

**NATIONAL BIOSOLIDS PARTNERSHIP
INTERIM AUDIT REPORT**

**City of Richmond,
Department of Public Utilities
Wastewater Treatment Plant
Richmond, Virginia**

Audit conducted by

NSF-International Strategic Registrations

William R. Hancuff, Lead Auditor

References:

**National Biosolids Partnership (NBP) BMP Elements
NBP Third Party Verification Auditor Guidance – November 2001
(Latest Revision August 2011)
NBP Code of Good Practice
City of Richmond, Virginia
Wastewater Treatment Plant
Biosolids Management Program Manual
Issued and Approved by Rosemary Green - Deputy Director
(Revised – 2019)**

Final Report – 30 December 2019

INTRODUCTION

The purpose of the Biosolids Management Program (BMP) interim audits is to verify through regular reviews the program's health and effectiveness between verification audits. The third party on-site interim audits provide an independent review and supports credibility between re-verification audits. In addition, one of the purposes of the interim audit is to collect and evaluate objective evidence related to a portion of the BMP such that over the course of the four interim audits conducted between verification audits all 17 elements are covered. The audits determine whether the City of Richmond Wastewater Treatment Plant BMP is functioning as intended, that practices and procedures are conducted as documented, and that the BMP as implemented conforms to the NBP's Code of Good Practice and BMP program objectives.

RECOMMENDATION

The results of the City of Richmond Wastewater Treatment Plant BMP interim audit are positive, and it is the recommendation of the audit team that the City of Richmond BMP retain its Certification at the Platinum recognition level.

AUDIT SCOPE

The NSF-International Strategic Registrations, Ltd. (NSF-ISR) conducted a third party interim audit of the City of Richmond Wastewater Treatment Plant BMP from December 16 through December 19, 2019. The on-site audit team consisted of Dr. William R. Hancuff, Lead Auditor.

The scope of the interim audit specifically included a review of the requirements of Elements 5, 14, and 17; namely the organization's progress toward goals and objectives; BMP outcomes (environmental performance, regulatory compliance, interested party relations, and quality practices); actions taken to correct minor non-conformances; the management review process; and corrective and preventive action requests and responses. Because other system elements interact with the above specific requirements the interim audit also included partial auditing of activities found in elements 1, 2, 4, 6, 9, 15, and 16.

Since the NBP allows that any individual interim audit cover a portion of the BMP, but requires that over the course of the four interim audits conducted between verification audits the entire BMP (i.e. all 17 elements) must be covered, the following elements were audited in their entirety as part of this ninth interim audit: elements 2, 4, 7, and 11. Auditing these elements involved document review, interviews, and activity evaluations.

The physical biosolids facilities included in the audit and reviewed during the interim audit included the following critical control points of the biosolids value chain: bar screens, scum tanks, anaerobic digesters, two biosolids storage tanks, final dewatering centrifuges, effluent filter building, truck biosolids loading facilities, truck scales, and concrete pad biosolids storage area and auxiliary landfill pad, and the former sludge drying beds being temporarily used for stabilized biosolids storage. Contractor discussion of one land application site in Goochland County and landfill operations.

The following individuals were interviewed as part of the audit process:

Rosemary Green, Deputy Director II, Wastewater Treatment Plant Operations
Edwin Edmondson, Utility Operations Superintendent II – Plant Manager
Noureddine E. Elamghari, Utility Operations supervisor and BMP coordinator
Faheem Abdulwahhaab, Operations Supervisor
Jarvis S Koonce, Operations Supervisor, Senior
Linwood Dabbs, Chief Operator
Makeen Salalie, Operator
Donald Carter, Project Management Analyst, Maintenance (Internal Auditor)
Eric Whitehurst, Environmental Compliance Officer
Cordell Hayes, Maintenance Program Manager
Doug Warehouse, Utilities Plant Electrical Supervisor
Willie E. Whitaker, Operations Supervisor
Brian Hawkins, Department of Public Utilities, WWTP Operator
Joey Simons, President, Simons Hauling Company (biosolids hauler - contractor)
David Simons, President, Nutriblend (biosolids applicator - contractor)
Neil Zahradka, State of Virginia, Department of Environmental Quality, Biosolids Program Manager

INTERIM AUDIT FINDINGS

The interim audit found no major non-conformances, no minor non-conformance, 4 opportunities for improvement and 1 positive commendation.

The following is a review of the positive observation made during the interim audit. The opportunities for improvement follow and are listed by item number, which correspond to the element minimum conformance requirements found in the NBP Third Party Verification Auditor Guidance. These findings are presented in the sequence of the NBP standard elements.

Positive Observations

The Richmond Wastewater management and all plant personnel involved in the biosolids environmental management program development and maintenance should be recognized for their outstanding achievements, and the exceptional features of their Biosolids Program. The following is a positive observation made during the interim audit.

Commendation:

The biosolids management program instituted a quarterly management review of its performance by the Deputy Director to ensure its continuing stability, adequacy and effectiveness. The meeting reviews progress on each of the goals and objectives as well as implementation of corrective actions. The results of the meeting are captured in “action items” to be addressed by the next quarterly meeting.

The hard work and dedication of the BMP Team must also be acknowledged. Maintaining the BMP platinum level certification recognition is obviously a team effort and the BMP team is to be commended. Additionally, the support, encouragement and active participation of Rosemary Green, during her tenure as the Deputy Director II ensured the continuous improvement of the program.

Opportunities for Improvement

Element 2 – The City is committed to the NBP Code of Good Practice, which sets forth as one of its principles the preparation and maintenance of a formal plan for preventive maintenance. The City uses “Mainsaver” as a tool in accomplishing preventive and corrective actions. The City has identified three Key Performance Indicators (KPIs) to improve performance for each of the maintenance trades and each of the employees within each trade. There is reported to be tracking, checking and regular monthly reporting on several measurable items, namely: the number of work orders completed, the number of open work orders, the hours planned for each work order versus the actual hours required for completion, the total hours each employee spent working on work orders versus total hours paid, the average time required to complete work orders in each priority category, etc. The maintenance team has a monthly meeting to discuss its accomplishments. However, there is no summary of the minutes of these meetings, which should include: date, time, attendees, discussion of overall performance in meeting KPIs, identification and praising those individuals who are star performers in each of the appropriate KPI categories, identification and praising of individuals who are most improved on a monthly basis, discussion of what things went well, discussion of areas of concern, and recording of follow-up action items. Also output from the meeting should provide recommendation of items to be published in the periodic “Biosolids News” to share the accomplishment of the maintenance management group with all plant employees.

Element 5 – Review the goal and objective for increasing grit removal to ensure that the baseline quantity of grit does not include materials removed by the bar screens.

Element 5 – Consider rewriting the goals and objectives addressing improvements in maintenance management to include specifically measurable targets for each KPI currently being tracked, i.e. 1) average days to complete facility-wide work orders (for example the average time to complete work orders during any single month shall not exceed 16 days); 2) planned work hours vs actual work hours (for example actual work hours to completed work orders should not exceed 20% of estimated work hours for that

work order); 3) the ratio of preventive maintenance actual hours to corrective maintenance actual hours (for example 60:40 on a running annual average basis).

Requirement 8.1 – Consider having two or three plant personnel receive ISO 14001 – Environmental Management System Auditor Training so that they can supplement and eventually replace the current internal auditors as part of succession planning.

CITY OF RICHMOND COMMENTS

The City of Richmond is proud to maintain its National Biosolids Partnership platinum certification. Richmond continues its commitment to best management practices and continual improvement. The interim audit helped us find organizational strengths and weaknesses. The City is pleased to work with Dr. Bill Hancuff the lead auditor and to address the audit's recommendations in a timely manner.

The Biosolids management program BMP has been very helpful and fruitful for the City to achieve its strategic goals and objectives. In 2019, The City of Richmond has made great improvement in several areas resulting in annual cost savings. The BMP will continue their efforts for continual improvement.

OUTCOMES MATTER

The City of Richmond Public Utilities Biosolids Management Team worked at improving its approach to more clearly formulating and rechecking its goals employing Specific, Measurable, Achievable, Relevant, and Time Bound (SMART) criteria. The wastewater treatment plant biosolids goals for its BMP were established cognizant of each of the four outcome areas of the NBP program as identified below:

- Environmental Performance,
- Regulatory Compliance,
- Relations with Interested Parties, and
- Quality Biosolids Management Practices

The biosolids team revised the goal numbering system and use the date on which the goal was established as its unique identifier. The narrative title is also used for clarification. The discussion below is presented using the goal number (date of origin) and descriptive titles. Currently there are seven on-going goals and objectives.

While it is not a requirement to accomplish all goals and objectives, it is a critical component of the system to make progress towards achieving the majority. The City of Richmond continued improvement of its Environmental Management System for Biosolids through progressing and completing goals established in previous years as well as the current year. A brief summary of the facilities' performance is presented below and the outcome groups affected by the goal are addressed at the end of each discussion. It

should be noted that the above-mentioned goals in some cases fulfill more than one outcome area.

10/01/14 – Improve Maintenance Management Work Order Processing And Closure (In Progress).

The objective of improving maintenance management was originally established in 2011. It was associated with improving the response time for maintenance work requests for biosolids related critical control points. This was found to be highly successful, and logically lead to establishment of two new objectives namely: generation of work requests for 100% of the incidents in the biosolids areas and improving internal communication in the biosolids areas such that the number of days a work order remains open is reduced. The latter was accomplished through daily monitoring of work order status.

In 2014 an evolved objective demonstrated considerable measurable improvement. The target was to lower the total days spent to close work orders. This was tracked by measuring three parameters: 1) lowering the percentage of open work orders closed in 100 days and up, to fewer than 10%, 2) increasing the percentage of work orders closed in less than two weeks to over 85%, and 3) increasing the percentage of work orders closed the same day to over 5%. Once this target was achieved the next goal for 2015 was established.

For 2015 the target was to lower the percentage of open work orders closed in 100 days and up, to fewer than 6%, to increase the percentage of work orders closed in less than two weeks to 90%, and to increase the percentage of work orders closed the same day to over 10%. The results thus far in 2015 showed a reduction to only 3.9% open after 100 days, 40% closed in less than two weeks, and 9.6% work orders closed the same day. The over 100 day open work orders surpass the target and the same day closures are close to the target, while the closure of work orders within two weeks is below target, but considerably improved from 2014 measure of 26%.

By the close of 2016 there was a significant increase in work orders open more than 100 days and was running 13% - over double the intended percentage and an increase of over triple the percentage of the previous year. The work orders closed in two weeks were 38% (less than half off the desired target) and virtually no improvement over the past year; and the same day closure were 12%, slightly better than the desired target, and the best showing to date. The latter target was the only one accomplished in 2016.

In 2017 the goal was redefined to lower the average time required to close biosolids related open work orders by 5% from 37 days to 35 days for 2017. For comparison the average time required to close work orders in 2015 was 84 days, in 2016 was 37 days, in June 2017 was 33 days and in October 2017 was 29 days. The measurement for 2017 will more than meet the goal.

In 2018 the goal was modified to lower the average time required to close open work orders by 5% from 33 days to 31 days for 2018. For comparison the average time

required to close work orders in 2016 was 37 days, in 2017 was 29 days and for 2018 was 16.3 days.

For 2019 the goal was modified to include all wastewater treatment plant operations, not only biosolids related activities, and the target established for the year was a reduction of 5% in total days to complete from the average in 2018 of 40 days to 38 days in 2019. There was a significant variation month-to-month throughout 2019 from as low as 20 days to as high as 65 days, with the average for the first 10 months being 36.8 days.

Outcome Areas: Environmental Performance.

10/02/14 – Generate Zero Noticeable Odors In The Gravity Thickening Area (In Progress).

This goal evolved from an earlier goal and is to create zero noticeable odors in the gravity thickening area upon startup of the fermentation process. To accomplish this goal in 2013 thickening tank covers were installed along with biofilters and carbon filters. This target was established to maintain zero noticeable odors for 2 years after start-up of the fermentation tank. Once operations began, the shift operators performed the subjective odor monitoring twice per day. Multiple year delays in completion of construction delayed the ability to commence monitoring.

In 2016 it was determined to use a more scientifically based measurement of odors by employing an olfactometer that provided objective numerical readings, and a goal of not to exceed 4 odor units (Dilution Threshold DT) was used as the target for this objective. The measurement device was purchased and background readings began the first of 2017.

The goal was modified and expanded in 2018 to include several sampling locations throughout the facility, namely: the gravity thickening area, the biosolids pads, the gravity thickener, the grit pad area, the sludge holding tanks, and in the proximity to digesters 5 and 6. The same level of acceptability of not to exceed 4 DT was used for 2018 and extended through December 2019.

All Dilution Threshold values have been at or below 4 in all areas from August 2018 through December 2019.

Outcome Areas: Environmental Performance, Regulatory Compliance, Relations with Interested Parties, and Quality Biosolids Management Practices.

01/01/15 – Improve Ratio of Preventive/Corrective Maintenance Work Hours (In Progress).

This was a new goal in 2015, which had long-term implications. To change the ratio of hours spent on preventive work orders to corrective work orders requires a long lead-time. Preventive measures reduce the frequency and resources required for corrective measures however, many assets that have not been properly maintained will fail even if

the required preventive measures are employed. This is due to the fact that the asset may have already sustained damage because of the lack of maintenance. The true savings associated with the improvement in this ratio is the cost reduction in replacement parts, materials, supplies and equipment associated with high cost assets.

A view of the history of preventive hours to corrective hour's ratios showed how the variation stayed within a range for the entire facility (including biosolids related activities): 2012: 51/49; 2013: 41/59; 2014:43/57; 2015: 52/48; and as of Aug 2016: 55/45. The shift in this ratio requires a few years to demonstrate an improvement. It was contemplated that by increasing as much as possible the number of assets in the preventive maintenance program that this will increase the preventive hours used for maintenance, and hopefully concurrently reduce the corrective hours required in the future. Also, the measurement of material/equipment/supply costs have been added to the tracking system, since this component can ultimately be a controlling variable in equipment replacement decision making.

In 2017 it was determined to refine the goal to be only applied to the biosolids areas, namely: thickening building, and dewatering control building (digesters 1 & 2). The goal for 2017 was set at a ratio of 62/38. For historical comparison purposes the ratios were: 2015 – 72/28; for 2016 – 67/33; for June 2017 – 66/34 and for Oct 2017 – 63/37.

In 2018 the goal was adjusted back to the entire plant; and modified to reflect this change by establishing a goal of 38/62 ratio. The historic ratio values were as follows: 2015 – 28/72; 2016 – 33/67, June 2017 – 34/66; Oct 2017 – 37/63; Oct 2018 – 39/61. By September 2019 the ratio had improved to 56/44.

For the 2020 a new goal was established to increase the ratio to 59/41.

Outcome Areas: Environmental Performance and Quality Biosolids Management Practices.

02/19/16 – Remove 90% of the influent grit through the new headworks degritting operation – redefined to measure the increase in total quantity of grit removed.

This goal and objective was established to reduce the quantity of grit entering the facilities as the first process in the biosolids value chain. Grit has been demonstrated to cause an increase in wear and tear on all moving parts of treatment most notably pumps and other conveyance mechanisms. It also fills the digesters with inorganic nondegradable material that reduces the capacity of the tanks and reduces the efficiency of anaerobic digestion and biosolids stabilization. The measurable goal for this objective is to increase the quantity of grit removed at the headworks by 50%. The baseline established in 2018/2019 is 150 tons per month. Therefore the target is to remove 225 tons per month. The action plan to accomplish this increase is the installation of a new headworks and grit chamber. The final engineering design was completed in June 2016. Permitting and approvals were granted in August and after numerous delays the bid and award was scheduled for August 2018. The bids received substantially exceeded the

budget and redesign of the headworks was required. The new design was 50% complete by December 2019. Construction is anticipated to be completed by early 2021 with operation by August 2021.

Outcome Areas: Environmental Performance and Quality Biosolids Management Practices.

09/22/17 – Improve centrifuge operations to obtain a monthly average solids concentration of 26% by October 2018 (initially).

A goal to improve centrifuge operating efficiencies was first established several years earlier and all the improvements were accomplished. The most recent past goal was to attain 25% solids, which was attained. During that period, it was observed that occasionally solids of 26% to 28% were achieved. Therefore, a new goal was established to regularly meet 26% solids on a monthly basis by October 2018. As of November 2018 the average was 26.2% and for the next twelve months the monthly average ranged from 26.2% to 28.8% with a full year of 27.6%.

Based on the attainment of the goal in 2018 a new goal was established for 2019, which was to not have any single monthly average drop below 27%. Unfortunately the monthly average from January through September was 26.4%, a full percentage point below the previous years average. Nevertheless, the annual cost savings attributable to this improvement is approximately \$20,000.

Outcome Areas: Environmental Performance and Quality Biosolids Management Practices.

10/12/2018 – Cover Biosolids Storage Area

Currently the biosolids storage and drying pads are uncovered and subject to long periods of precipitation making the material high in moisture content and seriously impacting the hauling cost of stabilized biosolids to land application sites.

The measurability of 100% coverage of solids does not actually identify the true measurable benefit of providing a cover.

As of December 2019 the design was reported to be 75% complete and construction scheduled for mid-2020.

Outcome Areas: Environmental Performance, Regulatory Compliance, Relations with Interested Parties, and Quality Biosolids Management Practices.

10/16/2018 – Improve Recordation of “Planned” labor hours in each work order to meet 100% of all work orders (preventive and corrective) by June 2019.

Presently only 51% of work orders have “planned” labor hours recorded in the work order. By making it a requirement that no work orders will be issued without an estimate of the “planned” hours included in the work order will accomplish this goal.

The goal was not attained and performance was quite poor – only meeting 74% of planned labor hours recorded by November 2019.

Outcome Areas: Environmental Performance, Regulatory Compliance and Quality Biosolids Management Practices.

CONCLUSIONS AND RECOMMENDATIONS

The results of the interim audit are positive. Since there were no major or minor nonconformities there were no corrective action plans that needed to be reviewed and approved by the auditor. However, as part of it emphasis on continual improvements corrective action plans were prepared for each of the opportunities for improvement. The implementation of the corrective action for the observations will be accomplished according to the corrective action schedule and will be reviewed during the next third party audit – the recertification audit. In the mean time, it is the recommendation of the audit team that the BMP retain its certification at the platinum recognition level.

As was mentioned previously, the BMP is a continually improving process. The results of this and future audits will provide value added to the system and should be viewed as an overall opportunity to improve. Every audit is a snapshot in time, and does not, or cannot, identify each and every area for improvement. And yet, while no single audit identifies all of the areas for improvement the results of each audit provide an additional incremental step in the overall system’s improvement.

Based on discussions between the Plant’s BMP Coordinator and the third party auditor, the schedule of individual elements to be audited in their entirety such that all the elements of the BMP are covered before the next re-verification audit are as follows:

Year 6 (third party) – Elements 3, 10, 12, 13 (completed)

Year 7 (third party) – Elements 1, 8, 15, 17 (completed)

Year 8 (third party) – Elements 5, 6, 9, 14, 16 (completed)

Year 9 (third party) – Elements 2, 4, 7, 11 (completed)

Year 10 (third party) Re-verification

Attachment 1

Documents and Other Objective Evidence Reviewed During the Interim Audit

Element 1. Documentation of Biosolids Management Program

- City of Richmond Wastewater Treatment Facility Biosolids Management Program Manual Issued and Approved by Rose Mary Green, Deputy Director II – 2019.
- BMP Element 1 – Documentation, Rev 15, 11/07/2016.
- Table 1.1 – BMP Organization by Categories.
- BMP Element 2 – Biosolids Management Policy, Rev 14, 10/28/2015.
- BMP Element 3: Critical Control Points, Rev 15, 11/08/2016.
- Element 3: Critical Control Points, Table 3.1- Critical Control Points (CCP) Operations (undated).
- BMP Element 6 – Public Participation in Planning, Rev 14, 10/28/2015.
- BMP Element 7 – Roles and Responsibilities, Rev 15, 11/10/2016.
- BMP Element 9 – Communication, Rev 15, 11/11/2016.
- BMP Element 11 – Emergency Preparedness and Response, Rev 14, 10/28/2015.
- Interview with Rosemary Green, Deputy Director II
- Interviews with Nouredine E. Elamghari and Faheem Abdul-wahhaab.

Element 2. Biosolids Management Policy

- BMP Element 2 – Biosolids Management Policy, (including Code of Good Practice), Rev 14, 10/28/2015.
- BMP Element 9 – Communication, Rev 15, 11/11/2016.
- Interview with Rosemary Green, Deputy Director II
- Interviews with Nouredine E. Elamghari and Ed Edmondson.
- Policy displayed throughout wastewater treatment plant on posters.
- Policy communicated to interested parties through availability on web site.

Element 3. Critical Control Points

- BMP Element 3: Critical Control Points, Rev 15, 11/08/2016.
- Element 3: Critical Control Points, Table 3.1- Critical Control Points (CCP) Operations (undated).
- Operations (including relationship to value chain, operational control references and environmental impacts). (undated)
- Field observation of select biosolids significant Critical Control Points.
- Interviews with plant personnel: Ed Edmondson, Nouredine E. Elamghari, Faheem Abdul-wahhaab, Jarvis S Koonce, Willie E. Whitaker, Donald Carter, Eric Whitehurst, Cordell Hayes, Doug Warehouse, and Brian Hawkins.

- Interview with contractor personnel: David Simons, President, Nutriblend (biosolids applicator) and Joey Simons, President, Simons Hauling Company (biosolids hauler).

Element 4. Legal and Other Requirements

- BMP Element 4 – Legal and Other Requirements, Rev 17, 11/01/2018.
- Table 4.1 List of Relevant Legal and Other Requirements.
- Interviews with Ed Edmondson, Nouredine E. Elamghari, Eric Whitehurst, Donald Carter, and Faheem Abdul-wahhaab.
- Interview with contractor personnel: David Simons, President, Nutriblend (biosolids applicator) and Joey Simons, President, Simons Hauling Company (biosolids hauler).
- Interview with State Regulator – Neil Zahradka, State of Virginia, Department of Environmental Quality, Biosolids Program Manager.

Element 5. Goals and Objectives for Continual Improvement

- BMP Element 5 – Goals and Objectives for Continual Improvement, Rev 14, 10/28/2015. (Element Procedure)
- BMP Element 5.1 (Table) – Goals and Objectives for Continual Improvement, Rev 16, 10/15/18.
- 2018 Biosolids Management Program Performance Report.
- Biosolids Goal Action Plan form for tracking outcomes and objectives and targets (print date 12/17/19).
- Evaluated each G&O for conformance with SMART criteria.
- Reviewed detailed data on work order processing and corrective action vs preventive action work order hours’ ratio and all other Key Performance Indicators (KPIs).
- Interview with Rosemary Green, Deputy Director II.
- Interviews with Ed Edmondson, Nouredine E. Elamghari, Faheem Abdul-wahhaab, Donald Carter, Cordell Hayes and Doug Warehouse.
- Reviewed progress on the measurability of each goal and objective.

Element 6. Public Participation in Planning

- BMP Element 6 – Public Participation in Planning, Rev 14, 10/28/2015.
- BMP Element 9 – Communication, Rev 15, 11/11/2016.
- Reviewed the City’s Biosolids BMP website information.
- Interviews with Nouredine E. Elamghari, and Faheem Abdul-wahhaab.
- Interviews with contractor personnel: David Simons, President, Nutriblend (biosolids applicator) and Joey Simons, President, Simons Hauling Company (biosolids hauler).
- Interview with State Regulator – Neil Zahradka, State of Virginia, Department of Environmental Quality, Biosolids Program Manager.

Element 7. Roles and Responsibilities

- BMP Element 7 – Roles and Responsibilities, Rev 15, 10/29/2019.
- Table 7.1 – Biosolids BMP Responsibilities.
- Interview with Rosemary Green, Deputy Director II
- Interviews with Ed Edmondson, Nouredine E. Elamghari, and Faheem Abdulwahhaab.
- Interviews with contractor personnel: David Simons, President, Nutriblend (biosolids applicator) and Joey Simons, President, Simons Hauling Company (biosolids hauler).

Element 8. Training

- BMP Element 8 – Training, Rev 14, 10/28/2015.
- Interviews with Nouredine E. Elamghari, Ed Edmondson, and Faheem Abdulwahhaab.
- Interviews with plant personnel: Donald Carter, Cordell Hayes, and Doug Warehouse.
- Interviews with contractor personnel: David Simons, President, Nutriblend (biosolids applicator) and Joey Simons, President, Simons Hauling Company (biosolids hauler).
- Discussed EMS Awareness Training Power Point slides.

Element 9. Communications

- BMP Element 9 – Communication, Rev 15, 11/11/2016.
- BMP Element 6 – Public Participation in Planning, Rev 14, 10/28/2015.
- Richmond Public Utilities webpage on Biosolids.
- Discussed EMS Awareness Training Power Point slides.
- Periodic Treatment Plant publication – Biosolids News.
- Interview with Rosemary Green, Deputy Director II
- Interviews with Nouredine E. Elamghari, Ed Edmondson, and Faheem Abdulwahhaab.
- Interviews with contractor personnel: David Simons, President, Nutriblend (biosolids applicator) and Joey Simons, President, Simons Hauling Company (biosolids hauler).
- Interview with State Regulator – Neil Zahradka, State of Virginia, Department of Environmental Quality, Biosolids Program Manager.

Element 10. Operational Control of Critical Control Points

- BMP Element 10 – Operational Control of Critical Control Points, Rev 15, 11/11/2016.
- Element 3: Critical Control Points, Table 3.1- Critical Control Points (CCP) Operations (including relationship to value chain, operational control references and environmental impacts). (undated)

- BMP Element 13 – Monitoring and Measurement, Rev 14, 10/28/2015.
- Reviewed detailed hours and costs for work orders processed, including the lack of data on estimated hours required for each work order issued.
- Interview with Rosemary Green, Deputy Director II
- Interviews with Nouredine E. Elamghari, Ed Edmondson, and Faheem Abdul-wahhaab.
- Interviews with plant personnel: Jarvis S Koonce, Willie E. Whitaker, Linwood Dabbs, Brian Hawkins, Makeen Salalie, Donald Carter, Cordell Hayes, and Doug Warehouse.
- Interviews with contractor personnel: David Simons, President, Nutriblend (biosolids applicator) and Joey Simons, President, Simons Hauling Company (biosolids hauler).

Element 11. Emergency Preparedness and Response

- BMP Element 11 – Emergency Preparedness and Response, Rev 14, 10/28/2015.
- SOP: Biosolids Spill Response Plan, Rev 14, 10/18/2018.
- Interviews with Nouredine E. Elamghari and Faheem Abdul-wahhaab.
- Reviewed Biosolids Spill drill post evaluation report for spill drill conducted on 10/09/2018.
- Reviewed internal audit finding on spill drill personnel training.

Element 12. BMP Documentation and Document Control

- BMP Element 12 – Documentation, Document Control, and Record Keeping, Rev 15, 11/01/2018.
- Reviewed Manual Element Change Log from 2014 to 2019.
- Interviews with Nouredine E. Elamghari and Faheem Abdul-wahhaab.

Element 13. Monitoring and Measurement

- BMP Element 13 – Monitoring and Measurement, Rev 14, 10/28/2015.
- Element 3: Critical Control Points, Table 3.1- Critical Control Points (CCP) Operations (including relationship to value chain, operational control references and environmental impacts). (undated)
- BMP Element 10 – Operational Control of Critical Control Points, Rev 15, 11/11/2016.
- Reviewed detailed hours and costs for work orders processed, including the lack of data on estimated hours required for each work order issued.
- Interview with Rosemary Green, Deputy Director II
- Interviews with Nouredine E. Elamghari, Ed Edmondson, and Faheem Abdul-wahhaab.
- Interviews with plant personnel: Jarvis S Koonce, Willie E. Whitaker, Linwood Dabbs, Brian Hawkins, Makeen Salalie, Donald Carter, Cordell Hayes, and Doug Warehouse.

- Interviews with contractor personnel: David Simons, President, Nutriblend (biosolids applicator) and Joey Simons, President, Simons Hauling Company (biosolids hauler).

Element 14. Nonconformances: Preventive and Corrective Action

- BMP Element 14 – Nonconformance: Preventive and Corrective Action, Rev 14, 10/28/2015.
- Reviewed CARs prepared to address third party interim audit from 2018 (CAR 178).
- Reviewed CARs prepared to address internal audit from 2018 (CAR 182 - 189)
- Reviewed Wastewater Plant Biosolids BMP Internal Audit Findings for audit conducted in 2018.
- Interviews with Nouredine E. Elamghari and Faheem Abdul-wahhaab,
- Interview with internal auditor - Donald Carter.

Element 15. Periodic Biosolids Program Report

- BMP Element 15 – Performance Report, Rev 14, 10/28/2015.
- BMP Element 6 – Public Participation in Planning, Rev 14, 10/28/2015.
- BMP Element 9 – Communication, Rev 15, 11/11/2016.
- Reviewed 2018 Biosolids Management Program Performance Report (BMPPR)
- Interview with Rosemary Green, Deputy Director II
- Interviews with Nouredine E. Elamghari and Faheem Abdul-wahhaab.

Element 16. Internal BMP Audit

- BMP Element 16 – Internal BMP Audit, Rev 14, 10/28/2015.
- Reviewed Wastewater Plant Biosolids BMP Internal Audit Report for 2019 audit.
- Reviewed 2019 internal audit results and actions taken in response to the audit findings.
- Reviewed CARs prepared to address internal audit from 2018 (CAR 163 – 174)
- Interviews with Nouredine E. Elamghari, Faheem Abdul-wahhaab, and Donald Carter.

Element 17. Periodic Management Review of Performance

- BMP Element 17 – Periodic Management Review of Performance, Rev 14, 10/28/2015.
- 2018 Biosolids Management Program Performance Report.
- BMP Management Review Meeting minutes for November 4, 2019.
- Interview with Rosemary Green, Deputy Director II
- Interviews with Ed Edmonson, Nouredine E. Elamghari and Faheem Abdul-wahhaab.