description — Existing Flow Monitoring Location
- Site Description — Proposed Flow Monitoring Location

Mine Workings
- Adit
- Shaft (to surface - connection to underground not determined)
- Pit

Topography
- Town
- Public Road
- Exploration Road
- Contour
- Watercourse
- Waterbody

Notes:
This map is for illustrative purposes only.
This is not a legal document.
National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced under license from © Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.
Projection: UTM Zone 8 NAD83
NTS Sheet 105M/14

ALEXCO
ACCESS CONSULTING GROUP

FLOW MONITORING PLAN

EXISTING AND PROPOSED FLOW MONITORING LOCATIONS

Drawn By: HD	Date: October 2008	**FIGURE 1**
Checked by: KN	File: D:\Project\AllProjects\ALEX-05-01\MonitoringPrograms\FlowMonPlan\Oct08\Fig1_FlowMonPlan.mxd	

4.0 MONITORING SCHEDULE

Throughout the term of the licence, the timeline for the monitoring of the flow stations will be conducted according to Schedule A, Part III, *On-site Monitoring Schedules of the Water Licence QZ07-078*. The flow monitoring program will consist of continuous, daily, monthly (May to October), and quarterly monitoring. The schedule will be as follows:

Continuous Monitoring:	KV-42 and KV-74
Daily Monitoring:	KV-43 and KV-75
Monthly (May to October) Monitoring:	KV-44
Quarterly Monitoring:	KV-37, KV-38, KV-41, KV-45, KV-65, KV-76 and KV-77
Not Specified in Schedule A, Part III:	KV-78

The culverts at KV-78 (the Onek Waste Rock Storage Facility) will be monitored monthly using a Heron Instruments Dipper-T probe to determine the accumulation amount of water within the storage facility. During pumping of clean, tested water from the Onek Waste Rock Storage Facility, the continuous flow will be calculated by monitoring the pump discharge rate, or if vacuum trucks are used to empty the culvert, the flow will be calculated on the basis of volume of solution removed by the trucks.

The Bellekeno East decline (KV-74) will not have a continuous flow. The decline will be inspected daily for flow and if any water is pumped from the Bellekeno East decline, the flow will be calculated by monitoring the pumping rate.

5.0 FLOW MONITORING METHODS

Flow monitoring will be conducted in accordance with the *Manual of Standard Operating Procedures for Hydrometric Surveys in British Columbia*, dated November 2, 1998. Depending on the flow condition (i.e. stream vs. adit piped flow), one of the following flow monitoring methods will be implemented at each monitoring station.

5.1 *Current Meter*

A current meter measures velocity at various points along the width of the stream. The manual of operation provided with the meter would be followed and the general current meter use and flow measurement procedure from this protocol would be followed.

Please note that text surrounded by quotation marks was taken from the "*Water Measurement Manual*" (U.S. Department of the Interior, 1984).

"*The essential features of conventional current meters are a wheel, which rotates when immersed in flowing water, and a device for determining the number of revolutions of the wheel.*" The relationship between the velocity of the water and number of revolutions of the wheel per unit time for various velocities would be provided by the manufacture of the device. The instrument would be calibrated by the manufacturer prior to its shipment.

The current meter would be calibrated every year prior to its use. As part of the calibration process, a relationship between the speed of rotation of the meter and the water velocity would be developed. The relationship is called a rating table. The relationship would be developed after each calibration and the curve is supplied with the meter. (a rating table from another current meter will not be used.)

Since there is a variety of equipment available to conduct flow measurements, it has been assumed that a Price-type current meter with top setting wading rod would be used to conduct the measurements. The Price-type current meter and top setting wading rod are commonly used in the Yukon. In addition, the following procedure would be for the "*sixth-tenths-depth*" measurements, in which the velocity at sixth-tenths of the stream depth is assumed to represent the average velocity through the vertical water column.

This procedure has been prepared under the assumption that a person wading across the stream would undertake the flow measurements. For detailed procedures on conducting flow measurements from a boat or bridge refer to the "*Water Measurement Manual*" published by the U.S. Department of the Interior (1984).

The flow measurement procedure would consist of the following steps:

- Locating the monitoring station, the stations would be clearly marked.
- The number of depth and velocity measurements would be determined to conduct across the stream or river. There would be at least 20 flow measurements across the channel. However, the number of measurements may be reduced for the very small streams if the distance between the measurements becomes less than 30 centimetres (U.S. Department of the Interior, 1984). There should be no flow measurement representing more than 10% of the overall channel flow. The width across the channel would be obtained by measuring from a fixed reference point on one bank to the other.
- A measuring tape or marked cable would be used to spread across the channel to outline the locations where depth and velocity measurements will be conducted.
- The water depth would be measured at each location using the wading rod. The rod would be graduated to 0.02 metres with the zero mark at the bottom of the rod. The depth is the point at which the level water surface intersects the rod. Observations would be made to the nearest 0.01 metre.
- Velocity would be measured at sixth-tenths (0.6) of the depth from the water surface. The height of the current meter would be adjusted to sixth-tenths of the depth. The manufacturer manual would be followed on how to adjust the current meter to the proper depth.
- The number of spins per unit time at each location would be measured. Either a set of headphones or a digital counter would be used to count the number of revolutions while timing is being conducted. The timing would be started immediately after the current meter has spun past the point where it records a complete revolution (i.e. a scratch sound using the earphones or number change on the digital reader). Also it would be ensured that the rotations are measured for a minimum of forty seconds.
- The location from the left bank (while facing upstream), depth and number of revolutions per unit time on a field data sheet (please refer to Appendix I for a blank field data sheet) would be recorded.
- The location of the person taking the flow measurements is important. They would face upstream and stand at least thirty centimetres downstream of the rod. The rod would be held vertically with the meter pointing in the direction of flow.

- The measurements would continue to be taken across the stream or river in equally spaced intervals until the right bank is reached.

5.2 *V-notch Sharp Crested Weir*

A V-notch sharp-crested weir measures volumetric flow rates of a stream. The weir would be designed and constructed to meet 2005 ASTM Standard D5242-92 – Standard Test Method for Open-Channel Flow Measurement of Water and Thin-Plate Weirs. Operation and installation of the weir would be in accordance with Environment Canada's *Guidance Document for Flow Measurement of Metal Mining Effluents* (EPS2/MM/4 – April, 2001). The purpose of the weir would be to calm creek waters and allow stilled water to be decanted through a specifically shaped notch within the weir. Water level-discharge relationships could then be applied to the specific shaped notch in order to calculate an instantaneous volumetric flow rate.

5.3 *Bucket and Stop Watch*

Volumetric analysis or the *'bucket and stopwatch method'* can be an extremely precise and accurate method that simply involves the collection of discharged water in a container of known volume for a measured period of time. This is a simple method for measuring small amounts of water where all of the flow can be concentrated (such as naturally within a rock cascade, a temporary dam with a pipe, or a discharge pipe from a settling pond). The method could also be used in larger streams which have flow concentrated or partitioned by culverts, pipes or weirs. A short, wide container is more suitable to fit under the falling water than a tall narrow one. The container volume should be such that it takes at least 3 seconds to fill. It is important that the bucket is held upright and that multiple (>3) readings are taken to reduce measurement error. An alternative approach is to hold down and open a heavy-gauge plastic garbage bag on the stream bed, time its filling, and empty the bag contents into a measuring container. The bag can also be weighed and the volume calculated if the density of the water is known.

Stream discharge (Q) in L/s would be calculated as:

Q = V/t where V is the contained volume (L) during time t (s).

Reference: Hauer & Lamberti, 1996. Methods in stream ecology. Academic Press.

5.4 *Continuous Flows*

Continuous flows are required at the Bellekeno 625 Adit (KV-42) and the Bellekeno East Decline (KV-74). The decline will be inspected daily for flow and if any water is pumped from the Bellekeno East decline, the flow will be calculated by monitoring the pumping rate.

The Bellekeno 625 Adit (KV-42) discharge is currently being treated by lime in a treatment shed prior to entering the settling ponds. A calibrated digital flow meter would be installed in the line to give continuous flow measurements. A daily average would be reported as well as the flow during at the time of monitoring. The digital flow meter would be installed, calibrated, maintained and used as per the manufactures specifications.

5.5 *Dipping Probe*

As previously mentioned, the culverts at KV-78 (the Onek Waste Rock Storage Facility) will be monitored monthly using a Heron Instruments Dipper-T probe to determine the accumulation amount of water within the storage facility. The Heron probe gives a solid beep when water is encountered. The base of the culvert and the water level would be measured to a designated point at the top of the culvert. The increase and decrease in the water volume could be calculated using the height of the water column. During pumping of clean, tested water from the Onek Waste Rock Storage Facility, the continuous flow will be calculated by monitoring the pump discharge rate.

6.0 REPORTING

A daily field report form (see Appendix I) will be filled out by competent and qualified field technicians while completing the daily flow monitoring (KV-42, KV-43, KV-74 and KV-75) and daily water quality testing. The daily average and the flow at the time of monitoring will be reported for stations that require continuous flow monitoring. Sites that require quarterly flow monitoring (KV-37, KV-38, KV-41, KV-45, KV-65, KV-76 ANF KV-77) as

well as the stations that require monthly monitoring (KV-44 and KV-78) will be recorded in the field during the Water Quality sampling program.

As per Section 18 and 19 of the QZ07-078 Water Licence:

> *"18. Unless otherwise specified in this licence, all monitoring data, reports, plans, studies, study results, designs or manual shall be submitted to the Board in an unbound form that is reproducible by standard photocopier and shall be accompanied by 5 copies."*
> And
> *"19. All monitoring data, reports, plans, studies, study results, designs or manuals shall be submitted in digital form on compact disk using an IBM compatible format that is readable using commonly available software".*

The flow monitoring data collected will be incorporated into the Water Licence QZ07-078 water quality monthly and annual reports. Requirements of the monthly and annual reports are outlined in Sections 14, 15, 16 and 17 of the Water Licence QZ07-078.

Alexco Resource Canada Corp.

Bellekeno Underground Development
Flow Monitoring Plan

Water Use Licence QZ07-078

APPENDIX I

Daily Field Report Form

Date: _____

Daily Field Report

Operator: _____

		KV-13	KV-14	KV-31	KV-32	KV-42	KV-43	KV-74	KV-75
Parameter	**Units**	**Silver King 100 Adit**	**Silver King 100 Decant**	**Galkeno 900 Adit**	**Galkeno 900 Decant**	**Bellekeno 625 Adit**	**Bellekeno 625 Decant**	**Bellekeno East Decline**	**Bellekeno East Decant**
Time	HH:MM (24h)								
Air Temperature	°C								
Water Temperature	°C								
pH	pH units								
Conductivity	µS								
Ammonia	mg/L								
Turbidity	NTU								
Flow Rate	sec/5 gal								
Lime Added - Flow Rate	sec/L								
Mix Tank Hz	Hz								
Mix Tank pH	pH								
Target pH	pH								
Lime Pump RPM	RPM								
Bioreactor Cell									
Freeboard	in								
Totalizer Reading	L/sec								
Water Temperature	°C								
Visual and smell impression in tank (sheen, odor, etc.)	G/B/U								
pH	pH units								
Conductivity	µS								
Dissolved Oxygen	mg/L								
Redox potential	V								

Comments: