Five-Year Periodic Review

Bee-Jay Scales Site
Sunnyside, WA 98944

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Sign-off Sheet

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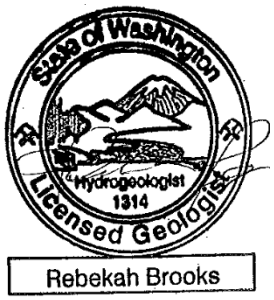

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1.0 Introduction

Stantec Consulting Services Inc. (Stantec) is submitting this Periodic Review to the Washington Department of Ecology (Ecology) for the Bee-Jay Scales Site (the Site), on behalf of Chevron Environmental Management Company (CEMC) and Remediation Management Services Company (RMSC) on behalf of Chevron Chemical Company and American Oil Company (Amoco), respectively. This Periodic Review has been prepared as required by Consent Decree No. 132017660 between Ecology, Chevron Chemical Company, and Amoco (Ecology, 2013a) and under the provisions of the Washington State Model Toxics Control Act (MTCA) Washington Administrative Code (WAC) 173-340 (WAC, 2007). The objective of the periodic review is to determine whether human health and the environment are being protected based on the factors established in WAC 173-340-420(4). Those factors are:

- The effectiveness of ongoing or completed cleanup actions, including the effectiveness of engineered controls and institutional controls in limiting exposure to hazardous substances remaining at the Site;
- New scientific information for individual hazardous substances or mixtures present at the Site;
- New applicable state and federal laws for hazardous substances present at the Site;
- Current and projected Site use;
- Availability and practicability of higher preference technologies; and
- The availability of improved analytical techniques to evaluate compliance with cleanup levels (CULs).

2.0 Summary of Site Conditions

2.1 SITE DESCRIPTION AND HISTORY

The Site is located in the City of Sunnyside (City), within Yakima County, Washington, and includes the two parcels where contaminants were historically released and the parcels where those contaminants have come to be located. The Site location is shown on **Figure 1**.

The two parcels where contaminants were historically released include Parcel No. 22102522014, located at 110 North 1st Street and owned by Bee-Jay Scales, Inc. (BJS), and Parcel No. 22102522015, located at 301 Warehouse Avenue and owned by Western General Land, LLC (WGL) (shown on **Figure 2**; note that only the last six digits of the parcel numbers are shown). The BJS parcel is approximately 3.0 acres in size. Three businesses currently operate at the parcel: Sandy Farms, a local trucking company; Sanleco, Inc., an interstate trucking company with a tractor-trailer repair garage; and Bee-Jay Scales, a commercial scale operation. The WGL parcel is approximately 0.9 acres in size and is currently used to park semi-trucks and trailers as well as store other equipment used by the food processing facility to the east.

The BJS and WGL parcels and the surrounding area have been the location of agricultural warehouses, lumber yards, coal storage, and railroad transportation activities since approximately 1906. Portions of these two parcels were owned by the Northern Pacific Railroad Company from 1906 until 1989 when they were purchased by the Glacier Park Company. An agricultural distribution facility operated at the BJS parcel from the 1960s through at least 1986. This facility consisted of buildings and aboveground storage tanks (ASTs), and was operated by at least two separate companies: Laneger Agricultural Services and Valley Agricultural, Inc. The ASTs have since been removed from the parcel. Documentation also indicates that Amoco, now part of BP, leased portions of the parcels from Northern Pacific Railroad Company between 1965 and 1972. A lagoon was constructed by Valley Agricultural, Inc. in the early 1980s to collect water from the washdown of farm chemical applicator vehicles.

The western portion of Lot 10 was purchased by Chevron Chemical Company in 1981 and sold to BJS in 1987. BJS purchased additional portions of Lots 10 and 11 in 1995 and 1996. Lots 10 and 11 are referenced in the Summary of Ownership included as Appendix B of the *Remedial Investigation/Feasibility Study Work Plan* (CH2M Hill, 2003). The exact locations and boundaries of Lots 10 and 11 are unknown based on available information.

Hickenbottom & Sons, Inc. leased the WGL parcel from the Northern Pacific Railroad Company beginning in 1961 and purchased portions of Lots 10 and 11 in 1992. The WGL parcel was previously used as pastureland; since 1961, it has been used for food packing, storage, and a transportation business. The parcel was purchased by WGL in 2010.

The BJS and WGL parcels were historically divided into six main study areas throughout the environmental investigation and assessment process. Those six study areas are shown on **Figure 2**.

On the BJS property, material is spilling out of the east wall of the Former Fertilizer Building and accumulating on the ground surface outside of the building. This was documented in letters submitted to Ecology on November 7, 2014 and November 1, 2019. It is assumed this material may be a fertilizer compound and could contain nitrate, ammonia, or other chemicals associated with fertilizer that may impact the Site remedy. The BJS property owner is responsible for addressing this continual release.

Historical releases from activities on the BJS and WGL parcels have impacted the groundwater at those parcels and have extended down-gradient to affect several additional parcels. The following parcels were affected by the contaminant groundwater plumes as defined by the *Groundwater Remedy Engineering Design Report* (GW EDR) dated November 15, 2016 (Stantec, 2016), and are considered part of the Site:

- Parcel 22102522016 is located adjacent to the WGL parcel to the east and is owned by Northwest American Land LLC. The parcel is approximately 1.8 acres in size and contains a fruit processing facility.
- Parcels 22102522902 and 22102522903 are located south of the BJS and WGL parcels. Both parcels are owned by Burlington Northern Santa Fe Railway Company (BNSF) and are adjacent to or surrounded by the railroad right-of-way (ROW).
- Parcel 22102522555 is located south of the railroad ROW and is owned by Valley Processing Inc. The parcel is approximately 3.6 acres in size and contains a fruit processing facility.
- Parcel 22102522502 is a long narrow parcel approximately 0.3 acres in size located south of Parcel 22102522555 and north of Blaine Avenue. The parcel is owned by Union Pacific Railroad but appears to be used by the Valley Processing Inc. facility to the north, possibly under a lease.
- Parcels 22102523416, 22102523418, 22102523419, 22102523420, 22102523421, 22102523437, 22102523438, 22102523439, 22102523440, and 22102523441 comprise the northeast portion of the triangular area bordered by Blaine Avenue to the north, S. 3rd Street to the east, a railroad spur to the south and S. 1st Street to the west. The parcels combined have an area of approximately 1.3 acres and are owned by Mary Ann Bliesner. These parcels are used as transportation parking associated with the local fruit processing facilities.
- Parcel 22102523901 coincides with the location of a large structure located south of Blaine Avenue. The parcel is owned by Valley Processing Inc. and occupies an area of 0.21 acres. The building appears to contain a fruit processing facility.
- Parcel 22102523417 is a square parcel 0.13 acres in size located at the southwest corner of Blaine Avenue and S. 3rd Street. The parcel is owned by George and Evelyn Johnson and is used as transportation parking.

The Site layout, including parcel numbers, monitoring well locations and other important features, is shown on **Figure 2**.

2.2 CLEANUP LEVELS AND POINTS OF COMPLIANCE

2.2.1 Soil Cleanup Levels

CULs have been established for two constituents for soil at the Site as identified in the Corrective Action Plan (CAP) dated March 8, 2013 (Ecology, 2013b). A nitrate CUL of 220 milligrams per kilogram (mg/kg)

has been established by MTCA modified Method B for the protection of groundwater using Site-specific leaching tests pursuant to WAC 173-340-747(3)(d). Site-specific testing has established that Site soils with nitrate concentrations below the CUL should not leach to groundwater above the groundwater nitrate CUL. The ammonia CUL of 385 mg/kg has been established based on MTCA Method B for protection against acute vapor health effects for a construction worker.

2.2.2 Soil Point of Compliance

The point of compliance (POC) for soil is the soil overlying groundwater within the BJS and WGL parcels (Ecology, 2013b).

2.2.3 Groundwater Cleanup Levels

Site-specific CULs for groundwater constituents have been developed from a combination of primary maximum contaminant levels (MCLs), standard MTCA Method A CULs, and standard and modified MTCA Method B CULs. When primary MCLs have been developed for Site groundwater constituents, they are set as the CUL. If no MCL has been established, modified MTCA Method B CULs are generally used. In cases where modified MTCA Method B CULs have not been developed, standard MTCA Method A or Method B CULs are used.

Though nitrate in groundwater above the MCL of 10 milligrams per liter (mg/L) is the main driver, CULs have been established for 24 constituents for groundwater at the Site. The constituents, CULs, and basis for the CUL are shown in **Table 1**. Per WAC 173-340-703, when defining cleanup requirements at a site that is contaminated with a large number of hazardous substances, some of those substances may be eliminated from consideration where those substances contribute a small percentage of the overall threat to human health and the environment. The remaining hazardous substances shall serve as indicator hazardous substances (IHSs) for purposes of defining cleanup requirements.

Twelve groundwater IHSs have been identified from the 24 groundwater constituents based on the remedial investigation and feasibility study process completed for the Site. The 12 Site groundwater IHSs were identified in the CAP dated March 8, 2013 (Ecology, 2013b) and are shown in **bold** in **Table 1**. Only the IHSs will be used to monitor compliance with the Site cleanup requirements.

2.2.4 Groundwater Point of Compliance

The POC for Site groundwater constituents is defined in the CAP as monitoring wells MW-4R, MW-5R, MW-6, MW-12R, and all monitoring wells, including those to be constructed as part of the remedial action, that are located down-gradient of those wells (generally to the south and southeast). The POC includes groundwater from the POC to the outer boundary of the Site plume. This plume is considered to apply to groundwater that has migrated from the BJS and WGL parcels, and any other sources would need to be considered separately. The following monitoring wells were determined to currently meet the CAP POC definition in the Groundwater Remedy Compliance Monitoring Plan (GW CMP; Stantec, 2019a): MW-4R, MW-5R, MW-6, MW-9, MW-12R, MW-13, MW-16, MW-19. In addition, well MW-21 was installed in October 2019 and is considered a groundwater POC.

2.3 CLEANUP ACTIONS

The CAP, dated March 8, 2013 and prepared for the Site by Ecology (Ecology 2013b), contains both soil and groundwater cleanup objectives. The selected cleanup action includes a combination of the removal of contaminated soil overlying groundwater, in-situ bioremediation of the Site groundwater plume via injection wells and/or vertical barrier wall treatment system(s), natural attenuation of the groundwater and soil contamination to meet the CULs at the defined POCs, and institutional controls (ICs) to protect against the use of groundwater by the public.

3.0 PERIODIC REVIEW

3.1 ASSESSMENT OF CLEANUP ACTIONS

3.1.1 Shallow Soil Excavation

Contaminated soils exceeding the nitrate and ammonia CULs and located above groundwater were excavated from the BJS and WGL parcels in 2014. The extent of contaminated soil was determined based on soil assessment activities completed in 2003 and 2004 (SECOR, 2003; SECOR, 2005). Additional soil assessment activities were completed in 2013 and 2014 to delineate the limits of soil contamination prior to the initiation of excavation activities. Each excavation was then designed to extend to a confirmation soil sample location not exceeding the soil CULs or to a property boundary or building location as detailed in the *Shallow Soil Excavation Engineering Design Report,* dated August 26, 2013 (Stantec, 2013). Completed excavation extents were then confirmed by survey.

A total of eight excavations were completed to depths ranging from 4.75 feet to 11 feet below ground surface (bgs), with approximately 6,605 cubic yards of contaminated soil transported under manifest for off-site disposal to the Waste Management Columbia Ridge Landfill in Arlington, Oregon. The locations of the excavations are shown on **Figure 3** and a summary of the excavation volumes are provided in **Table 2**. Full details regarding the shallow soil excavation activities can be found in the *Shallow Soil Excavation As-Built Completion Report,* dated April 23, 2015 (Stantec, 2015).

3.1.2 In-Situ Bioremediation of Groundwater

Planning for the implementation of in-situ bioremediation of the Site groundwater has been underway since 2015. The GW EDR was first submitted to Ecology for review on December 16, 2015. Ecology comments to the GW EDR were provided in letters dated May 26 and June 30, 2016. Additional comments were provided during a conference call between Ecology, Stantec, CEMC, and RMSC on September 30 and November 10, 2016 and the revised GW EDR was submitted to Ecology on November 15, 2016 (Stantec, 2016). Ecology approved the revised GW EDR on February 22, 2017.

The *Groundwater Remedy Construction Plans and Specifications* (GW CPS) and *Groundwater Remedy Compliance Monitoring Plan* (GW CMP) were first submitted to Ecology for review on April 14, 2017. Ecology comments to the GW CPS and GW CMP were received on June 19, 2017 and November 2, 2017, respectively. A revised GW CPS was submitted to Ecology on May 18, 2018 and a revised GW CMP was submitted to Ecology on June 15, 2018. Additional comments to the GW CPS were provided by Ecology on August 23, 2018 and to the GW CMP on December 10, 2018. After a second revision, the GW CPS and GW CMP were submitted to Ecology on May 1, 2019 (Stantec, 2019 a; 2019b). Ecology approved the revised GW CPS and GW CMP on August 21, 2019.

The groundwater remedy will be conducted in a phased approach, with data obtained during Phase I used to refine the Phase II implementation. Ten Phase I injection wells and three observation wells were installed at the Site from October 21 to 31, 2019, and soil samples were collected for both analytical and geotechnical testing. The injection and observation wells were surveyed by a licensed surveyor on

December 3, 2019. Slug testing of the ten Phase I injection wells was completed from December 3 to 5, 2019 to determine hydraulic conductivity. The Phase I enhanced in-situ bioremediation (EISB) injection is tentatively scheduled for first quarter 2020. A Phase I documentation report will be submitted in the second half of 2020 summarizing Phase I data collected and recommending any design changes to be implemented for Phase II.

3.1.3 Natural Attenuation of Groundwater

Groundwater monitoring has continued on a semi-annual schedule since the issuance of the Consent Decree. Groundwater monitoring data through August 2019 have been analyzed to provide an update to the IHS plume distributions and trends at the Site as part of this periodic review.

3.1.3.1 Groundwater Concentration and Trend Analysis

The IHS groundwater concentrations from the last six events (three [3] years) were analyzed, and, when IHS concentrations exceeded the CUL over that timeframe at a monitoring well location, the 3-year 95 percent (%) upper confidence limit concentration (UCL95) was calculated to define the area currently exceeding the CULs per the GW CMP. In addition, for applicable IHSs and monitoring well locations, a trend analysis was performed using the Ecology Package A, Natural Attenuation Analysis Tool Package (Ecology, 2005) and the ProUCL Version 5.1 statistical software (United States Environmental Protection Agency [EPA], 2016). The trend analysis was completed using the maximum amount (16) of monitoring events (up to eight years of Site data), if available. The calculation software outputs are provided for each applicable monitoring well in **Appendix A**.

Table 3 summarizes the status (concentration and trend) of each analyzed IHS at each of the monitoring wells as of the second half 2019 (2H19) groundwater monitoring event. The status of the groundwater concentrations for each IHS is further summarized below.

Nitrate and Nitrite

The nitrate 3-year UCL95 exceeds the CUL at 10 of the 19 monitoring well locations (MW-3, MW-4R, MW-5R, MW-6, MW-8, MW-9, MW-11, MW-12R, MW-13, and MW-16). The nitrate 3-year UCL95 concentrations and estimated plume extents are shown on **Figure 4**. Note that UCL95 concentrations were calculated at each monitoring well for nitrate, even when the nitrate concentrations didn't exceed the CUL; these nitrate UCL95 values are shown on **Figure 4**. The calculated concentration trend for each monitoring well with a UCL95 above the CUL indicates increasing trends at three locations (MW-3, MW-6, and MW-11) and decreasing or stable trends at the remaining seven locations (MW-4R, MW-5R, MW-8, MW-9, MW-12R, MW-13, and MW-16). An additional monitoring well location previously defined as within the nitrate plume in the GW EDR (MW-19) now has a 3-year nitrate UCL95 below the CUL and indicates a decreasing trend.

Collectively, it is difficult to draw a single conclusion from the collective trend analysis throughout the nitrate plume. The three wells in the downgradient plume area (MW-9, MW-13, and MW-16) and well MW-19 outside the plume all indicate decreasing trends which suggests a shrinking downgradient plume. Of the six monitoring wells located in the Site source area, four indicate decreasing or stable trends

(MW-4R, MW-5R, MW-8, and MW-12R) and two indicate increasing trends (MW-3 and MW-6). The most up-gradient monitoring well at the Site (MW-11) also indicates an increasing nitrate concentration trend; however, the UCL95 exceedance of the CUL is due to a high nitrate concentration observed during second half 2017. It is not clear what the source of that concentration spike was; however, due to the location of well MW-11 and a similar concentration spike observed in nearby well MW-10 during second half 2017, the source of these nitrate concentrations may be upgradient.

The nitrite UCL95 exceeds the CUL at three of the 19 monitoring well locations (MW-3, MW-9, and MW-19). Only MW-19 is outside of the current nitrate plume. The nitrite concentration trend is increasing at MW-3 and undetermined at MW-9 and MW-19. As discussed in the GW EDR, the presence of nitrite may be a result of the incomplete denitrification of nitrate or the incomplete nitrification of ammonia depending on the oxidation-reduction conditions present.

Dinoseb

The 3-year UCL95 exceeds the CUL at four of the five monitoring well locations (MW-4R, MW-9, MW-12R, and MW-16) where dinoseb is currently analyzed. The dinoseb 3-year UCL95 concentrations and estimated plume extents are shown on **Figure 5**. The calculated dinoseb concentration trend at each of the five locations shows decreasing trends, indicating a shrinking dinoseb plume. Well MW-13 was previously defined as within the dinoseb plume in the GW EDR, but the 3-year UCL95 is currently below the CUL at this location with a decreasing trend.

2,4-D

2,4-D has not been detected over the past six monitoring events above the CUL in any sample collected from the five monitoring wells where it is currently analyzed (MW-4R, MW-9, MW-12R, MW-13, and MW-16).

1,2-Dichloropropane

The 3-year UCL95 exceeds the CUL at all five of the monitoring well locations (MW-4R, MW-9, MW-12R, MW-16, and MW-19) where 1,2-dichloropropane (1,2-DCP) is currently analyzed. The 1,2-DCP 3-year UCL95 concentrations and estimated plume extents are shown on **Figure 6**. Four of the five locations (MW-4R, MW-12R, MW-16, and MW-19) show decreasing concentration trends while MW-9 indicates an increasing concentration trend. Overall, the 1,2-DCP plume is considered to be shrinking since 80% of the monitoring well locations where analyzed indicate decreasing trends.

Benzene and Chlorobenzene

The 3-year UCL95 for both benzene and chlorobenzene exceed the CUL at one of the five monitoring well locations (MW-12R) where they are currently analyzed. Both the benzene and chlorobenzene concentrations at MW-12R indicate decreasing trends.

2-Methylnaphthalene

2-Methylnaphthalene has not been detected over the past six monitoring events above the CUL in any sample collected from the five monitoring wells where it is currently analyzed (MW-4R, MW-9, MW-12R, MW-16, and MW-19).

TPH-Gx

TPH-Gx has not been analyzed at the Site since 2008.

Arsenic, Iron, and Manganese

Arsenic has been sampled the last six monitoring events in 11 of the 19 Site monitoring wells as part of the semi-annual groundwater monitoring and was sampled in all 19 Site monitoring wells during the most recent groundwater monitoring event in August 2019. The 3-year UCL95 exceeds the CUL at all 11 monitoring well locations (MW-3, MW-4R, MW-6, MW-10, MW-11, MW-12R, MW-14, MW-15, MW-18, MW-19, and MW-20). Arsenic concentrations exceeded the CUL in one of the eight monitoring well locations only sampled during the most recent monitoring event (MW-7). The arsenic 3-year UCL95 concentrations (or August 2019 concentrations where those are not available) and estimated plume extents are shown on **Figure 7**. The Site-wide arsenic concentrations from August 2019 were used to calculate a Site-wide UCL95 of 0.025 mg/L, which was below the Site-wide arsenic remediation level (RL) of 0.04 mg/L for the Site as defined in the Ecology-approved GW EDR (Stantec, 2016).

Arsenic concentrations do not follow a similar distribution to the other Site IHSs. Arsenic concentrations exceeding the CUL appear to be present in four potentially separate plumes with non-detectable concentrations indicated through the central portion of the Site nitrate plume (MW-5R, MW-8, MW-9, MW-13, and MW-16). Arsenic concentrations exceeding the CUL are present in the most up-gradient Site monitoring wells (MW-6, MW-7, MW-10, MW-11, and MW-14), in four monitoring wells at the northeast extent of the Site (MW-3, MW-4R, MW-12R, and MW-15), and in three monitoring wells at the southeast extent of the Site (MW-18, MW-19, and MW-20). Arsenic concentration trends are largely stable (8 of the 11 monitoring wells where analyzed) with decreasing trends indicated at MW-3 and MW-11 and an increasing trend indicated at MW-4R.

Total iron has been sampled the last six monitoring events in one of 19 Site monitoring wells (MW-19). The 3-year UCL95 of 20.3 mg/L exceeds the CUL and it indicates an undetermined concentration trend.

Manganese has not been analyzed at the Site since 2015.

3.1.4 Institutional Controls

The Consent Decree and CAP require a good faith effort to implement ICs in the form of restrictive covenants with the owners of the affected Site parcels. The purpose of a restrictive covenant is to prohibit activities that may interfere with a cleanup action or other measures necessary to assure the integrity of the cleanup action and to protect human health and the environment.

Stantec is working with CEMC and RMSC to implement restrictive covenants for Site parcels as detailed in the GW CPS. In 2019, Stantec obtained title reports for the applicable Site parcels. Stantec is currently working to draft restrictive covenants for review using the Ecology Environmental Covenant for MTCA Sites template and to identify all parties that would need to sign the restrictive covenant for each applicable Site parcel.

3.2 NEW SCIENTIFIC INFORMATION FOR INDIVIDUAL HAZARDOUS SUBSTANCES OR MIXTURES PRESENT AT THE SITE

The manganese Modified MTCA Method B CUL was adjusted from 2.24 mg/L in the Ecology 2015 Cleanup Levels and Risk Calculation (CLARC) table to 0.75 mg/L in the 2019 CLARC table (Ecology, 2019). The change is based on the EPA recommendation to reduce the oral reference dose by a factor of three when assessing exposure to water or soil instead of from food intake. The previous 2015 manganese CUL of 2.24 mg/L was based on manganese exposure from food intake.

3.3 NEW APPLICABLE STATE AND FEDERAL LAWS FOR HAZARDOUS SUBSTANCES PRESENT AT THE SITE

The groundwater cleanup at the Site is governed by MTCA and all other applicable, relevant and appropriate requirements (ARAR) as detailed in the GW EDR. MTCA has not been updated since 2013 when the CAP and Consent Decree for the Site were finalized.

No changes to MTCA or other ARARs identified in the GW EDR were identified which would substantively affect the implementation of the remediation of the Site.

3.4 CURRENT AND PROJECTED SITE USE

The Site is located in an industrial and food manufacturing area and the parcels comprising the Site contain food processing facilities or open staging areas for food transportation vehicles and containers. In addition, the Site includes a railroad ROW and several city street ROWs. The use of Site parcels has remained relatively unchanged and there are no known changes planned for the parcels comprising the Site; however, all Site parcels are third-party owned.

3.5 AVAILABILITY AND PRACTICABILITY OF HIGHER PREFERENCE TECHNOLOGIES

The remedy currently being implemented at the Site includes removal of contaminated soil overlying groundwater, in-situ bioremediation of the Site groundwater plume via injection wells and/or vertical barrier wall treatment system(s), natural attenuation of the groundwater and soil contamination, and ICs to protect against the use of groundwater by the public.

The groundwater remedy for the Site, utilizing EISB via injection wells, is being implemented in a two-phase approach to confirm the design of the selected remedy prior to the full-scale implementation. While higher preference cleanup technologies may be available, they are not currently practicable at this Site due to the current land use of the Site parcels.

3.6 AVAILABILITY OF IMPROVED ANALYTICAL TECHNIQUES TO EVALUATE COMPLIANCE WITH CLEANUP LEVELS

The method detection limit (MDL) for arsenic utilizing EPA Method 6010D is above the CUL of 0.01 mg/L. EPA Method 6020B offers an arsenic MDL of 0.00068 mg/L, which is well below the CUL. The MDLs for iron and manganese by 6010D are well below the respective CULs and the laboratory does not recommend iron analysis by EPA Method 6020B. Therefore, it is recommended that arsenic analysis to be implemented as part of the groundwater remedy performance monitoring be conducted by EPA Method 6020B while iron and manganese continue to be analyzed by EPA Method 6010D.

4.0 Conclusions

The following conclusions have been made as a result of this periodic review:

- The soil cleanup actions completed at the Site were completed in substantial compliance with the construction plans and specifications developed for the shallow soil remedy described in the CAP. The soil excavation actions have significantly reduced the presence of contaminant source soils above the groundwater table at the Site. The remaining soil concentrations in these areas are protective of human health and the environment.

- The groundwater remedy is currently being implemented per the plans and specifications as approved by Ecology on August 21, 2019.

- The existing semi-annual groundwater monitoring program has continued to monitor the distribution and natural attenuation of IHSs in the groundwater.

    - Nitrate concentrations remain above the CUL in the source and downgradient areas with decreasing or stable trends in all downgradient plume monitoring wells; however, the most up-gradient well (MW-11) and two of the source area monitoring wells (MW-3 and MW-6) indicate increasing trends. Well MW-19, previously defined as within the nitrate plume in the GW EDR, now has a 3-year nitrate UCL95 below the CUL and indicates a decreasing trend.

    - Nitrite concentrations exceed the CUL at three wells (MW-3, MW-9, and MW-19). The nitrite concentration trend is increasing at MW-3 and undetermined at MW-9 and MW-19.

    - Dinoseb concentrations remain above the CUL in the source and downgradient areas with decreasing trends in all analyzed monitoring wells. Well MW-13 was previously defined as within the dinoseb plume in the GW EDR, but the 3-year UCL95 is currently below the CUL.

    - 1,2-DCP concentrations remain above the CUL in the source and downgradient areas with decreasing trends in four of the five monitoring well locations and an increasing trend at MW-9.

    - Arsenic concentrations remain above the CUL in the source, downgradient, and up-gradient areas with stable or decreasing trends in 10 of the 11 monitoring wells exceeding the CUL. The Site-wide arsenic UCL95 for August 2019 was 0.025 mg/L, which is below the arsenic Site-wide RL of 0.04 mg/L.

    - Benzene and chlorobenzene are only above the CUL in source area well MW-12R, and both indicate decreasing trends.

  - Iron concentrations are above the CUL in downgradient well MW-19 with an undetermined trend.

- All Site parcels are within the City limits and are on municipal water supply from the City. No new structures have been constructed on Site parcels since the implementation of the Site Consent Decree and CAP. ICs in the form of restrictive covenants are being pursued for all Site parcels to further protect human health and the environment.

- A release of a material continues to occur at the Former Fertilizer Building of the BJS property, as documented in letters submitted to Ecology on November 7, 2014 and November 1, 2019. The BJS property owner is responsible for addressing this release.

5.0 References

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TABLES

Table 1
Groundwater Cleanup Levels
Bee-Jay Scales Site
Sunnyside, Washington

Analyte	Groundwater Cleanup Level (mg/L)	Source
1,2,3-Trichloropropane	0.00001	Modified MTCA Method B
1,2,4-Trimethylbenzene	0.4	Modified MTCA Method B
1,2-Dichloropropane	0.005	Primary MCL
1,3,5-Trimethylbenzene	0.4	Modified MTCA Method B
2-Methylnaphthalene	0.032	Modified MTCA Method B
2,4,5-T	0.16	Modified MTCA Method B
2,4,5-TP	0.05	Primary MCL
2,4-D	0.07	Primary MCL
2,4-DB	0.128	Modified MTCA Method B
Arsenic	0.01	Primary MCL
Benzene	0.005	Primary MCL
Chlorobenzene	0.1	Primary MCL
Dicamba	0.48	Modified MTCA Method B
Dinoseb	0.007	Primary MCL
Ethylbenzene	0.7	Primary MCL
Iron	11.2	Modified MTCA Method B
Manganese	2.2	Standard MTCA Method B
Naphthalene	0.16	Modified MTCA Method B
Nitrate Nitrogen	10	Primary MCL
Nitrite Nitrogen	1	Primary MCL
Pentachlorophenol	0.001	Primary MCL
Toluene	1	Primary MCL
TPH-Gx	0.8	Standard MTCA Method A
Xylenes	10	Primary MCL

Notes:
2,4,5-T = 2,4,5-Trichlorophenoxyacetic acid
2,4,5-TP = 2(2,4,5-Trichlorophenoxy)propionic acid
2,4-D = 2,4-Dichlorophenoxyacetic acid
2,4-DB = 4-(2,4-Dichlorophenoxy)butyric acid
TPH-Gx = Total petroleum hydrocarbons in the gasoline range
mg/L = milligrams per liter
MCL = Maximum Contaminant Level
MTCA = Model Toxics Control Act
Bold analytes are indicator hazardous substances (IHSs).

Table 2
Summary of Shallow Soil Excavation Areas and Volumes
Bee-Jay Scales Site
Sunnyside, Washington

Excavation ID	Estimated Area of Soil Exceeding Criteria	Total Area of Excavation Including Sloped Areas	Approximate Maximum Depth of Excavation	Calculated Total Volume of Excavated Soil	Estimated Volume of Excavated Soil Loaded for Off-Site Disposal	Estimated Volume of Excavated, Overlying Material Segregated from Impacted Soil[1]	Estimated Volume of Soil Excavated to Safely Slope the Excavation[2]
	(square feet)	(square feet)	(feet bgs)	(cubic yards)	(cubic yards)	(cubic yards)	(cubic yards)
Area 1 West	5,150	5,861	7.5	1,314	1,212	62	40
Area 1 East	13,100	15,178	7.5	3,251	3,016	184	51
Area 2	235	511	6.25	54	54	0	0
Area 4	320	546	4.75	54	54	0	0
Area 5 West	300	494	4.75	50	50	0	0
Area 5 East	2,700	6,361	11	1,370	620	322	428
Area 5 South	440	1,812	9	256	143	8	105
Area 6	5,200	8,661	8.5	1,820	1,456	172	192
Total	**27,445**	**39,424**		**8,169**	**6,605**	**748**	**816**

Notes:
[1] Includes overlaying soil that did not exceed the Site cleanup levels and was used as Site backfill, as well as asphalt and concrete which was segregated for off-site
[2] Estimated volume of soil excavated to safely slope the excavation that was outside of the area of soil exceeding criteria and was also segregated for use as Site backfill.
bgs = below ground surface

Table 3
Summary of Indicator Hazardous Substance Concenctrations and Trends in Site Groundwater
Bee-Jay Scales Site
Sunnyside, Washington

Monitoring Well ID	Well Designation	Indicator Hazardous Substance	CUL (mg/L)	Detected Conc. > CUL in Last 3 Years	3-Year UCL95 (mg/L)	3-Year UCL95 /CUL Status	Trend
MW-1	Up- or Cross-Gradient	Nitrate	10	No	NA	NA	NA
		Nitrite	1	No	NA	NA	NA
		Arsenic	0.01	No[1]	NA	NA	NA
MW-3	In Plume	Nitrate	10	Yes	137.6	Above	Increasing
		Nitrite	1	Yes	1.3	Above	Increasing
		Arsenic	0.01	Yes	0.018	Above	Decreasing
MW-4R	POC	Nitrate	10	Yes	358.2	Above	Decreasing
		Nitrite	1	Yes	0.87	Below	Decreasing
		Dinoseb	0.007	Yes	0.17	Above	Decreasing
		2,4-D	0.07	No	NA	NA	NA
		1,2-DCP	0.005	Yes	0.0067	Above	Decreasing
		Chlorobenzene	0.1	No	NA	NA	NA
		Benzene	0.005	No	NA	NA	NA
		Arsenic	0.01	Yes	0.023	Above	Increasing
		2-MN	0.032	No	NA	NA	NA
MW-5R	POC	Nitrate	10	Yes	270.6	Above	Decreasing
		Nitrite	1	No	0.27	Below	Increasing
		Arsenic	0.01	No[1]	NA	NA	NA
MW-6	POC	Nitrate	10	Yes	72.5	Above	Increasing
		Nitrite	1	No	NA	NA	NA
		Arsenic	0.01	Yes	0.032	Above	Stable
MW-7	Up- or Cross-Gradient	Nitrate	10	No	NA	NA	NA
		Nitrite	1	No	NA	NA	NA
		Arsenic	0.01	Yes	NA[1]	NA[1]	NA[1]
MW-8	In Plume	Nitrate	10	Yes	99.7	Above	Decreasing
		Nitrite	1	No	NA	NA	NA
		Arsenic	0.01	No[1]	NA	NA	NA
MW-9	In Plume	Nitrate	10	Yes	317.6	Above	Decreasing
		Nitrite	1	Yes	21.9	Above	Undetermined
		Dinoseb	0.007	Yes	0.42	Above	Decreasing
		2,4-D	0.07	No	NA	NA	NA
		1,2-DCP	0.005	Yes	0.049	Above	Increasing
		Chlorobenzene	0.1	No	NA	NA	NA
		Benzene	0.005	No	NA	NA	NA
		Arsenic	0.01	No[1]	NA	NA	NA
		2-MN	0.032	No	NA	NA	NA
MW-10	Up-Gradient	Nitrate	10	Yes	7.5	Below	Increasing
		Nitrite	1	No	NA	NA	NA
		Arsenic	0.01	Yes	0.033	Above	Stable
MW-11	Up-Gradient	Nitrate	10	Yes	29.9	Above	Increasing
		Nitrite	1	No	NA	NA	NA
		Arsenic	0.01	Yes	0.052	Above	Decreasing
MW-12R	POC	Nitrate	10	Yes	569.4	Above	Stable
		Nitrite	1	No	NA	NA	NA
		Dinoseb	0.007	Yes	1.06	Above	Decreasing
		2,4-D	0.07	No	NA	NA	NA
		1,2-DCP	0.005	Yes	0.79	Above	Decreasing
		Chlorobenzene	0.1	Yes	0.14	Above	Decreasing
		Benzene	0.005	Yes	0.0085	Above	Decreasing
		Arsenic	0.01	Yes	0.13	Above	Stable
		2-MN	0.032	No	NA	NA	NA

Table 3
Summary of Indicator Hazardous Substance Concenctrations and Trends in Site Groundwater
Bee-Jay Scales Site
Sunnyside, Washington

Monitoring Well ID	Well Designation	Indicator Hazardous Substance	CUL (mg/L)	Detected Conc. > CUL in Last 3 Years	3-Year UCL95 (mg/L)	3-Year UCL95 /CUL Status	Trend
MW-13	POC	Nitrate	10	Yes	31.3	Above	Decreasing
		Nitrite	1	No	NA	NA	NA
		Dinoseb	0.007	Yes	0.0067	Below	Decreasing
		2,4-D	0.07	No	NA	NA	NA
		Arsenic	0.01	No[1]	NA	NA	NA
MW-14	Boundary	Nitrate	10	No	NA	NA	NA
		Nitrite	1	No	NA	NA	NA
		Arsenic	0.01	Yes	0.015	Above	Stable
MW-15	Boundary	Nitrate	10	No	NA	NA	NA
		Nitrite	1	No	NA	NA	NA
		Arsenic	0.01	Yes	0.021	Above	Stable
MW-16	POC	Nitrate	10	Yes	131.9	Above	Decreasing
		Nitrite	1	No	NA	NA	NA
		Dinoseb	0.007	Yes	0.019	Above	Decreasing
		2,4-D	0.07	No	NA	NA	NA
		1,2-DCP	0.005	Yes	0.20	Above	Decreasing
		Chlorobenzene	0.1	No	NA	NA	NA
		Benzene	0.005	No	NA	NA	NA
		Arsenic	0.01	No[1]	NA	NA	NA
		2-MN	0.032	No	NA	NA	NA
MW-17	Boundary	Nitrate	10	No	NA	NA	NA
		Nitrite	1	No	NA	NA	NA
		Arsenic	0.01	No[1]	NA	NA	NA
MW-18	Boundary	Nitrate	10	No	NA	NA	NA
		Nitrite	1	No	NA	NA	NA
		Arsenic	0.01	Yes	0.026	Above	Stable
MW-19	POC	Nitrate	10	Yes	9.7	Below	Decreasing
		Nitrite	1	Yes	2.2	Above	Undetermined
		1,2-DCP	0.005	Yes	0.071	Above	Decreasing
		Chlorobenzene	0.1	No	NA	NA	NA
		Benzene	0.005	No	NA	NA	NA
		Arsenic	0.01	Yes	0.066	Above	Stable
		Iron	11.2	Yes	20.3	Above	Undetermined
		2-MN	0.032	No	NA	NA	NA
MW-20	Boundary	Nitrate	10	No	NA	NA	NA
		Nitrite	1	No	NA	NA	NA
		Arsenic	0.01	Yes	0.024	Above	Stable

Notes:
[1] Only sampled during the August 2019 groundwater monitoring event in the last 3 years.

NA = Not applicable because either no detected concentrations have exceeded the CUL in the last 3 years or insufficient sampling data are available to calculate a 3-year UCL95 and analyze trends.

2,4-D = 2,4-Dichlorophenoxyacetic acid

1,2-DCP = 1,2-Dichloropropane

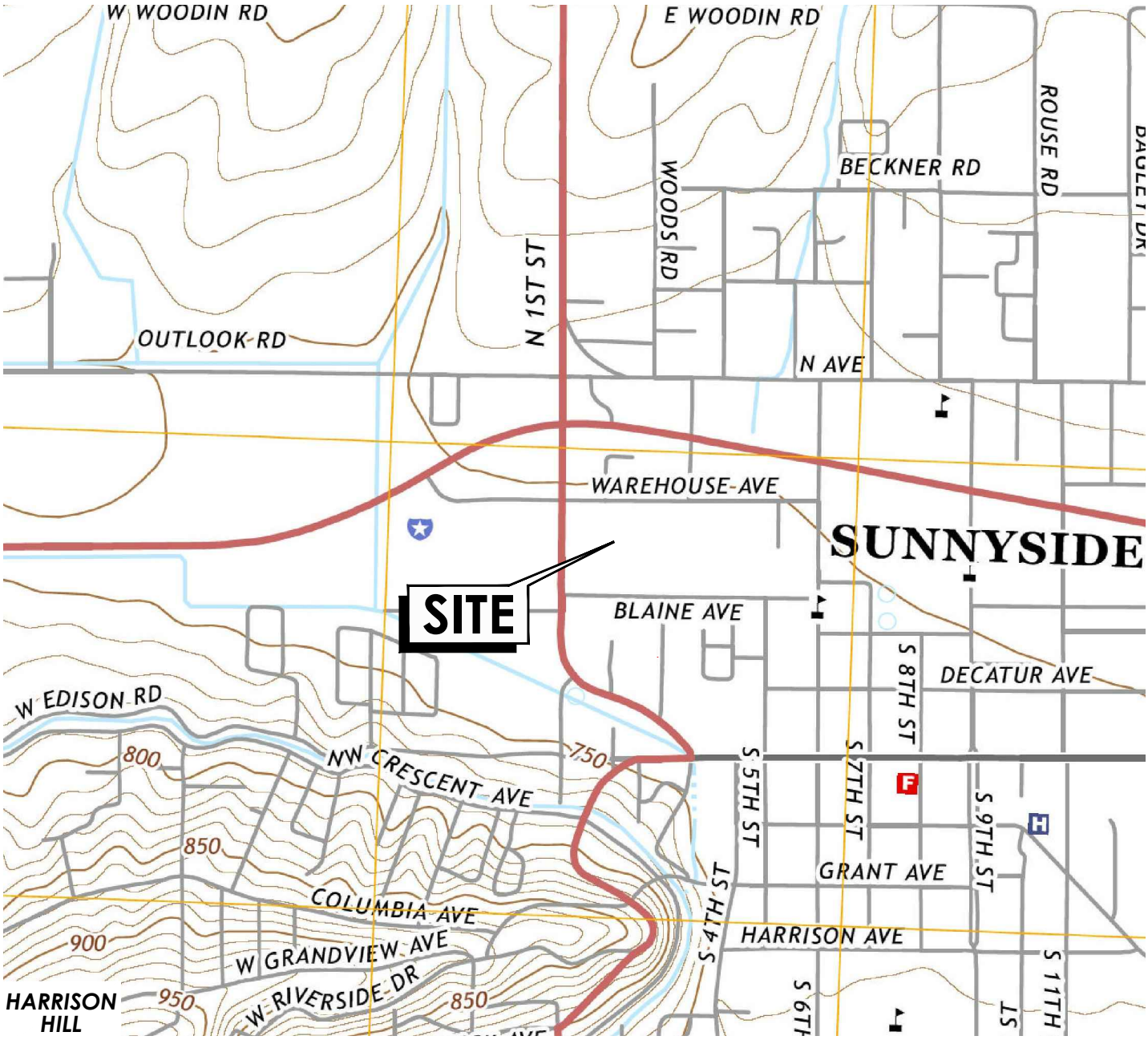
2-MN = 2-Methylnaphthalene

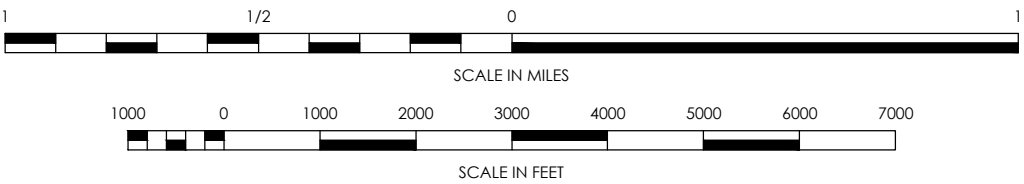
CUL = Cleanup Level

UCL95 = 95% Upper Confidence Limit

POC = Point of Compliance

FIGURES





REFERENCE: USGS 7.5 MINUTE QUADRANGLE; SUNNYSIDE, WASHINGTON; 2013

Stantec	FOR: BEE-JAY SCALES SITE SUNNYSIDE, WASHINGTON	SITE LOCATION MAP	FIGURE: 1

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WAREHOUSE AVENUE

#22503

CARPORT

AREA 4 - SUSPECTED HISTORIC WASHDOWN AREA

#22496 BLDG.

MW-7

MW-1

AREA 5- NORTH AREA

#22014 (BEE-JAY SCALES [BJS] PARCEL)

#22015 (WESTERN GENERAL LAND [WGL] PARCEL)

AREA 6- HICKENBOTTOM PROPERTY

#22016

BLDG.

MW-8

AREA 1 - LIQUID FERTILIZER PLANT AND TRUCK WASH AREA

BUILDING

AREA 2 - DRY FERTILIZER AREA

MW-3

MW-10

AREA 3 - DRUM STORAGE AREA

FORMER FERTILIZER BUILDING

FORMER LAGOON

CENTER OF NORTH RAIL FOR RAILROAD SIDE TRACK

MW-5

MW-11

MW-5R

MW-6

MW-4

MW-4R

MW-12

MW-12R

MW-15

#22902

MW-9

#22903

MW-14

N. 1ST STREET

VALLEY PROCESSING BUILDING

MW-17

#22555

MW-16

BUILDING

TRUCK SCALE LOCATION

#22502

MW-13

MW-18

BLAINE AVENUE

#23447

#23443

#23902 BUILDING

#23901 BUILDING

#23441

#23416

#23417

#23440

#23418

S. 3RD STREET

#23903

#23439

#23419

MW-20

#23442

MW-19

#23446

#23438

#23420

#23437

#23421

#23444

#23436

#23422

#23423

N

0 80 160

APPROXIMATE SCALE IN FEET

LEGEND

- SITE BOUNDARY (APPROXIMATE)
- PARCEL BOUNDARY (APPROXIMATE)
- #22503 PARCEL ID NUMBER (221025 PRECEDES ALL PARCEL NUMBERS AND IS NOT SHOWN)
- #22014 SITE PARCEL ID NUMBER (221025 PRECEDES ALL PARCEL NUMBERS AND IS NOT SHOWN)
- BUILDING
- BUILDING OVERHANG
- CHAIN LINK FENCE
- RAILROAD
- DECOMMISSIONED MONITORING WELL
- MONITORING WELL

Stantec

FOR: BEE-JAY SCALES SITE SUNNYSIDE, WASHINGTON

SITE PLAN

FIGURE: 2

JOB NUMBER:	DRAWN BY:	CHECKED BY:	APPROVED BY:	DATE:
213202156/213202157	JRO	EJB	MRK	12/02/19

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WAREHOUSE AVENUE

NORTH 1ST STREET

GATE

GATE

GATE

GATE

CARWASH

CARPORT

WAREHOUSE BUILDING

OFFICE

SCALE

GATE

SCALE BLDG

FORMER FERTILIZER BUILDING

TOWER

AREA 5 WEST EXCAVATION

AREA 5 EAST EXCAVATION

AREA 4 EXCAVATION

AREA 5 SOUTH EXCAVATION

AREA 2 EXCAVATION

AREA 1 WEST EXCAVATION

AREA 1 EAST EXCAVATION

AREA 6 EXCAVATION

MW-7 (10.42)

MW-1 (12.42)

MW-8 (6.80)

MW-3 (6.89)

MW-10 (6.02)

MW-11 (5.53)

MW-6 (6.24)

MW-5

MW-5R

MW-4

MW-4R

MW-12R

MW-12

MW-9 (7.79)

MW-14 (7.38)

8.50 9.00 9.50 10.00 11.00 11.50 12.00 10.50 7.50 7.00 6.50 6.00

745.00 744.00 743.00 742.00 741.00

LOCATION OF DISCONNECTED RAILROAD SPUR

DISCONNECTED RAILROAD SPUR

ACTIVE RAILROAD SPUR

LOCATION OF DISCONNECTED RAILROAD SPUR

N

0 50 100

APPROXIMATE SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY (APPROXIMATE)
- BUILDING
- BUILDING OVERHANG
- ASPHALT EDGE
- CONCRETE LOCATIONS
- GRAVEL DRIVE LOCATION
- CHAIN LINK FENCE
- TEMPORARY FENCE
- RAILROAD
- PRE-EXCAVATION ELEVATION CONTOUR (5'; APPROXIMATE)
- PRE-EXCAVATION ELEVATION CONTOUR (1'; APPROXIMATE)
- DECOMMISSIONED WELL
- MONITORING WELL
- 2014 SHALLOW SOIL EXCAVATION AREAS
- (12.42) AUGUST 22, 2014 SATURATION LEVEL SURFACE IN FEET BGS
- AUGUST 22, 2014 SATURATION LEVEL SURFACE CONTOUR
- BGS BELOW GROUND SURFACE

Stantec

FOR: BEE-JAY SCALES SITE
SUNNYSIDE, WASHINGTON

2014 SHALLOW SOIL EXCAVATION AREAS WITH ESTIMATED SATURATED ZONE CONTOURS

FIGURE: 3

JOB NUMBER:	DRAWN BY:	CHECKED BY:	APPROVED BY:	DATE:
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WAREHOUSE AVENUE

#22503
CARPORT
AREA 4 - SUSPECTED HISTORIC WASHDOWN AREA
#22496 BLDG.
MW-7 (4.7)
MW-1 (7.6)
AREA 5- NORTH AREA
#22014 (BEE-JAY SCALES [BJS] PARCEL)
#22015 (WESTERN GENERAL LAND [WGL] PARCEL)
AREA 6- HICKENBOTTOM PROPERTY
#22016
BUILDING
BLDG.
10
AREA 1 - LIQUID FERTILIZER PLANT AND TRUCK WASH AREA
MW-8 (99.7)
100
MW-3 (137.6)
AREA 2 - DRY FERTILIZER AREA
MW-10 (7.5)
AREA 3 - DRUM STORAGE AREA
FORMER FERTILIZER BUILDING
FORMER LAGOON
CENTER OF NORTH RAIL FOR RAILROAD SIDE TRACK
MW-11 (29.9)
MW-6 (72.5)
MW-5
MW-5R (270.6)
MW-4
MW-4R (358.2)
MW-12
MW-12R (569.4)
MW-15 (4.2)
#22902
MW-9 (317.6)
#22903
MW-14 (6.0)
N. 1ST STREET
VALLEY PROCESSING BUILDING
MW-17 (5.2)
#22555
MW-16 (131.9)
BUILDING
TRUCK SCALE LOCATION
100
#22502
MW-13 (31.3)
BLAINE AVENUE
MW-18 (3.6)
#23447
#23443
#23902
BUILDING
#23901
BUILDING
#23441
#23416
#23417
#23440
#23418
#23903
#23439
#23419
#23442
MW-19 (9.7)
MW-20 (4.2)
#23438
#23420
#23437
#23421
#23444
#23436
#23422
#23423
S. 3RD STREET
10
N
0 80 160
APPROXIMATE SCALE IN FEET

LEGEND

- SITE BOUNDARY (APPROXIMATE)
- #23446 PARCEL BOUNDARY (APPROXIMATE)
- #22503 PARCEL ID NUMBER (221025 PRECEDES ALL PARCEL NUMBERS AND IS NOT SHOWN)
- #22014 SITE PARCEL ID NUMBER (221025 PRECEDES ALL PARCEL NUMBERS AND IS NOT SHOWN)
- BUILDING
- BUILDING OVERHANG
- CHAIN LINK FENCE
- RAILROAD
- DECOMMISSIONED MONITORING WELL
- MONITORING WELL
- (7.6) NITRATE CONCENTRATION 3-YEAR UCL95 THROUGH 2H19
- CONTOURS FOR SITE-SPECIFIC NITRATE PLUME; DASHED WHERE INFERRED

NOTE

ALL CONCENTRATIONS IN MILLIGRAMS PER LITER (mg/L)

Stantec

FOR: BEE-JAY SCALES SITE SUNNYSIDE, WASHINGTON

NITRATE ISOCONCENTRATION MAP - 3-YEAR UCL95 THROUGH 2H19

FIGURE: 4

JOB NUMBER:	DRAWN BY:	CHECKED BY:	APPROVED BY:	DATE:
213202156/213202157	JRO	EJB	MRK	12/02/19

WAREHOUSE AVENUE

#22503

CARPORT

AREA 4 - SUSPECTED HISTORIC WASHDOWN AREA

#22496 BLDG.

MW-7 (NA)

MW-1 (NA)

AREA 5- NORTH AREA

#22014 (BEE-JAY SCALES [BJS] PARCEL)

#22015 (WESTERN GENERAL LAND [WGL] PARCEL)

AREA 6- HICKENBOTTOM PROPERTY

#22016

BUILDING

BLDG.

MW-8 (NA)

AREA 1 - LIQUID FERTILIZER PLANT AND TRUCK WASH AREA

AREA 2 - DRY FERTILIZER AREA

MW-10 (NA)

AREA 3 - DRUM STORAGE AREA

FORMER FERTILIZER BUILDING

MW-3 (NA)

FORMER LAGOON

CENTER OF NORTH RAIL FOR RAILROAD SIDE TRACK

MW-5

MW-11 (NA)

MW-6 (NA)

MW-5R (NA)

MW-4

MW-4R (0.17)

MW-12

MW-12R (1.06)

0.007

0.07

0.7

MW-15 (NA)

#22902

MW-9 (0.42)

#22903

MW-14 (NA)

VALLEY PROCESSING BUILDING

#22555

MW-16 (0.019)

BUILDING

TRUCK SCALE LOCATION

#22502

MW-17 (NA)

MW-13 (0.0067)

MW-18 (NA)

N. 1ST STREET

BLAINE AVENUE

#23447

#23443

#23902

BUILDING

#23901

BUILDING

#23441

#23440

#23416

#23417

#23418

#23419

#23439

#23442

#23438

#23420

#23437

#23421

#23436

#23422

#23423

#23444

#23446

#23903

S. 3RD STREET

MW-20 (NA)

MW-19 (NA)

N

0 80 160

APPROXIMATE SCALE IN FEET

LEGEND

- SITE BOUNDARY (APPROXIMATE)
- PARCEL BOUNDARY (APPROXIMATE)
- #22503 PARCEL ID NUMBER (221025 PRECEDES ALL PARCEL NUMBERS AND IS NOT SHOWN)
- #22014 SITE PARCEL ID NUMBER (221025 PRECEDES ALL PARCEL NUMBERS AND IS NOT SHOWN)
- BUILDING
- BUILDING OVERHANG
- CHAIN LINK FENCE
- RAILROAD
- DECOMMISSIONED MONITORING WELL
- MONITORING WELL
- (0.17) DINOSEB CONCENTRATION 3-YEAR UCL95 THROUGH 2H19
- (NA) NOT ANALYZED
- CONTOURS FOR SITE-SPECIFIC DINOSEB PLUME; DASHED WHERE INFERRED

NOTE

ALL CONCENTRATIONS IN MILLIGRAMS PER LITER (mg/L)

Stantec

FOR: BEE-JAY SCALES SITE SUNNYSIDE, WASHINGTON

DINOSEB ISOCONCENTRATION MAP - 3-YEAR UCL95 THROUGH 2H19

FIGURE: 5

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WAREHOUSE AVENUE

#22503
CARPORT
#22496
BLDG.
AREA 4 - SUSPECTED HISTORIC WASHDOWN AREA
MW-7 (NA)
MW-1 (NA)
AREA 5- NORTH AREA
#22014 (BEE-JAY SCALES [BJS] PARCEL)
#22015 (WESTERN GENERAL LAND [WGL] PARCEL)
AREA 6- HICKENBOTTOM PROPERTY
#22016
BUILDING
BLDG.
MW-8 (NA)
AREA 1 - LIQUID FERTILIZER PLANT AND TRUCK WASH AREA
AREA 2 - DRY FERTILIZER AREA
MW-10 (NA)
AREA 3 - DRUM STORAGE AREA
FORMER FERTILIZER BUILDING
MW-5
MW-11 (NA)
MW-6 (NA)
MW-5R (NA)
CENTER OF NORTH RAIL FOR RAILROAD SIDE TRACK
FORMER LAGOON
MW-4
MW-4R (0.0067)
MW-12
MW-12R (0.79)
MW-3 (NA)
0.005
0.05
0.5
MW-15 (NA)
#22902
MW-9 (0.049)
#22903
MW-14 (NA)
N. 1ST STREET
VALLEY PROCESSING BUILDING
MW-17 (NA)
#22555
MW-16 (0.20)
BUILDING
TRUCK SCALE LOCATION
#22502
MW-13 (NA)
BLAINE AVENUE
MW-18 (NA)
#23447
#23443
#23902
BUILDING
#23903
#23901
BUILDING
#23441
#23440
#23416
#23417
0.05
0.005
#23418
S. 3RD STREET
#23439
#23419
MW-20 (NA)
#23442
MW-19 (0.071)
#23438
#23420
#23437
#23421
#23436
#23422
#23423
N
0
80
160
APPROXIMATE SCALE IN FEET

LEGEND

- SITE BOUNDARY (APPROXIMATE)
- PARCEL BOUNDARY (APPROXIMATE)
- #22503 — PARCEL ID NUMBER (221025 PRECEDES ALL PARCEL NUMBERS AND IS NOT SHOWN)
- #22014 — SITE PARCEL ID NUMBER (221025 PRECEDES ALL PARCEL NUMBERS AND IS NOT SHOWN)
- BUILDING
- BUILDING OVERHANG
- CHAIN LINK FENCE
- RAILROAD
- DECOMMISSIONED MONITORING WELL
- MONITORING WELL
- (0.0067) — 1,2-DICHLOROPROPANE CONCENTRATION 3-YEAR UCL95 THROUGH 2H19
- (NA) — NOT ANALYZED
- CONTOURS FOR SITE-SPECIFIC 1,2-DICHLOROPROPANE PLUME; DASHED WHERE INFERRED

NOTE

ALL CONCENTRATIONS IN MILLIGRAMS PER LITER (mg/L)

Stantec

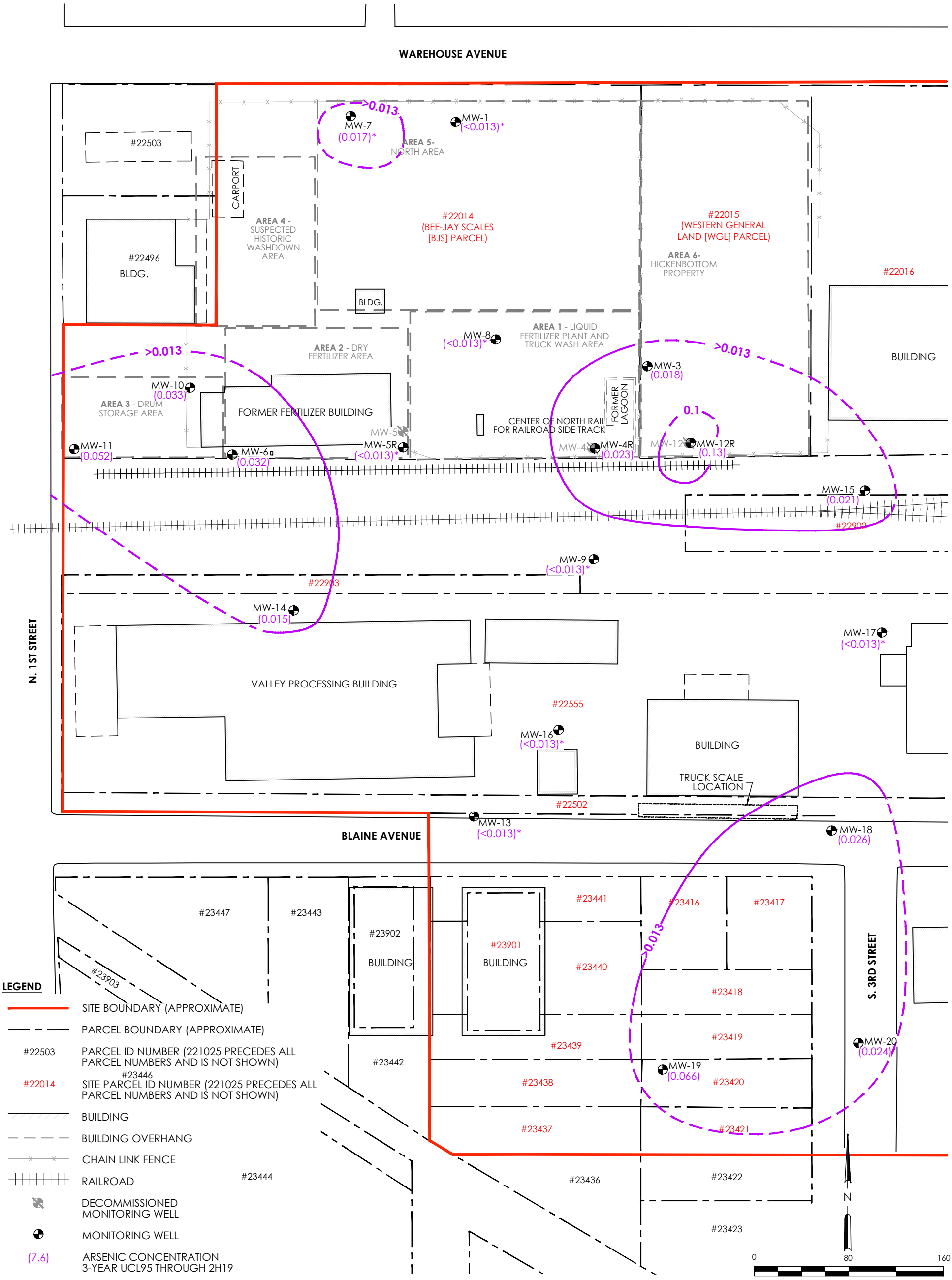
FOR: BEE-JAY SCALES SITE SUNNYSIDE, WASHINGTON

1,2-DICHLOROPROPANE ISOCONCENTRATION MAP - 3-YEAR UCL95 THROUGH 2H19

FIGURE: 6

JOB NUMBER:	DRAWN BY:	CHECKED BY:	APPROVED BY:	DATE:
213202156/213202157	JRO	EJB	MRK	12/02/19

FILEPATH:\\Us0257-ppfss01\workgroup\1826\active\213202156\05_report_deliv\dwgs_design\cad_figures\dwg_213202156_per-review_2019.dwg | mmeo | Dec 12, 2019 at 13:23 | Layout: fig6_sp



Stantec

FOR:			FIGURE:
BEE-JAY SCALES SITE SUNNYSIDE, WASHINGTON		ARSENIC ISOCONCENTRATION MAP - 3-YEAR UCL95 THROUGH 2H19	7
JOB NUMBER: 213202156/213202157	DRAWN BY: JRO	CHECKED BY: EJB	APPROVED BY: MRK	DATE: 12/02/19

APPENDIX A
Groundwater Concentration and Trend Analysis Software Outputs

MW-1

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/31/2019 11:26:27 AM
From File	mw01_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	2.8	Mean	6.075
Maximum	7.7	Median	6.925
SD	1.872	Std. Error of Mean	0.764
Coefficient of Variation	0.308	Skewness	-1.356

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.836	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.307	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	7.615	95% Adjusted-CLT UCL (Chen-1995)	6.88
		95% Modified-t UCL (Johnson-1978)	7.544

Gamma GOF Test

A-D Test Statistic	0.679	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.336	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.333	Data Not Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.501	k star (bias corrected MLE)	4.861
Theta hat (MLE)	0.639	Theta star (bias corrected MLE)	1.25
nu hat (MLE)	114	nu star (bias corrected)	58.34
MLE Mean (bias corrected)	6.075	MLE Sd (bias corrected)	2.755
		Approximate Chi Square Value (0.05)	41.78
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	36.78

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	8.483	95% Adjusted Gamma UCL (use when n<50)	9.636

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.777	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data Not Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.326	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data Not Lognormal at 5% Significance Level					
61	**Data Not Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	1.03			Mean of logged Data	1.751		
65					Maximum of Logged Data	2.041			SD of logged Data	0.387		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	9.386			90% Chebyshev (MVUE) UCL	9.029		
69					95% Chebyshev (MVUE) UCL	10.34			97.5% Chebyshev (MVUE) UCL	12.17		
70					99% Chebyshev (MVUE) UCL	15.75						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	7.332			95% Jackknife UCL	7.615		
77					95% Standard Bootstrap UCL	7.232			95% Bootstrap-t UCL	7.226		
78					95% Hall's Bootstrap UCL	6.889			95% Percentile Bootstrap UCL	7.158		
79					95% BCA Bootstrap UCL	7.05						
80					90% Chebyshev(Mean, Sd) UCL	8.368			95% Chebyshev(Mean, Sd) UCL	9.406		
81					97.5% Chebyshev(Mean, Sd) UCL	10.85			99% Chebyshev(Mean, Sd) UCL	13.68		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	7.615						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												

MW-3

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 11:51:31 AM
From File	mw03_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	7.7	Mean	94.33
Maximum	152	Median	88.3
SD	52.56	Std. Error of Mean	21.46
Coefficient of Variation	0.557	Skewness	-0.649

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.892	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.246	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	137.6	95% Adjusted-CLT UCL (Chen-1995)	123.6
		95% Modified-t UCL (Johnson-1978)	136.6

Gamma GOF Test

A-D Test Statistic	0.751	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.706	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.367	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.337	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.771	k star (bias corrected MLE)	0.997
Theta hat (MLE)	53.27	Theta star (bias corrected MLE)	94.66
nu hat (MLE)	21.25	nu star (bias corrected)	11.96
MLE Mean (bias corrected)	94.33	MLE Sd (bias corrected)	94.49
		Approximate Chi Square Value (0.05)	5.2
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	3.714

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	216.9	95% Adjusted Gamma UCL (use when n<50)	303.8

56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.704	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data Not Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.397	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data Not Lognormal at 5% Significance Level					
61	**Data Not Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	2.041	Mean of logged Data	4.239				
65					Maximum of Logged Data	5.024	SD of logged Data	1.11				
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	1205	90% Chebyshev (MVUE) UCL	260.8				
69					95% Chebyshev (MVUE) UCL	328.2	97.5% Chebyshev (MVUE) UCL	421.8				
70					99% Chebyshev (MVUE) UCL	605.5						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	129.6	95% Jackknife UCL	137.6				
77					95% Standard Bootstrap UCL	126.9	95% Bootstrap-t UCL	131.3				
78					95% Hall's Bootstrap UCL	141.5	95% Percentile Bootstrap UCL	127.2				
79					95% BCA Bootstrap UCL	118.8						
80					90% Chebyshev(Mean, Sd) UCL	158.7	95% Chebyshev(Mean, Sd) UCL	187.9				
81					97.5% Chebyshev(Mean, Sd) UCL	228.3	99% Chebyshev(Mean, Sd) UCL	307.9				
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	137.6						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 11:54:42 AM
From File	mw03_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrite

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.32	Mean	0.927
Maximum	1.7	Median	0.895
SD	0.448	Std. Error of Mean	0.183
Coefficient of Variation	0.484	Skewness	0.779

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.917	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.268	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.296	95% Adjusted-CLT UCL (Chen-1995)	1.29
		95% Modified-t UCL (Johnson-1978)	1.305

Gamma GOF Test

A-D Test Statistic	0.376	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.699	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.221	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.694	k star (bias corrected MLE)	2.458
Theta hat (MLE)	0.197	Theta star (bias corrected MLE)	0.377
nu hat (MLE)	56.33	nu star (bias corrected)	29.5
MLE Mean (bias corrected)	0.927	MLE Sd (bias corrected)	0.591
		Approximate Chi Square Value (0.05)	18.1
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	14.97

Assuming Gamma Distribution

54	95% Approximate Gamma UCL (use when n>=50))					1.51	95% Adjusted Gamma UCL (use when n<50)					1.826
55												
56	**Lognormal GOF Test**											
57	Shapiro Wilk Test Statistic					0.906	**Shapiro Wilk Lognormal GOF Test**					
58	5% Shapiro Wilk Critical Value					0.788	Data appear Lognormal at 5% Significance Level					
59	Lilliefors Test Statistic					0.26	**Lilliefors Lognormal GOF Test**					
60	5% Lilliefors Critical Value					0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64	Minimum of Logged Data					-1.139	Mean of logged Data					-0.186
65	Maximum of Logged Data					0.531	SD of logged Data					0.544
66												
67	**Assuming Lognormal Distribution**											
68	95% H-UCL					1.877	90% Chebyshev (MVUE) UCL					1.56
69	95% Chebyshev (MVUE) UCL					1.842	97.5% Chebyshev (MVUE) UCL					2.234
70	99% Chebyshev (MVUE) UCL					3.003						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76	95% CLT UCL					1.228	95% Jackknife UCL					1.296
77	95% Standard Bootstrap UCL					1.21	95% Bootstrap-t UCL					1.329
78	95% Hall's Bootstrap UCL					1.868	95% Percentile Bootstrap UCL					1.195
79	95% BCA Bootstrap UCL					1.247						
80	90% Chebyshev(Mean, Sd) UCL					1.476	95% Chebyshev(Mean, Sd) UCL					1.725
81	97.5% Chebyshev(Mean, Sd) UCL					2.07	99% Chebyshev(Mean, Sd) UCL					2.748
82												
83	**Suggested UCL to Use**											
84	95% Student's-t UCL					1.296						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 11:53:39 AM
From File	mw03_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
Number of Detects	3	Number of Non-Detects	3
Number of Distinct Detects	3	Number of Distinct Non-Detects	3
Minimum Detect	0.0101	Minimum Non-Detect	0.0097
Maximum Detect	0.0212	Maximum Non-Detect	0.016
Variance Detects	3.3510E-5	Percent Non-Detects	50%
Mean Detects	0.0166	SD Detects	0.00579
Median Detects	0.0185	CV Detects	0.349
Skewness Detects	-1.318	Kurtosis Detects	N/A
Mean of Logged Detects	-4.146	SD of Logged Detects	0.395

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.919	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.295	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0132	KM Standard Error of Mean	0.00238
KM SD	0.00476	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.018	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0171	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0204	95% KM Chebyshev UCL	0.0236
97.5% KM Chebyshev UCL	0.0281	99% KM Chebyshev UCL	0.0369

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	10.59	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00157	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	63.53	nu star (bias corrected)	N/A
Mean (detects)	0.0166		

56												
57	**Gamma ROS Statistics using Imputed Non-Detects**											
58	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
59	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)											
60	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
61	This is especially true when the sample size is small.											
62	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
63					Minimum	0.01				Mean	0.0133	
64					Maximum	0.0212				Median	0.0101	
65					SD	0.00515				CV	0.387	
66					k hat (MLE)	9.132				k star (bias corrected MLE)	4.677	
67					Theta hat (MLE)	0.00146				Theta star (bias corrected MLE)	0.00284	
68					nu hat (MLE)	109.6				nu star (bias corrected)	56.12	
69					Adjusted Level of Significance (β)	0.0122						
70					Approximate Chi Square Value (56.12, α)	39.9				Adjusted Chi Square Value (56.12, β)	35.03	
71					95% Gamma Approximate UCL (use when n>=50)	0.0187				95% Gamma Adjusted UCL (use when n<50)	N/A	
72												
73	**Estimates of Gamma Parameters using KM Estimates**											
74					Mean (KM)	0.0132				SD (KM)	0.00476	
75					Variance (KM)	2.2635E-5				SE of Mean (KM)	0.00238	
76					k hat (KM)	7.717				k star (KM)	3.97	
77					nu hat (KM)	92.61				nu star (KM)	47.64	
78					theta hat (KM)	0.00171				theta star (KM)	0.00333	
79					80% gamma percentile (KM)	0.0182				90% gamma percentile (KM)	0.0221	
80					95% gamma percentile (KM)	0.0257				99% gamma percentile (KM)	0.0333	
81												
82	**Gamma Kaplan-Meier (KM) Statistics**											
83					Approximate Chi Square Value (47.64, α)	32.8				Adjusted Chi Square Value (47.64, β)	28.42	
84					95% Gamma Approximate KM-UCL (use when n>=50)	0.0192				95% Gamma Adjusted KM-UCL (use when n<50)	0.0222	
85												
86	**Lognormal GOF Test on Detected Observations Only**											
87					Shapiro Wilk Test Statistic	0.882				**Shapiro Wilk GOF Test**		
88					5% Shapiro Wilk Critical Value	0.767				Detected Data appear Lognormal at 5% Significance Level		
89					Lilliefors Test Statistic	0.321				**Lilliefors GOF Test**		
90					5% Lilliefors Critical Value	0.425				Detected Data appear Lognormal at 5% Significance Level		
91	**Detected Data appear Lognormal at 5% Significance Level**											
92												
93	**Lognormal ROS Statistics Using Imputed Non-Detects**											
94					Mean in Original Scale	0.0119				Mean in Log Scale	-4.545	
95					SD in Original Scale	0.00636				SD in Log Scale	0.517	
96					95% t UCL (assumes normality of ROS data)	0.0171				95% Percentile Bootstrap UCL	0.016	
97					95% BCA Bootstrap UCL	0.0163				95% Bootstrap t UCL	0.0265	
98					95% H-UCL (Log ROS)	0.0226						
99												
100	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
101					KM Mean (logged)	-4.384				KM Geo Mean	0.0125	
102					KM SD (logged)	0.33				95% Critical H Value (KM-Log)	2.279	
103					KM Standard Error of Mean (logged)	0.165				95% H-UCL (KM -Log)	0.0184	
104					KM SD (logged)	0.33				95% Critical H Value (KM-Log)	2.279	
105					KM Standard Error of Mean (logged)	0.165						
106												
107	**DL/2 Statistics**											
108	**DL/2 Normal**									**DL/2 Log-Transformed**		
109					Mean in Original Scale	0.0115				Mean in Log Scale	-4.605	
110					SD in Original Scale	0.00673				SD in Log Scale	0.583	

	A	B	C	D	E	F	G	H	I	J	K	L
111				95% t UCL (Assumes normality)		0.0171					95% H-Stat UCL	0.0249
112	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
113												
114	**Nonparametric Distribution Free UCL Statistics**											
115	**Detected Data appear Normal Distributed at 5% Significance Level**											
116												
117	**Suggested UCL to Use**											
118					95% KM (t) UCL	0.018						
119												
120	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
121	Recommendations are based upon data size, data distribution, and skewness.											
122	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
123	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
124												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-03**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

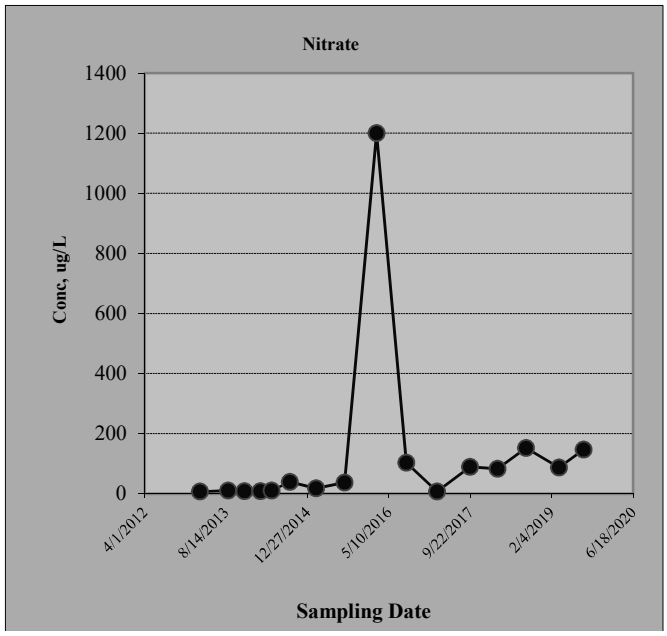
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Nitrate	Nitrite	Arsenic			
#1	3/6/2013	7	0.181	0.0115			
#2	8/27/2013	10.5	0.0075	0.0386			
#3	12/4/2013	8.4	0.024	0.0303			
#4	3/12/2014	8.5	0.0075	0.0303			
#5	5/21/2014	10.4	0.0075	0.0272			
#6	9/10/2014	39.7	0.9	0.0567			
#7	2/19/2015	17.9	0.0075	0.0351			
#8	8/12/2015	37.3	1.1	0.0486			
#9	2/24/2016	1200	0.49	0.019			
#10	8/25/2016	103	0.89	0.0275			
#11	3/2/2017	7.7	0.32	0.008			
#12	9/21/2017	89.4	0.88	0.0101			
#13	3/8/2018	82.7	1.7	0.0185			
#14	8/30/2018	152	0.75	0.0212			
#15	3/21/2019	87.2	0.91	0.008			
#16	8/20/2019	147	1	0.008			

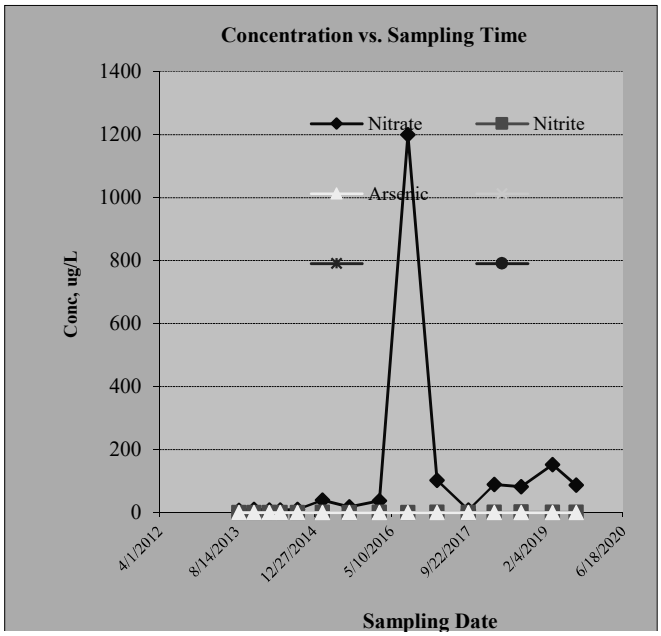
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Nitrate**	**Nitrite**	**Arsenic**			
Confidence Level Calculated?	99.90%	99.40%	99.00%	NA	NA	NA
Plume Stability?	***Expanding***	***Expanding***	Shrinking	NA	NA	NA
Coefficient of Variation?				n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	66	56	-52	0	0	0
Number of Sampling Rounds?	16	16	16	0	0	0
Average Concentration?	125.54	0.57	0.02	NA	NA	NA
Standard Deviation?	290.90	0.52	0.01	NA	NA	NA
Coefficient of Variation?	2.32	0.90	0.59	NA	NA	NA
Blank if No Errors found				n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Nitrate**
Plume Stability? **Expanding**





MW-4R

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/16/2019 2:11:09 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	161	Mean	296.1
Maximum	386	Median	312.3
SD	75.47	Std. Error of Mean	30.81
Coefficient of Variation	0.255	Skewness	-1.185

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.908	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.232	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	358.2	95% Adjusted-CLT UCL (Chen-1995)	330.8
		95% Modified-t UCL (Johnson-1978)	355.7

Gamma GOF Test

A-D Test Statistic	0.53	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.264	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	14.92	k star (bias corrected MLE)	7.573
Theta hat (MLE)	19.84	Theta star (bias corrected MLE)	39.1
nu hat (MLE)	179.1	nu star (bias corrected)	90.87
MLE Mean (bias corrected)	296.1	MLE Sd (bias corrected)	107.6
		Approximate Chi Square Value (0.05)	69.89
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	63.28

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	385	95% Adjusted Gamma UCL (use when n<50)	425.2

56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.828	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.281	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	5.081	Mean of logged Data	5.657				
65					Maximum of Logged Data	5.956	SD of logged Data	0.303				
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	405.2	90% Chebyshev (MVUE) UCL	407.4				
69					95% Chebyshev (MVUE) UCL	457.3	97.5% Chebyshev (MVUE) UCL	526.6				
70					99% Chebyshev (MVUE) UCL	662.6						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	346.8	95% Jackknife UCL	358.2				
77					95% Standard Bootstrap UCL	342.4	95% Bootstrap-t UCL	340.4				
78					95% Hall's Bootstrap UCL	334.5	95% Percentile Bootstrap UCL	339.3				
79					95% BCA Bootstrap UCL	331.1						
80					90% Chebyshev(Mean, Sd) UCL	388.5	95% Chebyshev(Mean, Sd) UCL	430.4				
81					97.5% Chebyshev(Mean, Sd) UCL	488.5	99% Chebyshev(Mean, Sd) UCL	602.6				
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	358.2						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												
94												
95												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/22/2019 2:20:36 PM
From File	mw04r_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrite

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	2
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.018	Minimum Non-Detect	0.015
Maximum Detect	1.4	Maximum Non-Detect	0.015
Variance Detects	0.427	Percent Non-Detects	33.33%
Mean Detects	0.552	SD Detects	0.653
Median Detects	0.394	CV Detects	1.184
Skewness Detects	0.824	Kurtosis Detects	-1.421
Mean of Logged Detects	-1.711	SD of Logged Detects	2.062

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.882	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.275	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.373	KM Standard Error of Mean	0.248
KM SD	0.527	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.873	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.781	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.117	95% KM Chebyshev UCL	1.455
97.5% KM Chebyshev UCL	1.923	99% KM Chebyshev UCL	2.843

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.341	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.678	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.274	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.409	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.56	k star (bias corrected MLE)	0.307
Theta hat (MLE)	0.985	Theta star (bias corrected MLE)	1.799
nu hat (MLE)	4.477	nu star (bias corrected)	2.453
Mean (detects)	0.552		

56												
57	**Gamma ROS Statistics using Imputed Non-Detects**											
58	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
59	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)											
60	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
61	This is especially true when the sample size is small.											
62	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
63					Minimum	0.01			Mean	0.371		
64					Maximum	1.4			Median	0.038		
65					SD	0.578			CV	1.558		
66					k hat (MLE)	0.392			k star (bias corrected MLE)	0.307		
67					Theta hat (MLE)	0.946			Theta star (bias corrected MLE)	1.208		
68					nu hat (MLE)	4.704			nu star (bias corrected)	3.686		
69					Adjusted Level of Significance (β)	0.0122						
70					Approximate Chi Square Value (3.69, α)	0.602			Adjusted Chi Square Value (3.69, β)	0.284		
71					95% Gamma Approximate UCL (use when n>=50)	2.273			95% Gamma Adjusted UCL (use when n<50)	N/A		
72												
73	**Estimates of Gamma Parameters using KM Estimates**											
74					Mean (KM)	0.373			SD (KM)	0.527		
75					Variance (KM)	0.277			SE of Mean (KM)	0.248		
76					k hat (KM)	0.501			k star (KM)	0.362		
77					nu hat (KM)	6.01			nu star (KM)	4.338		
78					theta hat (KM)	0.744			theta star (KM)	1.031		
79					80% gamma percentile (KM)	0.593			90% gamma percentile (KM)	1.071		
80					95% gamma percentile (KM)	1.603			99% gamma percentile (KM)	2.956		
81												
82	**Gamma Kaplan-Meier (KM) Statistics**											
83					Approximate Chi Square Value (4.34, α)	0.86			Adjusted Chi Square Value (4.34, β)	0.434		
84					95% Gamma Approximate KM-UCL (use when n>=50)	1.88			95% Gamma Adjusted KM-UCL (use when n<50)	3.724		
85												
86	**Lognormal GOF Test on Detected Observations Only**											
87					Shapiro Wilk Test Statistic	0.915			**Shapiro Wilk GOF Test**			
88					5% Shapiro Wilk Critical Value	0.748			Detected Data appear Lognormal at 5% Significance Level			
89					Lilliefors Test Statistic	0.251			**Lilliefors GOF Test**			
90					5% Lilliefors Critical Value	0.375			Detected Data appear Lognormal at 5% Significance Level			
91	**Detected Data appear Lognormal at 5% Significance Level**											
92												
93	**Lognormal ROS Statistics Using Imputed Non-Detects**											
94					Mean in Original Scale	0.368			Mean in Log Scale	-3.606		
95					SD in Original Scale	0.58			SD in Log Scale	3.389		
96					95% t UCL (assumes normality of ROS data)	0.845			95% Percentile Bootstrap UCL	0.72		
97					95% BCA Bootstrap UCL	0.831			95% Bootstrap t UCL	8.69		
98					95% H-UCL (Log ROS)	2.443E+9						
99												
100	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
101					KM Mean (logged)	-2.54			KM Geo Mean	0.0788		
102					KM SD (logged)	1.871			95% Critical H Value (KM-Log)	7.229		
103					KM Standard Error of Mean (logged)	0.882			95% H-UCL (KM -Log)	192.6		
104					KM SD (logged)	1.871			95% Critical H Value (KM-Log)	7.229		
105					KM Standard Error of Mean (logged)	0.882						
106												
107	**DL/2 Statistics**											
108	**DL/2 Normal**								**DL/2 Log-Transformed**			
109					Mean in Original Scale	0.37			Mean in Log Scale	-2.771		
110					SD in Original Scale	0.579			SD in Log Scale	2.291		

	A	B	C	D	E	F	G	H	I	J	K	L
111				95% t UCL (Assumes normality)		0.846					95% H-Stat UCL	6941
112	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
113												
114	**Nonparametric Distribution Free UCL Statistics**											
115	**Detected Data appear Normal Distributed at 5% Significance Level**											
116												
117	**Suggested UCL to Use**											
118					95% KM (t) UCL	0.873						
119												
120	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
121	Recommendations are based upon data size, data distribution, and skewness.											
122	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
123	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
124												

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.111/22/2019 2:18:27 PM										
5	From File	mw04r_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**Dinoseb**											
12												
13	**General Statistics**											
14	Total Number of Observations	6			Number of Distinct Observations	6						
15					Number of Missing Observations	0						
16	Minimum	0.052			Mean	0.119						
17	Maximum	0.21			Median	0.103						
18	SD	0.0618			Std. Error of Mean	0.0252						
19	Coefficient of Variation	0.518			Skewness	0.609						
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.927			**Shapiro Wilk GOF Test**							
28	5% Shapiro Wilk Critical Value	0.788			Data appear Normal at 5% Significance Level							
29	Lilliefors Test Statistic	0.211			**Lilliefors GOF Test**							
30	5% Lilliefors Critical Value	0.325			Data appear Normal at 5% Significance Level							
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**							
35	95% Student's-t UCL	0.17			95% Adjusted-CLT UCL (Chen-1995)	0.168						
36					95% Modified-t UCL (Johnson-1978)	0.171						
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.242			**Anderson-Darling Gamma GOF Test**							
40	5% A-D Critical Value	0.699			Detected data appear Gamma Distributed at 5% Significance Level							
41	K-S Test Statistic	0.198			**Kolmogorov-Smirnov Gamma GOF Test**							
42	5% K-S Critical Value	0.333			Detected data appear Gamma Distributed at 5% Significance Level							
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	4.482			k star (bias corrected MLE)	2.352						
47	Theta hat (MLE)	0.0266			Theta star (bias corrected MLE)	0.0507						
48	nu hat (MLE)	53.78			nu star (bias corrected)	28.22						
49	MLE Mean (bias corrected)	0.119			MLE Sd (bias corrected)	0.0778						
50					Approximate Chi Square Value (0.05)	17.1						
51	Adjusted Level of Significance	0.0122			Adjusted Chi Square Value	14.07						
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	0.197			95% Adjusted Gamma UCL (use when n<50)	0.239						
55												

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.964	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.163	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-2.957			Mean of logged Data	-2.242		
65					Maximum of Logged Data	-1.561			SD of logged Data	0.533		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.234			90% Chebyshev (MVUE) UCL	0.197		
69					95% Chebyshev (MVUE) UCL	0.232			97.5% Chebyshev (MVUE) UCL	0.281		
70					99% Chebyshev (MVUE) UCL	0.377						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.161			95% Jackknife UCL	0.17		
77					95% Standard Bootstrap UCL	0.157			95% Bootstrap-t UCL	0.194		
78					95% Hall's Bootstrap UCL	0.195			95% Percentile Bootstrap UCL	0.157		
79					95% BCA Bootstrap UCL	0.158						
80					90% Chebyshev(Mean, Sd) UCL	0.195			95% Chebyshev(Mean, Sd) UCL	0.229		
81					97.5% Chebyshev(Mean, Sd) UCL	0.277			99% Chebyshev(Mean, Sd) UCL	0.37		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.17						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/22/2019 2:19:25 PM
From File	mw04r_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1,2-DCP

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	4.0000E-4	Mean	0.00423
Maximum	0.007	Median	0.005
SD	0.00295	Std. Error of Mean	0.00121
Coefficient of Variation	0.698	Skewness	-0.492

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.854	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.225	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.00666	95% Adjusted-CLT UCL (Chen-1995)	0.00596
		95% Modified-t UCL (Johnson-1978)	0.00662

Gamma GOF Test

A-D Test Statistic	0.585	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.71	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.262	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.339	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.34	k star (bias corrected MLE)	0.781
Theta hat (MLE)	0.00316	Theta star (bias corrected MLE)	0.00542
nu hat (MLE)	16.08	nu star (bias corrected)	9.374
MLE Mean (bias corrected)	0.00423	MLE Sd (bias corrected)	0.00479
		Approximate Chi Square Value (0.05)	3.554
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	2.388

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0112	95% Adjusted Gamma UCL (use when n<50)	0.0166

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.811	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.285	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-7.824			Mean of logged Data	-5.882		
65					Maximum of Logged Data	-4.962			SD of logged Data	1.203		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.0773			90% Chebyshev (MVUE) UCL	0.0118		
69					95% Chebyshev (MVUE) UCL	0.015			97.5% Chebyshev (MVUE) UCL	0.0194		
70					99% Chebyshev (MVUE) UCL	0.028						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.00622			95% Jackknife UCL	0.00666		
77					95% Standard Bootstrap UCL	0.00605			95% Bootstrap-t UCL	0.00637		
78					95% Hall's Bootstrap UCL	0.00551			95% Percentile Bootstrap UCL	0.006		
79					95% BCA Bootstrap UCL	0.00573						
80					90% Chebyshev(Mean, Sd) UCL	0.00785			95% Chebyshev(Mean, Sd) UCL	0.00949		
81					97.5% Chebyshev(Mean, Sd) UCL	0.0118			99% Chebyshev(Mean, Sd) UCL	0.0162		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.00666						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.110/16/2019 2:30:11 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	1
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.0116	Minimum Non-Detect	0.016
Maximum Detect	0.0259	Maximum Non-Detect	0.016
Variance Detects	4.5850E-5	Percent Non-Detects	16.67%
Mean Detects	0.0184	SD Detects	0.00677
Median Detects	0.0147	CV Detects	0.368
Skewness Detects	0.464	Kurtosis Detects	-3.057
Mean of Logged Detects	-4.049	SD of Logged Detects	0.366

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.812	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.308	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0176	KM Standard Error of Mean	0.00268
KM SD	0.00585	95% KM (BCA) UCL	0.0219
95% KM (t) UCL	0.023	95% KM (Percentile Bootstrap) UCL	0.0219
95% KM (z) UCL	0.022	95% KM Bootstrap t UCL	0.0341
90% KM Chebyshev UCL	0.0256	95% KM Chebyshev UCL	0.0293
97.5% KM Chebyshev UCL	0.0344	99% KM Chebyshev UCL	0.0443

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.558	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.31	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	9.432	k star (bias corrected MLE)	3.906
Theta hat (MLE)	0.00195	Theta star (bias corrected MLE)	0.00471
nu hat (MLE)	94.32	nu star (bias corrected)	39.06
Mean (detects)	0.0184		

Gamma ROS Statistics using Imputed Non-Detects		
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs		
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)		
For such situations, GROS method may yield incorrect values of UCLs and BTVs		
This is especially true when the sample size is small.		
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates		
Minimum	0.0116	Mean 0.0177
Maximum	0.0259	Median 0.0145
SD	0.0063	CV 0.356
k hat (MLE)	10.27	k star (bias corrected MLE) 5.245
Theta hat (MLE)	0.00172	Theta star (bias corrected MLE) 0.00337
nu hat (MLE)	123.2	nu star (bias corrected) 62.94
Adjusted Level of Significance (β)	0.0122	
Approximate Chi Square Value (62.94, α)	45.69	Adjusted Chi Square Value (62.94, β) 40.44
95% Gamma Approximate UCL (use when n>=50)	0.0244	95% Gamma Adjusted UCL (use when n<50) 0.0275

Estimates of Gamma Parameters using KM Estimates		
Mean (KM)	0.0176	SD (KM) 0.00585
Variance (KM)	3.4172E-5	SE of Mean (KM) 0.00268
k hat (KM)	9.053	k star (KM) 4.638
nu hat (KM)	108.6	nu star (KM) 55.65
theta hat (KM)	0.00194	theta star (KM) 0.00379
80% gamma percentile (KM)	0.0238	90% gamma percentile (KM) 0.0285
95% gamma percentile (KM)	0.0328	99% gamma percentile (KM) 0.0419

Gamma Kaplan-Meier (KM) Statistics		
Approximate Chi Square Value (55.65, α)	39.51	Adjusted Chi Square Value (55.65, β) 34.66
95% Gamma Approximate KM-UCL (use when n>=50)	0.0248	95% Gamma Adjusted KM-UCL (use when n<50) 0.0282

Lognormal GOF Test on Detected Observations Only		
Shapiro Wilk Test Statistic	0.847	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.279	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level
Detected Data appear Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects		
Mean in Original Scale	0.0177	Mean in Log Scale -4.086
SD in Original Scale	0.00632	SD in Log Scale 0.339
95% t UCL (assumes normality of ROS data)	0.0229	95% Percentile Bootstrap UCL 0.0218
95% BCA Bootstrap UCL	0.0219	95% Bootstrap t UCL 0.0379
95% H-UCL (Log ROS)	0.0252	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution		
KM Mean (logged)	-4.092	KM Geo Mean 0.0167
KM SD (logged)	0.317	95% Critical H Value (KM-Log) 2.256
KM Standard Error of Mean (logged)	0.146	95% H-UCL (KM -Log) 0.0242
KM SD (logged)	0.317	95% Critical H Value (KM-Log) 2.256
KM Standard Error of Mean (logged)	0.146	

DL/2 Statistics		
DL/2 Normal		**DL/2 Log-Transformed**
Mean in Original Scale	0.0167	Mean in Log Scale -4.179
SD in Original Scale	0.0074	SD in Log Scale 0.456

111				95% t UCL (Assumes normality)	0.0228					95% H-Stat UCL	0.0285	
112	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
113												
114	**Nonparametric Distribution Free UCL Statistics**											
115	**Detected Data appear Normal Distributed at 5% Significance Level**											
116												
117	**Suggested UCL to Use**											
118				95% KM (t) UCL	0.023							
119												
120	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
121	Recommendations are based upon data size, data distribution, and skewness.											
122	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
123	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
124												
125	**Nitrite**											
126												
127	**General Statistics**											
128				Total Number of Observations	6					Number of Distinct Observations	5	
129				Number of Detects	4					Number of Non-Detects	2	
130				Number of Distinct Detects	4					Number of Distinct Non-Detects	1	
131				Minimum Detect	0.018					Minimum Non-Detect	0.015	
132				Maximum Detect	1.4					Maximum Non-Detect	0.015	
133				Variance Detects	0.427					Percent Non-Detects	33.33%	
134				Mean Detects	0.552					SD Detects	0.653	
135				Median Detects	0.394					CV Detects	1.184	
136				Skewness Detects	0.824					Kurtosis Detects	-1.421	
137				Mean of Logged Detects	-1.711					SD of Logged Detects	2.062	
138												
139	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
140	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
141	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
142	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
143												
144	**Normal GOF Test on Detects Only**											
145				Shapiro Wilk Test Statistic	0.882					**Shapiro Wilk GOF Test**		
146				5% Shapiro Wilk Critical Value	0.748					Detected Data appear Normal at 5% Significance Level		
147				Lilliefors Test Statistic	0.275					**Lilliefors GOF Test**		
148				5% Lilliefors Critical Value	0.375					Detected Data appear Normal at 5% Significance Level		
149	**Detected Data appear Normal at 5% Significance Level**											
150												
151	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
152				KM Mean	0.373					KM Standard Error of Mean	0.248	
153				KM SD	0.527					95% KM (BCA) UCL	N/A	
154				95% KM (t) UCL	0.873					95% KM (Percentile Bootstrap) UCL	N/A	
155				95% KM (z) UCL	0.781					95% KM Bootstrap t UCL	N/A	
156				90% KM Chebyshev UCL	1.117					95% KM Chebyshev UCL	1.455	
157				97.5% KM Chebyshev UCL	1.923					99% KM Chebyshev UCL	2.843	
158												
159	**Gamma GOF Tests on Detected Observations Only**											
160				A-D Test Statistic	0.341					**Anderson-Darling GOF Test**		
161				5% A-D Critical Value	0.678					Detected data appear Gamma Distributed at 5% Significance Level		
162				K-S Test Statistic	0.274					**Kolmogorov-Smirnov GOF**		
163				5% K-S Critical Value	0.409					Detected data appear Gamma Distributed at 5% Significance Level		
164	**Detected data appear Gamma Distributed at 5% Significance Level**											
165												

166	**Gamma Statistics on Detected Data Only**											
167					k hat (MLE)	0.56				k star (bias corrected MLE)	0.307	
168					Theta hat (MLE)	0.985				Theta star (bias corrected MLE)	1.799	
169					nu hat (MLE)	4.477				nu star (bias corrected)	2.453	
170					Mean (detects)	0.552						
171												
172	**Gamma ROS Statistics using Imputed Non-Detects**											
173	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
174	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)											
175	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
176	This is especially true when the sample size is small.											
177	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
178					Minimum	0.01				Mean	0.371	
179					Maximum	1.4				Median	0.038	
180					SD	0.578				CV	1.558	
181					k hat (MLE)	0.392				k star (bias corrected MLE)	0.307	
182					Theta hat (MLE)	0.946				Theta star (bias corrected MLE)	1.208	
183					nu hat (MLE)	4.704				nu star (bias corrected)	3.686	
184					Adjusted Level of Significance (β)	0.0122						
185					Approximate Chi Square Value (3.69, α)	0.602				Adjusted Chi Square Value (3.69, β)	0.284	
186					95% Gamma Approximate UCL (use when n>=50)	2.273				95% Gamma Adjusted UCL (use when n<50)	N/A	
187												
188	**Estimates of Gamma Parameters using KM Estimates**											
189					Mean (KM)	0.373				SD (KM)	0.527	
190					Variance (KM)	0.277				SE of Mean (KM)	0.248	
191					k hat (KM)	0.501				k star (KM)	0.362	
192					nu hat (KM)	6.01				nu star (KM)	4.338	
193					theta hat (KM)	0.744				theta star (KM)	1.031	
194					80% gamma percentile (KM)	0.593				90% gamma percentile (KM)	1.071	
195					95% gamma percentile (KM)	1.603				99% gamma percentile (KM)	2.956	
196												
197	**Gamma Kaplan-Meier (KM) Statistics**											
198					Approximate Chi Square Value (4.34, α)	0.86				Adjusted Chi Square Value (4.34, β)	0.434	
199					95% Gamma Approximate KM-UCL (use when n>=50)	1.88				95% Gamma Adjusted KM-UCL (use when n<50)	3.724	
200												
201	**Lognormal GOF Test on Detected Observations Only**											
202					Shapiro Wilk Test Statistic	0.915				**Shapiro Wilk GOF Test**		
203					5% Shapiro Wilk Critical Value	0.748				Detected Data appear Lognormal at 5% Significance Level		
204					Lilliefors Test Statistic	0.251				**Lilliefors GOF Test**		
205					5% Lilliefors Critical Value	0.375				Detected Data appear Lognormal at 5% Significance Level		
206	**Detected Data appear Lognormal at 5% Significance Level**											
207												
208	**Lognormal ROS Statistics Using Imputed Non-Detects**											
209					Mean in Original Scale	0.368				Mean in Log Scale	-3.606	
210					SD in Original Scale	0.58				SD in Log Scale	3.389	
211					95% t UCL (assumes normality of ROS data)	0.845				95% Percentile Bootstrap UCL	0.722	
212					95% BCA Bootstrap UCL	0.832				95% Bootstrap t UCL	8.596	
213					95% H-UCL (Log ROS)	2.443E+9						
214												
215	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
216					KM Mean (logged)	-2.54				KM Geo Mean	0.0788	
217					KM SD (logged)	1.871				95% Critical H Value (KM-Log)	7.229	
218					KM Standard Error of Mean (logged)	0.882				95% H-UCL (KM -Log)	192.6	
219					KM SD (logged)	1.871				95% Critical H Value (KM-Log)	7.229	
220					KM Standard Error of Mean (logged)	0.882						

	A	B	C	D	E	F	G	H	I	J	K	L
221												
222	**DL/2 Statistics**											
223	**DL/2 Normal**						**DL/2 Log-Transformed**					
224					Mean in Original Scale	0.37				Mean in Log Scale	-2.771	
225					SD in Original Scale	0.579				SD in Log Scale	2.291	
226					95% t UCL (Assumes normality)	0.846				95% H-Stat UCL	6941	
227	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
228												
229	**Nonparametric Distribution Free UCL Statistics**											
230	**Detected Data appear Normal Distributed at 5% Significance Level**											
231												
232	**Suggested UCL to Use**											
233					95% KM (t) UCL	0.873						
234												
235	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
236	Recommendations are based upon data size, data distribution, and skewness.											
237	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
238	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
239												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address: 110N. 1st	*Street, Sunnyside, WA Additional*
Description:	

Well (Sampling) Location?	**MW-4R**
Level of Confidence (Decision Criteria)?	**85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

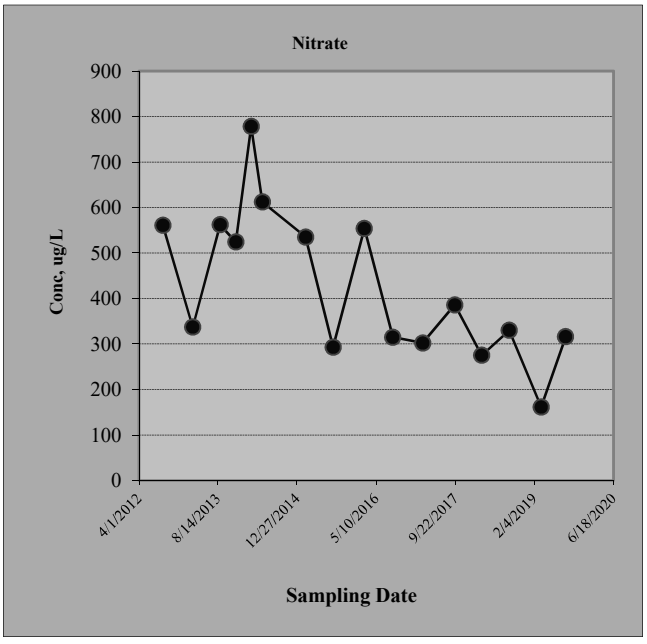
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Nitrate	1,2-DCP	Dinoseb	Arsenic	Nitrite	
#1	8/30/2012	561	0.017	0.19	0.0148	0.21	
#2	3/6/2013	337	0.012	0.26	0.008	0.45	
#3	8/27/2013	562	0.03	0.28	0.008	0.93	
#4	12/4/2013	524	0.021	0.43	0.008	0.0375	
#5	3/12/2014	778	0.011	0.14	0.008	0.13	
#6	5/21/2014	612	0.01	0.18	0.008	2.5	
#7	2/19/2015	535	0.029	0.13	0.0089	0.031	
#8	8/12/2015	293	0.019	0.47	0.008	0.0375	
#9	2/25/2016	554	0.00025	0.094	0.0096	1.4	
#10	8/23/2016	315	0.011	0.12	0.022	0.0375	
#11	3/1/2017	302	0.001	0.175	0.0116	1.4	
#12	9/19/2017	386	0.004	0.12	0.0143	0.058	
#13	3/8/2018	275	0.006	0.052	0.0259	0.0375	
#14	8/28/2018	330	0.007	0.085	0.0255	0.0375	
#15	3/19/2019	161	0.0004	0.21	0.008	0.018	
#16	8/20/2019	316	0.007	0.074	0.0147	0.73	

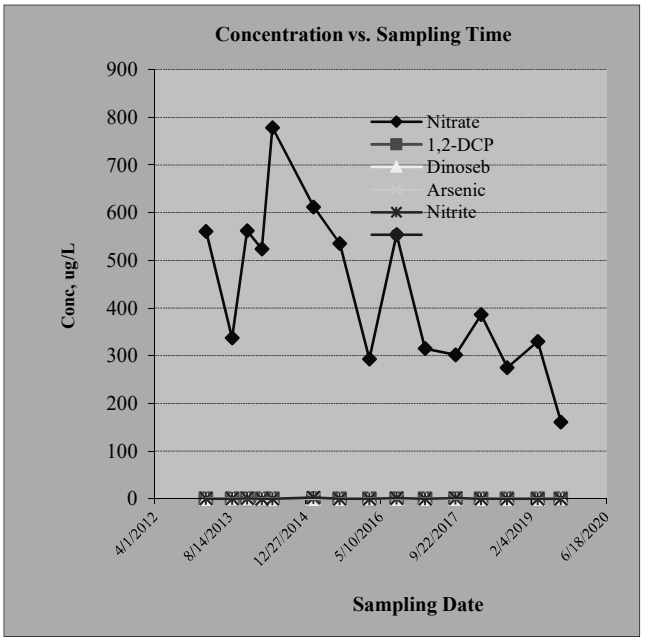
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Nitrate**	**1,2-DCP**	**Dinoseb**	**Arsenic**	**Nitrite**	
Confidence Level Calculated?	99.40%	99.40%	99.20%	97.90%	82.50%	NA
Plume Stability?	Shrinking	Shrinking	Shrinking	***Expanding***	Undetermined	NA
Coefficient of Variation?					CV > 1	n<4
Mann-Kendall Statistic "S" value?	-56	-56	-55	47	-23	0
Number of Sampling Rounds?	16	16	16	16	16	0
Average Concentration?	427.56	0.01	0.19	0.01	0.50	NA
Standard Deviation?	163.77	0.01	0.12	0.01	0.72	NA
Coefficient of Variation?	0.38	0.81	0.64	0.50	1.43	NA
Blank if No Errors found						n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Nitrate**
Plume Stability? **Shrinking**





MW-5R

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 12:48:09 PM
From File	mw05r_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	121	Mean	206.7
Maximum	308	Median	189.5
SD	77.76	Std. Error of Mean	31.74
Coefficient of Variation	0.376	Skewness	0.469

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.885	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.252	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	270.6	95% Adjusted-CLT UCL (Chen-1995)	265.4
		95% Modified-t UCL (Johnson-1978)	271.6

Gamma GOF Test

A-D Test Statistic	0.373	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.217	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.559	k star (bias corrected MLE)	4.39
Theta hat (MLE)	24.15	Theta star (bias corrected MLE)	47.07
nu hat (MLE)	102.7	nu star (bias corrected)	52.69
MLE Mean (bias corrected)	206.7	MLE Sd (bias corrected)	98.63
		Approximate Chi Square Value (0.05)	37.01
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	32.33

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	294.2	95% Adjusted Gamma UCL (use when n<50)	336.7

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.914	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.193	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	4.796			Mean of logged Data	5.272		
65					Maximum of Logged Data	5.73			SD of logged Data	0.379		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	312.9			90% Chebyshev (MVUE) UCL	302.5		
69					95% Chebyshev (MVUE) UCL	346			97.5% Chebyshev (MVUE) UCL	406.3		
70					99% Chebyshev (MVUE) UCL	524.7						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	258.9			95% Jackknife UCL	270.6		
77					95% Standard Bootstrap UCL	254.4			95% Bootstrap-t UCL	316.1		
78					95% Hall's Bootstrap UCL	383.2			95% Percentile Bootstrap UCL	255.2		
79					95% BCA Bootstrap UCL	257.7						
80					90% Chebyshev(Mean, Sd) UCL	301.9			95% Chebyshev(Mean, Sd) UCL	345		
81					97.5% Chebyshev(Mean, Sd) UCL	404.9			99% Chebyshev(Mean, Sd) UCL	522.5		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	270.6						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 12:49:12 PM
From File	mw05r_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrite

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	1
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.016	Minimum Non-Detect	0.015
Maximum Detect	0.39	Maximum Non-Detect	0.015
Variance Detects	0.0241	Percent Non-Detects	16.67%
Mean Detects	0.164	SD Detects	0.155
Median Detects	0.12	CV Detects	0.943
Skewness Detects	0.792	Kurtosis Detects	-0.81
Mean of Logged Detects	-2.332	SD of Logged Detects	1.292

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.921	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.213	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.14	KM Standard Error of Mean	0.0631
KM SD	0.138	95% KM (BCA) UCL	0.238
95% KM (t) UCL	0.267	95% KM (Percentile Bootstrap) UCL	0.241
95% KM (z) UCL	0.243	95% KM Bootstrap t UCL	0.389
90% KM Chebyshev UCL	0.329	95% KM Chebyshev UCL	0.415
97.5% KM Chebyshev UCL	0.534	99% KM Chebyshev UCL	0.768

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.204	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.69	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.183	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.364	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.085	k star (bias corrected MLE)	0.567
Theta hat (MLE)	0.152	Theta star (bias corrected MLE)	0.29
nu hat (MLE)	10.85	nu star (bias corrected)	5.673
Mean (detects)	0.164		

56												
57	**Gamma ROS Statistics using Imputed Non-Detects**											
58	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
59	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)											
60	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
61	This is especially true when the sample size is small.											
62	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
63					Minimum	0.01			Mean	0.139		
64					Maximum	0.39			Median	0.083		
65					SD	0.152			CV	1.099		
66					k hat (MLE)	0.806			k star (bias corrected MLE)	0.514		
67					Theta hat (MLE)	0.172			Theta star (bias corrected MLE)	0.27		
68					nu hat (MLE)	9.672			nu star (bias corrected)	6.17		
69					Adjusted Level of Significance (β)	0.0122						
70					Approximate Chi Square Value (6.17, α)	1.727			Adjusted Chi Square Value (6.17, β)	1.012		
71					95% Gamma Approximate UCL (use when n>=50)	0.495			95% Gamma Adjusted UCL (use when n<50)	0.846		
72												
73	**Estimates of Gamma Parameters using KM Estimates**											
74					Mean (KM)	0.14			SD (KM)	0.138		
75					Variance (KM)	0.0191			SE of Mean (KM)	0.0631		
76					k hat (KM)	1.017			k star (KM)	0.619		
77					nu hat (KM)	12.2			nu star (KM)	7.434		
78					theta hat (KM)	0.137			theta star (KM)	0.225		
79					80% gamma percentile (KM)	0.23			90% gamma percentile (KM)	0.36		
80					95% gamma percentile (KM)	0.496			99% gamma percentile (KM)	0.824		
81												
82	**Gamma Kaplan-Meier (KM) Statistics**											
83					Approximate Chi Square Value (7.43, α)	2.412			Adjusted Chi Square Value (7.43, β)	1.51		
84					95% Gamma Approximate KM-UCL (use when n>=50)	0.43			95% Gamma Adjusted KM-UCL (use when n<50)	0.687		
85												
86	**Lognormal GOF Test on Detected Observations Only**											
87					Shapiro Wilk Test Statistic	0.959			**Shapiro Wilk GOF Test**			
88					5% Shapiro Wilk Critical Value	0.762			Detected Data appear Lognormal at 5% Significance Level			
89					Lilliefors Test Statistic	0.168			**Lilliefors GOF Test**			
90					5% Lilliefors Critical Value	0.343			Detected Data appear Lognormal at 5% Significance Level			
91	**Detected Data appear Lognormal at 5% Significance Level**											
92												
93	**Lognormal ROS Statistics Using Imputed Non-Detects**											
94					Mean in Original Scale	0.138			Mean in Log Scale	-2.885		
95					SD in Original Scale	0.153			SD in Log Scale	1.779		
96					95% t UCL (assumes normality of ROS data)	0.264			95% Percentile Bootstrap UCL	0.241		
97					95% BCA Bootstrap UCL	0.247			95% Bootstrap t UCL	0.381		
98					95% H-UCL (Log ROS)	65.56						
99												
100	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
101					KM Mean (logged)	-2.644			KM Geo Mean	0.0711		
102					KM SD (logged)	1.264			95% Critical H Value (KM-Log)	5.039		
103					KM Standard Error of Mean (logged)	0.577			95% H-UCL (KM -Log)	2.729		
104					KM SD (logged)	1.264			95% Critical H Value (KM-Log)	5.039		
105					KM Standard Error of Mean (logged)	0.577						
106												
107	**DL/2 Statistics**											
108	**DL/2 Normal**								**DL/2 Log-Transformed**			
109					Mean in Original Scale	0.138			Mean in Log Scale	-2.759		
110					SD in Original Scale	0.153			SD in Log Scale	1.559		

	A	B	C	D	E	F	G	H	I	J	K	L
111				95% t UCL (Assumes normality)		0.264					95% H-Stat UCL	14.89
112	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
113												
114	**Nonparametric Distribution Free UCL Statistics**											
115	**Detected Data appear Normal Distributed at 5% Significance Level**											
116												
117	**Suggested UCL to Use**											
118					95% KM (t) UCL	0.267						
119												
120	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
121	Recommendations are based upon data size, data distribution, and skewness.											
122	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
123	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
124												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-5R**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

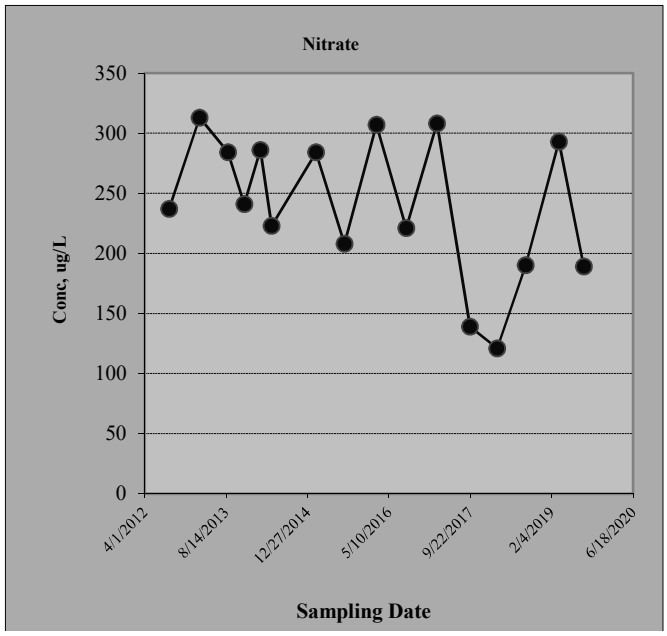
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Nitrate	Nitrite				
#1	8/29/2012	237	0.0075				
#2	3/5/2013	313	0.0075				
#3	8/26/2013	284	0.0075				
#4	12/4/2013	241	0.022				
#5	3/12/2014	286	0.0075				
#6	5/21/2014	223	0.0075				
#7	2/19/2015	284	3.9				
#8	8/12/2015	208	6.9				
#9	2/24/2016	307	0.4				
#10	8/25/2016	221	0.0075				
#11	3/2/2017	308	0.046				
#12	9/21/2017	139	0.016				
#13	3/7/2018	121	0.39				
#14	8/29/2018	190	0.0075				
#15	3/21/2019	293	0.12				
#16	8/21/2019	189	0.25				

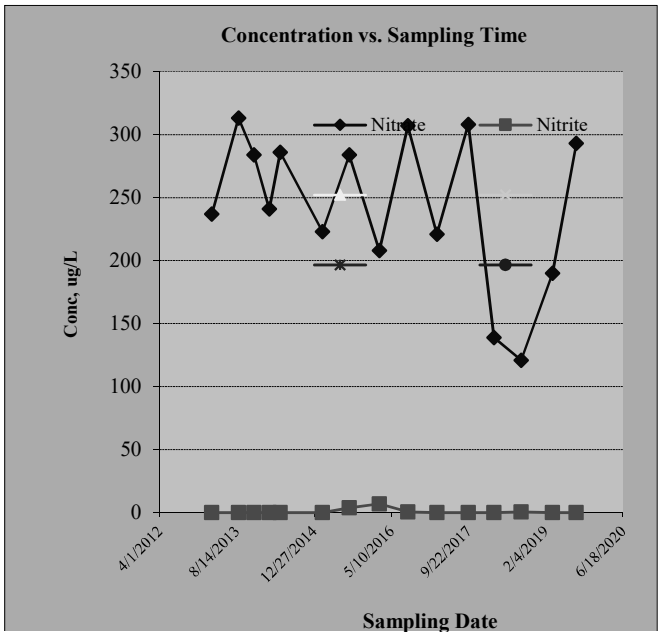
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Nitrate**	**Nitrite**				
Confidence Level Calculated?	94.20%	90.30%	NA	NA	NA	NA
Plume Stability?	Shrinking	***Expanding***	NA	NA	NA	NA
Coefficient of Variation?			n<4	n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	-37	31	0	0	0	0
Number of Sampling Rounds?	16	16	0	0	0	0
Average Concentration?	240.25	0.76	NA	NA	NA	NA
Standard Deviation?	60.21	1.90	NA	NA	NA	NA
Coefficient of Variation?	0.25	2.51	NA	NA	NA	NA
Blank if No Errors found			n<4	n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Nitrate**
Plume Stability? **Shrinking**





MW-6

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 1:08:05 PM
From File	mw06_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	5.5	Mean	32.55
Maximum	129	Median	10.45
SD	48.56	Std. Error of Mean	19.82
Coefficient of Variation	1.492	Skewness	2.183

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.662	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.318	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	72.5	95% Adjusted-CLT UCL (Chen-1995)	84.04
		95% Modified-t UCL (Johnson-1978)	75.44

Gamma GOF Test

A-D Test Statistic	0.648	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.72	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.28	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.343	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.775	k star (bias corrected MLE)	0.498
Theta hat (MLE)	42.02	Theta star (bias corrected MLE)	65.31
nu hat (MLE)	9.295	nu star (bias corrected)	5.981
MLE Mean (bias corrected)	32.55	MLE Sd (bias corrected)	46.11
		Approximate Chi Square Value (0.05)	1.63
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	0.943

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	119.4	95% Adjusted Gamma UCL (use when n<50)	206.4

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.838	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.272	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	1.705			Mean of logged Data	2.713		
65					Maximum of Logged Data	4.86			SD of logged Data	1.283		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	644.2			90% Chebyshev (MVUE) UCL	71.16		
69					95% Chebyshev (MVUE) UCL	90.57			97.5% Chebyshev (MVUE) UCL	117.5		
70					99% Chebyshev (MVUE) UCL	170.4						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	65.16			95% Jackknife UCL	72.5		
77					95% Standard Bootstrap UCL	62.06			95% Bootstrap-t UCL	268.8		
78					95% Hall's Bootstrap UCL	298.7			95% Percentile Bootstrap UCL	68.85		
79					95% BCA Bootstrap UCL	78.48						
80					90% Chebyshev(Mean, Sd) UCL	92.02			95% Chebyshev(Mean, Sd) UCL	119		
81					97.5% Chebyshev(Mean, Sd) UCL	156.3			99% Chebyshev(Mean, Sd) UCL	229.8		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	72.5						
85												
86	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
87	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
88												
89	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
90	Recommendations are based upon data size, data distribution, and skewness.											
91	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
92	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
93												

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/30/2019 1:09:12 PM										
5	From File	mw06_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**Arsenic**											
12												
13	**General Statistics**											
14	Total Number of Observations	6					Number of Distinct Observations	6				
15							Number of Missing Observations	0				
16	Minimum	0.0157					Mean	0.0263				
17	Maximum	0.0351					Median	0.026				
18	SD	0.00745					Std. Error of Mean	0.00304				
19	Coefficient of Variation	0.283					Skewness	-0.147				
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.941					**Shapiro Wilk GOF Test**					
28	5% Shapiro Wilk Critical Value	0.788					Data appear Normal at 5% Significance Level					
29	Lilliefors Test Statistic	0.183					**Lilliefors GOF Test**					
30	5% Lilliefors Critical Value	0.325					Data appear Normal at 5% Significance Level					
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
35	95% Student's-t UCL	0.0324					95% Adjusted-CLT UCL (Chen-1995)	0.0311				
36							95% Modified-t UCL (Johnson-1978)	0.0324				
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.28					**Anderson-Darling Gamma GOF Test**					
40	5% A-D Critical Value	0.698					Detected data appear Gamma Distributed at 5% Significance Level					
41	K-S Test Statistic	0.195					**Kolmogorov-Smirnov Gamma GOF Test**					
42	5% K-S Critical Value	0.332					Detected data appear Gamma Distributed at 5% Significance Level					
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	13.89					k star (bias corrected MLE)	7.057				
47	Theta hat (MLE)	0.00189					Theta star (bias corrected MLE)	0.00373				
48	nu hat (MLE)	166.7					nu star (bias corrected)	84.69				
49	MLE Mean (bias corrected)	0.0263					MLE Sd (bias corrected)	0.0099				
50							Approximate Chi Square Value (0.05)	64.48				
51	Adjusted Level of Significance	0.0122					Adjusted Chi Square Value	58.14				
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	0.0345					95% Adjusted Gamma UCL (use when n<50)	0.0383				
55												

56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.933	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.189	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-4.154	Mean of logged Data	-3.675				
65					Maximum of Logged Data	-3.35	SD of logged Data	0.303				
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.0359	90% Chebyshev (MVUE) UCL	0.0361				
69					95% Chebyshev (MVUE) UCL	0.0405	97.5% Chebyshev (MVUE) UCL	0.0467				
70					99% Chebyshev (MVUE) UCL	0.0587						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.0313	95% Jackknife UCL	0.0324				
77					95% Standard Bootstrap UCL	0.0309	95% Bootstrap-t UCL	0.0327				
78					95% Hall's Bootstrap UCL	0.0333	95% Percentile Bootstrap UCL	0.0305				
79					95% BCA Bootstrap UCL	0.0305						
80					90% Chebyshev(Mean, Sd) UCL	0.0354	95% Chebyshev(Mean, Sd) UCL	0.0396				
81					97.5% Chebyshev(Mean, Sd) UCL	0.0453	99% Chebyshev(Mean, Sd) UCL	0.0566				
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.0324						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-6**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

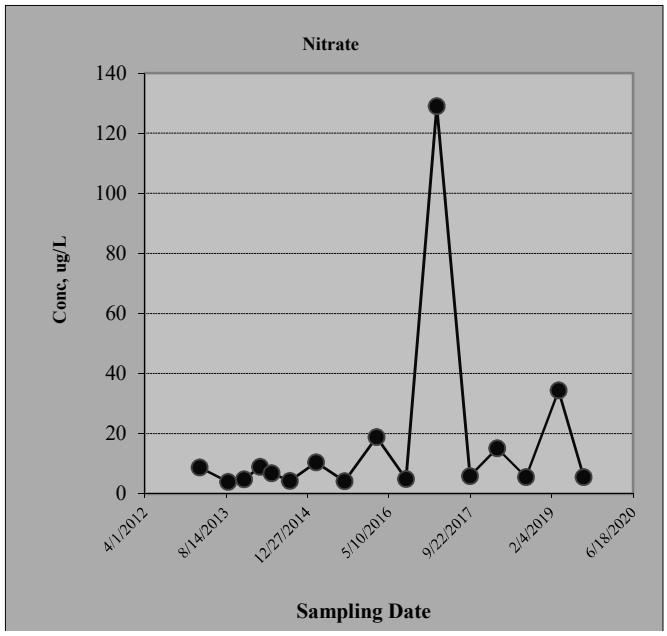
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Nitrate	Arsenic				
#1	3/5/2013	8.7	0.0255				
#2	8/26/2013	3.9	0.0302				
#3	12/3/2013	4.8	0.0241				
#4	3/11/2014	8.9	0.0279				
#5	5/20/2014	6.85	0.0256				
#6	9/9/2014	4.2	0.0272				
#7	2/18/2015	10.4	0.0236				
#8	8/12/2015	4.1	0.0243				
#9	2/25/2016	18.8	0.0332				
#10	8/24/2016	4.9	0.0236				
#11	2/28/2017	129	0.0157				
#12	9/20/2017	5.8	0.021				
#13	3/7/2018	15.1	0.034				
#14	8/30/2018	5.5	0.0351				
#15	3/20/2019	34.4	0.0258				
#16	8/20/2019	5.5	0.0262				

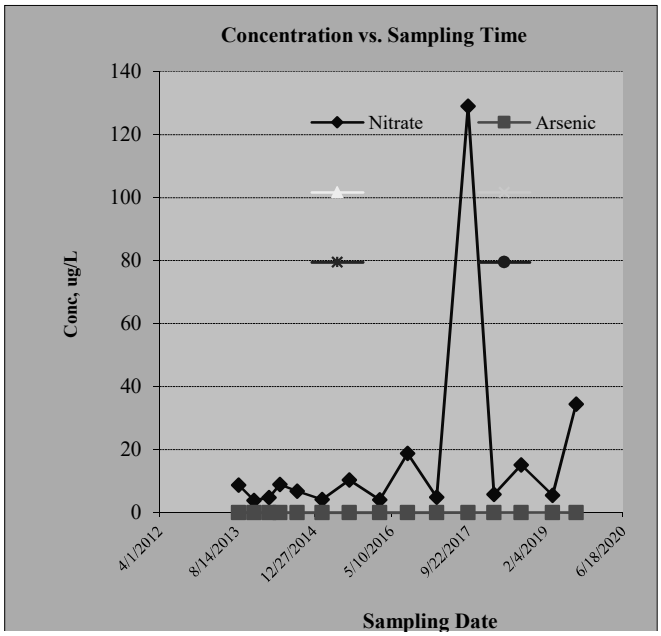
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Nitrate**	**Arsenic**				
Confidence Level Calculated?	88.60%	51.80%	NA	NA	NA	NA
Plume Stability?	***Expanding***	Stable	NA	NA	NA	NA
Coefficient of Variation?		CV <= 1	n<4	n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	29	3	0	0	0	0
Number of Sampling Rounds?	16	16	0	0	0	0
Average Concentration?	16.93	0.03	NA	NA	NA	NA
Standard Deviation?	30.90	0.00	NA	NA	NA	NA
Coefficient of Variation?	1.83	0.19	NA	NA	NA	NA
Blank if No Errors found			n<4	n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Nitrate**
Plume Stability? **Expanding**





MW-7

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/31/2019 11:19:33 AM										
5	From File	mw07_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**Nitrate**											
12												
13	**General Statistics**											
14	Total Number of Observations	6					Number of Distinct Observations	6				
15							Number of Missing Observations	0				
16	Minimum	2.65					Mean	4.025				
17	Maximum	5.3					Median	4.05				
18	SD	0.842					Std. Error of Mean	0.344				
19	Coefficient of Variation	0.209					Skewness	-0.264				
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.883					**Shapiro Wilk GOF Test**					
28	5% Shapiro Wilk Critical Value	0.788					Data appear Normal at 5% Significance Level					
29	Lilliefors Test Statistic	0.298					**Lilliefors GOF Test**					
30	5% Lilliefors Critical Value	0.325					Data appear Normal at 5% Significance Level					
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
35	95% Student's-t UCL	4.718					95% Adjusted-CLT UCL (Chen-1995)	4.551				
36							95% Modified-t UCL (Johnson-1978)	4.711				
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.586					**Anderson-Darling Gamma GOF Test**					
40	5% A-D Critical Value	0.697					Detected data appear Gamma Distributed at 5% Significance Level					
41	K-S Test Statistic	0.322					**Kolmogorov-Smirnov Gamma GOF Test**					
42	5% K-S Critical Value	0.332					Detected data appear Gamma Distributed at 5% Significance Level					
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	25.42					k star (bias corrected MLE)	12.82				
47	Theta hat (MLE)	0.158					Theta star (bias corrected MLE)	0.314				
48	nu hat (MLE)	305.1					nu star (bias corrected)	153.9				
49	MLE Mean (bias corrected)	4.025					MLE Sd (bias corrected)	1.124				
50							Approximate Chi Square Value (0.05)	126.2				
51	Adjusted Level of Significance	0.0122					Adjusted Chi Square Value	117.1				
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	4.908					95% Adjusted Gamma UCL (use when n<50)	5.288				
55												

56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.854	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.335	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data Not Lognormal at 5% Significance Level					
61	**Data appear Approximate Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	0.975	Mean of logged Data	1.373				
65					Maximum of Logged Data	1.668	SD of logged Data	0.223				
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	4.992	90% Chebyshev (MVUE) UCL	5.132				
69					95% Chebyshev (MVUE) UCL	5.631	97.5% Chebyshev (MVUE) UCL	6.324				
70					99% Chebyshev (MVUE) UCL	7.686						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	4.59	95% Jackknife UCL	4.718				
77					95% Standard Bootstrap UCL	4.544	95% Bootstrap-t UCL	4.582				
78					95% Hall's Bootstrap UCL	4.67	95% Percentile Bootstrap UCL	4.492				
79					95% BCA Bootstrap UCL	4.475						
80					90% Chebyshev(Mean, Sd) UCL	5.056	95% Chebyshev(Mean, Sd) UCL	5.523				
81					97.5% Chebyshev(Mean, Sd) UCL	6.171	99% Chebyshev(Mean, Sd) UCL	7.445				
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	4.718						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												

MW-8

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 1:25:06 PM
From File	mw08_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	41.1	Mean	68.92
Maximum	141	Median	58
SD	37.45	Std. Error of Mean	15.29
Coefficient of Variation	0.543	Skewness	1.88

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.774	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.276	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	99.72	95% Adjusted-CLT UCL (Chen-1995)	106.6
		95% Modified-t UCL (Johnson-1978)	101.7

Gamma GOF Test

A-D Test Statistic	0.502	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.25	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.265	k star (bias corrected MLE)	2.744
Theta hat (MLE)	13.09	Theta star (bias corrected MLE)	25.12
nu hat (MLE)	63.18	nu star (bias corrected)	32.92
MLE Mean (bias corrected)	68.92	MLE Sd (bias corrected)	41.61
		Approximate Chi Square Value (0.05)	20.81
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	17.42

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	109.1	95% Adjusted Gamma UCL (use when n<50)	130.3

56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.876	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.221	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	3.716	Mean of logged Data	4.135				
65					Maximum of Logged Data	4.949	SD of logged Data	0.459				
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	117.1	90% Chebyshev (MVUE) UCL	106.5				
69					95% Chebyshev (MVUE) UCL	123.8	97.5% Chebyshev (MVUE) UCL	147.9				
70					99% Chebyshev (MVUE) UCL	195.2						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	94.06	95% Jackknife UCL	99.72				
77					95% Standard Bootstrap UCL	92.65	95% Bootstrap-t UCL	148.7				
78					95% Hall's Bootstrap UCL	215.5	95% Percentile Bootstrap UCL	93.98				
79					95% BCA Bootstrap UCL	102						
80					90% Chebyshev(Mean, Sd) UCL	114.8	95% Chebyshev(Mean, Sd) UCL	135.6				
81					97.5% Chebyshev(Mean, Sd) UCL	164.4	99% Chebyshev(Mean, Sd) UCL	221				
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	99.72						
85												
86	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
87	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
88												
89	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
90	Recommendations are based upon data size, data distribution, and skewness.											
91	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
92	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
93												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-8**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

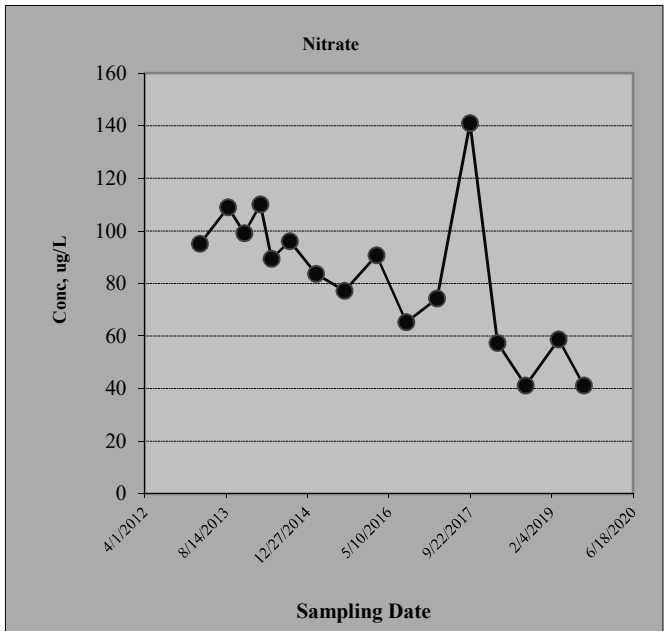
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Nitrate					
#1	3/6/2013	95.1					
#2	8/26/2013	109					
#3	12/4/2013	99.1					
#4	3/12/2014	110					
#5	5/21/2014	89.3					
#6	9/9/2014	96					
#7	2/19/2015	83.6					
#8	8/12/2015	77.2					
#9	2/25/2016	90.7					
#10	8/25/2016	65.3					
#11	3/2/2017	74.3					
#12	9/21/2017	141					
#13	3/8/2018	57.3					
#14	8/29/2018	41.1					
#15	3/20/2019	58.7					
#16	8/21/2019	41.1					

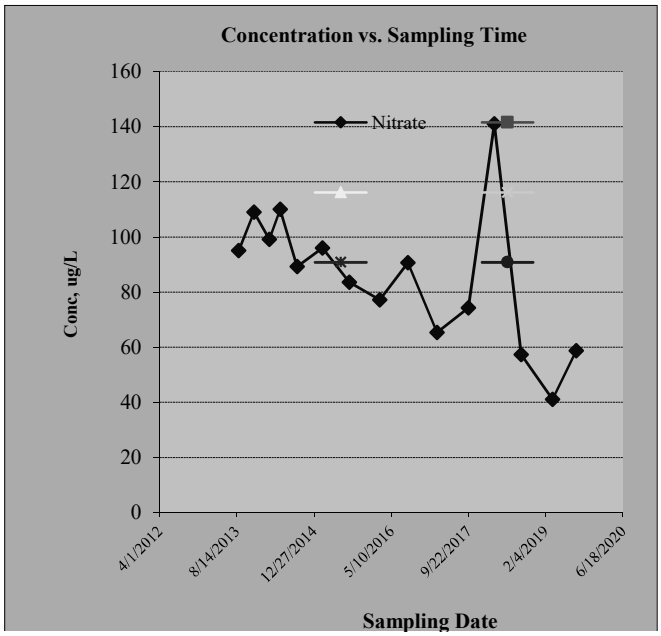
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Nitrate**					
Confidence Level Calculated?	99.90%	NA	NA	NA	NA	NA
Plume Stability?	Shrinking	NA	NA	NA	NA	NA
Coefficient of Variation?		n<4	n<4	n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	-71	0	0	0	0	0
Number of Sampling Rounds?	16	0	0	0	0	0
Average Concentration?	83.05	NA	NA	NA	NA	NA
Standard Deviation?	26.62	NA	NA	NA	NA	NA
Coefficient of Variation?	0.32	NA	NA	NA	NA	NA
Blank if No Errors found		n<4	n<4	n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Nitrate**
Plume Stability? **Shrinking**





MW-9

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 1:39:02 PM
From File	mw09_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	30	Mean	206.5
Maximum	359	Median	213
SD	135.1	Std. Error of Mean	55.14
Coefficient of Variation	0.654	Skewness	-0.158

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.887	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.26	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	317.6	95% Adjusted-CLT UCL (Chen-1995)	293.4
		95% Modified-t UCL (Johnson-1978)	317

Gamma GOF Test

A-D Test Statistic	0.443	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.705	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.287	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.336	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.897	k star (bias corrected MLE)	1.06
Theta hat (MLE)	108.8	Theta star (bias corrected MLE)	194.9
nu hat (MLE)	22.77	nu star (bias corrected)	12.72
MLE Mean (bias corrected)	206.5	MLE Sd (bias corrected)	200.6
		Approximate Chi Square Value (0.05)	5.703
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	4.128

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	460.5	95% Adjusted Gamma UCL (use when n<50)	636.1

56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.859	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.258	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	3.401			Mean of logged Data	5.044		
65					Maximum of Logged Data	5.883			SD of logged Data	0.95		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	1299			90% Chebyshev (MVUE) UCL	476.4		
69					95% Chebyshev (MVUE) UCL	591.7			97.5% Chebyshev (MVUE) UCL	751.7		
70					99% Chebyshev (MVUE) UCL	1066						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	297.2			95% Jackknife UCL	317.6		
77					95% Standard Bootstrap UCL	289.3			95% Bootstrap-t UCL	316.4		
78					95% Hall's Bootstrap UCL	268.3			95% Percentile Bootstrap UCL	291		
79					95% BCA Bootstrap UCL	285.8						
80					90% Chebyshev(Mean, Sd) UCL	371.9			95% Chebyshev(Mean, Sd) UCL	446.8		
81					97.5% Chebyshev(Mean, Sd) UCL	550.8			99% Chebyshev(Mean, Sd) UCL	755.1		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	317.6						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 1:42:30 PM
From File	mw09_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrite

General Statistics

Total Number of Observations	6	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	4
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.019	Minimum Non-Detect	0.015
Maximum Detect	9.5	Maximum Non-Detect	0.015
Variance Detects	44.94	Percent Non-Detects	66.67%
Mean Detects	4.76	SD Detects	6.704
Median Detects	4.76	CV Detects	1.409
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-0.856	SD of Logged Detects	4.394

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.597	KM Standard Error of Mean	2.041
KM SD	3.535	95% KM (BCA) UCL	N/A
95% KM (t) UCL	5.709	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	4.953	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	7.719	95% KM Chebyshev UCL	10.49
97.5% KM Chebyshev UCL	14.34	99% KM Chebyshev UCL	21.9

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	0.287	k star (bias corrected MLE)	N/A
Theta hat (MLE)	16.56	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1.15	nu star (bias corrected)	N/A
Mean (detects)	4.76		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.597	SD (KM)	3.535
Variance (KM)	12.49	SE of Mean (KM)	2.041

56					k hat (KM)	0.204					k star (KM)	0.213
57					nu hat (KM)	2.448					nu star (KM)	2.557
58					theta hat (KM)	7.825					theta star (KM)	7.491
59					80% gamma percentile (KM)	2.171					90% gamma percentile (KM)	4.827
60					95% gamma percentile (KM)	8.088					99% gamma percentile (KM)	16.98
61												
62					**Gamma Kaplan-Meier (KM) Statistics**							
63											Adjusted Level of Significance (β)	0.0122
64					Approximate Chi Square Value (2.56, α)	0.254					Adjusted Chi Square Value (2.56, β)	0.118
65					95% Gamma Approximate KM-UCL (use when n>=50)	16.05					95% Gamma Adjusted KM-UCL (use when n<50)	34.67
66												
67					**Lognormal GOF Test on Detected Observations Only**							
68					**Not Enough Data to Perform GOF Test**							
69												
70					**Lognormal ROS Statistics Using Imputed Non-Detects**							
71					Mean in Original Scale	1.587					Mean in Log Scale	-14.2
72					SD in Original Scale	3.877					SD in Log Scale	11.83
73					95% t UCL (assumes normality of ROS data)	4.776					95% Percentile Bootstrap UCL	4.75
74					95% BCA Bootstrap UCL	4.756					95% Bootstrap t UCL	6794023
75					95% H-UCL (Log ROS)	N/A						
76												
77					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
78					KM Mean (logged)	-3.085					KM Geo Mean	0.0457
79					KM SD (logged)	2.388					95% Critical H Value (KM-Log)	9.131
80					KM Standard Error of Mean (logged)	1.379					95% H-UCL (KM -Log)	13608
81					KM SD (logged)	2.388					95% Critical H Value (KM-Log)	9.131
82					KM Standard Error of Mean (logged)	1.379						
83												
84					**DL/2 Statistics**							
85					**DL/2 Normal**						**DL/2 Log-Transformed**	
86					Mean in Original Scale	1.592					Mean in Log Scale	-3.547
87					SD in Original Scale	3.874					SD in Log Scale	2.865
88					95% t UCL (Assumes normality)	4.779					95% H-Stat UCL	2022371
89					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
90												
91					**Nonparametric Distribution Free UCL Statistics**							
92					**Data do not follow a Discernible Distribution at 5% Significance Level**							
93												
94					**Suggested UCL to Use**							
95					99% KM (Chebyshev) UCL	21.9						
96					**Warning: Recommended UCL exceeds the maximum observation**							
97												
98					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
99					Recommendations are based upon data size, data distribution, and skewness.							
100					These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).							
101					However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.							
102												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 1:40:01 PM
From File	mw09_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Dinoseb

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.0099	Mean	0.102
Maximum	0.31	Median	0.072
SD	0.107	Std. Error of Mean	0.0435
Coefficient of Variation	1.048	Skewness	1.998

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.769	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.34	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.189	95% Adjusted-CLT UCL (Chen-1995)	0.211
		95% Modified-t UCL (Johnson-1978)	0.195

Gamma GOF Test

A-D Test Statistic	0.313	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.712	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.221	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.339	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.245	k star (bias corrected MLE)	0.734
Theta hat (MLE)	0.0817	Theta star (bias corrected MLE)	0.139
nu hat (MLE)	14.94	nu star (bias corrected)	8.802
MLE Mean (bias corrected)	0.102	MLE Sd (bias corrected)	0.119
		Approximate Chi Square Value (0.05)	3.208
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	2.117

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.279	95% Adjusted Gamma UCL (use when n<50)	0.423

56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.214	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-4.615	Mean of logged Data	-2.739				
65					Maximum of Logged Data	-1.171	SD of logged Data	1.124				
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	1.202	90% Chebyshev (MVUE) UCL	0.248				
69					95% Chebyshev (MVUE) UCL	0.312	97.5% Chebyshev (MVUE) UCL	0.401				
70					99% Chebyshev (MVUE) UCL	0.576						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.173	95% Jackknife UCL	0.189				
77					95% Standard Bootstrap UCL	0.168	95% Bootstrap-t UCL	0.299				
78					95% Hall's Bootstrap UCL	0.544	95% Percentile Bootstrap UCL	0.176				
79					95% BCA Bootstrap UCL	0.192						
80					90% Chebyshev(Mean, Sd) UCL	0.232	95% Chebyshev(Mean, Sd) UCL	0.291				
81					97.5% Chebyshev(Mean, Sd) UCL	0.373	99% Chebyshev(Mean, Sd) UCL	0.534				
82												
83	**Suggested UCL to Use**											
84					95% Adjusted Gamma UCL	0.423						
85												
86	**Recommended UCL exceeds the maximum observation**											
87												
88	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
89	Recommendations are based upon data size, data distribution, and skewness.											
90	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
91	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
92												

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/30/2019 1:41:16 PM										
5	From File	mw09_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**1,2-DCP**											
12												
13	**General Statistics**											
14	Total Number of Observations	6					Number of Distinct Observations	6				
15							Number of Missing Observations	0				
16	Minimum	0.016					Mean	0.0347				
17	Maximum	0.056					Median	0.0315				
18	SD	0.0173					Std. Error of Mean	0.00705				
19	Coefficient of Variation	0.498					Skewness	0.238				
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.873					**Shapiro Wilk GOF Test**					
28	5% Shapiro Wilk Critical Value	0.788					Data appear Normal at 5% Significance Level					
29	Lilliefors Test Statistic	0.268					**Lilliefors GOF Test**					
30	5% Lilliefors Critical Value	0.325					Data appear Normal at 5% Significance Level					
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
35	95% Student's-t UCL	0.0489					95% Adjusted-CLT UCL (Chen-1995)	0.047				
36							95% Modified-t UCL (Johnson-1978)	0.049				
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.454					**Anderson-Darling Gamma GOF Test**					
40	5% A-D Critical Value	0.699					Detected data appear Gamma Distributed at 5% Significance Level					
41	K-S Test Statistic	0.272					**Kolmogorov-Smirnov Gamma GOF Test**					
42	5% K-S Critical Value	0.333					Detected data appear Gamma Distributed at 5% Significance Level					
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	4.596					k star (bias corrected MLE)	2.409				
47	Theta hat (MLE)	0.00754					Theta star (bias corrected MLE)	0.0144				
48	nu hat (MLE)	55.15					nu star (bias corrected)	28.91				
49	MLE Mean (bias corrected)	0.0347					MLE Sd (bias corrected)	0.0223				
50							Approximate Chi Square Value (0.05)	17.64				
51	Adjusted Level of Significance	0.0122					Adjusted Chi Square Value	14.55				
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	0.0568					95% Adjusted Gamma UCL (use when n<50)	0.0689				
55												

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.886	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.241	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-4.135			Mean of logged Data	-3.475		
65					Maximum of Logged Data	-2.882			SD of logged Data	0.53		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.0677			90% Chebyshev (MVUE) UCL	0.0572		
69					95% Chebyshev (MVUE) UCL	0.0674			97.5% Chebyshev (MVUE) UCL	0.0816		
70					99% Chebyshev (MVUE) UCL	0.109						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.0463			95% Jackknife UCL	0.0489		
77					95% Standard Bootstrap UCL	0.0458			95% Bootstrap-t UCL	0.0477		
78					95% Hall's Bootstrap UCL	0.0427			95% Percentile Bootstrap UCL	0.0462		
79					95% BCA Bootstrap UCL	0.0452						
80					90% Chebyshev(Mean, Sd) UCL	0.0558			95% Chebyshev(Mean, Sd) UCL	0.0654		
81					97.5% Chebyshev(Mean, Sd) UCL	0.0787			99% Chebyshev(Mean, Sd) UCL	0.105		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.0489						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-9**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

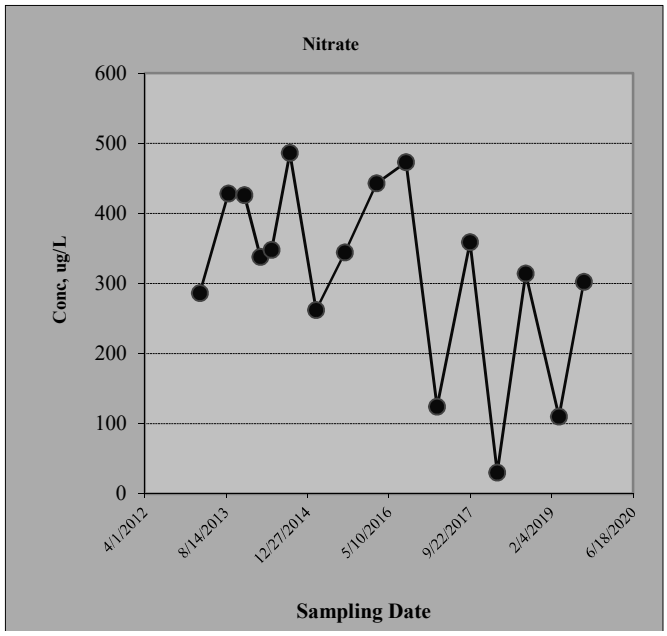
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Nitrate	Nitrite	Dinoseb	1,2-DCP		
#1	3/6/2013	286	0.0075	0.62	0.014		
#2	8/28/2013	428	0.0075	0.81	0.026		
#3	12/5/2013	426	0.0075	0.71	0.026		
#4	3/12/2014	338	0.0075	0.21	0.02		
#5	5/21/2014	348	0.0075	0.8	0.028		
#6	9/10/2014	486	0.0075	0.79	0.036		
#7	2/19/2015	262	0.0075	0.33	0.02		
#8	8/13/2015	344	0.0075	0.67	0.043		
#9	2/24/2016	443	0.0075	0.24	0.052		
#10	8/24/2016	473	0.0075	0.24	0.066		
#11	3/2/2017	124	9.5	0.068	0.022		
#12	9/20/2017	359	0.0075	0.31	0.056		
#13	3/7/2018	30	0.0075	0.0099	0.021		
#14	8/29/2018	314	0.0075	0.1	0.052		
#15	3/21/2019	110	0.019	0.046	0.016		
#16	8/21/2019	302	0.0075	0.076	0.041		

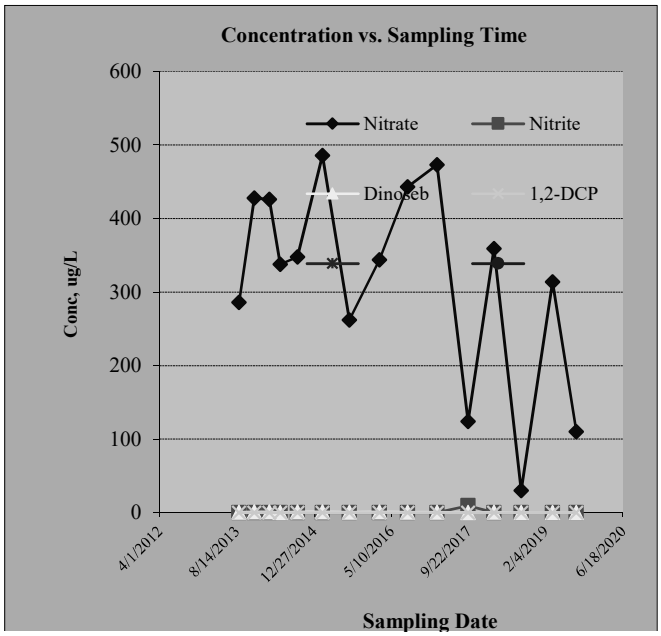
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Nitrate**	**Nitrite**	**Dinoseb**	**1,2-DCP**		
Confidence Level Calculated?	91.70%	74.70%	99.90%	90.30%	NA	NA
Plume Stability?	Shrinking	Undetermined	Shrinking	***Expanding***	NA	NA
Coefficient of Variation?		CV > 1			n<4	n<4
Mann-Kendall Statistic "S" value?	-32	17	-71	31	0	0
Number of Sampling Rounds?	16	16	16	16	0	0
Average Concentration?	317.06	0.60	0.38	0.03	NA	NA
Standard Deviation?	132.55	2.37	0.30	0.02	NA	NA
Coefficient of Variation?	0.42	3.95	0.80	0.48	NA	NA
Blank if No Errors found					n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Nitrate**
Plume Stability? **Shrinking**





MW-10

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 2:00:26 PM
From File	mw10_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.45	Mean	4.508
Maximum	11.3	Median	3.95
SD	3.648	Std. Error of Mean	1.489
Coefficient of Variation	0.809	Skewness	1.484

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.312	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	7.509	95% Adjusted-CLT UCL (Chen-1995)	7.922
		95% Modified-t UCL (Johnson-1978)	7.66

Gamma GOF Test

A-D Test Statistic	0.382	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.707	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.211	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.337	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.56	k star (bias corrected MLE)	0.891
Theta hat (MLE)	2.89	Theta star (bias corrected MLE)	5.059
nu hat (MLE)	18.72	nu star (bias corrected)	10.69
MLE Mean (bias corrected)	4.508	MLE Sd (bias corrected)	4.776
		Approximate Chi Square Value (0.05)	4.38
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	3.046

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	11.01	95% Adjusted Gamma UCL (use when n<50)	15.83

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.872	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.274	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-0.799			Mean of logged Data	1.152		
65					Maximum of Logged Data	2.425			SD of logged Data	1.068		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	45.1			90% Chebyshev (MVUE) UCL	11.29		
69					95% Chebyshev (MVUE) UCL	14.16			97.5% Chebyshev (MVUE) UCL	18.15		
70					99% Chebyshev (MVUE) UCL	25.98						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	6.958			95% Jackknife UCL	7.509		
77					95% Standard Bootstrap UCL	6.74			95% Bootstrap-t UCL	9.432		
78					95% Hall's Bootstrap UCL	20.36			95% Percentile Bootstrap UCL	7.042		
79					95% BCA Bootstrap UCL	7.533						
80					90% Chebyshev(Mean, Sd) UCL	8.976			95% Chebyshev(Mean, Sd) UCL	11		
81					97.5% Chebyshev(Mean, Sd) UCL	13.81			99% Chebyshev(Mean, Sd) UCL	19.33		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	7.509						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/30/2019 2:01:12 PM										
5	From File	mw10_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**Arsenic**											
12												
13	**General Statistics**											
14	Total Number of Observations	6			Number of Distinct Observations	6						
15					Number of Missing Observations	0						
16	Minimum	0.0179			Mean	0.0257						
17	Maximum	0.0423			Median	0.0242						
18	SD	0.00889			Std. Error of Mean	0.00363						
19	Coefficient of Variation	0.345			Skewness	1.579						
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.843			**Shapiro Wilk GOF Test**							
28	5% Shapiro Wilk Critical Value	0.788			Data appear Normal at 5% Significance Level							
29	Lilliefors Test Statistic	0.263			**Lilliefors GOF Test**							
30	5% Lilliefors Critical Value	0.325			Data appear Normal at 5% Significance Level							
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**							
35	95% Student's-t UCL	0.033			95% Adjusted-CLT UCL (Chen-1995)	0.0342						
36					95% Modified-t UCL (Johnson-1978)	0.0334						
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.385			**Anderson-Darling Gamma GOF Test**							
40	5% A-D Critical Value	0.698			Detected data appear Gamma Distributed at 5% Significance Level							
41	K-S Test Statistic	0.215			**Kolmogorov-Smirnov Gamma GOF Test**							
42	5% K-S Critical Value	0.332			Detected data appear Gamma Distributed at 5% Significance Level							
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	11.74			k star (bias corrected MLE)	5.979						
47	Theta hat (MLE)	0.00219			Theta star (bias corrected MLE)	0.0043						
48	nu hat (MLE)	140.8			nu star (bias corrected)	71.75						
49	MLE Mean (bias corrected)	0.0257			MLE Sd (bias corrected)	0.0105						
50					Approximate Chi Square Value (0.05)	53.25						
51	Adjusted Level of Significance	0.0122			Adjusted Chi Square Value	47.54						
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	0.0347			95% Adjusted Gamma UCL (use when n<50)	0.0388						
55												

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.911	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.205	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-4.023			Mean of logged Data	-3.703		
65					Maximum of Logged Data	-3.163			SD of logged Data	0.312		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.0354			90% Chebyshev (MVUE) UCL	0.0355		
69					95% Chebyshev (MVUE) UCL	0.0399			97.5% Chebyshev (MVUE) UCL	0.046		
70					99% Chebyshev (MVUE) UCL	0.0581						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.0317			95% Jackknife UCL	0.033		
77					95% Standard Bootstrap UCL	0.0312			95% Bootstrap-t UCL	0.0387		
78					95% Hall's Bootstrap UCL	0.0609			95% Percentile Bootstrap UCL	0.0317		
79					95% BCA Bootstrap UCL	0.0328						
80					90% Chebyshev(Mean, Sd) UCL	0.0366			95% Chebyshev(Mean, Sd) UCL	0.0416		
81					97.5% Chebyshev(Mean, Sd) UCL	0.0484			99% Chebyshev(Mean, Sd) UCL	0.0618		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.033						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-10**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

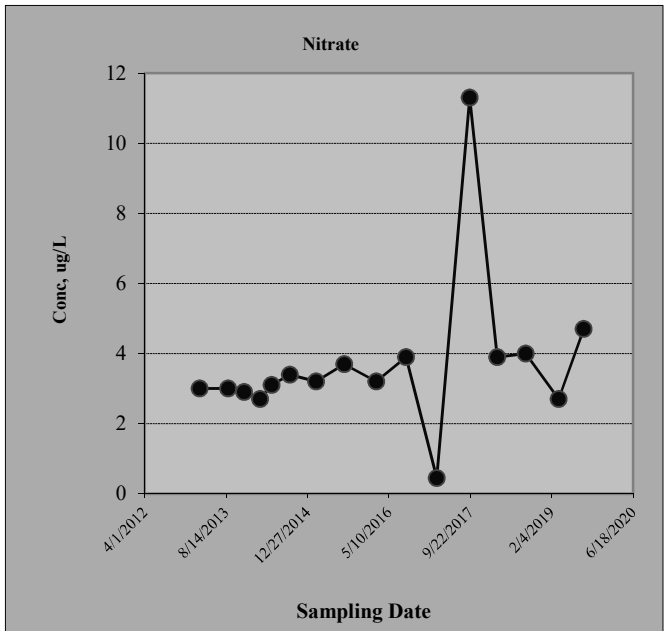
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Nitrate	Arsenic				
#1	3/5/2013	3	0.0154				
#2	8/26/2013	3	0.025				
#3	12/3/2013	2.9	0.0203				
#4	3/11/2014	2.7	0.0223				
#5	5/20/2014	3.1	0.0207				
#6	9/9/2014	3.4	0.0307				
#7	2/18/2015	3.2	0.0199				
#8	8/11/2015	3.7	0.0189				
#9	2/23/2016	3.2	0.0265				
#10	8/23/2016	3.9	0.0189				
#11	2/28/2017	0.45	0.0423				
#12	9/19/2017	11.3	0.0248				
#13	3/6/2018	3.9	0.0273				
#14	8/28/2018	4	0.0186				
#15	3/20/2019	2.7	0.0235				
#16	8/20/2019	4.7	0.0179				

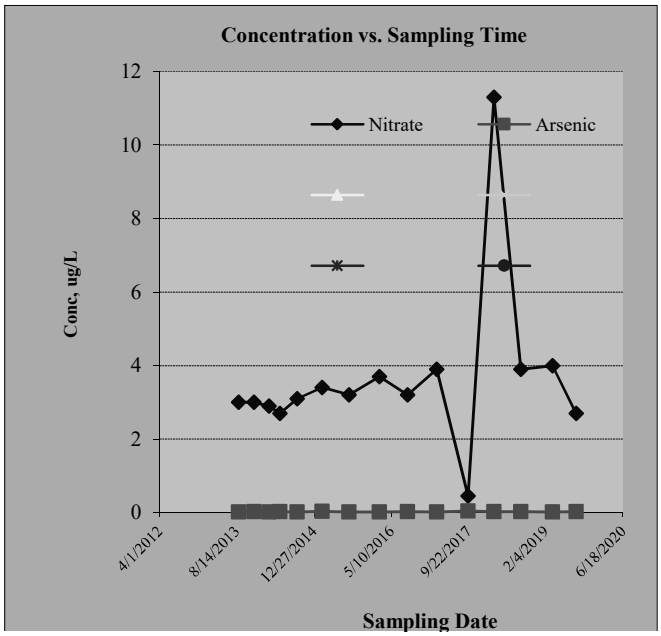
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Nitrate**	**Arsenic**				
Confidence Level Calculated?	98.70%	51.80%	NA	NA	NA	NA
Plume Stability?	***Expanding***	Stable	NA	NA	NA	NA
Coefficient of Variation?		CV <= 1	n<4	n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	50	-3	0	0	0	0
Number of Sampling Rounds?	16	16	0	0	0	0
Average Concentration?	3.70	0.02	NA	NA	NA	NA
Standard Deviation?	2.22	0.01	NA	NA	NA	NA
Coefficient of Variation?	0.60	0.28	NA	NA	NA	NA
Blank if No Errors found			n<4	n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Nitrate**
Plume Stability? **Expanding**





MW-11

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 2:11:37 PM
From File	mw11_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	6.2	Mean	11.24
Maximum	32.5	Median	6.875
SD	10.46	Std. Error of Mean	4.269
Coefficient of Variation	0.93	Skewness	2.407

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.57	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.429	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	19.84	95% Adjusted-CLT UCL (Chen-1995)	22.74
		95% Modified-t UCL (Johnson-1978)	20.54

Gamma GOF Test

A-D Test Statistic	1.211	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.703	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.395	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.335	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.367	k star (bias corrected MLE)	1.295
Theta hat (MLE)	4.75	Theta star (bias corrected MLE)	8.684
nu hat (MLE)	28.4	nu star (bias corrected)	15.53
MLE Mean (bias corrected)	11.24	MLE Sd (bias corrected)	9.88
		Approximate Chi Square Value (0.05)	7.635
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	5.751

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	22.87	95% Adjusted Gamma UCL (use when n<50)	30.36

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.657	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data Not Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.352	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data Not Lognormal at 5% Significance Level					
61	**Data Not Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	1.825			Mean of logged Data	2.194		
65					Maximum of Logged Data	3.481			SD of logged Data	0.643		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	26.22			90% Chebyshev (MVUE) UCL	18.94		
69					95% Chebyshev (MVUE) UCL	22.72			97.5% Chebyshev (MVUE) UCL	27.96		
70					99% Chebyshev (MVUE) UCL	38.24						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data do not follow a Discernible Distribution (0.05)**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	18.26			95% Jackknife UCL	19.84		
77					95% Standard Bootstrap UCL	17.7			95% Bootstrap-t UCL	123.8		
78					95% Hall's Bootstrap UCL	98.04			95% Percentile Bootstrap UCL	19.42		
79					95% BCA Bootstrap UCL	20.23						
80					90% Chebyshev(Mean, Sd) UCL	24.05			95% Chebyshev(Mean, Sd) UCL	29.85		
81					97.5% Chebyshev(Mean, Sd) UCL	37.9			99% Chebyshev(Mean, Sd) UCL	53.71		
82												
83	**Suggested UCL to Use**											
84					95% Chebyshev (Mean, Sd) UCL	29.85						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 2:12:43 PM
From File	mw11_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.0421	Mean	0.0476
Maximum	0.0564	Median	0.0474
SD	0.00494	Std. Error of Mean	0.00202
Coefficient of Variation	0.104	Skewness	1.201

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.894	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.289	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0516	95% Adjusted-CLT UCL (Chen-1995)	0.0519
		95% Modified-t UCL (Johnson-1978)	0.0518

Gamma GOF Test

A-D Test Statistic	0.379	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.696	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.272	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	116.4	k star (bias corrected MLE)	58.32
Theta hat (MLE)	4.0841E-4	Theta star (bias corrected MLE)	8.1526E-4
nu hat (MLE)	1397	nu star (bias corrected)	699.9
MLE Mean (bias corrected)	0.0476	MLE Sd (bias corrected)	0.00623
		Approximate Chi Square Value (0.05)	639.5
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	618.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.052	95% Adjusted Gamma UCL (use when n<50)	0.0538

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.917	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.271	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-3.168				Mean of logged Data	-3.05	
65					Maximum of Logged Data	-2.875				SD of logged Data	0.101	
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.0519				90% Chebyshev (MVUE) UCL	0.0534	
69					95% Chebyshev (MVUE) UCL	0.056				97.5% Chebyshev (MVUE) UCL	0.0597	
70					99% Chebyshev (MVUE) UCL	0.067						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.0509				95% Jackknife UCL	0.0516	
77					95% Standard Bootstrap UCL	0.0506				95% Bootstrap-t UCL	0.053	
78					95% Hall's Bootstrap UCL	0.0668				95% Percentile Bootstrap UCL	0.0507	
79					95% BCA Bootstrap UCL	0.0515						
80					90% Chebyshev(Mean, Sd) UCL	0.0536				95% Chebyshev(Mean, Sd) UCL	0.0563	
81					97.5% Chebyshev(Mean, Sd) UCL	0.0601				99% Chebyshev(Mean, Sd) UCL	0.0676	
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.0516						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-11**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

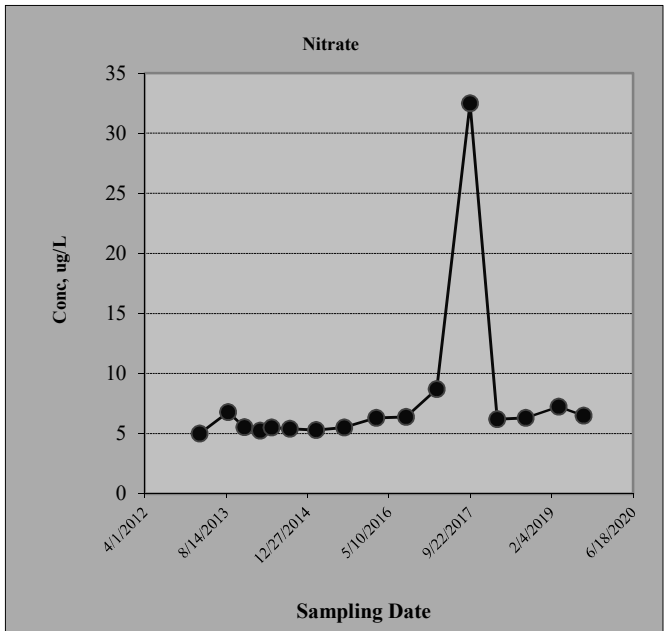
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Nitrate	Arsenic				
#1	3/5/2013	5	0.054				
#2	8/26/2013	6.8	0.0568				
#3	12/4/2013	5.55	0.0505				
#4	3/11/2014	5.25	0.0588				
#5	5/20/2014	5.5	0.0524				
#6	9/9/2014	5.4	0.0543				
#7	2/18/2015	5.3	0.0437				
#8	8/11/2015	5.5	0.0419				
#9	2/23/2016	6.3	0.051				
#10	8/24/2016	6.4	0.0479				
#11	3/1/2017	8.7	0.0439				
#12	9/20/2017	32.5	0.0478				
#13	3/7/2018	6.2	0.0564				
#14	8/28/2018	6.3	0.0421				
#15	3/20/2019	7.25	0.047				
#16	8/20/2019	6.5	0.0481				

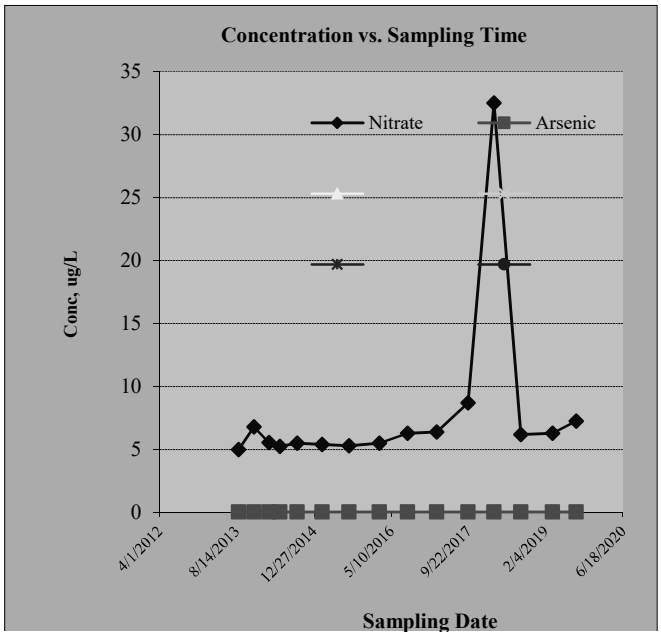
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Nitrate**	**Arsenic**				
Confidence Level Calculated?	99.40%	96.10%	NA	NA	NA	NA
Plume Stability?	***Expanding***	Shrinking	NA	NA	NA	NA
Coefficient of Variation?			n<4	n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	56	-40	0	0	0	0
Number of Sampling Rounds?	16	16	0	0	0	0
Average Concentration?	7.78	0.05	NA	NA	NA	NA
Standard Deviation?	6.66	0.01	NA	NA	NA	NA
Coefficient of Variation?	0.86	0.11	NA	NA	NA	NA
Blank if No Errors found			n<4	n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Nitrate**
Plume Stability? **Expanding**





MW-12R

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 2:54:13 PM
From File	mw12r_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	350	Mean	471.5
Maximum	642	Median	453
SD	119	Std. Error of Mean	48.58
Coefficient of Variation	0.252	Skewness	0.453

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.194	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	569.4	95% Adjusted-CLT UCL (Chen-1995)	561
		95% Modified-t UCL (Johnson-1978)	570.9

Gamma GOF Test

A-D Test Statistic	0.312	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.697	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.196	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	19.23	k star (bias corrected MLE)	9.725
Theta hat (MLE)	24.52	Theta star (bias corrected MLE)	48.48
nu hat (MLE)	230.7	nu star (bias corrected)	116.7
MLE Mean (bias corrected)	471.5	MLE Sd (bias corrected)	151.2
		Approximate Chi Square Value (0.05)	92.76
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	85.06

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	593.2	95% Adjusted Gamma UCL (use when n<50)	646.9

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.922	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.172	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	5.858			Mean of logged Data	6.13		
65					Maximum of Logged Data	6.465			SD of logged Data	0.25		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	602.3			90% Chebyshev (MVUE) UCL	615.8		
69					95% Chebyshev (MVUE) UCL	681.2			97.5% Chebyshev (MVUE) UCL	771.9		
70					99% Chebyshev (MVUE) UCL	950.3						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	551.4			95% Jackknife UCL	569.4		
77					95% Standard Bootstrap UCL	543.6			95% Bootstrap-t UCL	621.4		
78					95% Hall's Bootstrap UCL	565			95% Percentile Bootstrap UCL	545.2		
79					95% BCA Bootstrap UCL	553.3						
80					90% Chebyshev(Mean, Sd) UCL	617.2			95% Chebyshev(Mean, Sd) UCL	683.3		
81					97.5% Chebyshev(Mean, Sd) UCL	774.9			99% Chebyshev(Mean, Sd) UCL	954.9		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	569.4						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 3:05:08 PM
From File	mw12r_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Dinoseb

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.41	Mean	0.78
Maximum	1.2	Median	0.765
SD	0.341	Std. Error of Mean	0.139
Coefficient of Variation	0.437	Skewness	0.112

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.895	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.191	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.06	95% Adjusted-CLT UCL (Chen-1995)	1.015
		95% Modified-t UCL (Johnson-1978)	1.061

Gamma GOF Test

A-D Test Statistic	0.391	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.208	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.91	k star (bias corrected MLE)	3.066
Theta hat (MLE)	0.132	Theta star (bias corrected MLE)	0.254
nu hat (MLE)	70.92	nu star (bias corrected)	36.8
MLE Mean (bias corrected)	0.78	MLE Sd (bias corrected)	0.445
		Approximate Chi Square Value (0.05)	23.91
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	20.24

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1.2	95% Adjusted Gamma UCL (use when n<50)	1.418

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.89	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.206	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-0.892			Mean of logged Data	-0.335		
65					Maximum of Logged Data	0.182			SD of logged Data	0.466		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	1.359			90% Chebyshev (MVUE) UCL	1.228		
69					95% Chebyshev (MVUE) UCL	1.43			97.5% Chebyshev (MVUE) UCL	1.711		
70					99% Chebyshev (MVUE) UCL	2.262						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	1.009			95% Jackknife UCL	1.06		
77					95% Standard Bootstrap UCL	0.991			95% Bootstrap-t UCL	1.081		
78					95% Hall's Bootstrap UCL	0.962			95% Percentile Bootstrap UCL	0.992		
79					95% BCA Bootstrap UCL	0.993						
80					90% Chebyshev(Mean, Sd) UCL	1.197			95% Chebyshev(Mean, Sd) UCL	1.386		
81					97.5% Chebyshev(Mean, Sd) UCL	1.648			99% Chebyshev(Mean, Sd) UCL	2.163		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	1.06						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/30/2019 2:55:51 PM										
5	From File	mw12r_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**1,2-DCP**											
12												
13	**General Statistics**											
14	Total Number of Observations	6				Number of Distinct Observations	6					
15						Number of Missing Observations	0					
16	Minimum	0.081				Mean	0.407					
17	Maximum	1.3				Median	0.245					
18	SD	0.46				Std. Error of Mean	0.188					
19	Coefficient of Variation	1.131				Skewness	1.962					
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.754				**Shapiro Wilk GOF Test**						
28	5% Shapiro Wilk Critical Value	0.788				Data Not Normal at 5% Significance Level						
29	Lilliefors Test Statistic	0.296				**Lilliefors GOF Test**						
30	5% Lilliefors Critical Value	0.325				Data appear Normal at 5% Significance Level						
31	**Data appear Approximate Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
35	95% Student's-t UCL	0.785				95% Adjusted-CLT UCL (Chen-1995)	0.877					
36						95% Modified-t UCL (Johnson-1978)	0.81					
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.365				**Anderson-Darling Gamma GOF Test**						
40	5% A-D Critical Value	0.712				Detected data appear Gamma Distributed at 5% Significance Level						
41	K-S Test Statistic	0.235				**Kolmogorov-Smirnov Gamma GOF Test**						
42	5% K-S Critical Value	0.339				Detected data appear Gamma Distributed at 5% Significance Level						
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	1.231				k star (bias corrected MLE)	0.727					
47	Theta hat (MLE)	0.33				Theta star (bias corrected MLE)	0.56					
48	nu hat (MLE)	14.77				nu star (bias corrected)	8.72					
49	MLE Mean (bias corrected)	0.407				MLE Sd (bias corrected)	0.477					
50						Approximate Chi Square Value (0.05)	3.158					
51	Adjusted Level of Significance	0.0122				Adjusted Chi Square Value	2.079					
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	1.123				95% Adjusted Gamma UCL (use when n<50)	1.706					
55												

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.201	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-2.513			Mean of logged Data	-1.358		
65					Maximum of Logged Data	0.262			SD of logged Data	1.022		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	2.964			90% Chebyshev (MVUE) UCL	0.865		
69					95% Chebyshev (MVUE) UCL	1.081			97.5% Chebyshev (MVUE) UCL	1.381		
70					99% Chebyshev (MVUE) UCL	1.971						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.716			95% Jackknife UCL	0.785		
77					95% Standard Bootstrap UCL	0.689			95% Bootstrap-t UCL	1.276		
78					95% Hall's Bootstrap UCL	1.863			95% Percentile Bootstrap UCL	0.745		
79					95% BCA Bootstrap UCL	0.82						
80					90% Chebyshev(Mean, Sd) UCL	0.97			95% Chebyshev(Mean, Sd) UCL	1.226		
81					97.5% Chebyshev(Mean, Sd) UCL	1.58			99% Chebyshev(Mean, Sd) UCL	2.276		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.785						
85												
86	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
87	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
88												
89	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
90	Recommendations are based upon data size, data distribution, and skewness.											
91	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
92	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
93												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 2:56:56 PM
From File	mw12r_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Benzene

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	7.0000E-4	Mean	0.00445
Maximum	0.014	Median	0.003
SD	0.00497	Std. Error of Mean	0.00203
Coefficient of Variation	1.118	Skewness	1.86

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.785	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.289	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.00854	95% Adjusted-CLT UCL (Chen-1995)	0.00944
		95% Modified-t UCL (Johnson-1978)	0.0088

Gamma GOF Test

A-D Test Statistic	0.27	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.713	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.164	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.34	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.142	k star (bias corrected MLE)	0.682
Theta hat (MLE)	0.0039	Theta star (bias corrected MLE)	0.00652
nu hat (MLE)	13.71	nu star (bias corrected)	8.188
MLE Mean (bias corrected)	0.00445	MLE Sd (bias corrected)	0.00539
		Approximate Chi Square Value (0.05)	2.844
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	1.837

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0128	95% Adjusted Gamma UCL (use when n<50)	0.0198

56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.968	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.149	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-7.264	Mean of logged Data	-5.913				
65					Maximum of Logged Data	-4.269	SD of logged Data	1.108				
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.0467	90% Chebyshev (MVUE) UCL	0.0102				
69					95% Chebyshev (MVUE) UCL	0.0128	97.5% Chebyshev (MVUE) UCL	0.0164				
70					99% Chebyshev (MVUE) UCL	0.0236						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.00779	95% Jackknife UCL	0.00854				
77					95% Standard Bootstrap UCL	0.00754	95% Bootstrap-t UCL	0.0126				
78					95% Hall's Bootstrap UCL	0.0201	95% Percentile Bootstrap UCL	0.00795				
79					95% BCA Bootstrap UCL	0.00878						
80					90% Chebyshev(Mean, Sd) UCL	0.0105	95% Chebyshev(Mean, Sd) UCL	0.0133				
81					97.5% Chebyshev(Mean, Sd) UCL	0.0171	99% Chebyshev(Mean, Sd) UCL	0.0247				
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.00854						
85												
86	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
87	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
88												
89	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
90	Recommendations are based upon data size, data distribution, and skewness.											
91	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
92	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
93												

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/30/2019 2:57:43 PM										
5	From File	mw12r_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**Chlorobenzene**											
12												
13	**General Statistics**											
14	Total Number of Observations	6			Number of Distinct Observations	6						
15					Number of Missing Observations	0						
16	Minimum	0.028			Mean	0.0967						
17	Maximum	0.16			Median	0.094						
18	SD	0.0466			Std. Error of Mean	0.019						
19	Coefficient of Variation	0.483			Skewness	-0.143						
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.983			**Shapiro Wilk GOF Test**							
28	5% Shapiro Wilk Critical Value	0.788			Data appear Normal at 5% Significance Level							
29	Lilliefors Test Statistic	0.155			**Lilliefors GOF Test**							
30	5% Lilliefors Critical Value	0.325			Data appear Normal at 5% Significance Level							
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**							
35	95% Student's-t UCL	0.135			95% Adjusted-CLT UCL (Chen-1995)	0.127						
36					95% Modified-t UCL (Johnson-1978)	0.135						
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.281			**Anderson-Darling Gamma GOF Test**							
40	5% A-D Critical Value	0.7			Detected data appear Gamma Distributed at 5% Significance Level							
41	K-S Test Statistic	0.202			**Kolmogorov-Smirnov Gamma GOF Test**							
42	5% K-S Critical Value	0.334			Detected data appear Gamma Distributed at 5% Significance Level							
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	3.949			k star (bias corrected MLE)	2.086						
47	Theta hat (MLE)	0.0245			Theta star (bias corrected MLE)	0.0463						
48	nu hat (MLE)	47.39			nu star (bias corrected)	25.03						
49	MLE Mean (bias corrected)	0.0967			MLE Sd (bias corrected)	0.0669						
50					Approximate Chi Square Value (0.05)	14.63						
51	Adjusted Level of Significance	0.0122			Adjusted Chi Square Value	11.87						
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	0.165			95% Adjusted Gamma UCL (use when n<50)	0.204						
55												

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.899	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.247	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-3.576			Mean of logged Data	-2.468		
65					Maximum of Logged Data	-1.833			SD of logged Data	0.618		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.231			90% Chebyshev (MVUE) UCL	0.174		
69					95% Chebyshev (MVUE) UCL	0.207			97.5% Chebyshev (MVUE) UCL	0.254		
70					99% Chebyshev (MVUE) UCL	0.346						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.128			95% Jackknife UCL	0.135		
77					95% Standard Bootstrap UCL	0.126			95% Bootstrap-t UCL	0.136		
78					95% Hall's Bootstrap UCL	0.13			95% Percentile Bootstrap UCL	0.126		
79					95% BCA Bootstrap UCL	0.123						
80					90% Chebyshev(Mean, Sd) UCL	0.154			95% Chebyshev(Mean, Sd) UCL	0.18		
81					97.5% Chebyshev(Mean, Sd) UCL	0.216			99% Chebyshev(Mean, Sd) UCL	0.286		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.135						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/30/2019 3:01:17 PM										
5	From File	mw12r_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**Arsenic**											
12												
13	**General Statistics**											
14	Total Number of Observations	6			Number of Distinct Observations	6						
15					Number of Missing Observations	0						
16	Minimum	0.0687			Mean	0.108						
17	Maximum	0.147			Median	0.104						
18	SD	0.0322			Std. Error of Mean	0.0132						
19	Coefficient of Variation	0.3			Skewness	0.144						
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.917			**Shapiro Wilk GOF Test**							
28	5% Shapiro Wilk Critical Value	0.788			Data appear Normal at 5% Significance Level							
29	Lilliefors Test Statistic	0.216			**Lilliefors GOF Test**							
30	5% Lilliefors Critical Value	0.325			Data appear Normal at 5% Significance Level							
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**							
35	95% Student's-t UCL	0.134			95% Adjusted-CLT UCL (Chen-1995)	0.13						
36					95% Modified-t UCL (Johnson-1978)	0.134						
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.325			**Anderson-Darling Gamma GOF Test**							
40	5% A-D Critical Value	0.698			Detected data appear Gamma Distributed at 5% Significance Level							
41	K-S Test Statistic	0.214			**Kolmogorov-Smirnov Gamma GOF Test**							
42	5% K-S Critical Value	0.332			Detected data appear Gamma Distributed at 5% Significance Level							
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	13.06			k star (bias corrected MLE)	6.64						
47	Theta hat (MLE)	0.00824			Theta star (bias corrected MLE)	0.0162						
48	nu hat (MLE)	156.7			nu star (bias corrected)	79.68						
49	MLE Mean (bias corrected)	0.108			MLE Sd (bias corrected)	0.0417						
50					Approximate Chi Square Value (0.05)	60.12						
51	Adjusted Level of Significance	0.0122			Adjusted Chi Square Value	54.02						
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	0.143			95% Adjusted Gamma UCL (use when n<50)	0.159						
55												

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.926	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.186	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-2.678			Mean of logged Data	-2.269		
65					Maximum of Logged Data	-1.917			SD of logged Data	0.308		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.148			90% Chebyshev (MVUE) UCL	0.148		
69					95% Chebyshev (MVUE) UCL	0.167			97.5% Chebyshev (MVUE) UCL	0.192		
70					99% Chebyshev (MVUE) UCL	0.242						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.129			95% Jackknife UCL	0.134		
77					95% Standard Bootstrap UCL	0.127			95% Bootstrap-t UCL	0.144		
78					95% Hall's Bootstrap UCL	0.128			95% Percentile Bootstrap UCL	0.128		
79					95% BCA Bootstrap UCL	0.129						
80					90% Chebyshev(Mean, Sd) UCL	0.147			95% Chebyshev(Mean, Sd) UCL	0.165		
81					97.5% Chebyshev(Mean, Sd) UCL	0.19			99% Chebyshev(Mean, Sd) UCL	0.238		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.134						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-12R**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

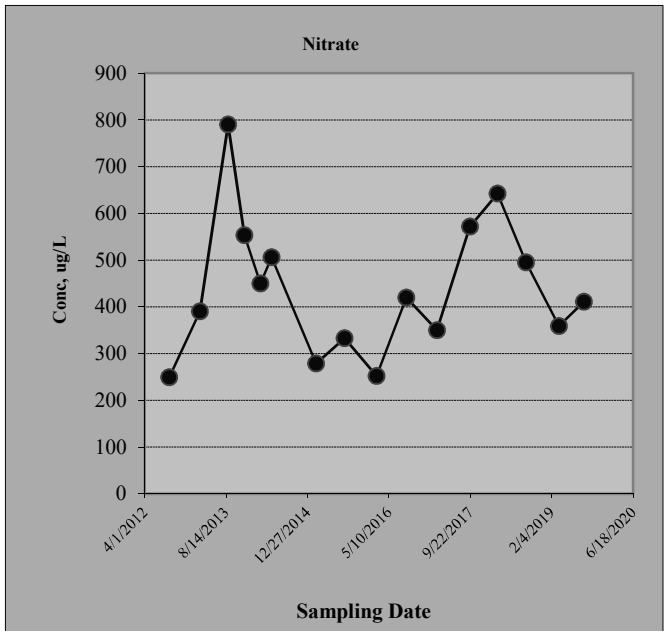
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Nitrate	Dinoseb	Benzene	Chlorobenzene	1,2-DCP	Arsenic
#1	8/30/2012	249	1.5	0.008	0.25	0.67	0.323
#2	3/6/2013	390	1.6	0.011	0.23	0.67	0.377
#3	8/27/2013	790	5.3	0.028	0.48	2.4	0.0181
#4	12/4/2013	553	2.6	0.027	0.45	2.6	0.0127
#5	3/12/2014	450	1.6	0.016	0.38	1.2	0.105
#6	5/21/2014	506	1.5	0.02	0.45	1.6	0.0389
#7	2/19/2015	279	0.73	0.006	0.16	0.55	0.0299
#8	8/12/2015	333	2.9	0.011	0.21	1.1	0.0608
#9	2/24/2016	252	0.22	0.002	0.1	0.16	0.185
#10	8/25/2016	420	0.97	0.009	0.19	0.69	0.0228
#11	3/2/2017	350	0.41	0.0007	0.028	0.15	0.147
#12	9/21/2017	572	0.92	0.004	0.13	0.34	0.0825
#13	3/8/2018	642	0.61	0.001	0.074	0.081	0.14
#14	8/30/2018	495	1.1	0.005	0.11	0.45	0.0891
#15	3/21/2019	359	0.44	0.002	0.078	0.12	0.118
#16	8/22/2019	411	1.2	0.014	0.16	1.3	0.0687

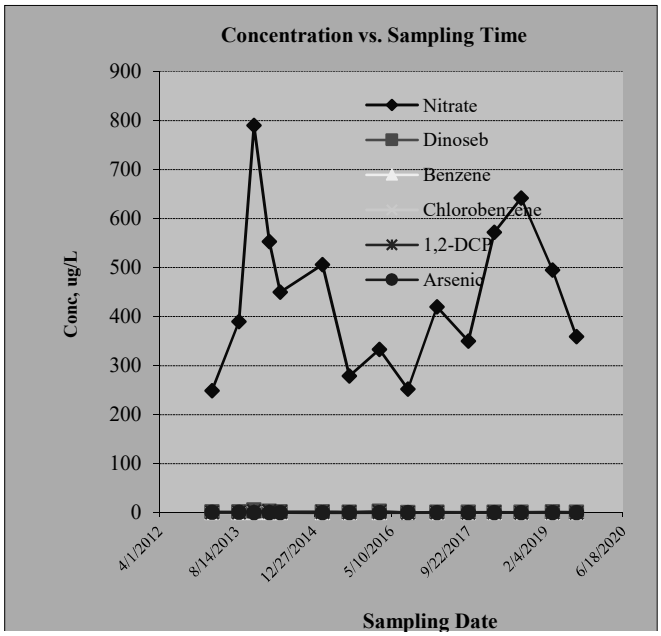
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Nitrate**	**Dinoseb**	**Benzene**	**Chlorobenzene**	**1,2-DCP**	**Arsenic**
Confidence Level Calculated?	62.20%	97.90%	98.40%	99.90%	97.90%	55.30%
Plume Stability?	Stable	Shrinking	Shrinking	Shrinking	Shrinking	Stable
Coefficient of Variation?	CV <= 1					CV <= 1
Mann-Kendall Statistic "S" value?	8	-46	-48	-66	-47	4
Number of Sampling Rounds?	16	16	16	16	16	16
Average Concentration?	440.69	1.48	0.01	0.22	0.88	0.11
Standard Deviation?	148.00	1.26	0.01	0.15	0.78	0.11
Coefficient of Variation?	0.34	0.85	0.85	0.67	0.88	0.93
Blank if No Errors found						

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Nitrate**
Plume Stability? **Stable**





MW-13

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/30/2019 3:19:08 PM										
5	From File	mw13_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**Nitrate**											
12												
13	**General Statistics**											
14	Total Number of Observations	6					Number of Distinct Observations	6				
15							Number of Missing Observations	0				
16	Minimum	23.9					Mean	27.9				
17	Maximum	34.6					Median	27.2				
18	SD	4.184					Std. Error of Mean	1.708				
19	Coefficient of Variation	0.15					Skewness	0.761				
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.887					**Shapiro Wilk GOF Test**					
28	5% Shapiro Wilk Critical Value	0.788					Data appear Normal at 5% Significance Level					
29	Lilliefors Test Statistic	0.256					**Lilliefors GOF Test**					
30	5% Lilliefors Critical Value	0.325					Data appear Normal at 5% Significance Level					
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
35	95% Student's-t UCL	31.34					95% Adjusted-CLT UCL (Chen-1995)	31.28				
36							95% Modified-t UCL (Johnson-1978)	31.43				
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.42					**Anderson-Darling Gamma GOF Test**					
40	5% A-D Critical Value	0.697					Detected data appear Gamma Distributed at 5% Significance Level					
41	K-S Test Statistic	0.276					**Kolmogorov-Smirnov Gamma GOF Test**					
42	5% K-S Critical Value	0.332					Detected data appear Gamma Distributed at 5% Significance Level					
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	55.43					k star (bias corrected MLE)	27.83				
47	Theta hat (MLE)	0.503					Theta star (bias corrected MLE)	1.003				
48	nu hat (MLE)	665.1					nu star (bias corrected)	333.9				
49	MLE Mean (bias corrected)	27.9					MLE Sd (bias corrected)	5.289				
50							Approximate Chi Square Value (0.05)	292.6				
51	Adjusted Level of Significance	0.0122					Adjusted Chi Square Value	278.5				
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	31.84					95% Adjusted Gamma UCL (use when n<50)	33.45				
55												

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.894	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.255	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	3.174			Mean of logged Data	3.32		
65					Maximum of Logged Data	3.544			SD of logged Data	0.146		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	31.84			90% Chebyshev (MVUE) UCL	32.89		
69					95% Chebyshev (MVUE) UCL	35.15			97.5% Chebyshev (MVUE) UCL	38.29		
70					99% Chebyshev (MVUE) UCL	44.45						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	30.71			95% Jackknife UCL	31.34		
77					95% Standard Bootstrap UCL	30.48			95% Bootstrap-t UCL	32.62		
78					95% Hall's Bootstrap UCL	30.45			95% Percentile Bootstrap UCL	30.5		
79					95% BCA Bootstrap UCL	30.7						
80					90% Chebyshev(Mean, Sd) UCL	33.02			95% Chebyshev(Mean, Sd) UCL	35.35		
81					97.5% Chebyshev(Mean, Sd) UCL	38.57			99% Chebyshev(Mean, Sd) UCL	44.89		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	31.34						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/30/2019 3:19:56 PM										
5	From File	mw13_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**Dinoseb**											
12												
13	**General Statistics**											
14	Total Number of Observations	6					Number of Distinct Observations	6				
15							Number of Missing Observations	0				
16	Minimum	0.0013					Mean	0.00492				
17	Maximum	0.0073					Median	0.0054				
18	SD	0.0021					Std. Error of Mean	8.5573E-4				
19	Coefficient of Variation	0.426					Skewness	-1.04				
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.936					**Shapiro Wilk GOF Test**					
28	5% Shapiro Wilk Critical Value	0.788					Data appear Normal at 5% Significance Level					
29	Lilliefors Test Statistic	0.181					**Lilliefors GOF Test**					
30	5% Lilliefors Critical Value	0.325					Data appear Normal at 5% Significance Level					
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
35	95% Student's-t UCL	0.00664					95% Adjusted-CLT UCL (Chen-1995)	0.00594				
36							95% Modified-t UCL (Johnson-1978)	0.00658				
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.534					**Anderson-Darling Gamma GOF Test**					
40	5% A-D Critical Value	0.7					Detected data appear Gamma Distributed at 5% Significance Level					
41	K-S Test Statistic	0.238					**Kolmogorov-Smirnov Gamma GOF Test**					
42	5% K-S Critical Value	0.333					Detected data appear Gamma Distributed at 5% Significance Level					
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	4.177					k star (bias corrected MLE)	2.199				
47	Theta hat (MLE)	0.00118					Theta star (bias corrected MLE)	0.00224				
48	nu hat (MLE)	50.12					nu star (bias corrected)	26.39				
49	MLE Mean (bias corrected)	0.00492					MLE Sd (bias corrected)	0.00332				
50							Approximate Chi Square Value (0.05)	15.68				
51	Adjusted Level of Significance	0.0122					Adjusted Chi Square Value	12.8				
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	0.00827					95% Adjusted Gamma UCL (use when n<50)	0.0101				
55												

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.792	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.281	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-6.645			Mean of logged Data	-5.44		
65					Maximum of Logged Data	-4.92			SD of logged Data	0.625		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.0121			90% Chebyshev (MVUE) UCL	0.00898		
69					95% Chebyshev (MVUE) UCL	0.0107			97.5% Chebyshev (MVUE) UCL	0.0132		
70					99% Chebyshev (MVUE) UCL	0.018						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.00632			95% Jackknife UCL	0.00664		
77					95% Standard Bootstrap UCL	0.0062			95% Bootstrap-t UCL	0.00629		
78					95% Hall's Bootstrap UCL	0.00599			95% Percentile Bootstrap UCL	0.00612		
79					95% BCA Bootstrap UCL	0.00592						
80					90% Chebyshev(Mean, Sd) UCL	0.00748			95% Chebyshev(Mean, Sd) UCL	0.00865		
81					97.5% Chebyshev(Mean, Sd) UCL	0.0103			99% Chebyshev(Mean, Sd) UCL	0.0134		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.00664						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-13**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

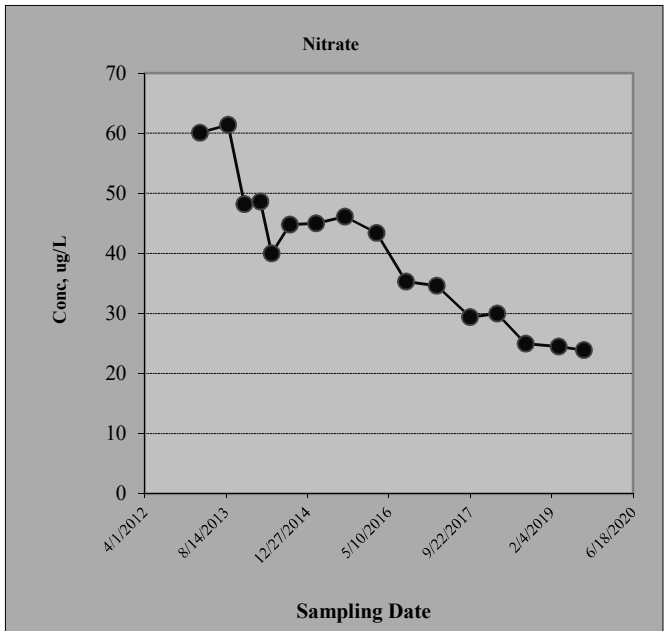
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Nitrate	Dinoseb				
#1	3/6/2013	60.1	0.0075				
#2	8/27/2013	61.4	0.0096				
#3	12/5/2013	48.2	0.014				
#4	3/12/2014	48.6	0.0076				
#5	5/21/2014	40	0.0078				
#6	9/9/2014	44.8	0.012				
#7	2/18/2015	45	0.0081				
#8	8/13/2015	46.1	0.0067				
#9	2/25/2016	43.4	0.0055				
#10	8/24/2016	35.3	0.0048				
#11	3/1/2017	34.6	0.0013				
#12	9/20/2017	29.4	0.0073				
#13	3/7/2018	30	0.0059				
#14	8/29/2018	25	0.0061				
#15	3/20/2019	24.5	0.004				
#16	8/21/2019	23.9	0.0049				

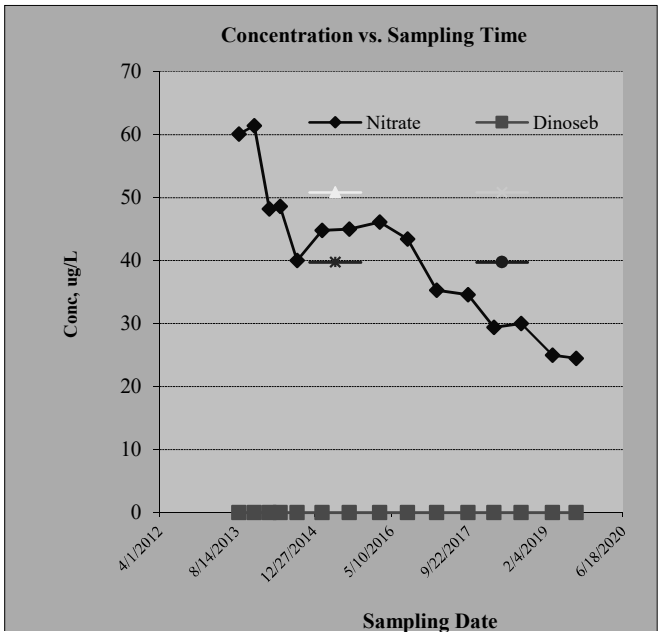
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Nitrate**	**Dinoseb**				
Confidence Level Calculated?	100.00%	99.90%	NA	NA	NA	NA
Plume Stability?	Shrinking	Shrinking	NA	NA	NA	NA
Coefficient of Variation?			n<4	n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	-100	-64	0	0	0	0
Number of Sampling Rounds?	16	16	0	0	0	0
Average Concentration?	40.02	0.01	NA	NA	NA	NA
Standard Deviation?	11.80	0.00	NA	NA	NA	NA
Coefficient of Variation?	0.29	0.43	NA	NA	NA	NA
Blank if No Errors found			n<4	n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Nitrate**
Plume Stability? **Shrinking**





MW-14

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/31/2019 10:35:17 AM										
5	From File	mw14_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**Nitrate**											
12												
13	**General Statistics**											
14	Total Number of Observations	6			Number of Distinct Observations	6						
15					Number of Missing Observations	0						
16	Minimum	3			Mean	4.433						
17	Maximum	7.8			Median	3.7						
18	SD	1.87			Std. Error of Mean	0.764						
19	Coefficient of Variation	0.422			Skewness	1.449						
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.822			**Shapiro Wilk GOF Test**							
28	5% Shapiro Wilk Critical Value	0.788			Data appear Normal at 5% Significance Level							
29	Lilliefors Test Statistic	0.245			**Lilliefors GOF Test**							
30	5% Lilliefors Critical Value	0.325			Data appear Normal at 5% Significance Level							
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**							
35	95% Student's-t UCL	5.972			95% Adjusted-CLT UCL (Chen-1995)	6.172						
36					95% Modified-t UCL (Johnson-1978)	6.047						
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.485			**Anderson-Darling Gamma GOF Test**							
40	5% A-D Critical Value	0.698			Detected data appear Gamma Distributed at 5% Significance Level							
41	K-S Test Statistic	0.274			**Kolmogorov-Smirnov Gamma GOF Test**							
42	5% K-S Critical Value	0.333			Detected data appear Gamma Distributed at 5% Significance Level							
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	7.959			k star (bias corrected MLE)	4.09						
47	Theta hat (MLE)	0.557			Theta star (bias corrected MLE)	1.084						
48	nu hat (MLE)	95.5			nu star (bias corrected)	49.09						
49	MLE Mean (bias corrected)	4.433			MLE Sd (bias corrected)	2.192						
50					Approximate Chi Square Value (0.05)	34						
51	Adjusted Level of Significance	0.0122			Adjusted Chi Square Value	29.54						
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	6.4			95% Adjusted Gamma UCL (use when n<50)	7.367						
55												

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.869	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.256	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	1.099			Mean of logged Data	1.425		
65					Maximum of Logged Data	2.054			SD of logged Data	0.378		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	6.673			90% Chebyshev (MVUE) UCL	6.455		
69					95% Chebyshev (MVUE) UCL	7.381			97.5% Chebyshev (MVUE) UCL	8.666		
70					99% Chebyshev (MVUE) UCL	11.19						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	5.689			95% Jackknife UCL	5.972		
77					95% Standard Bootstrap UCL	5.552			95% Bootstrap-t UCL	7.606		
78					95% Hall's Bootstrap UCL	11.12			95% Percentile Bootstrap UCL	5.767		
79					95% BCA Bootstrap UCL	5.983						
80					90% Chebyshev(Mean, Sd) UCL	6.724			95% Chebyshev(Mean, Sd) UCL	7.762		
81					97.5% Chebyshev(Mean, Sd) UCL	9.202			99% Chebyshev(Mean, Sd) UCL	12.03		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	5.972						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 3:30:07 PM
From File	mw14_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
Number of Detects	3	Number of Non-Detects	3
Number of Distinct Detects	3	Number of Distinct Non-Detects	2
Minimum Detect	0.0105	Minimum Non-Detect	0.013
Maximum Detect	0.0163	Maximum Non-Detect	0.016
Variance Detects	8.8133E-6	Percent Non-Detects	50%
Mean Detects	0.0138	SD Detects	0.00297
Median Detects	0.0145	CV Detects	0.216
Skewness Detects	-1.044	Kurtosis Detects	N/A
Mean of Logged Detects	-4.302	SD of Logged Detects	0.228

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.954	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.264	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0126	KM Standard Error of Mean	0.00139
KM SD	0.00239	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0154	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0149	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0167	95% KM Chebyshev UCL	0.0186
97.5% KM Chebyshev UCL	0.0212	99% KM Chebyshev UCL	0.0264

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	30.13	k star (bias corrected MLE)	N/A
Theta hat (MLE)	4.5693E-4	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	180.8	nu star (bias corrected)	N/A
Mean (detects)	0.0138		

56												
57	**Gamma ROS Statistics using Imputed Non-Detects**											
58	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
59	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)											
60	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
61	This is especially true when the sample size is small.											
62	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
63					Minimum	0.0105			Mean	0.0126		
64					Maximum	0.0163			Median	0.0118		
65					SD	0.00238			CV	0.188		
66					k hat (MLE)	35.46			k star (bias corrected MLE)	17.84		
67					Theta hat (MLE)	3.5575E-4			Theta star (bias corrected MLE)	7.0707E-4		
68					nu hat (MLE)	425.5			nu star (bias corrected)	214.1		
69					Adjusted Level of Significance (β)	0.0122						
70					Approximate Chi Square Value (214.08, α)	181.2			Adjusted Chi Square Value (214.08, β)	170.2		
71					95% Gamma Approximate UCL (use when n>=50)	0.0149			95% Gamma Adjusted UCL (use when n<50)	N/A		
72												
73	**Estimates of Gamma Parameters using KM Estimates**											
74					Mean (KM)	0.0126			SD (KM)	0.00239		
75					Variance (KM)	5.7340E-6			SE of Mean (KM)	0.00139		
76					k hat (KM)	27.59			k star (KM)	13.91		
77					nu hat (KM)	331.1			nu star (KM)	166.9		
78					theta hat (KM)	4.5588E-4			theta star (KM)	9.0447E-4		
79					80% gamma percentile (KM)	0.0153			90% gamma percentile (KM)	0.017		
80					95% gamma percentile (KM)	0.0186			99% gamma percentile (KM)	0.0217		
81												
82	**Gamma Kaplan-Meier (KM) Statistics**											
83					Approximate Chi Square Value (166.87, α)	138			Adjusted Chi Square Value (166.87, β)	128.5		
84					95% Gamma Approximate KM-UCL (use when n>=50)	0.0152			95% Gamma Adjusted KM-UCL (use when n<50)	0.0163		
85												
86	**Lognormal GOF Test on Detected Observations Only**											
87					Shapiro Wilk Test Statistic	0.932			**Shapiro Wilk GOF Test**			
88					5% Shapiro Wilk Critical Value	0.767			Detected Data appear Lognormal at 5% Significance Level			
89					Lilliefors Test Statistic	0.285			**Lilliefors GOF Test**			
90					5% Lilliefors Critical Value	0.425			Detected Data appear Lognormal at 5% Significance Level			
91	**Detected Data appear Lognormal at 5% Significance Level**											
92												
93	**Lognormal ROS Statistics Using Imputed Non-Detects**											
94					Mean in Original Scale	0.0126			Mean in Log Scale	-4.39		
95					SD in Original Scale	0.00239			SD in Log Scale	0.184		
96					95% t UCL (assumes normality of ROS data)	0.0145			95% Percentile Bootstrap UCL	0.0141		
97					95% BCA Bootstrap UCL	0.0142			95% Bootstrap t UCL	0.0154		
98					95% H-UCL (Log ROS)	0.0149						
99												
100	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
101					KM Mean (logged)	-4.393			KM Geo Mean	0.0124		
102					KM SD (logged)	0.186			95% Critical H Value (KM-Log)	2.05		
103					KM Standard Error of Mean (logged)	0.109			95% H-UCL (KM -Log)	0.0149		
104					KM SD (logged)	0.186			95% Critical H Value (KM-Log)	2.05		
105					KM Standard Error of Mean (logged)	0.109						
106												
107	**DL/2 Statistics**											
108	**DL/2 Normal**								**DL/2 Log-Transformed**			
109					Mean in Original Scale	0.0106			Mean in Log Scale	-4.6		
110					SD in Original Scale	0.00395			SD in Log Scale	0.364		

	A	B	C	D	E	F	G	H	I	J	K	L
111				95% t UCL (Assumes normality)		0.0139					95% H-Stat UCL	0.0157
112	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
113												
114	**Nonparametric Distribution Free UCL Statistics**											
115	**Detected Data appear Normal Distributed at 5% Significance Level**											
116												
117	**Suggested UCL to Use**											
118					95% KM (t) UCL	0.0154						
119												
120	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
121	Recommendations are based upon data size, data distribution, and skewness.											
122	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
123	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
124												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-14**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

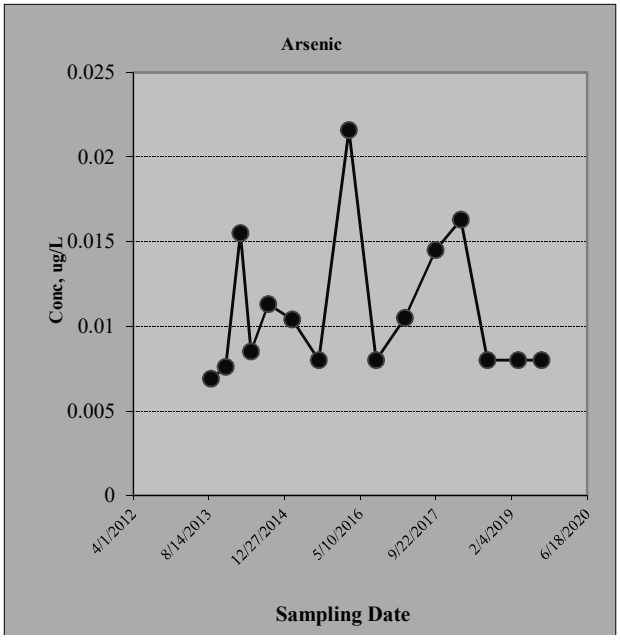
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Arsenic					
#1	8/28/2013	0.0069					
#2	12/3/2013	0.0076					
#3	3/11/2014	0.0155					
#4	5/20/2014	0.0085					
#5	9/10/2014	0.0113					
#6	2/17/2015	0.0104					
#7	8/11/2015	0.008					
#8	2/25/2016	0.0216					
#9	8/24/2016	0.008					
#10	3/2/2017	0.0105					
#11	9/20/2017	0.0145					
#12	3/6/2018	0.0163					
#13	8/28/2018	0.008					
#14	3/20/2019	0.008					
#15	8/22/2019	0.008					
#16							

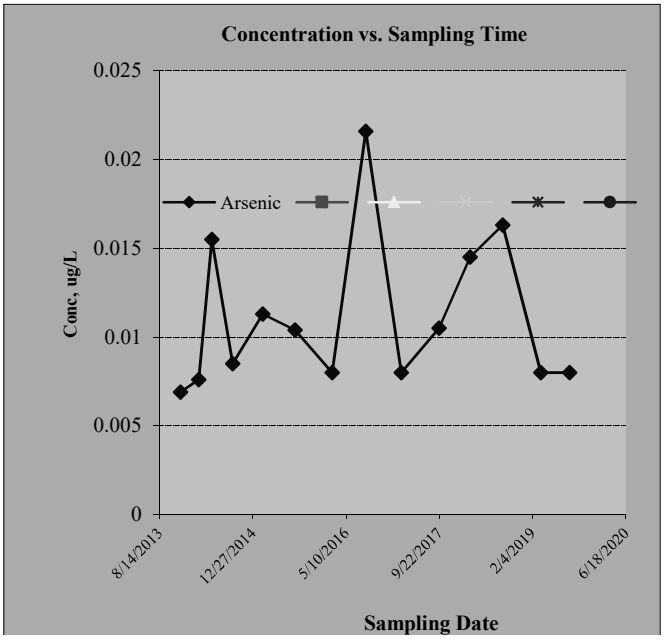
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Arsenic**					
Confidence Level Calculated?	65.10%	NA	NA	NA	NA	NA
Plume Stability?	Stable	NA	NA	NA	NA	NA
Coefficient of Variation?	CV <= 1	n<4	n<4	n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	9	0	0	0	0	0
Number of Sampling Rounds?	15	0	0	0	0	0
Average Concentration?	0.01	NA	NA	NA	NA	NA
Standard Deviation?	0.00	NA	NA	NA	NA	NA
Coefficient of Variation?	0.39	NA	NA	NA	NA	NA
Blank if No Errors found		n<4	n<4	n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Arsenic**
Plume Stability? **Stable**





MW-15

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/31/2019 10:29:29 AM										
5	From File	mw15_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**Nitrate**											
12												
13	**General Statistics**											
14	Total Number of Observations	6			Number of Distinct Observations	4						
15					Number of Missing Observations	0						
16	Minimum	3.5			Mean	3.9						
17	Maximum	4.2			Median	4.05						
18	SD	0.316			Std. Error of Mean	0.129						
19	Coefficient of Variation	0.0811			Skewness	-0.797						
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.787			**Shapiro Wilk GOF Test**							
28	5% Shapiro Wilk Critical Value	0.788			Data Not Normal at 5% Significance Level							
29	Lilliefors Test Statistic	0.291			**Lilliefors GOF Test**							
30	5% Lilliefors Critical Value	0.325			Data appear Normal at 5% Significance Level							
31	**Data appear Approximate Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**							
35	95% Student's-t UCL	4.16			95% Adjusted-CLT UCL (Chen-1995)	4.067						
36					95% Modified-t UCL (Johnson-1978)	4.153						
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.763			**Anderson-Darling Gamma GOF Test**							
40	5% A-D Critical Value	0.696			Data Not Gamma Distributed at 5% Significance Level							
41	K-S Test Statistic	0.308			**Kolmogorov-Smirnov Gamma GOF Test**							
42	5% K-S Critical Value	0.332			Detected data appear Gamma Distributed at 5% Significance Level							
43	**Detected data follow Appr. Gamma Distribution at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	176.8			k star (bias corrected MLE)	88.53						
47	Theta hat (MLE)	0.0221			Theta star (bias corrected MLE)	0.0441						
48	nu hat (MLE)	2122			nu star (bias corrected)	1062						
49	MLE Mean (bias corrected)	3.9			MLE Sd (bias corrected)	0.414						
50					Approximate Chi Square Value (0.05)	987.7						
51	Adjusted Level of Significance	0.0122			Adjusted Chi Square Value	961.4						
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	4.195			95% Adjusted Gamma UCL (use when n<50)	4.31						
55												

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.778	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data Not Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.299	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Approximate Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	1.253	Mean of logged Data	1.358				
65					Maximum of Logged Data	1.435	SD of logged Data	0.0831				
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	4.297				
69					95% Chebyshev (MVUE) UCL	4.477	97.5% Chebyshev (MVUE) UCL	4.726				
70					99% Chebyshev (MVUE) UCL	5.216						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	4.112	95% Jackknife UCL	4.16				
77					95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A				
78					95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A				
79					95% BCA Bootstrap UCL	N/A						
80					90% Chebyshev(Mean, Sd) UCL	4.287	95% Chebyshev(Mean, Sd) UCL	4.463				
81					97.5% Chebyshev(Mean, Sd) UCL	4.706	99% Chebyshev(Mean, Sd) UCL	5.185				
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	4.16						
85												
86	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
87	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
88												
89	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
90	Recommendations are based upon data size, data distribution, and skewness.											
91	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
92	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
93												
94	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
95	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
96												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.110/30/2019 3:46:18 PM
From File	mw15_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	1
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.0129	Minimum Non-Detect	0.016
Maximum Detect	0.0227	Maximum Non-Detect	0.016
Variance Detects	2.0612E-5	Percent Non-Detects	16.67%
Mean Detects	0.0178	SD Detects	0.00454
Median Detects	0.0171	CV Detects	0.255
Skewness Detects	0.157	Kurtosis Detects	-2.858
Mean of Logged Detects	-4.054	SD of Logged Detects	0.258

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.875	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.238	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0171	KM Standard Error of Mean	0.00185
KM SD	0.00405	95% KM (BCA) UCL	0.0198
95% KM (t) UCL	0.0208	95% KM (Percentile Bootstrap) UCL	0.02
95% KM (z) UCL	0.0201	95% KM Bootstrap t UCL	0.0227
90% KM Chebyshev UCL	0.0227	95% KM Chebyshev UCL	0.0252
97.5% KM Chebyshev UCL	0.0287	99% KM Chebyshev UCL	0.0355

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.398	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.263	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	19.08	k star (bias corrected MLE)	7.765
Theta hat (MLE)	9.3399E-4	Theta star (bias corrected MLE)	0.00229
nu hat (MLE)	190.8	nu star (bias corrected)	77.65
Mean (detects)	0.0178		

56												
57	**Gamma ROS Statistics using Imputed Non-Detects**											
58	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
59	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)											
60	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
61	This is especially true when the sample size is small.											
62	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
63					Minimum	0.0129			Mean	0.0171		
64					Maximum	0.0227			Median	0.0156		
65					SD	0.00441			CV	0.258		
66					k hat (MLE)	18.81			k star (bias corrected MLE)	9.516		
67					Theta hat (MLE)	9.0997E-4			Theta star (bias corrected MLE)	0.0018		
68					nu hat (MLE)	225.7			nu star (bias corrected)	114.2		
69					Adjusted Level of Significance (β)	0.0122						
70					Approximate Chi Square Value (114.19, α)	90.52			Adjusted Chi Square Value (114.19, β)	82.92		
71					95% Gamma Approximate UCL (use when n>=50)	0.0216			95% Gamma Adjusted UCL (use when n<50)	0.0236		
72												
73	**Estimates of Gamma Parameters using KM Estimates**											
74					Mean (KM)	0.0171			SD (KM)	0.00405		
75					Variance (KM)	1.6393E-5			SE of Mean (KM)	0.00185		
76					k hat (KM)	17.84			k star (KM)	9.03		
77					nu hat (KM)	214			nu star (KM)	108.4		
78					theta hat (KM)	9.5867E-4			theta star (KM)	0.00189		
79					80% gamma percentile (KM)	0.0216			90% gamma percentile (KM)	0.0247		
80					95% gamma percentile (KM)	0.0274			99% gamma percentile (KM)	0.033		
81												
82	**Gamma Kaplan-Meier (KM) Statistics**											
83					Approximate Chi Square Value (108.36, α)	85.33			Adjusted Chi Square Value (108.36, β)	77.97		
84					95% Gamma Approximate KM-UCL (use when n>=50)	0.0217			95% Gamma Adjusted KM-UCL (use when n<50)	0.0238		
85												
86	**Lognormal GOF Test on Detected Observations Only**											
87					Shapiro Wilk Test Statistic	0.888			**Shapiro Wilk GOF Test**			
88					5% Shapiro Wilk Critical Value	0.762			Detected Data appear Lognormal at 5% Significance Level			
89					Lilliefors Test Statistic	0.234			**Lilliefors GOF Test**			
90					5% Lilliefors Critical Value	0.343			Detected Data appear Lognormal at 5% Significance Level			
91	**Detected Data appear Lognormal at 5% Significance Level**											
92												
93	**Lognormal ROS Statistics Using Imputed Non-Detects**											
94					Mean in Original Scale	0.0171			Mean in Log Scale	-4.094		
95					SD in Original Scale	0.00441			SD in Log Scale	0.251		
96					95% t UCL (assumes normality of ROS data)	0.0207			95% Percentile Bootstrap UCL	0.0199		
97					95% BCA Bootstrap UCL	0.0201			95% Bootstrap t UCL	0.0228		
98					95% H-UCL (Log ROS)	0.0219						
99												
100	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
101					KM Mean (logged)	-4.096			KM Geo Mean	0.0166		
102					KM SD (logged)	0.231			95% Critical H Value (KM-Log)	2.115		
103					KM Standard Error of Mean (logged)	0.106			95% H-UCL (KM -Log)	0.0213		
104					KM SD (logged)	0.231			95% Critical H Value (KM-Log)	2.115		
105					KM Standard Error of Mean (logged)	0.106						
106												
107	**DL/2 Statistics**											
108	**DL/2 Normal**								**DL/2 Log-Transformed**			
109					Mean in Original Scale	0.0162			Mean in Log Scale	-4.183		
110					SD in Original Scale	0.00571			SD in Log Scale	0.391		

	A	B	C	D	E	F	G	H	I	J	K	L
111				95% t UCL (Assumes normality)		0.0209					95% H-Stat UCL	0.0251
112	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
113												
114	**Nonparametric Distribution Free UCL Statistics**											
115	**Detected Data appear Normal Distributed at 5% Significance Level**											
116												
117	**Suggested UCL to Use**											
118					95% KM (t) UCL	0.0208						
119												
120	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
121	Recommendations are based upon data size, data distribution, and skewness.											
122	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
123	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
124												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-15**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

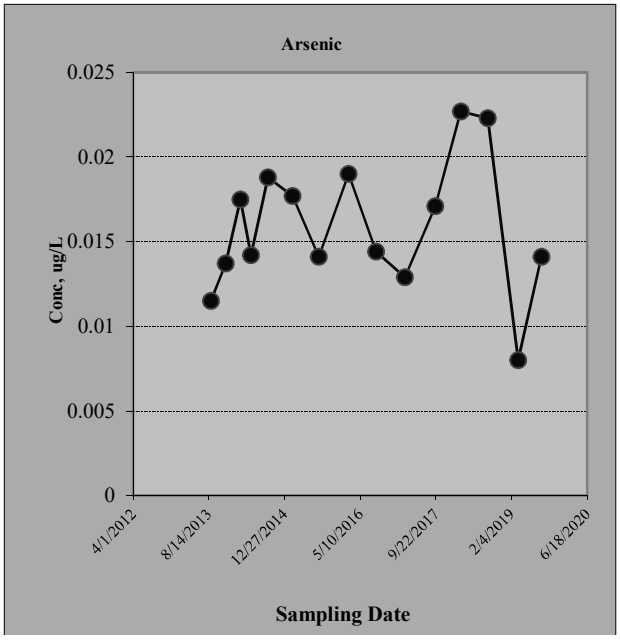
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Arsenic					
#1	8/28/2013	0.0115					
#2	12/4/2013	0.0137					
#3	3/11/2014	0.0175					
#4	5/20/2014	0.0142					
#5	9/9/2014	0.0188					
#6	2/18/2015	0.0177					
#7	8/11/2015	0.0141					
#8	2/23/2016	0.019					
#9	8/24/2016	0.0144					
#10	3/1/2017	0.0129					
#11	9/19/2017	0.0171					
#12	3/6/2018	0.0227					
#13	8/30/2018	0.0223					
#14	3/20/2019	0.008					
#15	8/20/2019	0.0141					
#16							

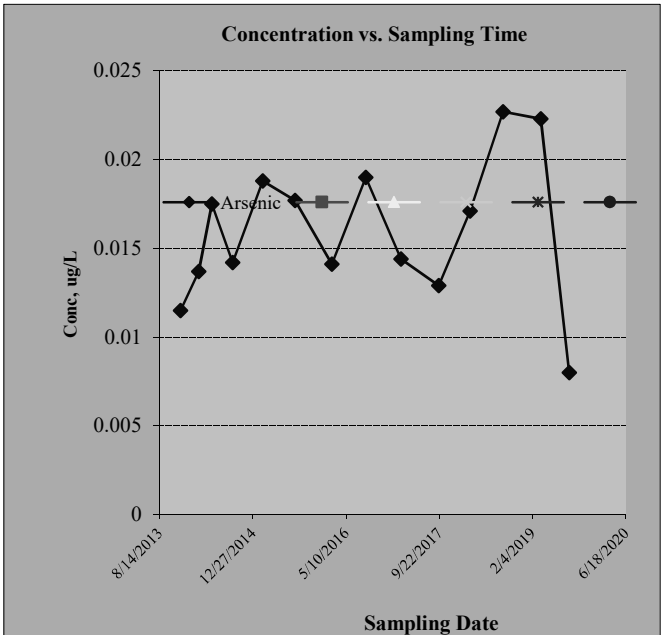
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Arsenic**					
Confidence Level Calculated?	72.10%	NA	NA	NA	NA	NA
Plume Stability?	Stable	NA	NA	NA	NA	NA
Coefficient of Variation?	CV <= 1	n<4	n<4	n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	14	0	0	0	0	0
Number of Sampling Rounds?	15	0	0	0	0	0
Average Concentration?	0.02	NA	NA	NA	NA	NA
Standard Deviation?	0.00	NA	NA	NA	NA	NA
Coefficient of Variation?	0.25	NA	NA	NA	NA	NA
Blank if No Errors found		n<4	n<4	n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Arsenic**
Plume Stability? **Stable**





MW-16

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/31/2019 8:33:52 AM
From File	mw16_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	57.3	Mean	103.6
Maximum	151	Median	102.7
SD	34.33	Std. Error of Mean	14.01
Coefficient of Variation	0.331	Skewness	0.0545

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.981	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.162	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	131.9	95% Adjusted-CLT UCL (Chen-1995)	127
		95% Modified-t UCL (Johnson-1978)	131.9

Gamma GOF Test

A-D Test Statistic	0.194	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.181	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	10.25	k star (bias corrected MLE)	5.236
Theta hat (MLE)	10.11	Theta star (bias corrected MLE)	19.79
nu hat (MLE)	123	nu star (bias corrected)	62.84
MLE Mean (bias corrected)	103.6	MLE Sd (bias corrected)	45.29
		Approximate Chi Square Value (0.05)	45.6
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	40.35

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	142.8	95% Adjusted Gamma UCL (use when n<50)	161.4

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.969	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.177	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	4.048			Mean of logged Data	4.591		
65					Maximum of Logged Data	5.017			SD of logged Data	0.353		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	151.5			90% Chebyshev (MVUE) UCL	148.7		
69					95% Chebyshev (MVUE) UCL	169.1			97.5% Chebyshev (MVUE) UCL	197.3		
70					99% Chebyshev (MVUE) UCL	252.7						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	126.7			95% Jackknife UCL	131.9		
77					95% Standard Bootstrap UCL	124.7			95% Bootstrap-t UCL	132.5		
78					95% Hall's Bootstrap UCL	126.4			95% Percentile Bootstrap UCL	125.4		
79					95% BCA Bootstrap UCL	123.9						
80					90% Chebyshev(Mean, Sd) UCL	145.7			95% Chebyshev(Mean, Sd) UCL	164.7		
81					97.5% Chebyshev(Mean, Sd) UCL	191.1			99% Chebyshev(Mean, Sd) UCL	243.1		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	131.9						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/31/2019 8:36:32 AM										
5	From File	mw16_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**Dinoseb**											
12												
13	**General Statistics**											
14	Total Number of Observations	6					Number of Distinct Observations	6				
15							Number of Missing Observations	0				
16	Minimum	0.0028					Mean	0.0128				
17	Maximum	0.021					Median	0.0145				
18	SD	0.00701					Std. Error of Mean	0.00286				
19	Coefficient of Variation	0.547					Skewness	-0.531				
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.933					**Shapiro Wilk GOF Test**					
28	5% Shapiro Wilk Critical Value	0.788					Data appear Normal at 5% Significance Level					
29	Lilliefors Test Statistic	0.234					**Lilliefors GOF Test**					
30	5% Lilliefors Critical Value	0.325					Data appear Normal at 5% Significance Level					
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
35	95% Student's-t UCL	0.0186					95% Adjusted-CLT UCL (Chen-1995)	0.0169				
36							95% Modified-t UCL (Johnson-1978)	0.0185				
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.454					**Anderson-Darling Gamma GOF Test**					
40	5% A-D Critical Value	0.702					Detected data appear Gamma Distributed at 5% Significance Level					
41	K-S Test Statistic	0.304					**Kolmogorov-Smirnov Gamma GOF Test**					
42	5% K-S Critical Value	0.335					Detected data appear Gamma Distributed at 5% Significance Level					
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	2.688					k star (bias corrected MLE)	1.455				
47	Theta hat (MLE)	0.00477					Theta star (bias corrected MLE)	0.00881				
48	nu hat (MLE)	32.25					nu star (bias corrected)	17.46				
49	MLE Mean (bias corrected)	0.0128					MLE Sd (bias corrected)	0.0106				
50							Approximate Chi Square Value (0.05)	9.001				
51	Adjusted Level of Significance	0.0122					Adjusted Chi Square Value	6.921				
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	0.0249					95% Adjusted Gamma UCL (use when n<50)	0.0323				
55												

56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.853	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.31	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-5.878	Mean of logged Data	-4.554				
65					Maximum of Logged Data	-3.863	SD of logged Data	0.778				
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.0465	90% Chebyshev (MVUE) UCL	0.0261				
69					95% Chebyshev (MVUE) UCL	0.0319	97.5% Chebyshev (MVUE) UCL	0.0398				
70					99% Chebyshev (MVUE) UCL	0.0555						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.0175	95% Jackknife UCL	0.0186				
77					95% Standard Bootstrap UCL	0.017	95% Bootstrap-t UCL	0.0176				
78					95% Hall's Bootstrap UCL	0.0162	95% Percentile Bootstrap UCL	0.017				
79					95% BCA Bootstrap UCL	0.0167						
80					90% Chebyshev(Mean, Sd) UCL	0.0214	95% Chebyshev(Mean, Sd) UCL	0.0253				
81					97.5% Chebyshev(Mean, Sd) UCL	0.0307	99% Chebyshev(Mean, Sd) UCL	0.0413				
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.0186						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/31/2019 8:35:22 AM										
5	From File	mw16_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**1,2-DCP**											
12												
13	**General Statistics**											
14	Total Number of Observations	6				Number of Distinct Observations	5					
15						Number of Missing Observations	0					
16	Minimum	0.14				Mean	0.172					
17	Maximum	0.22				Median	0.16					
18	SD	0.0319				Std. Error of Mean	0.013					
19	Coefficient of Variation	0.186				Skewness	0.773					
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.889				**Shapiro Wilk GOF Test**						
28	5% Shapiro Wilk Critical Value	0.788				Data appear Normal at 5% Significance Level						
29	Lilliefors Test Statistic	0.252				**Lilliefors GOF Test**						
30	5% Lilliefors Critical Value	0.325				Data appear Normal at 5% Significance Level						
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
35	95% Student's-t UCL	0.198				95% Adjusted-CLT UCL (Chen-1995)	0.197					
36						95% Modified-t UCL (Johnson-1978)	0.199					
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.409				**Anderson-Darling Gamma GOF Test**						
40	5% A-D Critical Value	0.697				Detected data appear Gamma Distributed at 5% Significance Level						
41	K-S Test Statistic	0.271				**Kolmogorov-Smirnov Gamma GOF Test**						
42	5% K-S Critical Value	0.332				Detected data appear Gamma Distributed at 5% Significance Level						
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	36.45				k star (bias corrected MLE)	18.34					
47	Theta hat (MLE)	0.00471				Theta star (bias corrected MLE)	0.00936					
48	nu hat (MLE)	437.5				nu star (bias corrected)	220.1					
49	MLE Mean (bias corrected)	0.172				MLE Sd (bias corrected)	0.0401					
50						Approximate Chi Square Value (0.05)	186.7					
51	Adjusted Level of Significance	0.0122				Adjusted Chi Square Value	175.6					
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	0.202				95% Adjusted Gamma UCL (use when n<50)	0.215					
55												

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.903	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.25	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-1.966			Mean of logged Data	-1.776		
65					Maximum of Logged Data	-1.514			SD of logged Data	0.18		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.203			90% Chebyshev (MVUE) UCL	0.209		
69					95% Chebyshev (MVUE) UCL	0.227			97.5% Chebyshev (MVUE) UCL	0.25		
70					99% Chebyshev (MVUE) UCL	0.297						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.193			95% Jackknife UCL	0.198		
77					95% Standard Bootstrap UCL	0.191			95% Bootstrap-t UCL	0.235		
78					95% Hall's Bootstrap UCL	0.217			95% Percentile Bootstrap UCL	0.192		
79					95% BCA Bootstrap UCL	0.193						
80					90% Chebyshev(Mean, Sd) UCL	0.211			95% Chebyshev(Mean, Sd) UCL	0.228		
81					97.5% Chebyshev(Mean, Sd) UCL	0.253			99% Chebyshev(Mean, Sd) UCL	0.301		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.198						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-16**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

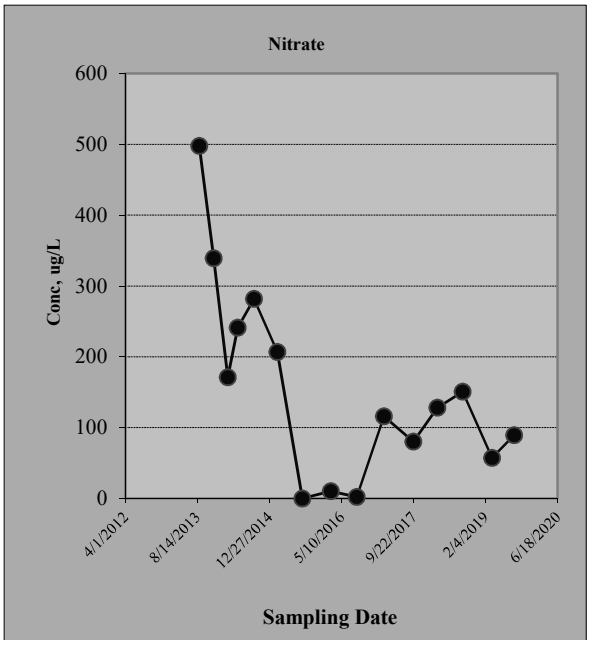
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Nitrate	Dinoseb	1,2-DCP			
#1	8/27/2013	498	0.088	0.65			
#2	12/5/2013	339	0.077	0.46			
#3	3/12/2014	171	0.045	0.2			
#4	5/21/2014	241	0.089	0.34			
#5	9/10/2014	282	0.066	0.27			
#6	2/19/2015	207	0.035	0.26			
#7	8/13/2015	0.02	0.00018	0.23			
#8	2/25/2016	10.2	0.00018	0.039			
#9	8/24/2016	2	0.0004	0.1			
#10	3/1/2017	116	0.0028	0.22			
#11	9/20/2017	80.2	0.0061	0.14			
#12	3/7/2018	128	0.014	0.17			
#13	8/29/2018	151	0.021	0.2			
#14	3/20/2019	57.3	0.015	0.15			
#15	8/21/2019	89.3	0.018	0.15			
#16							

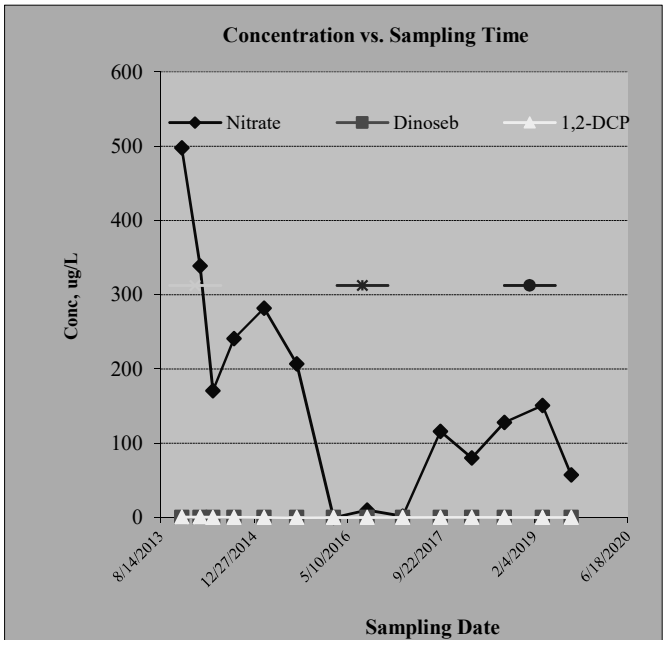
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Nitrate**	**Dinoseb**	**1,2-DCP**			
Confidence Level Calculated?	98.20%	91.60%	99.80%	NA	NA	NA
Plume Stability?	Shrinking	Shrinking	Shrinking	NA	NA	NA
Coefficient of Variation?				n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	-43	-30	-57	0	0	0
Number of Sampling Rounds?	15	15	15	0	0	0
Average Concentration?	158.13	0.03	0.24	NA	NA	NA
Standard Deviation?	138.35	0.03	0.15	NA	NA	NA
Coefficient of Variation?	0.87	1.04	0.64	NA	NA	NA
Blank if No Errors found				n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Nitrate**
Plume Stability? **Shrinking**





MW-17

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/31/2019 10:25:32 AM
From File	mw17_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	3.4	Mean	4.283
Maximum	6.2	Median	3.85
SD	1.08	Std. Error of Mean	0.441
Coefficient of Variation	0.252	Skewness	1.415

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.832	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.305	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	5.172	95% Adjusted-CLT UCL (Chen-1995)	5.28
		95% Modified-t UCL (Johnson-1978)	5.214

Gamma GOF Test

A-D Test Statistic	0.501	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.697	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.305	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	21.28	k star (bias corrected MLE)	10.75
Theta hat (MLE)	0.201	Theta star (bias corrected MLE)	0.398
nu hat (MLE)	255.3	nu star (bias corrected)	129
MLE Mean (bias corrected)	4.283	MLE Sd (bias corrected)	1.306
		Approximate Chi Square Value (0.05)	103.8
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	95.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5.325	95% Adjusted Gamma UCL (use when n<50)	5.78

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.868	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.285	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	1.224			Mean of logged Data	1.431		
65					Maximum of Logged Data	1.825			SD of logged Data	0.232		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	5.351			90% Chebyshev (MVUE) UCL	5.492		
69					95% Chebyshev (MVUE) UCL	6.042			97.5% Chebyshev (MVUE) UCL	6.806		
70					99% Chebyshev (MVUE) UCL	8.306						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	5.008			95% Jackknife UCL	5.172		
77					95% Standard Bootstrap UCL	4.934			95% Bootstrap-t UCL	7.473		
78					95% Hall's Bootstrap UCL	9.908			95% Percentile Bootstrap UCL	4.967		
79					95% BCA Bootstrap UCL	5.15						
80					90% Chebyshev(Mean, Sd) UCL	5.606			95% Chebyshev(Mean, Sd) UCL	6.205		
81					97.5% Chebyshev(Mean, Sd) UCL	7.036			99% Chebyshev(Mean, Sd) UCL	8.669		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	5.172						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

MW-18

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/31/2019 9:09:12 AM
From File	mw18_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	2.7	Mean	3.292
Maximum	3.75	Median	3.35
SD	0.372	Std. Error of Mean	0.152
Coefficient of Variation	0.113	Skewness	-0.586

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.212	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3.598	95% Adjusted-CLT UCL (Chen-1995)	3.503
		95% Modified-t UCL (Johnson-1978)	3.592

Gamma GOF Test

A-D Test Statistic	0.279	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.696	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.234	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	90.32	k star (bias corrected MLE)	45.27
Theta hat (MLE)	0.0364	Theta star (bias corrected MLE)	0.0727
nu hat (MLE)	1084	nu star (bias corrected)	543.2
MLE Mean (bias corrected)	3.292	MLE Sd (bias corrected)	0.489
		Approximate Chi Square Value (0.05)	490.2
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	471.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3.648	95% Adjusted Gamma UCL (use when n<50)	3.79

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.942	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.217	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	0.993			Mean of logged Data	1.186		
65					Maximum of Logged Data	1.322			SD of logged Data	0.117		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	3.651			90% Chebyshev (MVUE) UCL	3.762		
69					95% Chebyshev (MVUE) UCL	3.975			97.5% Chebyshev (MVUE) UCL	4.271		
70					99% Chebyshev (MVUE) UCL	4.852						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	3.541			95% Jackknife UCL	3.598		
77					95% Standard Bootstrap UCL	3.524			95% Bootstrap-t UCL	3.558		
78					95% Hall's Bootstrap UCL	3.518			95% Percentile Bootstrap UCL	3.517		
79					95% BCA Bootstrap UCL	3.492						
80					90% Chebyshev(Mean, Sd) UCL	3.747			95% Chebyshev(Mean, Sd) UCL	3.954		
81					97.5% Chebyshev(Mean, Sd) UCL	4.24			99% Chebyshev(Mean, Sd) UCL	4.803		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	3.598						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/31/2019 9:10:18 AM										
5	From File	mw18_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**Arsenic**											
12												
13	**General Statistics**											
14	Total Number of Observations	6			Number of Distinct Observations	6						
15					Number of Missing Observations	0						
16	Minimum	0.0189			Mean	0.0226						
17	Maximum	0.0294			Median	0.0219						
18	SD	0.00391			Std. Error of Mean	0.0016						
19	Coefficient of Variation	0.173			Skewness	1.138						
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.899			**Shapiro Wilk GOF Test**							
28	5% Shapiro Wilk Critical Value	0.788			Data appear Normal at 5% Significance Level							
29	Lilliefors Test Statistic	0.219			**Lilliefors GOF Test**							
30	5% Lilliefors Critical Value	0.325			Data appear Normal at 5% Significance Level							
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**							
35	95% Student's-t UCL	0.0258			95% Adjusted-CLT UCL (Chen-1995)	0.026						
36					95% Modified-t UCL (Johnson-1978)	0.026						
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.32			**Anderson-Darling Gamma GOF Test**							
40	5% A-D Critical Value	0.697			Detected data appear Gamma Distributed at 5% Significance Level							
41	K-S Test Statistic	0.206			**Kolmogorov-Smirnov Gamma GOF Test**							
42	5% K-S Critical Value	0.332			Detected data appear Gamma Distributed at 5% Significance Level							
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	42.95			k star (bias corrected MLE)	21.59						
47	Theta hat (MLE)	5.2652E-4			Theta star (bias corrected MLE)	0.00105						
48	nu hat (MLE)	515.5			nu star (bias corrected)	259.1						
49	MLE Mean (bias corrected)	0.0226			MLE Sd (bias corrected)	0.00487						
50					Approximate Chi Square Value (0.05)	222.8						
51	Adjusted Level of Significance	0.0122			Adjusted Chi Square Value	210.6						
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	0.0263			95% Adjusted Gamma UCL (use when n<50)	0.0278						
55												

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.924	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.194	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-3.969			Mean of logged Data	-3.801		
65					Maximum of Logged Data	-3.527			SD of logged Data	0.165		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.0263			90% Chebyshev (MVUE) UCL	0.0272		
69					95% Chebyshev (MVUE) UCL	0.0292			97.5% Chebyshev (MVUE) UCL	0.0321		
70					99% Chebyshev (MVUE) UCL	0.0378						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.0252			95% Jackknife UCL	0.0258		
77					95% Standard Bootstrap UCL	0.025			95% Bootstrap-t UCL	0.0278		
78					95% Hall's Bootstrap UCL	0.0415			95% Percentile Bootstrap UCL	0.0253		
79					95% BCA Bootstrap UCL	0.0257						
80					90% Chebyshev(Mean, Sd) UCL	0.0274			95% Chebyshev(Mean, Sd) UCL	0.0296		
81					97.5% Chebyshev(Mean, Sd) UCL	0.0326			99% Chebyshev(Mean, Sd) UCL	0.0385		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.0258						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-18**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

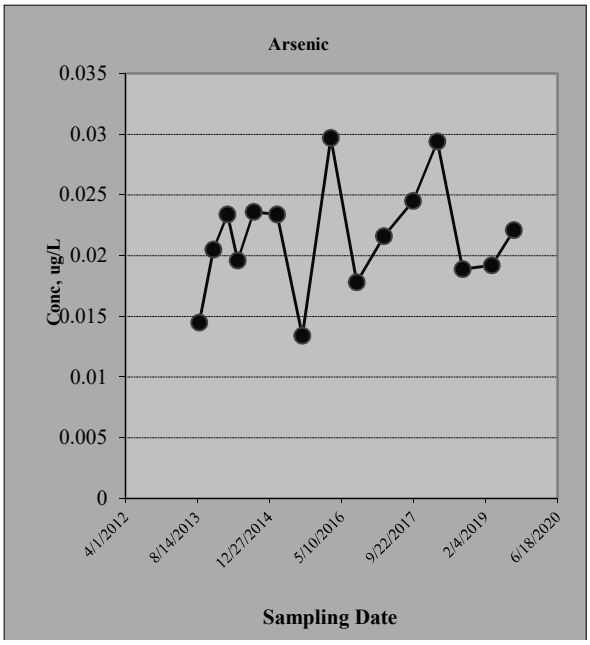
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Arsenic					
#1	8/27/2013	0.0145					
#2	12/3/2013	0.0205					
#3	3/11/2014	0.0234					
#4	5/20/2014	0.0196					
#5	9/9/2014	0.0236					
#6	2/17/2015	0.0234					
#7	8/11/2015	0.0134					
#8	2/25/2016	0.0297					
#9	8/23/2016	0.0178					
#10	2/28/2017	0.0216					
#11	9/19/2017	0.0245					
#12	3/6/2018	0.0294					
#13	8/28/2018	0.0189					
#14	3/19/2019	0.0192					
#15	8/20/2019	0.0221					
#16							

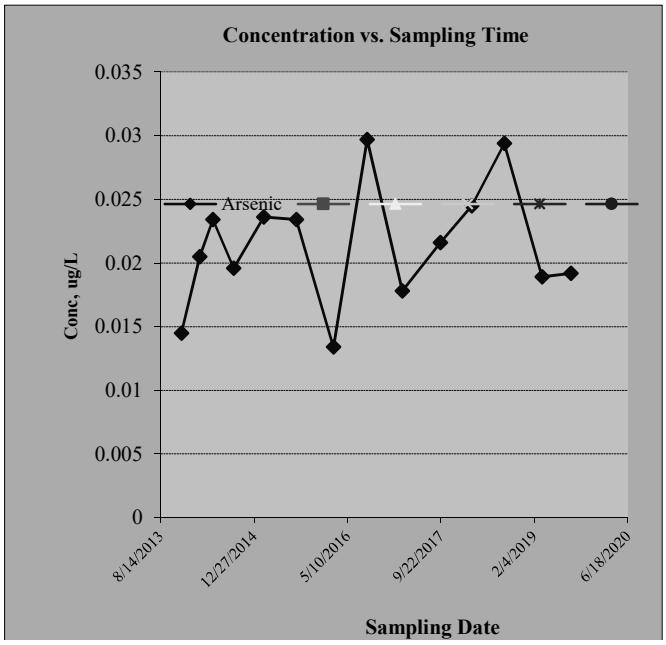
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Arsenic**					
Confidence Level Calculated?	72.10%	NA	NA	NA	NA	NA
Plume Stability?	Stable	NA	NA	NA	NA	NA
Coefficient of Variation?	CV <= 1	n<4	n<4	n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	14	0	0	0	0	0
Number of Sampling Rounds?	15	0	0	0	0	0
Average Concentration?	0.02	NA	NA	NA	NA	NA
Standard Deviation?	0.00	NA	NA	NA	NA	NA
Coefficient of Variation?	0.21	NA	NA	NA	NA	NA
Blank if No Errors found		n<4	n<4	n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Arsenic**
Plume Stability? **Stable**





MW-19

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/31/2019 9:27:22 AM
From File	mw19_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrate

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.82	Mean	5.977
Maximum	10.9	Median	6.85
SD	4.558	Std. Error of Mean	1.861
Coefficient of Variation	0.763	Skewness	-0.231

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.845	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.267	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9.726	95% Adjusted-CLT UCL (Chen-1995)	8.85
		95% Modified-t UCL (Johnson-1978)	9.697

Gamma GOF Test

A-D Test Statistic	0.638	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.712	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.295	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.339	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.236	k star (bias corrected MLE)	0.729
Theta hat (MLE)	4.836	Theta star (bias corrected MLE)	8.198
nu hat (MLE)	14.83	nu star (bias corrected)	8.748
MLE Mean (bias corrected)	5.977	MLE Sd (bias corrected)	7
		Approximate Chi Square Value (0.05)	3.176
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	2.092

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	16.46	95% Adjusted Gamma UCL (use when n<50)	24.99

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.784	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data Not Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.27	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Approximate Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-0.198			Mean of logged Data	1.332		
65					Maximum of Logged Data	2.389			SD of logged Data	1.218		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	113.8			90% Chebyshev (MVUE) UCL	16.41		
69					95% Chebyshev (MVUE) UCL	20.8			97.5% Chebyshev (MVUE) UCL	26.89		
70					99% Chebyshev (MVUE) UCL	38.87						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	9.037			95% Jackknife UCL	9.726		
77					95% Standard Bootstrap UCL	8.779			95% Bootstrap-t UCL	9.823		
78					95% Hall's Bootstrap UCL	8.005			95% Percentile Bootstrap UCL	8.74		
79					95% BCA Bootstrap UCL	8.74						
80					90% Chebyshev(Mean, Sd) UCL	11.56			95% Chebyshev(Mean, Sd) UCL	14.09		
81					97.5% Chebyshev(Mean, Sd) UCL	17.6			99% Chebyshev(Mean, Sd) UCL	24.49		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	9.726						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/31/2019 9:29:00 AM
From File	mw19_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nitrite

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.018	Mean	0.368
Maximum	1.4	Median	0.165
SD	0.515	Std. Error of Mean	0.21
Coefficient of Variation	1.398	Skewness	2.261

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.667	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.37	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.791	95% Adjusted-CLT UCL (Chen-1995)	0.921
		95% Modified-t UCL (Johnson-1978)	0.824

Gamma GOF Test

A-D Test Statistic	0.455	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.72	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.256	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.343	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.809	k star (bias corrected MLE)	0.516
Theta hat (MLE)	0.455	Theta star (bias corrected MLE)	0.713
nu hat (MLE)	9.712	nu star (bias corrected)	6.19
MLE Mean (bias corrected)	0.368	MLE Sd (bias corrected)	0.512
		Approximate Chi Square Value (0.05)	1.737
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	1.019

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	1.311	95% Adjusted Gamma UCL (use when n<50)	2.235

56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.93	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.267	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-4.017	Mean of logged Data	-1.732				
65					Maximum of Logged Data	0.336	SD of logged Data	1.408				
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	15.75	90% Chebyshev (MVUE) UCL	0.987				
69					95% Chebyshev (MVUE) UCL	1.264	97.5% Chebyshev (MVUE) UCL	1.65				
70					99% Chebyshev (MVUE) UCL	2.407						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.714	95% Jackknife UCL	0.791				
77					95% Standard Bootstrap UCL	0.684	95% Bootstrap-t UCL	2.389				
78					95% Hall's Bootstrap UCL	2.884	95% Percentile Bootstrap UCL	0.758				
79					95% BCA Bootstrap UCL	0.833						
80					90% Chebyshev(Mean, Sd) UCL	0.998	95% Chebyshev(Mean, Sd) UCL	1.284				
81					97.5% Chebyshev(Mean, Sd) UCL	1.68	99% Chebyshev(Mean, Sd) UCL	2.458				
82												
83	**Suggested UCL to Use**											
84					95% Adjusted Gamma UCL	2.235						
85												
86	**Recommended UCL exceeds the maximum observation**											
87												
88	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
89	Recommendations are based upon data size, data distribution, and skewness.											
90	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
91	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
92												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/31/2019 9:31:44 AM
From File	mw19_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1,2_DCP

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.011	Mean	0.028
Maximum	0.074	Median	0.0195
SD	0.023	Std. Error of Mean	0.00941
Coefficient of Variation	0.823	Skewness	2.212

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.692	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.368	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.047	95% Adjusted-CLT UCL (Chen-1995)	0.0525
		95% Modified-t UCL (Johnson-1978)	0.0484

Gamma GOF Test

A-D Test Statistic	0.672	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.702	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.298	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.335	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.649	k star (bias corrected MLE)	1.436
Theta hat (MLE)	0.0106	Theta star (bias corrected MLE)	0.0195
nu hat (MLE)	31.79	nu star (bias corrected)	17.23
MLE Mean (bias corrected)	0.028	MLE Sd (bias corrected)	0.0234
		Approximate Chi Square Value (0.05)	8.836
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	6.779

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.0546	95% Adjusted Gamma UCL (use when n<50)	0.0712

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.871	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.255	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-4.51			Mean of logged Data	-3.776		
65					Maximum of Logged Data	-2.604			SD of logged Data	0.639		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.0662			90% Chebyshev (MVUE) UCL	0.0482		
69					95% Chebyshev (MVUE) UCL	0.0577			97.5% Chebyshev (MVUE) UCL	0.071		
70					99% Chebyshev (MVUE) UCL	0.097						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.0435			95% Jackknife UCL	0.047		
77					95% Standard Bootstrap UCL	0.0417			95% Bootstrap-t UCL	0.098		
78					95% Hall's Bootstrap UCL	0.132			95% Percentile Bootstrap UCL	0.0452		
79					95% BCA Bootstrap UCL	0.0475						
80					90% Chebyshev(Mean, Sd) UCL	0.0562			95% Chebyshev(Mean, Sd) UCL	0.069		
81					97.5% Chebyshev(Mean, Sd) UCL	0.0867			99% Chebyshev(Mean, Sd) UCL	0.122		
82												
83	**Suggested UCL to Use**											
84					95% Adjusted Gamma UCL	0.0712						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/31/2019 9:29:52 AM
From File	mw19_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.0229	Mean	0.0497
Maximum	0.0833	Median	0.0448
SD	0.02	Std. Error of Mean	0.00818
Coefficient of Variation	0.403	Skewness	0.704

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.92	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.26	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0662	95% Adjusted-CLT UCL (Chen-1995)	0.0657
		95% Modified-t UCL (Johnson-1978)	0.0666

Gamma GOF Test

A-D Test Statistic	0.375	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.256	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.191	k star (bias corrected MLE)	3.707
Theta hat (MLE)	0.00691	Theta star (bias corrected MLE)	0.0134
nu hat (MLE)	86.29	nu star (bias corrected)	44.48
MLE Mean (bias corrected)	0.0497	MLE Sd (bias corrected)	0.0258
		Approximate Chi Square Value (0.05)	30.18
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	26

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0733	95% Adjusted Gamma UCL (use when n<50)	0.085

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.922	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.285	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-3.777			Mean of logged Data	-3.073		
65					Maximum of Logged Data	-2.485			SD of logged Data	0.424		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	0.0809			90% Chebyshev (MVUE) UCL	0.0758		
69					95% Chebyshev (MVUE) UCL	0.0875			97.5% Chebyshev (MVUE) UCL	0.104		
70					99% Chebyshev (MVUE) UCL	0.136						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	0.0632			95% Jackknife UCL	0.0662		
77					95% Standard Bootstrap UCL	0.0621			95% Bootstrap-t UCL	0.0719		
78					95% Hall's Bootstrap UCL	0.197			95% Percentile Bootstrap UCL	0.0627		
79					95% BCA Bootstrap UCL	0.0639						
80					90% Chebyshev(Mean, Sd) UCL	0.0742			95% Chebyshev(Mean, Sd) UCL	0.0854		
81					97.5% Chebyshev(Mean, Sd) UCL	0.101			99% Chebyshev(Mean, Sd) UCL	0.131		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	0.0662						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/31/2019 9:30:49 AM
From File	mw19_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Iron

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.955	Mean	11.22
Maximum	28.4	Median	8.985
SD	11.04	Std. Error of Mean	4.509
Coefficient of Variation	0.984	Skewness	0.686

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.891	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.247	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	20.31	95% Adjusted-CLT UCL (Chen-1995)	19.99
		95% Modified-t UCL (Johnson-1978)	20.52

Gamma GOF Test

A-D Test Statistic	0.337	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.717	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.217	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.342	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.905	k star (bias corrected MLE)	0.564
Theta hat (MLE)	12.4	Theta star (bias corrected MLE)	19.91
nu hat (MLE)	10.86	nu star (bias corrected)	6.765
MLE Mean (bias corrected)	11.22	MLE Sd (bias corrected)	14.95
		Approximate Chi Square Value (0.05)	2.042
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	1.238

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	37.18	95% Adjusted Gamma UCL (use when n<50)	61.34

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.91	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.233	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	-0.046			Mean of logged Data	1.773		
65					Maximum of Logged Data	3.346			SD of logged Data	1.405		
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	512.2			90% Chebyshev (MVUE) UCL	32.66		
69					95% Chebyshev (MVUE) UCL	41.85			97.5% Chebyshev (MVUE) UCL	54.6		
70					99% Chebyshev (MVUE) UCL	79.64						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	18.64			95% Jackknife UCL	20.31		
77					95% Standard Bootstrap UCL	18			95% Bootstrap-t UCL	26.16		
78					95% Hall's Bootstrap UCL	17.5			95% Percentile Bootstrap UCL	18.14		
79					95% BCA Bootstrap UCL	19.36						
80					90% Chebyshev(Mean, Sd) UCL	24.75			95% Chebyshev(Mean, Sd) UCL	30.88		
81					97.5% Chebyshev(Mean, Sd) UCL	39.38			99% Chebyshev(Mean, Sd) UCL	56.09		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	20.31						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-19**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

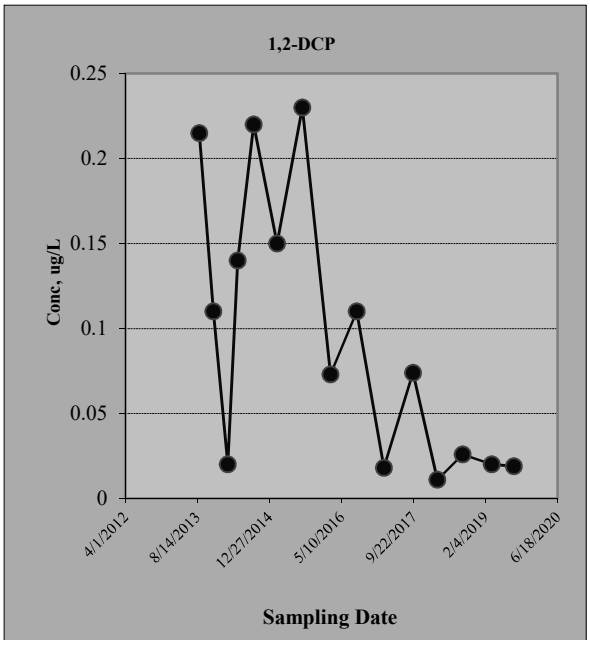
		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Nitrate	Nitrite	1,2-DCP	Arsenic	Iron	
#1	8/27/2013	21.1	3.3	0.215	0.0108	2.785	
#2	12/3/2013	21.9	0.81	0.11	0.0034	0.196	
#3	3/12/2014	1.2	0.0075	0.02	0.133	62.2	
#4	5/20/2014	7	0.13	0.14	0.05	14	
#5	9/9/2014	14.3	2.5	0.22	0.0161	0.922	
#6	2/18/2015	18.5	0.0075	0.15	0.0457	21.8	
#7	8/13/2015	26.4	0.72	0.23	0.0272	4.43	
#8	2/23/2016	9.8	0.57	0.073	0.0581	19	
#9	8/23/2016	13.1	0.09	0.11	0.0216	2.82	
#10	3/1/2017	10.9	0.018	0.018	0.0833	18.5	
#11	9/19/2017	9.3	1.4	0.074	0.0585	0.955	
#12	3/6/2018	9.6	0.16	0.011	0.045	1.52	
#13	8/28/2018	4.4	0.32	0.026	0.0229	3.87	
#14	3/19/2019	0.82	0.14	0.02	0.044	28.4	
#15	8/20/2019	0.84	0.17	0.019	0.0446	14.1	
#16							

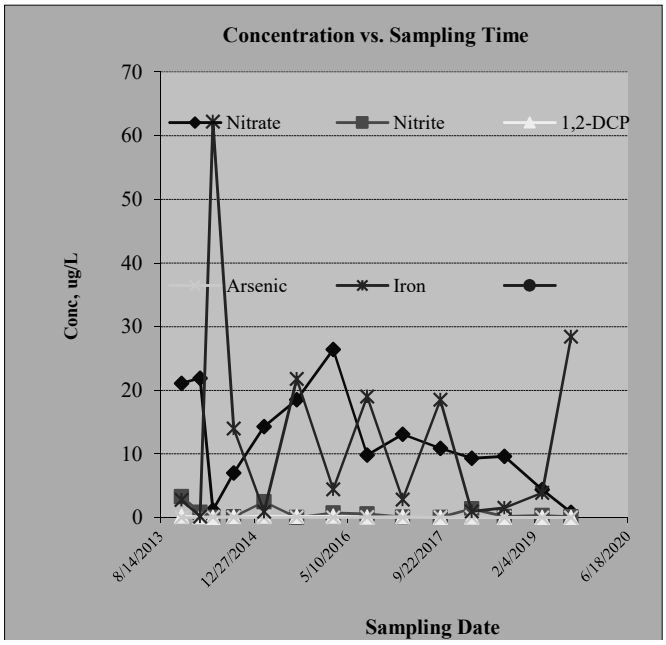
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Nitrate**	**Nitrite**	**1,2-DCP**	**Arsenic**	**Iron**	
Confidence Level Calculated?	99.20%	72.10%	99.00%	72.10%	68.70%	NA
Plume Stability?	Shrinking	Undetermined	Shrinking	Stable	Undetermined	NA
Coefficient of Variation?		CV > 1		CV <= 1	CV > 1	n<4
Mann-Kendall Statistic "S" value?	-49	-14	-47	13	11	0
Number of Sampling Rounds?	15	15	15	15	15	0
Average Concentration?	11.28	0.69	0.10	0.04	13.03	NA
Standard Deviation?	8.01	0.99	0.08	0.03	16.38	NA
Coefficient of Variation?	0.71	1.43	0.83	0.73	1.26	NA
Blank if No Errors found						n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **1,2-DCP**
Plume Stability? **Shrinking**





MW-20

1	**UCL Statistics for Uncensored Full Data Sets**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.110/31/2019 9:50:22 AM										
5	From File	mw20_3year_data.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	**Nitrate**											
12												
13	**General Statistics**											
14	Total Number of Observations	6			Number of Distinct Observations	5						
15					Number of Missing Observations	0						
16	Minimum	2.9			Mean	3.783						
17	Maximum	4.2			Median	4						
18	SD	0.5			Std. Error of Mean	0.204						
19	Coefficient of Variation	0.132			Skewness	-1.382						
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic	0.837			**Shapiro Wilk GOF Test**							
28	5% Shapiro Wilk Critical Value	0.788			Data appear Normal at 5% Significance Level							
29	Lilliefors Test Statistic	0.259			**Lilliefors GOF Test**							
30	5% Lilliefors Critical Value	0.325			Data appear Normal at 5% Significance Level							
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**							
35	95% Student's-t UCL	4.194			95% Adjusted-CLT UCL (Chen-1995)	3.996						
36					95% Modified-t UCL (Johnson-1978)	4.175						
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic	0.592			**Anderson-Darling Gamma GOF Test**							
40	5% A-D Critical Value	0.697			Detected data appear Gamma Distributed at 5% Significance Level							
41	K-S Test Statistic	0.278			**Kolmogorov-Smirnov Gamma GOF Test**							
42	5% K-S Critical Value	0.332			Detected data appear Gamma Distributed at 5% Significance Level							
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)	62.51			k star (bias corrected MLE)	31.36						
47	Theta hat (MLE)	0.0605			Theta star (bias corrected MLE)	0.121						
48	nu hat (MLE)	750.1			nu star (bias corrected)	376.4						
49	MLE Mean (bias corrected)	3.783			MLE Sd (bias corrected)	0.676						
50					Approximate Chi Square Value (0.05)	332.4						
51	Adjusted Level of Significance	0.0122			Adjusted Chi Square Value	317.4						
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))	4.284			95% Adjusted Gamma UCL (use when n<50)	4.487						
55												

	A	B	C	D	E	F	G	H	I	J	K	L
56	**Lognormal GOF Test**											
57					Shapiro Wilk Test Statistic	0.814	**Shapiro Wilk Lognormal GOF Test**					
58					5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level					
59					Lilliefors Test Statistic	0.273	**Lilliefors Lognormal GOF Test**					
60					5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64					Minimum of Logged Data	1.065				Mean of logged Data	1.323	
65					Maximum of Logged Data	1.435				SD of logged Data	0.142	
66												
67	**Assuming Lognormal Distribution**											
68					95% H-UCL	4.303				90% Chebyshev (MVUE) UCL	4.444	
69					95% Chebyshev (MVUE) UCL	4.743				97.5% Chebyshev (MVUE) UCL	5.157	
70					99% Chebyshev (MVUE) UCL	5.971						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	4.119				95% Jackknife UCL	4.194	
77					95% Standard Bootstrap UCL	4.09				95% Bootstrap-t UCL	4.102	
78					95% Hall's Bootstrap UCL	4.005				95% Percentile Bootstrap UCL	4.067	
79					95% BCA Bootstrap UCL	4.033						
80					90% Chebyshev(Mean, Sd) UCL	4.395				95% Chebyshev(Mean, Sd) UCL	4.672	
81					97.5% Chebyshev(Mean, Sd) UCL	5.057				99% Chebyshev(Mean, Sd) UCL	5.813	
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	4.194						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.110/31/2019 9:51:38 AM
From File	mw20_3year_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	1
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.0144	Minimum Non-Detect	0.016
Maximum Detect	0.0269	Maximum Non-Detect	0.016
Variance Detects	3.3580E-5	Percent Non-Detects	16.67%
Mean Detects	0.0206	SD Detects	0.00579
Median Detects	0.0229	CV Detects	0.281
Skewness Detects	-0.326	Kurtosis Detects	-2.842
Mean of Logged Detects	-3.917	SD of Logged Detects	0.298

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.848	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.254	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0196	KM Standard Error of Mean	0.0024
KM SD	0.00526	95% KM (BCA) UCL	0.0229
95% KM (t) UCL	0.0244	95% KM (Percentile Bootstrap) UCL	0.0233
95% KM (z) UCL	0.0235	95% KM Bootstrap t UCL	0.0246
90% KM Chebyshev UCL	0.0268	95% KM Chebyshev UCL	0.03
97.5% KM Chebyshev UCL	0.0346	99% KM Chebyshev UCL	0.0435

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.558	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.291	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	14.76	k star (bias corrected MLE)	6.036
Theta hat (MLE)	0.0014	Theta star (bias corrected MLE)	0.00341
nu hat (MLE)	147.6	nu star (bias corrected)	60.36
Mean (detects)	0.0206		

56												
57	**Gamma ROS Statistics using Imputed Non-Detects**											
58	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
59	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)											
60	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
61	This is especially true when the sample size is small.											
62	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
63					Minimum	0.0144			Mean	0.0197		
64					Maximum	0.0269			Median	0.019		
65					SD	0.00564			CV	0.286		
66					k hat (MLE)	14.58			k star (bias corrected MLE)	7.403		
67					Theta hat (MLE)	0.00135			Theta star (bias corrected MLE)	0.00266		
68					nu hat (MLE)	175			nu star (bias corrected)	88.84		
69					Adjusted Level of Significance (β)	0.0122						
70					Approximate Chi Square Value (88.84, α)	68.11			Adjusted Chi Square Value (88.84, β)	61.59		
71					95% Gamma Approximate UCL (use when n>=50)	0.0257			95% Gamma Adjusted UCL (use when n<50)	0.0284		
72												
73	**Estimates of Gamma Parameters using KM Estimates**											
74					Mean (KM)	0.0196			SD (KM)	0.00526		
75					Variance (KM)	2.7640E-5			SE of Mean (KM)	0.0024		
76					k hat (KM)	13.86			k star (KM)	7.043		
77					nu hat (KM)	166.4			nu star (KM)	84.51		
78					theta hat (KM)	0.00141			theta star (KM)	0.00278		
79					80% gamma percentile (KM)	0.0254			90% gamma percentile (KM)	0.0294		
80					95% gamma percentile (KM)	0.0331			99% gamma percentile (KM)	0.0407		
81												
82	**Gamma Kaplan-Meier (KM) Statistics**											
83					Approximate Chi Square Value (84.51, α)	64.32			Adjusted Chi Square Value (84.51, β)	58		
84					95% Gamma Approximate KM-UCL (use when n>=50)	0.0257			95% Gamma Adjusted KM-UCL (use when n<50)	0.0285		
85												
86	**Lognormal GOF Test on Detected Observations Only**											
87					Shapiro Wilk Test Statistic	0.82			**Shapiro Wilk GOF Test**			
88					5% Shapiro Wilk Critical Value	0.762			Detected Data appear Lognormal at 5% Significance Level			
89					Lilliefors Test Statistic	0.281			**Lilliefors GOF Test**			
90					5% Lilliefors Critical Value	0.343			Detected Data appear Lognormal at 5% Significance Level			
91	**Detected Data appear Lognormal at 5% Significance Level**											
92												
93	**Lognormal ROS Statistics Using Imputed Non-Detects**											
94					Mean in Original Scale	0.0197			Mean in Log Scale	-3.963		
95					SD in Original Scale	0.00565			SD in Log Scale	0.29		
96					95% t UCL (assumes normality of ROS data)	0.0243			95% Percentile Bootstrap UCL	0.0232		
97					95% BCA Bootstrap UCL	0.0233			95% Bootstrap t UCL	0.0246		
98					95% H-UCL (Log ROS)	0.0264						
99												
100	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
101					KM Mean (logged)	-3.97			KM Geo Mean	0.0189		
102					KM SD (logged)	0.271			95% Critical H Value (KM-Log)	2.177		
103					KM Standard Error of Mean (logged)	0.124			95% H-UCL (KM -Log)	0.0255		
104					KM SD (logged)	0.271			95% Critical H Value (KM-Log)	2.177		
105					KM Standard Error of Mean (logged)	0.124						
106												
107	**DL/2 Statistics**											
108	**DL/2 Normal**								**DL/2 Log-Transformed**			
109					Mean in Original Scale	0.0185			Mean in Log Scale	-4.069		
110					SD in Original Scale	0.0073			SD in Log Scale	0.458		

	A	B	C	D	E	F	G	H	I	J	K	L
111				95% t UCL (Assumes normality)		0.0245					95% H-Stat UCL	0.0319
112	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
113												
114	**Nonparametric Distribution Free UCL Statistics**											
115	**Detected Data appear Normal Distributed at 5% Significance Level**											
116												
117	**Suggested UCL to Use**											
118					95% KM (t) UCL	0.0244						
119												
120	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
121	Recommendations are based upon data size, data distribution, and skewness.											
122	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
123	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
124												

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Bee-Jay Scales*
Site Address:	*110 N. 1st Street, Sunnyside, WA*
Additional Description:	

Well (Sampling) Location? **MW-20**
Level of Confidence (Decision Criteria)? **85%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

		Hazardous Substances (unit is mg/L)					
Sampling Event	Date Sampled	Arsenic					
#1	8/28/2013	0.0112					
#2	12/3/2013	0.0156					
#3	3/11/2014	0.0216					
#4	5/20/2014	0.016					
#5	9/9/2014	0.0191					
#6	2/18/2015	0.015					
#7	8/13/2015	0.015					
#8	2/23/2016	0.0213					
#9	8/23/2016	0.0166					
#10	3/1/2017	0.0145					
#11	9/19/2017	0.0229					
#12	3/6/2018	0.0269					
#13	8/28/2018	0.008					
#14	3/19/2019	0.0243					
#15	8/20/2019	0.0144					
#16							

2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	**Arsenic**					
Confidence Level Calculated?	65.10%	NA	NA	NA	NA	NA
Plume Stability?	Stable	NA	NA	NA	NA	NA
Coefficient of Variation?	CV <= 1	n<4	n<4	n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	10	0	0	0	0	0
Number of Sampling Rounds?	15	0	0	0	0	0
Average Concentration?	0.02	NA	NA	NA	NA	NA
Standard Deviation?	0.01	NA	NA	NA	NA	NA
Coefficient of Variation?	0.29	NA	NA	NA	NA	NA
Blank if No Errors found		n<4	n<4	n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **Arsenic**
Plume Stability? **Stable**