CITY OF NEW BRUNSWICK
COMPREHENSIVE TECHNICAL ASSIATANCE (CTA)
MONTHLY PROGRESS REPORT

TO: FRANK J. MARASCIA

FROM: HOWARD J. WOODS, JR., P.E.

SUBJECT: REPORT FOR SEPTEMBER THROUGH NOVEMBER 2013

DATE: DECEMBER 10, 2013

I. PERFORMANCE LIMITING FACTORS DEFINED IN THE COMPREHENSIVE PERFORMANCE EVALUATION

A. ADMINISTRATION – POLICIES ADMINISTRATION (A)

1. Adopt Plant Performance Goals

At the outset of the CTA, we focused on the operational strategy used for the gravity filters. The filters are used in concert with the membrane filters to produce the volume of water needed each day. The membrane filters were constructed as a replacement for the pressure filters formerly in use at the City's water treatment plant. Since the construction of the membrane filters, the gravity filters were used to supplement the volume of water produced by the membrane filters. Over time, an operational strategy evolved whereby only four of the eight gravity filters were in use at any one time. Typically, filters would be in use during each eight-hour shift. At the end of the shift, the four in-service filters would be turned off and the four previously out-of-service filters would be placed on line. At times, the filters would be backwashed at the end of a shift while at other times the filters would be washed at the start of the shift. While in service, the filters would be operated at a low rate that would be varied to maintain a set water level in the gravity filter clearwell.

The operation of the gravity filters and the membrane filters has been changed. All eight gravity filters have been placed in continuous service at a rate of 0.8 to 1.0 million gallons per day (MGD) per filter. The gravity filters produce approximately 7.0 to 8.0 MGD and, for the month of October, this represented roughly 60% of the plant output.

The following new performance goals have been adopted:

- Settled water turbidity after lime addition – 1.0 NTU
- Gravity filter turbidity – 0.1 NTU
- Maximum gravity filter run time – 48 hours

Additional goals incorporating loss of head will be incorporated into the operating goals once these gages have been replaced.

Work will be ongoing during the CTA to further improve filter performance. The objective is to improve filter performance to the point where IFE turbidity is consistently below the target of 0.1 NTU. Current performance is consistently below 0.3 NTU. Further optimization of the filter backwash cycle, filter-to-waste cycle and a review of the sample tap locations for turbidity monitoring should lead to further performance improvements.

2. Outdated or Inadequate Continuous Monitoring Equipment

A streaming current monitor has been installed to continuously monitor the effect of coagulant addition. This minimizes the need to run jar tests as the only means of controlling coagulant does and gives the operators a real-time means of assuring that the proper coagulant dose is always being applied even as raw water conditions vary. Jar testing will be done periodically as a supplemental check of the performance of the coagulation and settling processes.

New continuous IFE turbidimeters have been installed on each of the gravity filters and data from these instruments is recorded in the existing Supervisory Control and Data Acquisition (SCADA) System. A procedure has been put in place to periodically verify that the data from each turbidimeter is properly transmitted through the controller unit and recorded in the SCADA system.

A new continuous chlorine residual analyzer has been installed to measure chlorine residual at the location of the high service pumps. This location will more accurately measure the chlorine residual of water leaving the plant after the water has passed through the gravity filter clearwell. This point will be used for compliance monitoring purposes. Initial operation of the new monitoring device was interrupted by inadequate pressure control in the supply line to the chlorine residual analyzer. This has been corrected and the new monitoring point is now on-line and data is being continuously recorded in the plant SCADA system. The chlorine residual analyzer in the clearwell (referred to as the "house chlorine monitoring point") will be relocated to the influent of the chlorine contact basin for additional operational control.

A more detailed evaluation of the plant SCADA system has been completed and it has been determined that the SCADA system is inadequate and should be replaced. The existing system does not have adequate redundancy to assure that the historical operating data will be properly stored for later recovery. A new System Integrator has been selected and provided the City with a proposal to phase-out the existing SCADA system and replace it with a new, state-of-the-art system. The estimated cost of the new SCADA system is $200,000 and it is expected to be placed in service in the second quarter of 2014.

3. Delayed Maintenance

The City has restructured the water treatment plant staff and designated an employee to be responsible for all maintenance planning. Work is currently in progress to identify a suitable maintenance planning software program.

The City has hired a new licensed operator with extensive maintenance experience and placed this individual in a front line supervisory position over all plant maintenance personnel. This new organizational structure will ensure that the maintenance personnel receive proper training and supervision.

4. Lack of Safety Equipment

The deteriorated walkway between the two sedimentation basins has been replaced.

The City requested a survey of the plant by P-OSHA. An inspection was completed and a report is pending.

B. SUPERVISION – ADMINISTRATION (A)

The City has completed the restructuring of the water treatment function. A new T-4/W-4 licensed operator has been hired to function as the plant superintendent and is scheduled to begin work on December 9, 2013. This individual will report directly to the Utility Director, who is also a T-4/W-4 licensed operator, and the plant superintendent will have responsibility for all plant operations and maintenance functions. The plant superintendent will have three direct reports: a supervisor or maintenance, a supervisor of operations and a maintenance planner. The supervisor of maintenance and supervisor of operations are both T-1 licensed operators.

C. WATER TREATMENT UNDERSTANDING – OPERATIONS (A)

In-service training of the plant operations and maintenance staff is now being performed by the newly installed operations staff. This training is also being supplemented by periodic visits by the CTA consultants.

Special studies have been conducted to verify the new gravity filter operations and determine that the flow pattern in the gravity filter clearwell is not hampered by short-circuiting. The data acquisition and computation of the CT and Inactivation Ratio have been confirmed.

A review of the existing SCADA system revealed that data trending functions for a variety of plant performance measures is available. However, the lack of a true data historian limits long-term trending capabilities. In addition, the lack of a historian and adequate redundancy in the system will require existing manual data logging to continue until the SCADA system is replaced.

D. DATA INTEGRITY – OPERATIONS (B)

The lack of an adequate data historian in the SCADA system limits the City's ability to eliminate the manual data recording procedures that have been in place for many years. Manual data recording creates many opportunities to introduce transcription errors into the data and manually recorded data does not facilitate ongoing trending and analysis by the plant operations staff. The existing SCADA system will remain in service for several more months.

In the interim, IFE data are downloaded to an Excel spreadsheet. Data within this spreadsheet are color-coded to identify periods when the filters are out of service for backwashing and operating in filter-to-waste mode.

A procedure has also been established to identify periods when each IFE turbidimeter is being calibrated or maintained. The turbidimeter controllers have an out-of-service feature that will hold the last value recorded during calibration or maintenance so that calibration level turbidites, which are as high as 20 NTU are not recorded along with operational turbidity data in the SCADA system. This feature will also be used during routine maintenance (e.g., flushing and cleaning) of the turbidimeters. In addition, the log for each filter operation will be annotated to indicated when

maintenance and calibration is being done on these instruments. Manual annotation of the IFE data logs will be necessary until the SCADA system has been replaced.

The System Integrator that has historically served the City will be released and a new System Integrated will be

engaged.

Continuous turbidity data for the months of September through November have been reviewed. The highest IFE turbidity occurs when each of the filters is initially placed in service after the completion of the filter to waste cycle. Additional studies will be done in December to identify the cause of this and determine additional improvements. Items under review include:

- The adequacy of the filter backwash rate and the bed expansion achieved during backwash; and
- The length of the backwash cycle and the duration of the filter-to waste cycle. It is possible that the wash cycle and filter-to-waste cycle are both too long and adversely impact the filter ripening time.

Spikes in IFE turbidity are now investigated. IFE turbidity is consistently below 0.3 NTU as a result of the revised filter operations schedule.

E. OPERATING GUIDELINES – OPERATIONS (B)

The gravity filter operations have been simplified greatly as a result of adopting a new filter scheduling system. All eight filters will be used continuously at filtration rates of 0.8 to 1.0 MGD. Individual filters will be removed from service to be backwashed when breakthrough has occurred or when 48 hours of operation has been accumulated. Loss of head criteria will also be added when the gages have been replaced.

The new plant operations supervisor has begun the development of a current operations manual. Plant records have been researched and several outdated operations manuals were found in the files. These documents contain relevant information regarding equipment that remains in service at the facility, however, the manuals do not adequately document plant operating or maintenance objectives or procedures. Up-to-date operating procedures will be developed by the plant operations and maintenance staffs, with assistance from the CTA consultants, and these updated procedures will be consolidated in a living operations manual. As new procedures are developed, the manual will be expanded.

The procedures used to complete the calculations for the monthly operating reports have been verified.

F. MAINTENANCE – MAINTENANCE (B)

The City has appointed an individual at the plant to be responsible for all maintenance planning and scheduling activities. Work is currently underway to evaluate programmed and preventative maintenance software packages and one will be selected for use by the Water Utility. While this system will be useful in production and distribution operations, the initial focus during implementation will be in the water treatment function.

Work has already been authorized by the City to purchase replacement membranes. The membranes are roughly 5 years old and some units will need to be replaced.

The membrane filter cells have been recoated.

A proposal has been received for a complete and detailed inspection of the gravity filters and this proposal is currently under review. The gravity filters were completely renovated in 2005. While the media should deliver ten or more years of service, detailed inspections have not been done since the renovation project. A rolling schedule for media replacement will be developed so that the replacement of media can be done on a frequency where one or two filters are replaced each year.

Both sedimentation basins have been manually cleaned. There is no continuous sludge removal equipment in the sedimentation basins, so manually cleaning is required a few times per year. This schedule will be reviewed periodically. The use of the streaming current monitor to control coagulation doses should positively impact the cleaning schedule, which will be adjusted based on actual plant performance.

G. REPRESENTATIVE SAMPLING – OPERATIONS (B)

A new CFE turbidity monitoring location will be created to provide a more representative CFE result for the gravity filters prior to introduction of water from the membrane filters. Once this is done, independent CFE reports for the membrane filters and for the gravity filters will be prepared. This will provide better operational control for the plant as a whole. The existing combined CFE monitoring point will be maintained for operational control as this point does provide a representative monitoring point for all water produced and delivered from the plant. These modifications will be coordinated with the SCADA improvements.

Additional investigations will be needed to determine the best location of the IFE monitoring point for the gravity filters. The current location is idea for monitoring the turbidity of the effluent to the gravity filter clearwell but it may not be the optimum location to monitor the turbidity in the filter-to-waste line. It would be desirable to monitor turbidity in the filter-to-waste line at the completion of a backwash. This information could be used to determine when to terminate filter-to-waste operations and return the filter to service.

The plant chlorine residual monitoring location has been changed. The new continuous residual analyzer is supplied water through the high service pump priming supply line. The priming supply is in continuous operation so the data generated at this location will be representative of the chlorine residual at the completion of treatment operations regardless of the status of the high service pumps.

The grab sampling routine for the plant will be reviewed after the replacement of the SCADA system. The current grab sampling schedule is redundant and nearly all of this work should be eliminated. However, this cannot be completely done until a reliable data historian is available in the SCADA system. At this point in time, the grab sampling routine provides a useful backup to the preferred automated monitoring system.

H. COMPENSATION – ADMINISTRATION (B)

This item has not yet been evaluated in the CTA. Changes in the compensation system must reflect the unionized nature of the workforce and the fact that these are public employees. A pilot proposal for training and licensing incentives is currently being developed.

II. ADDITIONAL ISSUES DEFINED DURING THE CTA

A. POTENTIAL SHORT-CIRCUITING IN THE GRAVITY FILTER CLEARWELL

A detailed review of plant construction documents and a visual inspection of the gravity filter clearwell was conducted to verify that the full volume of the clearwell can be relied upon for CT. The results of this investigation are described in the attached memo in Appendix A to this report. The clearwell is partitioned in such a way that short-circuiting is not possible. The partitioning also facilitates the installation of a new CFE monitoring point to measure the turbidity of the combined gravity filter effluent before any water is introduced from the membrane filters.

B. LOW INACTIVATION RATIO

Data provided by the plant operations staff during the CPE suggested that inadequate giardia lamblia inactivation might be possible if short-circuiting could occur in the gravity filter clearwell. The low inactivation ratio calculated during the Comprehensive Performance Evaluation was the result of missing data, not plant performance. This issue was fully reviewed in the CTA and the results of that review are described in Appendix B to this report.

C. LIME ADDITION RELIABILITY

During the CTA, reliability issues associated with the lime feeders have been identified. Alternatives to lime addition will be reviewed during the CTA to determine the best way to adjust pH. Caustic soda, which is available at the plant, may provide a more reliable pH adjustment process and may be desirable even though the chemical is generally more costly. An evaluation of the pH adjustment process and its impact on distribution system corrosion control will be done during the CTA.

D. PRIMARY CHLORINE APPLICATION POINT RELIABILITY

The primary disinfection point is at the influent to the chlorine contact basins following sedimentation. The initial monitoring point for chlorine residual is at the effluent of the contact basin. A failure in the chlorine feed system to the head of the contact basin would not be detectible until the effluent in the contact basin begins to decline. This is too late. An additional residual monitoring point may be possible at the influent to the contact basin. This is under study. By monitoring at this point, the chlorine dose could be better controlled and there would be an added benefit in detecting the interruption in chlorine feed at this point. Should an interruption occur, the operators could maintain adequate CT by increasing the chlorine feed to the gravity clearwell while repairs to the contact chamber chlorine feed could be completed. A review of this issue is ongoing.

E. PUBLIC NOTIFICATION

Proper public notification of the violations noted in the NJDEP Administrative Order and in the USEPA Sanitary Survey Report was completed in November.

F. DISINFECTION BYPRODUCT REPORT CALCULATIONS

This issue was identified in the USEPA Sanitary Survey. The erroneous cell in the calculation form has been corrected. A further detailed review of the calculations is pending and will be completed prior to the next required compliance report.

APPENDIX A:

EVALUATION OF GRAVITY FILTER CLEARWELL SHORT-CIRCUITING

INTEROFFICE MEMORANDUM

TO: FRANK MARASCIA

FROM: HOWARD J. WOODS, JR., P.E.

SUBJECT: GRAVITY CLEARWELL FLOW PATTERNS

DATE: OCTOBER 24, 2013

An issue was raised during the Comprehensive Performance Evaluation ("CPE") regarding the flow of filtered water through the gravity filter clearwell and the impact that this flow pattern could have on the effectiveness of the final disinfection step in your treatment process. The CPE Final Report suggests that there could be a potential for water coming from the gravity filters to quickly leave the clearwell and not benefit from the full amount of chlorine contact time available in the full clearwell volume. The report also indicated that confirmation of this hypothetical flow pattern could not be made during the CPE because of limited information available on record drawings and limited access to the clearwell for physical observations. A summary discussion of this issue and a sketch showing the hypothetical flow pattern is presented on page 21 of the final CPE report.

During the Comprehensive Technical Assistance ("CTA") phase, we were able to investigate this issue in detail and I am pleased to report that the hypothetical flow pattern described in the CPE cannot occur. Walls exist within the gravity filter clearwell that will eliminate any possibility of short-circuiting. The full volume of the clearwell is available for disinfectant contact. We reviewed detailed record drawings from the 1984 renovations to the filtration plant, we interviewed Mr. Joseph Stanley, P.E., the principal design engineer for the 1984 project, and we physically inspected the clearwell from the two available access ways located in the former high service pump room, which sits atop the clearwell.

Figure 1 shows a sketch of the clearwell floor plan and the flow pattern through the clearwell. The gravity filters are located on the level above the pipe gallery. Each filter has an independent filtered water effluent line that penetrates the floor of the pipe gallery and discharges to a sealed chamber below the pipe gallery. This area is highlighted in blue in Figure 1. Sodium hypochlorite is also added to the water in this chamber. There is only one outlet from the sealed chamber and that is a venturi tube installed in a channel in the floor of the clearwell under the front wall of the sealed chamber. This configuration ensures complete mixing of the water from the eight gravity filters. Water exiting the sealed chamber is forced to move through the clearwell in a clockwise direction by a partition wall that extends from floor to ceiling and from the pipe gallery to the front of the clearwell. Filtered water from the membrane filters is also introduced into the gravity filter clearwell in this area. A 24-inch diameter line penetrates the ceiling of the clearwell and allows water to drop straight into the clearwell. An additional sodium hypochlorite application point is also located in this area.

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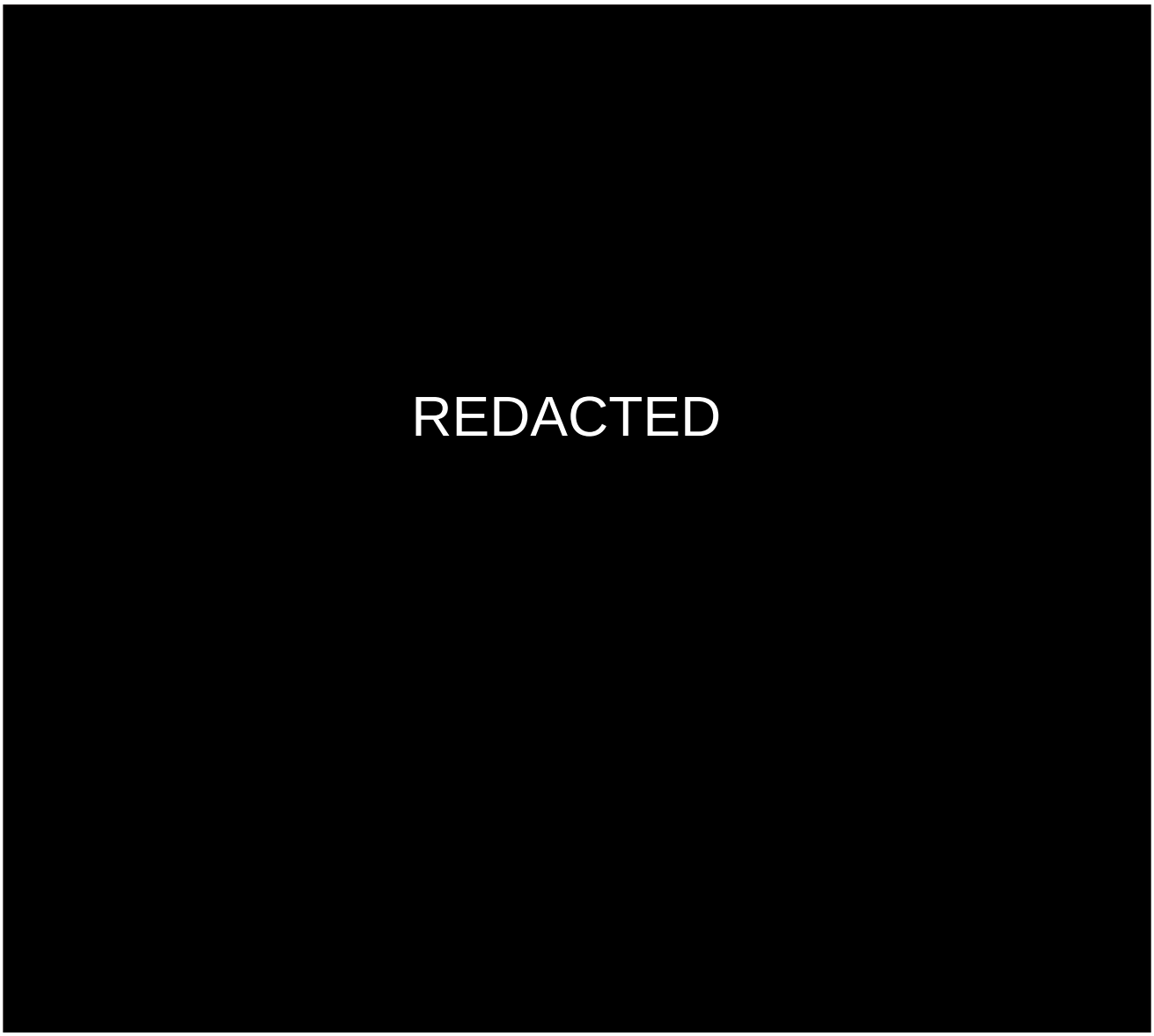


Figure 1: Gravity Filter Clearwell Flow Pattern

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Figure 2 shows a section of the clearwell highlighting the partition wall and the venturi tube through which all water from the gravity filters must flow.

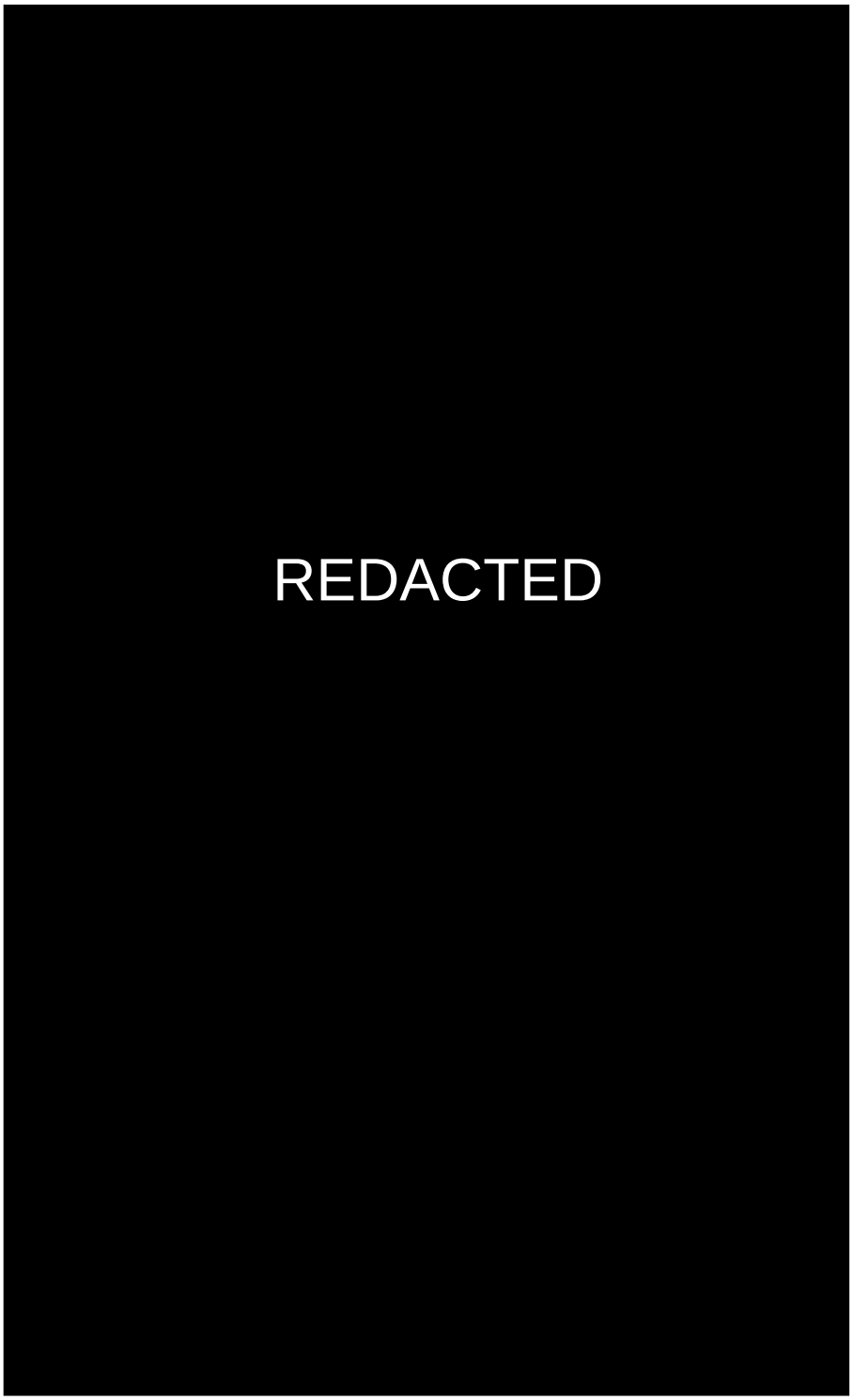


Figure 2: Partial Section of Gravity Filter Clearwell

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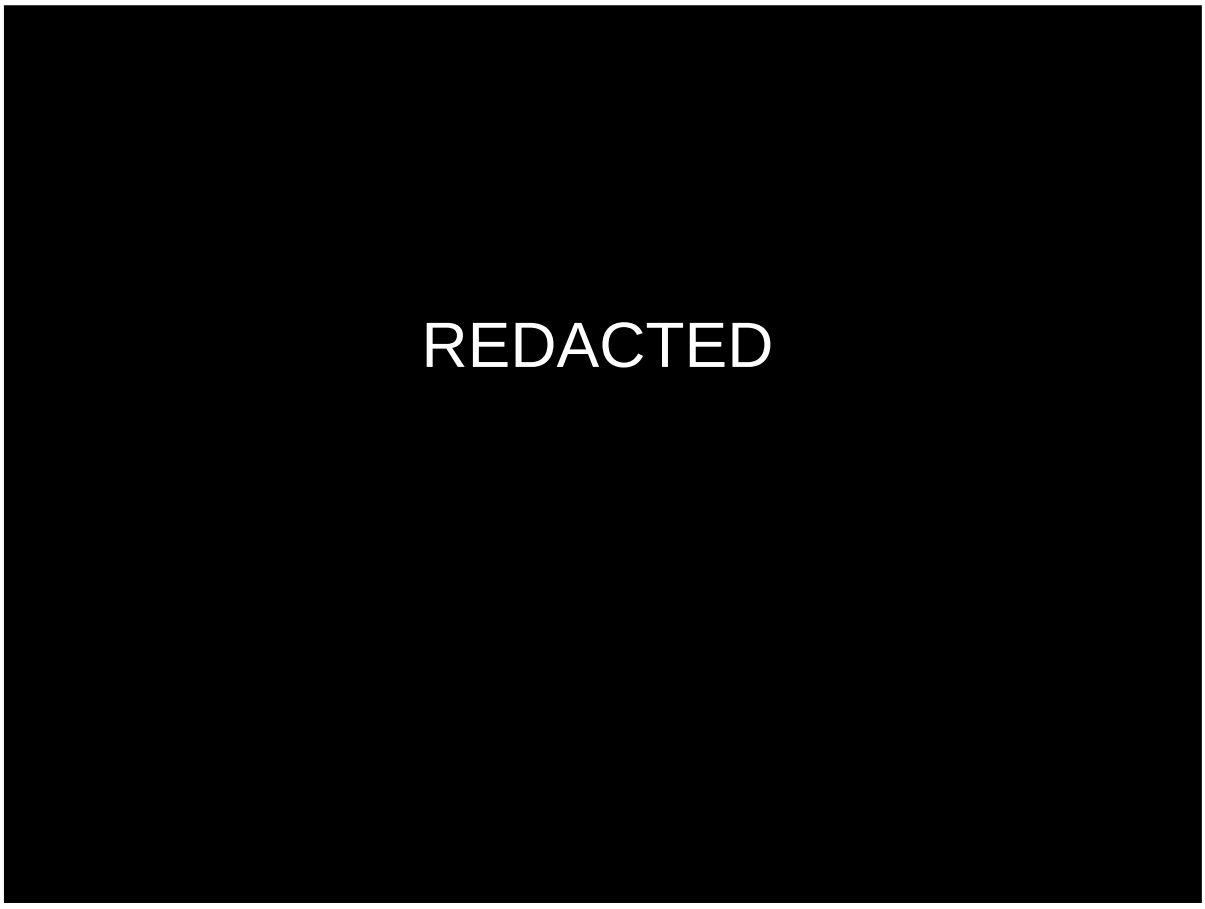


Figure 3: View of Clearwell Looking Toward the Pipe Gallery from Access Hatch No. 2

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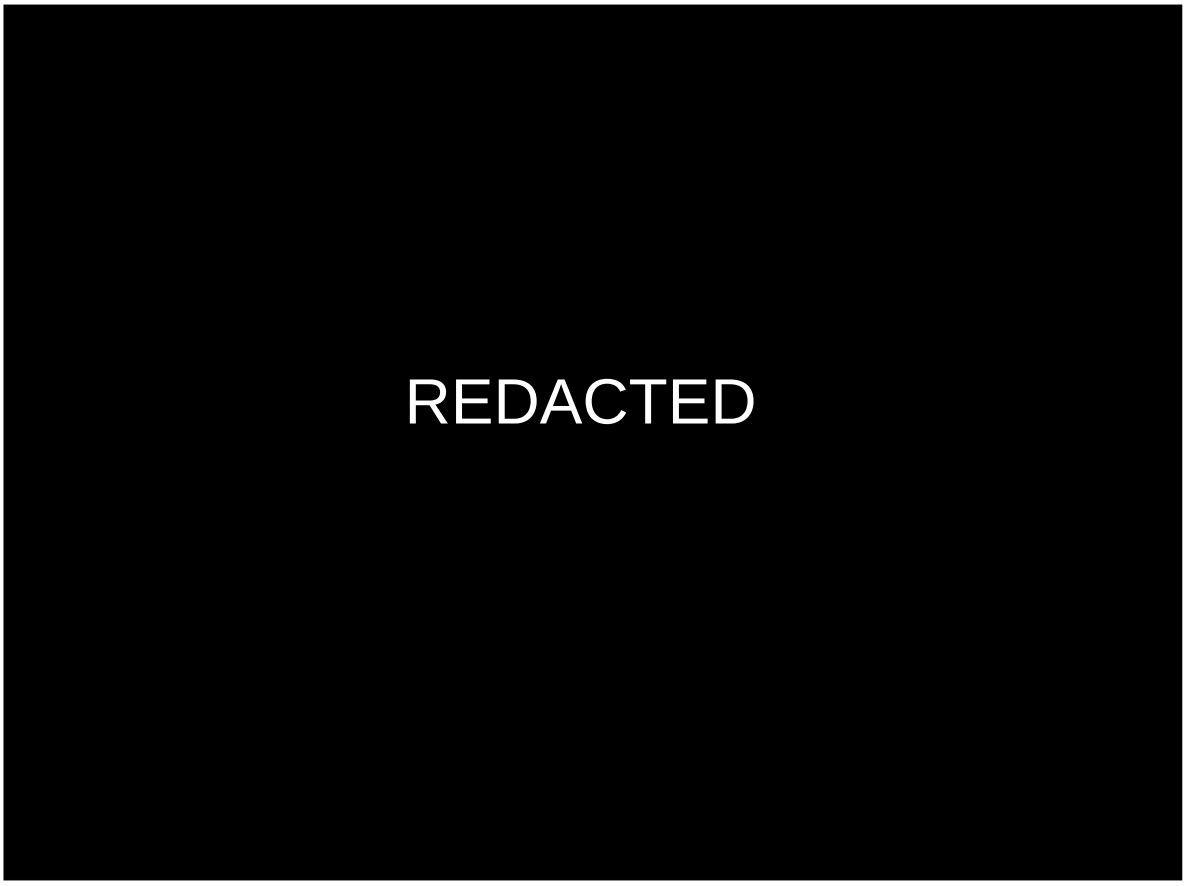


Figure 4: View of Partition Wall From Access Hatch No. 2

APPENDIX B:

REVIEW OF CPE INACTIVATION RATIO CALCULATIONS

INTEROFFICE MEMORANDUM

TO: FRANK MARASCIA

FROM: HOWARD J. WOODS, JR., P.E.

SUBJECT: INACTIVATION RATIO PLOTS

DATE: NOVEMBER 6, 2013

Figure 6 in the Comprehensive Performance Evaluation ("CPE") report illustrates the difference in the Inactivation Ratio for Giardia when the contribution of the gravity filter clearwell is excluded from the computation. Process Applications, Inc. ("PAI") raised an issue regarding the possible short-circuiting in the clearwell that would limit the amount of chlorine contact time actually realized. Based on information available during the CPE, PAI hypothesized that minimally disinfected water could leave the clearwell. We investigated this issue fully during the Comprehensive Technical Assistance and confirmed that the gravity filter clearwell is actually constructed in a way that short-circuiting of this nature is not possible. The configuration of the clearwell is such that all water from the gravity filters is chlorinated, thoroughly mixed and forced to move through the entire volume of the clearwell prior to the outlet. The volume of the clearwell is properly recognized in the CT and Inactivation Ratio calculations for the facility.

While we can dispose of the potential short-circuiting issue, Figure 6 does provide a useful illustration of the relative contribution of the chlorine contact basins and the gravity filter clearwell in achieving your disinfection objectives. During the limited time available for the CPE, PAI did not have access to all of the data for the time period covered in Figure 6. As a result, the graph appears to show that the Inactivation Ratio accounting for only the contact basin disinfection was zero for much of the month of July. The graph appears this way because the data was not available, not because of a failure in treatment. I have reproduced Figure 6 the way it appeared in the final CPE report on the following page. I have also updated Figure 6 to show the plot with the missing data included. This updated version of Figure 6 is on the last page of this report.

The Inactivation Ratio calculated correctly with the benefit of the gravity clearwell and the chlorine contact basin was always 1.0 or above for the period from September 1, 2012 through August 25, 2013, the period evaluated in the CPE. In fact, the lowest value during this period was 1.0 and this occurred on January 26, 2013. The median value for the period was 3.6 and the average for the period was 4.1. Ignoring the gravity filter clearwell, we can see what the Inactivation Ratio would have been if credit were given only for the contact basin. The minimum value occurred on July 4, 2013 and was 0.1. Over the period reviewed by PAI, the median value was 0.7 and the average value was 0.9. It would be possible to achieve the full inactivation credit in the contact basin simply by increasing the chlorine dose, but this is not necessary.

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Figure 6 As it Appears in PAI's Final CPE Report

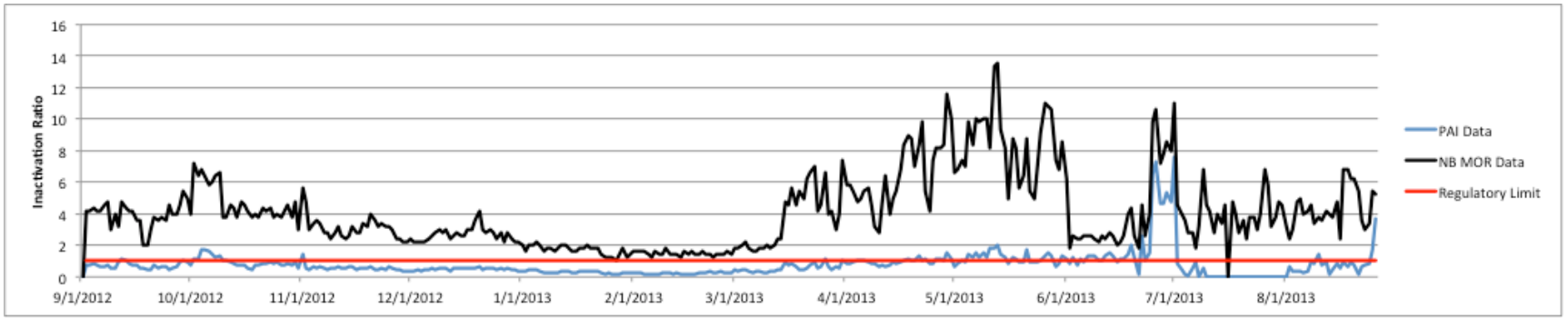


Figure 6 Corrected to include data from July 2013.

