| | |
|---|---|
| **From:** | Haskins, Tom |
| **To:** | HARMLESS, MARTY |
| **Cc:** | Loewe \ Jeff; Haney, Mark |
| **Subject:** | NIPSCO LLC Bailly Generating Station Post-Closure Groundwater Monitoring Well Network Device Installation Plan Revision 1 |
| **Date:** | Tuesday, July 2, 2024 2:41:17 PM |
| **Attachments:** | image001.png<br>BGS Device Installation Plan Revision 1 Final.pdf |



Good afternoon, Marty,

On April 25, 2024, on behalf of NIPSCO LLC (NIPSCO), WSP USA Inc (WSP) submitted the Post-Closure Monitoring Well Network Device Installation Plan (DIP) for the Bailly Generating Station (BGS) in Chesterton, Indiana in accordance with requirements of the March 28, 2024, Indiana Department of Environmental Management (IDEM) Approval of Closure/Post-Closure Plan, Northern Indiana Public Service Company LLC, Bailly Generating Station, SW Program ID 64-014. The DIP was approved by IDEM on May 20, 2024. Prior to mobilization and installation of the monitoring wells, WSP and NIPSCO determined the proximity to overhead utilities warranted alternate drilling methods and well construction than those detailed in the DIP (i.e., access with a limited-access drilling rig rather than full size auger rig). Attached to this email is NIPSCO's Post-Closure Monitoring Well Network Device Installation Plan Revision 1, which summarizes and incorporates the alternate drilling methods, rationale, and well construction details discussed between yourself and Jeff Loewe on June 28th, 2024.

Should you have any questions regarding this revision to the DIP, do not hesitate to contact me, Mark Haney at mark.haney@wsp.com, or Jeff Loewe at jloewe@nisource.com.

Regards,
Tom

**Tom Haskins, P.G. (IN, WA)**
Lead Consultant, Geologist

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Merrimack, NH 03054

wsp.com



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**REPORT**

# Post-Closure Monitoring Well Network Device Installation Plan

*Northern Indiana Public Service Company LLC*
*Bailly Generating Station*

Submitted to:

**Northern Indiana Public Service Company LLC**

801 East 86th Avenue
Merrillville, IN 46410

Submitted by:

**WSP USA Inc**
10 Al Paul Lane, Suite 103
Merrimack, NH 03054

+1 603 324 0894

31406779.5655

July 2024

Revision 1.0

# Table of Contents

## ATTACHMENTS

**Attachment 1**
Wood Closure Application for CCR Surface Impoundments – Bailly Generating Station (February 3, 2021)

**Attachment 2**
Example Soil Boring Log (GAMW-01)

# 1.0 INTRODUCTION

WSP USA Inc. (WSP) prepared this Post-Closure Monitoring Well Network Device Installation Plan Revision 1.0 (Device Installation Plan 1.0) for the Northern Indiana Public Service Company LLC (NIPSCO) Bailly Generating Station (BGS, Site), located at 246 Bailey Station Road, Chesterton, Porter County, Indiana (Figure 1). WSP prepared the first Device Installation Plan dated April 2024, which was approved by the Indiana Department of Environmental Management (IDEM) on May 20, 2024. The purpose of this Device Installation Plan 1.0 is to provide revised, IDEM-approved post-closure monitoring well drilling methods, in addition to the original well locations and depth intervals, sampling procedures, and other pertinent information stipulated in the IDEM March 28, 2024 Approval of Closure/Post-Closure Plan, Bailly Generating Station, SW Program ID 64-014, Jasper County (Approval Letter). WSP prepared this first revision of the Device Installation Plan to address a modified monitoring well installation approach due to the presence of overhead utilities within the vicinity of several of the proposed post-closure monitoring wells.

## 1.1 Background

On February 3, 2021, NIPSCO submitted a Surface Impoundment Closures (CCR Final Rule) Closure Application – Bailly Generating Station (Wood Environmental and Infrastructure Solutions, Inc [Wood, now WSP] 2021). This document included a proposed post-closure groundwater monitoring network for four former CCR surface impoundments at BGS: Primary Settling Pond No. 1 (Primary 1), Secondary Settling Pond No. 1 (Secondary 1), Primary Settling Pond No. 2 (Primary 2), and Boiler Slag Pond. Among other details, the proposed monitoring program specified well depths/screened intervals based on historical site data and information available at the time of submittal. The proposed well details were reviewed by and agreed to by IDEM in an Approval Letter dated March 28, 2024.

IDEM's Approval Letter requested additional post-closure monitoring wells to reduce spacing between devices in the groundwater monitoring network including:

- A new background well pair further upgradient (east) of the CCR Units
- An additional well between GAMW-13 and MW-112
- Additional wells to the south of CCR Units based on localized groundwater flow direction.

NIPSCO's plan for addressing these requirements is detailed in the April 2024 Device Installation Plan. Closure construction at the Site is anticipated to initiate in the second quarter of 2024, and anticipated completion of final construction is the third quarter of 2025.

While onsite in June 2024, WSP identified overhead utilities in the vicinity of three proposed post-closure monitoring wells (GAMW-24 and GAMW-25/25B) that required installation via a limited-access drilling rig. Title 329 of the Indiana Administrative Code (IAC) 10-21-4(b) (which is referenced in IDEM's Approval of the Closure/Post-Closure Plan) requires that "the diameter of [a] borehole is at least four (4) inches larger than the diameter of the ground water monitoring well casing and screen." The 4-inch difference in annular space is most typically achieved using a hollow-stem auger (HSA) drilling rig with 6.25-inch outer diameter flights, however, given the need for a limited-access drilling rig, direct-push drilling techniques with a smaller drilling rig may be used instead, yielding a borehole two inches larger than the diameter of the monitoring well,

rather than four inches. This Device Installation Plan 1.0 is revised to account for the use of either HSA or direct-push drilling techniques during monitoring well installation, as verbally approved by Mr. Marty Harmless (IDEM) on June 28th, 2024 via phone call.

## 2.0 MONITORING WELL NETWORK

The post-closure monitoring well network incorporates both new and existing Site groundwater monitoring wells. The proposed network was reviewed by IDEM, modified at IDEM's request, and was subsequently accepted, as documented in the Approval Letter and approval of the first Device Installation Plan. Of the proposed network, 29 post-closure monitoring wells and 5 piezometers were previously installed. A summary of the existing and proposed monitoring wells and piezometers is provided below and in attached Table 1.

| Post-Closure Background Monitoring Wells | | Post-Closure Downgradient Monitoring Wells |
|---|---|---|
| Existing | NA* | GAMW-01, GAMW-01B, GAMW-02, GAMW-03, GAMW-04, GAMW-06, GAMW-07, GAMW-08, GAMW-08B, GAMW-10, GAMW-11, GAMW-11B, GAMW-11C, GAMW-12R, GAMW-13, GAMW-14, GAMW-16, GAMW-17, GAMW-17B, GAMW-18, GAMW-19, GAMW-20, GAMW-21, GAMW-22, GAMW-22B, GAMW-23, GAMW-23B, MW-105, and MW-112 |
| Proposed | GAMW-25, GAMW-25B | GAMW-24, GAMW-26 |

*IDEM requested the current CCR Rule background pair GAMW-01/01B transition to downgradient status and be replaced with new well pair GAMW-25/25B in the IDEM post-closure monitoring well network.

## 2.1 Monitoring Well Installation Activities

One additional well pair and two monitoring wells will be installed concurrent with construction at the Site. Well pair GAMW-25/GAMW-25B will be installed upgradient to the east of Secondary 1, GAMW-26 will be installed northeast of the Boiler Slag Pond between existing monitoring wells GAMW-13 and MW-112, and GAMW-24 located south of Secondary 1, as requested by IDEM, as shown in Figure 2. Well installation will begin concurrent with closure construction activities in August 2024.

WSP will subcontract an Indiana State-licensed well driller to install the four devices using either 4.25-inch inside diameter (ID) HSA drilling techniques or direct-push drilling techniques. The anticipated proposed boring depths are provided in Table 1 and the table below; however, the boring depth may be adjusted in the field. After drilling is complete, the lower extent of the borehole will be sealed with bentonite and a one-foot sand filter pack buffer will be placed below the bottom of the well screen, if necessary. This will enable screening of the monitoring well at the upper level of the aquifer while mitigating the adverse effects of bentonite near the well screen (e.g., clogging). Monitoring well construction procedures and protocols are detailed in Section 3.3.

| Monitoring Well ID | Proposed Boring Depth (ft-bgs) | Screen Top Depth (ft-bgs) | Screen Bottom Depth (ft-bgs) | Well Diameter (in) |
|---|---|---|---|---|
| GAMW-24 | 24 | 13 | 23 | 2 |
| GAMW-25 | 24 | 13 | 23 | 2 |
| GAMW-25B | 32* | 27* | 32* | 2 |
| GAMW-26 | 24 | 13 | 23 | 2 |

*The GAMW-25B boring will be advanced until the clay layer present on the south side of the site is encountered, and the well will be screened such that the base of the screen is just above the clay layer. Bring depth and screen intervals may be modified in the field.

In accordance with 329 IAC 10-21-4(f), WSP will provide IDEM with a 10-day notice prior to the installation of the wells.

# 3.0 DEVICE INSTALLATION PLAN REQUIREMENTS

In general conformance with the applicable requirements of 40 CFR 257.91, 329 IAC 10-21-4, 329 IAC 10-24-3, and IDEM requirements stated in Subsection D3 of the Approval Letter, this Device Installation Plan 1.0 includes:

- A map showing the location of each device with respect to the facility's entire System and a current potentiometric surface.
- A demonstration that each device will yield representative groundwater samples at an appropriate location and depth within the same aquifer or aquifers as the facility's existing System and will meet the installation requirements of 40 CFR 257.91(e).
- Drilling methods and procedures that follow 329 IAC 10-21-4, as applicable, unless direct-push drilling techniques are required due to drilling rig access; well construction materials and details, including protocol for collecting, describing, and analyzing consolidated or unconsolidated materials (329 IAC 10-24-3(3)), as applicable to the Site.
- An example of a borehole log that includes information specified under 329 IAC 10-24-3(2), as applicable.
- Environmental qualifications of all field personnel.
- Provisions to include the installation records in the facility operating record (40 CFR 257.91(e)(1)).

These requirements are further discussed in the sections below.

## 3.1 Site Map and Potentiometric Surface Map

A site map showing each well included in the post-closure monitoring well network is included as Figure 2. The most recent potentiometric surface map from November 2023 is included as Figure 3.

## 3.2 Demonstration of Representative Device Locations and Depths

The Wood Closure Plan Application (Attachment 1) includes several maps and cross sections of the CCR Surface

Impoundments subject to closure (B-1070 through B-1077 in Appendix D), the post-closure well network (Figure 2), and potentiometric surface (Figure 3) together demonstrating that each post-closure monitoring well location and depth are a) appropriately located within the network, and b) are screened within the same aquifer(s) as the existing monitoring well network. The proposed locations of the new post-closure monitoring wells were addressed in the Approval Letter.

New monitoring wells will be installed and cased in a manner that maintains the integrity of the monitoring well, including installation, development, and decommissioning, as necessary, and in accordance with 40 CFR 257.91(e). The post-closure well network construction details are included in Table 1.

## 3.3 Drilling Methods, Procedures, and Protocols

Drilling methods and procedures, as well as protocol for collecting, describing, and analyzing consolidated and unconsolidated soil, are discussed in the following sections, and will be performed in general accordance with 329 IAC 10-21-4 and 329 IAC 10-24-3(3), unless otherwise noted. Proposed deviations from 329 IAC 10-21-4 and 329 IAC 10-4-3 and the rationale for deviations are discussed further herein.

### 3.3.1 Notification

The first Device Installation Plan was submitted to IDEM at least 60 days prior to the installation of new post-closure monitoring wells, as required by IDEM's Approval of the Closure/Post-Closure Plan. Following IDEM approval of this revision to the Device Installation Plan, IDEM will be notified prior to the monitoring well installation event, at that time with 10 days' notice in accordance with 329 IAC 10-21-4(f).

### 3.3.2 Soil Core Sampling and Retention

Continuous split-spoon samples (HSA) or core samples (direct-push) will be collected from the surface to the base of the deepest soil boring of a monitoring well pair or cluster using 4.25 ID HSA or direct-push drilling techniques. For the well pair, lithology will be duplicated from the deep pair boring log (i.e., shallow well GAMW-25 will not be logged, and boring logs will contain lithologies described in deep well GAMW-25B). The shallow well within the pair will not be sampled because stratigraphic differences between borings are unlikely given the spatial differences of borings within a pair (i.e., less than 5 feet apart).

Following logging for lithologic purposes, soil will be discarded in the vicinity of the well and will not otherwise be retained to minimize the risk of health and safety incidents related to the transport and placement of soil in a secure area (e.g., slips/trips on stairs, heavy lifting, potential spillage in other areas of the Site, etc.).

### 3.3.3 Soil Analysis

The Closure Approval references both 329 IAC 10-21-4 and 329 IAC 10-24-3(3), which contain separate, although similar, analysis requirements during soil boring installation, including analysis for grain size, cation exchange capacity (CEC), and hydraulic conductivity. Verbiage within these regulations suggests they are intended for monitoring well networks associated with new municipal or non-municipal solid waste landfills. For example, 329 IAC 10-24-3(3)(e) states "hydraulic conductivity sampling must occur … at a depth of approximately five (5) feet below *the proposed* base of waste placement." The CCR impoundments at BGS are being excavated and backfilled with a clean borrow source. The analyses listed in these regulations do not further the impoundment closure, nor do the results of the analysis benefit the ensuing long-term groundwater monitoring for

residual impacts from the former impoundments. Subsequently, analyses for grain size, CEC, and hydraulic conductivity will not be performed as the data collected during those analyses does not provide value to impoundment closure or post-closure activities.

Hydraulic conductivity data has previously been collected at the Site, including data from existing post-closure monitoring wells GAMW-01, GAMW-08, GAMW-11 and GAMW11B. Hydraulic conductivity data is included in the July 2023 CCR Groundwater Monitoring System Design Manual Revision 3.0 (WSP 2023).

### 3.3.4 Soil Description and Classification

All split-spoon or core samples will be photographed and logged in accordance with ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) and ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures) by a qualified WSP geologist or engineer. The Wentworth Grain Size Scale (329 IAC 10-21-4(h)(9)(f)) will not be used by itself as it is not industry standard, nor has it been previously used by itself at BGS.

### 3.3.5 Monitoring Well Completion

Monitoring well construction will be completed in general accordance with 329 IAC 10-21-4 with two-inch diameter, schedule 40 PVC with 10 feet of 0.010-inch (No. 10-slot) screen connected to flush-threaded (with a Teflon seal) schedule 40 PVC riser pipe. Sand pack will consist of a clean, washed, acid-resistant, #5-sized silica sand inside the annulus of the boreholes. If installed via HSA drilling techniques, the sand pack will be poured via tremie pipe and continuously sounded from 0.5 feet below the bottom of the screen (1 foot for deep wells) until it extends to at least 2 feet above the top of the screened interval. A minimum three-foot bentonite seal will be placed on top of the filter pack by tremie pipe and the remaining annular space between the borehole and the riser will be grouted (cement/bentonite mix) using a tremie pipe (side discharge) from above the bentonite seal to within 2 feet of ground surface. If installed via direct-push drilling techniques, a prepacked monitoring well constructed with 20/40 silica sand surrounded by stainless steel mesh screen will be used in place of manual construction via tremie pipe. #5-sized silica sand will be poured into the annulus after prepack screen installation until sand extends at least 2 feet above the top of the screened interval (note: borehole collapse may occur while constructing a well with prepacked materials). A concrete seal will be placed from 2 feet below ground surface to the surface. The wells will be completed with locking, steel stickup protective casings or flush mount monuments, concrete apron, and concrete-filled bollards capable of withstanding minor impacts by typical vehicular traffic.

### 3.3.6 Well Development

Monitoring well development will occur no earlier than 48 hours after completion of each monitoring well, allowing for the seal and grout to have set. Hydraulic conductivity testing will not be performed following development as hydraulic conductivity data do not benefit Site closure or inform post-closure monitoring plans and activities. Additionally, existing hydraulic conductivity data have previously been collected onsite, discussed in Section 3.3.3.

## 3.4 Borehole Log

Final borehole logs from post-closure network installation will include all required criteria as defined by 329 IAC 10-24-3(2), including date and method of drilling, monitoring well construction, textural classification, soil

descriptions, water bearing zones, and static water level following completion of the monitoring well. The borehole log will include monitoring well construction details outlined in 329 IAC 10-21-4. An example borehole log from downgradient well GAMW-01 is included in Attachment 2 for reference.

As discussed in Section 3.3.2, samples will only be collected for logging purposes from deep monitoring wells. Subsequently, lithologies will only be described in the deep well pairs. Where there is a shallow well collocated with a new or existing deep well that has been sampled and logged, shallow well lithologies will be assumed to be the same as deep well lithologies.

## 3.5 Survey Data

The horizontal survey data historically used at BGS is the Indiana State Plane West (latitude and longitude); however, 329 IAC 10-21-4(h) references Universal Transverse Mercator coordinate system. For consistency with previously collected onsite data and industry standard practices, the horizontal datum will be Indiana State Plane West.

The vertical elevation datum historically used at BGS is the North American Vertical Datum of 1988 (NAVD88); however, 329 IAC 10-21-4(h) references the National Geodetic Vertical Datum of 1929, and 329 IAC 10-24-3(2) references mean sea level. For consistency with previously collected onsite data and industry standard practices, the vertical elevation datum will be collected using NAVD88.

## 3.6 Environmental Qualifications of Field Personnel

All work will be performed under the guidance and direction of an Indiana-State Licensed Geologist. When not physically onsite, the geologist will be immediately available by phone for support.

## 3.7 Recordkeeping

Installation, development, and/or decommissioning records will be included in the facility operating record in accordance with 40 CFR §257.91(e)(1). All field documentation will be submitted to IDEM within 60 days after completing all related field work.

**Table 1: Post-Closure Monitoring Well Network**
**NIPSCO LLC Bailly Generating Station**
**Chesterton, Indiana**

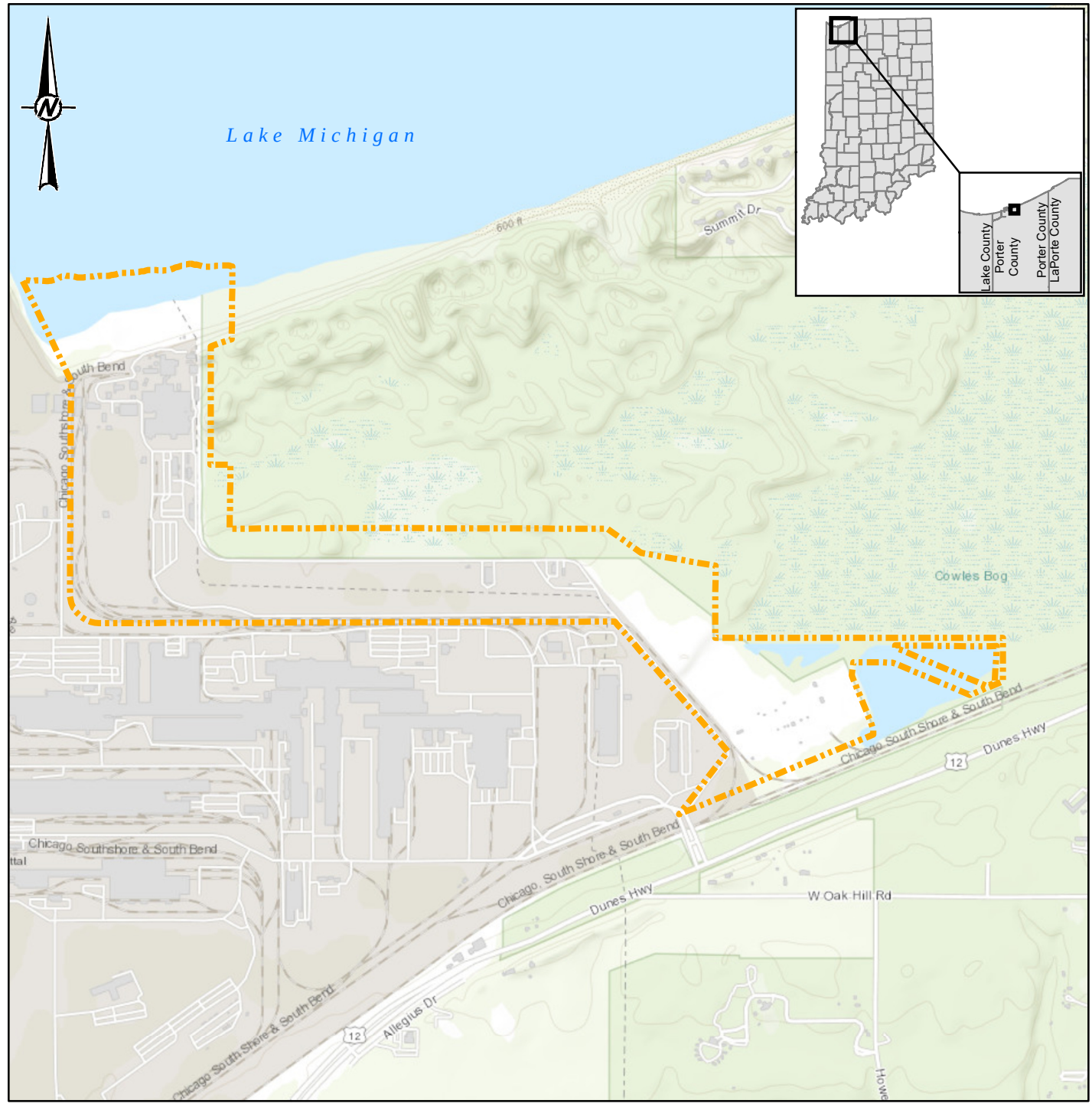
| | Monitoring Well ID | Ground Surface Elevation (ft-NAVD88) | Total Borehole Depth (ft-bgs) | Top of Casing Elevation (ft-NAVD88) | Sounded Well Depth (ft-btoc) | Well Material | Screen Length (ft) | Screen Depth | | Screen Elevation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Top (ft-bgs) | Bottom ft-bgs) | Top (ft-NAVD88) | Middle (ft-NAVD88) | Bottom (ft-NAVD88) |
| Background | GAMW-25[1] | TBD | TBD | TBD | TBD | 2" Sch 40 PVC | 10 | 13 | 23 | TBD | TBD | TBD |
| | GAMW-25B[1] | TBD | TBD | TBD | TBD | 2" Sch 40 PVC | 5 | 27 | 32 | TBD | TBD | TBD |
| Boiler Slag Pond | GAMW-12R | 622.94 | 28 | 625.91 | 31.40 | 2" Sch 40 PVC | 10 | 17 | 27 | 604.51 | 599.51 | 594.51 |
| | GAMW-13 | 622.10 | 23 | 625.34 | 26.43 | 2" Sch 40 PVC | 10 | 13 | 23 | 608.91 | 603.91 | 598.91 |
| | GAMW-14 | 621.60 | 23 | 624.32 | 26.46 | 2" Sch 40 PVC | 10 | 13 | 23 | 607.86 | 602.86 | 597.86 |
| | GAMW-26[1] | TBD | TBD | TBD | TBD | 2" Sch 40 PVC | 10 | 13 | 23 | TBD | TBD | TBD |
| | MW-105 | 619.17 | 18 | 622.05 | 21.29 | 2" Sch 40 PVC | 10 | 8 | 18 | 610.76 | 605.76 | 600.76 |
| Primary 1 and Primary 2 | GAMW-06 | 624.50 | 27 | 626.97 | 29.57 | 2" Sch 40 PVC | 10 | 17 | 27 | 607.40 | 602.40 | 597.40 |
| | GAMW-07 | 626.00 | 29 | 629.04 | 31.84 | 2" Sch 40 PVC | 10 | 19 | 29 | 607.20 | 602.20 | 597.20 |
| | GAMW-08 | 621.20 | 25 | 624.35 | 28.14 | 2" Sch 40 PVC | 10 | 15 | 25 | 606.21 | 601.21 | 596.21 |
| | GAMW-08B | 620.80 | 40 | 623.73 | 42.87 | 2" Sch 40 PVC | 10 | 30 | 40 | 590.86 | 585.86 | 580.86 |
| | GAMW-10 | 629.30 | 31 | 631.94 | 32.76 | 2" Sch 40 PVC | 10 | 21 | 31 | 609.18 | 604.18 | 599.18 |
| | GAMW-11 | 622.00 | 24 | 625.04 | 27.40 | 2" Sch 40 PVC | 10 | 14 | 24 | 607.64 | 602.64 | 597.64 |
| | GAMW-11B | 622.10 | 75 | 624.89 | 78.13 | 2" Sch 40 PVC | 5 | 70 | 75 | 551.76 | 549.26 | 546.76 |
| | GAMW-11C | 621.83 | 34 | 625.16 | 37.95 | 2" Sch 40 PVC | 5 | 29 | 34 | 592.21 | 589.71 | 587.21 |
| | GAMW-16 | 627.20 | 30 | 629.92 | 32.70 | 2" Sch 40 PVC | 10 | 20 | 30 | 607.22 | 602.22 | 597.22 |
| | GAMW-17 | 620.67 | 25 | 623.98 | 27.25 | 2" Sch 40 PVC | 10 | 14.5 | 24.5 | 606.73 | 601.73 | 596.73 |
| | GAMW-17B | 620.74 | 34 | 624.10 | 36.87 | 2" Sch 40 PVC | 5 | 28.5 | 33.5 | 592.23 | 589.73 | 587.23 |
| | GAMW-18 | 623.68 | 30 | 626.87 | 32.71 | 2" Sch 40 PVC | 10 | 20 | 30 | 604.16 | 599.16 | 594.16 |
| | GAMW-19 | 619.43 | 20 | 622.18 | 22.43 | 2" Sch 40 PVC | 10 | 9 | 19 | 609.75 | 604.75 | 599.75 |
| | GAMW-20 | 612.39 | 19 | 615.64 | 21.83 | 2" Sch 40 PVC | 10 | 8 | 18 | 603.81 | 598.81 | 593.81 |
| | GAMW-21 | 607.89 | 15 | 611.25 | 17.9 | 2" Sch 40 PVC | 10 | 4.3 | 14.3 | 603.35 | 598.35 | 593.35 |
| | GAMW-22 | 622.10 | 23 | 621.78 | 22.85 | 2" Sch 40 PVC | 10 | 12.9 | 22.9 | 608.93 | 603.93 | 598.93 |
| | GAMW-22B | 622.11 | 38 | 621.82 | 37.72 | 2" Sch 40 PVC | 10 | 28 | 38 | 594.10 | 589.10 | 584.10 |
| | GAMW-23 | 620.75 | 23 | 620.45 | 23.02 | 2" Sch 40 PVC | 10 | 13 | 23 | 607.43 | 602.43 | 597.43 |
| | GAMW-23B | 620.76 | 39 | 620.49 | 38.90 | 2" Sch 40 PVC | 10 | 29 | 39 | 591.59 | 586.59 | 581.59 |
| | MW-112 | 624.93 | 27 | 628.07 | 30.22 | 2" Sch 40 PVC | 10 | 17 | 27 | 607.85 | 602.85 | 597.85 |
| Secondary 1 | GAMW-01 | 621.26 | 23 | 624.53 | 26.32 | 2" Sch 40 PVC | 10 | 13 | 23 | 608.21 | 603.21 | 598.21 |
| | GAMW-01B | 621.08 | 32 | 623.76 | 34.98 | 2" Sch 40 PVC | 5 | 27 | 32 | 593.78 | 591.28 | 588.78 |
| | GAMW-02 | 621.30 | 23 | 624.20 | 26.48 | 2" Sch 40 PVC | 10 | 13 | 23 | 607.72 | 602.72 | 597.72 |
| | GAMW-03 | 621.00 | 23 | 624.35 | 27.09 | 2" Sch 40 PVC | 10 | 13 | 23 | 607.26 | 602.26 | 597.26 |
| | GAMW-04 | 620.90 | 23 | 624.12 | 26.37 | 2" Sch 40 PVC | 10 | 13 | 23 | 607.75 | 602.75 | 597.75 |
| | GAMW-24[1] | TBD | TBD | TBD | TBD | 2" Sch 40 PVC | 10 | 13 | 23 | TBD | TBD | TBD |
| Piezometers | MW-102 | 616.46 | 15 | 619.23 | 17.77 | 2" Sch 40 PVC | 10 | 5 | 15 | 611.46 | 606.46 | 601.46 |
| | MW-103 | 619.95 | 19 | 622.97 | 22.02 | 2" Sch 40 PVC | 10 | 9 | 19 | 610.95 | 605.95 | 600.95 |
| | MW-104 | 619.05 | 34 | 622.13 | 37.08 | 2" Sch 40 PVC | 10 | 9 | 19 | 595.05 | 590.05 | 585.05 |
| | MW-114 | 622.62 | 24 | 625.72 | 27.10 | 2" Sch 40 PVC | 10 | 14 | 24 | 608.62 | 603.62 | 598.62 |
| | MW-115 | 620.73 | 21 | 623.40 | 23.67 | 2" Sch 40 PVC | 10 | 11 | 21 | 609.73 | 604.73 | 599.73 |

Notes:

[1] Screen length and screen depth values are approximate target depths and may be adjusted based on field observations.

ft-bgs = feet below ground surface
ft-btoc = feet below top of casing
ft-NAVD88 = feet relative to the North American Vertical Datum of 1988
TBD = To Be Determined, values will be at time of device installation and/or well survey
2" Sch 40 PVC = Two-inch diameter well, constructed of schedule 40 polyvinyl chloride materials

Prepared by: SHL
Checked by: TDH
Reviewed by: MAH




**LEGEND**

Approximate Property Line

0 1,500 3,000

1 " = 1,500 feet Feet

**REFERENCE(S)**

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT

BAILLY GENERATING STATION
CHESTERTON, INDIANA

TITLE

**SITE LOCATION MAP**

CONSULTANT

wsp

| | |
|---|---|
| YYYY-MM-DD | 4/10/2024 |
| DESIGNED | DFS |
| PREPARED | SHL |
| REVIEWED | JSP |
| APPROVED | MAH |

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LEGEND

- Proposed Post Closure Monitoring Well
- Post Closure Monitoring Well
- Piezometer
- Approximate Property Line

0 400 800

1 " = 400 feet Feet

**NOTE(S)**

**REFERENCE(S)**

SERVICE LAYER CREDITS: © 2024 MICROSOFT CORPORATION © 2024 MAXAR ©CNES (2024) DISTRIBUTION AIRBUS DS

CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT

BAILLY GENERATING STATION
CHESTERTON, INDIANA
CLOSURE APPLICATION

TITLE

**POST-CLOSURE MONITORING WELL NETWORK**

CONSULTANT

wsp

| | |
|---|---|
| YYYY-MM-DD | 4/22/2024 |
| DESIGNED | SHL |
| PREPARED | SHL |
| REVIEWED | TDH |
| APPROVED | MAH |

| PROJECT NO. | CONTROL | REV. | FIGURE |
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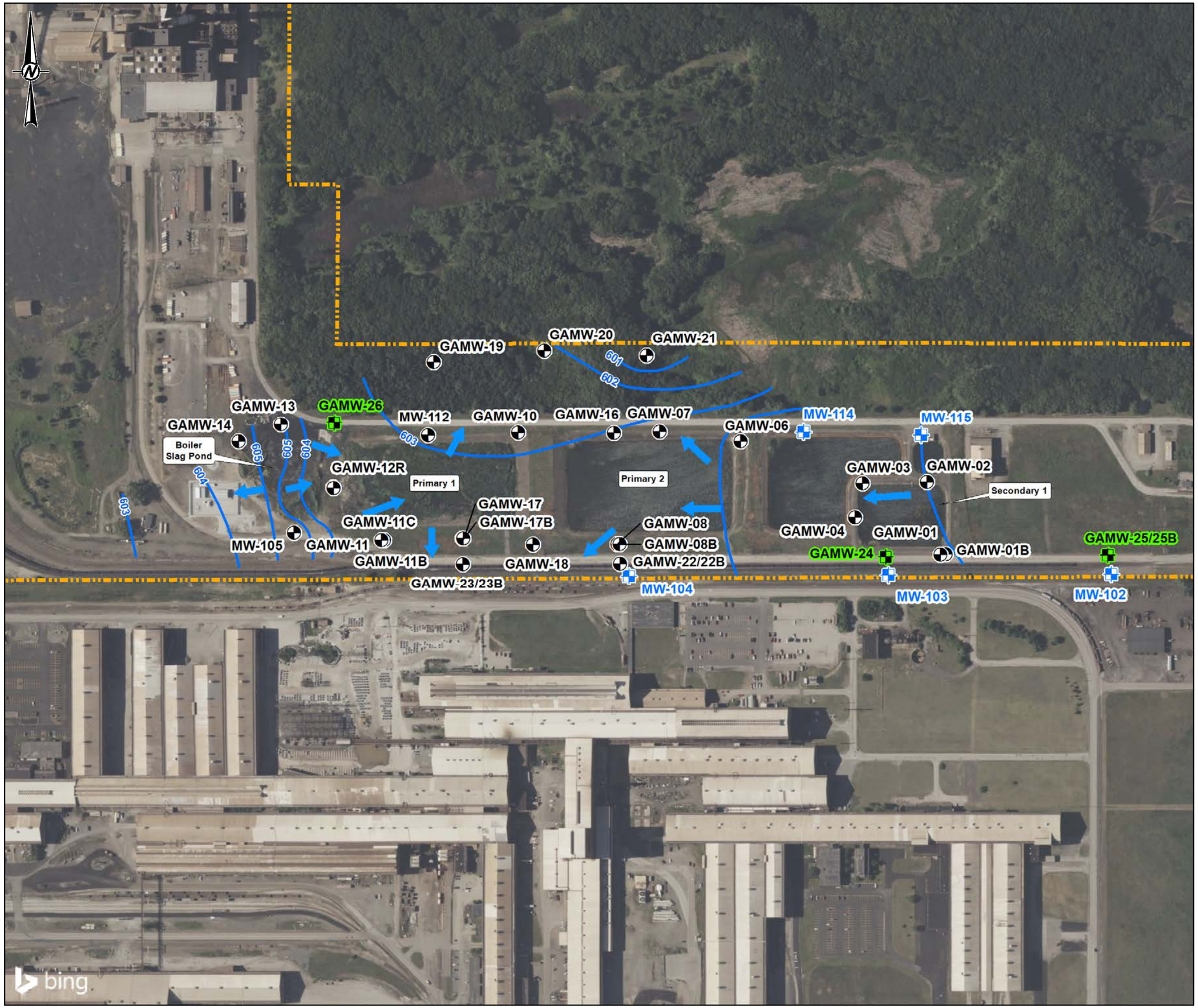


LEGEND

- Proposed Post Closure Monitoring Well
- Post Closure Monitoring Well
- Piezometer
- November 2023 Groundwater Elevation Contour (1 ft Interval)
- Generalized Flow Direction
- Approximate Property Line

0 400 800

1 " = 400 feet Feet

**NOTE(S)**

**REFERENCE(S)**

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CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT

BAILLY GENERATING STATION
CHESTERTON, INDIANA
CLOSURE APPLICATION

TITLE

**POTENTIOMETRIC SURFACE – NOVEMBER 2023**

CONSULTANT

wsp

| | |
|---|---|
| YYYY-MM-DD | 4/22/2024 |
| DESIGNED | SHL |
| PREPARED | SHL |
| REVIEWED | TDH |
| APPROVED | MAH |

| PROJECT NO. | CONTROL | REV. | FIGURE |
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**ATTACHMENT 1**

# Wood Closure Application for CCR Surface Impoundments – Bailly Generating Station (February 3, 2021)

NIPSCO

RECEIVED
FEB 4 2021
DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT
OFFICE OF LAND QUALITY

3 February 2021

Ms. Alysa Hopkins Raleigh, Permit Manager
Indiana Department of Environmental Management
Solid Waste Permits – IGCN 1101
100 North Senate Avenue
Indianapolis, IN 46204-2251

Subject: Closure Application for CCR Surface Impoundments
Bailly Generating Station
Chesterton, Indiana

Dear Ms. Raleigh:

The Northern Indiana Public Service Company LLC (NIPSCO LLC) respectfully submits the enclosed Closure Application for the CCR surface impoundments at the Bailly Generating Station. If you have questions or require additional information, please contact me at 219-647-5249 or jloewe@nisource.com.

Sincerely,

Jeffrey M. Loewe
Principal
NiSource Environmental

Attachments: Volume 1 – Closure Application and Drawings (Appendix A)
Volume 2 – Appendices B to G
Volume 3 – Appendix H

3 February 2021

Wood Environment & Infrastructure Solutions, Inc.
11003 Bluegrass Parkway
Suite 690
Louisville, Kentucky 40299
USA
T: 502-267-0700
**www.woodplc.com**

Mr. Jeff Loewe
Northern Indiana Public Service Company LLC
801 E. 86th Avenue
Merrillville, IN 46410

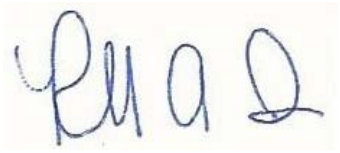
Re: Closure Application – CCR Surface Impoundments
Bailly Generating Station
Chesterton, Indiana
Wood Project No. 7382-17-3270

Dear Mr. Loewe:

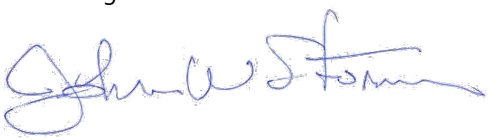
Wood Environment and Infrastructure Solutions (Wood) is submitting this Closure Application for CCR surface impoundments at the Bailly Generating Station. The Closure Application includes a closure plan, figures, and appendices describing the approach and conceptual methods to address removal of CCR materials to meet Federal and State of Indiana regulations.

We appreciate this opportunity to provide engineering services to Northern Indiana Public Service Company LLC. If you have questions regarding the Closure Application, please contact us at 502-267-0700.

Sincerely
Wood Environment and Infrastructure Solutions, Inc.



Richard A. Isaac, PE
Senior Engineer



John W. Storm PE
Project Manager, Principal Engineer

**Closure Application Attachments:**

Volume 1 - Closure Application and Drawings (Appendix A)
Volume 2 - Appendices B through G
Volume 3 - Appendix H

# Surface Impoundment Closures (CCR Final Rule) Closure Application

Bailly Generating Station

Northern Indiana Public Service Company LLC, Merrillville, Indiana

**Prepared for:**

Northern Indiana Public Service Company LLC
Merrillville, Indiana

**Prepared by:**

Wood Environment & Infrastructure Solutions, Inc.
11003 Bluegrass Parkway
Suite 690
Louisville, Kentucky 40299
USA
T: 502-267-0700

**2/3/2021**

# Table of contents

## List of figures



## List of tables



## List of appendices

# List of acronyms

| | |
|---|---|
| 3H:1V | 3 horizontal to 1 vertical |
| AMSL | above mean sea level |
| ASTM | American Society for Testing and Materials |
| bgs | below ground surface |
| BGS | Bailly Generating Station |
| CCR | coal combustion residuals |
| CFR | Code of Federal Regulations |
| cm/sec | centimeters per second |
| GWPS | groundwater protection standards |
| HDPE | high-density polyethylene |
| IAC | Indiana Administrative Code |
| IDEM | Indiana Department of Environmental Management |
| IDNP | Indiana Dunes National Park |
| IDNR | Indiana Department of Natural Resources |
| LCL | lower confidence limit |
| LKD | lime kiln dust |
| LPL | lower prediction limit |
| MCGS | Michigan City Generating Station |
| MCL | maximum contaminant level |
| NC | non-compliance |
| NGVD29 | National Geodetic Vertical Datum of 1929 |
| NIPSCO LLC | Northern Indiana Public Service Company LLC |
| NPDES | National Pollutant Discharge Elimination System |
| PVC | polyvinyl chloride |
| QAPP | quality assurance project plan |
| RCRA | Resource Conservation and Recovery Act |
| RMSGS | R.M. Schahfer Generating Station |
| SAP | sampling and analysis plan |
| SSI | statistically significant increase |
| SSL | statistically significant level |
| SWMU | solid waste management unit |
| UCL | upper confidence limit |
| UPL | upper prediction limit |
| USEPA | United States Environmental Protection Agency |
| USGS | United States Geological Survey |

# 1.0 Introduction

The Bailly Generating Station (BGS), owned by the Northern Indiana Public Service Company LLC (NIPSCO LLC), generated electricity using coal-fired boilers from 1962 until 2018. The coal-fired electricity generating process produced coal combustion residuals (CCR) in the form of boiler slag and fly ash. The CCR materials were sluiced into on-site surface impoundments located southeast of the generating station.

The United States Environmental Protection Agency (USEPA) published the Disposal of Coal Combustion Residuals from Electric Utilities Final Rule (CCR Rule) in the Federal Register on 17 April 2015 requiring closure of CCR surface impoundments not meeting the CCR Rule requirements. The State of Indiana Environmental Rules Board adopted an emergency rule incorporating the USEPA CCR Final Rule requirements for CCR surface impoundments into 329 Indiana Administrative Code (IAC) 10. The amendments in the emergency rule went through a full rule writing process and became permanent 10 December 2016. The Indiana Department of Environmental Management (IDEM) adopted an amendment to update Indiana's regulations for regulating CCR disposal facilities to standards equivalent to the USEPA Rule.

This closure application was prepared to outline and present the plan and objectives to close these regulated surface impoundments to meet federal and state requirements.

## 1.1 BGS surface impoundments

The BGS has six surface impoundments located southeast of the generating station. Four of the surface impoundments are CCR Rule regulated. Secondary Settling Pond No. 2 and the Forebay did not manage CCR and are not CCR Rule regulated.

| BGS Surface impoundments | |
|---|---|
| **CCR surface impoundments** | **Non-CCR impoundments** |
| Boiler Slag Pond | Secondary Settling Pond No. 2 |
| Primary Settling Pond No. 1 | Forebay |
| Primary Settling Pond No. 2 | |
| Secondary Settling Pond No. 1 | |

## 1.2 Closure application objectives

The closure application objectives are to:

- Comply with state and federal regulatory requirements
- Present rationale for proposed closure by removal
- Provide engineering drawings depicting limits and methods to achieve closure by removal
- Describe anticipated post-closure care monitoring and maintenance activities
- Present the post-closure care groundwater monitoring plan
- Develop a schedule for closure and post-closure care activities

- Develop closure and post-closure care opinion of probable costs

# 2.0 Facility overview

## 2.1 Location and setting

The BGS is located on the southern shore of Lake Michigan on approximately 350 acres near Chesterton, Indiana. (see Figure 1 - Site Location Map). The street address is 246 Bailly Station Road, Chesterton, Indiana 46304 at latitude 41° 38′ 18″ North, and 87° 07′ 02″ West. The Township is 37N, Range 6W, and Section 21. The BGS and surrounding area are shown on United States Geological Survey (USGS) Quadrangle Map Dune Acres (see Figure 2 - Site Vicinity Map).

The BGS is bounded on the north by Lake Michigan, the east by the Indiana Dunes National Park (IDNP), and on the west and south by ArcelorMittal Steel (formerly Mittal Steel, formerly International Steel Group, and before that, Bethlehem Steel), and partially on the south by US Route 12 and freight and commuter rail lines.

## 2.2 Facility development

The BGS initiated construction in 1959 with a single coal fired unit (Unit 7) and began commercial operation in 1962. Beginning in 1966, a major expansion project was undertaken to allow construction of a second coal-fired generating unit, Unit 8, which became operational in 1968.

The BGS ceased the coal-fired boilers operation 30 April 2018. A third generator (Unit No. 10), which burned natural gas was retired on 15 July 2020.

## 2.3 Surface impoundments

Four CCR surface impoundments are located southeast of the BGS generating station. An aerial photograph of the BGS, along with the surface impoundment locations, is presented in Figure 3 - Aerial Photograph of Surface Impoundments. The surface impoundments are primarily incised, constructed below ground surface, with interior side slopes to the pond bottoms. Sargent and Lundy Engineers designed the current configuration of the surface impoundments that began operation in 1981. The surface impoundments were constructed with a liner system consisting of one foot of natural clay and a geomembrane component, with a sand cushion layer and steel furnace slag surface protection. The area and estimated volume of CCR material within each of the surface impoundments is presented in Table 1.

**Table 1: Surface Impoundment Closure Information**
Surface Impoundments Closure Application, Bailly Generating Station

| Surface impoundment | Impoundment type | Impoundment **size (acres)** | Current Estimated CCR volume (cubic yards) |
|---|---|---|---|
| Boiler Slag Pond | Partially incised | 1.2 | 1,000[(1)] |
| Primary Settling Pond No. 1 | Incised | 5.6 | 28,000[(2)] |
| Primary Settling Pond No. 2 | Incised | 7.2 | 20,000[(3)] |
| Secondary Settling Pond No. 1 | Incised | 2.5 | 6,000[(2)] |

Note 1: The Closure Plan prepared by Haley and Aldrich dated 7 February 2019 indicated 11,000 cubic yards (CY) of boiler slag. In 2020, Harsco Recycling Co. removed usable boiler slag from the impoundment for beneficial use. It is estimated that 90% of the boiler slag was removed and current remaining volume is on the order of 1,000 CY.
Note 2: CCR volume based on Closure Plan prepared by Haley and Aldrich dated 7 February 2019.
Note 3: Volume based on Closure Plan prepared by Golder dated January 2019

Note that the current impoundment configuration is located within the footprint of a previous set of surface impoundments. It is believed that the original boiler slag pond, primary settling ponds and secondary ponds were first used when the facility operations began in 1962. Although no formal records were found to confirm this suspected date, a review of historic aerial photos and archived design drawings suggest that 1962 is reasonably correct. Significant reconstruction and reconfiguration of these impoundments took place when the original ponds were reportedly dredged and reconfigured with construction completed in 1981.

## 2.4 Previous site investigations

Previous site investigations have been performed at the BGS. The following are relevant to the surface impoundments:

- AMEC Earth & Environmental, Inc. (AMEC), 2005. RCRA Current Conditions Report, NIPSCO Bailly Generating Station Chesterton, Indiana, prepared for Northern Indiana Public Service Company, April 13, 2005.
- AMEC, 2007b. RCRA Facility Investigation Report. NIPSCO Bailly Generating Station, Chesterton, Indiana. August 30, 2007.
- Amec, 2008, *2008 Michigan City Generating Station Subsurface Investigation Summary*, Michigan City, Indiana.
- AMEC, 2010. RCRA Facility Investigation Report for Area B. NIPSCO Bailly Generating Station, Chesterton, Indiana. August 16, 2010.
- USGS Water Resources Investigation 81-16 (USGS, 1981). Data from this 1981 USGS water resources investigation titled, "Effects of Coal Fly Ash Disposal on Water Quality in and around the Indiana Dunes National Lakeshore."
- Water Resources Report 85-4340 (USGS, 1986). This 1986 USGS water resources investigation titled, "Shallow Ground-Water Flow, Water Levels, and Quality of Water 1980-84, Cowles Unit, Indiana Dunes National Lakeshore."
- Final Round 10 - Dam Assessment Report - Bailly Generating Station Coal Ash Impoundments. Prepared by GZA, Inc. dated 17 August 2012.RCRA Facility Investigation (RFI) Report submitted on August 30, 2007 (AMEC, 2007),

# 3.0 Geology and hydrogeology information

## 3.1 Physiography

The BGS is located within the Calumet Lacustrine Plain, a physiographic province characterized by three post-glacial dune-beach complexes and bordered on the north by Lake Michigan and on the south by the Valparaiso Morainal Area (Shedlock et al., 1994). The dune-beach complexes parallel the BGS and the current lakeshore boundary. Local geomorphology from the lakeshore to the south consists of the Holocene and Tolleston dune-beach complex, the western portion of the Great Marsh (an interdunal lowland), and the Calumet and Glenwood dune-beach complex; however, the landscape has been modified to support the BGS facility activities and consists primarily of cut and fill

materials (Cohen and Shedlock, 1986). The area northeast of the BGS is preserved largely in its natural state as part of the IDNL and consists of the Great Marsh and landforms of the Holocene and Tolleston dune-beach complex. Part of the Great Marsh northeast of the BGS is designated as the Cowles Bog National Natural Landmark (Cowles Bog).

The land surface elevation ranges from approximately 578 feet above mean sea level (AMSL) along the shore of Lake Michigan to approximately 627 feet AMSL within the BGS. The elevation ranges from approximately 619 feet to 627 feet AMSL. The locations of Geologic Cross Section A-A', and Geologic Cross Section B-B', are shown on Figure 1 and Figure 2, respectively in Appendix B.

## 3.2 Geology

The geology along the Lake Michigan southern shore represents a complex glacial and post-glacial history consisting of shallow-water coastal lake, wetland, and dune sedimentation that began during, and continued after, the final stages of glacial retreat in the Great Lakes area.

### 3.2.1 Bedrock geology

Unconsolidated deposits in the BGS vicinity are underlain by the Antrium Shale (Upper Devonian) and carbonate rock (Muscatatuck Group) of Devonian Age. Bedrock in the BGS vicinity ranges from 430 feet to 450 feet AMSL. The Antrium Shale consists of brown to black non-calcareous shale and para conformably (strata are parallel, and the contact is a simple bedding plane) overlies the Muscatatuck Group rocks in the BGS area. The Muscatatuck Group consists of rocks that are predominately limestone and dolomite.

A 1977 USGS boring near the eastern portion of the BGS encountered bedrock (Antrium Shale) at 175 feet below ground surface (bgs). A second USGS boring on the western portion of the BGS encountered shale (Antrium Shale) at 182 feet bgs.

### 3.2.2 Unconsolidated deposits

Indiana Dunes region subsurface unconsolidated deposits are comprised of three distinct sedimentary units: the basal, middle (till), and surface units. These three sedimentary units can be seen in Geologic Cross Section A-A' presented in Figure 1 in Appendix B.

The basal unit consists of randomly interbedded clay, sand and gravel, and till, and rests on the irregular Paleozoic bedrock surface. The thickness of this lowermost lithologic unit in the area of the BGS is highly variable because of the underlying bedrock's relief and sediments erosion.

The middle unit (till) consists of an assemblage of interbedded, till, glacial/lake clay, sand, and gravel. This unit outcrops in the region as the Lake Border Moraine, about 0.5 miles south of the BGS. The middle unit thickness ranges from 0 feet to 80 feet. The glacial/lake deposits are well developed northward within the unit, where the unit extends under Lake Michigan. The till deposit at the BGS is thickest to the north bordering Lake Michigan, and is thinnest southwest of the BGS, where the till may be discontinuous (Meyer and Tucci, 1979).

The surface unit, an outcropping along the Lake Michigan southern shore, consists of coastal sand with minor gravel, clay, calcareous mud, and peat. This series of dune complexes began forming in response to changes in lake level and changes in the amount of sediment supplied to the coastline. The Holocene and Tolleston dune-beach deposits underlying the BGS and extending northeast along the shore are composed of up to 50 feet of fine-grained, well-sorted eolian sand with lesser lacustrine beach sand and gravel (Hardy, 1981).

Historical USGS investigations indicate the unconsolidated deposits' upper 50 feet are composed of gray to tan fine sand with some zones of medium sand and gravel. The lower 130 feet are comprised of silty lake clay with interspersed thin beds of silty sands.

### 3.2.3 Soils

Soils in the BGS vicinity are composed primarily of five types: Oakville fine sand, Houghton muck, Adrian muck, Maumee loamy fine sand, and dune sand.

Soils (surficial deposits) in the BGS area are mainly dune deposits that contain sand and some fine gravel. In addition to the dune deposits, the IDNP intradunal wetlands contain paludal deposits (peat, muck, some marl, and mixtures of peat and sand). The largest portion of land used for industrial purposes is classified as cut and fill.

## 3.3 Hydrogeology

### 3.3.1 Bedrock aquifers

The occurrence of bedrock aquifers in the Lake Michigan region depends on the original composition of the rocks and post-depositional changes, which can influence hydraulic properties. The Antrium Shale is a poorly productive shale that overlies the fairly productive carbonates of the Muscatatuck Group. In general, bedrock aquifers are not utilized in the area because of the unproductive shale at the bedrock surface and availability of water from the overlying glacial deposits (Indiana Department of Natural Resources [IDNR], 1994).

### 3.3.2 Surficial aquifers

Surficial aquifers under the BGS consist of glacially derived sediments associated directly or indirectly with Lake Michigan ice lobe advance and retreat during the Wisconsinan glaciation. There are three major aquifers within the unconsolidated sediments surrounding the BGS: basal, subtill, and surficial. The basal sand aquifer appears to be thicker east of the BGS, although the aquifer extent is not well defined.

The most extensive confined aquifer in the area is the subtill aquifer, which consists primarily of sand with interbedded lenses of clay. The subtill aquifer is part of the geologic middle unit and underlies the entire area of the Lake Border Moraine, which originates in the upland areas south of the BGS and extends beneath the easternmost portion of the BGS based on multiple borings advanced by Wood during the Resource Conservation and Recovery Act (RCRA) Corrective Action program. The subtill aquifer does not appear to extend westward below the CCR Units.

The most extensive aquifer in the BGS area is the surficial aquifer, which consists primarily of unconfined lacustrine and eolian sands. The surficial aquifer under the BGS is approximately 50 feet thick, and groundwater flow in the surficial aquifer is primarily horizontal toward Lake Michigan. The surficial aquifer is sometimes separated into an upper and lower sand unit by a calcareous clay of variable thickness and continuity. This clay unit was encountered in some of the borings advanced near the CCR units during the RCRA Corrective Action and CCR programs. Near the CCR units the saturated thickness of the uppermost sand aquifer ranges from 15 feet to 30 feet depending on the height of the fluctuating water table. Regional estimates of aquifer transmissivity (unconsolidated deposits) in the vicinity range from 10,000 to 50,000 gallons per day per foot (IDNR, 1994). No water supply wells exist within the BGS and, according to information provided by the IDNR, no potable water supply wells exist within the portion of IDNL located hydraulically downgradient of the BGS.

A line of extraction wells was installed in an east-west alignment approximately 600 feet south of the BGS surface impoundments on the ArcelorMittal Steel property that were once used to dewater

foundations at several buildings. Online records available from the Indiana Department of Natural Resources (IDNR) show that the test capacities of these wells ranged from 300 to 1000 gallons per minute (gpm) at the time of installation. None of these wells are registered with the IDNR as Significant Withdraw Wells.

Additional wells were installed on the ArcelorMittal Steel property further south of the above referenced well alignment, including one Significant Withdraw Well. IDNR records indicate that this well has an average annual pumping rate of approximately 200 gpm. The following was stated in a letter by EPA provided to NiSource Environmental Remediation, dated January 21, 2021, "According to ArcelorMittal, of the 35 dewatering wells that were installed many years ago, only one is still in use…The only dewatering well that is currently in use is pumping groundwater at 15 gallons per minute." This information corroborates Woods understanding of the current pumping well south of the impoundments on the Arcelor Mittal property with the exception of the pumping rate.

### 3.3.3 Surface water

Lake Michigan is located immediately north of the BGS. Industrial consumers and public utilities use Lake Michigan for multiple purposes. The Little Calumet River is located approximately 0.5 miles south of the BGS, and discharges to Lake Michigan through Burns Ditch about 5 stream miles west of the BGS, as shown in Figure 3 - Aerial Photograph of Surface Impoundments.

Surface water features at the BGS include the Boiler Slag Pond, Primary Settling Pond No. 1, Primary Settling Pond No. 2, Secondary Settling Pond No. 1, Secondary Settling Pond No. 2, and the Forebay as shown in Figure 4. Surface water runoff predominately from the coal pile area is managed in the Coal Handling Maintenance Surface Impoundment and the Coal Pile Runoff Absorption Area. Permanent surface water bodies known as the Southeast Ponds are present abutting the far eastern portion of the BGS and wetlands that contain surface water depending on precipitation and groundwater elevations, including Central Blag Slough, Little Lake, and the Eastern Wetlands are present in the IDNP north and northwest of the CCR Units.

# 4.0 Regulatory framework

Federal regulations contain primary closure requirements for CCR surface impoundments at the BGS. The Federal CCR Rule (40 CFR 257), hereinafter referred to as "the CCR Final Rule," lists rules and requirements to be implemented to close the surface impoundments cited in this closure application.

Prior to the CCR Final Rule, the State of Indiana developed regulatory guidance for closing surface impoundments as outlined in 329 IAC 10. The State of Indiana has incorporated the CCR Final Rule by reference.

This closure application has been prepared to address the CCR Final Rule and applicable IDEM regulations as related to specific closure requirements and post-closure care and cost opinions.

## 4.1 Federal CCR Rule

The CCR Final Rule was published in the Federal Register 17 April 2015 and became effective 19 October 2015. Written closure plan and post-closure care requirements are set forth in 40 CFR § 257.102 (b)(1) and 40 CFR § 257.104, respectively, and are discussed more fully within this closure application. CCR Final Rule closure requirements applicable to the surface impoundments include:

- General Provisions in 257.50 through 257.53
- Ground water monitoring and corrective action standards in 257.90 through 257.98
- Closure and post-closure care standards in 257.100 through 257.104

- Recordkeeping, notification, and posting of information to the Internet in 257.105 through 257.107.

# 5.0 Surface impoundment description

Sargent & Lundy Engineers designed the surface impoundments beginning in 1978 with construction completed in 1981. The impoundments are incised, excavated below the surrounding ground surface. A perimeter slope was excavated downward to the relatively flat impoundment bottom. Each surface impoundment was constructed with a liner system consisting of the following components presented in descending order from top to bottom:

- One-foot of coarse-graded crushed steel furnace slag
- Six inches of sand
- A geomembrane
- Six inches of sand
- One foot of clay soil material.

One exception to this bottom liner system configuration is the Boiler Slag Pond has two feet of steel furnace slag as the top component.

Overhead power lines span all four of the surface impoundments in the east / west direction. Overhead power lines including transmission line support towers are present along the southern and northern impoundment limits. The support towers are located as follows:

- East of the Boiler Slag Pond and at the southwest corner of Primary Settling Pond No. 1
- At the southeast corner of Primary Settling Pond No. 1 and the southwest corner of Primary Settling Pond No. 2
- At the southeast corner of Primary Settling Pond No. 2 and the southwest corner of Secondary Settling Pond No. 2
- East of Secondary Settling Pond No. 1.

The support towers are located on unexcavated areas that exist between the impoundments. The overhead transmission lines and support towers were in place prior to construction of the currently configured surface impoundments.

A piping system was constructed to transfer operational water through the surface impoundment system. Boiler slag was sluiced from the generating station to the impoundment. Fly ash was sluiced to Primary Settling Pond No. 1 and Primary Settling Pond No. 2. Sluiced water was transferred from the Boiler Slag Pond to Primary Settling Pond No. 1. Operational waters were subsequently transferred from Primary Settling Pond No. 1 through the existing piping system and subsequently into the Forebay for discharge.

## 5.1 Boiler Slag Pond

The Boiler Slag Pond has an irregular shape, approximately 335 feet long by 160 feet wide and encompasses approximately 1.2 acres. Based on the Closure Plan prepared by Haley and Aldrich dated 7 February 2019, the impoundment contained as much as 11,000 CY of CCR material. In 2020, Harsco Recycling Co. (Harsco), removed usable boiler slag from the impoundment for beneficial use. It is estimated that approximately 90% of the boiler slag was removed and remaining CCR is estimated to be on the order of 1,000 CY.

The Boiler Slag Pond was designed as a lined surface impoundment with an approximate depth ranging from 8 to 9 feet. This depth corresponds to a bottom of impoundment elevation (top of liner) of approximately 618.5 to 619.5 feet NAVD88 (North American Vertical Datum of 1988) sloping toward Primary Settling Pond No. 1.

The impoundment interior slopes were designed at 3 horizontal to 1 vertical (3H:1V); however, excavation for slag removal and erosion have occurred, allowing steepened interior slopes with light vegetation near the ground surface. The exterior slopes are at 3H:1V, sparsely vegetated with grass, with some signs of erosion.

### 5.2 Primary Settling Pond No. 1

Primary Settling Pond No. 1 measures approximately 750 feet long by 350 feet wide and encompasses approximately 5.6 acres. The surface impoundment is incised with an approximately 120-foot-wide flat area between Primary Settling Pond No. 1 and Primary Settling Pond No. 2. The interior slopes are constructed at 3H:1V. Primary Settling Pond No. 1 contains approximately 28,000 cubic yards of CCR material, based on the Closure Plan prepare by Haley and Aldrich dated 7 February 2019. Primary Settling Pond No. 1 is a lined surface impoundment with an approximate depth ranging from 8 to 10 feet. The bottom elevation is approximately 611.5 feet to 613.5 NAVD88.

### 5.3 Primary Settling Pond No. 2

Primary Settling Pond No. 2 measures approximately 750 feet long by 400 feet wide and encompasses approximately 7.2 acres. Primary Settling Pond No. 2 is an incised pond with an approximately 100-foot-wide flat area present between Primary Settling Pond No. 2 and Secondary Settling Pond No. 2 located to the east. The interior slopes are constructed at 3H:1V.

Primary Settling Pond No. 2 is a lined surface impoundment with an approximate depth below ground surface ranging from 20 feet to 14 feet from west to east. It has a bottom elevation (top of liner elevation) of approximately 612.5 feet to 610.5 feet, sloping from west to east. The top of the impoundment is at approximately 625 feet on the north and east sides, approximately 620 feet along the south side, and approximately 635 feet on the west side. Primary Settling Pond No. 2 stores approximately 20,000 cubic yards of CCR material, based on the Closure Plan-Rev 2 prepared by Golder dated January 2019.

### 5.4 Secondary Settling Pond No. 1

Secondary Settling Pond No. 1 measures approximately 385 feet long by 275 feet wide and encompasses approximately 2.5 acres. It is an incised pond with interior slopes constructed at 3H:1V. Secondary Settling Pond No. contains approximately 6,000 cubic yards of CCR material, based on the Closure Plan prepared by Haley and Aldrich dated 7 February 2019.

Secondary Settling Pond No. 1 is a lined surface impoundment with a bottom elevation (top of liner elevation) of approximately 609.5 feet to 608.5 feet NAVD88, sloping from west to east. The top of the impoundment is at approximately 620 feet to 623 feet NAVD88 with an approximate depth ranging from 10 to 14 feet.

## 6.0 Closure approach

The following sections discuss the surface impoundments closure approach.

### 6.1 General approach

Removing the surface impoundment contents (CCR) is the proposed closure method. CCR material will be excavated and transported to the NIPSCO LLC R.M. Schahfer Generating Station (RMSGS)

onsite landfill for disposal (or possibly sold for beneficial use). The CCR materials from each surface impoundment will be excavated, placed in highway dump trucks, and transported over a pre-determined route to the RMSGS.

Closure by removal will include removing contents to the impoundments limits as determined from the Sargent and Lundy construction documents. The surface impoundment closure will consider requirements to preserve the overhead powerlines, including poles and high transmission metal towers running along the surface impoundment's northern and southern boundaries.

The surface impoundments liner components will be removed for disposal in the NIPSCO LLC RMSGS onsite landfill. The geomembrane material will be separated from the slag/sand/clay soil material for disposal at the RMSGS CCR Landfill or in an off-site facility permitted to accept the geomembrane material. The impoundment slopes associated with unexcavated areas between the impoundments were lined to extend up the perimeter slope beyond the CCR/ free water level. The liner will be removed from the perimeter slopes and verification procedures performed as described in this closure application.

As indicated, the impoundments were constructed by excavating below the ground surface, therefore berms were not constructed with the exception of the partial berm at the Boiler Slag Pond. The berm material at this location will be excavated and disposed at the RMSGS on-site CCR landfill.

Removal verification procedures will be conducted at the bottom of the surface impoundments upon excavation completion for the surface impoundment CCR and liner system. Verification will include visual observations for the presence of CCR and topographical survey of the CCR limits, liner system limits, and excavation bottom. Photographs will be taken to document the CCR removal conditions.

Grading and placing off-site soil/topsoil material to a minimum depth of 2 feet (18 inches of soil material and 6 inches of topsoil) will create a final cover and promote storm water runoff. Post closure storm water runoff will be managed by gravity drainage or by using the existing piping system and Forebay pumping station.

## 6.2 Closure performance standard

The CCR Rule as well as IDEM regulations establish requirements for the CCR surface impoundment closures. The closure performance standards are listed in Table 2.

**Table 2: Closure Performance Standards**

Surface Impoundment Closure Application, Bailly Generating Station

| Regulation | Citation | Closure performance standard |
|---|---|---|
| 40 CFR 257 | 102(c) | An owner or operator may elect to close a CCR unit by removing and decontaminating all areas affected by releases from the CCR unit.<br><br>CCR removal and decontamination of the CCR unit are complete when constituent concentrations throughout the CCR unit and any areas affected by releases from the CCR unit have been removed and groundwater monitoring concentrations do not exceed the groundwater protection standard established pursuant to §257.95(h) for constituents listed in Appendix IV to this part. |

| Regulation | Citation | Closure performance standard |
|---|---|---|
| 40CFR 257 | 102(d) | Control post closure infiltration of liquids through the former unit. Permeability of soil cover layer is not less than 1 x $10^{-5}$ centimeters per second (cm/sec).<br>Preclude the probability of future impoundment of water, sediment, or slurry.<br>Provide for major slope stability to prevent sloughing or movement.<br>Minimize need for maintenance<br>Timely completion of closure |
| 329 IAC | 10-30-1 | Owner or operators of Type I and Type II restricted waste sites and non-municipal solid waste landfills shall close the facilities in such a manner that:<br>• Minimizes the need for further maintenance<br>• Controls post-closure escape of waste, waste constituents, leachate, contaminated precipitation, or waste decomposition products to the ground or surface waters or the atmosphere<br>• At a minimum, is in compliance with applicable closure provisions and conditions imposed in the facility permit. |

# 7.0 Closure design

Closure will be conducted by removing surface impoundment contents (CCR materials). The following sections of this closure application provide closure methodology discussions and details. Removing impounded water, dewatering interstitial water, and moisture conditioning of the CCR will be conducted as necessary to complete the surface impoundment closures. The impoundment liner system (as described previously) will be removed and disposed. Backfill soil to achieve subgrade and a two-foot soil cover will be placed over the former surface impoundment areas following excavation to provide:

1. Grading to manage surface water runoff
2. Final cover as a separation layer and to limit infiltration.

Overhead electrical transmission lines including poles and high transmission metal towers are present along the surface impoundments' northern and southern boundaries. The support structures (towers) and below grade foundations are located adjacent to the surface impoundments. The transmission lines will remain in operation and final closure design must consider the towers' integrity with respect to CCR excavation and removal near them.

## 7.1 Demolition

The inflow pipelines associated with CCR and non-CCR discharge will be properly cut off and capped at the impoundment limit and grouted with a minimum length of 10 feet of flowable fill. The Boiler Slag Pond has a concrete retaining wall that will be demolished and properly disposed during closure.

System piping not used for post-closure grading and drainage will be removed when the excavation activity is performed. The removed piping will be cut for placement in roll-off boxes for off-site disposal in a disposal facility permitted to accept the pipe materials. Concrete structures associated with the piping system will be demolished with the reinforcing materials removed for recycling, if appropriate, and the concrete debris placed in roll-off boxes for off-site disposal in a disposal facility permitted to accept the demolished concrete materials.

## 7.2 Dewatering considerations

Water management will be required during surface impoundments closure activities. Requirements include free water removal, CCR interstitial water removal, storm water control during closure implementation, and potential groundwater inflow. Water management will be conducted using trenches and sumps, mechanical pumps, well point systems, or removal wells. Dewatering operations and associated discharges during closure will be managed to meet IDEM guidelines, federal discharge limits, and NPDES requirements, as appropriate. NIPSCO LLC will coordinate with IDEM's Office of Water Quality to develop allowable discharge conditions and constituent limits.

The groundwater level around the surface impoundments is typically located near the bottom on the ponds, depending on the varying bottom elevations. Levels have fluctuated since the BGS ceased operation of the coal-fired boiler operations. Groundwater levels dropped significantly at the Boiler Slag Pond to levels that are currently 6 feet or more below the deepest liner bottom elevation of 614.5 ft NAVD88. The water level decline at Primary Settling Pond 1 was less pronounced compared to the Boiler Slag Pond. Current groundwater elevations at Primary Settling Pond 1 are a foot or more below the deepest liner base elevation of 608.5 ft NAVD88. Water level declines after the plant shutdown were not evident at Primary Settling Pond 2 or Secondary Settling Pond 1. Groundwater levels at Primary Settling Pond 2 occasionally rise above the deepest liner base elevation of 607.5 ft NAVD88, whereas groundwater levels at Secondary Settling Pond 1 routinely rise above the highest liner base elevation of 606.5 ft NAVD, and since 2016 have always been above the lowest liner base elevation of 605.5 ft NAVD88.

Expected water management activities are discussed as follows:

- Free water removal - The surface impoundments at the BGS contain approximately 22 million gallons of free water (based on closure plans previously referenced). Free water removal will be performed by gravity flow and, where necessary, mechanical pumping, discharging to the permitted NPDES discharge. Shallow trenches or sumps excavated prior to commencing grading activities, and pumps installed, if necessary, can lower the surface impoundment water level to allow excavation activities to begin.

- CCR interstitial water removal - Water draining from the CCR materials during excavation will be managed during closure activities. This water will be collected in sumps for appropriate discharge and or disposal.

- Storm water control - Storm water from rainfall events will be managed based on the stage of closure for each of the surface impoundments. Rainfall occurring during the excavation activity will be diverted, as needed, using perimeter ditches, diversion berms, and/or swales to direct surface run on around/away from the surface impoundments. Rainfall within the excavation areas will be managed with ditches to direct the water to sumps. Storm water will be evaluated for appropriate discharge or disposal.

- Potential groundwater inflow -Closure activities are likely to encounter groundwater depending on the seasonal conditions and fluctuating groundwater elevations. Consideration will be given to performing excavation work during the summer construction season. Accumulated groundwater, if encountered, will be collected in sumps, by well points and/or rim ditches.

## 7.3 CCR excavation

CCR materials in the surface impoundments will be excavated following completion of the free water removal activity and transported for disposal in the RMSGS onsite landfill. The excavation sequence is expected to begin with the Boiler Slag Pond and move west to east to Primary Settling Pond No. 1, Primary Settling Pond No. 2, and finish with Secondary Settling Pond No. 1. The actual excavation sequence will be a collaborative decision of NIPSCO LLC and the selected closure contractor.

### 7.3.1 Excavation

CCR material will be excavated using appropriate equipment, e.g., track-mounted hydraulic excavators, bulldozers, on-road dump trucks, etc. The CCR materials will be excavated, drained of excess water, conditioned as necessary, and placed in over-the-road (highway) dump trucks for transport to the NIPSCO LLC RMSGS onsite landfill for disposal. Liner materials will be excavated using similar equipment and methods as the CCR material excavation. The blast furnace slag and geomembrane liner material will be separated from the sand and clay soil material for disposal at the RMSGS CCR Landfill or in an off-site disposal facility permitted to accept the blast furnace slag and geomembrane material. The sand and clay soil material will be loaded and transported for disposal in the NIPSCO LLC RMSGS onsite landfill. Material excavation information and estimated excavation volumes are presented in Table 3.

The CCR material will be excavated to the depth of the design bottom of each of the surface impoundments, plus removal of the bottom liner system. Visual verification of CCR removal will be performed upon completion of the surface impoundment excavation. The excavation limits i.e. bottom and side slopes, will be field surveyed to provide a record of the depth of the CCR materials, bottom liner system, and final excavation depth.

### 7.3.2 CCR conditioning

Based on the moisture level after dewatering, excavated CCR materials may require conditioning prior to loading and transporting the CCR materials for disposal. Conditioning may include draining by gravity, mixing with available drier material, and, if required, adding stabilization/ solidification materials such as quicklime, cement kiln dust (CKD), lime kiln dust (LKD), or Portland cement. The requirement for conditioning will be field determined based on site specific conditions and paint filter test results.

### 7.3.3 Dust Control

Construction dust will be carefully controlled and monitored throughout the closure project duration to comply with all local, state and national requirements. Per 40 CFR 257.80, NIPSCO has prepared a CCR Fugitive Dust Control Plan (Plan) for the Bailly Generating Station . While this Plan more directly addresses facility operations activities, the dust control measures are appropriate and will be applied/enforced during the closure construction activities. The contractor will be required to control and manage dust throughout every phase of the project. The contractor will be required to meet BGS's Air Quality Permit conditions. A project-specific dust control plan will be one of the contractor's required submittals for performing excavation, transport, and backfilling activities.

**Table 3: Preliminary Surface Impoundment Excavation Information**
Surface Impoundment Closure Application, Bailly Generating Station

| CCR impoundment name | Bottom of impoundment/CCR elevation (feet) | Removal excavation elevation (feet) | Current Estimated CCR Volume CY | Estimated Liner Volume CY | Estimated excavation volume (cubic yards) [1] |
|---|---|---|---|---|---|
| Boiler Slag Pond | 619 | 615 | 1,000 | 12,000 | 13,000 |
| Primary Settling Pond No. 1 | 612 | 609 | 28,000 | 29,000 | 57,000 |
| Primary Settling Pond No. 2 | 611 | 608 | 20,000 | 31,000 | 51,000 |
| Secondary Settling Pond No. 1 | 609 | 606 | 6,000 | 10,000 | 16,000 |
| Total | - | - | 55,000 | 82,000 | 137,000 |

Dust Control will incorporate measures to minimize CCR from becoming airborne during closure activities. Primary dust control will be addressed by applying water to haul roads, open excavation areas, and stockpiles. Appropriate measures will be taken to properly address site surface areas. This activity generally consists of wetting the CCR with water such that wind dispersal does not occur. Water is applied to site surface areas using water trucks, spray nozzles and all-terrain vehicles to maintain appropriate moisture conditions during construction. Dust control equipment will generally operate continuously during active construction hours unless site conditions are such that dust control is not necessary. Conditioning can also be accomplished with an appropriate chemical dust suppression agent. Stockpiles can be covered with tarps or plastic sheeting to prevent dust dispersal. Haul trucks used to transport CCR will be equipped with heavy duty tarps to cover/ contain the CCR during transport, as well as sealed tailgates.

### 7.3.4 CCR transport and disposal

Transportation and disposal of the excavated CCR will be to the NIPSCO LLC RMSGS onsite, CCR-compliant landfill. The excavated CCR/ liner materials will be loaded in highway-compatible trucks equipped with tarpaulins/covers and be transported using a pre-determined route to the NIPSCO LLC RMSGS onsite landfill. The CCR/liner materials will be disposed at the RMSGS onsite landfill as directed by the RMSGS onsite landfill operator. The required permits and/or authorizations for CCR/liner material transportation and disposal will be obtained in accordance with local, municipal, state, and federal rules and regulations. NIPSCO LLC, if required, will coordinate with IDEM any RMSGS onsite landfill permit amendments related to disposing of the CCR/liner materials, including possible CCR/liner conditioning materials such as LKD, Portland cement, or other amendments, from the surface impoundments. Off-site transportation and disposal of blast furnace slag and

geomembrane liner materials will follow the same procedures as the CCR/liner materials off-site transportation and disposal.

Transport and disposal of the CCR and liner materials will be documented during closure activities. The volume, method of disposal, and final location of the CCR/liner materials will be documented.

Measures will be employed to prevent trucks transporting the CCR/liner material for off-site disposal from carrying CCR/ liner material outside the impoundment closure footprint. One of the following methods or a combination thereof will be used:

- Construction of an aggregate construction entrance where the trucks leave the CCR impoundment footprint.
- Construction of a temporary wheel/undercarriage wash located where the vehicles leave the excavation areas and before the vehicles exit the BGS property.

### 7.3.5 Closure removal verification

Visual observations will be conducted to evaluate removal of physical CCR materials upon completion of the excavation of the CCR material and bottom liner materials. A topographic survey will be conducted to determine the final excavation limit and be documented with photographs.

An appropriately spaced grid system will be established in the field for each of the former surface impoundment areas. Verification will occur at the approximate center of each grid.

## 7.4 Closure certification

Closure certification for the surface impoundments will include:

- A certification statement signed by NIPSCO LLC and a qualified Indiana professional engineer stating the surface impoundments have been closed in accordance with the approved closure application.
    - A notification of former surface impoundments closure completion will be placed in the BGS's operating record
    - The notification of completion will be submitted within 60 days of completing the former surface impoundments closure.
- Verification NIPSCO LLC has recorded a notation on the deed to the property, which will, in perpetuity, notify any potential purchaser of the property the land was formerly used as CCR material surface impoundment. At a minimum, the recorded notation will contain:
    - The general types and locations of where the former CCR materials resided
    - The former CCR materials depth
    - A plot plan, with surface contours at intervals of 2 feet, indicating:
        - Final land surface water run-off direction(s)
        - Surface water control structures after closure completion
        - Final grading
    - A statement prohibiting construction; installation of wells, pipes, conduits, or septic systems; or any other excavation on the property without approval by the IDEM commissioner.

Certification will require documentation that the surface impoundments closure meets the requirements contained in the drawings and technical specifications for closure by removal. This

closure application includes a construction quality assurance plan (see Appendix D) used to document implementation of the surface impoundments closure including CCR material excavation and disposal, structural fill installation, topsoil installation, and final surface area vegetation.

# 8.0 Post closure grading/soil cover

A 2-foot soil cover will be required over the excavated areas to meet the closure performance standard as defined in the CCR Rule. The former surface impoundment areas will be backfilled with off-site soil material to the elevations and grades shown on Drawing 4 - Final Grading Plan provided in Appendix A. The contour elevations shown on the final grading plan represent the top of the placed surface cover. The final grades also consider surface water control/management. The volume of final grading/backfill material including topsoil is shown in Table 4.

**Table 4: Preliminary Surface Impoundments Soil Cover Information**
Closure Application, Bailly Generating Station

| Material | Estimated grading/backfill volume (cubic yards) |
|---|---|
| Soil cover - 18 inches | 90,000 |
| Topsoil - 6 inches | 15,000 |
| Total | 105,000 |

## 8.1 Borrow source/soil cover requirements

Two feet of soil cover will include a minimum of 18 inches of soil material and six inches of topsoil material. A borrow source will be determined by the contractor at the time of closure construction to provide necessary final grading and soil cover requirements. Therefore, the borrow location(s) are not currently available. The following soil cover properties will be required and verified when selecting the borrow source:

- A maximum particle size of 3 inches
- A Unified Soil Classification System classification of SC, ML, ML-CL, or CL as determined by American Society for Testing and Materials (ASTM) D2487-11
- Permeability ≤ 1 x 10-05 cm/sec as determined by ASTM D5084-16a.

The topsoil material will be obtained from an off-site source meeting requirement for particle size analysis (ASTM D422-63(2007) e2), organic content (ASTM D2974-14), and pH (ASTM D4972-13).

## 8.2 Soil cover placement

The soil cover will consist of off-site borrow material placed in successive lifts of loose material not more than 12 inches thick. Each lift will be uniformly spread on the preceding lift that has been moistened or aerated, as necessary, and scarified or otherwise broken up in such a manner that the material bonds with the surface on which it is placed. Off-site borrow material should be placed with the following considerations:

- Slope the surface of each lift as shown on the drawings to promote free draining of water from the lift
- The surface of each lift will be free of loose material and foreign objects

- Remove the soil material in any areas where it becomes soft or yielding, replace with satisfactory soil borrow materials, and compact the soil borrow materials
- Fill and level ruts in the surface of any lift before compacting
- Seal the surface of the last lift placed at the end of each day using a vibratory smooth-drum roller
- Compaction accomplished by pneumatic-tired roller, vibratory compactor, or other equipment suitable to compact the soil material to a Standard Proctor of 95%
- Acceptable criteria for compaction are at an appropriate moisture content determined by the Standard Proctor (ASTM D698-12e2) optimum moisture content to achieve a dry density greater than or equal to 95% of the Standard Proctor (ASTM D698-12e2) maximum dry density
- In-place density testing using a nuclear density gauge to verify acceptance of the compaction effort.

Moisture condition the fill (if necessary) for any areas that fail the compaction requirements and re-compact the area until it meets compaction requirements. Scarify or moisture condition the entire lift before the succeeding lift is placed if large areas of any lift fail the compaction requirements.

The topsoil will be placed and graded using low-ground-pressure track-mounted equipment to minimize consolidation in the topsoil material. The cover area will be seeded following acceptance of the topsoil material placement, to establish vegetative growth to minimize potential erosion and sediment issues. A disc will be used, if required, to break up the top surface of the topsoil to provide an adequate seed bed. The topsoil and seed mix including material characteristics and type will be specified in the technical specifications prepared for contractors to use in installing the topsoil cover and vegetation.

## 8.3 Post-closure surface water management

Final grading was conceptually developed to allow surface drainage of storm water through the post-closure surface impoundment system. Storm water runoff from the Boiler Slag Pond to Primary Settling Pond No. 1 will discharge by gravity through the existing 24-inch drainpipe. Similarly, storm water from Primary Settling Pond No. 1 and Primary Settling Pond No. 2 will drain to Secondary Settling Pond No. 1 by gravity flow through the existing 36-inch and 30-inch drainpipes, respectively.

Secondary Settling Pond No. 1 will be adapted as a permanent detention pond in conjunction with the Forebay discharge structure. Gravity or mechanical means will be used to transfer storm water to the Forebay for discharge. The existing pump station at the Forebay has ample capacity to pump down the storm water runoff to the permitted NPDES discharge. A geosynthetic liner will be installed at Secondary Settling Pond No. 1 for containment purposes.

The Final CCR Rule 40 CFR §257.81 provides requirements for surface water run-on and run-off controls. The surface water run-off was designed to handle the peak discharge from a 25-year, 24-hour storm event. As discussed previously, perimeter ditches/swales are included in the surface impoundments final backfill grading. The final surface water control structures are shown on Drawing 6 provided in Appendix A, with the calculations for the surface water controls included in Appendix C.

Appropriate erosion protection and sediment controls will be established for the post-closure condition. Erosion protection and sediment control drawings will be included in the closure drawings to provide adequate on-site control and prevent surface materials off-site migration. Loss-of-material calculations will be performed based on the selected backfill/surface cover materials. NIPSCO LLC will prepare a Storm Water Pollution Prevention Plan (SWPPP), based on design and configuration of the

erosion protection and sediment controls required throughout surface impoundment closure activities.

# 9.0 Closure schedule

The BGS surface impoundment closure schedule is provided in Table 5. The closure schedule was developed considering:

- Current estimate of the year in which the surface impoundment closure activities will be completed
- Description of sequential steps to close the surface impoundments:
  - Coordinating and obtaining permit approvals
  - Dewatering and removing the CCR materials
  - Installing the soil cover.

Closure dates other than the completed closure (regulatory) date are considered preliminary for establishing the closure sequence and relative time periods to perform primary activities. These dates may be adjusted in the future.

**Table 5: Proposed Surface Impoundments Closure Schedule**

Surface Impoundments Closure Application, Bailly Generating Station

| Closure activity | Scheduled start | Scheduled completion |
|---|---|---|
| Submit closure application to IDEM | | 3 February 2021 |
| Public outreach meeting | | To Be Determined |
| IDEM closure approval period | 21 January 2021 | 31 December 2021 |
| Prepare closure construction documents, bid and award | 01 Mar 2021 | 31 December 2021 |
| Estimated surface impoundments closure | Q2 2024 | Q3 2025 |

# 10.0 Post-closure care

The post-closure care plan describes operations, monitoring, and maintenance activities required for the closed surface impoundments throughout the post-closure care period. The post-closure care period duration is mandated to be a minimum of 30 years following IDEM acceptance of the surface impoundment closure certifications and can be extended if any of the subject former surface impoundments are under assessment monitoring in accordance with 40 CFR §257.95. NIPSCO LLC will be responsible for compliance with 40 CFR §257.104 and 329 IAC 10-31 following IDEM acceptance of closure certifications for the surface impoundments, including, but not limited to:

- Maintaining final backfill area integrity and effectiveness
- Repairing the final backfill as necessary to correct effects of settlement, subsidence, erosion, or other issues, and preventing run-on and run-off from eroding or otherwise damaging the final backfill area
- Maintaining the groundwater monitoring system and monitoring groundwater in accordance with 40 CFR §257.90 through §257.98, 329 IAC 10-29 and 10-31, and additional IDEM closure requirements as may be applicable under the approved Closure Application

The items included in the post-closure care plan for the closed surface impoundments are described in the following sections.

## 10.1 Groundwater monitoring

Post-closure requirements include establishing, operating, and maintaining a groundwater monitoring program that addresses each of the subject closed surface impoundments and meets the applicable standards of 40 CFR §257.90-98, 40 CFR §104, 329 IAC 10-29, and 329 IAC 10-31.

Surface impoundments Primary Settling Pond 1 (Primary 1), Primary Settling Pond 2 (Primary 2), Secondary Settling Pond 1 (Secondary 1), and the Boiler Slag Pond are subject to the self-implementing CCR Rule requirements, including groundwater monitoring to identify whether releases have occurred during operating and post-closure care periods. In addition to the self-implementing Federal CCR Rule requirements, when and where applicable, the IDEM Office of Land Quality has released and previously indicated that NIPSCO LLC will be subject to application of the Surface Impoundment Closure Guidance (SICG) during any Closure Application review process.

### 10.1.1 Overview of existing groundwater monitoring system

NIPSCO LLC designed the monitoring network described herein to meet the performance standards specified in 40 CFR §257.91, modifying and supplementing the initial system as appropriate to address site conditions. The monitoring network adequately monitors representative background groundwater conditions and the quality of groundwater downgradient of each CCR Unit. In designing and installing the network, NIPSCO LLC identified two existing monitoring wells (MW-105 and MW-112 – installed as part of the BGS RCRA Corrective Action program) that are appropriately located and constructed to serve as CCR Rule-compliant monitoring wells. In 2016, NIPSCO installed additional monitoring wells at each CCR Unit based on knowledge of historical site conditions, a Site Conceptual Model, and interpretation of the CCR Rule requirements.

To complete and update the monitoring well network for the CCR Units (i.e., BSP, combined Primary 1 and 2, and Secondary 1), NIPSCO LLC ultimately installed 21 monitoring wells, including six new wells in 2019 at the locations shown in Drawing BGS-04 in Appendix A. NIPSCO LLC selected monitoring wells GAMW-01 and GAMW-01B (installed in 2019) to serve as background wells for all CCR Units. The downgradient monitoring well networks around the BSP and Secondary 1 remain unchanged since inception of the CCR Rule monitoring program. NIPSCO LLC modified the existing monitoring well network near Primary 1 and Primary 2 (now considered one CCR Unit for the purposes of groundwater monitoring) to account for changed conditions and additional information about the site and area conditions, including the variable groundwater flow directions resulting from the cessation of influent to the CCR Units.

### 10.1.2 Monitoring program approach

Going forward, until IDEM adopts the Federal CCR regulations at the state level in final form and is authorized to implement Indiana's rules in lieu of the Federal program, NIPSCO LLC is faced with operating groundwater program(s) to satisfy two separate and at times overlapping requirements. These somewhat similar, although not identical, requirements include monitoring to satisfy the CCR Rule self-implementing requirements, and, ultimately, enacting a post-closure monitoring program referenced in 329 IAC Rule 10-29 and 329 IAC Rule 10-31 as a condition of Closure Application approval.

Satisfying these two programs simultaneously makes design, coordination with, and approval by IDEM and subsequent operation of such monitoring complex. This is due to the possibility that, under the self-implementing CCR Rule regulations, monitoring parameters and frequencies can change because of groundwater monitoring results (e.g., transition from detection monitoring to assessment monitoring or vice-versa, establishment of groundwater protection standards [GWPS], exceedance of one or more GWPS). The current monitoring program, driven by the Federal CCR Rule regulatory

requirements in place at this time, does not lend itself to a traditional 329 IAC post-closure monitoring approach.

For these four surface impoundments included in the Closure Application – Primary 1, Primary 2, Secondary 1, and Boiler Slag Pond – NIPSCO LLC proposes a comprehensive post-closure groundwater monitoring program that addresses aspects of and combines appropriate existing elements from each of the applicable Federal and state obligations identified above – namely, the CCR Rule requirements and 329 IAC Rule 10-29 and 329 IAC Rule 10-31 regulations – and considers the findings and implications of the CCR monitoring data. Details of the post-closure program are presented in sections as follows: monitoring well network and basis of design, sampling and analysis plan, sampling frequency, monitoring parameters, data evaluation/statistics, quality assurance project plan, corrective action, data reporting, post-closure monitoring term, and summary and supporting documents.

### 10.1.3 Monitoring well network and basis of design

NIPSCO LLC is currently monitoring a series of existing background and downgradient wells screened within the uppermost aquifer to satisfy ongoing Federal CCR Rule program requirements.

Site geology in the vicinity of the surface impoundments from ground surface to depth includes:

- Fill: A fill layer is generally present around the CCR Units from ground surface to approximately three to 10 feet below ground surface (ft bgs). The fill material includes a mixture of fly ash, boiler slag, and sand.
- Light Brown/Brown Sand: A loose to compact fine to coarse-grained light brown to brown dune-beach and lacustrine sand with varying quantities of fine gravels and silts underlies the fill material and varies in thickness from approximately 20 to 30 feet.
- Silty Clay (upper clay unit): An approximately two- to four-foot thick interbedded clay with little sand and gravel underlies the light brown to brown sand beneath the CCR Units and is present at an approximate depth of 30 to 40 ft bgs. The silty clay delineates the base of the uppermost aquifer.
- Gray Sand: A loose to compact fine to coarse-grained gray sand underlies the upper silty clay unit. The gray sand varies in thickness and is up to 70 feet thick on the southern side of the CCR Units.
- Basal Clay and Till Unit: A basal clay and silt underlies the gray sand. The basal till and silt are up to 105 feet thick on the northern side of the CCR Units. The thickness of the basal unit is highly variable due to erosion of the sediments and the underlying bedrock's relief.
- Bedrock: A fractured dolomitic limestone was encountered near the eastern portion of the Site at an approximate depth of 145 feet bgs.

Based on geologic information reviewed and consistent with industry interpretations of the definition provided in 40 CFR §257.53, the Site's uppermost aquifer consists of the unconfined fill material, native dune beach sand, and lacustrine light brown to brown sands and gravels that underlie each of the surface impoundments addressed by the Closure Application. The saturated thickness of the aquifer is approximately 15 to 30 feet depending upon seasonal variation of the water table and depth to the uppermost confining layer.

Under natural conditions, general groundwater flow direction and discharge would be expected to be toward Lake Michigan (i.e., toward the north). Except for data from wells located around the perimeter of the Boiler Slag Pond, historical piezometric data also indicated a flat to northerly gradient in the

vicinity of the surface impoundments. However, groundwater dewatering activities at the ArcelorMittal property located due south of the Site alters the local Site groundwater flow direction. Golder understands that ArcelorMittal withdraws over 1,000-gallons per minute from wells located to the south of the CCR units to reduce groundwater infiltration into pits/basements of buildings associated with their steel manufacturing operations. Golder has assumed that ArcelorMittal will continue to operate their dewatering wells and that the potentiometric surface will remain constant during the post-closure monitoring.

Based on the historical and recent BGS hydrogeologic information, there is an apparent groundwater mound beneath the Boiler Slag Pond. Therefore, the well network around the Boiler Slag Pond was designed and is being monitored to account for the localized effect of groundwater mounding. This CCR Unit features four downgradient wells. In addition, due to a) the effects of the ArcelorMittal off-Site groundwater extraction system on Site groundwater flow and b) reduced discharge of influent into the CCR Units, NIPSCO LLC has modified its prior CCR Rule-design monitoring network and selected monitoring wells GAMW-01/01B to represent background groundwater quality conditions for all the CCR Units.

The current Primary 1 and Primary 2 combined monitoring well network includes four monitoring wells (MW-112, GAMW-10, GAMW-16, and GAMW-07) located north of these impoundments that historically were consistently downgradient. Presently, these monitoring wells are not hydraulically downgradient of Primary 1 and Primary 2 based on the new data indicating groundwater flow direction to the south. However, for data collection and evaluation purposes, NIPSCO LLC will continue to consider these four wells as part of the downgradient monitoring well network because the hydraulic gradients are generally flat across Primary 1 and 2 and these wells have historically indicated detections of Appendix IV parameters. Monitoring wells that constitute the downgradient monitoring systems for all surface impoundments subject to closure and post-closure (i.e., Boiler Slag Pond, Primary 1, Primary 2, and Secondary 1) are outlined in Table 6.

Based upon site-specific data, average horizontal groundwater flow velocity was calculated at approximately 213 feet/year. The vertical hydraulic gradient calculations indicate a general downward gradient across the Site. The native sand materials appear to be more conducive to vertical flow versus the overlying fill materials.

Consistent with the self-implementing requirements of 40 CFR §257.91, NIPSCO LLC designed a monitoring system for Primary 1, Primary 2, Secondary 1, and the Boiler Slag Pond that was certified by a qualified Indiana-licensed Professional Engineer as meeting the technical requirements under the CCR Rule. This system consists of two background monitoring wells and 19 downgradient monitoring wells. The monitoring well placement accounted for and addressed the aquifer saturated thickness, horizontal and vertical flow conditions, and release mechanisms as identified by the Site Conceptual Model.

NIPSCO LLC has developed the proposed post-closure monitoring network based on knowledge of current groundwater flow directions and quality; proposed extent of closure excavation, backfill and grading, and surface water drainage plans; presumed post-construction influences on existing groundwater flow conditions; current CCR Rule obligations for the four surface impoundments; and interpretation of 329 IAC Rule 10-29 and 10-31 applicability.

The post-closure groundwater monitoring program will include 21 existing groundwater wells to monitor groundwater quality near the four surface impoundments in accordance with IDEM-approved closure plans. Each monitoring well number and the monitoring well's designated purpose is presented in Table 6. The surface impoundments addressed by the closure plans and background and downgradient monitoring well locations that comprise the post-closure network are depicted on

Drawing BGS-04 in Appendix A. Boring logs and construction diagrams for the 21 groundwater wells are provided in Appendix B.

**Table 6: Surface Impoundments Groundwater Monitoring Wells**

Surface Impoundments Closure Application, Bailly Generating Station

| | Monitoring Well Locations | Top of Casing Elevation (ft-msl) | Screen Interval | | | Well Diameter (inches) |
|---|---|---|---|---|---|---|
| | | | Top (ft-bgs) | | Bottom (ft-bgs) | |
| Background | PC-GAMW-01 | 624.53 | 13 | | 23 | 2 |
| | PC-GAMW-01B | 623.76 | 27 | | 32 | 2 |
| Downgradient | PC-GAMW-02 | 624.20 | 13 | | 23 | 2 |
| | PC-GAMW-03 | 624.35 | 13 | | 23 | 2 |
| | PC-GAMW-04 | 624.12 | 13 | | 23 | 2 |
| | PC-GAMW-06 | 626.97 | 17 | | 27 | 2 |
| | PC-GAMW-07 | 629.04 | 19 | | 29 | 2 |
| | PC-GAMW-08 | 624.35 | 15 | | 25 | 2 |
| | PC-GAMW-08B | 623.73 | 30 | | 40 | 2 |
| | PC-GAMW-10 | 631.94 | 21 | | 31 | 2 |
| | PC-GAMW-11 | 625.04 | 14 | | 24 | 2 |
| | PC-GAMW-11C | 625.16 | 29 | | 34 | 2 |
| | PC-GAMW-12R | TBD | 15 | | 25 | 2 |
| | PC-GAMW-13 | 625.34 | 13 | | 23 | 2 |
| | PC-GAMW-14 | 624.32 | 13 | | 23 | 2 |
| | PC-GAMW-16 | 629.92 | 20 | | 30 | 2 |
| | PC-GAMW-17 | 623.96 | 14.5 | | 24.5 | 2 |
| | PC-GAMW-17B | 624.12 | 28.5 | | 33.5 | 2 |
| | PC-GAMW-18 | 626.87 | 20 | | 30 | 2 |
| | PC-MW-105 | 622.05 | 8 | | 18 | 2 |
| | PC-MW-112 | 628.07 | 17 | | 27 | 2 |

**Notes:**

Locations surveyed in US State Plane Indiana West Zone NAD 1983, NAVD 1988 (ft)

ft-bgs = feet below ground surface

ft-msl = feet above mean sea level

TBD = to be determined

### 10.1.4 Sampling and analysis plan (SAP)

NIPSCO LLC will perform post-closure groundwater monitoring in accordance with procedures and protocols consistent with 329 IAC 10-29-2 and outlined in a Site-specific SAP, the complete, stand-alone version of which is provided in Appendix E. The SAP will include the following elements to provide reliable, consistent, and defensible data:

- Groundwater monitoring procedures that provide representative samples that minimize the potential for cross-contamination
- A quality assurance program that provides quantitative detection limits and the degree of error for analysis of each chemical of concern

- Sample preservation and shipment procedures that maintain reliability of the sample collected for analysis
- Chain-of-custody procedures that prevent tampering and maintain samples integrity prior to analysis.
- The SAP will be reviewed periodically as dictated by alterations in site conditions (e.g., initiation of corrective measures/corrective action, changes in groundwater flow direction) or groundwater monitoring program changes (e.g., addition or deletion of monitoring parameters, addition, or deletion of monitoring wells) and, if necessary, NIPSCO LLC will update the document to reflect necessary modifications.

### 10.1.5 Sampling frequency

NIPSCO LLC is currently collecting semi-annual groundwater samples in accordance with the CCR Rule requirements (i.e., 40 CFR Part 257 Appendix III and IV parameter lists). Prior to closure of the surface impoundments, NIPSCO LLC will have collected the necessary number of data points to perform statistical analyses as described in the Section 10.1.7 - Data Evaluation/Statistics.

NIPSCO LLC will begin post-closure monitoring during the first calendar quarter after completion of the impoundment closure construction activities and submittal of the Closure Certification Report by the certifying engineer. NIPSCO LLC will perform quarterly post-closure monitoring for a minimum of eight consecutive quarters (i.e., two years) to assess 1) changes in groundwater quality and 2) potential changes in groundwater flow direction, both related to conditions associated with closure activities (i.e., source removal, emplacement of a low permeability cover system, surface water [precipitation run-on] diversion). The two-year quarterly monitoring period is necessary to assist NIPSCO LLC with refining the Conceptual Site Model that will be used to assess whether additional groundwater monitoring or management activities are required, if any.

Following the initial two-year quarterly monitoring events, NIPSCO LLC will continue post-closure groundwater monitoring on a semi-annual basis for parameters appropriate to detect/assess changes in groundwater quality because of completed closure activities. NIPSCO LLC will maintain consistency with the ongoing semi-annual CCR Rule monitoring program, for which sampling is currently conducted primarily in April and October. The initial semi-annual event will be scheduled for the earlier of either April or October following the final two-year quarterly monitoring event. NIPSCO LLC will continue semi-annual groundwater monitoring for a minimum of 28 years (30-years total), or a shorter duration and/or frequency if changes in regulations allow. If groundwater concentrations do not meet the groundwater benchmarks, NIPSCO LLC will continue groundwater monitoring beyond the nominal 30 years.

### 10.1.6 Monitoring parameters

NIPSCO LLC proposes a monitoring parameter list appropriate to the Site environmental, industrial, and geological background conditions; Site investigation findings; surface impoundment waste management history; and current monitoring provisions of the CCR Rule. From the perspective of evaluating potential post-closure impacts to water quality, the results generated from this approach will be amenable to applying statistical-based (e.g., intra-well or inter-well) or standards-based comparisons. Consistent with the CCR Rule monitoring requirements, the post-closure monitoring parameter list will include:

| | |
|---|---|
| Field-based water quality parameters | pH, specific conductivity, temperature, turbidity, oxidation-reduction potential |

| | |
|---|---|
| 40 CFR, Part 257 Appendix III Detection Monitoring Parameters | Boron, calcium, chloride, fluoride, sulfate, total dissolved solids, pH |
| 40 CFR, Part 257 Appendix IV Assessment Monitoring Parameters | Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, selenium, thallium, radium 226 and 228 (combined) |

### 10.1.7 Data evaluation/statistics

Golder developed the selected statistical method for the BGS Closure Application in accordance with 40 CFR Part 257.93 and 329 IAC 10-29, using methodology presented in *Statistical Analysis of Groundwater Data at RCRA Facilities, Unified Guidance, March 2009, EPA 530/R-09-007* (Unified Guidance). For consistency between CCR Rule self-implementing and IDEM Solid Waste closure requirements, the statistical approach proposed herein is the same as the approach currently being used in the monitoring program required under 40 CFR Part 257.93. The full statistical analysis plan is provided as part of the SAP. The statistical methods used for Detection Monitoring under 40 CFR Part 257.93 will be the same as those used to comply with 329 IAC 10-29-6 (also referred to as Phase I), while the statistical methods used for Assessment Monitoring under 40 CFR Part 257.93 will be the same as those used to comply with 329 IAC 10-29-7 (also referred to as Phase II). Corrective Action Monitoring under 40 CFR Part 257.98 will be the same as those used to comply with 329 IAC 10-29-9. The post-closure monitoring program will begin in Corrective Action Monitoring.

The background populations for each monitoring well and constituent, general background statistics have been developed using the baseline data set. These general statistics include: 1) a review of the intra-well data for potential outliers, 2) an analysis for underlying trends, and 3) an examination of data distribution (i.e., data normality). Following general statistical procedures, data will be reviewed periodically, and outliers will be removed (if applicable) and data will be processed as appropriate for the data distribution detected. Parametric testing methods will be used if the data are normally or transform-normally distributed. Non-parametric testing techniques will be used if the data are non-normally distributed.

#### 10.1.7.1 Phase I - Detection monitoring

Under the Detection Monitoring Phase (referenced as Phase I in 329 IAC 10-29-6), the prediction interval method will be used to evaluate groundwater monitoring data for 40 CFR Part 257 Appendix III parameters. An inter-well testing approach will be used – meaning that data from downgradient wells will be compared to compliance limits derived from background groundwater quality data in hydraulically-upgradient locations. Background data from the upgradient monitoring wells network will be pooled to calculate an upper prediction limit (UPL) (and lower prediction limit [LPL] for pH) for each Appendix III parameter. Results from the final detection monitoring event at the downgradient monitoring wells will be evaluated by comparing individual results to the UPL (and LPL for pH) for each monitoring event. Under this method, an "initial exceedance" occurs when the concentration of any Appendix III constituent in a downgradient monitoring well exceeds the UPL (or is lower than the LPL for pH).

If data from a downgradient monitoring well exceeds the UPL, a 1-of-2 resampling strategy will be used to verify the initial exceedance. One independent resample will be collected and evaluated within 90 days of the initial statistical evaluation to determine whether the initial exceedance is verified. The initial exceedance is considered a spurious result if the resample result does not verify the initial result, and detection monitoring continues for that constituent/well combination. The verified result is considered a statistically significant increase (SSI) if the verification sample result

confirms the initial exceedance. Unless an alternate source demonstration (ASD) can be provided to contradict the SSI, the next step will be to enter assessment monitoring (referenced as Phase II in 329 IAC 10-29-7), as described in the following section.

#### 10.1.7.2 Phase II - Assessment monitoring

Under the Assessment Monitoring phase (i.e., Phase II), the statistical method used will be the confidence interval method. As in detection monitoring, an inter-well approach will be used – meaning data from downgradient monitoring wells will be compared to compliance limits derived from background groundwater quality data in hydraulically-upgradient locations. A GWPS will be calculated for each 40 CFR Part 257 Appendix IV constituent. In accordance with 257.95(h), the GWPS will be the maximum contaminant level (MCL)/health-based standard or the background concentration for each analyte as calculated using a tolerance/prediction limit procedure. Results from the downgradient monitoring wells will be evaluated by comparing the calculated intra-well lower confidence limit (LCL) with the GWPS for each Appendix IV constituent. If the LCL exceeds the GWPS, there is statistical evidence of a statistically significant level (SSL), which will trigger additional response activities, including a delineation of the nature and extent of the noted SSLs and, potentially, Corrective Action. If concentrations of all 40 CFR Part 257 Appendix III and Appendix IV constituents are below background values for two consecutive sampling events, the monitoring program can return to Detection Monitoring.

#### 10.1.7.3 Corrective Action Monitoring

During Corrective Action implementation, the groundwater monitoring approach is the same as that described under Assessment Monitoring. In Corrective Action Monitoring, the statistical method used to evaluate the data will also be the inter-well confidence interval method (i.e., the same method used for Assessment Monitoring). However, there is one significant difference between Assessment Monitoring and Corrective Action Monitoring. During Corrective Action Monitoring, results from the downgradient monitoring wells will be evaluated by comparing the calculated intra-well Upper Confidence Limit (UCL) with the GWPS for each Appendix IV constituent. If the UCL exceeds the GWPS, there is statistical evidence of non-compliance (NC), which will result in continued Corrective Action Monitoring and possible additional Corrective Action remedies.

If NC is noted under Corrective Action Monitoring, trend analysis and other data analysis tools will be applied to understand whether the data are stable or trending. If increasing trends are noted for key indicators, additional remedies may be necessary. If trends are stable or decreasing during Corrective Action Monitoring, no additional actions may be necessary and Corrective Action Monitoring will continue. Once the UCL is below the GWPS for three consecutive years for each Appendix IV constituent in each well, the Corrective Action remedy is considered complete (from the standpoint of groundwater monitoring), and the monitoring program can return to Assessment Monitoring.

### 10.1.8 Quality assurance project plan (QAPP)

To monitor, control, and enhance data quality so that the data is acceptable for reporting and evaluation purposes, NIPSCO LLC has developed and will follow a QAPP that addresses, at a minimum, quality assurance objectives and controls; field sample collection; sample handling and preservation; chain of custody and transport; field equipment calibration and laboratory analytical methods; internal quality control checks; and performance and system audits. The site-specific QAPP is provided in Appendix F.

The QAPP will be reviewed periodically as dictated by groundwater monitoring program changes (e.g., addition or deletion of monitoring parameters, addition, or deletion of monitoring wells) and, if necessary, NIPSCO LLC will update the document to reflect necessary modifications.

### 10.1.9 Corrective actions

NIPSCO LLC has developed a conceptual Corrective Action Monitoring program that considers technical, regulatory, and programmatic impacts. Specifically, the Corrective Action Monitoring program allows for the effects of post-closure source removal to be reflected in groundwater quality monitoring results and has been sequenced accordingly. Corrective Action may be indicated for certain groundwater-related events including, but not limited to:

- Exceedances of regulatory benchmarks or guidelines for more than two consecutive sampling periods
- Consistent upward trends (or downward, in the case of pH only) for more than two consecutive sampling periods

Depending upon degree and timing of changes in groundwater quality post-closure, Corrective Actions may include activities ranging from addition of monitoring parameters, increased frequency of monitoring, and/or modification/expansion of the post-closure monitoring network, to monitored natural attenuation (MNA), the installation of passive barriers, or the design and operation of active groundwater recovery and treatment systems. Response action(s) and system(s) of choice will necessarily be based upon numerous factors including demonstrated effectiveness of the source removal closures, location and degree of groundwater impacts, improving or declining groundwater quality trends post-closure, and other time-dependent variables. NIPSCO LLC will notify IDEM within 14 days of receipt of validated sampling results in response to these conditions and provide a proposed course of action consistent with 329 IAC 10-29-9 to address the potential need for Corrective Actions to supplement source removal. Because such an event will be in the mature stages of post-closure monitoring and plume conditions will be expected to have reached stability, NIPSCO LLC anticipates that this response will focus primarily on Corrective Actions. Also, by this time NIPSCO LLC anticipates that alternatives will have been identified and screened such that an evaluation will be straightforward. Within 180 days of receipt of validated sampling results, NIPSCO LLC will present a proposed approach to Corrective Actions (e.g., MNA, groundwater extraction, control, and treatment systems) to IDEM for approval. Should the proposed remedy at this stage also require modification to the existing groundwater monitoring program (other than compliance with self-implementing provisions of the CCR Rule or state-adopted equivalent), NIPSCO LLC will also submit a simultaneous request to IDEM and obtain concurrence before making such change(s) to that aspect of the post-closure program.

If Corrective Actions are required and during Corrective Actions implementation, the groundwater monitoring approach statistical evaluation will be completed as described under Section 10.1.7.3.

### 10.1.10 Data reporting

NIPSCO LLC will prepare reports including summaries of sampling activities, data tables and interpretations, supporting figures, and planned modifications and response activities, if necessary, and submit them to IDEM within 60 days of receipt of sampling data, data evaluation, and performance of statistical analysis.

### 10.1.11 Post-closure monitoring term

NIPSCO LLC will maintain and operate the groundwater monitoring system for a post-closure care period of up to 30 years minimum in accordance with the applicable requirements of 40 CFR, Part 257.104 and 329 IAC 10-31-2 and as provided in Section 10.1.5. The post-closure monitoring period may be extended past 30 years until monitoring has returned to the detection phase for a period of three consecutive years, at which point the monitoring term will cease.

## 10.2 Inspection requirements

Inspections of the closed former surface impoundments will be performed throughout the post-closure care period. Inspections will be performed biannually with an inspection report prepared and submitted to IDEM in accordance with 329 IAC 10-31-2(2). Items inspected include, but are not limited to:

- Final backfill area
  - Settlement/subsidence
  - Accumulated surface water
  - Slope stability issues
  - Erosion issues
  - Vegetation quality - e.g. stressed or missing
  - Vegetation other than grass on the final cover
  - Need for mowing
  - Burrowing animals
- Surface water management system
  - Erosion issues
  - Vegetation quality - e.g. stressed or missing
  - Vegetation other than grass in the ditches, diversions, and/or swales
  - Obstructions blocking water flow - e.g. large rocks, fallen trees/limbs/brush, etc.
  - Burrowing animals
- Groundwater monitoring program
  - Groundwater monitoring wells integrity
  - Protective casing and concrete pads integrity
  - Locks present and in working condition
  - Access to the monitoring locations
- General

    Site benchmarks and other survey control integrity.

An inspection form (example provided in Appendix G) for each of the closed former surface impoundments will be completed for each of the biannual inspections. The inspection forms will be included in an inspection report prepared to provide, but not be limited to:

- Inspection summary
- Discussion of issues observed during the inspection
- Discussion of how identified issues will be handled
- Discussion of how issue(s) identified during past inspections were addressed
- Schedule for addressing the issues

- Inspection forms
- Photographs to document the inspection and any maintenance activities.

The inspection reports will be maintained in the BGS operating record.

## 10.3 Maintenance requirements

The maintenance activities will depend on the issues observed during the biannual inspections throughout the post-closure care period. The post-closure care plan addresses how the identified issues will be handled in a general sense, with specific remedial efforts determined based on each identified issue's severity. A schedule for addressing identified issues will be included in the inspection report, again, determined based on each identified issue's severity.

The maintenance activity for each issue will be performed as soon as practical. Maintenance activities initiation and length of time required to address each issue will vary depending on issue severity. For example, replacing a missing or broken lock on a groundwater monitoring well protective casing can be performed in a much shorter timeframe than repairing erosion gullies/rills or settlement in the final backfill area. Based on the inspection items provided in Section 10.2, typical maintenance activities can include, but are not limited to:

- Final backfill area
  - Using non-impacted soil to repair settlement/subsidence areas, erosion gullies/rills, slope failure(s), and area(s) where animal burrows are identified
  - Revegetating the area of disturbance to establish a healthy stand of grass
  - Revegetating missing and/or stressed vegetation
  - Removing vegetation other than grass from the final backfill area surface
  - Mowing the grass, a minimum of twice per year - spring and fall
- Surface water management system
  - Using non-impacted soil to repair erosion gullies/rills
  - Revegetating the area of disturbance to establish a healthy stand of grass
  - Revegetating missing and/or stressed vegetation
  - Removing obstructions blocking water flow - e.g. large rocks, fallen trees/limbs/brush, etc.
  - Removing vegetation other than grass from the ditches, diversions, and/or swales
- Groundwater monitoring program
  - Replacing groundwater monitoring wells including abandoning compromised groundwater monitoring wells
  - Replacing compromised protective casing and concrete pads
  - Replacing missing and/or inoperable locks
- General

  Repairing/replacing site benchmarks and other survey control.

A discussion, including photographs, of how the identified issue(s) were addressed will be included in the inspection reports. Changes to the maintenance activity schedule will also be addressed.

### 10.4 Post-closure care contact

The primary NIPSCO LLC person who can be contacted during the post-closure care period and who is responsible for post-closure care maintenance and monitoring is:

| | |
|---|---|
| Contact Name: | Jeff Neumeier |
| Contact Physical Address: | 246 Bailly Station Road, Chesterton, Indiana 46304 |
| Contact Telephone Number: | (219) 787-7298 (BGS office) |
| | (219) 873-7337 (Michigan City Generating Station office) |
| | (219) 680-7098 (mobile) |
| Contact E-Mail Address: | JNeumeier@NiSource.com |

### 10.5 Post-closure use of the property

BGS plans no long-term use of the property where the former surface impoundments are located at the time of this closure application submittal. NIPSCO LLC and BGS reserve the right to use this area at a future time, when a use for this area is determined.

A demonstration will be prepared to establish that future use of this area does not compromise the final backfill integrity or monitoring systems function and does not increase the threat to human health or the environment.

### 10.6 Post-closure certification

NIPSCO LLC will prepare a notification that post-closure care has been completed no later than 60 days following completion of the post-closure care period. The notification will include certification by NIPSCO LLC and a qualified Indiana professional engineer, verifying the post-closure care has been completed in accordance with the post-closure care plan. The notification will be placed in the NIPSCO LLC BGS CCR Operating Record as required by 40 CFR 257.105 (i) (13) for the former surface impoundments.

## 11.0 Opinion of probable closure and post-closure care cost

An opinion of probable closure and post-closure care cost has been prepared for the former surface impoundments on forms provided by IDEM, and is included in Appendix H.

The closure activities include, but are not limited to:

- Installing erosion and sedimentation controls
- Excavating CCR materials and bottom liner system
- Loading, transporting, and disposing of the CCR materials in the RMSGS onsite landfill
- Loading, transporting, and disposing of the blast furnace slag and geomembrane liner materials in an off-site disposal facility permitted to accept the blast furnace slag and geomembrane materials
- Backfilling the former surface impoundments with off-site soil and topsoil
- Installing surface water control/management features
- Vegetating the final surface.

The opinion of probable closure care cost was prepared for each of the closure activities identified for the former surface impoundments. The closure activities are as presented in Sections 6.0 and 7.0 of the closure application. The total opinion of probable closure cost is $27,084,198.

The post-closure care activities can include, but are not limited to:

- Semi-annual inspections of the final backfill for erosion, surface water ponding, and storm drainage features
- Vegetation mowing
- Repairing areas where erosion has occurred
- Maintaining vegetation to prevent erosion
- Groundwater monitoring.

The opinion of probable post-closure care cost was prepared for each of the monitoring, inspection, and maintenance activities identified for the former surface impoundments. The monitoring, inspection, and maintenance activities are as presented in Sections 10.2 and 10.3 of the post-closure care plan. The total opinion of probable post-closure care cost is $2,027,500 for the 30-year post-closure care period.

The unit costs and/or lump sum costs were obtained from sources including, but not limited to, historical costs for activities of like/similar scope, RS Means Cost Data, contractor/vendor quotes, and other consultant costs.

The mobilization/demobilization, engineering, construction quality assurance, and contingency typically calculated and included as part of the closure and post-closure care opinion of probable costs are not included in the IDEM forms and; therefore, are not included.

# 12.0 Financial assurance

Financial assurance is required for closure and post-closure care of the surface impoundments under 329 IAC 10-39-3. Financial assurance is not required under the CCR Final Rule.

The financial assurance mechanism for the closure and post-closure care activities is:

329 IAC 10-39-3(a)(5) - A financial test

NIPSCO LLC will demonstrate the financial test has been met by submitting to the commissioner the documents required in 329 IAC 10-39-3(a)(5)(C) upon closure application approval and annually within 90 days after the close of each fiscal year.

The opinion of probable post-closure care cost included with this closure application was calculated using the IDEM format. NIPSCO LLC will review the opinion of probable post-closure care cost annually until the post-closure care of the former surface impoundments certification is deemed adequate and submit to the commissioner no later than 15 June of any given year. The opinion of post-closure care cost will be adjusted for inflation using one of the following methods:

- Recalculating the opinion of post-closure care cost in current dollars
- Using an inflation factor derived from the most recent implicit price deflator for gross national product published by the United States Department of Commerce in its Survey of Current Business.

If the post-closure care plan has changed, NIPSCO LLC. will revise the opinion of post-closure care cost not later than 30 days after the commissioner has approved the changed post-closure care plan. The revised opinion of post-closure care cost will be adjusted for inflation as previously specified.

# 13.0 Public outreach

NIPSCO LLC intends to provide public information opportunities about closure of the surface impoundments. NIPSCO LLC will prepare a public outreach plan describing the surface impoundment closures and subsequent corrective action activities.

NIPSCO LLC regularly publishes and updates documents for the BGS operating record (https://www.nipsco.com/about-us/ccr-rule-compliance in accordance with requirements contained in the Federal CCR Rule (40 CFR 257.105). Documents have been, or will be posted for:

- Location restrictions
- Design criteria
- Operating criteria
- Groundwater monitoring and corrective action
- Closure and post-closure care.

# 14.0 References

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IDNR, 1990, 1994, *Unconsolidated Aquifer Systems of La Porte County, Indiana,* Indiana Department of Natural Resources, Division of Water.

Shedlock, Robert J., David A Cohen, Thomas E. Imbrigiotta, and Todd A Thompson, 1994. *Hydrogeology and Hydrochemistry of Dunes and Wetlands along the Southern Shore of Lake Michigan, Indiana*. U.S. Geological Survey, Open File Report 92-139, 1994.

# Figures


C:\Users\eric.thompson\Documents\Projects\Rick\2019\NIPSCO Bailly Figures.dwg Tue, 14 May 2019 – 2:57pm eric.thompson

| | | |
|---|---|---|
| NIPSCO<br>BAILLY GENERATING STATION<br>CHESTERTON, INDIANA | wood. | SITE LOCATION MAP<br>CCR SURFACE IMPOUNDMENT<br>FIGURE-1 |

# Surface Impoundment Closure Site Vicinity Map

Northern Indiana Public Service Company

Bailly Generating Station
Chesterton, Indiana


## Legend

- Bailly Generating Station Property Line
- Roads
- Wetland
- Natural/Forested Area
- Urban

## Location of Site


## Notes and Sources

# FIGURE 2

USGS DRG: March 2003
Courtesy of USA PhotoMaps
Cross Section: USGS Open File Report 92-39, 1994

N

0 1,000 2,000 Feet

wood.
Wood Environment & Infrastructure Solutions, Inc.
271 Mill Road
Chelmsford, MA 01824
(978) 692-9090

H:\NiSource\BaillyGenerating\Task100\Fig2_SiteVicintiyMap.mxd May 13, 2019 DWN: andrew.nelson CHKD: RAI


# Surface Impoundment Closure Aerial Photograph

Northern Indiana Public Service Company

Bailly Generating Station
Chesterton, Indiana

## Legend

- Bailly Generating Station Property Boundary
- Railroad

## Location of Site


## Notes and Sources

FIGURE 3

0 700 1,400 Feet

N

wood.
Wood Environment & Infrastructure Solutions, Inc.
271 Mill Road
Chelmsford, MA 01824
(978) 692-9090

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# Surface Impoundment Closure Area Designations

Northern Indiana Public Service Company

Bailly Generating Station
Chesterton, Indiana

## Legend

- Bailly Generating Station Property Boundary
- Railroad
- Area A
- Area B
- Area C

## Location of Site


## Notes and Sources

FIGURE 4

0 1,000 2,000 Feet

N

wood.
Wood Environment & Infrastructure Solutions, Inc.
271 Mill Road
Chelmsford, MA 01824
(978) 692-9090

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LEGEND

- Post Closure Monitoring Well
- Piezometer
- Approximate Property Line

0 400 800

1 " = 400 feet

Feet

**NOTE(S)**

**REFERENCE(S)**

SERVICE LAYER CREDITS: © 2021 MICROSOFT CORPORATION © 2021 MAXAR ©CNES (2021) DISTRIBUTION AIRBUS DS

CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT

BAILLY GENERATING STATION
CHESTERTON, INDIANA
CLOSURE APPLICATION

TITLE

**POST CLOSURE MONITORING WELL NETWORK**

CONSULTANT

GOLDER

| | |
|---|---|
| YYYY-MM-DD | 1/29/2021 |
| DESIGNED | JSP |
| PREPARED | SHL |
| REVIEWED | JSP |
| APPROVED | MAH |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
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# Appendix A

BGS-01
SHEET 01

# COVER SHEET

## CCR IMPOUNDMENT CLOSURE PLAN PERMIT APPLICATION

BOILER SLAG POND
PRIMARY SETTLING POND NO. 1
PRIMARY SETTLING POND NO. 2
SECONDARY SETTLING POND NO. 1

BAILLY GENERATING STATION

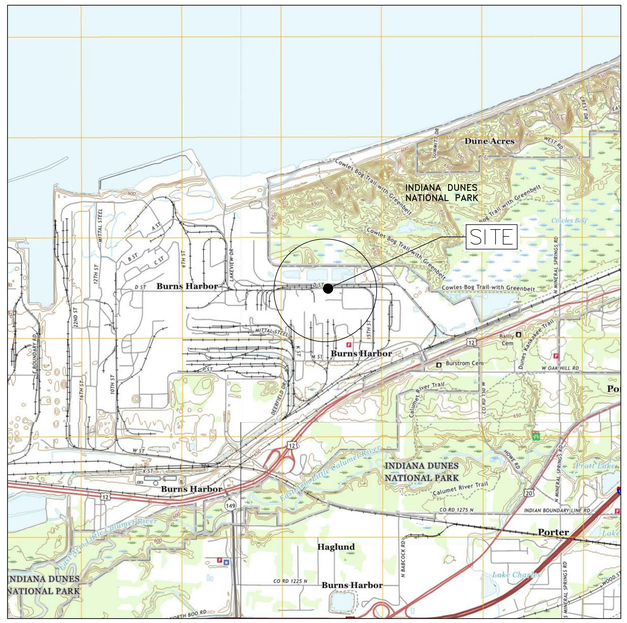
PORTER COUNTY, CHESTERTON, INDIANA
LATITUDE: 41° 38' 18" N, LONGITUDE: 87° 07' 03" W

OWNER:
NORTHERN INDIANA PUBLIC SERVICE COMPANY, LLC
246 BAILLY STATION ROAD, CHESTERTON, IN 46304

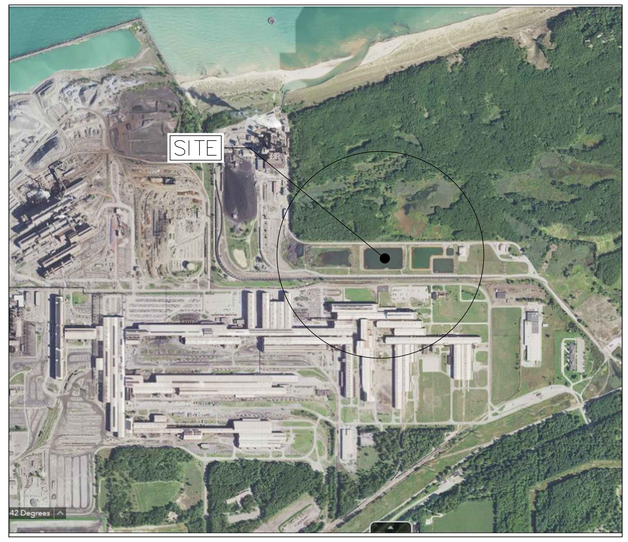
PREPARED BY:
WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS, INC.
11003 BLUEGRASS PARKWAY SUITE 690, LOUISVILLE, KENTUCKY 40299




LOCATION MAP
SOURCE: INDOT/USCB STREETS BASEMAP (dated 2011)
SCALE: 1" = 5 MILES
5 miles 0 5 miles 10 miles




VICINITY MAP
SOURCE: HTTPS://STORE.USGS.GOV (dated 2019)
SCALE: 1" = 1/2 MILE
1 MILE 0.5 MILE 0 MILE




AERIAL PHOTOGRAPHY
SOURCE: USGS THE NATIONAL MAP: Orthoimagery (dated 2019)
1" = 1000'
1000 0 1000 2000

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Phone: (502) 267-0700 Fax: (502) 267-5900

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| DATE: | 01-06-2021 |
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| TITLE | BAILLY GENERATING STATION |
| LOCATION | CHESTERTON, INDIANA |
| DETAIL | COVER SHEET AND LOCATION MAPS<br>CCR IMPOUNDMENT CLOSURE |
| W.O./ACCT. NO. | 7382173270 |

| NIPSCO DRAWING NO. | REV. |
|---|---|
| BGS-01 | 0 |
| SHEET 01 | |

Plotted By:Foraker, Lydia Sheet Set:New Sheet Set (3) Layout:SHT 1 – COVER December 22, 2020 12:53:34pm P:\Projects\7382\7382193347 NIPSCO Bailly\Plansheets\BGS Permit Set Rev 0 2020-1217.dwg

## DRAWING INDEX

| DRAWING NUMBER | SHEET NUMBER | DETAIL TITLE |
|---|---|---|
| BGS-01 | 01 | COVER SHEET & LOCATION MAPS |
| BGS-02 | 02 | LEGEND, ABBREVIATIONS, GENERAL NOTES, AND DRAWING INDEX |
| BGS-03 | 03 | OVERALL SITE PLAN |
| BGS-04 | 04 | EXISTING CONDITIONS PLAN |
| BGS-05 | 05 | EXCAVATION PLAN |
| BGS-06 | 06 | GRADING PLAN |
| BGS-07 | 07 | BASELINE PROFILES |
| BGS-08 | 08 | CROSS SECTIONS: STA. |
| BGS-09 | 09 | GENERAL DETAILS |
| BGS-10 | 10 | EROSION PREVENTION AND SEDIMENT CONTROL PLAN |
| BGS-11 | 11 | EROSION PREVENTION AND SEDIMENT CONTROL DETAILS |

### GENERAL NOTES:

1. EXISTING TOPOGRAPHIC MAPPING SHOWN WAS DEVELOPED BY DLZ INDUSTRIAL, LLC, 316 TECH DRIVE, BURNS HARBOR, IN 46304, DATED OCTOBER 6, 2017.
2. THE SURVEY CONTROL HEREON SHOWS COORDINATE VALUES IN INDIANA COORDINATE SYSTEM OF 1983 (NAD 83, WEST ZONE). UNITS ARE IN US FEET.
3. THE SURVEY CONTROL TABLE HEREON SHOWS ELEVATIONS IN NAVD88 (NORTH AMERICAN DATUM 1988).
4. ONLY UTILITIES OBSERVED AT THE TIME OF SURVEY WERE RECORDED. ADDITIONAL UTILITIES EXIST IN ADDITION TO THOSE HEREON. *SEE SARGENT AND LUNDY DRAWINGS B-565, B-566, AND B-569 FOR ADDITIONAL UNDERGROUND UTILITIES.
5. ADDITIONAL INFORMATION
   STREET ADDRESS: 246 BAILLY STATION ROAD,CHESTERTON, INDIANA 46304
   COUNTY: PORTER
   TOWNSHIP: 37 N
   RANGE: 6 W
   SECTION: 21
   USGS QUADRANGLE MAP: DUNE ACRES
6. USE CAUTION WHEN WORKING BENEATH OVERHEAD ELECTRICAL TRANSMISSION LINES, IN ACCORDANCE WITH THE OWNER'S REQUIREMENTS. VERIFY ADEQUATE CLEARANCE FOR EQUIPMENT. PRIOR TO PERFORMING WORK, SELECT EQUIPMENT AND CONDUCT OPERATIONS TO MAINTAIN ADEQUATE CLEARANCE BENEATH ELECTRICAL CONDUCTORS.
7. GROUNDWATER MONITORING WELLS FOR SURFACE IMPOUNDMENTS ARE LISTED WITHIN THE TABLE AND ARE SHOWN ON THE EXISTING CONDITIONS DRAWING.
8. EXISTING DISCHARGE PIPES USED TO CONVEY ACCUMULATED WATER WITHIN THE BOILER SLAG POND, AND PRIMARY SETTLING PONDS 1 AND 2 ARE BEING RE-PURPOSED FOR USE AS STORM DRAIN PIPING DURING THE POST-CLOSURE PERIOD. AN ASSESSMENT IS PLANNED DURING DETAILED DESIGN, AND PIPING REHABILITATION, IF REQUIRED, WILL BE PROPOSED BY NIPSCO FOR CONCURRENCE BY IDEM.
9. INVERT ELEVATIONS SHOWN ON EXISTING UNDERGROUND DRAINAGE PIPING ARE TAKEN FROM SARGENT AND LUNDY DRAWINGS B-565, B-566, AND B-569.

### STATION NOTES:

1. CLOSURE OF THE CCR SURFACE IMPOUNDMENTS AT BGS INCLUDES THE FOLLOWING SURFACE IMPOUNDMENTS:
   - BOILER SLAG POND
   - PRIMARY SETTLING POND NO. 1
   - PRIMARY SETTLING POND NO. 2
   - SECONDARY SETTLING POND NO. 1
2. WORK PERFORMED FOR THE CCR SURFACE IMPOUNDMENT CLOSURE IS GOVERNED BY THE REQUIREMENTS OUTLINED IN THE CCR SURFACE IMPOUNDMENT CLOSURE APPLICATION FOR BAILLY GENERATING STATION.
3. CONDUCT CONSTRUCTION ACTIVITIES FOR THE CCR SURFACE IMPOUNDMENT CLOSURE IN ACCORDANCE WITH THE REQUIREMENTS CONTAINED IN THE "BAILLY GENERATING STATION CCR FUGITIVE DUST CONTROL PLAN".
4. PERFORM WORK FOR THE CCR SURFACE IMPOUNDMENT CLOSURE IN CONFORMANCE WITH THE APPROVED STORM WATER POLLUTION PREVENTION PLAN.
5. WATER SURFACE ELEVATIONS (WSE) SHOWN ON EXISTING CONDITIONS DRAWING REFLECT ELEVATIONS AT THE TIME OF THE SURVEY.
6. WATER SURFACE ELEVATIONS (WSE) SHOWN ON THE EXISTING CONDITIONS DRAWING REFLECT ELEVATIONS AT THE TIME OF THE SURVEY.

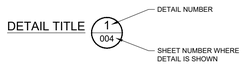
### SURVEY TABLE

(SEE GENERAL NOTE 3)

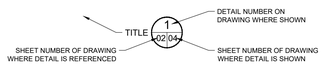
| CONTROL POINT NO. | INDIANA WEST NAD83 STATE PLANE | | NAVD 88 | DESCRIPTION |
|---|---|---|---|---|
| | NORTHING | EASTING | ELEVATION | |
| 5 | 2,329,455.30 | 2,911,425.77 | 619.27 | MAG NAIL |
| M-8 | 2,329,734.40 | 2,941,564.88 | 619.33 | PLANT MONUMENT |
| M-5 | 2,330,030.14 | 2,941,986.27 | 616.84 | PLANT MONUMENT |
| 13036 | 2,327,710.02 | 2,944,937.04 | 621.58 | CUT "BOX" FOUND |
| 13060 | 2,327,822.02 | 2,943,494.13 | 633.35 | CUT "BOX" FOUND |

### LEGEND

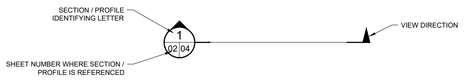
- GAS METER
- ELECTRIC METER
- BEEHIVE INLET
- UTILITY POLE
- POWER POLE
- LIGHT POLE
- HYDRANT
- SURVEY MARKER - MAG NAIL
- SURVEY MARKER - MONUMENT
- GROUNDWATER MONITORING WELL
- CCR DOWNGRADIENT MONITORING WELL
- CCR BACKGROUND MONITORING WELL
- GAS PIPELINE MARKER
- VERTICAL VENT
- ELECTRICAL BOX
- GUARD POST
- MANHOLE
- PROPERTY LINE
- ABOVE GROUND PIPING
- UNDERGROUND PIPING
- POST CLOSURE STORM DRAIN SYSTEM
- EXISTING UNDERGROUND STORM DRAINS
- RAIL ROAD (RR)
- OVERHEAD POWER LINE (OE)
- OVERHEAD ELECTRIC TOWER
- BURIED ELECTRIC POWER LINE (BE)
- UNDERGROUND GAS LINE (GAS)
- UNDERGROUND TELEPHONE LINE (T)
- EXISTING CONTOURS
- PROPOSED CONTOURS (600)
- SPOT ELEVATIONS (600)
- GUARDRAIL
- FENCE
- PAVED ROAD
- GRAVEL ROAD
- CONCRETE
- BUILDING
- METAL GRATING
- WATER EDGE
- VEGETATION LINE
- SURFACE IMPOUNDMENT BOUNDARY
- (TBD) TO BE DEMOLISHED
- H.P. HIGH POINT




DETAIL TITLE & NUMBER




DRAWING CALL OUT
& DETAIL REFERENCE




SECTION / PROFILE
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### ABBREVIATIONS

| ACRONYM | DESCRIPTION |
|---|---|
| @ | AT |
| CCR | COAL COMBUSTION RESIDUALS |
| CCR RULE | US EPA FINAL RULE FOR DISPOSAL OF COAL COMBUSTION RESIDUALS FROM ELECTRIC UTILITIES |
| CL | CENTER LINE |
| CLR | CLEARANCE |
| CY | CUBIC YARD |
| DIA | DIAMETER |
| ELEV | ELEVATION |
| EPSC | EROSION PROTECTION AND SEDIMENT CONTROL |
| U.S. EPA | UNITED STATES ENVIRONMENTAL PROTECTION AGENCY |
| FSS | FIXATED SCRUBBER SLUDGE |
| HDPE | HIGH DENSITY POLYETHYLENE |
| H | HORIZONTAL |
| INV | INVERT |
| LF | LINEAR FEET |
| MAX | MAXIMUM |
| MIN | MINIMUM |
| NO. | NUMBER |
| NTS | NOT TO SCALE |
| OD | OUTER DIAMETER |
| OH | OVERHEAD |
| OZ | OUNCES |
| RR | RAILROAD TRACKS |
| SDR | STANDARD DIMENSION RATIO |
| SF | SQUARE FEET |
| SR | STATE ROUTE |
| STA | STATION OR STATIONING |
| STD | STANDARD |
| SY | SQUARE YARDS |
| TEMP | TEMPORARY |
| TYP | TYPICAL |
| UG | UNDERGROUND |
| UNO | UNLESS NOTED OTHERWISE |
| WS | WATER SURFACE |
| WSE | WATER SURFACE ELEVATION |

### GROUNDWATER MONITORING WELLS

| CCR UNIT | MW NUMBER | DESIGNATION |
|---|---|---|
| ALL | GAMW-01 | BACKGROUND |
| | GAMW-01B | BACKGROUND |
| BOILER SLAG POND | GAMW-12R | DOWNGRADIENT |
| | GAMW-13 | DOWNGRADIENT |
| | GAMW-14 | DOWNGRADIENT |
| | MW-105 | DOWNGRADIENT |
| PRIMARY SETTLING POND 1 / PRIMARY SETTLING POND 2 | GAMW-06 | DOWNGRADIENT |
| | GAMW-07 | DOWNGRADIENT |
| | GAMW-08 | DOWNGRADIENT |
| | GAMW-08B | DOWNGRADIENT |
| | GAMW-10 | DOWNGRADIENT |
| | GAMW-11 | DOWNGRADIENT |
| | GAMW-11C | DOWNGRADIENT |
| | GAMW-16 | DOWNGRADIENT |
| | GAMW-17 | DOWNGRADIENT |
| | GAMW-17B | DOWNGRADIENT |
| | GAMW-18 | DOWNGRADIENT |
| | MW-112 | DOWNGRADIENT |
| SECONDARY SETTLING POND 1 | GAMW-02 | DOWNGRADIENT |
| | GAMW-03 | DOWNGRADIENT |
| | GAMW-04 | DOWNGRADIENT |

NOTE: MW GAMW-12R IS LOCATED NEAR GAMW-12

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TITLE BAILLY GENERATING STATION
LOCATION CHESTERTON, INDIANA
DETAIL LEGEND, ABBREVIATIONS, GENERAL NOTES AND DRAWING INDEX CCR IMPOUNDMENT CLOSURE
W.O./ACCT. NO. 7382173270

NIPSCO DRAWING NO. BGS-02
REV. 0
SHEET 02

Plotted By:Foraker, Lydia Sheet Set:New Sheet Set (3) Layout:SHT 2 – LEGEND AND INDEX January 04, 2021 08:47:23am P:\Projects\7382\7382193347 NIPSCO Bailly\Plansheets\BGS Permit Set Rev 0 2021-0106.dwg

BGS-03
SHEET 03


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0 150 300 450

SCALE: 1" = 150'

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| DATE: | 01-06-2021 |
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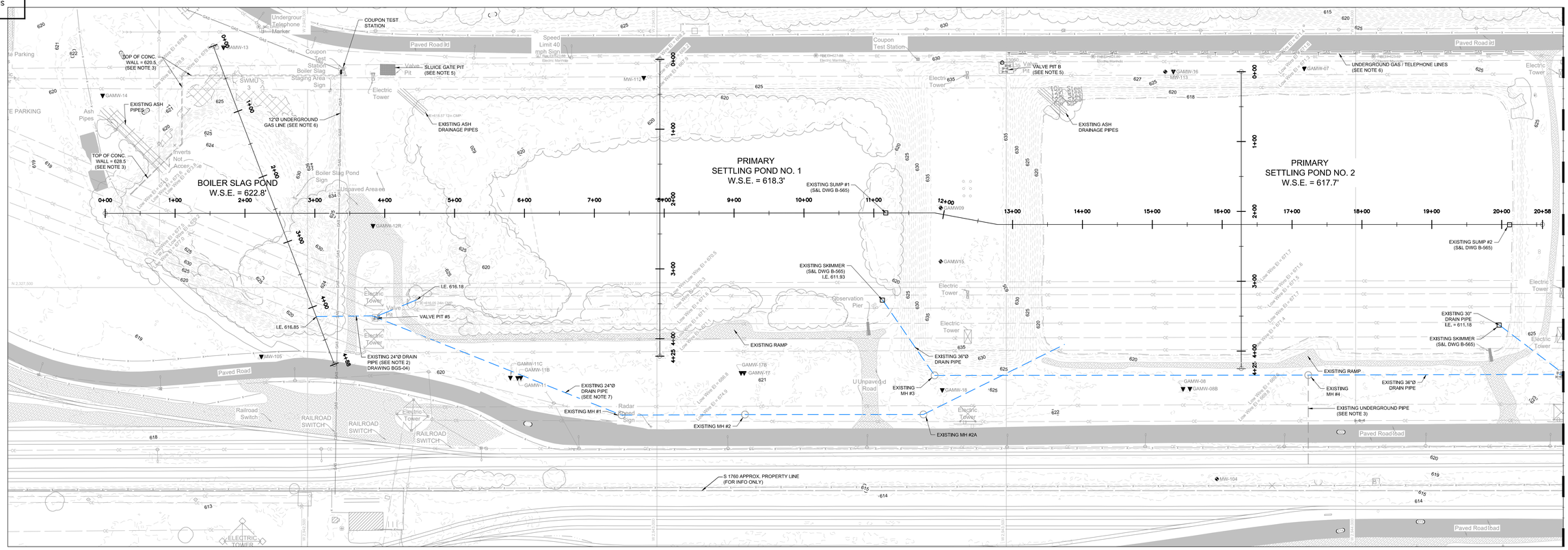
TITLE BAILLY GENERATING STATION
LOCATION CHESTERTON, INDIANA
DETAIL OVERALL SITE PLAN
CCR IMPOUNDMENT CLOSURE
W.O./ACCT. NO. 7382173270

NIPSCO DRAWING NO. BGS-03
REV. 0
SHEET 03

Plotted By:Foraker, Lydia Sheet Set:New Sheet Set (3) Layout:SHT 3 – OVERALL SITE December 22, 2020 12:54:19pm P:\Projects\7382\7382193347 NIPSCO Bailly\Plansheets\BGS Permit Set Rev 0 2020-1217.dwg




NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE DRAWING BGS-02.
2. EXISTING UNDERGROUND DRAINAGE PIPE IS ASBESTOS BONDED CORRUGATED METAL PIPE (U.N.O.)
3. VERIFY EXISTING UNDERGROUND PIPE (ARCELORMITTAL) FROM PUMP STATION EXISTS.
4. EXISTING POND BOUNDARIES SHOWN ARE TAKEN FROM SARGENT AND LUNDY DRAWING B-565, AND ARE APPROXIMATE. DURING POND CLOSURE, CONTRACTOR SHALL STAKE BOUNDARY AND EXCAVATE TO EXPOSE LIMITS OF LINER SYSTEM. LINER EXCAVATION LIMITS NEAR TRANSMISSION TOWERS ARE DESIGNATED ON THE IMPOUNDMENT EXCAVATION PROFILE SHOWN ON BGS-07.
5. FOR UNDERGROUND ASH PIPING, CONNECTED TO EXISTING VALVE VAULTS, SEE SARGENT & LUNDY DRAWING B-565.
6. UNDERGROUND 12"Ø NATURAL GAS LINE AND TELEPHONE LINE LOCATIONS ARE APPROXIMATE AND ARE NOT FIELD VERIFIED. SEE SARGENT & LUNDY DRAWINGS B-565 AND M501-33.
7. THE 24"Ø STORM DRAIN FROM VALVE PIT 5 TO PRIMARY SETTLING POND No. 2 HAS BEEN ABANDONED.
8. DRAIN PIPES LOCATED IN VALVE PIT #6 HAVE BEEN GROUTED.
9. ALL INVERT ELEVATIONS SHOWN SHALL BE FIELD VERIFIED BEFORE BEGINNING CONSTRUCTION.
10. FOR EXISTING LINER DETAILS FOR THE BOILER SLAG AND PRIMARY/SECONDARY SETTLING PONDS, SEE DETAILS 1 AND 2 ON DRAWING BGS-07.

N

0 30 60 90

SCALE: 1" = 30'

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| APPROVED: | JS |
| DATE: | 01-06-2021 |
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TITLE: BAILLY GENERATING STATION
LOCATION: CHESTERTON, INDIANA
DETAIL: EXISTING CONDITIONS PLAN
CCR IMPOUNDMENT CLOSURE
W.O./ACCT. NO. 7382173270

NIPSCO DRAWING NO. BGS-04 REV. 0
SHEET 04

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BOILER SLAG POND

PRIMARY SETTLING POND NO. 1

PRIMARY SETTLING POND NO. 2

SECONDARY SETTLING POND NO. 2

SECONDARY SETTLING POND NO. 1

FOREBAY

MATCH LINE - SEE BELOW

MATCH LINE - SEE ABOVE

CONTOURS ARE 1' INTERVAL

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE DRAWING BGS-02.
2. LOCATE UNDERGROUND UTILITIES PRIOR TO EXCAVATION. MAINTAIN SAFE EXCAVATION DISTANCES FROM OVERHEAD TRANSMISSION TOWERS AND UNDERGROUND GAS LINES.
3. DEMOLISH EXISTING CONCRETE WALL PRIOR TO, AND DURING, EXCAVATION OF THE BOILER SLAG POND.
4. MODIFY EXCAVATION AS SHOWN TO EXPOSE THE END OF THE EXISTING 24"Ø DRAIN PIPE.

0 30 60 90
SCALE: 1" = 30'

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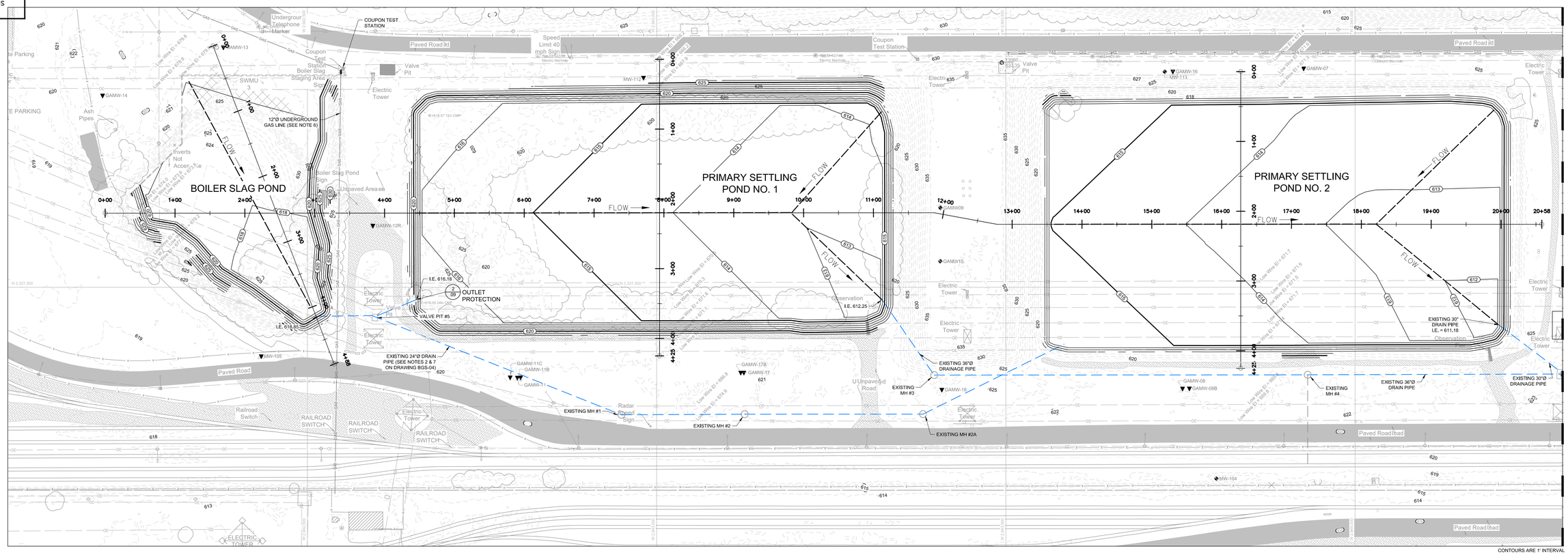
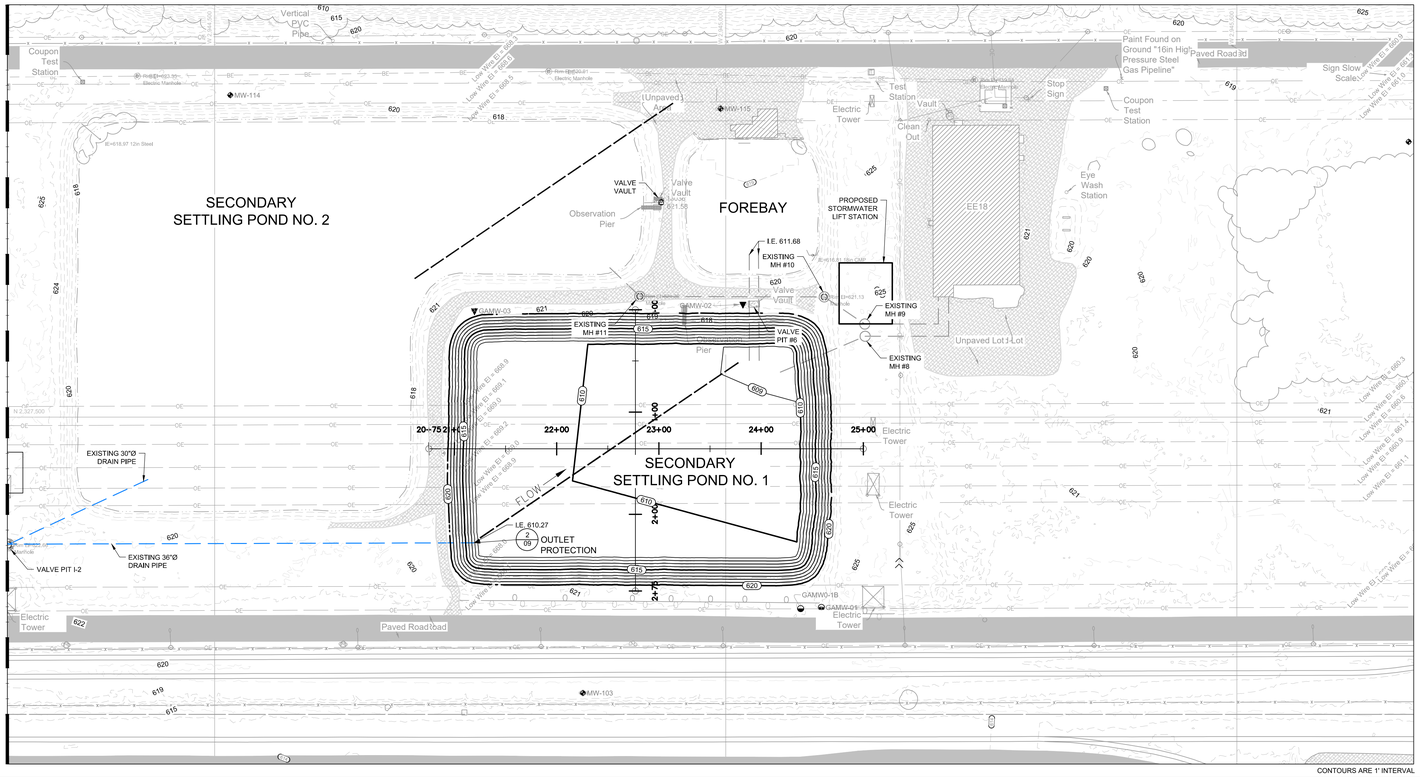
| DATE: | 01-06-2021 |
| SCALE: | AS SHOWN |

TITLE BAILLY GENERATING STATION
LOCATION CHESTERTON, INDIANA
DETAIL EXCAVATION PLAN
CCR IMPOUNDMENT CLOSURE
W.O./ACCT. NO. 7382173270

NIPSCO DRAWING NO. BGS-05 REV. 0
SHEET 05




NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE DRAWING BGS-02.
2. EXISTING UNDERGROUND STORM DRAINS TO REMAIN IN SERVICE POST-CLOSURE SHOWN THUS: — — — —

N

0 30 60 90

SCALE: 1" = 30'

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| DATE: | 01-06-2021 |
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| TITLE | BAILLY GENERATING STATION |
| LOCATION | CHESTERTON, INDIANA |
| DETAIL | GRADING PLAN |
| | CCR IMPOUNDMENT CLOSURE |
| W.O./ACCT. NO. | 7382173270 |

| NIPSCO DRAWING NO. | REV. |
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| BGS-06 | 0 |
| SHEET 06 | |

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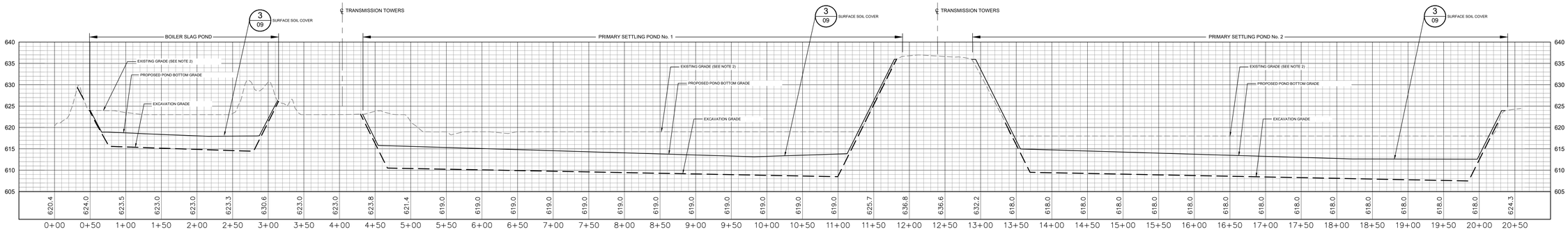
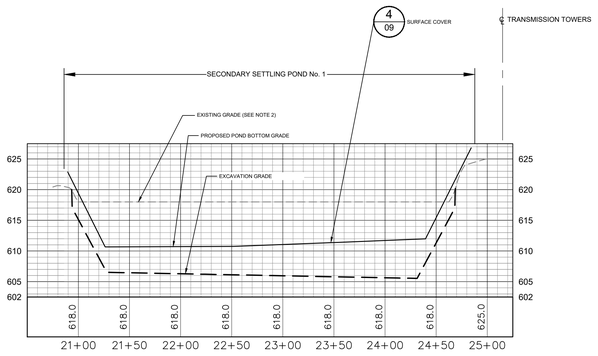
NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE DRAWING BGS-02.
2. EXISTING GRADE SHOWN REFLECTS THE WATER SURFACE ELEVATION (WHERE PRESENT) AT THE TIME THE TOPOGRAPHIC SURVEY WAS PERFORMED, AND DOES NOT DEPICT THE CCR SURFACE WITHIN THE PRIMARY SETTLING PONDS Nos. 1 & 2, AND SECONDARY SETTLING POND No. 1.
3. THE BOTTOM OF LINER ELEVATION SHOWN WAS ESTIMATED FROM SARGENT & LUNDY DRAWING B-565.




## BASELINE PROFILE No. 1
## (BOILER SLAG POND, PRIMARY SETTLING POND No. 1 & PRIMARY SETTLING POND No. 2)

SCALE: 1"=60', HORIZONTAL: 1"=10', VERTICAL




## BASELINE PROFILE No. 1
## (SECONDARY SETTLING POND No. 1)

SCALE: 1"=60', HORIZONTAL: 1"=10', VERTICAL




1/07 LIMIT OF EXISTING IMPOUNDMENT LINER EXCAVATION
(PRIMARY SETTLING PONDS 1 & 2, AND SECONDARY SETTLING POND)
NTS




2/07 LIMIT OF EXISTING IMPOUNDMENT LINER EXCAVATION
(BOILER SLAG POND)
NTS

0 30 60 90
SCALE: 1" = 30'

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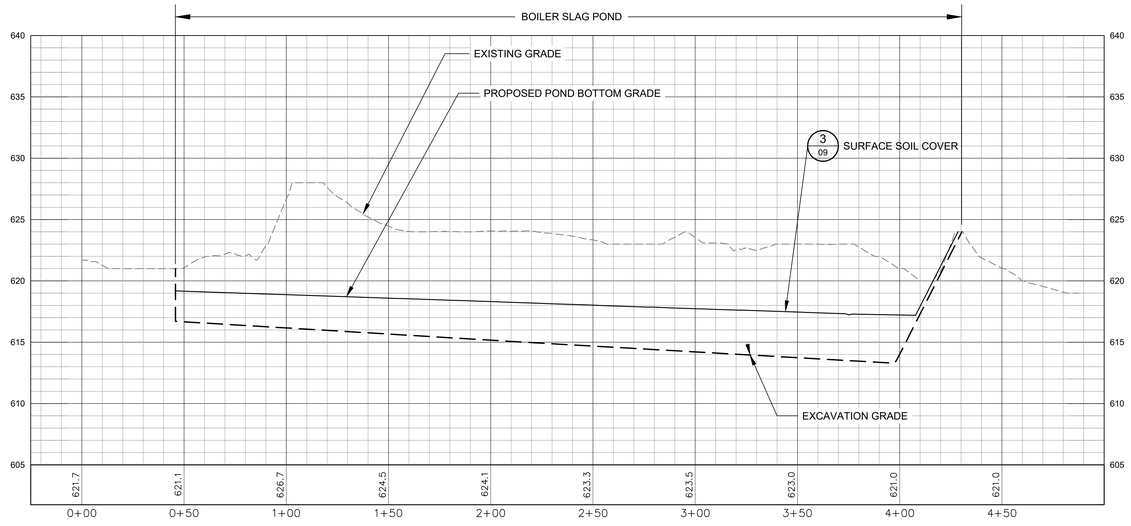
| DRAWN: | RB |
| ENGINEER: | DRS |
| APPROVED: | JS |
| DATE: | 01-06-2021 |
| SCALE: | AS SHOWN |

TITLE: BAILLY GENERATING STATION
LOCATION: CHESTERTON, INDIANA
DETAIL: BASELINE PROFILES
CCR IMPOUNDMENT CLOSURE
W.O./ACCT. NO. 7382173270

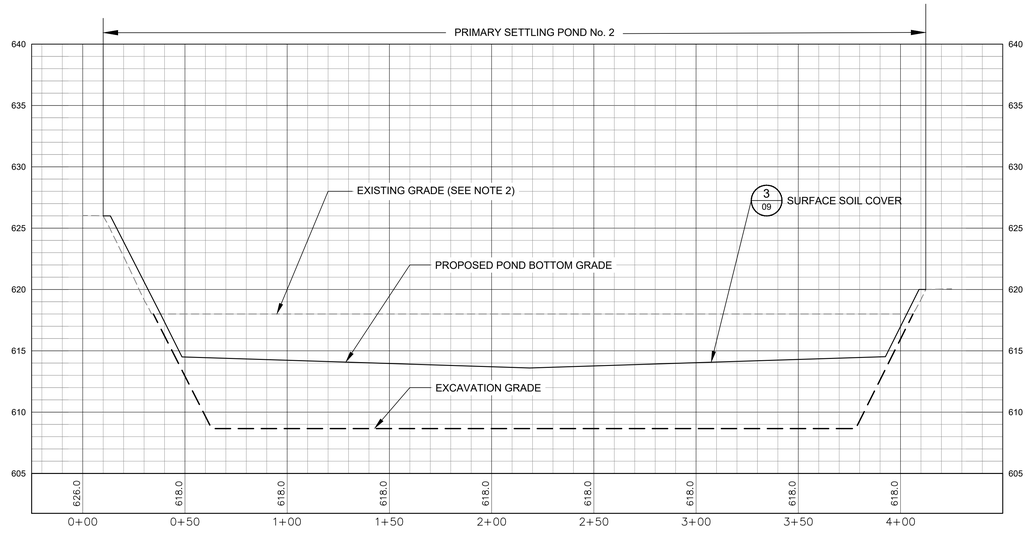
NIPSCO DRAWING NO. BGS-07 REV. 0
SHEET 07

Plotted By:Foraker, Lydia Sheet Set:New Sheet Set (3) Layout:SHT 7 – BASELINE December 22, 2020 12:59:28pm P:\Projects\7382\7382193347 NIPSCO Bailly\Plansheets\BGS Permit Set Rev 0 2020-1217.dwg



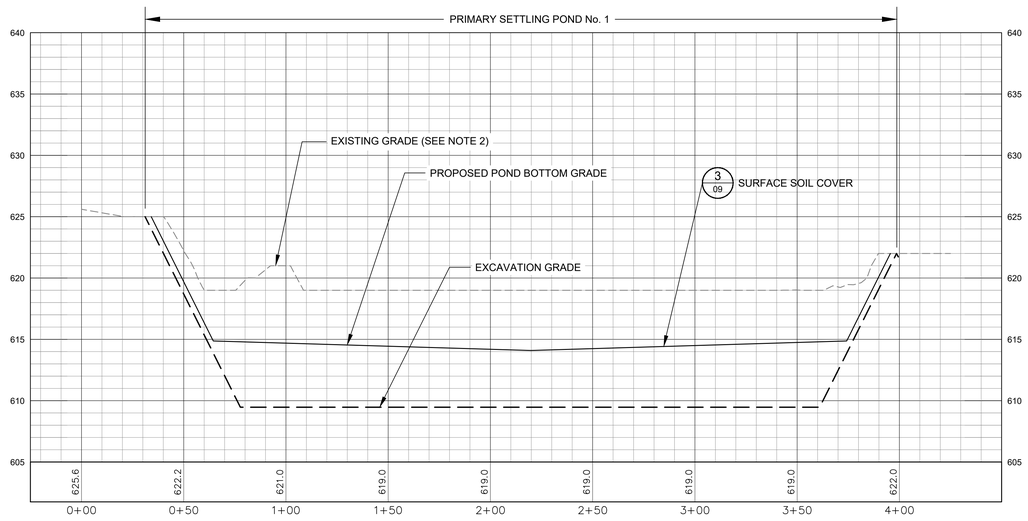

## BOILER SLAG POND

SCALE: 1"=30', HORIZONTAL; 1"=10', VERTICAL



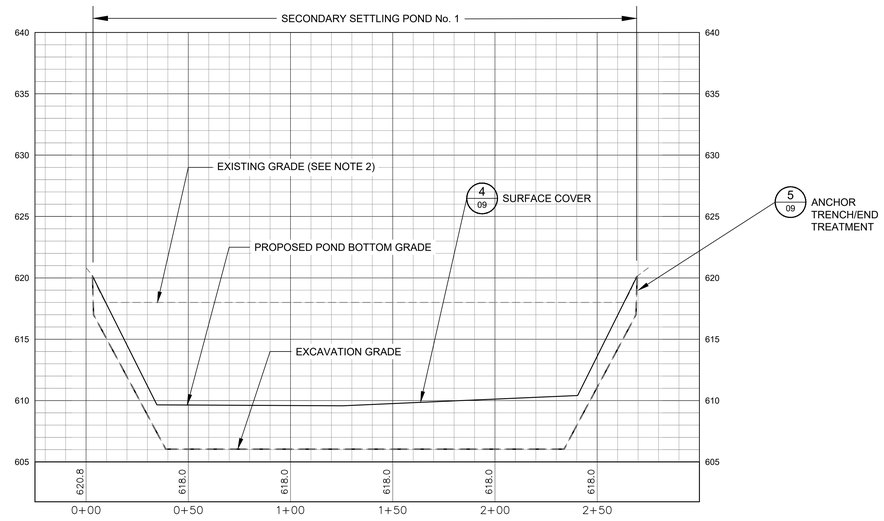

## PRIMARY SETTLING POND No. 2

SCALE: 1"=30', HORIZONTAL; 1"=10', VERTICAL




## PRIMARY SETTLING POND No. 1

SCALE: 1"=30', HORIZONTAL; 1"=10', VERTICAL




## SECONDARY SETTLING POND No. 1

SCALE: 1"=30', HORIZONTAL; 1"=10', VERTICAL

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE DRAWING BGS-02.
2. EXISTING GRADE SHOWN REFLECTS THE WATER SURFACE ELEVATION (WHERE PRESENT) AT THE TIME THE TOPOGRAPHIC SURVEY WAS PERFORMED, AND DOES NOT DEPICT THE CCR SURFACE WITHIN THE PRIMARY SETTLING PONDS Nos. 1 & 2, AND SECONDARY SETTLING POND No. 1.
3. THE BOTTOM OF LINER ELEVATION SHOWN WAS ESTIMATED FROM SARGENT & LUNDY DRAWING B-565.

0 30 60 90
SCALE: 1" = 30'

PERMIT DRAWINGS
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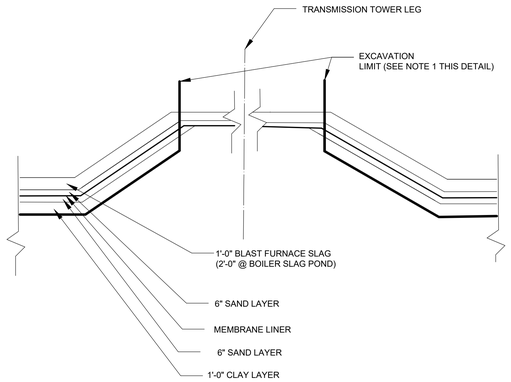
| APPROVED: | JS |
| DATE: | 01-06-2021 |
| SCALE: | AS SHOWN |

TITLE BAILLY GENERATING STATION
LOCATION CHESTERTON, INDIANA
DETAIL CROSS SECTIONS
CCR IMPOUNDMENT CLOSURE
W.O./ACCT. NO. 7382173270

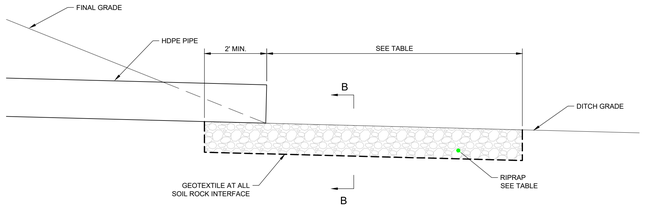
NIPSCO DRAWING NO. BGS-08 REV. 0
SHEET 08

Plotted By:Foraker, Lydia Sheet Set:New Sheet Set (3) Layout:SHT 8 – XSEC December 22, 2020 12:59:52pm P:\Projects\7382\738219347 NIPSCO Bailly\Plansheets\BGS Permit Set Rev 0 2020-1217.dwg

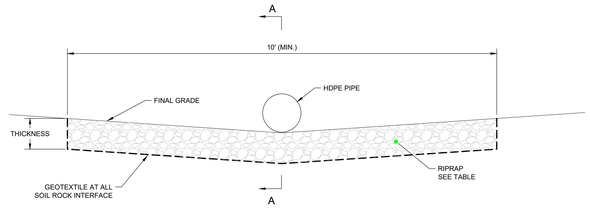



NOTES:
1. LIMIT OF EXCAVATION SHALL BE A MINIMUM OF 30' FRO THE EXISTING TRANSMISSION TOWER LEG. CUT EXISTING MEMBRANE LINER MATERIAL AND ABANDON REMAINING LINER MATERIAL IN PLACE.

LINER EXCAVATION DETAIL 1/09
NTS




PROFILE A-A




SECTION B-B

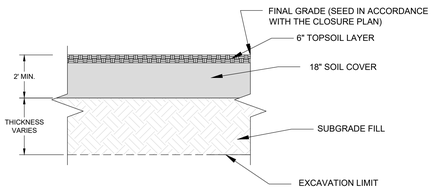
| RIPRAP OUTLET PROTECTION | | | | |
|---|---|---|---|---|
| CULVERT ID | GRADATION (SEE NOTE 1) | APRON LENGTH (FT) | APRON THICKNESS (FT) | APRON WIDTH (FT) |
| PRIMARY SETTLING POND 1 | UNIFORM A | 10 | 1 | 10 |
| SECONDARY SETTLING POND 1 | UNIFORM A | 10 | 1 | 10 |

NOTES:
1. SEE INDOT COURSE AGGREGATE SIZE SPECIFICATIONS FOR AGGREGATE GRADING.

CULVERT OUTLET PROTECTION 2/09
NTS

NOTES:
1. FOR GENERAL NOTES AND LEGEND, SEE BGS-01.

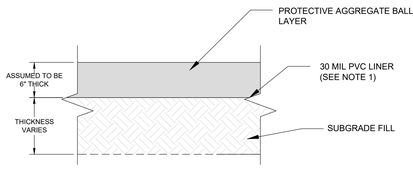
BOILER SLAG POND, PRIMARY SETTLING PONDS 1 & 2 ONLY




NOTE:
DETAIL TYPICAL FOR THE FOLLOWING IMPOUNDMENT BOTTOM AND SIDE SLOPES: BOILER SLAG POND, PRIMARY SETTLING PONDS 1 & 2 AND SECONDARY SETTLING POND 1

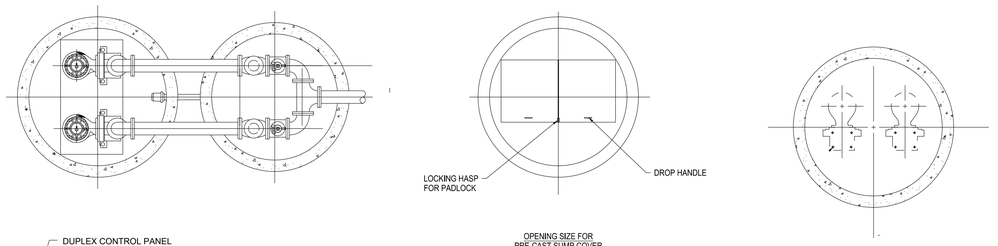
SURFACE SOIL COVER DETAIL 3/09
NTS

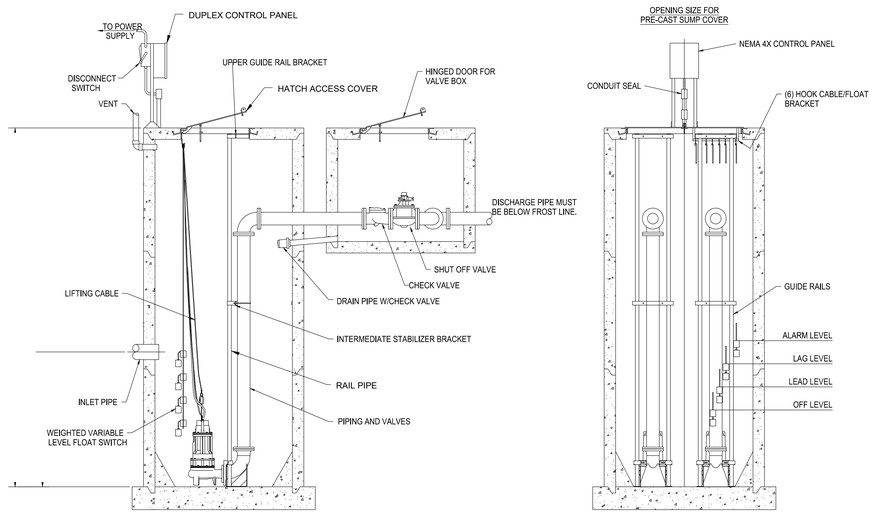
SECONDARY SETTLING POND 1 ONLY




NOTE:
1. A NON-WOVEN GEOTEXTILE (NOT SHOWN FOR CLARITY) MAY BE REQUIRED DEPENDING ON THE TYPE OF AGGREGATE AVAILABLE. FOR PUNCTURE RESISTANCE.
2. ACCESS RAMP(S) INTO SECONDARY SETTLING POND NO. 1 IF REQUIRED, WILL BE DESIGNED AND INCLUDED IN CONSTRUCTION BID DRAWINGS TO BE DEVELOPED.

SURFACE COVER DETAIL 4/09
NTS

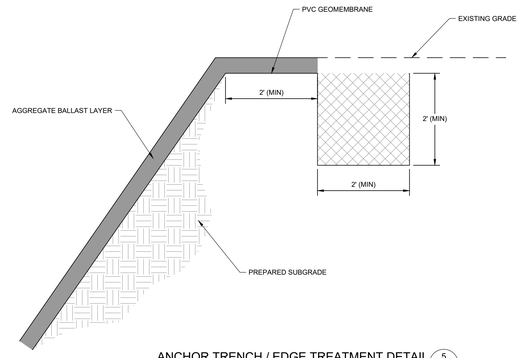






STORMWATER LIFT STATION 4/09
NTS




ANCHOR TRENCH / EDGE TREATMENT DETAIL 5/09
N.T.S

PERMIT DRAWINGS
PRELIMINARY – NOT FOR CONSTRUCTION

CONTOURS ARE 1' INTERVAL

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| APPROVED: | JS |
| DATE: | 01-06-2021 |
| SCALE: | AS SHOWN |

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|---|---|
| TITLE | BAILLY GENERATING STATION |
| LOCATION | CHESTERTON, INDIANA |
| DETAIL | GENERAL DETAILS |
| | CCR IMPOUNDMENT CLOSURE |
| W.O./ACCT. NO. | 7382173270 |

| NIPSCO DRAWING NO. | REV. |
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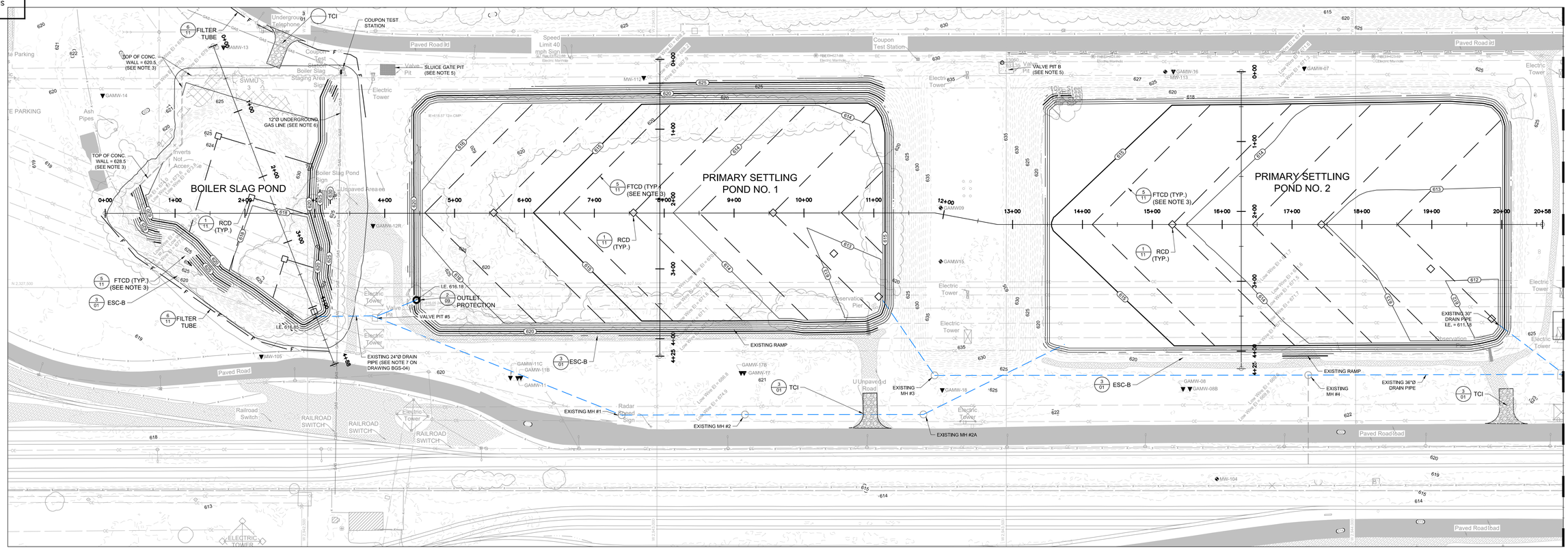
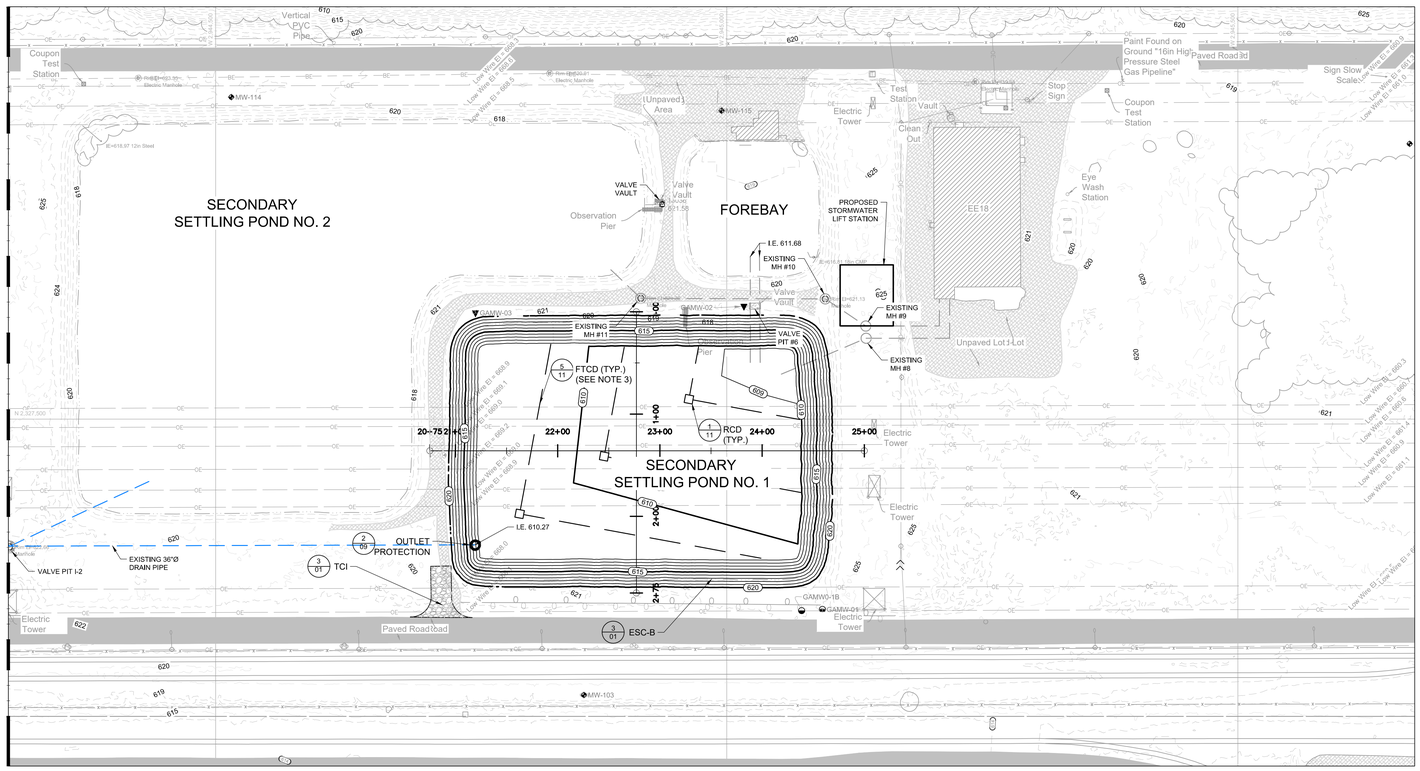
| BGS-09 | 0 |
| SHEET 09 | |

Plotted By:Foraker, Lydia Sheet Set:New Sheet Set (3) Layout:SHT 9 - GENERAL DETAILS December 22, 2020 01:01:14pm P:\Projects\7382\7382193347 NIPSCO Bailly\Plansheets\BGS Permit Set Rev 0 2020-1217.dwg




NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE DRAWING BGS-02.
2. INSTALL SEDIMENT AND EROSION CONTROLS IN ACCORDANCE WITH THE APPROVED SWPPP. MAINTAIN CONTROLS UNTIL THE SITE IS STABILIZED AND REMOVAL OF EROSION PROTECTION MEASURES IS AUTHORIZED.
3. INSTALL FILTER TUBE CHECK DAMS AS SHOWN USING AN APPROXIMATE 100' SPACING.

N

0 30 60 90

SCALE: 1" = 30'

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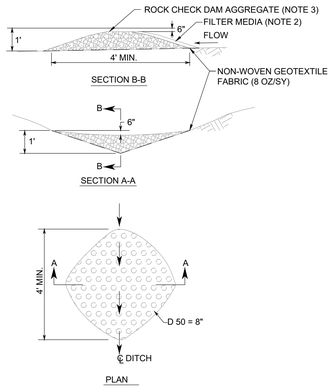
| APPROVED: | JS |
| DATE: | 01-06-2021 |
| SCALE: | AS SHOWN |

TITLE: BAILLY GENERATING STATION
LOCATION: CHESTERTON, INDIANA
DETAIL: EROSION AND SEDIMENT CONTROL PLAN
CCR IMPOUNDMENT CLOSURE
W.O./ACCT. NO. 7382173270

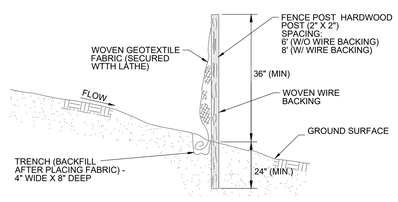
NIPSCO DRAWING NO. BGS-10 REV. 0
SHEET 10




1. SPACE ROCK CHECK DAMS AT 100 FOOT INTERVALS.
2. FILTER MEDIA SHAL BE PLACED ON UPSTREAM SIDE AND CONSIST OF INDOT COARSE AGGREGATE NO. 5 (PREFERRED) OR COARSE AGGREGATE NO. 8.
3. ROCK CHECK DAM MATERIAL SHALL BE INDOT REVETMENT RIPRAP.

ROCK CHECK DAM (1/11)
NTS

RCD

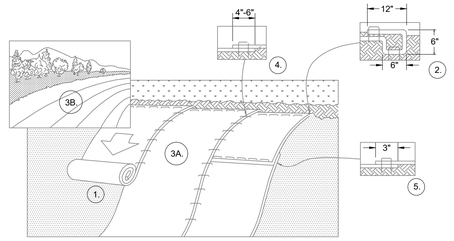



1. SILT FENCE GEOTEXTILE FABRIC SHALL CONFORM TO THE TABLE BELOW.
2. SILT FENCES MAY BE PURCHASED COMMERCIALLY.

| PHYSICAL PROPERTY | WOVEN GEOTEXTILE FABRIC |
|---|---|
| FILTERING EFFICIENCY | 85% |
| TEXTILE STRENGTH AT 20% ELONGATION<br>STANDARD STRENGTH<br>EXTRA STRENGTH | <br>30 LBS. PER LINEAR INCH<br>50 LBS PER LINEAR INCH |
| SLURRY FLOW RATE | 0.3 GAL/MIN/SQUARE FOOT |
| WATER FLOW RATE | 15 GAL MIN/SQUARE FOOT |
| UV RESISTANCE | 70% |

SILT FENCE DETAIL (2/11)
NTS

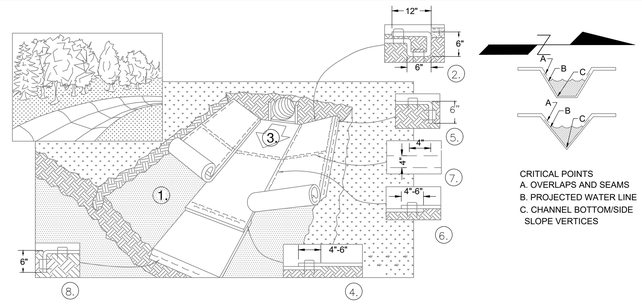
SF




1. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. ALL ROCKS OR CLODS 1 ½" IN DIAMETER OR GREATER, AND ALL STICKS AND OTHER FOREIGN MATTER SHALL BE REMOVED.
2. ON SLOPES, BLANKETS MAY BE UNROLLED EITHER HORIZONTALLY OR VERTICALLY TO THE SLOPE. ENDS AND SIDES SHALL BE STAPLED. WHEN MULTIPLE BLANKETS ARE UTILIZED, THE UPSLOPE BLANKET SHOULD OVER LAP THE DOWN SLOPE BLANKET. PLACE STAPLES PER MANUFACTURERS RECOMMENDATIONS FOR THE APPROPRIATE SLOPE BEING APPLIED.
3. EROSION PROTECTION BLANKETS PLACED IN CHANNELS SHALL BE IN ACCORDANCE WITH THE INDIANA STORM WATER CONTROL MANUAL.
4. INSTALL EROSION CONTROL BLANKETS WITHIN CHANNELS WHEN FINAL SEEDING IS BEING PERFORMED, ON SLOPES EXCEEDING 4 FEET HORIZONTAL TO 1 FOOT VERTICAL.

EROSION CONTROL BLANKET (SLOPE INSTALLATION) (3/11)

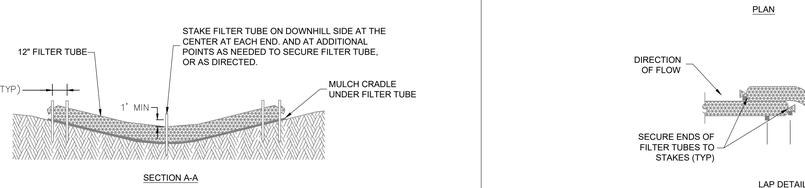
ECB-S




1. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. ALL ROCKS OR CLODS 1 ½" IN DIAMETER OR GREATER, AND ALL STICKS AND OTHER FOREIGN MATTER SHALL BE REMOVED.
2. BEGIN AT THE TOP OF THE CHANNEL BY ANCHORING THE BLANKET IN A 6" DEEP X 6" WIDE TRENCH WITH APPROXIMATELY 12" OF BLANKET EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE BLANKET WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12"APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12"PORTION OF BLANKET BACK OVER SEED AND COMPACTED SOIL. SECURE BLANKET OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" APART ACROSS THE WIDTH OF THE BLANKET.
3. IF NETTING IS SPECIFIED FOR ONE SIDE ONLY, THE BLANKET SHOULD BE PLACED WITH THE NETTING ON TOP AND THE FIBERS IN CONTACT WITH THE SOIL.
4. IN DITCHES, BLANKETS SHOULD BE UNROLLED IN THE DIRECTION OF WATER FLOW, AND STAPLED EVERY 5 FEET AT JOINTS AND EDGES OR AS SPECIFIED IN THE PLANS. WHEN MULTIPLE BLANKETS ARE USED, THE UPSTREAM BLANKETS SHOULD OVERLAP THE DOWNSTREAM BLANKETS.
5. EROSION PROTECTION BLANKETS PLACED IN CHANNELS SHALL BE IN ACCORDANCE WITH THE INDIANA STORM WATER CONTROL MANUAL.
6. INSTALL EROSION CONTROL BLANKETS WITHIN CHANNELS WHEN FINAL SEEDING IS BEING PERFORMED.

EROSION CONTROL BLANKET (CHANNEL INSTALLATION) (4/11)

ECB-C

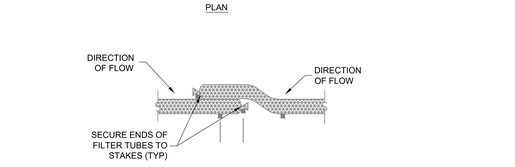



NOTES:

1. FIBER TUBE SHALL BE IN ACCORDANCE WITH THE INDIANA STORM WATER QUALITY MANUAL.
2. PROVIDE STAKES AND SECURE FIBER TUBES IN ACCORDANCE WITH THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.
3. SPACE FILTER TUBE CHECK DAM AT 50 FOOT INTERVALS WHEN USEDIN DRAINAGE CHANNELS.

FILTER TUBE CHECK DAM (5/11)
NTS

FTCD

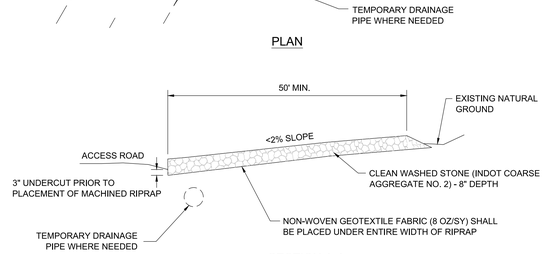



NOTES:

1. FILTER TUBE SHALL BE IN ACCORDANCE WITH THE INDIANA STORM WATER QUALITY MANUAL.
2. PROVIDE STAKES AND SECURE FILTER TUBES IN ACCORDANCE WITH THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.

FILTER TUBE (6/11)
NTS

FT




TEMPORARY CONSTRUCTION INGRESS/EGRESS PAD (7/11)
NTS

TCI

PERMIT DRAWINGS
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| DRAWN: | RB |
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| APPROVED: | JS |
| DATE: | 01-06-2021 |
| SCALE: | AS SHOWN |

TITLE BAILLY GENERATING STATION
LOCATION CHESTERTON, INDIANA
DETAIL EROSION AND SEDIMENT CONTROL DETAILS
CCR IMPOUNDMENT CLOSURE
W.O./ACCT. NO. 7382173270

NIPSCO DRAWING NO. BGS-11
REV. 0
SHEET 11

Plotted By:Foraker, Lydia Sheet Set:New Sheet Set (3) Layout:SHT 11 – ESC Details December 22, 2020 01:02:45pm P:\Projects\7382\7382193347 NIPSCO Bailly\Plansheets\BGS Permit Set Rev 0 2020-1217.dwg

# Appendix B

# BOREHOLE LOG: GAMW-01



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 23
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327313.72 E: 2945093.535
GROUND SURFACE ELEV.: 621.26
TOP OF CASING ELEV.: 624.53
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Direct Push
CORING METHOD:
DRILL RIG: Geoprobe 7720DT
START DATE/TIME: 6/6/2016
END DATE/TIME: 6/6/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 620.0 | light brown to black fine to medium SAND, some silt, trace gravel | | 1 | DP | | 2 / 4 | 0-2.8': SAND, trace gravel, fine to medium, poorly-graded; brown; non-cohesive, dry, loose. (SP)<br>2.8-3.5': SAND, fine, poorly-graded; light brown, orange mottling; non-cohesive, moist, dense. (SP)<br>3.5-3.75': SAND, some silt, fine, poorly-graded; black; non-cohesive, moist, dense. (SP)<br>3.75-4': SAND, fine; light brown; non-cohesive, dry, loose. (SP) | | Bentonite grout mix 0-9 ft-bgs |
| | | | 2 | DP | | 3.8 / 4 | 4-5.4': SAND, trace fine rounded gravel, fine to medium, poorly-graded; light brown; non-cohesive, moist, dense. (SP)<br>5.4-6.3': SAND, fine to medium, poorly-graded; orange; non-cohesive, moist, dense. (SP)<br>6.3-8': SAND, fine to medium, poorly-graded; light tan, orange mottling. (SP) | | |
| 615.0 | orange to light brown fine to medium SAND, some silt, trace gravel | | 3 | DP | | 2.1 / 4 | 8-10.1': SAND, fine to medium, poorly-graded; light brown, dark brown streaking; non-cohesive, moist, dense. (SP)<br>10.1-12': SAND, fine to medium, poorly-graded; light brown, orange mottling; non-cohesive, moist, dense. (SP) | | Bentonite chips 9-11 ft-bgs |
| 610.0 | | | 4 | DP | | 3.8 / 4 | 12-13.3': SAND, little fine subrounded gravel, fine to medium, poorly-graded; orange to light brown; non-cohesive, dry, loose. (SP)<br>13.3-16': SAND, fine to medium, poorly-graded; orange; non-cohesive, wet, dense. (SP) | | Filter Pack #5 Sand 11-23 ft-bgs<br>2 PVC Screen slot 0.010 13-23 ft-bgs |
| 605.0 | | | 5 | DP | | 2.6 / 4 | 16-19.25': SAND, fine to medium, poorly-graded; light orange; non-cohesive, wet, dense. (SP)<br>19.25-19.3': SAND and SILT, poorly-graded; black; non-cohesive, wet, dense. (SM)<br>19.3-19.75': SAND, fine to medium, poorly-graded; light brown, black streaking; non-cohesive, wet, dense. (SP)<br>19.75-19.8': SAND and SILT, poorly-graded; black; non-cohesive, wet, dense. (SM)<br>19.8-20': SAND, fine to medium, poorly-graded; light brown, black streaking; non-cohesive, wet, dense. (SP) | | |
| | light brown to black fine to medium SAND, some silt | | | | | | | | |
| 600.0 | | | 6 | DP | | 3 / 3 | | | |
| | | | | | | | 20-23': SAND, 3-inch black sand and silt band, fine to medium, poorly-graded; brown; non-cohesive, wet, dense. (SP) | | |

LITHOLOGY LEGEND

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: Earth Exploration
DRILLER: Zach
DRILL RIG: Geoprobe 7720DT

LOGGED BY: DSD
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-01B



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 32
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327312.628 E: 2845073.317
GROUND SURFACE ELEV.: 621.08
TOP OF CASING ELEV.: 623.76
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: ROTOSONIC
CORING METHOD:
DRILL RIG: Track Mounted Diedrich D-50
START DATE/TIME: 9/14/2019 11:05:00 PM
END DATE/TIME: 9/14/2019 12:15:00 PM

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| | dark brown fine SAND | | | RS | | | 0' to 0.5': SAND, trace organics, some rounded gravel < 1 inch, fine, poorly graded; dark brown; dry, loose. (FILL) | | Bentonite grout mix 0-24 ft-bgs |
| | gray coarse SAND and GRAVEL | | | RS | | | | | |
| 620.0 | dark brown fine SAND and CLAY | | | RS | | | | | |
| | tan and brown fine to medium SAND | | | RS | | | 0.5' to 0.8' SAND and GRAVEL, fine to medium sand; coarse, gray, rounded gravel < 1 inch, well-graded; dry, loose. (FILL) | | |
| | | | | | | | 0.8' to 1.1': SAND and CLAY, fine, poorly graded; dark brown; cohesive, moist, compact. (FILL) | | |
| | tan and gray fine to medium SAND | | | RS | | | 1.1' to 3.3': SAND, trace rounded gravel < 1inch, trace boiler slag, fine to medium, well-graded; tan and brown; moist, loose. (FILL) | | |
| | | | | | | | 3.3' to 5.8': SAND, fine to medium, well graded; tan; moist, loose. (SW) | | |
| 615.0 | | | | | | | | | |
| | | | | RS | | | 10' to 11': SAND, fine to medium, well graded; tan and gray; moist, loose. (SW) | | |
| 610.0 | | | | | | | 11' to 14.6': SAND, fine to medium, well graded; tan and gray; moist, loose. (SW) | | |
| | | | | RS | | | | | |
| | | | | RS | | | 14.6' to 15.6': SAND, fine to medium, well graded; tan; moist, loose. (SW) | | |
| | dark brown fine to medium SAND | | | RS | | | 15.6' to 15.8': SAND, fine to medium, well-graded; light brown; wet, compact. (SW) | | |
| 605.0 | light brown to yellowish-brown fine to medium SAND | | | RS | | | 15.8' to 17.1': SAND, fine to medium, well-graded; light brown; wet, loose. (SW) | | |
| | | | | | | | 20' to 27.5': SAND, fine to medium, well-graded; light brown; wet, loose. (SW) | | |
| 600.0 | | | | RS | | | | | Bentonite chips 24-25.8 ft-bgs |

LITHOLOGY LEGEND

Fill (made ground) | USCS Well-graded Sand (SW) | USCS Poorly-graded Sand (SP)

DRILLING COMPANY: LAYNE
DRILLER: C. Stoizenbach
DRILL RIG: Track Mounted Diedrich D-50

LOGGED BY: TK
CHECKED BY: AMH
DATE: 9/23/19

Golder Associates

NIPSCO RMSGS 1648171 NIPSCO CCR BAILLY.GPJ GOLDER NH 2011.GDT 10/8/19

# BOREHOLE LOG: GAMW-01B



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 32
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327312.628 E: 2845073.317
GROUND SURFACE ELEV.: 621.08
TOP OF CASING ELEV.: 623.76
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: ROTOSONIC
CORING METHOD:
DRILL RIG: Track Mounted Diedrich D-50
START DATE/TIME: 9/14/2019 11:05:00 PM
END DATE/TIME: 9/14/2019 12:15:00 PM

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 595.0 | light brown to yellowish-brown fine to medium SAND | | | RS | | | | | Filter Pack #5 Sand 25.8-32 ft-bgs<br>2 PVC Screen slot 0.010 27-32 ft-bgs |
| | | | | | | | 30' to 32' SAND, trace fines, fine to medium, poorly-graded; yellowish-brown. (SP) | | |
| 590.0 | | | | RS | | | | | |
| 585.0 | | | | | | | | | |
| 580.0 | | | | | | | | | |
| 575.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Well-graded Sand (SW)

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: LAYNE
DRILLER: C. Stoizenbach
DRILL RIG: Track Mounted Diedrich D-50

LOGGED BY: TK
CHECKED BY: AMH
DATE: 9/23/19

Golder Associates

NIPSCO RMSGS 1648171 NIPSCO CCR BAILLY.GPJ GOLDER NH 2011.GDT 10/8/19

# BOREHOLE LOG: GAMW-02



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 23
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327610.231 E: 2945017.001
GROUND SURFACE ELEV.: 621.27
TOP OF CASING ELEV.: 624.20
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Hollow-stem auger
CORING METHOD:
DRILL RIG: CME 55
START DATE/TIME: 6/6/2016
END DATE/TIME: 6/6/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 620.0 | grey GRAVEL | | 1 | SS | | 1.3 / 2 | 0-1.4': GRAVEL, angular, well-graded; grey; non-cohesive, dry, loose. (GW)<br>1.4-2': SAND, medium, poorly-graded; brown; non-cohesive, moist, loose. (SP)<br>SPTs (2-2-4-5) | | Bentonite grout mix 0-9 ft-bgs |
| | brown to grey medium SAND, some organics, trace gravel | | | | | | | | |
| | | | 2 | SS | | 1.8 / 2 | 5-6': SAND, organics, fine to medium, well-graded; dark brown; non-cohesive, dry, loose. (SW)<br>6-6.25': GRAVEL, angular, well-graded; grey; non-cohesive, dry, loose. (GW)<br>6.25-7': SAND, medium, poorly-graded; brown; non-cohesive, dry, loose. (SP)<br>SPTs (1-3-2-3) | | |
| 615.0 | | | | | | | | | |
| | | | 3 | SS | | 1.6 / 2 | 10-10.7': SAND, organics, fine to medium, well-graded; dark brown; non-cohesive, dry, very loose. (SW)<br>10.7-10.75': GRAVEL, angular, well-graded; grey; non-cohesive, dry, very loose. (GW)<br>10.75-12': SAND, medium, poorly-graded; light brown to brown; non-cohesive, moist, very loose. (SP)<br>SPTs (1-2-2-3) | | Bentonite chips 9-11 ft-bgs<br>Filter Pack #5 Sand 11-23 ft-bgs<br>2 PVC Screen slot 0.010 13-23 ft-bgs |
| 610.0 | | | | | | | | | |
| | | | 4 | SS | | 1.3 / 2 | 15-15.9': SAND, trace gravel, medium, well-graded; grey; non-cohesive, wet, very loose. (SW)<br>15.9-17': SAND, medium, poorly-graded; light brown; non-cohesive, wet, very loose. (SP)<br>SPTs (2-2-2-2) | | |
| 605.0 | light brown medium SAND | | | | | | | | |
| | | | 5 | SS | | 2 / 2 | 20-22': SAND, trace gravel, medium, poorly-graded; light brown; non-cohesive, wet, very loose. (SP)<br>SPTs (1-1-1-2) | | |
| 600.0 | | | | | | | | | |
| | | | 6 | SS | | 1 / 1 | | | |

LITHOLOGY LEGEND

USCS Well-graded Gravel (GW)

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: Earth Exploration
DRILLER: Doug Carlson
DRILL RIG: CME 55

LOGGED BY: HV
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-02



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 23
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327610.231 E: 2945017.001
GROUND SURFACE ELEV.: 621.27
TOP OF CASING ELEV.: 624.20
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Hollow-stem auger
CORING METHOD:
DRILL RIG: CME 55
START DATE/TIME: 6/6/2016
END DATE/TIME: 6/6/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 595.0 | | | | | | | 22-22.5': SAND, medium, poorly-graded; light brown; non-cohesive, wet, very loose. (SP)<br>22.5-22.75': SAND, trace clays lenses, trace organics, medium, well-graded; light brown; non-cohesive, wet, very loose. (SW)<br>22.75-23': SAND, some grey angular well-graded gravel, medium, poorly-graded; light brown; non-cohesive, wet, very loose. (SW)<br>SPTs (1-1-1-1) | | |
| 590.0 | | | | | | | | | |
| 585.0 | | | | | | | | | |
| 580.0 | | | | | | | | | |
| 575.0 | | | | | | | | | |

LITHOLOGY LEGEND

USCS Well-graded Gravel (GW)

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: Earth Exploration
DRILLER: Doug Carlson
DRILL RIG: CME 55

LOGGED BY: HV
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-03



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 23
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327603.697 E: 2944754.25
GROUND SURFACE ELEV.: 620.95
TOP OF CASING ELEV.: 624.35
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Hollow-stem auger
CORING METHOD:
DRILL RIG: CME 55
START DATE/TIME: 6/6/2016
END DATE/TIME: 6/6/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 620.0 | grey GRAVEL | | 1 | SS | | 1.1 / 2 | 0-1.3': GRAVEL, angular, well-graded; grey; non-cohesive, dry, loose. (GW)<br>1.3-2': SAND, medium, poorly-graded; light brown; non-cohesive, dry, loose. (SP)<br>SPTs (2-2-4-5) | | Bentonite grout mix 0-9 ft-bgs |
| | light brown medium SAND | | | | | | | | |
| 615.0 | light brown to black medium SAND, grey gravel | | 2 | SS | | 0.8 / 2 | 5-6.8': SAND, grey angular well-graded gravel, medium, well-graded; black; non-cohesive, dry, loose. (SW)<br>6.8-7': SAND, medium, poorly-graded; light brown; non-cohesive, dry, loose. (SP)<br>SPTs (2-4-3-4) | | |
| 610.0 | grey to dark grey GRAVEL | | 3 | SS | | 1.3 / 2 | 10-11.1': GRAVEL, angular, well-graded; grey to dark grey; non-cohesive, dry, loose. (GW)<br>11.1-12': SAND, medium, poorly-graded; light brown; non-cohesive, moist, loose. (SP)<br>SPTs (2-4-4-4) | | Bentonite chips 9-11 ft-bgs<br>Filter Pack #5 Sand 11-23 ft-bgs<br>2 PVC Screen slot 0.010 13-23 ft-bgs |
| | light brown medium SAND | | | | | | | | |
| 605.0 | grey GRAVEL | | 4 | SS | | 1.4 / 2 | 15-15.9': GRAVEL, angular, well-graded; grey; non-cohesive, dry, loose. (GW)<br>15.9-17': SAND, medium, poorly-graded; light brown; non-cohesive, moist, very loose. (SP)<br>SPTs (2-2-2-4) | | |
| | light brown medium SAND | | | | | | | | |
| 600.0 | | | 5 | SS | | 1.7 / 2 | 20-22': SAND, medium, poorly-graded; light brown; non-cohesive, wet, very loose. (SP)<br>SPTs (1-1-1-1) | | |

LITHOLOGY LEGEND

USCS Well-graded Gravel (GW) | USCS Poorly-graded Sand (SP) | USCS Well-graded Sand (SW)

DRILLING COMPANY: Earth Exploration
DRILLER: Zach
DRILL RIG: CME 55

LOGGED BY: DSD
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-04



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 23
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327464.582 E: 2944724.465
GROUND SURFACE ELEV.: 620.88
TOP OF CASING ELEV.: 624.12
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Direct Push
CORING METHOD:
DRILL RIG: Geoprobe 7720DT
START DATE/TIME: 6/6/2016
END DATE/TIME: 6/6/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 620.0 | FILL- BALLAST, SAND, fine GRAVEL, FLY ASH, BOILER SLAG | | 1 | DP | | 1.3 / 4 | 0-3.4': BALLAST, fine gravel, little medium poorly-graded; light brown; non-cohesive, dry, loose. (FILL)<br>3.4-4': SAND, fine to medium, poorly-graded; brown; non-cohesive, moist, loose. (FILL) | | Bentonite grout mix 0-9 ft-bgs |
| 615.0 | | | 2 | DP | | 1.3 / 4 | 4-6.75': CLAY, little fine rounded gravel, little fine poorly-graded sand; dark grey; cohesive, wet, firm. (FILL)<br>6.75-7.4': SAND, little fly ash/ boiler slag, fine to medium, poorly-graded; light brown; non-cohesive, dry, loose. (FILL)<br>7.4-8': SAND, fly ash, fine to medium, poorly-graded; dark brown; non-cohesive, dry, loose. (FILL) | | |
| 610.0 | | | 3 | DP | | 1.3 / 4 | 8-11.2': SAND, fly ash, fine to medium, poorly-graded; dark brown; non-cohesive, moist, loose. (FILL)<br>11.2-12': SAND, trace fly ash, fine to medium, poorly-graded; tan, orange mottling; non-cohesive, moist, compact. (FILL) | | Bentonite chips 9-11 ft-bgs<br>Filter Pack #5 Sand 11-23 ft-bgs |
| | tan to orange fine to medium SAND, some silt, trace gravel | | 4 | DP | | 2.7 / 4 | 12-13.8': SAND, little black silt, fine, poorly-graded; tan, orange mottling; non-cohesive, moist, compact. (SP)<br>13.8-14.2': SAND, trace gravel, fine to medium, poorly-graded; tan, orange mottling; non-cohesive, moist, compact. (SP)<br>14.2-14.75': SILT, some fine poorly-graded sand, trace organics; black; cohesive, moist, very soft. (ML) | | 2 PVC Screen slot 0.010 13-23 ft-bgs |
| 605.0 | tan to dark brown fine to medium SAND, some silt | | 5 | DP | | 3.75 / 4 | 14.75-15.2': SAND, some silt, fine to medium, poorly-graded; dark orange; non-cohesive, wet, compact. (SP)<br>15.2-15.6': SAND, fine to medium, poorly-graded; light orange; non-cohesive, wet, compact. (SP)<br>15.6-16': SAND, fine to medium, poorly-graded; tan; non-cohesive, moist, compact. (SP) | | |
| 600.0 | light grey fine to medium SAND, some silt | | 6 | DP | | 3 / 3 | 16-18.5': SAND, fine to medium, poorly-graded; tan; non-cohesive, wet, compact. (SP)<br>18.5-18.6': SILT and SAND, poorly-graded; black; non-cohesive, wet, compact. (ML)<br>18.6-20': SAND, fine to medium, poorly-graded; tan; non-cohesive, wet, compact. (SP) | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: Earth Exploration
DRILLER: Zach
DRILL RIG: Geoprobe 7720DT

LOGGED BY: DSD
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-04



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 23
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327464.582 E: 2944724.465
GROUND SURFACE ELEV.: 620.88
TOP OF CASING ELEV.: 624.12
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Direct Push
CORING METHOD:
DRILL RIG: Geoprobe 7720DT
START DATE/TIME: 6/6/2016
END DATE/TIME: 6/6/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 595.0 | | | | | | | 20-20.75': SAND, fine to medium, poorly-graded; brown; non-cohesive, wet, compact. (SP)<br>20.75-20.8': SILTY SAND, poorly-graded; dark brown; non-cohesive, wet, compact. (SM)<br>20.8-23': SAND, fine to medium, poorly-graded; light grey; non-cohesive, wet, compact. (SP) | | |
| 590.0 | | | | | | | | | |
| 585.0 | | | | | | | | | |
| 580.0 | | | | | | | | | |
| 575.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: Earth Exploration
DRILLER: Zach
DRILL RIG: Geoprobe 7720DT

LOGGED BY: DSD
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-06



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 27
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327775.277 E: 2944256.52
GROUND SURFACE ELEV.: 624.45
TOP OF CASING ELEV.: 626.97
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Hollow-stem auger
CORING METHOD:
DRILL RIG: CME 55
START DATE/TIME: 6/6/2016
END DATE/TIME: 6/6/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| | FILL- ORGANICS, SAND, GRAVEL, OBSIDIAN/ FLY ASH/ BOILER SLAG | | 1 | SS | | 1.6 / 2 | 0-0.9': ORGANICS, SAND, trace obsidian/ fly ash/ boiler slag, fine to medium, poorly-graded; dark brown to black; non-cohesive, loose. (FILL)<br>0.9-2': SAND, fine to medium, poorly-graded; light brown; non-cohesive, dry, loose. (FILL)<br>SPTs (9-2-3-5) | | Bentonite grout mix 0-13 ft-bgs |
| 620.0 | | | 2 | SS | | 1.6 / 2 | 5-5.75': ORGANICS, SAND, fine to medium, poorly-graded; dark brown to black; non-cohesive, dry, loose. (FILL)<br>5.75-5.9': GRAVEL, angular, well-graded; white to grey; non-cohesive, dry, loose. (FILL)<br>5.9-7': SAND, trace gravel, medium, poorly-graded; light brown; non-cohesive, dry, loose. (FILL)<br>SPTs (5-4-5-4) | | |
| 615.0 | | | 3 | SS | | 1.2 / 2 | 10-11': SAND, trace gravel, trace obsidian/ fly ash/ boiler slag, medium, poorly-graded; light brown to brown; non-cohesive, dry, loose. (FILL)<br>11-12': SAND, medium, poorly-graded; light brown; non-cohesive, dry, compact. (FILL)<br>SPTs (6-10-7-7) | | Bentonite chips 13-15 ft-bgs |
| 610.0 | | | 4 | SS | | 2 / 2 | 15-15.2': SAND, medium, poorly-graded; brown; non-cohesive, dry, loose. (FILL)<br>15.2-15.25': GRAVEL, angular, well-graded; white to grey; non-cohesive, dry, loose. (FILL)<br>15.25-16.25': SAND, trace fly ash/ boiler slag, medium, poorly-graded; light brown; non-cohesive, dry, loose. (FILL)<br>16.25-17': SAND, medium, poorly-graded; light brown; non-cohesive, wet, loose. (FILL)<br>SPTs (5-5-4-7) | | Filter Pack #5 Sand 15-27 ft-bgs<br>2 PVC Screen slot 0.010 17-27 ft-bgs |
| 605.0 | | | 5 | SS | | 1.6 / 2 | 20-21.5': SAND, trace fly ash/ boiler slag, medium, poorly-graded; light brown; non-cohesive, moist, loose. (FILL)<br>21.5-22': SAND, medium, poorly-graded; light brown; non-cohesive, wet, loose. (FILL)<br>SPTs (4-4-3-4) | | |
| 600.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

DRILLING COMPANY: Earth Exploration
DRILLER: Doug Carlson
DRILL RIG: CME 55

LOGGED BY: HV
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-06



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 27
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327775.277 E: 2944256.52
GROUND SURFACE ELEV.: 624.45
TOP OF CASING ELEV.: 626.97
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Hollow-stem auger
CORING METHOD:
DRILL RIG: CME 55
START DATE/TIME: 6/6/2016
END DATE/TIME: 6/6/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| | FILL- ORGANICS, SAND, GRAVEL, OBSIDIAN/ FLY ASH/ BOILER SLAG | | 6 | SS | | 2 / 2 | 25-25.75': SAND, trace gravel, trace fly ash/ boiler slag, medium, well-graded; black; non-cohesive, moist, loose. (FILL)<br>25.75-27': SAND, trace fly ash/ boiler slag, medium, poorly-graded; light brown; non-cohesive, wet, loose. (FILL)<br>SPTs (4-6-3-6) | | |
| 595.0 | | | | | | | | | |
| 590.0 | | | | | | | | | |
| 585.0 | | | | | | | | | |
| 580.0 | | | | | | | | | |
| 575.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

DRILLING COMPANY: Earth Exploration
DRILLER: Doug Carlson
DRILL RIG: CME 55

LOGGED BY: HV
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-07



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 29
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327813.592 E: 2943926.623
GROUND SURFACE ELEV.: 625.99
TOP OF CASING ELEV.: 629.04
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Direct Push
CORING METHOD:
DRILL RIG: Geoprobe 7720DT
START DATE/TIME: 6/7/2016
END DATE/TIME: 6/7/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 625.0 | FILL- FLY ASH, BOILER SLAG, SAND, GRAVEL, BRICK FRAGMENTS | | 1 | DP | | 1.75 / 4 | 0-2.6': SAND, some gravel, trace fly ash, fine to medium, poorly-graded; brown; non-cohesive, dry, loose. (FILL)<br>2.6-2.7': SAND, fine to medium, poorly-graded; orange to tan; non-cohesive, dry, loose. (FILL)<br>2.7-4': FLY ASH/ BOILER SLAG, brick fragments, 1-inch poorly-graded sand lens; black; non-cohesive, dry, loose. (FILL) | | Bentonite grout mix 0-15 ft-bgs |
| 620.0 | orange to tan fine to medium SAND | | 2 | DP | | 2.8 / 4 | 4-6.75': SAND, fine to medium, poorly-graded; brown; non-cohesive, moist, loose. (FILL)<br>6.75-8': SAND, fine to medium, poorly-graded; orange to tan; non-cohesive, moist, loose. (SP) | | |
| | | | 3 | DP | | 2.7 / 4 | 8-12': SAND, fine to medium, poorly-graded; light orange to tan, black lens at 11.2'; non-cohesive, moist, loose. (SP) | | |
| 615.0 | | | 4 | DP | | 2.7 / 4 | 12-16': SAND, fine to medium, poorly-graded; orange to tan; non-cohesive, moist, compact. (SP) | | Bentonite chips 15-17 ft-bgs |
| 610.0 | | | 5 | DP | | 2 / 4 | 16-19': SAND, fine to medium, poorly-graded; orange to tan; non-cohesive, moist, compact. (SP)<br>19-20': SAND, fine to medium, poorly-graded; orange to tan; non-cohesive, wet, compact. (SP) | | Filter Pack #5 Sand 17-29 ft-bgs<br>2 PVC Screen slot 0.010 19-29 ft-bgs |
| 605.0 | dark reddish brown PEAT | | 6 | DP | | 3.25 / 4 | 20-21.25': SAND, fine to medium, poorly-graded; grey; non-cohesive, wet, compact. (SP)<br>21.25-22.8': PEAT; dark reddish brown; cohesive, moist, very stiff. (Pt)<br>22.8-23.25': SAND, fine to medium, poorly-graded; grey, black lenses; non-cohesive, moist, compact. (SP)<br>23.25-24': SAND, fine to medium, poorly-graded; light brown; non-cohesive, wet, compact. (SP) | | |
| | grey to light brown fine to medium SAND | | 7 | DP | | 4 / 5 | | | |

LITHOLOGY LEGEND

Fill (made ground) | USCS Poorly-graded Sand (SP) | Peat

DRILLING COMPANY: Earth Exploration
DRILLER: Zach
DRILL RIG: Geoprobe 7720DT

LOGGED BY: DSD
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-07



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 29
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327813.592 E: 2943926.623
GROUND SURFACE ELEV.: 625.99
TOP OF CASING ELEV.: 629.04
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Direct Push
CORING METHOD:
DRILL RIG: Geoprobe 7720DT
START DATE/TIME: 6/7/2016
END DATE/TIME: 6/7/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 600.0 | grey to light brown fine to medium SAND | | 7 | DP | | 4 / 5 | 24-29': SAND, fine to medium, poorly-graded; light brown; non-cohesive, wet, compact. (SP) | | |
| 595.0 | | | | | | | | | |
| 590.0 | | | | | | | | | |
| 585.0 | | | | | | | | | |
| 580.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Poorly-graded Sand (SP)

Peat

DRILLING COMPANY: Earth Exploration
DRILLER: Zach
DRILL RIG: Geoprobe 7720DT

LOGGED BY: DSD
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-08



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 25
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327355.094 E: 2943752.817
GROUND SURFACE ELEV.: 621.17
TOP OF CASING ELEV.: 624.35
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Direct Push
CORING METHOD:
DRILL RIG: Geoprobe 7720DT
START DATE/TIME: 6/7/2016
END DATE/TIME: 6/7/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 620.0 | FILL- SAND, little gravel, little boiler slag, trace organics | | 1 | DP | | 2.2 / 4 | 0-2.2': SAND, little gravel, little boiler slag, trace organics, fine to medium, poorly-graded; brown; non-cohesive, dry, loose. (FILL)<br>2.2-2.7': SAND, little boiler slag, fine to medium, poorly-graded; dark brown; non-cohesive, moist, loose. (FILL)<br>2.7-3': SAND, little gravel, little boiler slag, fine to medium, poorly-graded; light brown; non-cohesive, moist, loose. (FILL)<br>3-3.2': GRAVEL, some fine to medium sand, poorly-graded; light brown; non-cohesive, moist, loose. (FILL)<br>3.2-4': SAND, fine to medium, poorly-graded; tan; non-cohesive, moist, compact. (SP) | | Bentonite grout mix 0-11 ft-bgs |
| | light orange to brown fine to medium SAND | | | | | | | | |
| 615.0 | | | 2 | DP | | 2.6 / 4 | 4-8': SAND, fine to medium, poorly-graded; tan; non-cohesive, moist, compact. (SP) | | |
| | | | 3 | DP | | 2.3 / 4 | 8-12': SAND, fine to medium, poorly-graded; light orange to tan; non-cohesive, moist, compact. (SP) | | |
| 610.0 | | | | | | | | | Bentonite chips 11-13 ft-bgs |
| | | | 4 | DP | | 2.3 / 4 | 12-14.25': SAND, fine to medium, poorly-graded; orange to tan; non-cohesive, moist, compact. (SP)<br>14.25-16': SAND, fine to medium, poorly-graded; light orange; non-cohesive, wet, compact. (SP) | | Filter Pack #5 Sand 13-25 ft-bgs<br>2 PVC Screen slot 0.010 15-25 ft-bgs |
| 605.0 | | | 5 | DP | | 2.7 / 4 | 16-20': SAND, fine to medium, poorly-graded; orangish brown; non-cohesive, wet, compact. (SP) | | |
| 600.0 | | | 6 | DP | | 4.4 / 5 | 20-25': SAND, fine to medium, poorly-graded; orangish brown; non-cohesive, wet, compact. (SP) | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: Earth Exploration
DRILLER: Zach
DRILL RIG: Geoprobe 7720DT

LOGGED BY: DSD
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-08B



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 40
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327355.257 E: 2943762.735
GROUND SURFACE ELEV.: 620.80
TOP OF CASING ELEV.: 623.73
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: ROTOSONIC
CORING METHOD:
DRILL RIG: Track Mounted Diedrich D-50
START DATE/TIME: 9/9/2019 12:30:00 PM
END DATE/TIME: 9/9/2019 9:10:00 AM

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 620.0 | brown to tan fine SAND | | | RS | | | 0 to 0.25': SAND, some organics, fine, poorly-graded; brown; moist, loose. (SP) | | Bentonite grout mix 0-26 ft-bgs |
| | | | | RS | | | 0.25' to 1.7': SAND, fine, poorly-graded; brown; dry, loose. (SP) | | |
| | | | | RS | | | 1.7' to 3.3': SAND, some rounded gravel < 1 inch, fine, poorly-graded; light brown; dry, loose. (SP) | | |
| | | | | RS | | | 3.3' to 3.6': SAND, fine, poorly graded; brown; dry, loose. (SP) | | |
| | | | | RS | | | 3.6' to 6.7': SAND, fine, poorly graded; tan; dry, loose. (SP) | | |
| 615.0 | | | | RS | | | 6.7' to 7.7': SAND, trace rounded gravel <1 cm, fine, poorly graded; brown and tan; dry, loose. (SP) | | |
| | dark brown to tan fine to medium SAND, trace gravel | | | RS | | | 7.7' to 8': SAND, trace rounded gravel <1 cm, fine to medium, well graded; dark brown; wet, loose. (SW) | | |
| | | | | RS | | | 10' to 10.8': SAND, trace gravel rounded <1 cm, fine to medium, well graded; light brown; wet, loose. (SW) | | |
| 610.0 | | | | RS | | | 10.8' to 11': SAND, fine to medium, well graded; dark brown; wet, loose. (SW) | | |
| | light brown to tan fine to medium SAND | | | RS | | | 11' to 15.3': SAND, fine to medium, well-graded; light brown to tan. (SW) | | |
| 605.0 | | | | | | | | | |
| | | | | RS | | | 20' to 21.25': SAND, fine to medium, poorly-graded; tan. (SP) | | |
| 600.0 | | | | RS | | | 21.25' to 26.3': SAND, trace fines, fine to medium, poorly-graded; yellow-ish brown. (SP) | | |

LITHOLOGY LEGEND

USCS Poorly-graded Sand (SP)

USCS Well-graded Sand (SW)

USCS Poorly-graded Sand with Clay (SP-SC)

DRILLING COMPANY: LAYNE
DRILLER: C. Stoizenbach
DRILL RIG: Track Mounted Diedrich D-50

LOGGED BY: DFS
CHECKED BY: AMH
DATE: 9/20/19

Golder Associates

# BOREHOLE LOG: GAMW-08B



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 40
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327355.257 E: 2943762.735
GROUND SURFACE ELEV.: 620.80
TOP OF CASING ELEV.: 623.73
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: ROTOSONIC
CORING METHOD:
DRILL RIG: Track Mounted Diedrich D-50
START DATE/TIME: 9/9/2019 12:30:00 PM
END DATE/TIME: 9/9/2019 9:10:00 AM

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 595.0 | light brown to tan fine to medium SAND | | | RS | | | | | Bentonite chips 26-28 ft-bgs |
| | | | | | | | | | Filter Pack #5 Sand 28-40 ft-bgs |
| | | | | | | | 30' to 33' SAND, fine to medium, well-graded; tan; wet, loose. (SW) | | 2 PVC Screen slot 0.010 30-40 ft-bgs |
| 590.0 | | | | RS | | | | | |
| | | | | RS | | | 33' to 33.6': SAND, fine to medium, well-graded; tan to brown; wet, cohesive. (SW) | | |
| | brown fine SAND and CLAY | | | RS | | | 33.6' to 34': SAND and CLAY, fine, poorly graded; brown; wet, cohesive. (SP) | | |
| | brown fine to coarse SAND | | | RS | | | 34' to 36.8': SAND, fine to coarse, well graded; brown; wet, loose. (SW) | | |
| 585.0 | | | | | | | | | |
| | | | | RS | | | 40': SAND, fine to coarse, well graded; brown; wet, loose. (SW) | | |
| 580.0 | | | | | | | | | |
| 575.0 | | | | | | | | | |

LITHOLOGY LEGEND

USCS Poorly-graded Sand (SP)

USCS Well-graded Sand (SW)

USCS Poorly-graded Sand with Clay (SP-SC)

DRILLING COMPANY: LAYNE
DRILLER: C. Stoizenbach
DRILL RIG: Track Mounted Diedrich D-50

LOGGED BY: DFS
CHECKED BY: AMH
DATE: 9/20/19

Golder Associates

# BOREHOLE LOG: GAMW-10



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 31
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327809.736 E: 2943347.679
GROUND SURFACE ELEV.: 629.34
TOP OF CASING ELEV.: 631.94
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Direct Push
CORING METHOD:
DRILL RIG: Geoprobe 7720DT
START DATE/TIME: 6/7/2016
END DATE/TIME: 6/8/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| | FILL- SAND, some gravel, some boiler slag | | 1 | DP | | 3 / 4 | 0-1.75': SAND, some gravel, some boiler slag, fine to medium, well-graded; brown; non-cohesive, dry, loose. (FILL)<br>1.75-2.1': SAND, boiler slag, fine, poorly-graded; black; non-cohesive, dry, loose. (FILL)<br>2.1-2.3': SAND, fine to medium, poorly-graded; orange, black banding; non-cohesive, moist, compact. (SP) | | Bentonite grout mix 0-17 ft-bgs |
| | light tan to orange fine to medium SAND | | | | | | | | |
| 625.0 | | | 2 | DP | | 2.75 / 4 | 2.3-3.2': SAND, fine to medium, poorly-graded; orange; non-cohesive, moist, compact. (SP)<br>3.4-4': SAND, fine to medium, poorly-graded; black; non-cohesive, moist, compact. (SP)<br>4-6.8': SAND, fine to medium, poorly-graded; orange; non-cohesive, moist, compact. (SP)<br>6.8-8': SAND, fine to medium, poorly-graded; orange to tan; non-cohesive, moist, compact. (SP) | | |
| 620.0 | | | 3 | DP | | 2.7 / 4 | 8-12': SAND, fine to medium, poorly-graded; orange to tan; non-cohesive, moist, compact. (SP) | | |
| | | | 4 | DP | | 2.6 / 4 | 12-16': SAND, fine to medium, poorly-graded; light tan; non-cohesive, moist, compact. (SP) | | |
| 615.0 | | | 5 | DP | | 2.5 / 4 | 16-20': SAND, fine to medium, poorly-graded; light tan; non-cohesive, moist, compact. (SP) | | Bentonite chips 17-19 ft-bgs |
| 610.0 | | | 6 | DP | | 3 / 4 | 20-22': SAND, fine to medium, poorly-graded; tan; non-cohesive, wet, compact. (SP)<br>22-24': SAND, fine to medium, poorly-graded; light orange to tan; non-cohesive, wet, loose. (SP) | | Filter Pack #5 Sand 19-31 ft-bgs<br>2 PVC Screen slot 0.010 21-31 ft-bgs |
| 605.0 | | | 7 | DP | | 4 / 4 | | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: Earth Exploration
DRILLER: Zach
DRILL RIG: Geoprobe 7720DT

LOGGED BY: DSD
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-10



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 31
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327809.736 E: 2943347.679
GROUND SURFACE ELEV.: 629.34
TOP OF CASING ELEV.: 631.94
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Direct Push
CORING METHOD:
DRILL RIG: Geoprobe 7720DT
START DATE/TIME: 6/7/2016
END DATE/TIME: 6/8/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| | light tan to orange fine to medium SAND | | 7 | DP | | 4 / 4 | 24-28': SAND, fine to medium, poorly-graded; light orange; non-cohesive, wet, compact. (SP) | | |
| 600.0 | | | 8 | DP | | 3 / 3 | 28-31': SAND, fine to medium, poorly-graded; tan, orange mottling; non-cohesive, saturated, dense. (SP) | | |
| 595.0 | | | | | | | | | |
| 590.0 | | | | | | | | | |
| 585.0 | | | | | | | | | |
| 580.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: Earth Exploration
DRILLER: Zach
DRILL RIG: Geoprobe 7720DT

LOGGED BY: DSD
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-11



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 24
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327370.896 E: 2942800.52
GROUND SURFACE ELEV.: 621.99
TOP OF CASING ELEV.: 625.04
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Hollow-stem auger
CORING METHOD:
DRILL RIG: CME 55
START DATE/TIME: 6/7/2016
END DATE/TIME: 6/7/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| | FILL- SAND, ORGANICS, trace gravel, trace fly ash/ boiler slag | | 1 | SS | | 1.6 / 2 | 0-2': ORGANICS, SAND, trace gravel, trace fly ash/ boiler slag, fine to medium, poorly-graded; light brown; non-cohesive, dry, loose. (FILL)<br>SPTs (2-2-3-4) | | Bentonite grout mix 0-10 ft-bgs |
| 620.0 | | | 2 | SS | | 2 / 2 | 5-6': SAND, trace gravel, trace fly ash/ boiler slag, fine to medium, well-graded; light brown to brown; non-cohesive, dry, compact. (FILL)<br>6-6.4': SAND, some fly ash/ boiler slag, fine to medium, well-graded; dark brown; non-cohesive, dry, compact. (FILL)<br>6.4-7': SAND, medium, poorly-graded; light brown; non-cohesive, dry, compact. (FILL)<br>SPTs (6-7-9-9) | | |
| 615.0 | | | 3 | SS | | 1.8 / 2 | 10-10.7': SAND, trace fly ash/ boiler slag, fine to medium, well-graded; brown; non-cohesive, dry, compact. (FILL)<br>10.7-11.2': SAND, trace fly ash/ boiler slag, medium, poorly-graded; dark brown; non-cohesive, dry, compact. (FILL)<br>11.2-12': SAND, medium, poorly-graded; light brown; non-cohesive, moist, compact. (FILL)<br>SPTs (7-5-6-5) | | Bentonite chips 10-12 ft-bgs |
| 610.0 | | | | | | | | | Filter Pack #5 Sand 12-24 ft-bgs |
| | | | 4 | SS | | 1.4 / 2 | 15-15.8': SAND, trace fly ash/ boiler slag, medium, poorly-graded; light brown; non-cohesive, wet, loose. (FILL)<br>15.8-17': SAND, medium, poorly-graded; light brown; non-cohesive, wet, loose. (FILL)<br>SPTs (4-1-2-1) | | 2 PVC Screen slot 0.010 14-24 ft-bgs |
| 605.0 | | | | | | | | | |
| | light brown fine to medium SAND | | 5 | SS | | 1.8 / 2 | 20-21': SAND, some fly ash/ boiler slag, trace gravel, trace organics, medium to coarse, well-graded; light brown to black; non-cohesive, wet, loose. (FILL)<br>21-22': SAND, fine to medium, poorly-graded; light brown; non-cohesive, wet, loose. (SP)<br>SPTs (4-3-4-3) | | |
| 600.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: Earth Exploration
DRILLER: Doug Carlson
DRILL RIG: CME 55

LOGGED BY: HV
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-11C



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 34
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327401.585 E: 2942433.781
GROUND SURFACE ELEV.: 619.06
TOP OF CASING ELEV.: 625.16
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: ROTOSONIC
CORING METHOD:
DRILL RIG: Track Mounted Diedrich D-50
START DATE/TIME: 9/13/2019 7:30:00 AM
END DATE/TIME: 9/13/2019 9:00:00 AM

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| | dark brown fine SAND, some organics | | | RS | | | 0' to 0.6': SAND, some rounded gravel < 1cm, some organics, fine, poorly graded; dark brown; moist, loose. (FILL) | | Bentonite grout mix 0-25 ft-bgs |
| | gray fine to medium SAND | | | RS | | | 0.6' to 2.75': SAND, some rounded gravel < 1inch (0.6' to 1.2'), some boiler slag, fine to medium, well-graded; gray; dry, loose. (FILL) | | |
| | tan fine to medium SAND | | | RS | | | 2.75' to 3.4': SAND, fine to medium, well-graded; tan; dry, loose. (FILL) | | |
| 615.0 | | | | RS | | | 5' to 5.5': SAND, fine to medium, well-graded; tan; dry, loose. (FILL) | | |
| | fine to medium SAND, trace boiler slag | | | RS | | | 5.5' to 6.75': SAND, some rounded gravel < 1inch, trace boiler slag, some stiff clay (6.55' to 6.75'), fine to medium, well-graded; gray; dry, loose. (FILL) | | |
| | | | | RS | | | 6.75' to 8.9': SAND, fine to medium, well-graded; tan; dry, loose. (FILL) | | |
| 610.0 | | | | | | | 10' to 11.6': SAND, trace rounded gravel < 1cm, trace boiler slag, fine to medium, well-graded; brownish-gray; wet (washout), compact. (FILL) | | |
| | tan fine to medium SAND | | | RS | | | 11.6' to 15.25': SAND, fine to medium, well-graded; tan; wet, loose. (SW) | | |
| 605.0 | | | | | | | | | |
| | | | | RS | | | | | |
| 600.0 | yellowish-brown fine to medium SAND | | | RS | | | 20' to 21.7': SAND, trace fines, fine to medium, poorly-graded; yellowish-brown. (SP) | | |
| | | | | RS | | | 21.7' to 29.7': SAND, fine to medium, well-graded; light brown; wet, loose. (SW) | | |
| 595.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground) | USCS Well-graded Sand (SW) | USCS Poorly-graded Sand (SP)

DRILLING COMPANY: LAYNE
DRILLER: C. Stoizenbach
DRILL RIG: Track Mounted Diedrich D-50

LOGGED BY: DFS
CHECKED BY: AMH
DATE: 9/20/19

Golder Associates

NIPSCO RMSGS 1648171 NIPSCO CCR BAILLY.GPJ GOLDER NH 2011.GDT 10/8/19

# BOREHOLE LOG: GAMW-11C



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 34
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327401.585 E: 2942433.781
GROUND SURFACE ELEV.: 619.06
TOP OF CASING ELEV.: 625.16
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: ROTOSONIC
CORING METHOD:
DRILL RIG: Track Mounted Diedrich D-50
START DATE/TIME: 9/13/2019 7:30:00 AM
END DATE/TIME: 9/13/2019 9:00:00 AM

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| | yellowish-brown fine to medium SAND | | | RS | | | | | Bentonite chips 25-27 ft-bgs |
| 590.0 | | | | RS | | | 30' to 32.7': SAND, trace fines, fine to medium, poorly-graded; yellowish-brown. (SP) | | Filter Pack #5 Sand 27-34 ft-bgs |
| 585.0 | | | | RS | | | 32.7' to 34': SAND, fine to medium, poorly-graded; yellowish-brown to gray. (SP) | | 2 PVC Screen slot 0.010 29-34 ft-bgs |
| 580.0 | | | | | | | | | |
| 575.0 | | | | | | | | | |
| 570.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Well-graded Sand (SW)

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: LAYNE
DRILLER: C. Stoizenbach
DRILL RIG: Track Mounted Diedrich D-50

LOGGED BY: DFS
CHECKED BY: AMH
DATE: 9/20/19

Golder Associates

# BOREHOLE LOG: GAMW-13



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 23
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327843.757 E: 2942379.216
GROUND SURFACE ELEV.: 622.14
TOP OF CASING ELEV.: 625.34
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Hollow-stem auger
CORING METHOD:
DRILL RIG: CME 55
START DATE/TIME: 6/7/2016
END DATE/TIME: 6/8/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| | FILL- SAND, BOILER SLAG, GRAVEL | | | | | | 0-2': BOILER SLAG. Pre-drilled by Geoprobe, did not sample. | | Bentonite grout mix 0-9 ft-bgs |
| 620.0 | | | 1 | SS | | 2 / 2 | 5-5.8': BOILER SLAG. (FILL)<br>5.8-6.2': BOILER SLAG, grey angular, well-graded; gravel; non-cohesive, dry, loose. (FILL)<br>6.2-6.5': GRAVEL, angular, well-graded; grey; non-cohesive, dry, loose. (FILL)<br>6.5-7': SAND, medium, poorly-graded; light brown; non-cohesive, dry, loose. (FILL)<br>SPTs (4-4-4-5) | | |
| 615.0 | | | 2 | SS | | 1.7 / 2 | 10-10.8': SAND, trace boiler slag, medium, poorly-graded; light brown; non-cohesive, dry, loose. (FILL)<br>10.8-12': SAND, medium, poorly-graded; light brown; non-cohesive, dry, loose. (FILL)<br>SPTs (3-3-5-5) | | Bentonite chips 9-11 ft-bgs<br>Filter Pack #5 Sand 11-23 ft-bgs |
| 610.0 | | | 3 | SS | | 1.7 / 2 | 15-17': SAND, trace gravel, medium, poorly-graded; light brown; non-cohesive, dry, loose. (FILL)<br>SPTs (5-6-7-9) | | 2 PVC Screen slot 0.010 13-23 ft-bgs |
| 605.0 | | | 4 | SS | | 1.7 / 2 | 20-22': SAND, trace gravel, trace boiler slag, medium, poorly-graded; light brown; non-cohesive, wet, compact. (FILL)<br>SPTs (5-7-9-13) | | |
| 600.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

DRILLING COMPANY: Earth Exploration
DRILLER: Doug Carlson
DRILL RIG: CME 55

LOGGED BY: HV
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-14



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 23
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327774.968 E: 2942206.644
GROUND SURFACE ELEV.: 621.62
TOP OF CASING ELEV.: 624.32
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Direct Push/ HSA
CORING METHOD:
DRILL RIG: Geoprobe 7720DT/ CME 55
START DATE/TIME: 6/7/2016
END DATE/TIME: 6/8/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 620.0 | FILL- SAND, BOILER SLAG, FLY ASH, some silt, little gravel | | 1 | DP | | 2.25 / 4 | 0-4': SAND, fly ash, little gravel, little boiler slag, fine to medium, poorly-graded; dark brown; non-cohesive, moist, loose. (FILL) | | Bentonite grout mix 0-9 ft-bgs |
| | | | 2 | DP | | 2.25 / 4 | 4-6.6': SAND, fly ash, some gravel, some boiler slag, fine to medium, poorly-graded; dark brown; non-cohesive, moist, loose. (FILL)<br>6.6-8': SAND, fine to medium, poorly-graded; orange; non-cohesive, wet, loose. (FILL) | | |
| 615.0 | | | 3 | DP | | 2.75 / 4 | 8-11.9': SAND, fine to medium, poorly-graded; orange to tan, light grey mottling; non-cohesive, wet, compact. (FILL)<br>11.9-12': SAND and SILT, trace organics, poorly-graded; black; non-cohesive, wet, loose. (FILL) | | Bentonite chips 9-11 ft-bgs |
| 610.0 | | | | | | | | | Filter Pack #5 Sand 11-23 ft-bgs |
| | | | 4 | SS | | 1.7 / 2 | 15-16.3': BOILER SLAG, moist, compact. (FILL)<br>16.3-17': SAND, fine to medium, poorly-graded; light brown; non-cohesive, wet, compact. (FILL)<br>SPTs (8-9-11-11) | | 2 PVC Screen slot 0.010 13-23 ft-bgs |
| 605.0 | | | | | | | | | |
| | | | 5 | SS | | 2 / 2 | 20-22': SAND, trace gravel, trace fly ash, fine to medium, poorly-graded; light brown; non-cohesive, wet, compact. (FILL)<br>SPTs (4-5-7-7) | | |
| 600.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

DRILLING COMPANY: Earth Exploration
DRILLER: Zach/ D. Carlson
DRILL RIG: Geoprobe 7720DT/ CME 55

LOGGED BY: HV/ DSD
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-16



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 30
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2943739.261 E: 2327808.883
GROUND SURFACE ELEV.: 627.2
TOP OF CASING ELEV.: 629.92
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Hollow-stem auger
CORING METHOD:
DRILL RIG: CME 55
START DATE/TIME: 2/2/2017
END DATE/TIME: 2/2/2017

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| | FILL- SAND, trace gravel, trace boiler slag | | 1 | SS | | 1.2 / 2 | 0-1.7': SAND, trace gravel, fine, poorly graded; tan; non-cohesive, dry, loose. (FILL)<br>1.7-2': SAND, trace boiler slag, fine, poorly graded; tan; non-cohesive, dry, loose. (FILL)<br>SPTs (3-4-6-9) | | Bentonite grout mix 0-16 ft-bgs |
| 625.0 | | | 2 | SS | | 1.4 / 2 | 5-6.3': SAND, trace boiler slag, fine, well graded; tan; non-cohesive, dry, loose. (FILL)<br>6.3-7': SAND, fine, poorly graded; tan; non-cohesive, dry, loose. (FILL)<br>SPTs (3-3-6-7) | | |
| 620.0 | | | 3 | SS | | 2 / 2 | 10-10.3': SAND, trace boiler slag, trace gravel, fine, well graded; tan; non-cohesive, dry, loose. (FILL)<br>10.3-10.4': BOILER SLAG. (FILL)<br>10.4-12': SAND, fine, well graded; tan; non-cohesive, dry, loose. (FILL)<br>SPTs (2-2-3-3) | | |
| 615.0 | | | 4 | SS | | 2 / 2 | 15-15.4': SAND, trace boiler slag, fine, well graded; tan; non-cohesive, dry, loose. (FILL)<br>15.4-15.5': GRAVEL, some sand, angular, well graded; grey; non-cohesive, dry, loose. (FILL)<br>15.5-17': SAND, fine, well graded; tan; non-cohesive, moist, loose. (FILL)<br>SPTs (4-2-2-2) | | Bentonite chips 16-18 ft-bgs<br>Filter Pack #7 Sand 18-30 ft-bgs |
| 610.0 | tan fine to medium SAND, trace gravel | | 5 | SS | | 2 / 2 | 20-20.3': SAND, trace boiler slag, trace gravel, fine, well graded; tan; non-cohesive, dry, loose. (FILL)<br>20.3-21': SAND, poorly graded; tan; non-cohesive, moist, loose. (SP)<br>21-22': SAND, poorly graded; tan; non-cohesive, wet, loose. (SP)<br>SPTs (2-2-2-2) | | 2 PVC Screen slot 0.010 20-30 ft-bgs |
| 605.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: Earth Exploration
DRILLER: J. Silcox
DRILL RIG: CME 55

LOGGED BY: HV
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-16



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 30
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2943739.261 E: 2327808.883
GROUND SURFACE ELEV.: 627.2
TOP OF CASING ELEV.: 629.92
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Hollow-stem auger
CORING METHOD:
DRILL RIG: CME 55
START DATE/TIME: 2/2/2017
END DATE/TIME: 2/2/2017

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 600.0 | tan fine to medium SAND, trace gravel | | 6 | SS | | 1.7 / 2 | 25-25.8': SAND, fine, poorly graded; tan; non-cohesive, wet, loose. (SP)<br>25.8-26.4': SAND, trace gravel, well graded; tan; non-cohesive, wet, loose. (SW)<br>26.4-27': SAND, poorly graded; tan; non-cohesive, wet, loose. (SP)<br>SPTs (2-2-6-10) | | |
| 595.0 | | | | | | | | | |
| 590.0 | | | | | | | | | |
| 585.0 | | | | | | | | | |
| 580.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: Earth Exploration
DRILLER: J. Silcox
DRILL RIG: CME 55

LOGGED BY: HV
CHECKED BY: JMR
DATE: 3/22/17

Golder Associates

# BOREHOLE LOG: GAMW-17



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 25
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327377.935 E: 2943124.864
GROUND SURFACE ELEV.: 620.67
TOP OF CASING ELEV.: 623.96
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: ROTOSONIC
CORING METHOD:
DRILL RIG: Track Mounted Diedrich D-50
START DATE/TIME: 9/12/2019 7:45:00 AM
END DATE/TIME: 9/14/2019 9:50:00 AM

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 620.0 | brown fine SILTY SAND, some organics | | | RS | | | 0' to 0.3': SILTY SAND, some organics, fine; brown; moist, loose. (FILL) | | Bentonite grout mix 0-11 ft-bgs |
| | brown fine SAND, trace boiler slag | | | RS | | | 0.3' to 3': SAND, trace boiler slag, trace rounded gravel < 1 cm, fine, poorly-graded; brown; dry, loose. (FILL) | | |
| 615.0 | brown fine to medium SAND, trace boiler slag, trace gravel | | | RS | | | 3' to 7.5': SAND, trace boiler slag, trace rounded gravel < 1 inch, fine to medium, well-graded; brown; moist, loose. (FILL) | | |
| 610.0 | | | | RS | | | 10' to 11.7': SAND, trace boiler slag, trace rounded gravel < 1 inch, fine to medium, well-graded; brown; wet (washout), loose. (FILL) | | Bentonite chips 11-13 ft-bgs |
| | | | | RS | | | 11.7' to 13': SAND, trace boiler slag, fine to medium, well-graded; brown; moist, loose. (FILL) | | |
| | gray to dark gray CLAY | | | RS | | | 13' to 13.2': CLAY, gray, cohesive, stiff. (FILL) | | Filter Pack #5 Sand 13-25 ft-bgs |
| | | | | RS | | | 13.2' to 14.3': CLAY, gray, some rounded gravel < 3 inch. (FILL) | | |
| | | | | RS | | | 14.3' to 15': CLAY, some fine sand, dark gray, cohesive. (FILL) | | 2 PVC Screen slot 0.010 14.5-24.5 ft-bgs |
| 605.0 | light brown to yellowish-brown fine to medium SAND | | | RS | | | 15' to 16.7': SAND, fine to medium, well-graded; light brown; moist, loose. (SW) | | |
| 600.0 | | | | RS | | | 20' to 23.2': SAND, trace fines, fine to medium, poorly-graded; yellowish-brown. (SP) | | |
| | pale grayish-brown fine to medium SAND | | | RS | | | 23.2' to 24': SAND, fine to medium, poorly-graded; gray. (SP) | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: LAYNE
DRILLER: C. Stoizenbach
DRILL RIG: Track Mounted Diedrich D-50

LOGGED BY: DFS
CHECKED BY: AMH
DATE: 9/20/19

Golder Associates

# BOREHOLE LOG: GAMW-17B



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 34
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327377.87 E: 2943120.346
GROUND SURFACE ELEV.: 620.74
TOP OF CASING ELEV.: 624.12
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: ROTOSONIC
CORING METHOD:
DRILL RIG: Track Mounted Diedrich D-50
START DATE/TIME: 9/12/2019 7:45:00 AM
END DATE/TIME: 9/14/2019 9:50:00 AM

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 620.0 | brown fine SILTY SAND, some organics | | | RS | | | 0' to 0.3': SILTY SAND, some organics, fine; brown; moist, loose. (FILL) | | Bentonite grout mix 0-26 ft-bgs |
| | brown fine SAND, trace boiler slag | | | RS | | | 0.3' to 3': SAND, trace boiler slag, trace rounded gravel < 1 cm, fine, poorly-graded; brown; dry, loose. (FILL) | | |
| 615.0 | brown fine to medium SAND, trace boiler slag, trace gravel | | | RS | | | 3' to 7.5': SAND, trace boiler slag, trace rounded gravel < 1 inch, fine to medium, well-graded; brown; moist, loose. (FILL) | | |
| 610.0 | | | | RS | | | 10' to 11.7': SAND, trace boiler slag, trace rounded gravel < 1 inch, fine to medium, well-graded; brown; wet (washout), loose. (FILL) | | |
| | | | | RS | | | 11.7' to 13': SAND, trace boiler slag, fine to medium, well-graded; brown; moist, loose. (FILL) | | |
| | gray to dark gray CLAY | | | RS | | | 13' to 13.2': CLAY, gray, cohesive, stiff. (FILL) | | |
| | | | | RS | | | 13.2' to 14.3': CLAY, gray, some rounded gravel < 3 inch. (FILL) | | |
| | | | | RS | | | 14.3' to 15': CLAY, some fine sand, dark gray, cohesive. (FILL) | | |
| 605.0 | light brown to yellowish-brown fine to medium SAND | | | RS | | | 15' to 16.7': SAND, fine to medium, well-graded; light brown; moist, loose. (SW) | | |
| 600.0 | | | | RS | | | 20' to 23.2': SAND, trace fines, fine to medium, poorly-graded; yellowish-brown. (SP) | | |
| | pale grayish-brown fine to medium SAND | | | RS | | | 23.2' to 26': SAND, fine to medium, poorly-graded; gray. (SP) | | |

LITHOLOGY LEGEND

Fill (made ground) | USCS Poorly-graded Sand (SP) | USCS Low Plasticity Clay (CL)

DRILLING COMPANY: LAYNE
DRILLER: C. Stoizenbach
DRILL RIG: Track Mounted Diedrich D-50

LOGGED BY: DFS
CHECKED BY: AMH
DATE: 9/20/19

Golder Associates

# BOREHOLE LOG: GAMW-17B



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 34
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327377.87 E: 2943120.346
GROUND SURFACE ELEV.: 620.74
TOP OF CASING ELEV.: 624.12
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: ROTOSONIC
CORING METHOD:
DRILL RIG: Track Mounted Diedrich D-50
START DATE/TIME: 9/12/2019 7:45:00 AM
END DATE/TIME: 9/14/2019 9:50:00 AM

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 595.0 | pale grayish-brown fine to medium SAND | | | RS | | | | | Bentonite chips 26-27.5 ft-bgs<br>Filter Pack #5 Sand 27.5-33.5 ft-bgs<br>2 PVC Screen slot 0.010 28.5-33.5 ft-bgs |
| 590.0 | | | | RS | | | 30' to 33.7': SAND, trace fines, fine to coarse, poorly-graded; pale grayish-brown. (SP) | | |
| | gray CLAY | | | RS | | | 33.7' to 34': CLAY, gray, w ~ PL, hard. (CL) | | |
| 585.0 | | | | | | | | | |
| 580.0 | | | | | | | | | |
| 575.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Poorly-graded Sand (SP)

USCS Low Plasticity Clay (CL)

DRILLING COMPANY: LAYNE
DRILLER: C. Stoizenbach
DRILL RIG: Track Mounted Diedrich D-50

LOGGED BY: DFS
CHECKED BY: AMH
DATE: 9/20/19

Golder Associates

# BOREHOLE LOG: GAMW-18



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 30
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327353.427 E: 2943408.296
GROUND SURFACE ELEV.: 623.69
TOP OF CASING ELEV.: 626.87
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: ROTOSONIC
CORING METHOD:
DRILL RIG: Track Mounted Diedrich D-50
START DATE/TIME: 9/10/2019 2:30:00 PM
END DATE/TIME: 9/11/2019 12:30:00 PM

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| | brown fine SAND, trace boiler slag | | | | | | 0 to 0.3': SAND, some organics, fine; brown; dry, loose. (FILL) | | Bentonite grout mix 0-16 ft-bgs |
| | | | | | | | 0.3' to 2.3': SAND, trace boiler slag, trace rounded gravel <2 inch, fine, poorly-graded; brown; dry, loose. (FILL) | | |
| 620.0 | | | | | | | 2.3' to 4.7': SAND, trace rounded gravel <1 inch, trace boiler slag, fine, poorly-graded; brown to light brown; moist, loose. (FILL) | | |
| 615.0 | dark brown to yellowish-brown fine to medium SAND | | | | | | 10' to 11.5': SAND, fine to medium, well-graded; dark brown; wet, compact. (SW) | | |
| | | | | | | | 11.5' to 13.7': SAND, fine to medium, well-graded; yellowish-brown; wet, loose. (SW) | | |
| 610.0 | | | | | | | | | Bentonite chips 16-18 ft-bgs |
| 605.0 | | | | | | | 20' to 27': SAND, trace fines, fine to medium, poorly-graded; yellowish-brown. (SP) | | Filter Pack #5 Sand 18-30 ft-bgs<br>2 PVC Screen slot 0.010 20-30 ft-bgs |
| 600.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Well-graded Sand (SW)

DRILLING COMPANY: LAYNE
DRILLER: C. Stoizenbach
DRILL RIG: Track Mounted Diedrich D-50

LOGGED BY: DFS
CHECKED BY: AMH
DATE: 9/20/19

Golder Associates

# BOREHOLE LOG: GAMW-18



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 30
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327353.427 E: 2943408.296
GROUND SURFACE ELEV.: 623.69
TOP OF CASING ELEV.: 626.87
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: ROTOSONIC
CORING METHOD:
DRILL RIG: Track Mounted Diedrich D-50
START DATE/TIME: 9/10/2019 2:30:00 PM
END DATE/TIME: 9/11/2019 12:30:00 PM

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| | dark brown to yellowish-brown fine to medium SAND | | | | | | | | |
| 595.0 | | | | | | | 30': SAND, fine to medium, poorly-graded; yellowish-brown. (SP) | | |
| 590.0 | | | | | | | | | |
| 585.0 | | | | | | | | | |
| 580.0 | | | | | | | | | |
| 575.0 | | | | | | | | | |

LITHOLOGY LEGEND

Fill (made ground)

USCS Well-graded Sand (SW)

DRILLING COMPANY: LAYNE
DRILLER: C. Stoizenbach
DRILL RIG: Track Mounted Diedrich D-50

LOGGED BY: DFS
CHECKED BY: AMH
DATE: 9/20/19

Golder Associates

# Boring No.: MW-105

| | | | |
|---|---|---|---|
| Project Name: NIPSCO-BGS | Project Number: 377880004 | Northing: 2327402.24<br>Easting: 2942433.55 | |
| Environmental Contractor: AMEC Earth and Environmental | | Riser Elevation: 622.65 | |
| Drilling Contractor: Boart Longyear | | TOR Height AGL: 3.48 | |
| Drilling Method: Hollow Stem Auger | Well Type: Monitoring Well | Drill Hole Depth: 18 | |
| Date Boring Started: 6/22/05 | Date Boring Completed: 6/22/05 | Ground Surface Elevation: 619.17 | Page 1 of 1 |
| QA Check by: NWE/JMC | Notes: | | |

| Depth (feet) | Lithology | Legend | USCS | Description | Well Construction | PID (ppm) | Blow Count | Elevation (feet AMSL) |
|---|---|---|---|---|---|---|---|---|
| 0 | SAND FILL | | | SAND FILL, fine grained, subangular to subrounded, loose, medium dense, sand with little gravel, dry. | CONCRETE | | | 618 |
| 2 | | | | | | 0.5 | 10 | |
| | SAND | | SP | SAND, 2.5YR 7/8 light red, fine grained, subangular to subrounded, moist to very moist. | | | | 616 |
| 4 | | | | | PVC CASING<br>BENTONITE SEAL | 0.8 | 13 | |
| | | | | | | | | 614 |
| 6 | | | | | | 0.7 | 24 | |
| | | | | | | | | 612 |
| 8 | | | | | | 0.6 | 41 | |
| | | | | | | | | 610 |
| 10 | | | | | | 1.1 | 33 | |
| | | | | | | | | 608 |
| 12 | | | | | SAND PACK | 0.8 | 35 | |
| | | | | | PVC SCREEN<br>10 Slot | | | 606 |
| 14 | | | | | | 0.9 | 10 | |
| | PEAT | | PT | PEAT, trace silt and fine to medium sand, trace wood, moist. | | | | 604 |
| 16 | SAND | | SP | SAND, 2.5YR 7/8 light red, fine grained, subangular to subrounded. | | 1.5 | 2 | |
| | | | | | | | | 602 |
| 18 | | | | | | 1.1 | 6 | |
| | | | | | | | | 600 |

PID_N_NIPSCO.GPJ AMEC MNPLS.GDT 8/5/05

# Boring No.: MW-112

| | | | |
|---|---|---|---|
| Project Name: NIPSCO-BGS | Project Number: 377880004 | Northing: 2327800.87<br>Easting: 2942980.97 | |
| Environmental Contractor: AMEC Earth and Environmental | | Riser Elevation: 628.59 | |
| Drilling Contractor: Boart Longyear | | TOR Height AGL: 3.66 | |
| Drilling Method: Hollow Stem Auger | Well Type: Monitoring Well | Drill Hole Depth: 27 | |
| Date Boring Started: 6/29/05 | Date Boring Completed: 6/29/05 | Ground Surface Elevation: 624.93 | Page 1 of 2 |
| QA Check by: NWE/JMC | Notes: | | |

| Depth (feet) | Lithology | Legend | USCS | Description | Well Construction | PID (ppm) | Blow Count | Elevation (feet AMSL) |
|---|---|---|---|---|---|---|---|---|
| | TOPSOIL | | | TOPSOIL. | CONCRETE | | | 624 |
| | SAND | | SP | SAND, dark brown, fine grained, wet at 22 feet, logged soil from cuttings due to overhead utilities. | | | | |
| 2 | | | | | | | | 622 |
| 4 | | | | | | | | 620 |
| 6 | | | | | | | | 618 |
| 8 | | | | | BENTONITE SEAL<br>PVC CASING | | | 616 |
| 10 | | | | | | | | 614 |
| 12 | | | | | | | | 612 |
| 14 | | | | | | | | 610 |
| 16 | | | | | | | | 608 |
| 18 | | | | | | | | 606 |

PID_N_NIPSCO.GPJ AMEC MNPLS.GDT 8/5/05

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# Appendix C

# Stormwater Runoff Analysis

Surface Impoundments Closure

Bailly Generating Station

**Prepared for:**
Northern Indiana Public Service Company
Merrillville, Indiana

**Prepared by:**
Wood Environment & Infrastructure Solutions, Inc.
11003 Bluegrass Parkway
Suite 690
Louisville, Kentucky 40299

October 01, 2020

## Bailly Generating Station Stormwater Runoff Analysis

## 1. Background

The Bailly Generating Station (BGS) owned by the Northern Indiana Public Service Company (NIPSCO) is located on the southern shore of Lake Michigan on approximately 350 acres near Chesterton, Indiana. The street address is 246 Bailly Station Road, Chesterton, IN 46304.

The BGS generated electricity using coal-fired boilers from 1962 until 2018. The coal-fired electricity generating process produced coal combustion residuals (CCR) in the form of boiler slag and fly ash. The CCR materials were sluiced to surface impoundments located on-site. The BGS has six surface impoundments located on-site that were used to manage CCR and non-CCR discharges (**Table 1**). The Secondary Settling Pond No. 2 (SSP #2) was used to manage air-heater wash flow as well as other non-CCR discharges and was not determined to be a CCR impoundment. The Forebay is a holding (wet well) facility for the pump station and not determined to be a CCR impoundment. Secondary Settling Pond No. 2 and the Forebay are not subject to closure under the Federal CCR Rule or State of Indiana regulations. The remaining four CCR surface impoundments identified in **Table 1** are scheduled for closure in response to regulations enacted by the U.S. EPA and the Indiana Department of Environmental Management (IDEM).

*Table 1: Bailly Generating Station Surface Impoundments*

| BGS Surface Impoundments | |
|---|---|
| CCR Surface Impoundments | Non-CCR Impoundments |
| Boiler Slag Pond | Secondary Settling Pond No. 2 |
| Primary Settling Pond No. 1 | Forebay |
| Primary Settling Pond No. 2 | |
| Secondary Settling Pond No. 1 | |

The surface impoundments are primarily incised and constructed below ground surface, with interior side slopes to the pond bottoms. They were constructed with a bottom liner system, consisting of (in descending order): blast furnace slag, a synthetic membrane liner placed in between sand layers, and a compacted clay liner. A piping system was constructed to convey boiler slag and fly ash from the plant to the impoundments by sluicing CCR material mixed with water. Specifically, boiler slag was sluiced from the plant to the Boiler Slag Pond (BSP), allowed to settle, and decant water was conveyed via gravity flow to either Primary Settling Pond No. 1 (PSP #1) or 2 (PSP #2). Fly ash was sluiced from the plant to PSP #1 or PSP #2. Decant water from the primary settling ponds was subsequently conveyed via gravity flow to Secondary Settling Pond No. 1 (SSP #1) and into the Forebay for discharge via pumping to the permitted discharge point on Lake Michigan or returned to the station as makeup water for operations. BGS operations transitioned fly ash management to a dry handling system in 1981, further limiting use of the impoundments for CCR storage.

This report reviews the planned stormwater drainage design for the closed CCR impoundments. Locations of the impoundments can be found on the Drawings Sheet **BGS-03 *Overall Site Plan***.

## 2. Closure Method

Removing the surface impoundment contents (CCR) is the proposed closure method. CCR material will be excavated and transported to the NIPSCO R.M. Schahfer Generating Station (RMSGS) onsite CCR-compliant

landfill for disposal, or possibly sold for beneficial use. Grading and placing soil/topsoil material to a minimum depth of 2 feet (18 inches of soil material and 6 inches of topsoil) will create a soil cover and promote storm water runoff. The cover will be vegetated with grass to limit soil erosion of the cover. Positive drainage will be provided to limit ponding on the soil cover. The existing piping system and Forebay pumping station will be used to provide post-closure surface drainage. The final grading plan (closure condition) is shown on the Drawing Sheet (**BGS-06 *Proposed Grading Plan***). The final drainage plan is shown in **Attachment 1** Drainage Map.

## 3. Runoff Calculations

Drainage area boundaries were determined from the most recent topographic data of the site (**BGS-04 *Existing Conditions Plan***) and from the proposed grading plan (**BGS-06 *Proposed Grading Plan***) in the BGS CCR Impoundment Closure Application drawings set. The project area was divided into six (6) primary drainage basins to account for runoff occurring within each surface impoundment as shown in **Attachment 1** Drainage Map.

**Table 2** lists the rainfall totals data used for this study; rainfall totals were referenced from NOAA Atlas 14, tabular precipitation frequency for Station Ogden Dunes, IN (**Attachment 7**). The SCS Type 2 rainfall distribution was used for the 24-hour storm events.

Storm runoff volumes were calculated using the SCS Curve Number method. The runoff curve number used for the closed conditions considered the impoundments to have a vegetated grass cover (fair condition) and a hydrologic soil group C (CN = 79) taken from the Indiana Department of Transportation Drainage Manual (IDOT, 2013). Because of their disturbed nature the soils were assigned a hydrologic soil group C. **Table 3** below shows the drainage area, curve number, and runoff volumes for each of the CCR drainage basins. **Attachment 2** provides the runoff depth and volume calculations for each CCR basin.

The SCS unit hydrograph method was used in determining peak runoff flowrates for each basin. The time of concentration were calculated using the TR-55 velocity method. **Attachment 3** provides a report of the time of concentration and peak runoff calculation for each of the CCR basins using the WinTR-55 application.

*Table 2: Rainfall Depths from NOAA Atlas 14 Station Ogden Dunes*

| Design Storm | Rainfall Depth (in) | Storm Distribution |
|---|---|---|
| 2-year, 24-hour | 2.77 | SCS Type 2 |
| 5-year, 24-hour | 3.58 | SCS Type 2 |
| 10-year, 24-hour | 4.24 | SCS Type 2 |
| 25-year, 24-hour | 5.21 | SCS Type 2 |

*Table 3: Runoff Volume Summary*

| Basin ID | Drainage Area (ac) | CN[1] | 25-year Runoff Depth[2] (ft) | 25-year Runoff Volume[2] (ac-ft) |
|---|---|---|---|---|
| Boiler Slag Pond | 3.7 | 79 | 2.98 | 0.92 |
| Primary Settling Pond No. 1 | 8.87 | 79 | 2.98 | 2.21 |
| Primary Settling Pond No. 2 | 10.91 | 79 | 2.98 | 2.71 |
| Secondary Settling Pond No. 1 | 3.28 | 79 | 2.98 | 0.82 |
| 1) Curve Number from INDOT drainage manual for "grass fair condition" | | | | |
| 2) 25-year, 24-hour rainfall depth 5.21-in | | | | |

## 4. Stormwater Drainage Plan

The stormwater drainage plan design focuses on the four (4) CCR impoundments planned to be closed. The existing piping system will be utilized to convey stormwater runoff through the CCR impoundments. The final (closure) grading plan for the CCR impoundments was designed to the elevations of the existing piping infrastructure to allow for gravity flow. The existing pipe system will convey stormwater runoff from the BSP, PSP#1, PSP#2, and SSP#1; a lift station will be placed in SSP #1 to pump the collected stormwater to the Forebay. The design of the pumping lift station connecting SSP #1 to the Forebay will occur in a future design submittal. The SSP#2 was not part of the closure design as it is not a CCR impoundment.

Several segments of the existing piping system have been abandoned or will not be used for stormwater management of the closed impoundments. **Attachment 1** Drainage Map provides the layout of the existing pipe system with identification of the segments of the pipe system to be abandoned or not used. **Table 4** provides information on the existing pipe system that will be utilized. As part of the closure activities Wood recommends inspection of the existing pipe network to verify the condition and determination of the invert elevations. The outlet of the stormwater pipe system is the SSP #1. Stormwater will be temporarily stored within the closed impoundments; until it is pumped from the SSP #1 to the Forebay where it will ultimately be pumped to the permitted discharge on Lake Michigan.

*Table 4: Piping System Information*

| Surface Impoundment Closure Pipe Network Information | | | | | |
|---|---|---|---|---|---|
| Pipe Schedule ID[1] | from | to | Inlet elev[2] (ft) | Outlet elev[2] (ft) | Diameter (in) |
| 5 | BSP | VP #5 | 616.85 | 616.68 | 24 |
| 18 | VP #5 | PSP #1 | 616.68 | 616.18 | 24 |
| 10 | PSP #1 | MH #3 | 611.93 | 611.81 | 36 |
| 11 | MH #3 | MH #4 | 611.81 | 611.23 | 36 |
| 12 | MH #4 | VP #1-2 | 611.23 | 610.85 | 36 |
| 13 | PSP #2 | VP #1-2 | 611.18 | 610.85 | 30 |
| 14 | VP #1-2 | SSP #1 | 610.85 | 610.27 | 36 |
| 1) Referenced from Sargent & Lundy Drawings B-565, B-566 | | | | | |
| 2) Elevations in NAVD88 | | | | | |
| Note) BSP = Boiler Slag Pond; PSP #1 = Primary Settling Pond #1; PSP #2 = Primary Settling Pond #2; SSP #1 = Secondary Settling Pond #1; VP = Valve Pit; MH = Manhole | | | | | |

The 25-year storm was used as the design basis for surface runoff within the closed CCR impoundments. The closed impoundments will have available storage to contain the entire 25-year runoff volume (shown in **Table 3**). **Table 5** provides the storage available within each basin per the final grading plan and shows the maximum pool depth during the 25-year storm. The results in the **Table 5** indicates the runoff will be contained in a shallow pool (equalize) within the closed impoundments until being pumped out from SSP #1 to the Forebay. **Attachment 4** provides the stormwater model calculations of the pipe system from the stormwater management model (SWMM 5.0). Note, the Attachment 4 calculations assume the pipes listed in **Table 4** are in working condition and the Sargent and Lundy design drawings B-566 accurately represent existing conditions. As noted above, Wood recommends inspection of the existing pipe network to verify the condition and determination of the invert elevations, if modifications are needed to rehab any of the pipes, new calculation can be performed and provided to IDEM.

The surface cover of the closed impoundments will be vegetated with grass and will serve as an open channel during storm events, conveying runoff across the length of the impoundment. The peak flow rates within the closed impoundments are shown **Attachment 4**. The slope across the impoundments in the direction of flow was set to 0.5 %. **Figure 1** provides a cross section sketch of the PSP #1 and #2 in the direction of flow. **Figure 2** provides a cross section sketch of the BSP and SSP #1 in the direction of flow. **Attachment 5** provides the channel hydraulics calculations over the impoundment covers. The calculated velocities on the cover will be less than 1 feet per second and grass was determined to be acceptable cover within the runoff flow paths.

Culvert outlet protection at Pipe 18 into PSP #1 and Pipe 14 into SSP #1 will consist of riprap apron of INDOT Uniform A riprap. The riprap gradation information for Uniform A riprap can be found in **Attachment 6** and based on this gradation information the Uniform A riprap was estimated to have a median diameter between 3 and 6 inches. The peak flow through Pipe 18 into PSP #1 was 10 cfs which is the peak flow into the BSP, this is conservative as runoff will be attenuated as it moves through the BSP. The peak flow of 22 cfs through Pipe 14 into SSP #2 was determined by the stormwater model (**Attachment 4**). For both Pipe 18 and Pipe 14 this peak flow in the pipe is subcritical and the outlet flow calculations (**Attachment 5**) show Uniform A riprap apron to be stable. The riprap apron will dissipate the energy at the pipe outlets before going onto the soil cover.

*Table 5: Surface Impoundment Closure Information*

| Surface Impoundment Closure Information | | | | |
|---|---|---|---|---|
| Surface impoundment | Impoundment type | Impoundment size (acres) | Volume[1] (ac-ft) | 25-year Max Pool Depth (ft) |
| Boiler Slag Pond | Partially incised | 1.2 | 2.6 | 0.5 |
| Primary Settling Pond No. 1 | Incised | 5.6 | 27.5 | 0.8 |
| Primary Settling Pond No. 2 | Incised | 7.2 | 33.8 | 1.3 |
| Secondary Settling Pond No. 1 | Incised | 2.5 | 15.8 | 3.0 |
| 1) App. closed impoundment storage volume below elev 620' | | | | |

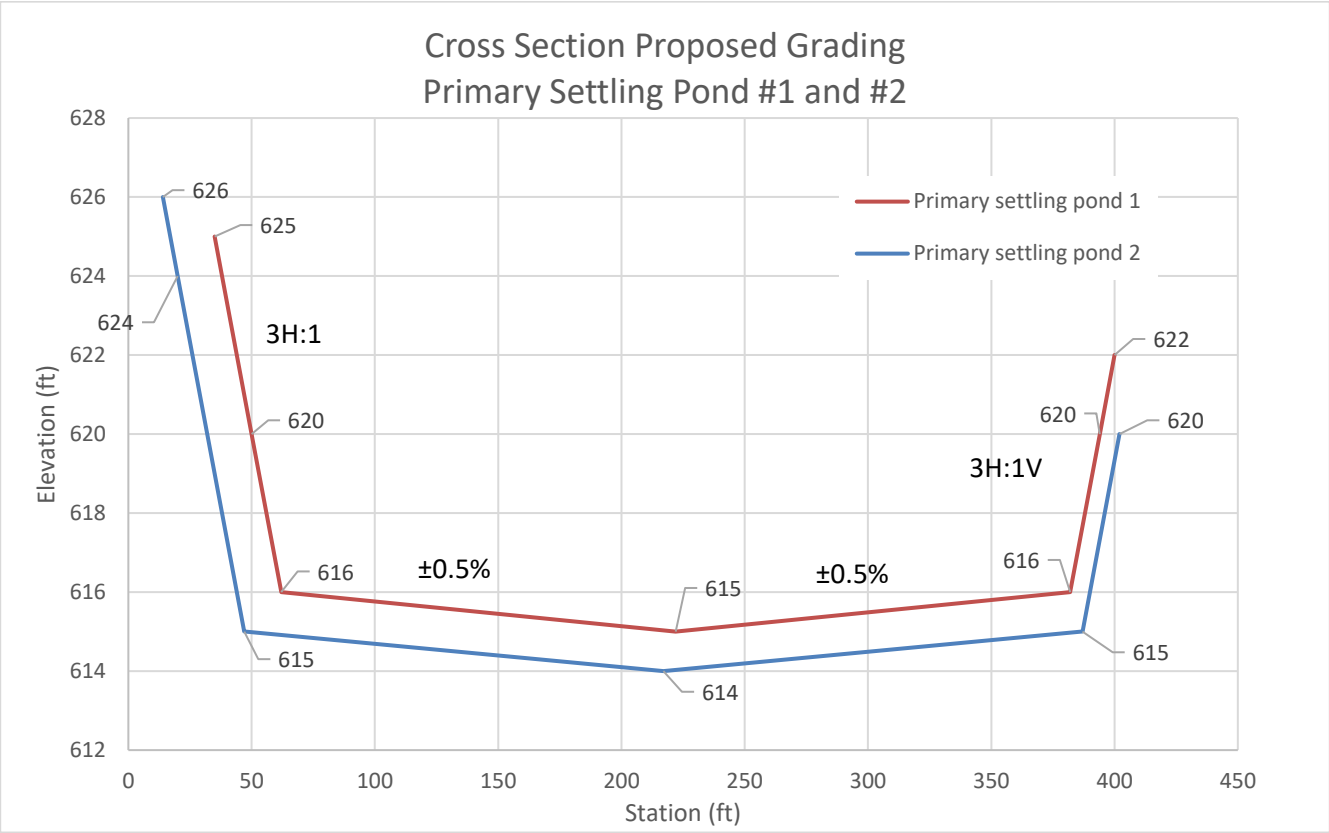



*Figure 1: Cross Section sketch PSP#1 and #2*

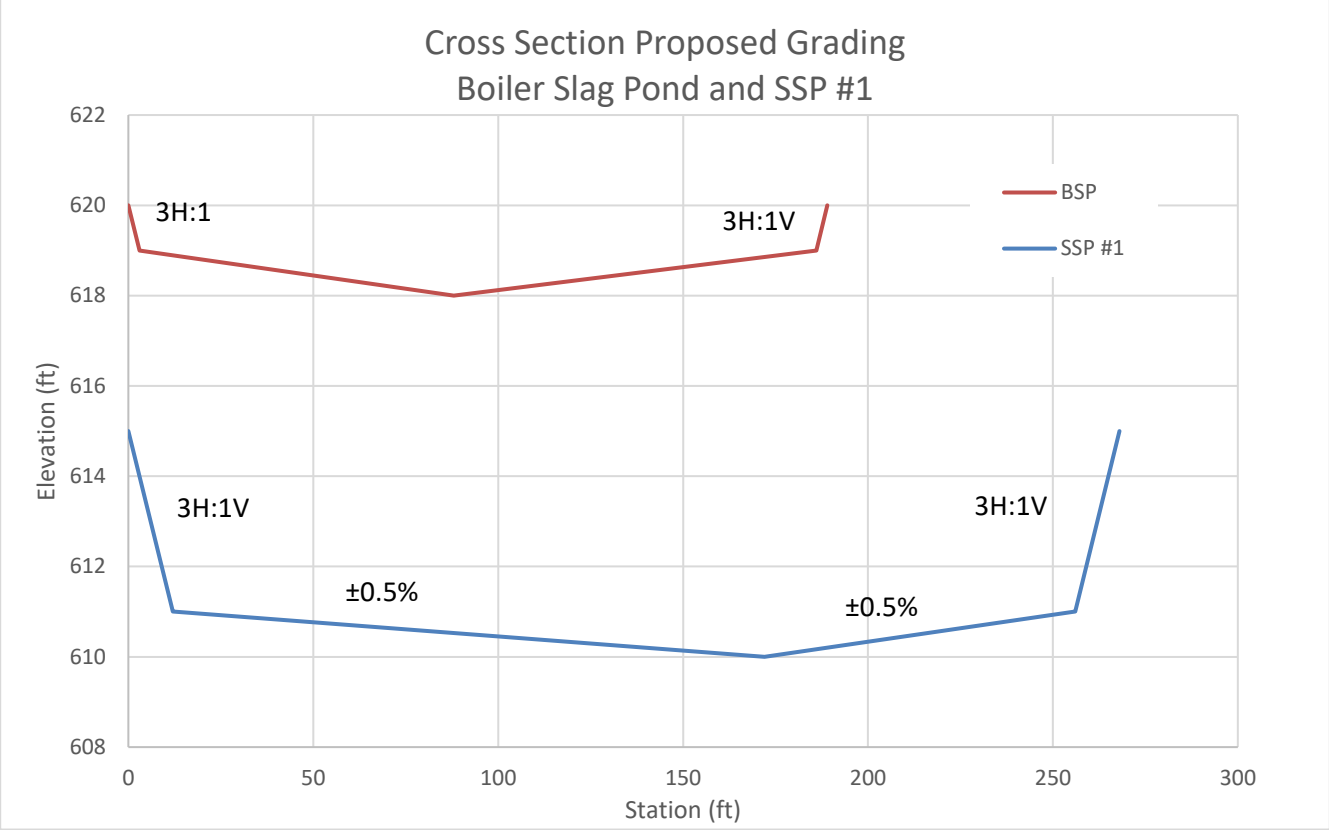



*Figure 2: Cross Section sketch BSP and SSP#1*

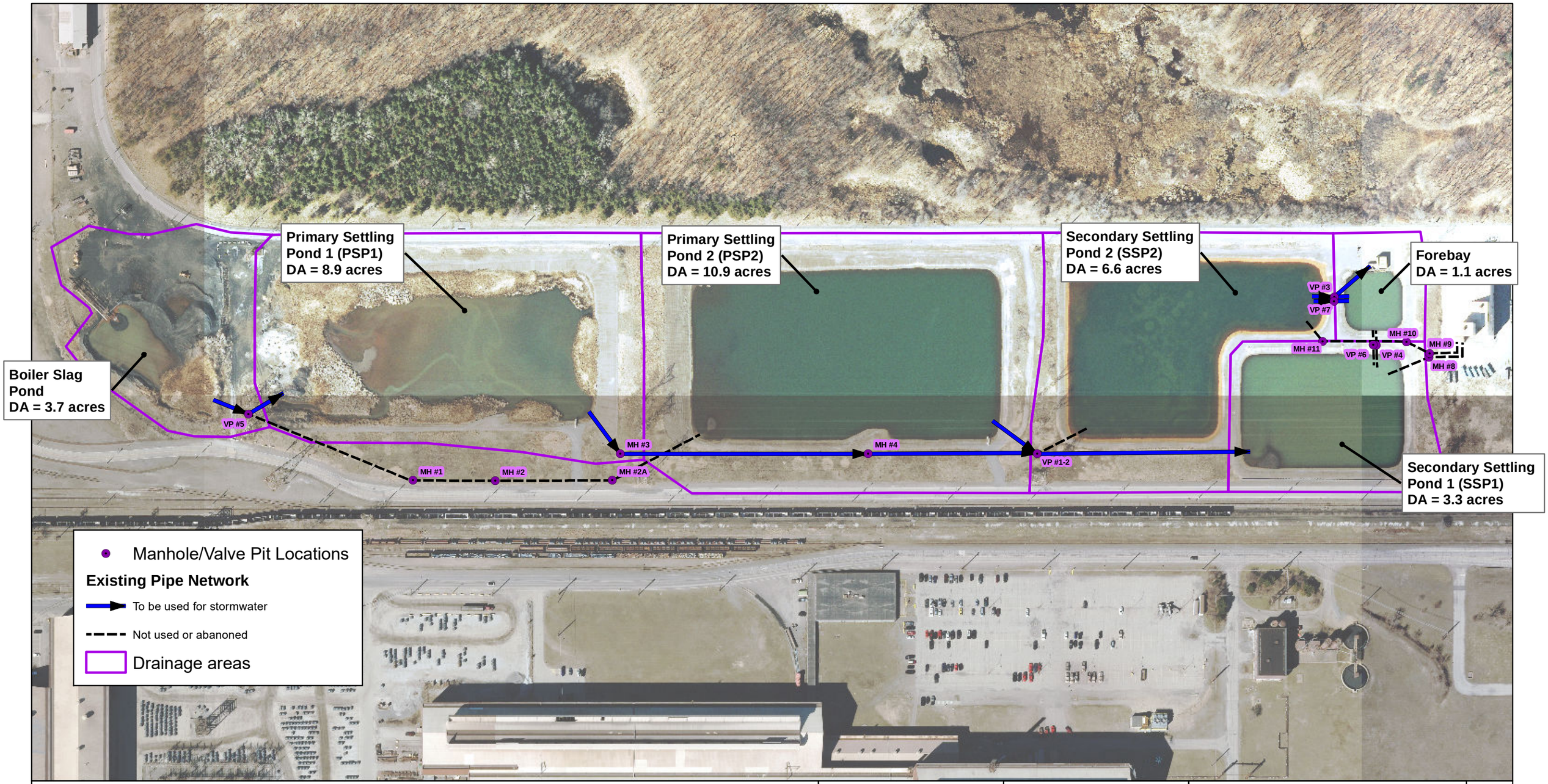
## 5. References

(IDOT, 2013). Indiana Department of Transportation, 2013 Design Manual. Chapter 202 Hydrology

(S&L Engineers). Sargent & Lundy Engineers, Drawings Bailly Generating Station. Drawings # B-565, B-566, B-569

## 6. Attachments

**Attachment 1:  Drainage Map**




**Notes**

N

0 100 200 400 Feet

wood.

Environment & Infrastructure Solutions, Inc.
2030 Falling Waters Rd., Suite 300
Knoxville, TN 37922

CLIENT: NIPSCO

SITE LOCATION: Bailly Generating Station
Chesterton, Indiana

Attach No. 1

TITLE: Stormwater Drainage Map

SCALE: 1" = 200' | DATE: 02/12/2020 | PROJECT: 7382173270

DRAWN BY: JMP | CHECKED BY: DRS

ESRI IMAGERY

**Attachment 2: Direct Runoff Calculation**

# Direct Runoff Calculations

## Rainfall Depths from NOAA Atlas 14
## (Location: Ogden Dunes, Station ID: 12-6542)

| Design Storm | Rainfall Depth (in) | Storm Distribution |
|---|---|---|
| 2-year, 24-hour | 2.77 | SCS Type 2 |
| 5-year, 24-hour | 3.58 | SCS Type 2 |
| 10-year, 24-hour | 4.24 | SCS Type 2 |
| 25-year, 24-hour | 5.21 | SCS Type 2 |

## Curve Number selection for project area

Indiana Department of Transportation 2013 Design Manual
Chapter 202 Hydrology
Figure 202-2F (Runoff Curve Number for Urban Area)
Developing Urban Area

Grass open space fair condition 79

National Engineering Handbook, Chapter 10
Equation 10-12

| | |
|---|---|
| Max potential retention, S (in) | |
| CN = (1000) / (10 + S) | |
| CN | 79 |
| S | 2.66 |

Equation 10-11

| | | |
|---|---|---|
| Runoff equation | | |
| $Q = (P - 0.2S)^2 / (P + 0.8S)$ | | |
| Direct runoff, Q (in) | | |
| Rainfall depth, P (in) | | |
| Initial abstraction, Ia (in) | 0.2S | |
| Direct runoff design storms (in) | | |
| Q2 (in) | | 1.02 |
| Q5 (in) | | 1.63 |
| Q10 (in) | | 2.16 |
| Q25 (in) | | 2.98 |

Runoff Volume (ac-ft) = Direct runoff (in) * (ft / 12 in) * Drainage area (ac)

Runoff Summary table

| Subbasin ID | Drainage Area (ac) | CN[1] | 2-year Runoff volume (ac-ft) | 5-year Runoff volume (ac-ft) | 10-year Runoff volume (ac-ft) | 25-year Runoff volume (ac-ft) |
|---|---|---|---|---|---|---|
| Boiler Slag Pond | 3.7 | 79 | 0.32 | 0.50 | 0.67 | 0.92 |
| Primary Settling Pond #1 | 8.87 | 79 | 0.76 | 1.20 | 1.60 | 2.21 |
| Primary Settling Pond #2 | 10.91 | 79 | 0.93 | 1.48 | 1.96 | 2.71 |
| Secondary Settling Pond #1 | 3.28 | 79 | 0.28 | 0.45 | 0.59 | 0.82 |
| Secondary Settling Pond #2 | 6.56 | 79 | 0.56 | 0.89 | 1.18 | 1.63 |
| Forebay | 1.05 | 79 | 0.09 | 0.14 | 0.19 | 0.26 |
| Note 1) IDOT Drainage Manual 2013; grass cover fair condition type C soil = CN 79 | | | | | | |

**Attachment 3:  TR-55 Peak Flow and Time Concentration calcs**

WinTR-55 Current Data Description

--- Identification Data ---

User: Joe
Project:
SubTitle:
State: Indiana
County: Porter NOAA-B
Filename: P:\projects\ENGINEERING\NIPSCO\7382173270_BGS\5 Supporting Materials\Stormwater Calcs_Permit Ap

Date: 9/11/2020
Units: English
Areal Units: Acres

--- Sub-Area Data ---

| Name | Description | Reach | Area(ac) | RCN | Tc |
|---|---|---|---|---|---|
| BSP | | Outlet | 3.7 | 79 | .494 |
| PSP1 | | Outlet | 8.87 | 79 | .582 |
| PSP2 | | Outlet | 10.91 | 79 | .578 |
| SSP1 | | Outlet | 3.28 | 79 | .486 |

Total area: 26.76 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

| 2-Yr (in) | 5-Yr (in) | 10-Yr (in) | 25-Yr (in) | 50-Yr (in) | 100-Yr (in) | 1-Yr (in) |
|---|---|---|---|---|---|---|
| 2.85 | 3.67 | 4.35 | 5.21 | 6.18 | 7.08 | 2.33 |

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

Joe

Porter NOAA-B County, Indiana

Storm Data

Rainfall Depth by Rainfall Return Period

| 2-Yr (in) | 5-Yr (in) | 10-Yr (in) | 25-Yr (in) | 50-Yr (in) | 100-Yr (in) | 1-Yr (in) |
|---|---|---|---|---|---|---|
| 2.85 | 3.67 | 4.35 | 5.21 | 6.18 | 7.08 | 2.33 |

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

Joe

Porter NOAA-B County, Indiana

Watershed Peak Table

| Sub-Area or Reach Identifier | Peak Flow by Rainfall Return Period 2-Yr (cfs) | 5-Yr (cfs) | 10-Yr (cfs) | 25-Yr (cfs) | 100-Yr (cfs) |
|---|---|---|---|---|---|
| SUBAREAS | | | | | |
| BSP | 3.44 | 5.53 | 7.40 | 9.83 | 15.29 |
| PSP1 | 7.38 | 11.97 | 15.97 | 21.32 | 33.19 |
| PSP2 | 9.15 | 14.77 | 19.78 | 26.33 | 41.06 |
| SSP1 | 3.08 | 4.97 | 6.63 | 8.81 | 13.71 |
| REACHES | | | | | |
| OUTLET | 22.84 | 36.92 | 49.40 | 65.60 | 102.22 |

Joe

Porter NOAA-B County, Indiana

Hydrograph Peak/Peak Time Table

| Sub-Area or Reach Identifier | Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) | (hr) | 5-Yr (cfs) | (hr) | 10-Yr (cfs) | (hr) | 25-Yr (cfs) | (hr) | 100-Yr (cfs) | (hr) |
|---|---|---|---|---|---|---|---|---|---|---|
| SUBAREAS | | | | | | | | | | |
| BSP | 3.44 | 12.19 | 5.53 | 12.18 | 7.40 | 12.19 | 9.83 | 12.17 | 15.29 | 12.18 |
| PSP1 | 7.38 | 12.23 | 11.97 | 12.24 | 15.97 | 12.22 | 21.32 | 12.22 | 33.19 | 12.23 |
| PSP2 | 9.15 | 12.25 | 14.77 | 12.22 | 19.78 | 12.22 | 26.33 | 12.23 | 41.06 | 12.22 |
| SSP1 | 3.08 | 12.19 | 4.97 | 12.19 | 6.63 | 12.18 | 8.81 | 12.18 | 13.71 | 12.17 |
| REACHES | | | | | | | | | | |
| OUTLET | 22.84 | | 36.92 | | 49.40 | | 65.60 | | 102.22 | |

Joe

Porter NOAA-B County, Indiana

Sub-Area Summary Table

| Sub-Area Identifier | Drainage Area (ac) | Time of Concentration (hr) | Curve Number | Receiving Reach | Sub-Area Description |
|---|---|---|---|---|---|
| BSP | 3.70 | 0.494 | 79 | Outlet | |
| PSP1 | 8.87 | 0.582 | 79 | Outlet | |
| PSP2 | 10.91 | 0.578 | 79 | Outlet | |
| SSP1 | 3.28 | 0.486 | 79 | Outlet | |

Total Area: 26.76 (ac)

Joe

Porter NOAA-B County, Indiana

Sub-Area Time of Concentration Details

| Sub-Area Identifier/ | Flow Length (ft) | Slope (ft/ft) | Mannings's n | End Area (sq ft) | Wetted Perimeter (ft) | Velocity (ft/sec) | Travel Time (hr) |
|---|---|---|---|---|---|---|---|
| BSP | | | | | | | |
| SHEET | 100 | 0.0050 | 0.240 | | | | 0.439 |
| SHALLOW | 225 | 0.0050 | 2.85 | | | | 0.055 |
| | | | | | Time of Concentration | | .494 |
| PSP1 | | | | | | | |
| SHEET | 100 | 0.0050 | 0.240 | | | | 0.439 |
| SHALLOW | 589 | 0.0050 | 2.85 | | | | 0.143 |
| | | | | | Time of Concentration | | .582 |
| PSP2 | | | | | | | |
| SHEET | 100 | 0.0050 | 0.240 | | | | 0.439 |
| SHALLOW | 569 | 0.0050 | 2.85 | | | | 0.139 |
| | | | | | Time of Concentration | | .578 |
| SSP1 | | | | | | | |
| SHEET | 100 | 0.0050 | 0.240 | | | | 0.439 |
| SHALLOW | 193 | 0.0050 | 2.85 | | | | 0.047 |
| | | | | | Time of Concentration | | .486 |

Joe

Porter NOAA-B County, Indiana

Sub-Area Land Use and Curve Number Details

| Sub-Area Identifier | Land Use | Hydrologic Soil Group | Sub-Area Area (ac) | Curve Number |
|---|---|---|---|---|
| BSP | Open space; grass cover 50% to 75% (fair) | C | 3.7 | 79 |
| | **Total Area / Weighted Curve Number** | | **3.7** | **79** |
| PSP1 | Open space; grass cover 50% to 75% (fair) | C | 8.87 | 79 |
| | **Total Area / Weighted Curve Number** | | **8.87** | **79** |
| PSP2 | Open space; grass cover 50% to 75% (fair) | C | 10.91 | 79 |
| | **Total Area / Weighted Curve Number** | | **10.91** | **79** |
| SSP1 | Open space; grass cover 50% to 75% (fair) | C | 3.28 | 79 |
| | **Total Area / Weighted Curve Number** | | **3.28** | **79** |

**Attachment 4: Stormwater Model calculation**

```
[TITLE]


[OPTIONS]
;;Options            Value
;;------------------ ------------
FLOW_UNITS           CFS
INFILTRATION         CURVE_NUMBER
FLOW_ROUTING         DYNWAVE
LINK_OFFSETS         ELEVATION
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO
START_DATE           01/28/2020
START_TIME           00:00:00
REPORT_START_DATE    01/28/2020
REPORT_START_TIME    00:00:00
END_DATE             01/31/2020
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:01:00
WET_STEP             00:05:00
DRY_STEP             00:05:00
ROUTING_STEP         1
INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         0
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              4

[EVAPORATION]
;;Type           Parameters
;;-------------- ----------
CONSTANT     0.0
DRY_ONLY     NO

[RAINGAGES]
;;               Rain      Time   Snow   Data
;;Name           Type      Intrvl Catch  Source
;;-------------- --------- ------ ------ ----------
;25-yr, 24-hr storm
25-yr            CUMULATIVE 0:06   1.0    TIMESERIES SCS_Type_II_5.21in

[SUBCATCHMENTS]
;;                                                  Total    Pcnt.             Pcnt.
  Curb     Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope
  Length   Pack
;;-------------- ---------------- ---------------- -------- -------- --------
-------- --------
BSP_runoff       25-yr            BSP              3.7      0        1343.1   0.5
  0
Forebay_runoff   25-yr            Forebay          1.05     0        213.729  0.5
  0
```

| | | | | | | |
|---|---|---|---|---|---|---|
| PSP1_runoff | 25-yr | J200 | 8.87 | 0 | 2492.756 | 0.5 0 |
| PSP2_runoff | 25-yr | J300 | 10.91 | 0 | 3066.062 | 0.5 0 |
| SSP1_runoff | 25-yr | SSP1 | 3.28 | 0 | 1190.64 | 0.5 0 |
| SSP2_runoff | 25-yr | SSP2 | 6.56 | 0 | 534.119 | 0.5 0 |

[SUBAREAS]

| ;;Subcatchment | N-Imperv | N-Perv | S-Imperv | S-Perv | PctZero | RouteTo | PctRouted |
|---|---|---|---|---|---|---|---|
| BSP_runoff | 0.01 | 0.24 | 0.05 | 0.43 | 0 | OUTLET | |
| Forebay_runoff | 0.01 | 0.24 | 0.05 | 0.2 | 0 | OUTLET | |
| PSP1_runoff | 0.01 | 0.24 | 0.05 | 0.43 | 0 | OUTLET | |
| PSP2_runoff | 0.01 | 0.24 | 0.05 | 0.43 | 0 | OUTLET | |
| SSP1_runoff | 0.01 | 0.24 | 0.05 | 0.43 | 0 | OUTLET | |
| SSP2_runoff | 0.01 | 0.24 | 0.05 | 0.43 | 0 | OUTLET | |

[INFILTRATION]

| ;;Subcatchment | CurveNum | HydCon | DryTime |
|---|---|---|---|
| BSP_runoff | 79 | 0.5 | 7 |
| Forebay_runoff | 79 | 0.5 | 7 |
| PSP1_runoff | 79 | 0.5 | 7 |
| PSP2_runoff | 79 | 0.5 | 7 |
| SSP1_runoff | 79 | 0.5 | 7 |
| SSP2_runoff | 79 | 0.5 | 7 |

[JUNCTIONS]

| ;;Name | Invert Elev. | Max. Depth | Init. Depth | Surcharge Depth | Ponded Area |
|---|---|---|---|---|---|
| dummy | 616.68 | 5 | 0 | 0 | 0 |
| dummy2 | 0 | 0 | 0 | 0 | 0 |
| dummy3 | 0 | 0 | 0 | 0 | 0 |
| J200 | 616 | 4 | 0 | 0 | 0 |
| J201 | 615 | 5 | 0 | 0 | 0 |
| J202 | 613.2 | 6.8 | 0 | 0 | 0 |
| J203 | 614 | 6 | 0 | 0 | 0 |
| J300 | 614.6 | 5.4 | 0 | 0 | 0 |
| J301 | 612.7 | 7.3 | 0 | 0 | 0 |
| J302 | 613 | 7 | 0 | 0 | 0 |
| MH#1 | 616.18 | 4.5 | 0 | 0 | 0 |
| MH#2 | 615.18 | 5.5 | 0 | 0 | 0 |
| MH#2A | 614.18 | 6.5 | 0 | 0 | 0 |
| MH#3 | 611.51 | 9.17 | 0 | 0 | 0 |
| MH#4 | 611.18 | 9.5 | 0 | 1 | 0 |
| VP#12 | 610.85 | 10.83 | 0 | 0 | 0 |
| VP#3 | 611.93 | 9.75 | 0 | 0 | 0 |
| VP#4 | 611.93 | 9.75 | 0 | 0 | 0 |
| VP#5 | 616.68 | 5 | 0 | 0 | 0 |
| VP#6 | 611.68 | 10 | 0 | 0 | 0 |
| VP#7 | 611.68 | 10 | 0 | 0 | 0 |

[OUTFALLS]

| ;;Name | Invert Elev. | Outfall Type | Stage/Table Time Series | Tide Gate | Route To |
|---|---|---|---|---|---|
| reuse | 608.2 | FREE | | NO | |
| reuse2 | 608.2 | FREE | | NO | |

```
[STORAGE]
;;               Invert   Max.     Init.    Storage    Curve
      Evap.
;;Name           Elev.    Depth    Depth    Curve      Params
      Frac.    Infiltration parameters
;;-------------- -------- -------- -------- ---------- -------- -------- --------
-------- -------- ----------------------
BSP              618      2        0        TABULAR    BSP                       0
      0
Forebay          608.2    12       0        TABULAR    Forebay                   0
      0
;normal pool 618.3
PSP1             613      9        5.3      TABULAR    PSP1                      0
      0
;normal pool 617.7
PSP2             612      9        5.7      TABULAR    PSP2                      0
      0
;normal pool 617.6
SSP1             611      8        0        TABULAR    SSP1                      0
      0
;normal pool 617.4
SSP2             608.2    11.8     0        TABULAR    SSP2                      0
      0

[CONDUITS]
;;               Inlet            Outlet                      Manning    Inlet
Outlet     Init.      Max.
;;Name           Node             Node             Length     N          Offset
Offset     Flow       Flow
;;-------------- ---------------- ---------------- ---------- ---------- ----------
---------- ---------- ----------
P1               dummy2           VP#6             44         0.01       611.68
611.68     0          0
P10              J202             MH#3             120        0.01       611.93
611.81     0          0
P11              MH#3             MH#4             578        0.01       611.81
611.23     0          0
P12              MH#4             VP#12            360        0.01       611.23
610.85     0          0
P13              J301             VP#12            120        0.01       611.18
610.85     0          0
P14              VP#12            SSP1             460        0.01       610.85
610.27     0          0
P18              VP#5             J200             88         0.02       616.68
616.18     0          0
P2               VP#6             dummy3           32         0.01       611.68
611.68     0          0
P23              SSP2             VP#3             48         0.01       612.18
611.93     0          0
P25              VP#3             reuse            32         0.01       611.93
611.68     0          0
P26              dummy2           VP#4             48         0.01       612.18
611.93     0          0
P27              VP#4             dummy3           32         0.01       611.93
611.68     0          0
P3               SSP2             VP#7             44         0.01       611.68
611.68     0          0
P4               VP#7             reuse2           32         0.01       611.68
611.68     0          0
P5               BSP              VP#5             82         0.02       616.85
616.68     0          0
P6               dummy            MH#1             374        0.01       616.68
```

```
615.92     0          0
P7                 MH#1               MH#2               178        0.01       615.92
615.56     0          0
P8                 MH#2               MH#2A              254        0.01       615.56
615.04     0          0
P9                 MH#2A              J300               214        0.01       615.04
614.6      0          0
PSP1_surface1      J200               J201               162        0.08       616
615        0          0
PSP1_surface2      J201               J202               368        0.08       615
613.2      0          0
PSP1_surface3      J203               J202               130        0.08       614
613.2      0          0
PSP2_surface1      J300               J301               460        0.08       615
608.7      0          0
PSP2_surface2      J302               J301               170        0.08       609
608.7      0          0

[XSECTIONS]
;;Link            Shape        Geom1            Geom2      Geom3      Geom4
Barrels
;;--------------- ------------ ---------------- ---------- ---------- ----------
----------
P1                 CIRCULAR     2.5              0          0          0          1

P10                CIRCULAR     3                0          0          0          1

P11                CIRCULAR     3                0          0          0          1

P12                CIRCULAR     3                0          0          0          1

P13                CIRCULAR     2.5              0          0          0          1

P14                CIRCULAR     3                0          0          0          1

P18                CIRCULAR     2                0          0          0          1

P2                 CIRCULAR     2.5              0          0          0          1

P23                CIRCULAR     2                0          0          0          1

P25                CIRCULAR     2                0          0          0          1

P26                CIRCULAR     2                0          0          0          1

P27                CIRCULAR     2                0          0          0          1

P3                 CIRCULAR     2.5              0          0          0          1

P4                 CIRCULAR     2.5              0          0          0          1

P5                 CIRCULAR     2                0          0          0          1

P6                 CIRCULAR     2                0          0          0          1

P7                 CIRCULAR     2                0          0          0          1

P8                 CIRCULAR     2                0          0          0          1

P9                 CIRCULAR     2                0          0          0          1

PSP1_surface1      IRREGULAR    PSP1             0          0          0          1
```

```
PSP1_surface2    IRREGULAR    PSP1              0          0          0          1

PSP1_surface3    IRREGULAR    PSP1              0          0          0          1

PSP2_surface1    IRREGULAR    PSP2              0          0          0          1

PSP2_surface2    IRREGULAR    PSP2              0          0          0          1


[TRANSECTS]

NC 0.08     0.08     0.08
X1 PSP1             5        12       332      0.0       0.0       0.0       0.0
0.0
GR 5        0        1        12       0        172      1        332      5
344

NC 0.08     0.08     0.08
X1 PSP2             5        27       367      0.0       0.0       0.0       0.0
0.0
GR 10       0        1        27       0        197      1        367      10
394

[LOSSES]
;;Link           Inlet      Outlet     Average    Flap Gate  SeepageRate
;;-------------- ---------- ---------- ---------- ---------- ----------
P10              0.9        0.4        0          NO         0
P11              0.4        0.2        0          NO         0
P12              0.2        0.4        0          NO         0
P13              0          0.4        0          NO         0
P14              0.2        1          0          NO         0
P18              0.4        1          0          NO         0
P5               0.9        0.4        0          NO         0
P9               0          1          0          NO         0

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
;invert = 618 (NAVD88)
BSP              Storage    0          9171
BSP                         1          59847
BSP                         2          100759

;invert = 608.2 (NAVD88)
Forebay          Storage    0          6294
Forebay                     1          7145
Forebay                     2          8026
Forebay                     3          8936
Forebay                     4          9874
Forebay                     5          10840
Forebay                     6          11834
Forebay                     7          12857
Forebay                     8          13910
Forebay                     9          14992
Forebay                     10         16105
Forebay                     11         17250
Forebay                     12         18424

;invert = 613 (NAVD88)
PSP1             Storage    0          8114
PSP1                        1          65002
PSP1                        2          133865
PSP1                        3          199240
```

```
PSP1                        4           219862
PSP1                        5           225760
PSP1                        6           231713
PSP1                        7           237723
PSP1                        8           243788
PSP1                        9           249909

;invert = 612 (NAVD88)
PSP2              Storage   0           5256
PSP2                        1           42684
PSP2                        2           125334
PSP2                        3           197332
PSP2                        4           234235
PSP2                        5           240241
PSP2                        6           246304
PSP2                        7           252424
PSP2                        8           258601
PSP2                        9           266015

;invert = 611 (NAVD88)
SSP1              Storage   0           5641
SSP1                        1           54223
SSP1                        2           73421
SSP1                        3           76673
SSP1                        4           79983
SSP1                        5           83351
SSP1                        6           86776
SSP1                        7           90259
SSP1                        8           93799

;invert = 608.2 (NAVD88)
SSP2              Storage   0           0
SSP2                        1           123735
SSP2                        9.8         161833
SSP2                        10.8        168972
SSP2                        11.8        174616

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
;SCS_Type_II_5.21in design storm, total rainfall = 5.21 in, rain interval = 6
minutes, rain units = in.
SCS_Type_II_5.21in            0:00       0.00526
SCS_Type_II_5.21in            0:06       0.01052
SCS_Type_II_5.21in            0:12       0.01589
SCS_Type_II_5.21in            0:18       0.02126
SCS_Type_II_5.21in            0:24       0.02673
SCS_Type_II_5.21in            0:30       0.0322
SCS_Type_II_5.21in            0:36       0.03777
SCS_Type_II_5.21in            0:42       0.04335
SCS_Type_II_5.21in            0:48       0.04903
SCS_Type_II_5.21in            0:54       0.0547
SCS_Type_II_5.21in            1:00       0.06049
SCS_Type_II_5.21in            1:06       0.06627
SCS_Type_II_5.21in            1:12       0.07216
SCS_Type_II_5.21in            1:18       0.07805
SCS_Type_II_5.21in            1:24       0.08404
SCS_Type_II_5.21in            1:30       0.09003
SCS_Type_II_5.21in            1:36       0.09612
SCS_Type_II_5.21in            1:42       0.10222
SCS_Type_II_5.21in            1:48       0.10842
SCS_Type_II_5.21in            1:54       0.11462
SCS_Type_II_5.21in            2:00       0.12092
```

| | | |
|---|---|---|
| SCS_Type_II_5.21in | 2:06 | 0.12723 |
| SCS_Type_II_5.21in | 2:12 | 0.13364 |
| SCS_Type_II_5.21in | 2:18 | 0.14004 |
| SCS_Type_II_5.21in | 2:24 | 0.14656 |
| SCS_Type_II_5.21in | 2:30 | 0.15307 |
| SCS_Type_II_5.21in | 2:36 | 0.15969 |
| SCS_Type_II_5.21in | 2:42 | 0.1663 |
| SCS_Type_II_5.21in | 2:48 | 0.17302 |
| SCS_Type_II_5.21in | 2:54 | 0.17974 |
| SCS_Type_II_5.21in | 3:00 | 0.18657 |
| SCS_Type_II_5.21in | 3:06 | 0.1934 |
| SCS_Type_II_5.21in | 3:12 | 0.20032 |
| SCS_Type_II_5.21in | 3:18 | 0.20725 |
| SCS_Type_II_5.21in | 3:24 | 0.21429 |
| SCS_Type_II_5.21in | 3:30 | 0.22132 |
| SCS_Type_II_5.21in | 3:36 | 0.22846 |
| SCS_Type_II_5.21in | 3:42 | 0.2356 |
| SCS_Type_II_5.21in | 3:48 | 0.24284 |
| SCS_Type_II_5.21in | 3:54 | 0.25008 |
| SCS_Type_II_5.21in | 4:00 | 0.25743 |
| SCS_Type_II_5.21in | 4:06 | 0.26488 |
| SCS_Type_II_5.21in | 4:12 | 0.27243 |
| SCS_Type_II_5.21in | 4:18 | 0.28009 |
| SCS_Type_II_5.21in | 4:24 | 0.28785 |
| SCS_Type_II_5.21in | 4:30 | 0.29572 |
| SCS_Type_II_5.21in | 4:36 | 0.30369 |
| SCS_Type_II_5.21in | 4:42 | 0.31177 |
| SCS_Type_II_5.21in | 4:48 | 0.31995 |
| SCS_Type_II_5.21in | 4:54 | 0.32823 |
| SCS_Type_II_5.21in | 5:00 | 0.33662 |
| SCS_Type_II_5.21in | 5:06 | 0.34511 |
| SCS_Type_II_5.21in | 5:12 | 0.35371 |
| SCS_Type_II_5.21in | 5:18 | 0.36241 |
| SCS_Type_II_5.21in | 5:24 | 0.37121 |
| SCS_Type_II_5.21in | 5:30 | 0.38012 |
| SCS_Type_II_5.21in | 5:36 | 0.38913 |
| SCS_Type_II_5.21in | 5:42 | 0.39825 |
| SCS_Type_II_5.21in | 5:48 | 0.40747 |
| SCS_Type_II_5.21in | 5:54 | 0.4168 |
| SCS_Type_II_5.21in | 6:00 | 0.42623 |
| SCS_Type_II_5.21in | 6:06 | 0.43576 |
| SCS_Type_II_5.21in | 6:12 | 0.4454 |
| SCS_Type_II_5.21in | 6:18 | 0.45515 |
| SCS_Type_II_5.21in | 6:24 | 0.46499 |
| SCS_Type_II_5.21in | 6:30 | 0.47494 |
| SCS_Type_II_5.21in | 6:36 | 0.485 |
| SCS_Type_II_5.21in | 6:42 | 0.49516 |
| SCS_Type_II_5.21in | 6:48 | 0.50542 |
| SCS_Type_II_5.21in | 6:54 | 0.51579 |
| SCS_Type_II_5.21in | 7:00 | 0.52626 |
| SCS_Type_II_5.21in | 7:06 | 0.53684 |
| SCS_Type_II_5.21in | 7:12 | 0.54752 |
| SCS_Type_II_5.21in | 7:18 | 0.5583 |
| SCS_Type_II_5.21in | 7:24 | 0.56919 |
| SCS_Type_II_5.21in | 7:30 | 0.58019 |
| SCS_Type_II_5.21in | 7:36 | 0.59128 |
| SCS_Type_II_5.21in | 7:42 | 0.60248 |
| SCS_Type_II_5.21in | 7:48 | 0.61379 |
| SCS_Type_II_5.21in | 7:54 | 0.6252 |
| SCS_Type_II_5.21in | 8:00 | 0.63692 |
| SCS_Type_II_5.21in | 8:06 | 0.64917 |
| SCS_Type_II_5.21in | 8:12 | 0.66193 |
| SCS_Type_II_5.21in | 8:18 | 0.67522 |

| | | |
|---|---|---|
| SCS_Type_II_5.21in | 8:24 | 0.68902 |
| SCS_Type_II_5.21in | 8:30 | 0.70335 |
| SCS_Type_II_5.21in | 8:36 | 0.7182 |
| SCS_Type_II_5.21in | 8:42 | 0.73357 |
| SCS_Type_II_5.21in | 8:48 | 0.74946 |
| SCS_Type_II_5.21in | 8:54 | 0.76587 |
| SCS_Type_II_5.21in | 9:00 | 0.78254 |
| SCS_Type_II_5.21in | 9:06 | 0.79921 |
| SCS_Type_II_5.21in | 9:12 | 0.81589 |
| SCS_Type_II_5.21in | 9:18 | 0.83256 |
| SCS_Type_II_5.21in | 9:24 | 0.84923 |
| SCS_Type_II_5.21in | 9:30 | 0.86632 |
| SCS_Type_II_5.21in | 9:36 | 0.88424 |
| SCS_Type_II_5.21in | 9:42 | 0.903 |
| SCS_Type_II_5.21in | 9:48 | 0.92259 |
| SCS_Type_II_5.21in | 9:54 | 0.94301 |
| SCS_Type_II_5.21in | 10:00 | 0.96448 |
| SCS_Type_II_5.21in | 10:06 | 0.98719 |
| SCS_Type_II_5.21in | 10:12 | 1.01116 |
| SCS_Type_II_5.21in | 10:18 | 1.03637 |
| SCS_Type_II_5.21in | 10:24 | 1.06284 |
| SCS_Type_II_5.21in | 10:30 | 1.09097 |
| SCS_Type_II_5.21in | 10:36 | 1.12119 |
| SCS_Type_II_5.21in | 10:42 | 1.15349 |
| SCS_Type_II_5.21in | 10:48 | 1.18788 |
| SCS_Type_II_5.21in | 10:54 | 1.22435 |
| SCS_Type_II_5.21in | 11:00 | 1.26436 |
| SCS_Type_II_5.21in | 11:06 | 1.30938 |
| SCS_Type_II_5.21in | 11:12 | 1.35939 |
| SCS_Type_II_5.21in | 11:18 | 1.41441 |
| SCS_Type_II_5.21in | 11:24 | 1.47443 |
| SCS_Type_II_5.21in | 11:30 | 1.59864 |
| SCS_Type_II_5.21in | 11:36 | 1.84622 |
| SCS_Type_II_5.21in | 11:42 | 2.24442 |
| SCS_Type_II_5.21in | 11:48 | 2.95855 |
| SCS_Type_II_5.21in | 11:54 | 3.45423 |
| SCS_Type_II_5.21in | 12:00 | 3.55301 |
| SCS_Type_II_5.21in | 12:06 | 3.63991 |
| SCS_Type_II_5.21in | 12:12 | 3.71494 |
| SCS_Type_II_5.21in | 12:18 | 3.77808 |
| SCS_Type_II_5.21in | 12:24 | 3.82935 |
| SCS_Type_II_5.21in | 12:30 | 3.87332 |
| SCS_Type_II_5.21in | 12:36 | 3.91459 |
| SCS_Type_II_5.21in | 12:42 | 3.95314 |
| SCS_Type_II_5.21in | 12:48 | 3.98898 |
| SCS_Type_II_5.21in | 12:54 | 4.02212 |
| SCS_Type_II_5.21in | 13:00 | 4.05317 |
| SCS_Type_II_5.21in | 13:06 | 4.08276 |
| SCS_Type_II_5.21in | 13:12 | 4.1109 |
| SCS_Type_II_5.21in | 13:18 | 4.13757 |
| SCS_Type_II_5.21in | 13:24 | 4.16279 |
| SCS_Type_II_5.21in | 13:30 | 4.18676 |
| SCS_Type_II_5.21in | 13:36 | 4.20968 |
| SCS_Type_II_5.21in | 13:42 | 4.23156 |
| SCS_Type_II_5.21in | 13:48 | 4.2524 |
| SCS_Type_II_5.21in | 13:54 | 4.2722 |
| SCS_Type_II_5.21in | 14:00 | 4.29132 |
| SCS_Type_II_5.21in | 14:06 | 4.31002 |
| SCS_Type_II_5.21in | 14:12 | 4.32842 |
| SCS_Type_II_5.21in | 14:18 | 4.34639 |
| SCS_Type_II_5.21in | 14:24 | 4.36405 |
| SCS_Type_II_5.21in | 14:30 | 4.3813 |
| SCS_Type_II_5.21in | 14:36 | 4.39823 |

| | | |
|---|---|---|
| SCS_Type_II_5.21in | 14:42 | 4.41475 |
| SCS_Type_II_5.21in | 14:48 | 4.43095 |
| SCS_Type_II_5.21in | 14:54 | 4.44674 |
| SCS_Type_II_5.21in | 15:00 | 4.46221 |
| SCS_Type_II_5.21in | 15:06 | 4.47727 |
| SCS_Type_II_5.21in | 15:12 | 4.49201 |
| SCS_Type_II_5.21in | 15:18 | 4.50634 |
| SCS_Type_II_5.21in | 15:24 | 4.52035 |
| SCS_Type_II_5.21in | 15:30 | 4.53395 |
| SCS_Type_II_5.21in | 15:36 | 4.54724 |
| SCS_Type_II_5.21in | 15:42 | 4.5601 |
| SCS_Type_II_5.21in | 15:48 | 4.57266 |
| SCS_Type_II_5.21in | 15:54 | 4.5848 |
| SCS_Type_II_5.21in | 16:00 | 4.59673 |
| SCS_Type_II_5.21in | 16:06 | 4.60851 |
| SCS_Type_II_5.21in | 16:12 | 4.62018 |
| SCS_Type_II_5.21in | 16:18 | 4.63169 |
| SCS_Type_II_5.21in | 16:24 | 4.6431 |
| SCS_Type_II_5.21in | 16:30 | 4.65435 |
| SCS_Type_II_5.21in | 16:36 | 4.6655 |
| SCS_Type_II_5.21in | 16:42 | 4.6765 |
| SCS_Type_II_5.21in | 16:48 | 4.68738 |
| SCS_Type_II_5.21in | 16:54 | 4.69812 |
| SCS_Type_II_5.21in | 17:00 | 4.70875 |
| SCS_Type_II_5.21in | 17:06 | 4.71922 |
| SCS_Type_II_5.21in | 17:12 | 4.72959 |
| SCS_Type_II_5.21in | 17:18 | 4.7398 |
| SCS_Type_II_5.21in | 17:24 | 4.7499 |
| SCS_Type_II_5.21in | 17:30 | 4.75986 |
| SCS_Type_II_5.21in | 17:36 | 4.7697 |
| SCS_Type_II_5.21in | 17:42 | 4.77939 |
| SCS_Type_II_5.21in | 17:48 | 4.78898 |
| SCS_Type_II_5.21in | 17:54 | 4.79841 |
| SCS_Type_II_5.21in | 18:00 | 4.80774 |
| SCS_Type_II_5.21in | 18:06 | 4.81691 |
| SCS_Type_II_5.21in | 18:12 | 4.82597 |
| SCS_Type_II_5.21in | 18:18 | 4.83488 |
| SCS_Type_II_5.21in | 18:24 | 4.84368 |
| SCS_Type_II_5.21in | 18:30 | 4.85233 |
| SCS_Type_II_5.21in | 18:36 | 4.86088 |
| SCS_Type_II_5.21in | 18:42 | 4.86927 |
| SCS_Type_II_5.21in | 18:48 | 4.87755 |
| SCS_Type_II_5.21in | 18:54 | 4.88568 |
| SCS_Type_II_5.21in | 19:00 | 4.8937 |
| SCS_Type_II_5.21in | 19:06 | 4.90157 |
| SCS_Type_II_5.21in | 19:12 | 4.90933 |
| SCS_Type_II_5.21in | 19:18 | 4.91694 |
| SCS_Type_II_5.21in | 19:24 | 4.92444 |
| SCS_Type_II_5.21in | 19:30 | 4.93179 |
| SCS_Type_II_5.21in | 19:36 | 4.93903 |
| SCS_Type_II_5.21in | 19:42 | 4.94611 |
| SCS_Type_II_5.21in | 19:48 | 4.95309 |
| SCS_Type_II_5.21in | 19:54 | 4.95992 |
| SCS_Type_II_5.21in | 20:00 | 4.96669 |
| SCS_Type_II_5.21in | 20:06 | 4.97341 |
| SCS_Type_II_5.21in | 20:12 | 4.98013 |
| SCS_Type_II_5.21in | 20:18 | 4.9868 |
| SCS_Type_II_5.21in | 20:24 | 4.99347 |
| SCS_Type_II_5.21in | 20:30 | 5.00009 |
| SCS_Type_II_5.21in | 20:36 | 5.00671 |
| SCS_Type_II_5.21in | 20:42 | 5.01327 |
| SCS_Type_II_5.21in | 20:48 | 5.01983 |
| SCS_Type_II_5.21in | 20:54 | 5.02635 |

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SCS_Type_II_5.21in            21:00      5.03286
SCS_Type_II_5.21in            21:06      5.03932
SCS_Type_II_5.21in            21:12      5.04578
SCS_Type_II_5.21in            21:18      5.05219
SCS_Type_II_5.21in            21:24      5.0586
SCS_Type_II_5.21in            21:30      5.06495
SCS_Type_II_5.21in            21:36      5.07131
SCS_Type_II_5.21in            21:42      5.07761
SCS_Type_II_5.21in            21:48      5.08392
SCS_Type_II_5.21in            21:54      5.09017
SCS_Type_II_5.21in            22:00      5.09642
SCS_Type_II_5.21in            22:06      5.10262
SCS_Type_II_5.21in            22:12      5.10882
SCS_Type_II_5.21in            22:18      5.11497
SCS_Type_II_5.21in            22:24      5.12112
SCS_Type_II_5.21in            22:30      5.12721
SCS_Type_II_5.21in            22:36      5.13331
SCS_Type_II_5.21in            22:42      5.13935
SCS_Type_II_5.21in            22:48      5.1454
SCS_Type_II_5.21in            22:54      5.15139
SCS_Type_II_5.21in            23:00      5.15738
SCS_Type_II_5.21in            23:06      5.16332
SCS_Type_II_5.21in            23:12      5.16926
SCS_Type_II_5.21in            23:18      5.17515
SCS_Type_II_5.21in            23:24      5.18103
SCS_Type_II_5.21in            23:30      5.18687
SCS_Type_II_5.21in            23:36      5.1927
SCS_Type_II_5.21in            23:42      5.19849
SCS_Type_II_5.21in            23:48      5.20427
SCS_Type_II_5.21in            23:54      5.21

[REPORT]
INPUT      YES
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS       2942018.55761919 2325176.8296714  2945323.9939577  2325816.81299819
UNITS            Feet

[COORDINATES]
;;Node           X-Coord          Y-Coord
;;-------------- ---------------- ----------------
dummy            2942639.945      2325323.804
dummy2           2944951.087      2325455.405
dummy3           2944962.926      2325587.513
J200             2942676.037      2325522.157
J201             2942830.996      2325521.992
J202             2943197.51       2325521.512
J203             2943333.6        2325526.026
J300             2943572.581      2325506.374
J301             2944036.253      2325505.08
J302             2944202.412      2325506.137
MH#1             2942950.126      2325233.575
MH#2             2943129.986      2325230.995
MH#2A            2943381.54       2325232.147
MH#3             2943399.172      2325291.033
MH#4             2943933.723      2325290.827
VP#12            2944302.25       2325293.198
```

| | | |
|---|---|---|
| VP#3 | 2944940.273 | 2325630.628 |
| VP#4 | 2945032.241 | 2325526.747 |
| VP#5 | 2942595.496 | 2325376.573 |
| VP#6 | 2945024.222 | 2325526.75 |
| VP#7 | 2944939.848 | 2325620.958 |
| reuse | 2945002.321 | 2325705.768 |
| reuse2 | 2945009.785 | 2325705.025 |
| BSP | 2942373.5 | 2325489.371 |
| Forebay | 2945019.069 | 2325621.601 |
| PSP1 | 2943002.108 | 2325658.917 |
| PSP2 | 2943870.472 | 2325660.891 |
| SSP1 | 2944938.613 | 2325387.823 |
| SSP2 | 2944542.324 | 2325509.413 |

[VERTICES]

| ;;Link | X-Coord | Y-Coord |
|---|---|---|
| P1 | 2945026.38 | 2325481.045 |
| P10 | 2943332.801 | 2325383.074 |
| P13 | 2944202.807 | 2325361.318 |
| P14 | 2944760.778 | 2325295.661 |
| P18 | 2942672.946 | 2325424.744 |
| P2 | 2945023.904 | 2325558.425 |
| P23 | 2944892.62 | 2325632.049 |
| P25 | 2944970.351 | 2325632.653 |
| P26 | 2945033.405 | 2325478.698 |
| P27 | 2945031.764 | 2325557.948 |
| P3 | 2944894.599 | 2325620.22 |
| P4 | 2944971.4 | 2325621.171 |
| P5 | 2942518.14 | 2325407.054 |
| P9 | 2943575.047 | 2325333.551 |

[POLYGONS]

| ;;Subcatchment | X-Coord | Y-Coord |
|---|---|---|
| BSP_runoff | 2942645.983 | 2325764.632 |
| BSP_runoff | 2942610.566 | 2325727.826 |
| BSP_runoff | 2942607.789 | 2325593.798 |
| BSP_runoff | 2942607.789 | 2325444.493 |
| BSP_runoff | 2942640.427 | 2325349.354 |
| BSP_runoff | 2942555.351 | 2325328.18 |
| BSP_runoff | 2942476.792 | 2325329.048 |
| BSP_runoff | 2942419.935 | 2325341.635 |
| BSP_runoff | 2942245.021 | 2325465.767 |
| BSP_runoff | 2942200.317 | 2325523.493 |
| BSP_runoff | 2942255.872 | 2325595.541 |
| BSP_runoff | 2942250.228 | 2325607.341 |
| BSP_runoff | 2942189.812 | 2325655.778 |
| BSP_runoff | 2942168.805 | 2325738.244 |
| BSP_runoff | 2942248.666 | 2325783.817 |
| BSP_runoff | 2942336.773 | 2325766.89 |
| BSP_runoff | 2942381.044 | 2325765.153 |
| BSP_runoff | 2942481.739 | 2325787.723 |
| BSP_runoff | 2942555.958 | 2325769.928 |
| BSP_runoff | 2942645.983 | 2325764.632 |
| Forebay_runoff | 2944938.157 | 2325768.246 |
| Forebay_runoff | 2945126.525 | 2325771.198 |
| Forebay_runoff | 2945138.677 | 2325694.809 |
| Forebay_runoff | 2945136.247 | 2325534.045 |
| Forebay_runoff | 2944944.233 | 2325535.607 |
| Forebay_runoff | 2944938.719 | 2325746.724 |
| Forebay_runoff | 2944938.157 | 2325768.246 |
| PSP1_runoff | 2943448.414 | 2325278.889 |

```
PSP1_runoff      2943344.681      2325269.775
PSP1_runoff      2943185.653      2325295.296
PSP1_runoff      2942979.143      2325314.805
PSP1_runoff      2942728.622      2325315.847
PSP1_runoff      2942640.427      2325349.354
PSP1_runoff      2942607.789      2325444.493
PSP1_runoff      2942607.789      2325593.798
PSP1_runoff      2942610.566      2325727.826
PSP1_runoff      2942645.983      2325764.632
PSP1_runoff      2942814.039      2325767.409
PSP1_runoff      2943117.467      2325768.408
PSP1_runoff      2943271.547      2325769.493
PSP1_runoff      2943442.988      2325768.408
PSP1_runoff      2943444.073      2325684.857
PSP1_runoff      2943449.499      2325527.522
PSP1_runoff      2943448.414      2325278.889
PSP2_runoff      2943448.414      2325278.889
PSP2_runoff      2943449.499      2325527.522
PSP2_runoff      2943444.073      2325684.857
PSP2_runoff      2943442.988      2325768.408
PSP2_runoff      2943659.591      2325767.981
PSP2_runoff      2943862.716      2325768.502
PSP2_runoff      2944073.654      2325767.981
PSP2_runoff      2944310.633      2325769.543
PSP2_runoff      2944314.279      2325694.543
PSP2_runoff      2944311.675      2325546.106
PSP2_runoff      2944285.112      2325354.439
PSP2_runoff      2944284.07       2325257.043
PSP2_runoff      2944281.907      2325206.961
PSP2_runoff      2943993.452      2325207.656
PSP2_runoff      2943825.049      2325205.92
PSP2_runoff      2943552.479      2325205.92
PSP2_runoff      2943448.414      2325278.889
SSP1_runoff      2944711.073      2325209.566
SSP1_runoff      2944716.585      2325505.876
SSP1_runoff      2944742.627      2325534.088
SSP1_runoff      2944944.233      2325535.607
SSP1_runoff      2945136.247      2325534.045
SSP1_runoff      2945141.802      2325412.517
SSP1_runoff      2945173.052      2325277.1
SSP1_runoff      2945173.747      2325208.35
SSP1_runoff      2944711.073      2325209.566
SSP2_runoff      2944284.07       2325257.043
SSP2_runoff      2944285.112      2325354.439
SSP2_runoff      2944311.675      2325546.106
SSP2_runoff      2944314.279      2325694.543
SSP2_runoff      2944310.633      2325769.543
SSP2_runoff      2944644.754      2325769.982
SSP2_runoff      2944938.157      2325768.246
SSP2_runoff      2944938.719      2325746.724
SSP2_runoff      2944944.233      2325535.607
SSP2_runoff      2944742.627      2325534.088
SSP2_runoff      2944716.585      2325505.876
SSP2_runoff      2944711.073      2325209.566
SSP2_runoff      2944281.907      2325206.961
SSP2_runoff      2944284.07       2325257.043

[SYMBOLS]
;;Gage           X-Coord          Y-Coord
;;-------------- ---------------- ----------------
```

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
---

WARNING 04: minimum elevation drop used for Conduit P1
WARNING 03: negative offset ignored for Link P10
WARNING 03: negative offset ignored for Link P13
WARNING 03: negative offset ignored for Link P14
WARNING 04: minimum elevation drop used for Conduit P2
WARNING 04: minimum elevation drop used for Conduit P3
WARNING 04: minimum elevation drop used for Conduit P4
WARNING 03: negative offset ignored for Link P5
WARNING 03: negative offset ignored for Link P6
WARNING 03: negative offset ignored for Link P7
WARNING 03: negative offset ignored for Link PSP2_surface1
WARNING 03: negative offset ignored for Link PSP2_surface2
WARNING 03: negative offset ignored for Link PSP2_surface2
WARNING 02: maximum depth increased for Node J200
WARNING 02: maximum depth increased for Node J300
WARNING 02: maximum depth increased for Node J301
WARNING 02: maximum depth increased for Node J302

**********
Element Count
**********
Number of rain gages ..... 1
Number of subcatchments ... 6
Number of nodes ..... 29
Number of links ..... 24
Number of pollutants ..... 0
Number of land uses ..... 0

**********
Raingage Summary
**********

| Name | Data Source | Data Type | Recording Interval |
|---|---|---|---|
| 25-yr | SCS_Type_II_5.21in | CUMULATIVE | 6 min. |

**********
Subcatchment Summary
**********

| Name | Area | Width | %Imperv | %Slope | Rain Gage | Outlet |
|---|---|---|---|---|---|---|
| BSP_runoff | 3.70 | 1343.10 | 0.00 | 0.5000 | 25-yr | BSP |
| Forebay_runoff | 1.05 | 213.73 | 0.00 | 0.5000 | 25-yr | Forebay |
| PSP1_runoff | 8.87 | 2492.76 | 0.00 | 0.5000 | 25-yr | J200 |
| PSP2_runoff | 10.91 | 3066.06 | 0.00 | 0.5000 | 25-yr | J300 |
| SSP1_runoff | 3.28 | 1190.64 | 0.00 | 0.5000 | 25-yr | SSP1 |
| SSP2_runoff | 6.56 | 534.12 | 0.00 | 0.5000 | 25-yr | SSP2 |

**********
Node Summary
**********

| Name | Type | Invert Elev. | Max. Depth | Ponded Area | External Inflow |
|---|---|---|---|---|---|
| dummy | JUNCTION | 616.68 | 5.00 | 0.0 | |
| dummy2 | JUNCTION | 0.00 | 614.18 | 0.0 | |
| dummy3 | JUNCTION | 0.00 | 614.18 | 0.0 | |
| J200 | JUNCTION | 616.00 | 5.00 | 0.0 | |
| J201 | JUNCTION | 615.00 | 5.00 | 0.0 | |
| J202 | JUNCTION | 613.20 | 6.80 | 0.0 | |
| J203 | JUNCTION | 614.00 | 6.00 | 0.0 | |
| J300 | JUNCTION | 614.60 | 10.40 | 0.0 | |
| J301 | JUNCTION | 612.70 | 10.00 | 0.0 | |
| J302 | JUNCTION | 613.00 | 10.00 | 0.0 | |
| MH#1 | JUNCTION | 616.18 | 4.50 | 0.0 | |
| MH#2 | JUNCTION | 615.18 | 5.50 | 0.0 | |
| MH#2A | JUNCTION | 614.18 | 6.50 | 0.0 | |
| MH#3 | JUNCTION | 611.51 | 9.17 | 0.0 | |
| MH#4 | JUNCTION | 611.18 | 9.50 | 0.0 | |
| VP#12 | JUNCTION | 610.85 | 10.83 | 0.0 | |
| VP#3 | JUNCTION | 611.93 | 9.75 | 0.0 | |
| VP#4 | JUNCTION | 611.93 | 9.75 | 0.0 | |
| VP#5 | JUNCTION | 616.68 | 5.00 | 0.0 | |
| VP#6 | JUNCTION | 611.68 | 10.00 | 0.0 | |
| VP#7 | JUNCTION | 611.68 | 10.00 | 0.0 | |
| reuse | OUTFALL | 608.20 | 5.48 | 0.0 | |
| reuse2 | OUTFALL | 608.20 | 5.98 | 0.0 | |
| BSP | STORAGE | 618.00 | 2.00 | 0.0 | |
| Forebay | STORAGE | 608.20 | 12.00 | 0.0 | |
| PSP1 | STORAGE | 613.00 | 9.00 | 0.0 | |
| PSP2 | STORAGE | 612.00 | 9.00 | 0.0 | |
| SSP1 | STORAGE | 611.00 | 8.00 | 0.0 | |
| SSP2 | STORAGE | 608.20 | 11.80 | 0.0 | |

**********
Link Summary
**********

| Name | From Node | To Node | Type | Length | %Slope | Roughness |
|---|---|---|---|---|---|---|
| P1 | dummy2 | VP#6 | CONDUIT | 44.0 | 0.0023 | 0.0100 |
| P10 | J202 | MH#3 | CONDUIT | 120.0 | 1.1584 | 0.0100 |
| P11 | MH#3 | MH#4 | CONDUIT | 578.0 | 0.1003 | 0.0100 |
| P12 | MH#4 | VP#12 | CONDUIT | 360.0 | 0.1056 | 0.0100 |
| P13 | J301 | VP#12 | CONDUIT | 120.0 | 1.5418 | 0.0100 |
| P14 | VP#12 | SSP1 | CONDUIT | 460.0 | -0.0326 | 0.0100 |
| P18 | VP#5 | J200 | CONDUIT | 88.0 | 0.5682 | 0.0200 |
| P2 | VP#6 | dummy3 | CONDUIT | 32.0 | 0.0031 | 0.0100 |
| P23 | SSP2 | VP#3 | CONDUIT | 48.0 | | |

| | | | | | |
|---|---|---|---|---|---|
| 0.5208 | 0.0100 | | | | |
| P25 | | VP#3 | reuse | CONDUIT | 32.0 |
| 0.7813 | 0.0100 | | | | |
| P26 | | dummy2 | VP#4 | CONDUIT | 48.0 |
| 0.5208 | 0.0100 | | | | |
| P27 | | VP#4 | dummy3 | CONDUIT | 32.0 |
| 0.7813 | 0.0100 | | | | |
| P3 | | SSP2 | VP#7 | CONDUIT | 44.0 |
| 0.0023 | 0.0100 | | | | |
| P4 | | VP#7 | reuse2 | CONDUIT | 32.0 |
| 0.0031 | 0.0100 | | | | |
| P5 | | BSP | VP#5 | CONDUIT | 82.0 |
| 1.6100 | 0.0200 | | | | |
| P6 | | dummy | MH#1 | CONDUIT | 374.0 |
| 0.1337 | 0.0100 | | | | |
| P7 | | MH#1 | MH#2 | CONDUIT | 178.0 |
| 0.3483 | 0.0100 | | | | |
| P8 | | MH#2 | MH#2A | CONDUIT | 254.0 |
| 0.2047 | 0.0100 | | | | |
| P9 | | MH#2A | J300 | CONDUIT | 214.0 |
| 0.2056 | 0.0100 | | | | |
| PSP1_surface1 | | J200 | J201 | CONDUIT | 162.0 |
| 0.6173 | 0.0800 | | | | |
| PSP1_surface2 | | J201 | J202 | CONDUIT | 368.0 |
| 0.4891 | 0.0800 | | | | |
| PSP1_surface3 | | J203 | J202 | CONDUIT | 130.0 |
| 0.6154 | 0.0800 | | | | |
| PSP2_surface1 | | J300 | J301 | CONDUIT | 460.0 |
| 0.5000 | 0.0800 | | | | |
| PSP2_surface2 | | J302 | J301 | CONDUIT | 170.0 |
| 0.1765 | 0.0800 | | | | |

**********
Cross Section Summary
**********

| Conduit | Shape | Full Depth | Full Area | Hyd. Rad. | Max. Width | No. of Barrels | Full Flow |
|---|---|---|---|---|---|---|---|
| P1 | CIRCULAR | 2.50 | 4.91 | 0.63 | 2.50 | 1 | 2.54 |
| P10 | CIRCULAR | 3.00 | 7.07 | 0.75 | 3.00 | 1 | 93.32 |
| P11 | CIRCULAR | 3.00 | 7.07 | 0.75 | 3.00 | 1 | 27.47 |
| P12 | CIRCULAR | 3.00 | 7.07 | 0.75 | 3.00 | 1 | 28.17 |
| P13 | CIRCULAR | 2.50 | 4.91 | 0.63 | 2.50 | 1 | 66.21 |
| P14 | CIRCULAR | 3.00 | 7.07 | 0.75 | 3.00 | 1 | 15.66 |
| P18 | CIRCULAR | 2.00 | 3.14 | 0.50 | 2.00 | 1 | 11.08 |
| P2 | CIRCULAR | 2.50 | 4.91 | 0.63 | 2.50 | 1 | 2.98 |
| P23 | CIRCULAR | 2.00 | 3.14 | 0.50 | 2.00 | 1 | 21.22 |
| P25 | CIRCULAR | 2.00 | 3.14 | 0.50 | 2.00 | 1 | 25.99 |

| | | | | | | |
|---|---|---|---|---|---|---|
| P26 | CIRCULAR | 2.00 | 3.14 | 0.50 | 2.00 | 1 |
| 21.22 | | | | | | |
| P27 | CIRCULAR | 2.00 | 3.14 | 0.50 | 2.00 | 1 |
| 25.99 | | | | | | |
| P3 | CIRCULAR | 2.50 | 4.91 | 0.63 | 2.50 | 1 |
| 2.54 | | | | | | |
| P4 | CIRCULAR | 2.50 | 4.91 | 0.63 | 2.50 | 1 |
| 2.98 | | | | | | |
| P5 | CIRCULAR | 2.00 | 3.14 | 0.50 | 2.00 | 1 |
| 18.66 | | | | | | |
| P6 | CIRCULAR | 2.00 | 3.14 | 0.50 | 2.00 | 1 |
| 10.75 | | | | | | |
| P7 | CIRCULAR | 2.00 | 3.14 | 0.50 | 2.00 | 1 |
| 17.36 | | | | | | |
| P8 | CIRCULAR | 2.00 | 3.14 | 0.50 | 2.00 | 1 |
| 13.31 | | | | | | |
| P9 | CIRCULAR | 2.00 | 3.14 | 0.50 | 2.00 | 1 |
| 13.34 | | | | | | |
| PSP1_surface1 | PSP1 | 5.00 | 1488.00 | 4.29 | 344.00 | 1 |
| 5735.15 | | | | | | |
| PSP1_surface2 | PSP1 | 5.00 | 1488.00 | 4.29 | 344.00 | 1 |
| 5105.20 | | | | | | |
| PSP1_surface3 | PSP1 | 5.00 | 1488.00 | 4.29 | 344.00 | 1 |
| 5726.32 | | | | | | |
| PSP2_surface1 | PSP2 | 10.00 | 3473.00 | 8.71 | 394.00 | 1 |
| 19317.46 | | | | | | |
| PSP2_surface2 | PSP2 | 10.00 | 3473.00 | 8.71 | 394.00 | 1 |
| 11476.22 | | | | | | |

**********
Transect Summary
**********

Transect PSP1
Area:

| | | | | |
|---|---|---|---|---|
| 0.0011 | 0.0043 | 0.0097 | 0.0172 | 0.0269 |
| 0.0387 | 0.0527 | 0.0688 | 0.0871 | 0.1075 |
| 0.1291 | 0.1506 | 0.1722 | 0.1939 | 0.2156 |
| 0.2373 | 0.2591 | 0.2809 | 0.3027 | 0.3246 |
| 0.3465 | 0.3685 | 0.3905 | 0.4126 | 0.4346 |
| 0.4568 | 0.4789 | 0.5012 | 0.5234 | 0.5457 |
| 0.5680 | 0.5904 | 0.6128 | 0.6353 | 0.6578 |
| 0.6803 | 0.7029 | 0.7255 | 0.7481 | 0.7708 |
| 0.7936 | 0.8163 | 0.8392 | 0.8620 | 0.8849 |
| 0.9078 | 0.9308 | 0.9538 | 0.9769 | 1.0000 |

Hrad:

| | | | | |
|---|---|---|---|---|
| 0.0116 | 0.0232 | 0.0348 | 0.0464 | 0.0580 |
| 0.0696 | 0.0812 | 0.0928 | 0.1044 | 0.1160 |
| 0.1390 | 0.1619 | 0.1847 | 0.2076 | 0.2303 |
| 0.2530 | 0.2757 | 0.2983 | 0.3209 | 0.3435 |
| 0.3660 | 0.3884 | 0.4108 | 0.4332 | 0.4555 |
| 0.4778 | 0.5000 | 0.5222 | 0.5443 | 0.5664 |
| 0.5885 | 0.6105 | 0.6325 | 0.6544 | 0.6763 |
| 0.6982 | 0.7200 | 0.7418 | 0.7635 | 0.7852 |
| 0.8069 | 0.8285 | 0.8501 | 0.8716 | 0.8931 |
| 0.9145 | 0.9360 | 0.9574 | 0.9787 | 1.0000 |

Width:

| | | | | |
|---|---|---|---|---|
| 0.0930 | 0.1860 | 0.2791 | 0.3721 | 0.4651 |
| 0.5581 | 0.6512 | 0.7442 | 0.8372 | 0.9302 |
| 0.9320 | 0.9337 | 0.9355 | 0.9372 | 0.9390 |
| 0.9407 | 0.9424 | 0.9442 | 0.9459 | 0.9477 |

| | | | | |
|---|---|---|---|---|
| 0.9494 | 0.9512 | 0.9529 | 0.9547 | 0.9564 |
| 0.9581 | 0.9599 | 0.9616 | 0.9634 | 0.9651 |
| 0.9669 | 0.9686 | 0.9703 | 0.9721 | 0.9738 |
| 0.9756 | 0.9773 | 0.9791 | 0.9808 | 0.9826 |
| 0.9843 | 0.9860 | 0.9878 | 0.9895 | 0.9913 |
| 0.9930 | 0.9948 | 0.9965 | 0.9983 | 1.0000 |

Transect PSP2
Area:

| | | | | |
|---|---|---|---|---|
| 0.0020 | 0.0078 | 0.0176 | 0.0313 | 0.0489 |
| 0.0686 | 0.0882 | 0.1080 | 0.1278 | 0.1477 |
| 0.1677 | 0.1877 | 0.2078 | 0.2280 | 0.2482 |
| 0.2685 | 0.2889 | 0.3093 | 0.3298 | 0.3504 |
| 0.3711 | 0.3918 | 0.4126 | 0.4334 | 0.4544 |
| 0.4754 | 0.4964 | 0.5176 | 0.5388 | 0.5600 |
| 0.5814 | 0.6028 | 0.6243 | 0.6458 | 0.6674 |
| 0.6891 | 0.7109 | 0.7327 | 0.7546 | 0.7766 |
| 0.7986 | 0.8207 | 0.8429 | 0.8651 | 0.8874 |
| 0.9098 | 0.9322 | 0.9548 | 0.9773 | 1.0000 |

Hrad:

| | | | | |
|---|---|---|---|---|
| 0.0114 | 0.0229 | 0.0343 | 0.0457 | 0.0571 |
| 0.0797 | 0.1023 | 0.1247 | 0.1470 | 0.1693 |
| 0.1915 | 0.2136 | 0.2356 | 0.2575 | 0.2794 |
| 0.3011 | 0.3228 | 0.3444 | 0.3660 | 0.3875 |
| 0.4089 | 0.4302 | 0.4514 | 0.4726 | 0.4937 |
| 0.5147 | 0.5357 | 0.5566 | 0.5774 | 0.5982 |
| 0.6188 | 0.6395 | 0.6600 | 0.6805 | 0.7009 |
| 0.7213 | 0.7416 | 0.7618 | 0.7820 | 0.8021 |
| 0.8222 | 0.8422 | 0.8621 | 0.8820 | 0.9018 |
| 0.9215 | 0.9412 | 0.9609 | 0.9805 | 1.0000 |

Width:

| | | | | |
|---|---|---|---|---|
| 0.1726 | 0.3452 | 0.5178 | 0.6904 | 0.8629 |
| 0.8660 | 0.8690 | 0.8721 | 0.8751 | 0.8782 |
| 0.8812 | 0.8843 | 0.8873 | 0.8904 | 0.8934 |
| 0.8964 | 0.8995 | 0.9025 | 0.9056 | 0.9086 |
| 0.9117 | 0.9147 | 0.9178 | 0.9208 | 0.9239 |
| 0.9269 | 0.9299 | 0.9330 | 0.9360 | 0.9391 |
| 0.9421 | 0.9452 | 0.9482 | 0.9513 | 0.9543 |
| 0.9574 | 0.9604 | 0.9635 | 0.9665 | 0.9695 |
| 0.9726 | 0.9756 | 0.9787 | 0.9817 | 0.9848 |
| 0.9878 | 0.9909 | 0.9939 | 0.9970 | 1.0000 |

**********
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
**********

**********
Analysis Options
**********
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... NO
  Water Quality ..... NO
Infiltration Method ..... CURVE_NUMBER
Flow Routing Method ..... DYNWAVE

Starting Date ..... 01/28/2020 00:00:00
Ending Date ..... 01/31/2020 00:00:00
Antecedent Dry Days ..... 0.0
Report Time Step ..... 00:01:00
Wet Time Step ..... 00:05:00
Dry Time Step ..... 00:05:00
Routing Time Step ..... 1.00 sec
Variable Time Step ..... YES
Maximum Trials ..... 8
Number of Threads ..... 4
Head Tolerance ..... 0.005000 ft

| Runoff Quantity Continuity | Volume acre-feet | Depth inches |
|---|---|---|
| Total Precipitation ..... | 14.922 | 5.210 |
| Evaporation Loss ..... | 0.000 | 0.000 |
| Infiltration Loss ..... | 5.931 | 2.071 |
| Surface Runoff ..... | 8.522 | 2.975 |
| Final Storage ..... | 0.474 | 0.166 |
| Continuity Error (%) ..... | -0.032 | |

| Flow Routing Continuity | Volume acre-feet | Volume 10^6 gal |
|---|---|---|
| Dry Weather Inflow ..... | 0.000 | 0.000 |
| Wet Weather Inflow ..... | 8.529 | 2.779 |
| Groundwater Inflow ..... | 0.000 | 0.000 |
| RDII Inflow ..... | 0.000 | 0.000 |
| External Inflow ..... | 0.000 | 0.000 |
| External Outflow ..... | 0.000 | 0.000 |
| Flooding Loss ..... | 0.000 | 0.000 |
| Evaporation Loss ..... | 0.000 | 0.000 |
| Exfiltration Loss ..... | 0.000 | 0.000 |
| Initial Stored Volume .... | 38.908 | 12.679 |
| Final Stored Volume ..... | 47.829 | 15.586 |
| Continuity Error (%) ..... | -0.827 | |

**Highest Continuity Errors**

Node J301 (56.64%)
Node MH#2 (-32.58%)
Node J202 (17.93%)
Node J300 (-6.89%)
Node MH#2A (6.55%)

**Time-Step Critical Elements**

None

**Highest Flow Instability Indexes**

All links are stable.

**********
Routing Time Step Summary
**********

| | | |
|---|---|---|
| Minimum Time Step | : | 0.50 sec |
| Average Time Step | : | 1.00 sec |
| Maximum Time Step | : | 1.00 sec |
| Percent in Steady State | : | 0.00 |
| Average Iterations per Step | : | 2.00 |
| Percent Not Converging | : | 0.00 |

**********
Subcatchment Runoff Summary
**********

| Subcatchment | Total Precip in | Total Runon in | Total Evap in | Total Infil in | Total Runoff in | Total Runoff 10^6 gal | Peak Runoff CFS | Runoff Coeff |
|---|---|---|---|---|---|---|---|---|
| BSP_runoff | 5.21 | 0.00 | 0.00 | 2.07 | 2.98 | 0.30 | 10.11 | 0.573 |
| Forebay_runoff | 5.21 | 0.00 | 0.00 | 1.96 | 3.20 | 0.09 | 2.25 | 0.614 |
| PSP1_runoff | 5.21 | 0.00 | 0.00 | 2.07 | 2.98 | 0.72 | 21.14 | 0.571 |
| PSP2_runoff | 5.21 | 0.00 | 0.00 | 2.07 | 2.98 | 0.88 | 26.00 | 0.571 |
| SSP1_runoff | 5.21 | 0.00 | 0.00 | 2.07 | 2.98 | 0.27 | 8.97 | 0.573 |
| SSP2_runoff | 5.21 | 0.00 | 0.00 | 2.07 | 2.92 | 0.52 | 6.36 | 0.561 |

**********
Node Depth Summary
**********

| Node | Type | Average Depth Feet | Maximum Depth Feet | Maximum HGL Feet | Time of Max Occurrence days hr:min | Reported Max Depth Feet |
|---|---|---|---|---|---|---|
| dummy | JUNCTION | 0.00 | 0.00 | 616.68 | 0 00:00 | 0.00 |
| dummy2 | JUNCTION | 0.00 | 0.00 | 0.00 | 0 00:00 | 0.00 |
| dummy3 | JUNCTION | 0.00 | 0.00 | 0.00 | 0 00:00 | 0.00 |
| J200 | JUNCTION | 0.05 | 0.53 | 616.53 | 0 11:57 | 0.53 |
| J201 | JUNCTION | 0.06 | 0.60 | 615.60 | 0 12:08 | 0.60 |
| J202 | JUNCTION | 0.64 | 0.81 | 614.01 | 2 23:29 | 0.81 |
| J203 | JUNCTION | 0.00 | 0.01 | 614.01 | 2 23:28 | 0.01 |
| J300 | JUNCTION | 0.39 | 1.07 | 615.67 | 0 12:05 | 1.07 |
| J301 | JUNCTION | 1.03 | 1.31 | 614.01 | 2 23:56 | 1.31 |
| J302 | JUNCTION | 0.78 | 1.01 | 614.01 | 2 23:56 | 1.01 |
| MH#1 | JUNCTION | 0.00 | 0.00 | 616.18 | 0 00:00 | 0.00 |
| MH#2 | JUNCTION | 0.32 | 0.52 | 615.70 | 0 12:05 | 0.52 |
| MH#2A | JUNCTION | 0.75 | 1.50 | 615.68 | 0 12:06 | 1.50 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| MH#3 | JUNCTION | 2.03 | 2.50 | 614.01 | 2 | 23:30 | 2.50 |
| MH#4 | JUNCTION | 2.30 | 2.83 | 614.01 | 2 | 23:57 | 2.83 |
| VP#12 | JUNCTION | 2.57 | 3.16 | 614.01 | 2 | 23:58 | 3.16 |
| VP#3 | JUNCTION | 0.00 | 0.00 | 611.93 | 0 | 00:00 | 0.00 |
| VP#4 | JUNCTION | 0.00 | 0.00 | 611.93 | 0 | 00:00 | 0.00 |
| VP#5 | JUNCTION | 0.10 | 0.81 | 617.49 | 0 | 12:36 | 0.81 |
| VP#6 | JUNCTION | 0.00 | 0.00 | 611.68 | 0 | 00:00 | 0.00 |
| VP#7 | JUNCTION | 0.00 | 0.00 | 611.68 | 0 | 00:00 | 0.00 |
| reuse | OUTFALL | 0.00 | 0.00 | 608.20 | 0 | 00:00 | 0.00 |
| reuse2 | OUTFALL | 0.00 | 0.00 | 608.20 | 0 | 00:00 | 0.00 |
| BSP | STORAGE | 0.06 | 0.54 | 618.54 | 0 | 12:36 | 0.54 |
| Forebay | STORAGE | 1.39 | 1.73 | 609.93 | 1 | 08:20 | 1.73 |
| PSP1 | STORAGE | 5.30 | 5.30 | 618.30 | 0 | 00:00 | 5.30 |
| PSP2 | STORAGE | 5.70 | 5.70 | 617.70 | 0 | 00:00 | 5.70 |
| SSP1 | STORAGE | 2.43 | 3.01 | 614.01 | 3 | 00:00 | 3.01 |
| SSP2 | STORAGE | 0.85 | 1.06 | 609.26 | 1 | 14:40 | 1.06 |

**********
Node Inflow Summary
**********

| Node | Type | Maximum Lateral Inflow CFS | Maximum Total Inflow CFS | Time of Max Occurrence days hr:min | | Lateral Inflow Volume 10^6 gal | Total Inflow Volume 10^6 gal | Flow Balance Error Percent |
|---|---|---|---|---|---|---|---|---|
| dummy | JUNCTION | 0.00 | 0.00 | 0 | 00:00 | 0 | 0 | 0.000 gal |
| dummy2 | JUNCTION | 0.00 | 0.00 | 0 | 00:00 | 0 | 0 | 0.000 gal |
| dummy3 | JUNCTION | 0.00 | 0.00 | 0 | 00:00 | 0 | 0 | 0.000 gal |
| J200 | JUNCTION | 21.14 | 22.19 | 0 | 12:00 | 0.718 | 1.02 | -0.504 |
| J201 | JUNCTION | 0.00 | 24.25 | 0 | 12:01 | 0 | 1.02 | -3.027 |
| J202 | JUNCTION | 0.00 | 27.20 | 0 | 12:14 | 0 | 1.05 | 21.847 |
| J203 | JUNCTION | 0.00 | 0.09 | 0 | 12:44 | 0 | 0.00026 | 1798.139 |
| J300 | JUNCTION | 26.00 | 26.00 | 0 | 12:00 | 0.883 | 0.885 | -6.450 |
| J301 | JUNCTION | 0.00 | 30.05 | 0 | 12:14 | 0 | 1.07 | 130.637 |
| J302 | JUNCTION | 0.00 | 4.63 | 0 | 12:20 | 0 | 0.138 | 1335.794 |
| MH#1 | JUNCTION | 0.00 | 0.00 | 0 | 00:00 | 0 | 0 | 0.000 gal |
| MH#2 | JUNCTION | 0.00 | 0.09 | 0 | 12:03 | 0 | 0.00015 | -24.577 |
| MH#2A | JUNCTION | 0.00 | 0.34 | 0 | 12:01 | 0 | 0.00237 | 7.013 |
| MH#3 | JUNCTION | 0.00 | 11.33 | 0 | 12:48 | 0 | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.865 | 1.712 | | | | | | | | |
| MH#4 | | JUNCTION | 0.00 | 12.62 | 0 | 12:45 | | 0 | |
| 0.852 | 2.877 | | | | | | | | |
| VP#12 | | JUNCTION | 0.00 | 22.60 | 0 | 12:46 | | 0 | |
| 1.16 | 2.238 | | | | | | | | |
| VP#3 | | JUNCTION | 0.00 | 0.00 | 0 | 00:00 | | 0 | |
| 0 | 0.000 gal | | | | | | | | |
| VP#4 | | JUNCTION | 0.00 | 0.00 | 0 | 00:00 | | 0 | |
| 0 | 0.000 gal | | | | | | | | |
| VP#5 | | JUNCTION | 0.00 | 3.02 | 0 | 12:36 | | 0 | |
| 0.3 | -0.049 | | | | | | | | |
| VP#6 | | JUNCTION | 0.00 | 0.00 | 0 | 00:00 | | 0 | |
| 0 | 0.000 gal | | | | | | | | |
| VP#7 | | JUNCTION | 0.00 | 0.00 | 0 | 00:00 | | 0 | |
| 0 | 0.000 gal | | | | | | | | |
| reuse | | OUTFALL | 0.00 | 0.00 | 0 | 00:00 | | 0 | |
| 0 | 0.000 gal | | | | | | | | |
| reuse2 | | OUTFALL | 0.00 | 0.00 | 0 | 00:00 | | 0 | |
| 0 | 0.000 gal | | | | | | | | |
| BSP | | STORAGE | 10.11 | 10.11 | 0 | 12:00 | | 0.3 | |
| 0.3 | -0.001 | | | | | | | | |
| Forebay | | STORAGE | 2.25 | 2.25 | 0 | 12:00 | | 0.0912 | |
| 0.0912 | 0.000 | | | | | | | | |
| PSP1 | | STORAGE | 0.00 | 0.00 | 0 | 00:00 | | 0 | |
| 6.01 | 0.000 | | | | | | | | |
| PSP2 | | STORAGE | 0.00 | 0.00 | 0 | 00:00 | | 0 | |
| 6.67 | 0.000 | | | | | | | | |
| SSP1 | | STORAGE | 8.97 | 23.96 | 0 | 12:41 | | 0.266 | |
| 1.28 | 0.947 | | | | | | | | |
| SSP2 | | STORAGE | 6.36 | 6.36 | 0 | 12:00 | | 0.521 | |
| 0.521 | 0.000 | | | | | | | | |

**********
Node Surcharge Summary
**********

Surcharging occurs when water rises above the top of the highest conduit.

| Node | Type | Hours Surcharged | Max. Height Above Crown Feet | Min. Depth Below Rim Feet |
|---|---|---|---|---|
| VP#12 | JUNCTION | 51.77 | 0.156 | 7.674 |

**********
Node Flooding Summary
**********

No nodes were flooded.

**********
Storage Volume Summary
**********

| | Average Volume | Avg Pcnt | Evap Pcnt | Exfil Pcnt | Maximum Volume | Max Pcnt | Time of Max | Maximum |
|---|---|---|---|---|---|---|---|---|

| Storage Unit | 1000 ft3 | Full | Loss | Loss | 1000 ft3 | Full | days | Occurrence hr:min | Outflow CFS |
|---|---|---|---|---|---|---|---|---|---|
| BSP | 0.977 | 1 | 0 | 0 | 12.505 | 11 | 0 | 12:36 | 3.02 |
| Forebay | 9.728 | 7 | 0 | 0 | 12.192 | 8 | 1 | 08:20 | 0.00 |
| PSP1 | 802.902 | 48 | 0 | 0 | 802.902 | 48 | 0 | 00:00 | 0.00 |
| PSP2 | 891.988 | 51 | 0 | 0 | 891.988 | 51 | 0 | 00:00 | 0.00 |
| SSP1 | 135.447 | 23 | 0 | 0 | 169.284 | 28 | 3 | 00:00 | 0.68 |
| SSP2 | 54.460 | 3 | 0 | 0 | 69.675 | 4 | 1 | 14:40 | 0.00 |

**********
Outfall Loading Summary
**********

| Outfall Node | Flow Freq Pcnt | Avg Flow CFS | Max Flow CFS | Total Volume 10^6 gal |
|---|---|---|---|---|
| reuse | 0.00 | 0.00 | 0.00 | 0.000 |
| reuse2 | 0.00 | 0.00 | 0.00 | 0.000 |
| System | 0.00 | 0.00 | 0.00 | 0.000 |

**********
Link Flow Summary
**********

| Link | Type | Maximum \|Flow\| CFS | Time of Max Occurrence days | hr:min | Maximum \|Veloc\| ft/sec | Max/ Full Flow | Max/ Full Depth |
|---|---|---|---|---|---|---|---|
| P1 | CONDUIT | 0.00 | 0 | 00:00 | 0.00 | 0.00 | 0.00 |
| P10 | CONDUIT | 11.33 | 0 | 12:48 | 4.23 | 0.12 | 0.50 |
| P11 | CONDUIT | 12.62 | 0 | 12:45 | 2.45 | 0.46 | 0.83 |
| P12 | CONDUIT | 13.94 | 0 | 12:33 | 2.29 | 0.49 | 0.96 |
| P13 | CONDUIT | 11.40 | 0 | 12:46 | 3.54 | 0.17 | 0.76 |
| P14 | CONDUIT | 21.99 | 0 | 12:52 | 4.27 | 1.40 | 1.00 |
| P18 | CONDUIT | 3.02 | 0 | 12:36 | 3.05 | 0.27 | 0.35 |
| P2 | CONDUIT | 0.00 | 0 | 00:00 | 0.00 | 0.00 | 0.00 |
| P23 | CONDUIT | 0.00 | 0 | 00:00 | 0.00 | 0.00 | 0.00 |
| P25 | CONDUIT | 0.00 | 0 | 00:00 | 0.00 | 0.00 | 0.00 |
| P26 | CONDUIT | 0.00 | 0 | 00:00 | 0.00 | 0.00 | 0.00 |
| P27 | CONDUIT | 0.00 | 0 | 00:00 | 0.00 | 0.00 | 0.00 |
| P3 | CONDUIT | 0.00 | 0 | 00:00 | 0.00 | 0.00 | 0.00 |
| P4 | CONDUIT | 0.00 | 0 | 00:00 | 0.00 | 0.00 | 0.00 |
| P5 | CONDUIT | 3.02 | 0 | 12:36 | 3.24 | 0.16 | 0.34 |
| P6 | CONDUIT | 0.00 | 0 | 00:00 | 0.00 | 0.00 | 0.00 |
| P7 | CONDUIT | 0.00 | 0 | 00:00 | 0.00 | 0.00 | 0.03 |
| P8 | CONDUIT | 0.09 | 0 | 12:03 | 0.23 | 0.01 | 0.19 |
| P9 | CONDUIT | 0.34 | 0 | 12:01 | 0.39 | 0.03 | 0.43 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PSP1_surface1 | CHANNEL | 24.25 | 0 | 12:01 | 0.59 | 0.00 | 0.11 |
| PSP1_surface2 | CHANNEL | 27.20 | 0 | 12:14 | 0.55 | 0.01 | 0.12 |
| PSP1_surface3 | CHANNEL | 0.09 | 0 | 12:44 | 0.00 | 0.00 | 0.08 |
| PSP2_surface1 | CHANNEL | 30.05 | 0 | 12:14 | 0.57 | 0.00 | 0.07 |
| PSP2_surface2 | CHANNEL | 4.63 | 0 | 12:20 | 0.17 | 0.00 | 0.12 |

**********
Flow Classification Summary
**********

| Inlet Conduit | Adjusted /Actual Length | Fraction of Time in Flow Class: Dry | Up Dry | Down Dry | Sub Crit | Sup Crit | Up Crit | Down Crit | Norm Ltd | Ctrl |
|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| P10 | 1.00 | 0.16 | 0.00 | 0.00 | 0.83 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| P11 | 1.00 | 0.17 | 0.00 | 0.00 | 0.83 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| P12 | 1.00 | 0.16 | 0.01 | 0.00 | 0.83 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| P13 | 1.00 | 0.16 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 |
| P14 | 1.00 | 0.16 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| P18 | 1.00 | 0.16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 |
| P2 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| P23 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| P25 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| P26 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| P27 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| P3 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| P4 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| P5 | 1.00 | 0.16 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 | 0.00 | 0.84 | 0.00 |
| P6 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| P7 | 1.00 | 0.96 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| P8 | 1.00 | 0.68 | 0.28 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.83 | 0.00 |
| P9 | 1.00 | 0.16 | 0.53 | 0.00 | 0.32 | 0.00 | 0.00 | 0.00 | 0.54 | 0.00 |
| PSP1_surface1 | 1.00 | 0.16 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 | 0.00 | 0.83 | 0.00 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PSP1_surface2 | 1.00 | 0.16 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 | 0.00 | 0.83 |
| 0.00 | | | | | | | | | |
| PSP1_surface3 | 1.00 | 0.16 | 0.01 | 0.00 | 0.82 | 0.00 | 0.00 | 0.00 | 0.33 |
| 0.00 | | | | | | | | | |
| PSP2_surface1 | 1.00 | 0.16 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 | 0.00 | 0.83 |
| 0.00 | | | | | | | | | |
| PSP2_surface2 | 1.00 | 0.16 | 0.01 | 0.00 | 0.83 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0.00 | | | | | | | | | |

**********
Conduit Surcharge Summary
**********

| Conduit | Hours Full (Both Ends) | Hours Full (Upstream) | Hours Full (Dnstream) | Hours Above Full Normal Flow | Hours Capacity Limited |
|---|---|---|---|---|---|
| P12 | 0.01 | 0.01 | 51.76 | 0.01 | 0.01 |
| P13 | 0.01 | 0.01 | 59.39 | 0.01 | 0.01 |
| P14 | 37.64 | 37.64 | 51.76 | 1.02 | 0.01 |

Analysis begun on:  Thu Sep 10 13:57:47 2020
Analysis ended on:  Thu Sep 10 13:57:55 2020
Total elapsed time: 00:00:08

**Attachment 5: Cover Flow and outlet protection calculation**

# Hydraulic Analysis Report

## Project Data

Project Title:

Designer:

Project Date: Tuesday, February 11, 2020

Project Units:  U.S. Customary Units

Notes:

## Channel Analysis: PSP1 Channel Analysis

Notes:  Surface runoff on cover of the Primary settling pond 1

Peak flow (31 cfs) = BSP runoff (10 cfs) + PSP#1 runoff (21 cfs)

## Input Parameters

Channel Type:  Custom Cross Section

## Cross Section Data

| Elevation (ft) | Elevation (ft) | Manning's n |
|---|---|---|
| 0.00 | 5.00 | 0.0903 |
| 12.00 | 1.00 | 0.0903 |
| 172.00 | 0.00 | 0.0903 |
| 332.00 | 1.00 | 0.0903 |
| 344.00 | 5.00 | ----- |

Longitudinal Slope: 0.0050 ft/ft

Flow: 31.0000 cfs

## Result Parameters

Depth: 0.6072 ft

Area of Flow: 58.9939 ft^2

Wetted Perimeter: 194.3130 ft

Hydraulic Radius: 0.3036 ft

Average Velocity: 0.5255 ft/s

Top Width: 194.3092 ft

Froude Number:  0.1681

Critical Depth: 0.2975 ft

Critical Velocity: 2.1887 ft/s

Critical Slope: 0.2245 ft/ft

Critical Top Width: 95.21 ft

Calculated Max Shear Stress: 0.1895 lb/ft^2

Calculated Avg Shear Stress: 0.0947 lb/ft^2

Composite Manning's n Equation:  Lotter method

Manning's n:  0.0903

## Channel Lining Analysis: PSP1 Channel Lining

Notes:

## Lining Input Parameters

Channel Lining Type: Vegetation

Specific Weight of Water: 62.4 lb/ft^3

Height of Vegetation: 0.333 ft

Vegetation Condition is good

Growth Form of Vegetation is mixed

Cf: 0.75

See HEC-15, Table 4.5 (default: 0.75 for Good cover factor and Mixed growth form)

soil is noncohesive

D75: 0.1

Safety Factor: 1

## Lining Results

Cn: 0.165205

Permissible Soil Shear Stress: 0.04 lb/ft^2

Mean Boundary Shear Stress: 0.0947239 lb/ft^2

Maximum Shear Stress on the Channel Bottom: 0.189451 lb/ft^2

Manning's n: 0.0903273

Soil Grain Roughness: 0.0177136

Effective Shear Stress: 0.00148607 lb/ft^2

Permissible Shear Stress on Vegetation: 4.16049 lb/ft^2

This value is compared with the maximum shear stress times the safety factor to determine lining stability

## Channel Bottom Shear Results

channel bottom is stable

## Channel Lining Stability Results

the channel is stable

## Channel Summary

Name of Selected Channel: PSP1 Channel Analysis

## Channel Analysis: PSP2 Channel Analysis

Notes:  Surface runoff on cover of the Primary settling pond 2

Peak flow = 26 cfs

## Input Parameters

Channel Type:  Custom Cross Section

## Cross Section Data

| Elevation (ft) | Elevation (ft) | Manning's n |
|---|---|---|
| 0.00 | 10.00 | 0.0932 |
| 27.00 | 1.00 | 0.0932 |
| 197.00 | 0.00 | 0.0932 |
| 367.00 | 1.00 | 0.0932 |
| 394.00 | 10.00 | ----- |

Longitudinal Slope: 0.0050 ft/ft

Flow: 26.0000 cfs

## Result Parameters

Depth: 0.5621 ft

Area of Flow: 53.7212 ft^2

Wetted Perimeter: 191.1326 ft

Hydraulic Radius: 0.2811 ft

Average Velocity: 0.4840 ft/s

Top Width: 191.1293 ft

Froude Number:  0.1609

Critical Depth: 0.2707 ft

Critical Velocity: 2.0876 ft/s

Critical Slope: 0.2465 ft/ft

Critical Top Width: 92.03 ft

Calculated Max Shear Stress: 0.1754 lb/ft^2

Calculated Avg Shear Stress: 0.0877 lb/ft^2

Composite Manning's n Equation:  Lotter method

Manning's n:  0.0932

## Channel Lining Analysis: PSP2 Channel Lining

Notes:

## Lining Input Parameters

Channel Lining Type: Vegetation

Specific Weight of Water: 62.4 lb/ft^3

Height of Vegetation: 0.333 ft

Vegetation Condition is good

Growth Form of Vegetation is mixed

Cf: 0.75

See HEC-15, Table 4.5 (default: 0.75 for Good cover factor and Mixed growth form)

soil is noncohesive

D75: 0.1

Safety Factor: 1

## Lining Results

Cn: 0.165205

Permissible Soil Shear Stress: 0.04 lb/ft^2

Mean Boundary Shear Stress: 0.0876931 lb/ft^2

Maximum Shear Stress on the Channel Bottom: 0.175389 lb/ft^2

Manning's n: 0.0931572

Soil Grain Roughness: 0.0177136

Effective Shear Stress: 0.00129345 lb/ft^2

Permissible Shear Stress on Vegetation: 4.42527 lb/ft^2

This value is compared with the maximum shear stress times the safety factor to determine lining stability

## Channel Bottom Shear Results

channel bottom is stable

## Channel Lining Stability Results

the channel is stable

## Channel Summary

Name of Selected Channel: PSP2 Channel Analysis

## Channel Analysis: P18

Notes:  Peak Discharge from P18 from BSP runoff (10 cfs)

## Input Parameters

Channel Type:  Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.0057 ft/ft

Manning's n:  0.0200

Flow: 10.0000 cfs

## Result Parameters

Depth: 1.4844 ft

Area of Flow: 2.5002 ft^2

Wetted Perimeter: 4.1529 ft

Hydraulic Radius: 0.6020 ft

Average Velocity: 3.9996 ft/s

Top Width: 1.7497 ft

Froude Number:  0.5896

Critical Depth: 1.1309 ft

Critical Velocity: 5.4592 ft/s

Critical Slope: 0.0123 ft/ft

Critical Top Width: 1.98 ft

Calculated Max Shear Stress: 0.5280 lb/ft^2

Calculated Avg Shear Stress: 0.2141 lb/ft^2

## Riprap Analysis: P18

Notes:

## Input Parameters

Riprap Type: Culvert Outlet Protection

Flow: 10 cfs

Culvert Diameter: 2 ft

Normal Depth in Culvert: 1.48439 ft

Tailwater Depth: 0.8 ft

If tailwater is unknown, use 0.4D

flow is sbcritical

## Result Parameters

Tailwater Depth Used in Computations: 0.8 ft

Culvert Diameter Used in Computations: 2 ft

Computed D50: 2.53558 in

## Riprap Class

### Riprap Name: CLASS I

Riprap Class: I

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 12 in

d85: 9 in

d50: 6.5 in

d15: 4.5 in

## Layout Recommendations

Apron Length: 8 ft

Apron Depth: 1.89583 ft

Apron Width (at end): 11.3333 ft

Name of Selected Channel: P18

No channel used in calculations

## Channel Analysis: P14

Notes:  Peak Discharge from P14 runoff (22 cfs)

## Input Parameters

Channel Type:  Circular

Pipe Diameter: 3.0000 ft

Longitudinal Slope: 0.0012 ft/ft

Manning's n:  0.0100

Flow: 22.0000 cfs

## Result Parameters

Depth: 1.9069 ft

Area of Flow: 4.7400 ft^2

Wetted Perimeter: 5.5366 ft

Hydraulic Radius: 0.8561 ft

Average Velocity: 4.6414 ft/s

Top Width: 2.8875 ft

Froude Number:  0.6384

Critical Depth: 1.5088 ft

Critical Velocity: 6.1786 ft/s

Critical Slope: 0.0025 ft/ft

Critical Top Width: 3.00 ft

Calculated Max Shear Stress: 0.1428 lb/ft^2

Calculated Avg Shear Stress: 0.0641 lb/ft^2

## Riprap Analysis: P14

Notes:

## Input Parameters

Riprap Type: Culvert Outlet Protection

Flow: 22 cfs

Culvert Diameter: 3 ft

Normal Depth in Culvert: 1.90695 ft

Tailwater Depth: 1.2 ft

If tailwater is unknown, use 0.4D

flow is sbcritical

## Result Parameters

Tailwater Depth Used in Computations: 1.2 ft

Culvert Diameter Used in Computations: 3 ft

Computed D50: 2.81684 in

## Riprap Class

### Riprap Name: CLASS I

Riprap Class: I

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 12 in

d85: 9 in

d50: 6.5 in

d15: 4.5 in

## Layout Recommendations

Apron Length: 12 ft

Apron Depth: 1.89583 ft

Apron Width (at end): 17 ft

Name of Selected Channel: P14

No channel used in calculations

## Channel Analysis: BSP Channel Analysis

Notes:  Surface runoff on cover of the BSP

Peak flow = 10 cfs

## Input Parameters

Channel Type:  Custom Cross Section

## Cross Section Data

| Elevation (ft) | Elevation (ft) | Manning's n |
|---|---|---|
| 0.00 | 620.00 | 0.0973 |
| 3.00 | 619.00 | 0.0973 |
| 88.00 | 618.00 | 0.0973 |
| 186.00 | 619.00 | 0.0973 |
| 189.00 | 620.00 | ----- |

Longitudinal Slope: 0.0050 ft/ft

Flow: 10.0000 cfs

## Result Parameters

Depth: 0.5038 ft

Area of Flow: 23.2246 ft^2

Wetted Perimeter: 92.2021 ft

Hydraulic Radius: 0.2519 ft

Average Velocity: 0.4306 ft/s

Top Width: 92.1966 ft

Froude Number:  0.1512

Critical Depth: 0.2366 ft

Critical Velocity: 1.9522 ft/s

Critical Slope: 0.2815 ft/ft

Critical Top Width: 43.30 ft

Calculated Max Shear Stress: 0.1572 lb/ft^2

Calculated Avg Shear Stress: 0.0786 lb/ft^2

Composite Manning's n Equation:  Lotter method

Manning's n:  0.0973

## Channel Lining Analysis: BSP Channel Lining

Notes:

## Lining Input Parameters

Channel Lining Type: Vegetation

Specific Weight of Water: 62.4 lb/ft^3

Height of Vegetation: 0.333 ft

Vegetation Condition is good

Growth Form of Vegetation is mixed

Cf: 0.75

See HEC-15, Table 4.5 (default: 0.75 for Good cover factor and Mixed growth form)

soil is noncohesive

D75: 0.1

Safety Factor: 1

## Lining Results

Cn: 0.165205

Permissible Soil Shear Stress: 0.04 lb/ft^2

Mean Boundary Shear Stress: 0.0785891 lb/ft^2

Maximum Shear Stress on the Channel Bottom: 0.157188 lb/ft^2

Manning's n: 0.0973325

Soil Grain Roughness: 0.0177136

Effective Shear Stress: 0.0010619 lb/ft^2

Permissible Shear Stress on Vegetation: 4.83084 lb/ft^2

This value is compared with the maximum shear stress times the safety factor to determine lining stability

## Channel Bottom Shear Results

channel bottom is stable

## Channel Lining Stability Results

the channel is stable

## Channel Summary

Name of Selected Channel: BSP Channel Analysis

## Channel Analysis: SSP1 Channel Analysis

Notes:  Surface runoff on cover of the SSP1 from stormwater model 22 cfs (from P14)

## Input Parameters

Channel Type:  Custom Cross Section

## Cross Section Data

| Elevation (ft) | Elevation (ft) | Manning's n |
|---|---|---|
| 0.00 | 615.00 | 0.0973 |
| 12.00 | 611.00 | 0.0973 |
| 172.00 | 610.00 | 0.0973 |
| 256.00 | 611.00 | 0.0973 |
| 268.00 | 615.00 | ----- |

Longitudinal Slope: 0.0050 ft/ft

Flow: 22.0000 cfs

## Result Parameters

Depth: 0.6079 ft

Area of Flow: 45.0812 ft^2

Wetted Perimeter: 148.3282 ft

Hydraulic Radius: 0.3039 ft

Average Velocity: 0.4880 ft/s

Top Width: 148.3227 ft

Froude Number:  0.1560

Critical Depth: 0.2891 ft

Critical Velocity: 2.1583 ft/s

Critical Slope: 0.2635 ft/ft

Critical Top Width: 70.53 ft

Calculated Max Shear Stress: 0.1897 lb/ft^2

Calculated Avg Shear Stress: 0.0948 lb/ft^2

Composite Manning's n Equation:  Lotter method

Manning's n:  0.0973

## Channel Lining Analysis: SSP1 Channel Lining

Notes:

## Lining Input Parameters

Channel Lining Type: Vegetation

Specific Weight of Water: 62.4 lb/ft^3

Height of Vegetation: 0.333 ft

Vegetation Condition is good

Growth Form of Vegetation is mixed

Cf: 0.75

See HEC-15, Table 4.5 (default: 0.75 for Good cover factor and Mixed growth form)

soil is noncohesive

D75: 0.1

Safety Factor: 1

## Lining Results

Cn: 0.165205

Permissible Soil Shear Stress: 0.04 lb/ft^2

Mean Boundary Shear Stress: 0.0785891 lb/ft^2

Maximum Shear Stress on the Channel Bottom: 0.157188 lb/ft^2

Manning's n: 0.0973325

Soil Grain Roughness: 0.0177136

Effective Shear Stress: 0.0010619 lb/ft^2

Permissible Shear Stress on Vegetation: 4.83084 lb/ft^2

This value is compared with the maximum shear stress times the safety factor to determine lining stability

## Channel Bottom Shear Results

channel bottom is stable

## Channel Lining Stability Results

the channel is stable

## Channel Summary

Name of Selected Channel: BSP Channel Analysis

**Attachment 6: INDOT Riprap Gradation**

# APPENDIX D — INDOT COURSE AGGREGATE SIZE SPECIFICATIONS

| Sieve Sizes | Coarse Aggregate Sizes (Percent Passing) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Coarse Graded | | | | | | | | Dense Graded | |
| | 2 | 5 | 8 | 9 | 11 | 12 | 43[1] | 91 | 53[1] | 73[1] |
| 4 in. (100 mm) | | | | | | | | | | |
| 3½ in. (90 mm) | | | | | | | | | | |
| 2½ in. (63 mm) | 100 | | | | | | | | | |
| 2 in. (50 mm) | 80-100 | | | | | | | | | |
| 1½ in. (37.5 mm) | | 100 | | | | | 100 | | 100 | |
| 1 in. (25 mm) | 0-25 | 85-98 | 100 | | | | 70-90 | 100 | 80-100 | 100 |
| ¾ in. (19 mm) | 0-10 | 60-85 | 75-95 | 100 | | | 50-70 | | 70-90 | 90-100 |
| ½ in. (12.5 mm) | 0-7 | 30-60 | 40-70 | 60-85 | 100 | 100 | 35-50 | | 55-80 | 60-90 |
| 3/8 in. (9.5 mm) | | 15-45 | 20-50 | 30-60 | 75-95 | 95-100 | | | | |
| No. 4 (4.75 mm) | | 0-15 | 0-15 | 0-15 | 10-30 | 50-80 | 20-40 | | 35-60 | 35-60 |
| No. 8 (2.36 mm) | | 0-10 | 0-10 | 0-10 | 0-10 | 0-35 | 15-35 | | 25-50 | |
| No. 30 (600 Km) | | | | | | 0-4 | 5-20 | | 12-30 | 12-30 |
| No. 200 (75 Km)[2] | | | | | | | 0-6 | | 5-10 | 5-12 |

Notes:

[1] The liquid limit shall not exceed 25 (35 if slag) and the plasticity index shall not exceed 5. The liquid limit shall be determined in accordance with AASHTO T 89 and the plasticity index in accordance with AASHTO T 90.

[2] Includes the total amount passing the No. 200 (75 micrometers) sieve as determined by AASHTO T 11 and T 27.

# APPENDIX D — INDOT COURSE AGGREGATE SIZE SPECIFICATIONS

| Riprap Gradation Requirements (Percent Smaller) | | | | | |
|---|---|---|---|---|---|
| **Size, in. (mm)** | **Revetment** | **Class 1** | **Class 2** | **Uniform A** | **Uniform B** |
| 30 (750) | | | 100 | | |
| 24 (600) | | 100 | 85-100 | | |
| 18 (450) | 100 | 85-100 | 60-80 | | |
| 12 (300) | 90-100 | 35-50 | 20-40 | | |
| 8 (200) | | | | 100 | |
| 6 (150) | 20-40 | 10-30 | 0-20 | 35-80 | 95-100 |
| 3 (75) | 0-10 | 0-10 | 0-10 | | 35-80 |
| 1 (25) | | | | 0-20 | 0-20 |
| | | | | | |
| Depth of Riprap, minimum | 18 in. (450 mm) | 24 in. (600 mm) | 30 in. (750 mm) | | |

**Attachment 7:  NOAA Atlas 14**

**NOAA Atlas 14, Volume 2, Version 3**
**OGDEN DUNES**
**Station ID: 12-6542**
**Location name: Portage, Indiana, USA***
**Latitude: 41.6167°, Longitude: -87.1833°**
**Elevation:**
**Elevation (station metadata): 610 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

# PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **0.367** (0.329–0.411) | **0.434** (0.388–0.484) | **0.516** (0.461–0.575) | **0.588** (0.525–0.654) | **0.674** (0.600–0.749) | **0.746** (0.660–0.829) | **0.814** (0.716–0.905) | **0.884** (0.773–0.985) | **0.979** (0.848–1.09) | **1.05** (0.906–1.18) |
| 10-min | **0.571** (0.511–0.639) | **0.677** (0.606–0.755) | **0.802** (0.717–0.893) | **0.908** (0.811–1.01) | **1.03** (0.917–1.15) | **1.13** (1.00–1.26) | **1.23** (1.08–1.36) | **1.32** (1.15–1.47) | **1.44** (1.25–1.61) | **1.54** (1.32–1.72) |
| 15-min | **0.699** (0.626–0.783) | **0.828** (0.741–0.924) | **0.985** (0.880–1.10) | **1.12** (0.998–1.24) | **1.27** (1.13–1.42) | **1.40** (1.24–1.56) | **1.52** (1.34–1.69) | **1.64** (1.44–1.83) | **1.80** (1.56–2.01) | **1.92** (1.65–2.15) |
| 30-min | **0.925** (0.829–1.04) | **1.11** (0.992–1.24) | **1.35** (1.21–1.50) | **1.55** (1.39–1.72) | **1.80** (1.60–2.00) | **2.00** (1.77–2.22) | **2.20** (1.93–2.44) | **2.40** (2.10–2.67) | **2.66** (2.30–2.97) | **2.88** (2.47–3.23) |
| 60-min | **1.13** (1.01–1.26) | **1.36** (1.22–1.52) | **1.69** (1.51–1.89) | **1.97** (1.76–2.19) | **2.33** (2.08–2.59) | **2.64** (2.33–2.93) | **2.94** (2.59–3.27) | **3.25** (2.84–3.62) | **3.68** (3.19–4.11) | **4.04** (3.47–4.53) |
| 2-hr | **1.31** (1.17–1.46) | **1.58** (1.41–1.76) | **2.01** (1.79–2.23) | **2.37** (2.11–2.63) | **2.85** (2.53–3.16) | **3.26** (2.88–3.61) | **3.68** (3.22–4.08) | **4.12** (3.58–4.57) | **4.72** (4.07–5.25) | **5.22** (4.46–5.83) |
| 3-hr | **1.41** (1.26–1.58) | **1.71** (1.53–1.91) | **2.17** (1.94–2.42) | **2.58** (2.29–2.88) | **3.11** (2.76–3.46) | **3.57** (3.15–3.97) | **4.03** (3.54–4.49) | **4.53** (3.94–5.04) | **5.22** (4.49–5.83) | **5.79** (4.94–6.48) |
| 6-hr | **1.68** (1.48–1.91) | **2.03** (1.79–2.31) | **2.60** (2.29–2.96) | **3.12** (2.74–3.55) | **3.83** (3.34–4.35) | **4.46** (3.87–5.06) | **5.13** (4.41–5.81) | **5.85** (4.98–6.63) | **6.89** (5.78–7.83) | **7.80** (6.46–8.88) |
| 12-hr | **1.96** (1.73–2.22) | **2.36** (2.09–2.68) | **3.00** (2.65–3.40) | **3.58** (3.15–4.05) | **4.37** (3.83–4.94) | **5.07** (4.41–5.71) | **5.81** (5.01–6.54) | **6.61** (5.65–7.44) | **7.75** (6.53–8.75) | **8.73** (7.27–9.89) |
| 24-hr | **2.28** (2.05–2.56) | **2.77** (2.49–3.12) | **3.58** (3.20–4.02) | **4.24** (3.77–4.76) | **5.21** (4.59–5.83) | **6.02** (5.28–6.74) | **6.90** (5.99–7.72) | **7.85** (6.75–8.80) | **9.24** (7.82–10.4) | **10.4** (8.68–11.7) |
| 2-day | **2.67** (2.44–2.94) | **3.23** (2.95–3.56) | **4.08** (3.72–4.49) | **4.77** (4.34–5.24) | **5.78** (5.22–6.35) | **6.61** (5.93–7.28) | **7.51** (6.67–8.28) | **8.47** (7.43–9.39) | **9.84** (8.48–11.0) | **11.0** (9.31–12.4) |
| 3-day | **2.86** (2.62–3.12) | **3.44** (3.15–3.76) | **4.29** (3.93–4.69) | **4.99** (4.56–5.45) | **5.99** (5.43–6.54) | **6.81** (6.13–7.46) | **7.69** (6.86–8.44) | **8.62** (7.61–9.50) | **9.95** (8.63–11.1) | **11.0** (9.44–12.5) |
| 4-day | **3.04** (2.80–3.30) | **3.64** (3.35–3.95) | **4.51** (4.14–4.89) | **5.21** (4.78–5.66) | **6.20** (5.65–6.73) | **7.01** (6.34–7.64) | **7.87** (7.05–8.60) | **8.77** (7.79–9.62) | **10.1** (8.79–11.1) | **11.1** (9.57–12.5) |
| 7-day | **3.57** (3.32–3.83) | **4.25** (3.96–4.56) | **5.14** (4.78–5.52) | **5.85** (5.43–6.28) | **6.84** (6.31–7.34) | **7.63** (7.00–8.20) | **8.44** (7.70–9.10) | **9.27** (8.39–10.0) | **10.4** (9.31–11.3) | **11.3** (10.0–12.6) |
| 10-day | **4.08** (3.78–4.43) | **4.84** (4.48–5.26) | **5.81** (5.37–6.32) | **6.61** (6.09–7.19) | **7.73** (7.06–8.40) | **8.64** (7.85–9.41) | **9.59** (8.64–10.5) | **10.6** (9.43–11.6) | **12.0** (10.5–13.2) | **13.1** (11.3–14.5) |
| 20-day | **5.52** (5.16–5.95) | **6.53** (6.09–7.02) | **7.68** (7.16–8.26) | **8.59** (7.98–9.23) | **9.80** (9.07–10.5) | **10.7** (9.89–11.6) | **11.7** (10.7–12.6) | **12.6** (11.5–13.7) | **13.8** (12.5–15.1) | **14.7** (13.2–16.1) |
| 30-day | **6.82** (6.44–7.24) | **8.03** (7.57–8.52) | **9.29** (8.75–9.86) | **10.2** (9.62–10.9) | **11.4** (10.7–12.1) | **12.3** (11.5–13.1) | **13.1** (12.2–14.0) | **13.9** (12.8–14.8) | **14.8** (13.6–15.9) | **15.5** (14.2–16.7) |
| 45-day | **8.56** (8.14–9.01) | **10.0** (9.53–10.5) | **11.4** (10.8–12.0) | **12.4** (11.8–13.0) | **13.6** (12.9–14.3) | **14.5** (13.7–15.3) | **15.2** (14.4–16.1) | **15.9** (15.0–16.9) | **16.8** (15.8–17.8) | **17.4** (16.2–18.5) |
| 60-day | **10.2** (9.73–10.7) | **12.0** (11.4–12.6) | **13.6** (13.0–14.3) | **14.8** (14.1–15.6) | **16.3** (15.5–17.1) | **17.4** (16.5–18.3) | **18.3** (17.3–19.3) | **19.2** (18.1–20.3) | **20.3** (19.0–21.5) | **21.0** (19.6–22.4) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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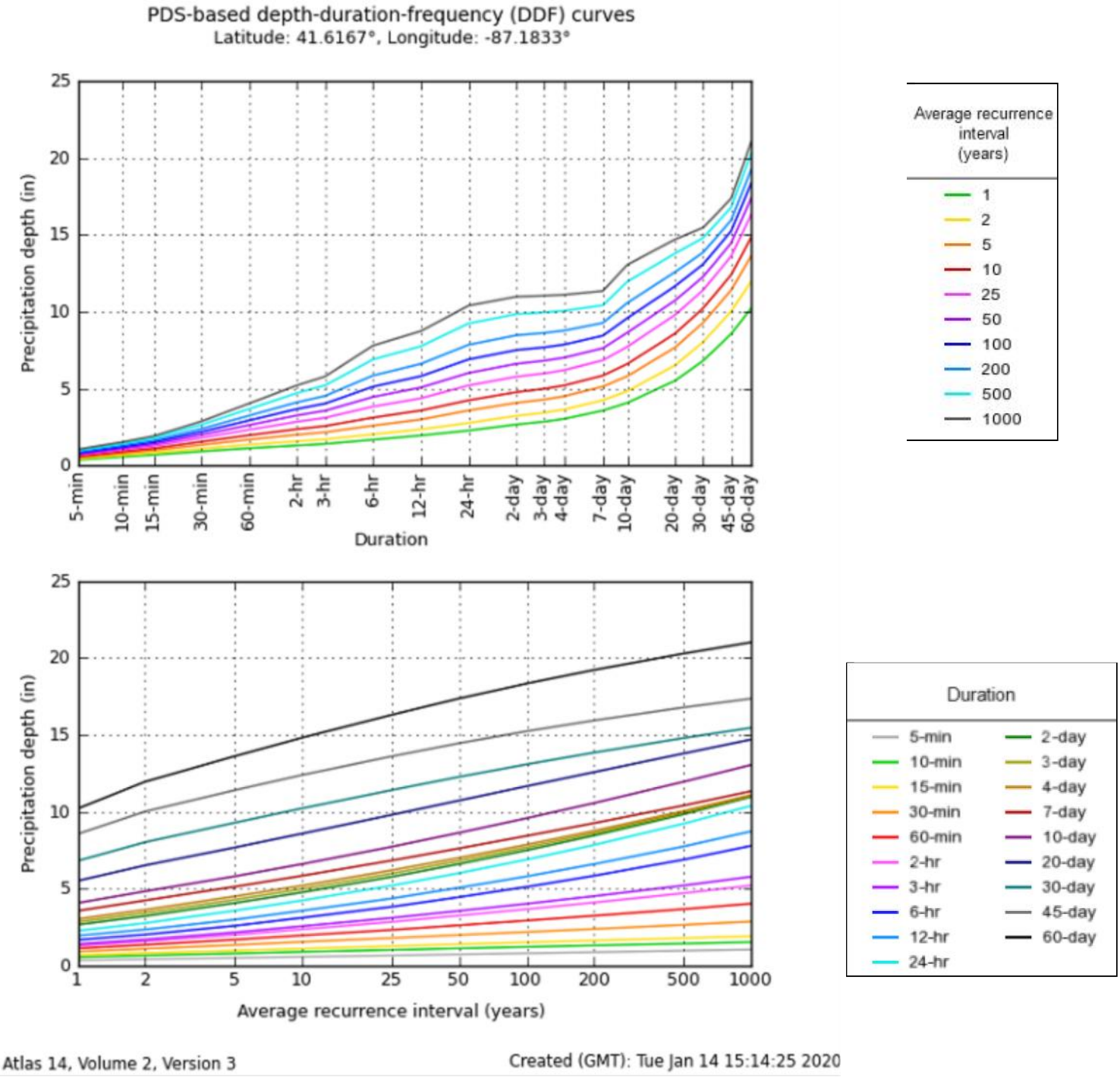
## PF graphical

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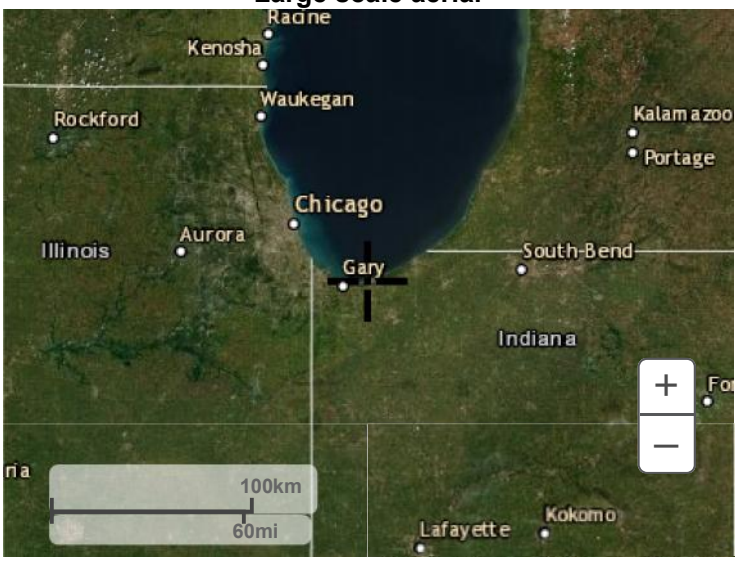
# Maps & aerials

**Small scale terrain**


**Large scale terrain**


**Large scale map**

**Large scale aerial**

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# Appendix D

# NIPSCO CCR Surface Impoundment Closures – Construction Quality Assurance Plan

Northern Indiana Public Service Company, LLC, Merrillville, Indiana

**Prepared for:**

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## List of figures



## List of tables



## List of acronyms

| | |
|---|---|
| ASTM | American Society for Testing and Materials |
| BGS | Bailly Generating Station |
| CCR | coal combustion residuals |
| CFR | Code of Federal Regulations |
| CQA | Construction Quality Assurance |
| CQA/CQC | Construction Quality Assurance/Construction Quality Control |
| CQAP | Construction Quality Assurance Plan |
| CQC | Construction Quality Control |
| cm/sec | centimeters per second |
| FTMS | Federal Test Method Standards |
| HASP | Health and Safety Plan |
| HDPE | high density polyethylene |
| IAC | Indiana Administrative Code |
| IDEM | Indiana Department of Environmental Management |
| INDOT | Indiana Department of Transportation |
| k | permeability |
| mm | millimeters |
| N/A | not applicable |
| NIPSCO | Northern Indiana Public Service Company, LLC |
| NPDES | National Pollutant Discharge Elimination System |
| PPI | Plastic Pipe Institute |
| psi | pounds per square inch |
| QA/QC | Quality Assurance/Quality Control |
| RMSGS | Rollin M. Schahfer Generation Station |
| SDR | Standard Dimension Ratio |
| SI | International System of Units |
| % | percent |

# 1.0 Introduction

This Construction Quality Assurance Plan (CQAP) is being submitted as part of the Northern Indiana Public Service Company, LLC (NIPSCO) Surface Impoundment Closure Application (Closure Application). This CQAP was prepared accounting for the relevant sections of 40 Code of Federal Regulations (CFR) Part 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments (40 CFR Part 257) pertaining to construction quality assurance and quality control (QA/QC) and 329 Indiana Administrative Code (IAC) Article 10. Solid Waste Land Disposal Facilities, Rule 17. Municipal Solid Waste Landfill Liner System; Design, Construction, and CQA/CQC Requirements (329 IAC 10-17) as related to QA/QC for surface impoundment closure implementation.

The purpose of this CQAP is to present the principles and practices of quality management that will be implemented during construction of the engineered components of the Bailly Generating Station (BGS) coal combustion residuals (CCR) surface impoundments (hereinafter refer to as "surface impoundments") closures including, but not limited to, the following:

- CCR material excavation
- Embankment grading
- Soil cover placement
- Topsoil cover
- Vegetation
- High density polyethylene (HDPE) pipe

Quality management involves the performance of both QA/QC activities to verify that the construction meets the design criteria, plans, and specifications.

## 1.1 Definitions and use of terms

The following provides general information regarding specific terms, references, and units as used in this CQAP.

### 1.1.1 Definitions relating to construction quality assurance

Construction Quality Assurance and Construction Quality Control are defined as follows:

- Construction Quality Assurance (CQA): A planned and systematic pattern of means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service
- Construction Quality Control (CQC): Those actions that provide a means to measure and regulate the characteristics of an item or service to contractual and regulatory requirements

### 1.1.2 Use of terms

The terms CQA and CQC are used as follows:

- CQA refers to means and actions employed by the CQA Consultant to assess conformity of construction with the CQAP, drawings, and specifications. The CQA Consultant is a party independent from the Owner and Contractors
- CQC refers to those actions taken by the manufacturer, supplier, and contractor to meet the requirements for materials and workmanship as stated in the CQAP, drawings, and specifications

### 1.1.3 References to standards

This CQAP includes references to test procedures of the ASTM International, the Federal Test Method Standards (FTMS), and other relevant guidelines.

### 1.1.4 Units

Properties and dimensions given in this CQAP are expressed in Standard U.S. units and/or the International System of Units (SI).

# 2.0 Project background

The surface impoundments closure project consists of designing, permitting, and implementing the closure associated with each individual surface impoundment at the BGS:

BGS Surface Impoundments:

- Boiler Slag Pond
- Primary Settlement Pond No. 1
- Primary Settlement Pond No. 2
- Secondary Settlement Pond No. 1

The objective of this CQAP is to outline the construction monitoring and testing program that documents that the closure of the surface impoundments was implemented in general accordance with the permitted design and Closure Application.

The surface impoundments closure construction includes a combination of earthwork and pipeline construction. The surface impoundments will be closed using the following method:

- Closure by removal

Closure by removal includes excavation of the existing CCR materials including liner system(s), if present, and disposal of the excavated CCR materials and liner materials in a licensed disposal facility permitted to accept the CCR materials and liner materials. The excavated CCR materials and liner materials from the surface impoundments will be transported and disposed of in the NIPSCO Rollin M. Schahfer Generating Station (RMSGS) onsite CCR landfill. The footprint of the surface impoundments will be over excavated both in the lateral and vertical direction to obtain any potentially impacted soils lying beneath and adjacent to the surface impoundments footprint. The excavation area will be graded promoting surface water runoff and eliminating the accumulation of surface water within the excavation area by using Owner-approved off-site cover soil overlain by topsoil material to the final elevations and grades. The topsoil material will be vegetated with pollinator habitat vegetation.

The following CQAP sections define the roles and responsibilities of the CQA project team and the CQA requirements for construction elements.

# 3.0 Project team and responsibilities

## 3.1 Owner

NIPSCO is the project Owner with overall responsibility for the project and will maintain the contractual relationships with the appropriate project team members. This responsibility includes compliance with the approved Closure Application and the submission of CQA documentation demonstrating that the surface impoundments closure was constructed in conformance with the drawings and specifications.

The Owner has the authority to select and dismiss parties charged with design, CQA, and construction activities. The Owner also has the authority to accept or reject design plans and specifications, CQAP, reports and recommendations of the CQA Consultant, and the materials and workmanship of contractors.

## 3.2 CQA project team

The CQA Project Team will oversee the construction of the surface impoundments closure and will provide certification of the closure construction. The CQA Project Team will report to the Owner's Project Manager who will manage the overall execution of the project. An organization chart depicting the CQA Project Team relationships is provided as Figure 1 in the Figures section of the CQAP.

### 3.2.1 CQA project manager

The CQA Project Manager is an official representative of the Owner and is responsible for oversight of the CQA field activities. The CQA Project Manager works with the Owner's Project Manager related to communications between the Owner, Design Engineer, CQA Engineer, and Contractor. The CQA Project Manager can be the Design Engineer or the CQA Engineer.

### 3.2.2 Design engineer of record

The Design Engineer of Record (Engineer) is responsible for defining quality assurance requirements compatible with the project objectives, reviewing and approving shop drawings, reviewing and approving submittals, outlining procedures for the analysis of test data, and preparing quality assurance memorandums and quality assurance reports. The Engineer is responsible for design changes (as approved by the Indiana Department of Environmental Management (IDEM), when applicable), clarifications, and specification addenda. The Engineer also has the ultimate responsibility for approving or disapproving elements of the project. The responsibility to stop work is held by the Owner. CQA documents will be prepared, signed and sealed by the Engineer assuming the CQA firm is the same as the design firm. The Engineer will review field and laboratory test data on a regular basis. The Engineer will be a registered Professional Engineer in the State of Indiana and will report to the Owner.

### 3.2.3 Construction quality assurance engineer

The Construction Quality Assurance Engineer (CQA Engineer) will be experienced in quality assurance testing and monitoring. The CQA Engineer will report to the CQA Project Manager and can be one in the same entity. The CQA Engineer serves as the on-site representative of the Owner and is responsible for the field construction of the approved quality assurance program as follows:

- Scheduling, coordinating, and performing CQA activities
- Performing independent on-site observation of the work in progress to assess compliance with drawings and specifications
- Monitor the quality assurance activities of the field testing and document conformance with test procedures and the Technical Specifications
- Recording and maintaining test data accurately
- Inform the Engineer of quality assurance activities and non-conformance to the approved CQA program, if any
- Observe that sample handling procedures are in accordance with the appropriate guidelines for the testing to be conducted

- Organize, assign, and direct engineering technicians
- Maintain an awareness of the overall field-testing operations to identify conditions that may jeopardize the quality of testing
- Documenting that corrective measures are implemented
- Documenting and reporting CQA activities
- Collecting data needed for CQA documentation
- Maintaining open lines of communications with the other parties involved in the construction

### 3.2.4 Engineering technicians

The engineering technicians (technicians) are responsible for field observations and testing at the direction of the CQA Engineer. Technicians will be assigned to the project as deemed necessary by the CQA Engineer. The CQA Engineer may perform and conduct field observations and testing himself. Technicians will be under the direct supervision of the CQA Engineer.

## 3.3 Contractor

The Contractor is the organization who the Owner has entered into a contractual agreement to complete the closure construction. The Contractor and his subcontractor(s) will be responsible for providing materials, labor, and equipment to complete the scope of work as defined in the contract documents. Often, the Contractor is responsible for earthwork and general overall construction activities.

### 3.3.1 Pipe installer

The Pipe Installer is responsible for unloading from shipment, storage, field handling, placing, joining, field testing, temporarily securing (against flotation), and other aspects of the pipe installation. The Pipe Installer is also responsible for the excavation and backfilling of the trench excavation. The Pipe Installer may be the Contractor.

# 4.0 Project meetings

To achieve a high degree of quality during the surface impoundments closure construction, clear, open channels of communication are essential. To facilitate communication, several meetings will be held before construction is initiated and throughout the construction performance. These meetings are discussed in the following sections.

## 4.1 Pre-construction meeting

A Pre-Construction Meeting will be conducted prior to the start of construction at the BGS site. The Pre-Construction Meeting will be attended by the Owner, the Engineer, the CQA Engineer, the Contractor, and subcontractors who the Contractor deems necessary to attend. The meeting will include, but not be limited to, discussion of:

- Health and safety
- Review the CQAP
- Construction management organization including lines of authority and communication
- Respective duties and responsibilities of the construction management organization and the Contractor(s)

- Distribute the project documents e.g., final copy of the Project specifications and drawings, final copy of the CQAP; Site Specific Health and Safety Plan (HASP), air permit(s), surface water permit(s), NPDES permits, etc.
- Review procedures for documentation and reporting including distribution of documents and reports
- Proposed construction schedule
- Testing requirements and procedures
- Establish protocols for handling deficiencies, repairs, and re-testing
- Review repair procedures
- Periodic reporting requirements for test results and construction activities
- Conduct a site walkthrough to discuss the construction activities including the Contractor's staging area(s) and material storage/stockpile locations

The CQA Engineer will take minutes of the meeting and prepare a draft meeting summary for distribution to the meeting participants. The meeting participants will have the opportunity to review the draft meeting summary for providing comments. The CQA engineer will revise, as appropriate, the draft meeting summary and distribute the final meeting summary to the meeting participants.

## 4.2 Progress meetings

Progress meetings will be held on a regular basis (schedule i.e., weekly, biweekly, etc. to be determined by the Owner's Project Manager and the Contractor based on construction progress, difficulties, etc.), and as needed, between the Owner, Engineer, CQA Project Manager, CQA Engineer, Contractor, and representatives of other involved parties. The meetings will include, but not be limited to, discussion of:

- Health and safety
- Status of the project i.e., work activities completed during the previous work period
- Scheduled activities i.e., work planned for the next work period
- Project schedule
- Changes to the project scope
- Comments/questions including resolutions

The CQA Engineer will take minutes of the progress meetings and prepare a draft meeting summary for distribution to the progress meeting participants. The progress meeting participants will have the opportunity to review the draft meeting summary for providing comments. The CQA Engineer will revise, as appropriate, the draft meeting minutes. The status of the project, scheduled activities, and construction related subjects will be discussed.

## 4.3 Troubleshooting meetings

If problems develop or should deficiencies arise during construction, troubleshooting meetings will be held between the Owner, Engineer, the CQA Engineer, the Contractor, and representatives of other involved parties. If the problem or deficiency involves or may involve a design change/modification, the Design Engineer should attend the meeting. The following will be discussed at the meeting:

- Define the problem(s)

- Review alternative(s) to correct the problem(s)
- Discuss a resolution and reach an agreement by all parties

The CQA Engineer will take minutes of the meetings and prepare a draft meeting summary for distribution to the meeting participants. The meeting participants will have the opportunity to review the draft meeting summary for providing comments. The CQA Engineer will revise, as appropriate, the draft meeting summary and distribute the final meeting summary to the meeting participants.

# 5.0 Excavation

Excavation of CCR materials for the closure by removal option will be performed by the Contractor. The Contractor will perform the excavation activities as described in the Contractor's Excavation Plan approved by the CQA Engineer.

## 5.1 Material

The CCR material will be existing CCR disposed/placed in the surface impoundments in the normal course the BGS operations. The excavation materials may also include the bottom liner materials consisting of blast furnace slag, sand, and clay soil for those surface impoundments having a constructed bottom liner. The geomembrane component of the bottom liner will be segregated and taken to an off-site disposal facility permitted to accept the geomembrane material.

These materials are expected to be granular in texture with various gradations present throughout.

## 5.2 Excavation

The CCR material will be excavated to the lines and grades shown on the drawings. The excavation will, at a minimum, include the identified CCR materials and the bottom liner materials. The Contractor will place the excavated material in end dump trucks or roll-off boxes equipped with liners capable of being covered for transportation to the RMSGS onsite landfill.

The Contractor will not perform the excavation activity in a manner that could cause over-excavation of the excavation area(s). Additional excavation may be required if visual observation indicates that additional material needs to be removed from the excavation area(s). This additional excavation will be performed by the Contractor only when directed by the CQA Engineer under the approval of the Owner. Unauthorized excavation will be corrected by the Contractor.

## 5.3 Observations

The CQA Engineer or the CQA Engineer's representative will observe and document the excavation activities. The observations will include, but not be limited to, proper excavation depth, excavation from the designated excavation area(s), lateral and vertical over-excavation, over-excavation repairs, etc. The CQA Engineer or the CQA Engineer's representative will observe the placement of the excavation materials into the trucks/roll-off boxes for transportation to the RMSGS onsite landfill. Paperwork (bill of lading, manifests, etc.) associated with each load of excavated material transported to the RMSGS onsite landfill will be collected by the CQA Engineer or the CQA Engineer's representative.

# 6.0 Final cover

The final cover is Owner-approved off-site borrow soil material placed to achieve the proposed final contours for the former surface impoundments area closed by removal. The final cover contours will be constructed and compacted to the lines and grade shown on the drawings.

The thickness of the final cover will be verified by the CQA Engineer to determine adequate coverage.

## 6.1 Material

The final cover consists of soil from the embankments of the former surface impoundments and Owner-approved off-site borrow soil material that meets the project specifications and that is free of organic material, refuse, or debris. The final cover contours will be constructed and compacted to the lines and grades shown on the drawings.

## 6.2 Construction

The onsite soil material will be obtained from grading the soil material in the embankments of the former surface impoundments designated as cut areas and from Owner-approved off-site soil borrow source(s). The soil material from the embankments will be graded to the interior of the former surface impoundments area to the lines and grades shown on the final grading plan. Off-site soil borrow material will augment the embankment soil material.

Off-site borrow soil material will be approved in advance by the Owner. Final acceptance is based on successful completion of CQA testing outlined herein and in the Technical Specifications. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to use.

The procedure for testing during excavation and stockpiling is outlined as follows:

- Each load of soil will be examined either at the borrow source or the stockpile area. Unsuitable material will be routed to separate stockpiles consistent with the unsuitable material end use.
- During stockpiling operations, one bulk sample will be collected for every 20,000 cubic yards of material stockpiled and tested.

Approval reports of the material to be used as soil cover will be prepared by the Contractor and will include a summary of laboratory test data; a drawing showing sample and test locations and limits of stockpile or borrow area investigated; and a summary of construction, sampling and testing methods, and recommendations.

The soil material will be graded/placed and compacted in lifts not exceeding 12 inches in compacted thickness. The Engineer may modify maximum allowable lift thickness depending on soil type used, construction equipment, and methods employed.

The Contractor will make the required efforts to obtain the required compaction. The number of passes required by the compactor will be evaluated based on the results of the field compaction tests. One pass is defined as a compactor drum passing over a location one time.

The measured in-place dry density immediately after soil material compaction will equal or exceed 95 percent of the maximum Standard Proctor dry density from the most recent representative Standard Proctor curve developed for the soil material in the existing embankments and from the soil borrow source. The measured in-place dry density and moisture content will then be compared to the most representative moisture-density-permeability comparison test to approximate the in-situ permeability at that location.

Nuclear density methods are preferred for all density testing. Nuclear density test locations will be determined by the on-site monitor with consideration given to evenly distributing the test locations over the constructed lift and as directed by the Engineer or CQA Engineer.

## 6.3 Observations

Prior to soil material placement, the base surface or surface of the previous lift will be observed. Soils will be monitored to evaluate that the materials are free of deleterious materials and meet the

specification requirements. During soil material placement, observations of lift thickness and uniform mixing of soils will be performed.

### 6.4 Testing

Testing of the soil material will consist of both in-place and laboratory testing described as follows.

#### 6.4.1 Laboratory testing

Bulk samples of the borrow soils will be retained for each 20,000 cubic yards of soil placed. The Engineer may modify the number of bulk samples needed depending on the variability of the soils being placed. Laboratory testing will include, but not be limited, to the tests presented in Table 1 - Geotechnical Laboratory Testing Requirements for the common borrow soil materials.

#### 6.4.2 In-place testing

In-place field density and moisture content tests will be performed as shown in Table 2 - In-Place Field Density Testing Requirements. Where multiple test methods are listed, only one test method need be used.

Required field density and moisture content tests will be completed before the overlying lift of soil is placed. The surface preparation (e.g. wetting, drying, scarification, etc.) will be completed prior to placement of subsequent fill lifts.

## 7.0 Topsoil

Topsoil material will be placed over the soil material associated with the closure by removal. The topsoil will be at least six-inches thick. The thickness of the topsoil will be verified by the Contractor to determine adequate coverage.

### 7.1 Material

The topsoil will consist of off-site materials which are loose, friable, natural loam, sandy loam, silty loam, or clay loam humus-bearing soil that is free of stones one inch or greater in overall dimension, admixture of subsoil, refuse, stumps, roots, brush, weeds, and other material that prevent the formation of a suitable seed bed.

### 7.2 Construction

The topsoil will be placed in one lift in a method to be approved by the Engineer. The CQA Engineer will monitor the topsoil placement.

The surface of the underlying soil material will be scarified to provide a surface to which the topsoil can bond when placed. Only use equipment to place, spread, and compact the topsoil that produces ground pressures compliant with the minimum thickness presented in Table 3 – Equipment/Cover Soil or Topsoil Material Requirements.

### 7.3 Testing

The topsoil testing will consist of the laboratory and in-place testing described as follows.

#### 7.3.1 Laboratory testing

Bulk samples of the topsoil will be retained for each 3,000 cubic yards of material placed. The CQA Engineer may reduce or increase the number of bulk samples needed depending on the variability of

the topsoil being used. Laboratory testing will include, but not be limited to, the tests presented in Table 1 – Geotechnical Laboratory Testing Requirements.

### 7.3.2 In-place testing

In-place testing of topsoil is not required. However, the CQA Engineer or the CQA Engineer's representative will monitor the topsoil placement.

# 8.0 HDPE pipe

HDPE pipe will be installed for the surface water management system associated with the surface impoundments closure.

## 8.1 Material

The HDPE pipe consists of perforated and non-perforated HDPE piping ranging in sizes indicted on drawings manufactured from resin that meets or exceeds the requirements of the Plastic Piping Institute (PPI) designation PE 4710 and meets the specifications of ASTM D3350-08 with a cell classification of PE: 445574C. Pipe wall thicknesses are specified in terms of the standard dimension ratio (SDR) as indicated in the Technical Specifications and shown on the drawings.

## 8.2 HDPE pipe manufacturer and contractor submittals

The supplier of the HDPE pipe will provide the CQA Engineer with the manufacturer's Technical Specifications and quality control information.

## 8.3 HDPE pipe installation

The HDPE pipe will be installed to the lines and grades shown on the drawings. Butt fusion welding of the pipe will be monitored by the CQA Engineer or the CQA Engineer's representative.

Butt fusion welds will exhibit a uniform melt bead. The melt bead will be removed or reamed from the interior of the pipe prior to placement.

Pressure testing of the HDPE pipelines will be performed by the Contractor and observed by the CQA Engineer or the CQA Engineer's representative. The pressure and time at the beginning and end of the test will be recorded for each section of pipe tested. The Contractor will repair pipe sections not meeting the test requirements.

## 8.4 Acceptance and closeout procedures

The Contractor is responsible for providing record drawing(s) of the completed HDPE pipe installation. The record drawing(s) will include pipe locations to identify the position of the pipe. Survey timing should be coordinated with the Contractor and the CQA Engineer so as not to impact the construction schedule of the overlying materials.

# 9.0 Aggregates

Aggregate materials will be used as bedding material and pipe, manholes or concrete structures backfill material. The CQA Engineer or the CQA Engineer's representative will observe and document the aggregate use and placement.

Delivery tickets from the aggregate supplier will be collected for each load of aggregate delivered to the BGS site. The CQA Engineer or the CQA Engineer's representative will verify the aggregate materials are as specified and record the total volume of aggregate materials used.

## 9.1 Material

The aggregate materials will be granular and coarse aggregate bedding material. The granular bedding material will consist of imported material free of any metals, roots, trees, stumps, concrete, construction debris, or any organic matter or deleterious material meeting the requirements of the Indiana department of Transportation (INDOT) 2018 Standard Specifications, Section 904.03 Coarse Aggregates.

The coarse aggregate bedding material will consist of imported material free of any metals, roots, trees, stumps, concrete, construction debris, or any organic matter or deleterious material meeting the requirements of the INDOT 2018 Standard Specifications, Section 904.03e Sizes of Coarse Aggregates specifically, Gradation Size No. 9.

The aggregate materials will be natural, rounded, crushed, non-carbonate stone.

The Contractor will collect samples for every 3,000 cubic yards of aggregate bedding materials used for geotechnical testing performed as specified in Table 1. Geotechnical Laboratory Testing Requirements. The aggregate material test results will be submitted to the CQA Engineer for approval before any of the aggregate material is delivered to the BGS site.

## 9.2 Trench bedding material

The aggregate bedding material will be placed below the barrel of the pipe and the manhole/precast concrete structure base. The aggregate material will be placed and compacted in minimum six-inch lifts around and above the pipe and the manhole/precast concrete structures for the full width of the trench/excavation.

## 9.3 Field quality control

The CQA Engineer or the CQA Engineer's representative will visually observe and document the proper placement and compaction of the aggregate materials used in the bedding and backfilling of pipelines and/or manhole/precast concrete structures.

## 9.4 Acceptance and closeout procedures

The Contractor is responsible for providing record drawing(s) of the completed aggregate bedding material locations. The record drawing(s) will include locations to identify where the aggregate bedding material was used. Survey timing should be coordinated with the Contractor and the CQA Engineer so as not to impact the construction schedule of the overlying materials.

# 10.0 Record drawings

The Contractor will retain a third-party surveyor registered in the State of Indiana. The Contractor will be responsible for submitting to the Engineer the following:

- Existing Conditions Survey
- Excavation Survey

- Final Soil Material Placement Survey
- Topsoil Survey
- Installed surface water piping elevations and locations
- Material certification and warranty information for installed material

The final soil material and topsoil topographic surveys will be performed on a grid no greater than 200-feet in dimension with berms, toes, crests and breaks-in-slope also surveyed. Topographic surveys will be performed on the same grid such that survey point locations are consistent with the survey points of the underlying layer. Surveys will also include a table summarizing northings, eastings, and elevations for each grid point to provide a comparison for thickness verification. Surveys will also show contours of the completed surface at one-foot contour intervals.

Locations and details for construction of the surface water management system will also be submitted to the Engineer by the Contractor. Drawings will include pipe locations within and outside the former surface impoundments footprint to adequately identify the position of the pipe. Survey timing should be coordinated with the Contractor and the CQA Engineer so as not to impact the construction schedule of the overlying materials.

# 11.0 Certification report

The CQA Engineer will prepare a Certification Report upon completion of the surface impoundments closure construction for certification by the Engineer of Record; a registered Indiana Professional Engineer. The Certification Report will contain test results and monitoring documentation performed for construction including:

- Limits of CCR material removal
- Top of cover soil
- Top of topsoil
- Compacted soil material, berms, roadways and surface water control structures

Portions of the above items may be submitted to IDEM as individual certification reports during construction. Following construction, the individual certification reports will be compiled into one Certification Report for the final closure submittal.

Record drawings and a comprehensive narrative of the construction process and CQA activities, including daily reports from the CQA Engineer and documentation of progress meetings, will be included with the Certification Report. Color photographs of key elements for the surface impoundments closure construction will also be included in the Certification Report.

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# Figures

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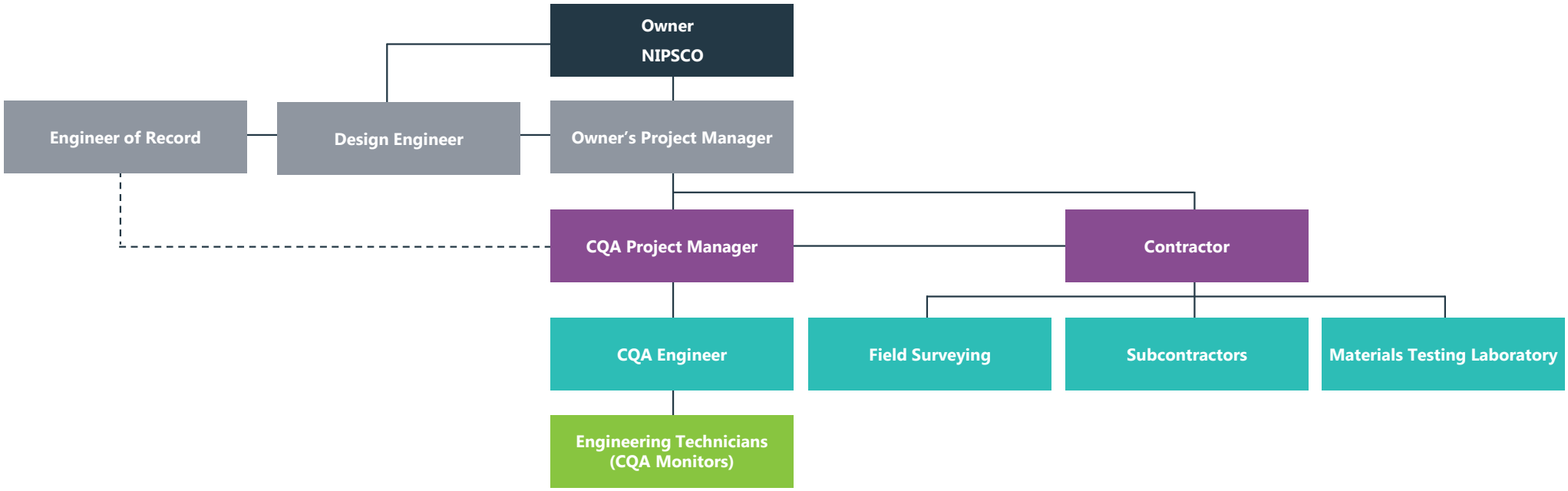


Figure 1: Draft CCR Surface Impoundments CQA Organization Chart
Construction Quality Assurance Plan, Bailly Generating Station

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# Tables

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**Table 1: GEOTECHNICAL LABORATORY TESTING REQUIREMENTS**

NIPSCO CCR Surface Impoundments Closures, Construction Quality Assurance Plan

| Test Method | Title | Minimum Frequency | Acceptance Criteria |
|---|---|---|---|
| Soil back fill material | | | |
| ASTM D422-63(2007) | Standard Test Method for Particle Size Analysis | 1 per 20,000 cubic yards | 100% ≤ 6-inches; 90% ≤ 2-inches; 50% ≤ No. 4 sieve; 20% ≤ 0.002 mm |
| ASTM D1557-07 | Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort | 1 per 20,000 cubic yards | N/A |
| ASTM D2216-05 | Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass | 1 per 20,000 cubic yards | N/A (not excessively wet) |
| ASTM D2487-06e1 | Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) | 1 per 20,000 cubic yards | GC, SC, ML, ML-CL, CL |
| ASTM D4318-05 | Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils | 1 per 20,000 cubic yards | 5% < plasticity index < 20% |
| Topsoil material | | | |
| ASTM D422-63(2007) | Standard Test Method for Particle Size Analysis | 1 per 3,000 cubic yards | 40% ≤ No. 10 sieve |
| ASTM D2216-05 | Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass | 1 per 3,000 cubic yards | N/A (not excessively wet) |
| ASTM D2974-07a | Standard Test Method for Moisture, Ash, and Organic Matter of Peat and other Organic Soils | 1 per 3,000 cubic yards | Organic content > 4 and < 20 |
| ASTM D4972-01(2007) | Standard Test Method for pH of Soils | 1 per 3,000 cubic yards | pH ≥ 6 and < 8 |
| Granular material | | | |
| ASTM C136/C136M-14 | Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates | 1 per 3,000 cubic yards | As specified |
| ASTM D2434-68(2006) | Standard Test Method for Permeability of Granular Soils (Constant Head) | 1 per 3,000 cubic yards | $k \geq 1 \times 10^{-03}$ cm/sec |
| ASTM D3042-17 | Standard Test Method for Insoluable Residue in Carbonate Aggregates | 1 per 3,000 cubic yards | < 5% |

**Table 2: IN-PLACE FIELD DENSITY TESTING REQUIREMENTS**

NIPSCO CCR Surface Impoundments Closures, Construction Quality Assurance Plan

| Test | Test Method | Title | Minimum Frequency |
|---|---|---|---|
| Soil cover material | | | |
| Field Density | ASTM D1556/D1556M-15e1 | Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method | 1 test per acre per lift |
| | ASTM D2937-17e1 | Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method | 1 test per acre per lift |
| | ASTM D6938-17 | Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) | 1 test per acre per lift |
| Moisture Content | ASTM D2216-10 | Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass | 1 test per acre per lift |

**Table 3: EQUIPMENT REQUIREMENTS: COVER SOIL OR TOPSOIL MATERIAL**

NIPSCO CCR Surface Impoundments Closures, Construction Quality Assurance Plan

| Maximum Allowable Equipment Ground Pressure (psi) | Initial Lift Thickness of Overlying Soil Cover (feet) |
|---|---|
| <5 | 1.0 |
| <10 but >5 | 1.5 |
| <20 but >10 | 2.0 |
| >20 | 3.0 |

Notes:

psi – pounds per square inch; < - less than; > - greater than

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# Appendix E

# SAMPLING AND ANALYSIS PLAN
# CLOSURE APPLICATION

*Bailly Generating Station*
*Chesterton, IN*

Submitted to:

**Northern Indiana Public Service Company LLC**
801 East 86th Avenue
Merrillville, IN 46410

Submitted by:

**Golder Associates Inc.**
670 North Commercial Street, Suite 103
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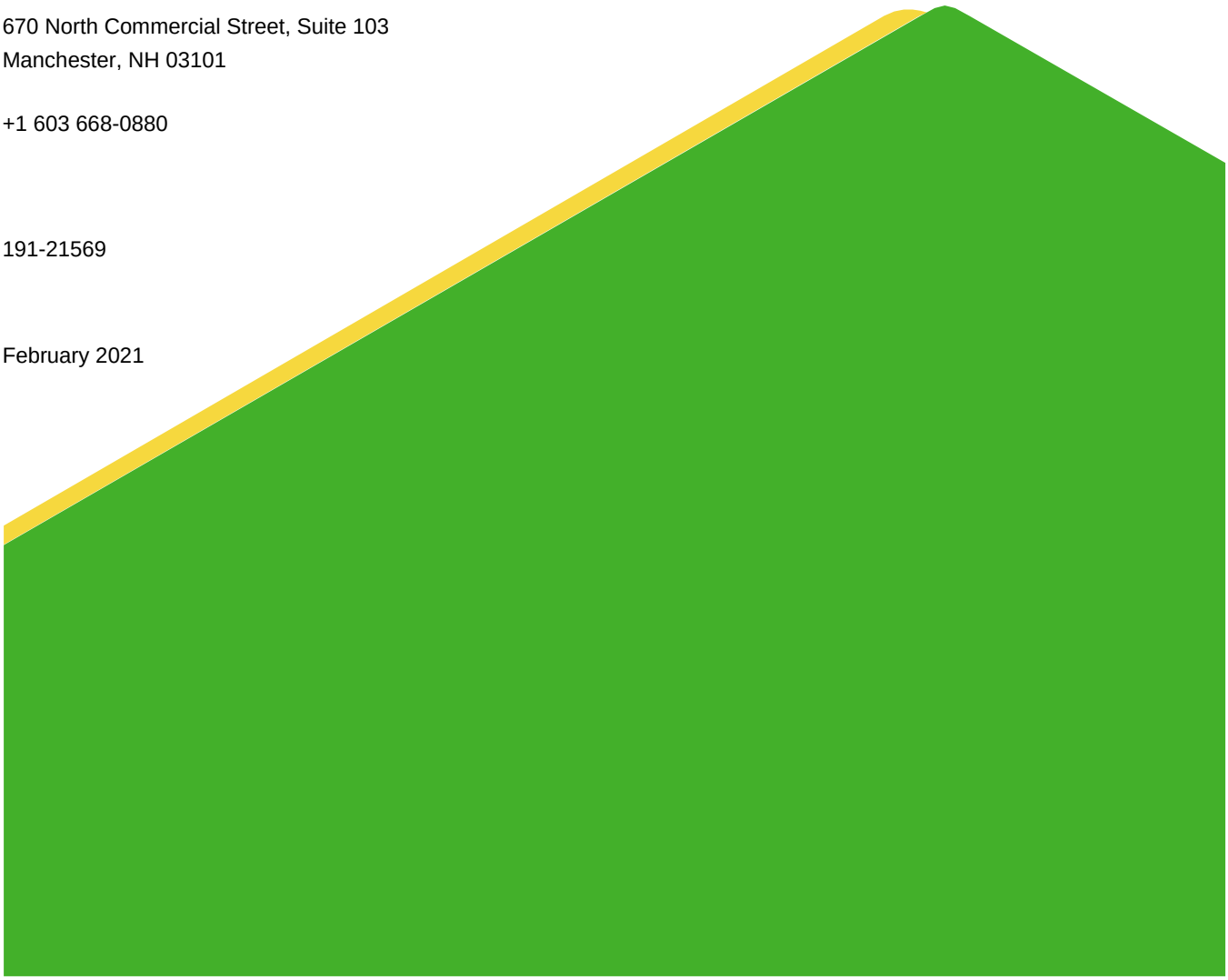
191-21569

February 2021



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**APPENDICES**

# 1.0 INTRODUCTION

## 1.1 Background

Northern Indiana Public Service Company LLC (NIPSCO LLC) plans to perform closure-by-removal of the Coal Combustion Residuals (CCR) materials (i.e., fly ash and boiler slag) located within the Site's four surface impoundments at the Bailly Generating Station (BGS or Site) located in Chesterton, Indiana including Primary Settling Pond No. 1 (Primary 1), Secondary Settling Pond No. 1 (Secondary 1), Primary Settling Pond No. 2 (primary 2), and Boiler Slag Pond (BSP). Following closure, NIPSCO LLC will implement a post-closure groundwater monitoring program, which will include a stand-alone Sampling and Analysis Plan (SAP) and a Quality Assurance Project Plan (QAPP). In addition to the self-implementing Federal Coal Combustion Residuals (CCR) Rule requirements, when and where applicable, the IDEM Office of Land Quality (OLQ) has released and previously indicated that NIPSCO LLC will be subject to application of the Surface Impoundment Closure Guidance (SICG) during any closure plan review process. Post-closure care requirements including groundwater monitoring are also addressed by and regulated under 329 Indiana Administrative Code (IAC), Article 10, Rule 31.

Golder Associates Inc. (Golder) prepared this SAP on behalf of NIPSCO LLC to address regulatory requirements and guidance outlined above. The intent of this SAP is to describe (1) the current monitoring program and associated quality assurance (QA) protocols for groundwater monitoring and (2) the monitoring required as part of the Closure Corrective Measures to assess post-closure groundwater quality. This document has been appended to the Coal Combustion Residual Surface Impoundment Closures Application, Bailly Generating Station, Northern Indiana Public Service Company, Merrillville, Indiana, dated December 2020, prepared by Wood Environment & Infrastructure Solutions, Inc (Wood). This SAP should be used in conjunction with the Quality Assurance Project Plan (QAPP) prepared by Golder for the Closure Application.

# 2.0 GROUNDWATER SAMPLING AND ANALYSIS

## 2.1 Sampling Goal, Personnel, Approach, and Controls

NIPSCO LLC's overall goals of the groundwater monitoring program are a) the collection of representative samples that achieve data quality objectives, and b) when the analytical results are evaluated statistically, they allow for accurate and early detections of impacts, if any, to groundwater quality as a result of a verified release from the regulated unit or units being monitored. The collection of samples by qualified, consistent field staff familiar with both program requirements and the specifics of the monitoring network represent a key component and serve as a quality control function that allows the achievement of these program goals.

Golder's groundwater sampling team consists of experienced individuals that perform the work in accordance with generally accepted practices within the industry, applicable provisions of the IDEM Remediation Closure Guide (RCG – revised March 2020 edition), and the Standard Operating Procedures (SOPs) discussed herein. The following sections, which are consistent with USEPA low-flow sampling guidance and the requirements of the CCR Rule, outline the program sample collection procedures. Although this section provides reference to specific forms, the use of other equivalent forms to record the necessary data may be substituted so long as the same basic requirements are met.

## 2.2 Sampling Order

Each monitoring well is equipped with a dedicated bladder pump; therefore, the use of dedicated pumps, combined with specific field techniques that address sample collection procedures, reduce the likelihood of cross-contamination and associated effects on samples. Accordingly, the routine sampling order typically follows a

sequence based on consideration of field conditions (e.g., access, individual well recharge rates at the time of sampling, potential, or actual weather impacts), not necessarily a simple default approach of sampling background locations prior to any downgradient locations.

## 2.3 Assessment of Monitoring Well and Piezometer Condition

The monitoring wells are being operated and maintained so they perform to their design specifications throughout the life of the monitoring program (see Table 1 for monitoring well construction details). Piezometers will be subject to the same requirements as monitoring wells. During each sampling event, all wells subject to monitoring, including those for which measurement of water levels is the only scheduled activity, are located and their identity confirmed (See Figure 1 for post-closure monitoring well locations). Prior to performing any water level measurements, purging, or sampling, each monitoring well is visually inspected to assess its integrity. The condition of each monitoring well, including protective bollards, protective steel casings or road boxes, operation and security of locks, concrete pads, PVC casing, and inner cap is assessed for any physical damage or other breach that may indicate compromised integrity. The results of the well inspections are documented in the comments section of the field sampling forms and/or in field notebooks. In addition, any indications of significant damage, tampering, etc. are promptly reported to NIPSCO LLC's environmental compliance management personnel for appropriate follow-up action. Necessary repairs, other than replacement, will be completed within 10 days of discovery unless otherwise approved by IDEM.

## 2.4 Equipment Calibration

Equipment used to record field water quality parameters is calibrated each day prior to use. Calibrations are performed following manufacturers' recommendations and, at a minimum, re-checked at the end of each day. Calibration solutions for standardization materials are freshly prepared or taken from non-expired stock. In the absence of manufacturer specifications or regulatory guidance, field equipment is calibrated to within +/- 10 percent of the standard (or 0.1 standard units for pH meters), if possible. Equipment that fails calibration may not be used until repaired and calibrated or replaced. Calibration data are recorded in the field and records are maintained as part of the permanent project file. A sample field Instrument Calibration Form is included in Appendix A.

## 2.5 Water Level Gauging

Static water levels are measured in each monitoring well prior to purging using an electric meter accurate to 0.01 foot. Measurements are obtained from the surveyed measuring point on each well. To the extent feasible, these measurements are taken within a 24-hour period Site-wide. Data are recorded on the Record of Water Level Readings form or Groundwater Sample Collection form, examples of which are included in Appendix A.

Prior to initial use and between wells, the portion of the water level indicator that contacts groundwater in the well is decontaminated to avoid cross-contamination between monitoring wells. In addition to decontaminating the downhole equipment, sampling personnel don new gloves between wells, and more frequently as needed, to reduce the potential for cross-contamination.

## 2.6 Pre-sample Well Purging

Golder follows USEPA low-flow sampling protocols to collect the groundwater samples. Low-flow sampling is advantageous because it can greatly reduce the volume of water that must be purged from a well before representative samples can be collected, and typically provides for the collection of more representative samples

than do other purge methods, as well as consistency in analytical results between sampling events. Low-flow sampling is accomplished using dedicated low-flow bladder pumps.

Purging is targeted at a rate equal to the well yield to avoid drawing stagnant well column water into the pump (i.e., between 100 and 500 milliliters per minute). During the well purge activities, the flow rate and the depth to groundwater is typically monitored on regular intervals (every 3 to 5 minutes) to verify that the purge activities are not removing stagnant water from the water column in the monitoring well. Stabilization of the water column is considered achieved when three consecutive water level measurements vary by 0.3 foot or less at a pumping rate of no more than 500 ml/min.

Depth to water and field water quality parameter measurements are made during purging on approximate 3- to 5-minute intervals. If a field meter equipped with a flow cell is used, the volume of the flow cell is purged between field measurements. Stabilization is attained, and purging deemed complete when three consecutive measurements of each field parameter vary within the following ranges:

- Temperature: +/- 10% - Degrees Celsius
- pH: +/- 0.1 - Standard Units
- Conductivity: +/- 3% - milliSiemens
- ORP: +/- 10 mV - millivolt
- DO: +/- 10% (or +/- 0.1 mg/L if less than 1.0 mg/L) – milligrams per liter
- Turbidity: Less than 5 Nephelometric Turbidity Unit (NTU)

All data gathered during monitoring well purging are recorded on a Groundwater Sample Collection form. Field personnel manage purge water generated during sampling activities in consultation with NIPSCO LLC environmental compliance management personnel.

If dedicated equipment malfunctions during a sampling event, non-dedicated equipment may be used to collect a groundwater sample, provided the pump is decontaminated prior to use in each well. The pump and associated discharge hoses will be decontaminated using a non-phosphate-based detergent and water mixture followed by a deionized water rinse to avoid cross-contamination between monitoring wells as provided in the Section 2.10.

## 2.7 Sample Collection

Once the water quality field measurement data indicate that purging activities have been successfully completed, required samples are collected directly from the discharge line on the dedicated, low-flow pump into laboratory-provided, pre-preserved sample containers selected for the required parameters or compatible parameters (e.g., all metals samples are collected in one bottle). Sample collection is performed at the same rate (or lower) than was used during the well purging process. Sample containers are kept closed until the time each set of sample containers is to be filled. Groundwater samples collected as part of the monitoring program are not filtered prior to analysis. Groundwater samples are collected in the designated size and type of containers required for specific parameters. Sample containers are filled in such a manner as to prevent loss of preservatives due to spilling or overfilling. The parameters sampled for during each phase of monitoring is provided in Table 2 and the analytical methods and practical quantitation limits (PQLs) associated with these parameters are provided in Table 3. Planned sample containers, minimum volumes, chemical preservatives, and holding times for each analyte are

provided in Table 4. These may change depending on laboratory requirements and will be verified by the field team prior to each sampling event.

## 2.8 Sample Preservation and Handling

Upon obtaining the groundwater samples, they are packed into insulated, ice-filled coolers that are kept closed unless contents are being removed or added. Sample preservation methods including chemical addition, refrigeration, and protection from light are used to retard biological action, retard hydrolysis, and reduce sorption effects. Samples are kept at no more than 6°C from collection to laboratory delivery. Samples are delivered directly to the laboratory or sent via overnight courier following chain-of-custody (COC) procedures.

## 2.9 Chain-of-Custody Program

The COC program allows for tracing and documenting sample possession and handling from the time of field collection through laboratory analysis. The COC program includes sample labels, sample seals, field Groundwater Sample Collection forms, and the COC record. Each sample is assigned a unique sample identification number to be recorded on the sample label. Each sample identification number and description are recorded on the field Groundwater Sample Collection form and on the COC document.

The intent of this SOP is to provide guidance to maintain sample integrity. The chain-of-custody form provides evidence and documentation of sample collection, shipment, laboratory receipt, and laboratory custody until disposal of the sample. The chain-of-custody form identifies each sample collected and the individuals responsible for sample collection, shipment, and receipt.

Once collected, samples are considered to be in one's custody if they are: (1) in the custodian's possession or view; (2) in a secured location (under lock) with restricted access; or (3) in a container that is secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s).

### 2.9.1 Responsibilities

Field personnel who collect the samples are responsible to initiate the chain-of-custody protocol. Upon sample collection, but prior to storage, shipment, or transportation, field personnel shall properly and completely fill out the chain-of-custody form with a waterproof ink pen. The Field Team Leader shall review the form prior to sample storage, shipment, or transportation. If an individual makes an error during the completion of the chain-of-custody form, a line shall be drawn through the error and the correction entered. Field personnel completing the form shall initial and date the error. Under no circumstances is white-out or erasing acceptable. Field sampling personnel are responsible for making a copy of the completed chain-of-custody form and giving the form to the Golder Project Manager. The Golder Quality Assurance Manager or designee shall review the form and place it in the project file with the field sampling forms. Upon receipt by the laboratory, the laboratory sample custodian shall assume responsibility for completing the chain-of-custody procedures. Upon completion of analysis, the laboratory shall submit a copy of the completed chain-of-custody form with the analytical data to the Project Manager who will place it in the project file.

Equipment Description

- Chain-of-custody forms
- A waterproof ink pen

### 2.9.2 Procedures

Field personnel shall use a waterproof ink pen to complete the chain-of-custody forms. Preparation of the chain-of-custody form includes:

- Complete the chain-of-custody form by entering the project name, client name, laboratory name and address, the person to whom the chemical analyses results shall be reported, and invoicing information at the top of the form. An example Chain-of-custody form is provided as Attachment A.
- COC(s) will be completed and sent with the samples for each shipment.
- Sample-specific information shall include the field identification number, the date and time the sample is collected, the depth at which the sample was taken, the type of sample (e.g., groundwater), the type of analyses requested, and preservatives used. Samples shall be grouped for shipment with other samples for similar analysis and use a common form. More than one chain-of-custody form shall be used if the number of samples placed in a cooler is greater than the number of entry spaces on the chain-of-custody form.
- The COC record will identify the contents of each shipment and maintain the custodial integrity of the samples. A locked seal will be placed across the front and back of each cooler containing samples when coolers are ready for shipment. All custody seals will be signed and dated. The chain-of-custody form will be cross-checked for errors and signed.
- Each person taking possession of the samples shall sign and date the chain-of-custody both as a recipient and as a relinquisher of the samples. When the samples are delivered to the laboratory, the laboratory sample custodian will sign the chain-of-custody as the last recipient of the samples.
- If the samples are directly transported to the laboratory, the chain-of-custody shall be kept in the possession of the person delivering the samples. Upon receipt by the laboratory, the sample receiver(s) shall open the shipping containers, compare the contents with the chain-of-custody form, and sign and date the form. Any discrepancies shall be noted on the chain-of-custody form and the Project Manager notified immediately.
- Prior to shipment by a commercial carrier, make a copy of the chain-of-custody form. If the samples are delivered directly to the laboratory by field personnel, a copy of the form shall be made after the laboratory representative signs and dates the chain-of-custody form.
- Chain-of-custody forms shall be maintained with the analytical data.

### 2.9.3 Sample Labels

Sample labels sufficiently durable to remain legible when wet contain the following information, written with indelible ink:

- Site and sample identification number
- Monitoring well number or other location
- Date and time of collection
- Name of collector
- Parameters to be analyzed

- Preservative, if applicable

Sample names are unique between sampling events. Sample names are in the format Well ID-MMDDYY such that MMDDYY is the sample date with two digits for the month, day, and year. No spaces or underscores are allowed in sample IDs. The date does not contain any dashes or underscores.

### 2.9.4 Sample Seal

The shipping container is sealed to prevent the samples from being disturbed during transport to the laboratory. A seal is placed across the front and back of each cooler containing samples when coolers are ready for shipment. All custody seals are signed and dated.

### 2.9.5 Field Forms

All field information is completely and accurately documented to become part of the final report for the groundwater monitoring event. Equipment calibration readings are included on field forms. Example field forms are included in Appendix A. The field forms document the following information:

- Identification of the monitoring well
- Sample identification number
- Field meter calibration information
- Static water level depth
- Purge volume
- Time monitoring well was purged
- Date and time of collection
- Parameters requested for analysis
- QA/QC samples, if collected
- Preservative used
- Field water quality parameter measurements
- Water levels recorded during low-flow purge
- Field observations on sampling event
- Name of collector(s)
- Weather conditions including air temperature and precipitation

The COC record is required for tracking sample possession from time of collection to time of receipt at the laboratory. The National Enforcement Investigations Center (NEIC) of USEPA considers a sample to be in custody under any of the following conditions:

- It is in the individual’s possession
- It is in the individual’s view after being in his possession

- It was in the individual's possession and he/she locked it up
- It is in a designated secure area

All environmental samples are handled under strict COC procedures beginning in the field. The Field Team Leader is the field sample custodian, responsible for ensuring that COC procedures are followed. A COC record accompanies each individual shipment. The record contains the following information:

- Sample destination and transporter
- Sample identification numbers
- Signature of collector
- Date and time of collection
- Sample type
- Identification of monitoring well
- Number of sample containers in shipping container
- Parameters requested for analysis
- Signature of person(s) involved in the chain of possession
- Inclusive dates of possession

A copy of the completed COC form is placed in a water-resistant bag, accompanies the shipment, and is returned to the shipper after the shipping container reaches its destination. The COC record is also used as the analysis request sheet. When shipping by courier, the courier does not sign the COC record: copies of shipping forms are retained to document custody.

## 2.10 Field Equipment Decontamination

Field personnel will use the procedures in this section to decontaminate all non-dedicated monitoring equipment (e.g., field water quality meter and water level meter) to collect field water quality measurements. The procedures include:

1) Clean with tap water and soap (e.g., Alconox) using a brush to remove obvious particulate matter and surface films;

2) Rinse thoroughly with tap water; and

3) Rinse thoroughly with deionized or distilled water.

# 3.0 ANALYTICAL AND QUALITY CONTROL PROCEDURES

## 3.1 Analytical Methods

NIPSCO LLC proposes a monitoring parameter list appropriate to the site environmental, industrial (e.g., located near ArcelorMittal Steel Mill), and geological background conditions; Site investigation findings; surface impoundment waste management history; and current monitoring provisions of the CCR Rule and 329 IAC, Article 10, Rule 9. From the perspective of evaluating potential post-closure impacts to water quality, the results

generated from this approach will be amenable to applying statistical-based (e.g., intra-well or inter-well) or standards-based comparisons. Consistent with the CCR Rule monitoring requirements and the Closure Application and subsequent supporting documents, the post-closure monitoring parameter list will include:

| | |
|---|---|
| Field-based water quality parameters | pH, specific conductivity, temperature, turbidity, oxidation-reduction potential |
| 40 CFR, Part 257 Appendix III Detection Monitoring Parameters | Boron, calcium, chloride, fluoride, sulfate, total dissolved solids, pH |
| 40 CFR, Part 257 Appendix IV Assessment Monitoring Parameters | Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, selenium, thallium, radium 226 and 228 (combined) |

## 3.2 Data Quality Objectives

As part of the evaluation component of the Quality Assurance (QA) program, analytical results are evaluated for precision, accuracy, representativeness, completeness, and comparability (PARCC). These are defined as follows:

- Precision is the agreement or reproducibility among individual measurements of the same property, usually made under the same conditions
- Accuracy is the degree of agreement of a measurement with the true or accepted value
- Representativeness is the degree to which a measurement accurately and precisely represents a characteristic of a population, parameter, or variations at a sampling point, a process condition, or an environmental condition
- Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under correct normal conditions
- Comparability is an expression of the confidence with which one data set can be compared with another data set regarding the same property

The accuracy, precision and representativeness of data will be functions of the sample origin, analytical procedures, and the specific sample matrices. Quality Control (QC) practices for the evaluation of these data quality indicators include the use of accepted analytical procedures, adherence to hold time, and analysis of QC samples (e.g., blanks, replicates, spikes, calibration standards, and reference standards).

Quantitative QA objectives for precision and accuracy, along with sensitivity (detection limits) are established in accordance with the specific analytical methodologies, historical data, laboratory method validation studies, and laboratory experience with similar samples. The representativeness of the analytical data is a function of the procedures used to process the samples (see the full QAPP in Appendix F).

Completeness is a qualitative characteristic which is defined as the fraction of valid data obtained from a measurement system (e.g., sampling and analysis) compared to that which was planned. Completeness can be less than 100 percent due to poor sample recovery, sample damage, or disqualification of results, which are outside of control limits due to laboratory error or matrix-specific interferences. Completeness is documented by including sufficient information in the laboratory reports to allow the data user to assess the quality of the results.

The overall completeness goal for each task is difficult to determine prior to data acquisition. For this project, all reasonable attempts will be made to attain 90% completeness or better (laboratory).

Comparability is a qualitative characteristic, which allows for comparison of analytical results with those obtained by other laboratories. This may be accomplished using standard accepted methodologies, traceability of standards to the National Bureau of Standards (NBS) or USEPA sources, use of appropriate levels of quality control, reporting results in consistent, standard units of measure, and participation in inter-laboratory studies designed to evaluate laboratory performance.

Data quality and the standard commercial report package will be evaluated with respect to PARCC criteria using the laboratory's QA practices, use of standard analytical methods, certifications, participation in inter-laboratory studies, temperature control, adherence to hold times, and COC documentation following the data quality assessment procedures (also frequently referred to Data Validation) described herein. The laboratory QC control limits in place at the time of sample analysis, which are routinely re-evaluated following the procedures in the laboratory quality assurance policies and the requirements of the analytical methods, will be used as the quantitative QC criteria.

## 3.3 Quality Assurance/Quality Control Samples

This section describes the various Quality Assurance/Quality Control (QA/QC) samples that are collected in the field and analyzed in the laboratory and the frequency at which they will be performed. A summary of the groundwater and QA/QC samples is provided in Table 5.

### 3.3.1 Field Equipment Rinsate Blanks

In situations where sampling equipment is not dedicated or disposable, an equipment rinsate blank is collected. The equipment rinsate blanks are prepared in the field using laboratory-supplied analyte-free water. The water is poured over and through each type of sampling equipment following decontamination and submitted to the laboratory for analysis of target constituents. One rinsate blank is collected for every 10 samples, if needed (e.g., equipment malfunction requires use of different, non-dedicated bladder pump).

### 3.3.2 Field Duplicates

Field duplicates are collected by sampling the same location twice, but the field duplicate is assigned a unique sample identification number. Samplers document which location is used for the duplicate sample. One field duplicate is collected for every 10 samples.

Field duplicate samples are given a unique sample ID in the form FDNN-MMDDYY where NN is a sequential number for the event and MMDDYY is the sample date with two digits for the month, day, and year. The field duplicate sample is submitted with a generic sampling time of 12:00 so that the sample time cannot be used to deduce the sampling location. The location where the field duplicate sample is collected is recorded on both the field form and in the field notebook.

### 3.3.3 Field Blank

Field blanks are also collected as part of the field sampling QA/QC program. The purpose of the field blank is to detect any contamination that might be introduced into the groundwater samples through the air or through sampling activities.

Field blanks are prepared in the field (at the sampling site) using laboratory-supplied bottles and deionized or laboratory reagent-quality water. Each field blank is prepared by pouring the deionized water into the sample

bottles at the location of one of the wells in the sampling program. Preservatives are added to specific sample bottles as required. The well at which the field blank is prepared is identified on the Field Log along with any observations that may help explain anomalous results (e.g., prevailing wind direction, up-wind potential sources of contamination). Once a field blank is collected, it is handled and shipped in the same manner as the rest of the samples.

Field blank results are reported in the laboratory results as separate samples, using the designation FBNN-MMDDYY where NN is a sequential number for the event and MMDDYY is the sample date with two digits for the month, day, and year. One field blank is collected for every 10 samples.

### 3.3.4 Laboratory Quality Control Samples

NIPSCO LLC selected Pace Analytical Services (Pace), a national laboratory, to analyze the groundwater samples. Pace's Indianapolis, Indiana, and Pittsburg, Pennsylvania laboratories analyze the metals/anions/total dissolved solids, and radium 226/228, respectively. Pace has an established QC check program using procedural (method) blanks, laboratory control spikes, matrix spikes, and duplicates. Details of the internal QC checks used by Pace are found in the laboratory Quality Assurance Manuals (QAM) and the published analytical methods. These QC samples are used to determine if results may have been affected by field activities or procedures used in sample transportation or if matrix interferences are an issue. One (1) Matrix Spike (MS)/ Matrix Spike Duplicate (MSD) set (i.e., one sample plus one MS, and one MSD sample at one location) is collected per 20 samples. MS/MSD samples have a naming convention as follows:

- Sample: GAMW-01-MMDDYY
- MS: GAMW-01-MS-MMDDYY
- MSD: GAMW-01-MSD-MMDDYY

## 3.4 Laboratory Quality Control Procedures

Pace adheres to a quality assurance program that complies with the National Environmental Laboratory Accreditation Conference (NELAC) program, which is documented in their QAMs. This document describes mechanisms employed by Pace that produces analytical data that meets or exceeds applicable EPA and State requirements. The QAM describes the laboratory's experience, its organizational structure, and procedures in place to provide quality analytical data. The QAM outlines the sampling, analysis, and reporting procedures used by the laboratory. Pace is responsible for the implementation of and adherence to the QA/QC requirements outlined in the QAM. Copies of Pace's QAMs (Indianapolis, Indiana and Pittsburg, Pennsylvania laboratories) are provided in the QAPP.

Audits are an important component of the quality assurance program at the laboratory. Internal system and performance audits are conducted periodically to confirm adherence by all laboratory departments to the QAM. External audits are conducted by accrediting agencies or states. These reports are transmitted to department managers for review and response. Pace will take corrective measures for any finding or deficiency found in an audit per their accreditation requirements.

Data Quality Reviews (DQRs), or equivalent, are requests submitted to the laboratory to formally review results that differ from historical results, or that exceed certain permit requirements or quality control criteria. The laboratory prepares a formal written response to DQRs explaining discrepancies. The DQR is the first line of investigation following any anomalous result.

### 3.4.1 Laboratory Documentation

Upon receipt of the samples at Pace, the following activities are recommended:

- The samples will be examined upon receipt to confirm that the samples were collected in EPA-approved containers for the requested analysis. The sample collection data and time will also be reviewed to confirm that the EPA-required sample holding time has not expired or will not expire before the analysis can be performed.
- The information concerning transportation mode and manner will be reported on the form. Samples will be transported on ice or under refrigeration, and the inside temperature of the cooler recorded upon opening.
- The pH of each sample as well as the sample appearance will be recorded if required by the analytical method. Also, preservative adjustments, filtration, and sample splitting will also occur as required prior to distribution. Sample adjustments will be fully documented.

During analysis of the samples, it is recommended that the laboratory agent maintain the integrity of the samples as follows:

- During the sample analysis period, the samples will be preserved in accordance with method guidelines.
- If at any point during the analysis process, the results are considered technically inaccurate, the analysis will be performed again if holding times have not been exceeded.
- Documentation activities should be completed with permanent ink in a legible manner with mistakes crossed out with a single line.

## 3.5 Laboratory Analyses

Analytical procedures will be performed in accordance with EPA *Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846,* as updated and other EPA-approved methods. The CCR Detection Monitoring Program and CCR Assessment Monitoring Program constituents, along with proposed test methods and Practical Quantitation Limit (PQLs), are listed in Tables 2 and 3. The selected analytical methods provide PQLs that are below applicable groundwater standards.

Alternate methods may be used if they have the same or lower PQL. Methods with higher PQLs will be considered if the concentration of the parameter is such that an alternate test method with a higher PQL will provide the same result.

### 3.5.1 Practical Quantitation Limit

Laboratory-specific PQLs will be used as the reporting limits for quantified detections of required monitored constituents. Laboratory PQLs should be reported with the sample results.

### 3.5.2 Method Detection Limits

Laboratory-specific Method Detection Limits (MDLs) will be used as the reporting limits for estimated detections of required monitored constituents. Constituents detected at concentrations above the MDL but below the PQL will be reported as estimated with a qualifying “J” flag on the laboratory certificates of analysis. Laboratory MDLs should be reported with the sample results.

### 3.5.3 Method Blanks

Laboratory method blanks are used during the analytical process to detect any laboratory-introduced contamination that may occur during analysis. A minimum of one method blank should be analyzed by the laboratory per sample batch.

## 3.6 Data Review, Verification, and Validation

Data review, verification, and validation techniques include screening, accepting, rejecting, or qualifying data based on specific QC criteria to identify quality issues which could affect the use of the data for decision making purposes. Following receipt of the analytical data from the subcontract laboratory, Golder validates 100% of the groundwater data generated as part of the CCR monitoring in accordance with the National Functional Guidelines for Inorganic Data Review (EPA 540-R-2017-001, January 2017). Using the terminology from Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA 540 R-10-006, January 2009), 100% of the data undergoes Stage 2A data validation which assesses both sample-related and instrument-related QC parameters. In particular, the data are reviewed for completeness and adherence to the requested analytical methods. Quantitative sample and instrument specific QC parameters, including field and method blank data, MS/MSD recovery and precision; laboratory control samples (LCS) and instrument calibrations presented in the summaries provided in the laboratory data packages are reviewed for conformance with the laboratory QC criteria.

Should QC non-conformances be identified during the data validation, the following qualifiers will be appended to the data[1]:

**U** The analyte was analyzed for but was not detected above the level of the reported sample quantitation limit.

**J** The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample. No direction of bias is indicated.

**J+** The result is an estimated quantity, but the result may be biased high.

**J-** The result is an estimated quantity, but the result may be biased low.

**UJ** The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

**R** The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

Qualified results are reported for validated samples on the analytical reporting forms provided in the data packages or as data summary tables accompanying the laboratory deliverable package. Qualified results, data packages, and analytical results are stored in the operating record.

The PARCC criteria and criteria specified in applicable guidelines may not always be achievable. The data validation guidelines provide directions for the determination of data usability. Qualified data can often provide useful information, although the degree of certainty associated with the result may not be as planned.

[1] Note that the U and J qualifiers may also be associated with the data by the laboratory to indicate non-detect and estimated values below the PQL respectively.

Professional judgment, in conjunction with USEPA guidance documents, is used to determine data usability and where necessary, professional judgment is used to evaluate scenarios not specifically described in the referenced documents. Should the Stage 2A validation identify deficiencies that were not addressed, after consultation with NIPSCO LLC, Golder would move to a more extensive validation for that data package.

## 3.7 Reconciliation with User Requirements

Throughout the project, NIPSCO LLC and Golder will determine if project data quality objectives (DQO) are being met and assess whether the data being collected is sufficient and appropriate. Periodic evaluations of the monitoring program will be made to determine if a change in frequency or analytical parameters is appropriate. Individuals making measurements throughout the process will also assess whether the DQO are being met.

Individuals making field measurements will determine whether field quality control criteria were met. The field QA/QC will be overseen by the field team leader. Corrective actions will be initiated in the field, as necessary. This corrective action may include recalibration of instruments or use of a different type of instrument.

The analysts in the laboratory will determine if analytical QC criteria are achieved. Corrective action in the form of re-analysis or re-calibration may be warranted. Laboratory analytical data and field data will be assessed by a data validation specialist under the direction of the QA Manager to determine usability regarding the DQO.

As noted in the data validation guidelines, data may not always meet precision and accuracy requirements but may still be considered usable. The data will be assessed regarding the project DQO, and professional judgment used in conjunction with guidance documents will determine data usability.

# 4.0 STATISTICAL EVALUATION OF DATA

Golder developed the selected statistical method for the BGS Closure Application in accordance with 40 CFR Part 257.93 and 329 IAC 10-29, using methodology presented in Statistical Analysis of Groundwater Data at RCRA Facilities, Unified Guidance, March 2009, EPA 530/R-09-007 (Unified Guidance). For consistency, the statistical approach proposed herein is the same as the approach currently being used in the monitoring program required under 40 CFR Part 257.93. The statistical methods used for detection monitoring under 40 CFR Part 257.93 are the same as those used to comply with 329 IAC 10-29-6 (also referred to as Phase I), while the statistical methods used for assessment monitoring under 40 CFR Part 257.93 will be the same as those used to comply with 329 IAC 10-29-7 (also referred to as Phase II). If corrective measures are ultimately required (as defined by 329 IAC 10-29-9), a separate statistical plan will be generated as a part of the corrective measures program.

Following completion of data validation, statistical analysis of the data is performed as discussed in the following subsections. These techniques represent a proven, reasonable approach to groundwater data analysis, are protective of human health and the environment, and incorporate appropriate statistical and other evaluation methodologies.

## 4.1 Groundwater Data

The background populations for each monitoring well and constituent and general background statistics have been developed using the baseline data set. These general statistics include: 1) a review of the intra-well data for potential outliers, 2) an analysis for underlying trends, and 3) an examination of data distribution (i.e., data normality). NIPSCO LLC selected an inter-well approach to compare downgradient monitoring wells to compliance limits derived from background groundwater quality data and/or MCLs in hydraulically-upgradient locations.

NIPSCO LLC will review the analytical data following each monitoring event and compare it to the established MCLs and to background concentrations to obtain a general understanding of the analytical results per impoundment.

## 4.2 Managing Linear Trends

Along with data normality and sample independence, one of the important assumptions of statistical data analysis is the absence of trends in the background data set. It is generally inappropriate to calculate a statistical limit when a data series exhibits a linear trend. If, based on a statistical trend analysis (e.g., Mann-Kendall/Sen's Slope Analysis), trends are noted in the intrawell background data, additional information and records will be evaluated to determine an underlying cause. Trends can result from a multitude of causes, including natural temporal variability, incomplete well development (particularly for new background wells), well damage or deterioration, systematic laboratory or field sampling errors, influence of an off-Site upgradient source, and leakage from an impoundment. In any case, it is generally considered inappropriate to incorporate trending data in the calculation of a statistical limit, since trends will typically result in an over-estimate of the background variability. While techniques exist to "detrend" the data, these techniques should be used with caution and should generally be avoided unless it can be definitively proven that the trends arise from strictly natural causes (i.e., Site-wide fluctuation in groundwater concentrations). If the trends are the result of Site-wide effects, they should be apparent in both upgradient and downgradient monitoring locations. If trends are noted in a background population and no specific underlying cause can be discerned, the most appropriate course is to evaluate the data from the trending well location using statistical trend analysis techniques, such as Mann-Kendall/Sen's Slope Analysis, until such time that the trend is no longer discernible, and a statistical limit can be calculated based on non-trending data.

## 4.3 Statistical Methodology

The statistical test used to evaluate the groundwater monitoring data will be the prediction interval/limit method as allowed by the CCR Rule. Except for pH, statistical limits are generally established as one-sided, upper prediction limits, because the parameters being tested under the CCR Rule are only expected to increase because of leakage from an impoundment. If statistical limits are required for pH, a two-sided prediction interval approach can be used unless a particular directional influence of leakage on pH is known for a particular facility. If one or more alternative statistical tests are used, NIPSCO LLC will collect an appropriate number of independent samples for the proposed statistical method, such that the individual false-positive rate will be no less than 0.01 percent and the site-wide false positive rate will be no less than 0.05 percent. If it is determined that prediction limits are not appropriate, an alternative statistical test method that meets the performance standards specified in the CCR Rule will be used.

The statistical analysis chosen to evaluate the groundwater data will meet the following performance standards:

1) The statistical method used to evaluate groundwater monitoring data shall be appropriate for the distribution of monitoring parameters or constituents. If the distribution is shown by the NIPSCO LLC to be inappropriate for a normal theory test, then the data should be transformed, or a distribution-free theory test should be used. If the distributions for the constituents differ, more than one statistical method may be needed.

2) If an individual well comparison procedure is used to compare an individual compliance well constituent concentration with background constituent concentrations or a ground water protection standard (GWPS), the test shall be done at a Type I error level no less than 0.01 for each testing period. If a multiple

comparisons procedure is used, the Type I experiment-wise error rate for each testing period shall be no less than 0.05; however, the Type I error of no less than 0.01 for individual well comparisons will be maintained. This performance standard does not apply to tolerance intervals, predictions intervals, or control charts.

3) If a control chart approach is used to evaluate groundwater monitoring data, the specific type of control chart and its associated parameter values shall be protective of human health and the environment. The parameters shall be determined after considering the number of samples in the background database, the data distribution, and the range of the concentration for each constituent of concern.

4) If a tolerance interval or a prediction interval is used to evaluate groundwater monitoring data, the levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain, shall be protective of human health and the environment. These parameters shall be determined after considering the number of samples in the background database, the data distribution, and the range of the concentrations for each constituent of concern.

5) The statistical method shall account for data below the PQL with one or more statistical procedures that shall be at least as effective as any other approach in this section for evaluating groundwater data. Any MDL that is used in the statistical method shall be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the Facility.

6) If necessary, the statistical method shall include procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data.

### 4.3.1 Reporting of Low and Zero Values

Chemical constituents that are not present above the detection limit of the analytical procedure are reported as NOT DETECTED (ND), or less than the method detection limit (MDL), rather than as zero or not present, and the laboratory's MDL is to be provided on the analytical report. There are a variety of ways to deal with data that include values below detection limits. General guidelines for handling non-detect data are further discussed in Chapter 2 of *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance*, March 2009.

### 4.3.2 Normality Testing

The original data will be tested for normality using the Shapiro-Wilk Test of Normality (either single group or multiple group version) for sample size up to 50, and the Shapiro-Francia Test of Normality for sample size more than 50, or other acceptable test methods. If an alternative test method is proposed for evaluating the normality of data, NIPSCO LLC will document supporting information demonstrating that the alternative method has a similar level of power to detect deviations from the normal distribution as the Shapiro-Wilk and Shapiro-Francia test methods, as appropriate. The following guidelines are used for decisions in normality testing:

1) If the raw data are not normally distributed, then the data should be natural log-transformed and re-tested for normality using the above methods.

2) If the raw or the natural log-transformed data are normally distributed, then a normal distribution test (also referred to as a Parametric test) can be applied.

3) If neither the raw nor the natural log-transformed data fit a normal distribution, then a distribution-free test will be applied.

### 4.3.3 Outliers

An outlier is a value that is statistically different from most other values in a data set for a given groundwater chemical constituent. Reasons for outliers may include:

- Sampling errors or field contamination;
- Analytical errors or laboratory contamination;
- Recording or transcription errors;
- Faulty sample preparation or preservation, or shelf-life exceedance; or
- Extreme, but accurately detected environmental conditions (e.g., spills, migration from the Facility).

Formal testing for outliers should be performed on each data set. Outliers will be tested using the methods described in the *Unified Guidance*. The outlier test assumes the background data are normally distributed. Thus, if the background data are log-normally distributed, the outlier test should be applied to the log-normally transformed data and not the raw data.

If a statistical outlier is detected by the outlier test, the source of the abnormal measurement should be investigated. Valid reasons for the outlier values may include contaminated sampling equipment, laboratory contamination of the sample, errors in transcription of the data values, or the value may be a true, but extreme data point. Once a specific reason for the outlier is documented, the data point should be excluded from further statistical analysis. If a plausible reason cannot be identified, the result should be treated as a true but extreme value and should remain in the database. However, in some cases, professional judgement may be used to remove extreme outliers, even when an underlying cause cannot be identified. As described in Section 5.2.3 of the *Unified Guidance*, the removal of extreme outliers (even those for which a cause cannot be identified) has the effect of reducing the background mean and standard deviation, thus resulting in a more conservative (i.e., protective) statistical limit. Identified outliers should be maintained in the Facility's database and simply flagged as outliers, because even extreme outliers may ultimately be identified as members of the actual sample population as additional data are added to the database over time. It is important to remember that the true population can never be known, because it would take an infinite number of samples to perfectly identify a given population. Statistical analysis is a procedure for modeling the true population using a limited number of existing data points, but as more data are gathered, the true population can be more closely modeled.

### 4.3.4 Statistical Power

As discussed above, one of the primary goals of the selection of a proper statistical evaluation method is to limit the potential for results to falsely trigger an SSI while also maintaining sufficient statistical power to detect a true SSI. Falsely triggering an SSI when no release from the impoundment has occurred is referred to as a false positive. The False Positive Rate (FPR), typically denoted by the Greek letter α, is also known as the "significance level". The FPR is the probability that a future compliance observation will be declared to be from a different statistical distribution than the background data. If the FPR is set too high, it can lead to the conclusion that there is evidence of impact when none exists. Conversely, if the FPR is set too low, it can lead to a false conclusion that no contamination exists, when it does exist (also known as a "false negative"). Ultimately, the ability to accurately identify SSIs depends on the selection of an appropriate FPR, which is referred to as the statistical power. FPRs

are set for each parameter (or for each parameter in each well for intrawell analysis). However, statistical analysis programs and the resulting decision making do not depend on each individual measurement/comparison error rates but are dependent on the collective error rate from all the individual comparisons. When the individual FPRs are integrated over the entire statistical monitoring program, it is referred to as the Site-wide false positive rate (SWFPR), which is a better measure of the ability of the entire statistical program to detect false positive observations.

### 4.3.5 Site-Wide False Positive Rate

For CCR monitoring, detection monitoring events are based on multiple comparisons (i.e., the seven Appendix III parameters at each compliance monitoring well). The SWFPR can be calculated based on several input parameters, including the assumed FPR, the number of downgradient monitoring wells (n), the number of parameters, and the number of statistical comparisons events each year for the impoundment. The *Unified Guidance* recommends that a statistical evaluation program be designed with an annual, cumulative SWFPR of approximately 10%.

The *Unified Guidance* recommends measuring statistical power using power curves which display the probability that an individual comparison will detect a concentration increase relative to background results. After determining the statistical method based on the background data, a power curve can be generated to determine the statistical power of the compliance monitoring program. The methods and procedures for calculating the SWFPR are described in Section 6.2.2 of the *Unified Guidance*.

### 4.3.6 Verification Sampling

Verification Sampling is an important aspect of any statistical analysis program, as it improves statistical power while maintaining the SWFPR. Most statistical evaluations incorporate verification sampling mathematically into their determination of the SWFPR.

Verification sampling is typically completed as a 1 of 2 pass strategy. As described above, if an initial statistical exceedance is reported, then verification sampling will be performed to confirm the initial exceedance. Verification samples should be collected on a schedule that allows for physical independence of the samples. In a 1 of 2 pass strategy, if the concentration of the verification sample is less than the calculated compliance limit, then no SSI is triggered. If the initial and subsequent verification observation are above the calculated compliance limit, an SSI is triggered.

Verification sampling within 90 days (assuming a 1 of 2 pass verification sampling strategy) will typically allow sufficient time to complete laboratory and statistical analysis in accordance with the timeframes set forth in the CCR Rules.

### 4.3.7 Prediction Intervals

40 Code of Federal Regulations (CFR) §257.93(F)(3) outlines using prediction intervals or tolerance intervals for statistical evaluation. Based on procedures described in the *Unified Guidance* as well as Golder's experience, prediction limits are the preferred method for calculating detection monitoring compliance limits and will be used to calculate compliance limits for the seven Appendix III constituents. In addition, the *Unified Guidance* suggests using prediction limits with verification sampling (Chapter 19 of the Unified Guidance), because prediction limits help to maintain low SWFPR while still providing high statistical power. Tolerance intervals, which are a backward-looking procedure, should not be used for detection monitoring, but will be used in assessment

monitoring, as further described in Section 4.4 below. If, at any point in the future, a different statistical method becomes more applicable to the site conditions, this document may be modified to include that method.

Prediction interval methods can be used for parametric and non-parametric datasets as well as for intrawell or interwell statistical analysis. Prediction limits use background data from background monitoring wells to calculate an interwell concentration that represents an upper limit of expected future concentrations for a particular population. In contrast to tolerance limits, prediction intervals are a forward looking, predictive analysis, which incorporate uncertainty in future measurements, and are thus the most appropriate method for detection monitoring programs. Typically, a one-sided upper prediction limit is used to evaluate detection monitoring observations. Observations must be lower than the prediction limit (or within the upper and lower prediction limits for pH) to be considered “in control”. Parametric methods are generally preferred over non-parametric methods because they result in lower SWFPRs and higher statistical power.

For detection monitoring, if parametric testing is required, the procedures outlined in Section 19.3.1 of the *Unified Guidance* should be used for the statistical analysis. If non-parametric testing is required, the procedures outlined in Section 19.4.1 of the *Unified Guidance* should be used. Most groundwater statistical software includes algorithms for calculating either parametric or non-parametric prediction limits.

### 4.3.8 Double Quantification Rule

In situations where the entire background dataset is reported as ND, the Double Quantification Rule (DQR) will be used to supplement the prediction limit analyses. Generally, the Appendix III constituents occur at detectable concentrations in natural groundwater; however, if ND results are encountered for a given constituent, the DQR can be implemented. A demonstration can be made that this statistical evaluation is as least as effective as any other test and results as described in §257.93(F)(5). The DQR is recommended by the *Unified Guidance* as a supplement to prediction limits because it reduces the number of non-detects used for statistical analysis and provides a lower SWFPR while maintaining statistical power.

Under the DQR, an SSI is triggered if a compliance well observation is higher than the PQL in either: (1) both a detection monitoring sample and its verification sample, or (2) two consecutive sampling events in a program where verification sampling is not utilized.

### 4.3.9 Responding to SSIs

If the statistical evaluation for an Appendix III analyte triggers an SSI, the data must be evaluated to determine if the cause of the SSI is due to a release from the impoundment or from an alternative source. Possible alternative sources may include laboratory causes, sampling causes, statistical evaluation causes, or natural variation. If the SSI can be attributed to one of these sources and the SSI was not caused by the impoundment, an alternative source demonstration (ASD) can be completed. If the SSI cannot be attributed to an alternative source and is from the impoundment, then Assessment Monitoring is triggered (as described further in Section 4.4).

## 4.4 Updating Background Values

The *Unified Guidance* suggests that updating statistical limits should only be completed after a minimum of four to eight new measurements are available (i.e., every two to four years of semiannual monitoring, assuming no verification sampling). The periodic update of background datasets, during which additional data are incorporated into the background, improves statistical power and accuracy by providing a more conservative estimate of the true background population. Prior to incorporating new data into the background dataset, a test should be

performed to demonstrate that the “new data” are from the same statistical population as the existing background results.

The Mann-Whitney (Wilcoxon Rank Sum) Test is the statistical test that will be used to determine whether new observations should be included in the background dataset. It is important to note that a failure of the Mann-Whitney Test does not automatically preclude the incorporation of “new data” into the background; however, if differences are noted, a review of the “new data” will be conducted to determine whether the noted difference is a result of a change in the natural conditions of the groundwater or if it is the result of a potential release from the impoundment. If the new data are incorporated in the background dataset, the prediction limits will be recalculated, as described in Section 4.2.7 above.

## 4.5 Assessment Monitoring Statistical Evaluation

This section discusses the procedures, methods, and processes that will be implemented as part of the assessment monitoring statistical evaluation, if required. Assessment monitoring will be initiated if an SSI is triggered during detection monitoring. As described in Section §257.95(b) of the CCR Rule, assessment monitoring must be initiated within 90 days of identifying an SSI (not within 90 days of the sample event which produced the data that resulted in the SSI). This 90-day period includes sampling the groundwater monitoring network for the Appendix IV constituents. Following the initial assessment sampling event for all Appendix IV constituents, the monitoring network is then sampled again within 90 days of receiving the results from the initial Appendix IV sampling event. Following these initial assessment monitoring events, assessment monitoring is then performed on a semiannual basis. Assessment monitoring is terminated if concentrations for all Appendix III and Appendix IV constituents in all compliance wells are statistically lower than background for two consecutive sampling events (§257.95(e)). The following sections discuss the procedures, methods, and processes that will be implemented as part of the assessment monitoring statistical evaluation.

Many of the statistical comparisons used in assessment monitoring require various analyses to be completed prior to the data being accepted into the statistical evaluation. Before using the results from assessment monitoring events, the steps outlined in Section 3.0 will be completed. In addition, the general statistical procedures described in Sections 4.1 and 4.2 (trends, outliers, normality, etc.) will be performed. Please refer to those sections for descriptions on the methods and techniques required to complete these analyses.

### 4.5.1 Establishing a Ground Water Protection Standard (GWPS)

Following the removal of outliers and the performance of general statistics described in Sections 4.1 and 4.2, the GWPS will be developed for use in the assessment monitoring program. The GWPS is a key element to the assessment monitoring process. GWPS must be generated for each of the detected Appendix IV analytes. Because interwell methods are proposed, a site-wide GWPS will be generated for each analyte based on Appendix IV results from background/hydraulically upgradient wells.

The GWPS is set equal to the MCL or health-based standard. For those constituents, whose background concentrations are greater than the MCL or health-based standard, the GWPS will be calculated from the background data.

### 4.5.2 MCL or Health-Based Standard GWPS

Many of the Appendix IV analytes have USEPA MCL levels and lead, cobalt, lithium, and molybdenum have approved health-based standards. As specified in the CCR Rule in Section §257.95(b), the GWPS must either be

the MCL/health-based standard, or a limit based on background data, whichever is greater. This section describes the methods to be used for statistical analysis when the MCL/health-based standard is used as the GWPS.

For Assessment Monitoring, the *Unified Guidance* recommends the confidence interval method to evaluate for potential exceedances, which are referred to as "statistically significant levels" (SSLs) (Chapter 21, *Unified Guidance*). Using confidence intervals, SSLs are identified by comparing the calculated confidence interval against the GWPS. A confidence interval statistically defines the upper and lower bounds of a specified population within a stipulated level of significance. Confidence intervals are required to be calculated based on a minimum of four independent observations, but a more representative confidence interval can be developed when all the available data are utilized.

The specific type of confidence interval should be based the attributes of the data being analyzed, including: (1) the data distribution, (2) the detection frequency, and (3) potential trends in the data. The Table below is based on Table 4-4 from the Electric Power Research Institute's (EPRI) *Groundwater Monitoring Guidance for the Coal Combustion Residual Rule* (2015), which displays the criteria for selecting an appropriate confidence interval. The method and procedure for calculating the Upper Confidence Limit (UCL) and Lower Confidence Limit (LCL) is provided in the section reference from the *Unified Guidance*, which is listed in the last column of the Confidence Interval Method Selection Table below.

| Data Distribution | Non-detect Frequency | Data Trend | *Unified Guidance* Confidence Interval Method |
|---|---|---|---|
| Normal | Low | Stable | Confidence Interval Around Normal Mean (Section 21.1.1) |
| Transformed Normal (Log-Normal) | Low | Stable | Confidence Interval Around Lognormal Arithmetic Mean (Section 21.1.3) |
| Non-normal | N/A | Stable | Nonparametric Confidence Interval Around Median (Section 21.2) |
| Cannot Be Determined | High | Stable | Nonparametric Confidence Interval Around Median (Section 21.2) |
| Residuals After Subtracting Trend are Normal (with equal variance) | Low | Trend | Confidence Band Around Linear Regression (Section 21.3.1) |
| Residuals after Subtracting Trend are Non-Normal | Low | Trend | Confidence Band Around Theil-Sen Line (Section 21.3.2) |

In an assessment monitoring program, the LCL is of prime interest. If the LCL exceeds the GWPS, there is statistical evidence that an SSL has been triggered. An initial SSL should be confirmed by verification sampling. If only the UCL exceeds the GWPS while the LCL is below the GWPS, the test is considered inconclusive and the *Unified Guidance* recommends that this situation be interpreted as "in compliance". If both the UCL and the LCL are below the GWPS, the data are also "in compliance" with the GWPS.

It is important to note that a slightly different set of criteria are used to determine whether assessment monitoring can be terminated. Additional discussion of the criteria used for exiting assessment monitoring and returning to detection monitoring is provided below in Section 4.4.4.

During Assessment Monitoring, a per test FPR (α) of 0.05 will be used as an initial error level for calculating the two-tailed confidence intervals for the compliance wells (which means 2.5% FPR per tail). In some cases, it is appropriate to adjust the FPR of the confidence interval based on the number of data points available as well as the distribution of the data being evaluated. If deemed necessary, an approach is provided in Section 22 of the *Unified Guidance* for determining an appropriate per test FPR based on the data characteristics.

When performing assessment monitoring statistical evaluations, it is important to evaluate the compliance data for shifts. If no shifts have occurred, then all the available Appendix IV data for a particular constituent can be used in the statistical evaluation. If shifts are noted (typically based on qualitative evaluation of a time series plot), only the data collected after the shift should be used in the statistical evaluation.

### 4.5.3 Background Based GWPS

Background or historical concentration limits should be assessed using the following techniques for all Appendix IV analytes. These concentration limits should then be compared with the MCL/heath-based standard and the higher of these two values will be used as the GWPS.

The *Unified Guidance* provides two acceptable approaches for establishing a background based GWPS. The two methods include the tolerance interval approach or the prediction interval approach.

#### *4.5.3.1 Tolerance Interval Approach*

If the background dataset is normally or transformed normally distributed, *Unified Guidance* recommends Tolerance Intervals over the Prediction Intervals for establishing a GWPS. The GWPS should be based on a 95 percent coverage/95 percent confidence tolerance interval. If the background data are non-normal (even after transformation), then many background observations are required to calculate a non-parametric tolerance interval (typically a minimum of 60 background observations are required to meet these requirements). If there is an insufficient number of background observations to calculate a non-parametric tolerance interval, then a non-parametric Prediction Interval approach should be used, as described in Section 4.3.2 below.

The Upper Tolerance Limit (UTL) is calculated for each detected Appendix VI constituent. Tolerance Limits, as outlined in the *Unified Guidance* (Section 17.2), are a concentration limit that is designed to contain a pre-specified percentage of the dataset population. Two coefficients associated tolerance intervals are (1) the specified population proportion and (2) the statistical confidence. The coverage coefficient (γ), which is used to contain the population portion, and the tolerance coefficient (or confidence level (1-α)), which is used to set the confidence of the test. Typically, the UTL is calculated to have a coverage and confidence of 95%. When an MCL does not exist or the background concentrations are greater than the MCL, the calculated UTL for each constituent is used as the GWPS. The confidence interval for each compliance well is then then compared with the GWPS.

To calculate a valid confidence interval, a minimum of four data points is necessary for each of the detected Appendix IV constituents in each compliance monitoring well (or four “new” assessment monitoring observations in each well when intrawell statistical methods are employed). Using the Tolerance Interval Approach, an SSL is triggered when calculated LCL for each compliance well is greater than the GWPS.

Tolerance limits can be completed using both parametric (Section 17.2.1 of *Unified Guidance*) or non-parametric methods (Section 17.2.2 of *Unified Guidance*). However, as described above, the non-parametric method requires at least 60 background (or historical) measurements to achieve 95% confidence with 95% coverage. Tolerance Intervals can be calculated using most groundwater statistical software packages.

#### 4.5.3.2 Prediction Interval Approach

If Tolerance Intervals cannot be used to calculate the GWPS, then a Prediction Interval method should be used. This method is very similar to the method described in Section 4.2.7 of this document; however, for assessment monitoring, the *Unified Guidance* suggests using a prediction interval about a future mean for normally/transformed-normally distributed datasets or a prediction interval about a future median for datasets with a high percent of ND or non-normally distributed data.

When using prediction intervals to calculate for a GWPS, a one-sided prediction interval is calculated using background (or historical) datasets based on a specified number of future comparisons - four future comparisons is typical. The Upper Prediction Limit that is calculated as a product of this method then becomes the GWPS and is compared against the confidence interval for the compliance data, as described in Section 4.3.1, above. As also described above, if the LCL is greater than the calculated prediction limit then an SSL is triggered.

### 4.5.4 Returning to Background Detection Monitoring from Assessment Monitoring

As specified in 257.95(e) of the CCR Rule, to return to detection monitoring, it must be demonstrated that the concentration of all constituents listed in Appendix III and Appendix IV are at or below calculated “background (or historical) values” for two consecutive semiannual sampling events. This determination of background values is based on the statistical evaluation procedure established for detection monitoring. Therefore, if prediction limits (with the double quantification rule for analytes with all non-detects) are used for detection monitoring, prediction limits should be calculated and used for all Appendix III and IV analytes to determine when the monitoring program can return to Detection Monitoring. If this statistical evaluation demonstrates that any of the Appendix III or Appendix IV are at a concentration above background levels, but no SSLs have been triggered, then the impoundment will remain in assessment monitoring (257.95(f)).

### 4.5.5 Updating Background Values in Assessment Monitoring

The background for Assessment Monitoring parameters should be updated using the same methods and techniques described in Section 4.3 for updating detection monitoring background data.

## 4.6 Corrective Measures Monitoring

During Corrective Measures, the groundwater monitoring approach is very similar to that used under Assessment Monitoring. The statistical method used to evaluate the data in Corrective Measures will also be the inter-well confidence interval method. However, there is one significant difference between Assessment and Corrective Measures Monitoring statistics, the results from downgradient monitoring wells will be evaluated by comparing the calculated intra-well UPPER confidence limit (UCL) with the GWPS for each Appendix IV constituent. If the UCL exceeds the GWPS, there is statistical evidence of non-compliance (NC), which will result in continued Corrective Measures monitoring and possible additional Corrective Measures remedies. Other than those two differences, the other components of the statistical analysis under Corrective Measures remain the same as Assessment Monitoring. The GWPSs established under the Assessment Monitoring program will be carried over into the Corrective Measures Monitoring program.

If a NC is noted under Corrective Measures Monitoring, trend analysis and other data analysis tools will be applied to understand whether the data are stable or trending. As described under Section 4.1 above, Mann-Kendall/Sen’s Slope Analysis, or another non-parametric trend analysis technique, is recommended for detecting trends. The Mann-Kendall/Sen’s Slope Analysis approach is less prone to bias by outliers and, thus, represents a better estimate of trends in data sets.

If a NC is noted and increasing trends are also detected for key Appendix IV indicator parameters, additional remedies may be necessary. If trends are stable or decreasing during Corrective Action, no additional actions may be necessary and Corrective Measures Monitoring will continue.

Corrective Measures Monitoring can be considered complete when the UCL falls below the GWPS for three consecutive years for each Appendix IV constituent in each well. At that point, the Corrective Measures remedy is considered complete (from the standpoint of groundwater monitoring), and the Site can return to Assessment Monitoring.

# Tables

**Table 1: Monitoring Well Construction Details**
**NIPSCO LLC Bailly Generating Station**
**Chesterton, Indiana**

| | Monitoring Well ID | Ground Surface Elevation (ft-msl) | Total Borehole Depth (ft-bgs) | Top of Casing Elevation (ft-msl) | Sounded Well Depth (ft-btoc) | Well Material | Screen Length (ft) | Screen Depth | | Screen Elevation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Top (ft-bgs) | Bottom ft-bgs) | Top (ft-msl) | Middle (ft-msl) | Bottom (ft-msl) |
| Background | PC-GAMW-01 | 621.26 | 23 | 624.53 | 26.32 | 2" Sch 40 PVC | 10 | 13 | 23 | 608.26 | 603.26 | 598.3 |
| | PC-GAMW-01B | 621.08 | 32 | 623.76 | 34.98 | 2" Sch 40 PVC | 5 | 27 | 32 | 593.78 | 591.28 | 588.78 |
| Boiler Slag Pond | PC-GAMW-12R | 622.96 | 25 | TBD | TBD | 2" Sch 40 PVC | 10 | 15 | 25 | 607.96 | 602.96 | 598.0 |
| | PC-GAMW-13 | 622.14 | 23 | 625.34 | 26.29 | 2" Sch 40 PVC | 10 | 13 | 23 | 609.14 | 604.14 | 599.1 |
| | PC-GAMW-14 | 621.62 | 23 | 624.32 | 26.35 | 2" Sch 40 PVC | 10 | 13 | 23 | 608.62 | 603.62 | 598.6 |
| | PC-MW-105 | 619.11 | 20 | 622.05 | 21.20 | 2" Sch 40 PVC | 10 | 10 | 20 | 609.11 | 604.11 | 599.1 |
| Primary 1 and Primary 2 | PC-GAMW-06 | 624.45 | 27 | 626.97 | 29.62 | 2" Sch 40 PVC | 10 | 17 | 27 | 607.45 | 602.45 | 597.5 |
| | PC-GAMW-07 | 625.99 | 29 | 629.04 | 31.73 | 2" Sch 40 PVC | 10 | 19 | 29 | 606.99 | 601.99 | 597.0 |
| | PC-GAMW-08 | 621.17 | 25 | 624.35 | 27.56 | 2" Sch 40 PVC | 10 | 15 | 25 | 606.17 | 601.17 | 596.2 |
| | PC-GAMW-08B | 620.80 | 40 | 623.73 | 42.87 | 2" Sch 40 PVC | 10 | 30 | 40 | 590.86 | 585.86 | 580.86 |
| | PC-GAMW-10 | 629.34 | 31 | 631.94 | 32.62 | 2" Sch 40 PVC | 10 | 21 | 31 | 608.34 | 603.34 | 598.3 |
| | PC-GAMW-11 | 621.99 | 24 | 625.04 | 27.23 | 2" Sch 40 PVC | 10 | 14 | 24 | 607.99 | 602.99 | 598.0 |
| | PC-GAMW-11C | 621.83 | 34 | 625.16 | 37.95 | 2" Sch 40 PVC | 5 | 29 | 34 | 592.21 | 589.71 | 587.21 |
| | PC-GAMW-16 | 627.20 | 30 | 629.92 | 32.71 | 2" Sch 40 PVC | 10 | 20 | 30 | 607.21 | 602.21 | 597.21 |
| | PC-GAMW-17 | 620.67 | 25 | 623.96 | 27.25 | 2" Sch 40 PVC | 10 | 14.5 | 24.5 | 606.71 | 601.71 | 596.71 |
| | PC-GAMW-17B | 620.74 | 34 | 624.12 | 36.87 | 2" Sch 40 PVC | 5 | 28.5 | 33.5 | 592.25 | 589.75 | 587.25 |
| | PC-GAMW-18 | 623.68 | 30 | 626.87 | 32.71 | 2" Sch 40 PVC | 10 | 20 | 30 | 604.16 | 599.16 | 594.16 |
| | PC-MW-112 | 624.80 | 27 | 628.07 | 30.15 | 2" Sch 40 PVC | 10 | 17 | 27 | 607.80 | 602.80 | 597.8 |
| Secondary 1 | PC-GAMW-02 | 621.27 | 23 | 624.20 | 26.41 | 2" Sch 40 PVC | 10 | 13 | 23 | 608.27 | 603.27 | 598.3 |
| | PC-GAMW-03 | 620.95 | 23 | 624.35 | 26.88 | 2" Sch 40 PVC | 10 | 13 | 23 | 607.95 | 602.95 | 598.0 |
| | PC-GAMW-04 | 620.88 | 23 | 624.12 | 26.31 | 2" Sch 40 PVC | 10 | 13 | 23 | 607.88 | 602.88 | 597.9 |
| Piezometers | GAMW-05 | 624.64 | 27 | 627.70 | 31.04 | 2" Sch 40 PVC | 10 | 17 | 27 | 607.64 | 602.64 | 597.6 |
| | GAMW-09 | 636.61 | 40 | 639.48 | 42.25 | 2" Sch 40 PVC | 10 | 30 | 40 | 606.61 | 601.61 | 596.6 |
| | GAMW-11B | 622.07 | 75 | 624.89 | 77.35 | 2" Sch 40 PVC | 5 | 70 | 75 | 552.07 | 549.57 | 547.1 |
| | GAMW-15 | 636.60 | 40 | 639.29 | 42.58 | 2" Sch 40 PVC | 10 | 30 | 40 | 606.60 | 601.60 | 596.6 |
| | MW-102 | 616.46 | 15 | 619.23 | 17.92 | 2" Sch 40 PVC | 10 | 5 | 15 | 611.46 | 606.46 | 601.5 |
| | MW-103 | 619.95 | 19 | 622.97 | 22.19 | 2" Sch 40 PVC | 10 | 9 | 19 | 610.95 | 605.95 | 601.0 |
| | MW-104 | 619.05 | 19 | 622.13 | 22.32 | 2" Sch 40 PVC | 10 | 9 | 19 | 610.05 | 605.05 | 600.1 |
| | MW-105 | 619.17 | 18 | 622.05 | 21.20 | 2" Sch 40 PVC | 10 | 8 | 18 | 611.17 | 606.17 | 601.2 |
| | MW-113 | 627.23 | 24 | 630.07 | 27.31 | 2" Sch 40 PVC | 10 | 14 | 24 | 613.23 | 608.23 | 603.2 |
| | MW-114 | 622.62 | 24 | 625.74 | 26.80 | 2" Sch 40 PVC | 10 | 14 | 24 | 608.62 | 603.62 | 598.6 |
| | MW-115 | 620.73 | 21 | 623.41 | 23.06 | 2" Sch 40 PVC | 10 | 11 | 21 | 609.73 | 604.73 | 599.7 |
| | MW-116 | 621.34 | 20 | 624.18 | 23.23 | 2" Sch 40 PVC | 10 | 10 | 20 | 611.34 | 606.34 | 601.3 |

Notes:

ft-bgs = feet below ground surface
ft-msl = feet above mean sea level
ft-btoc = feet below top of casing
TBD = to be determined
2" Sch 40 PVC = Two-inch diameter well, constructed of schedule 40 polyvinyl chloride materials
Survey elevations for wells obtained from Marbach, Brady, and Weaver survey

Prepared by: DFSC
Checked by: KMC
Reviewed by: MAH

**Table 2: Groundwater Quality Monitoring Parameters**
**NIPSCO LLC Bailly Generating Station**
**Chesterton, Indiana**

| Monitoring Parameter | |
|---|---|
| **Field Parameters** | Temperature, pH, Conductivity, Dissolved Oxygen, and Turbidity |
| **Appendix III[1]** | Boron |
| | Calcium |
| | Chloride |
| | Fluoride |
| | Sulfate |
| | pH |
| | Total Dissolved Solids (TDS) |
| **Appendix IV[1]** | Antimony |
| | Arsenic |
| | Barium |
| | Beryllium |
| | Cadmium |
| | Chromium |
| | Cobalt |
| | Fluoride |
| | Lead |
| | Lithium |
| | Mercury |
| | Molybdenum |
| | Selenium |
| | Thallium |
| | Radium 226 & 228 |

Notes:

1.) Analyte lists match requirements for monitoring from USEPA Rule 40 CFR Part 257.94(b).

Prepared By: DFSC
Checked By: JSP
Reviewed By: MAH

**Table 3: Analytical Methods and Practical Quantitation Limits**
**NIPSCO LLC Bailly Generating Station**
**Chesterton, Indiana**

| Analyte | Analytical Method[3,4] | Preservative | Hold Times | PQL (mg/L) | MCL (mg/L) |
|---|---|---|---|---|---|
| **Appendix III - Detection Monitoring[1]** | | | | | |
| Boron | SW-846 6010C | $HNO_3$ | 6 months | 0.1 | NA |
| Calcium | SW-846 6010C | $HNO_3$ | 6 months | 1 | NA |
| Chloride | SW-846 9056A | NA | 28 days | 1 | NA |
| Fluoride | SW-846 9056A | NA | 28 days | 0.05 | 4 |
| pH | SW-846 9040B | NA | NA | - | NA |
| Sulfate | SW-846 9056A | NA | 28 days | 1 | NA |
| Total Dissolved Solids (TDS) | SM-2540C | NA | 7 days | 10 | NA |
| **Appendix IV - Assessment Monitoring[1]** | | | | | |
| Antimony | SW-846 6020A[5] | $HNO_3$ | 6 months | 0.002 | 0.006 |
| Arsenic | SW-846 6020A[5] | $HNO_3$ | 6 months | 0.005 | 0.010 |
| Barium | SW-846 6020A[5] | $HNO_3$ | 6 months | 0.005 | 2.000 |
| Beryllium | SW-846 6020A[5] | $HNO_3$ | 6 months | 0.001 | 0.004 |
| Cadmium | SW-846 6020A[5] | $HNO_3$ | 6 months | 0.001 | 0.005 |
| Chromium | SW-846 6020A[5] | $HNO_3$ | 6 months | 0.002 | 0.100 |
| Cobalt[8] | SW-846 6020A[5] | $HNO_3$ | 6 months | 0.001 | 0.0068 |
| Fluoride | SW-846 9056A | NA | 28 days | 0.05 | 4 |
| Lead[8] | SW-846 6020A[5] | $HNO_3$ | 6 months | 0.001 | 0.015 |
| Lithium[8] | SW-846 6010C | $HNO_3$ | 6 months | 0.008 | 0.048 |
| Mercury | SW-846 7470A | $HNO_3$ | 28 days | 0.0002 | 0.002 |
| Molybdenum[8] | SW-846 6020A[5] | $HNO_3$ | 6 months | 0.010 | 0.180 |
| Selenium | SW-846 6020A[5] | $HNO_3$ | 6 months | 0.001 | 0.050 |
| Thallium | SW-846 6020A[5] | $HNO_3$ | 6 months | 0.001 | 0.002 |
| Radium 226 & 228 | EPA 903.1 (Radium 226), EPA 904.0 (Radium 228) | $HNO_3$ | - | NA | 5 |

Notes:

1.) Analyte lists matches requirements for detection and assessment monitoring from United States Environmental Protection Agency (USEPA) Detection - USEPA Appendix III Constituents and Assessment Monitoring - USEPA Appendix IV Constituents - 40 CFR Part 257.Monitoring.

2.) SW-846 denotes Test Methods for Evaluating Solid Waste, Physical- Chemical Methods, EPA publication SW-846, 3rd edition, and subsequent updates.

3.) Other industry-used or agency-approved methods may be used provided that they produce the necessary level of precision and accuracy for data use and reporting.

4.) Updates to the methods listed here are approved for use.

5.) EPA Method 6020A with a collision cell

7.) Radium results have a sample-specific minimum detectable concentration in pCi/L.

8.) These four constituents do not have MCLs. The value listed under the MCL column is the applicable health-based standard.

Dash (-) = no information available

$HNO_3$ - Nitric acid

MCL = Maximum Contaminant Level from USEPA 2016 Edition of the Drinking Water Standards and Health Advisories. (http://water.epa.gov/drink/contaminants/index.cfm.)

mg/L = Milligrams per liter

NA = Not applicable

pCi/L = Picocuries per liter

PQL = Practical Quantitation Limit

Prepared By: DFSC
Checked By: JSP
Reviewed By: MAH

**Table 4: Sample Container Information and Hold Times**
**NIPSCO LLC Bailly Generating Station**
**Chesterton, Indiana**

| Parameter | Container & Volume | Preservative | Maximum Holding Time |
|---|---|---|---|
| pH, Specific Conductance, temperature, ORP, turbidity | Flow-through cell | None | 15 minutes (field analysis) |
| Mercury (total) | Plastic, 250 mL | $HNO_3$ to pH<2 | 28 days |
| Metals (total) except mercury | | | 6 months |
| Total Dissolved Solids (TDS) | Plastic, 500 mL | None | 7 days |
| Fluoride, Chloride, Sulfate | Plastic, 250 mL | None | 28 days |
| Radium 226/228 | Plastic, 2 x 1 Liter | $HNO_3$ to pH<2 | 6 months |

Notes:
mL - Milliliter
$HNO_3$ = Nitric acid

Prepared By: DFSC
Checked By: JSP
Reviewed By: MAH

**Table 5: Groundwater and QA/QC Sampling Plan**
**Post-Closure Groundwater Monitoring**
**NIPSCO LLC Bailly Generating Station**
**Chesterton, Indiana**

| Unit | Well ID | Analyte Group | Methods[1] | Sample Bottles | Field Samples | Filtered? | Field Duplicates[2] | Field Blank[3] | MS/MSD[4] |
|---|---|---|---|---|---|---|---|---|---|
| Background | PC-GAMW-01, PC-GAMW-01B | Radium | 903.1, 904.0 | 2 x 1 L | 21 | No | 2 | 2 | 2 |
| Boiler Slag Pond | PC-GAMW-12R, PC-GAMW-13, PC-GAMW-14, PC-MW-105 | Metals | 6010C, 6020A, 7470A | 1 x 500 mL | | | | | |
| Primary 1 and Primary 2 | PC-GAMW-06, PC-GAMW-07, PC-GAMW-08, PC-GAMW-08B, PC-GAMW-10, PC-GAMW-11, PC-GAMW-11C, PC-GAMW-16, PC-GAMW-17, PC-GAMW-17B, PC-GAMW-18, PC-MW-112 | Anions | 9056A | 1 x 500 mL | | | | | |
| Secondary 1 | PC-GAMW-02, PC-GAMW-03, PC-GAMW-04 | TDS/pH | SM 2540C, 9040B | | | | | | |
| | | Field Parameters | Field Analysis[5] | Flow-through Cell | | | | | |
| | | | | | **Total Samples:** | | | **27** | |

Notes:
1.) Methods test for the following parameters:
6010C: Boron
6020A (collision cell): Antimony, Arsenic, Barium, Beryllium, Calcium, Cadmium, Cobalt, Chromium, Molybdenum, Lead, Selenium, Thallium, and Lithiun
7470A: Mercury
SM 2540C: TDS
9056A: Anions - Chloride, Fluoride, and Sulfate
9040B: pH
2.) Field duplicates will be collected at a frequency of 1 per 10 samples, per analysis, per sampling round
3.) Field blank will be collected at a frequency of 1 per 10 samples, per analysis, per sampling round using laboratory provided deionized wate
4.) Matrix spike and matrix spike duplicate (MS/MSD) samples will be collected at a frequency of 1 per 20 samples, per analysis, per sampling round (4 MS/MSD samples equals 2 MS and 2 MSD
5.) Must sample for monitoring well water-quality parameters including temperature, pH, dissolved oxygen, specific conductance, oxidation-reduction potential, and turbidity. Turbidity must be <5 NTU's in all samples.

$CaCO_3$ = Calcium carbonate

mL = Milliliter
L = Liter
TDS = Total dissolved solids

Prepared By: DFSC
Checked By: JSP
Reviewed By: MAH

**Table 6: Summary of Statistical Methods for Databases with Non-Detect Data**
**NIPSCO LLC Bailly Generating Station**
**Chesterton, Indiana**

| Percentage of Non-Detects in the Database | Statistical Analysis Method |
|---|---|
| Less than 15% | Replace NDs with 1/2 the PQL, then proceed with parametric procedures. |
| 15 to 50% | Replace NDs with 1/2 the PQL, then use the Kaplan-Meier or robust regression on ordered statics to estimate the mean and standard deviation. |
| More than 50% | Replace NDs with 1/2 the PQL, then proceed with nonparametric methods. |

Notes:
ND = Not detected above laboratory detection limit
PQL = Practical Quantitation Limit

Prepared By: DFSC
Checked By: JSP
Reviewed By: MAH

# Figures


LEGEND

- Post Closure Monitoring Well
- Piezometer
- Approximate Property Line

0 400 800

1 " = 400 feet

Feet

**NOTE(S)**

**REFERENCE(S)**

SERVICE LAYER CREDITS: © 2021 MICROSOFT CORPORATION © 2021 MAXAR ©CNES (2021) DISTRIBUTION AIRBUS DS

CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT

BAILLY GENERATING STATION
CHESTERTON, INDIANA
CLOSURE APPLICATION

TITLE

**POST CLOSURE MONITORING WELL NETWORK**

CONSULTANT

GOLDER

| | |
|---|---|
| YYYY-MM-DD | 1/29/2021 |
| DESIGNED | JSP |
| PREPARED | SHL |
| REVIEWED | JSP |
| APPROVED | MAH |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 19121569 | A | 0 | 4 |

# Appendix A
# Field Forms

# CALIBRATION FORM

GOLDER

**GAI Project Name:** NIPSCO/BGS/IN **Project Number:** 191-21569

**Golder Personnel Present:**

**Date:**

Meter Type: **YSI**

Model Number:

S/N

**Specific Conductivity** **Lot # :** **Expire Date:**

| Standard | Unit | | Meter reading | | Time | |
|---|---|---|---|---|---|---|
| **1.413** | mS/cm | | | | | Initial |
| | | | | | | Check |
| | | | | | | Check |

Acceptable Range 1.342-1.484

**Dissolved Oxygen**

| Baro Pressure | Temp °C | % D.O. | mg / L D.O. | D.O. Charge | Time | |
|---|---|---|---|---|---|---|
| | | | | | | Initial |
| | | | | | | Check |
| | | | | | | Check |

**pH**

**4.01 Buffer: Lot #:** **Exp. Date:** **7.01 Buffer: Lot #:** **Exp. Date:**

| Standard | Meter reading | | Meter reading | | Meter reading |
|---|---|---|---|---|---|
| | Initial | | Check | | Check |
| Time | | Acceptable Range | | | |
| **4.01** | | 3.81-4.21 | | | |
| **7.01** | | 6.75-7.36 | | | |
| **10.00** | | 9.50-10.50 | | | |

**10.00 Buffer: Lot #:** **Exp. Date:**

**ORP** **Lot#:** **Expire Date:**

| Standard | Meter reading | | Meter reading | | Meter reading |
|---|---|---|---|---|---|
| | Initial | | Check | | Check |
| Time | | Acceptable Range | | | |
| **240.0** | | 228-252 | | | |

**Turbidity**

Meter Type: **LaMotte**

Model Number: **20/20**

S/N

| Standard | Meter reading | | Meter reading | | Meter reading |
|---|---|---|---|---|---|
| | Initial | | Check | | Check |
| Time | | Acceptable Range | | | |
| **1.00** | | 0.95-1.05 | | | |
| **10.00** | | 9.50-10.5 | | | |
| | | | | | |

**Comments:**

Sampler Signature: Date:

**GROUNDWATER SAMPLE COLLECTION FORM**

GOLDER

**SITE DESCRIPTION**

Project Name: NIPSCO/BGS/IN
Project Number: 191-21569
Location: Chesterton, Indiana

**WEATHER CONDITIONS**

Temperature:
Wind:
Precipitation:

**SAMPLE DESCRIPTION**

Sample ID:
Date:
Time at Well Site:
Time of Sample Collection:
Sampled by:
Sampling Method: Bladder Pump
Type of Sampling Equipment: Pump tubing

**FIELD BLANK NOTES**

Field Blank Name:
Field Blank /Rinse Water type:
Lot Number:
Analyses:

**VOLUME OF WATER TO BE PURGED**

Casing Inside Diameter: inches
Casing Volume: liters/ft
Column of Water in Well: feet
Volume of Water in Well: liters
Well Volumes to Purge:
Min. Volume to be Purged: liters
Method of Purging:
Well Purged Dry?: Yes No

**COLUMN OF WATER IN WELL BEFORE PURGE**

Total Depth of Well: ft TOC
Depth to Water : ft TOC
Column of Water in Well: ft
Depth to Water after Purge: ft TOC

Appearance of Sample:

**WELL PURGE CONTROL**

| | Purge 1 | Purge 2 | Purge 3 | Purge 4 | Purge 5 | Purge 6 | Purge 7 |
|---|---|---|---|---|---|---|---|
| Time: | | | | | | | |
| Volume Removed (liters): | | | | | | | |
| pH: | | | | | | | |
| Specific Conductance (uS/cm): | | | | | | | |
| Temperature (Degrees C): | | | | | | | |
| Turbidity (NTU): | | | | | | | |
| ORP (millivolts): | | | | | | | |
| DO (mg/l) : | | | | | | | |
| Water Level (ft BTOC) | | | | | | | |

Starting Purge Time:
Ending Purge Time:
Average Purge Rate: ml/min
Total Volume Purged: liters

**SAMPLE CONTAINERS REQUIRED**

| Analysis | Container Number, Type and Size | Filter | Preservative and Source |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
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Chain of Custody #:
Shuttle ID:
Trip Blank ID:
Lab Name:
Air Bill #:

**REMARKS:** 2" - 0.617 liters/ft 1" - 0.053 liters/ft
1.5" - 0.347 liters/ft

Field Team Leader:

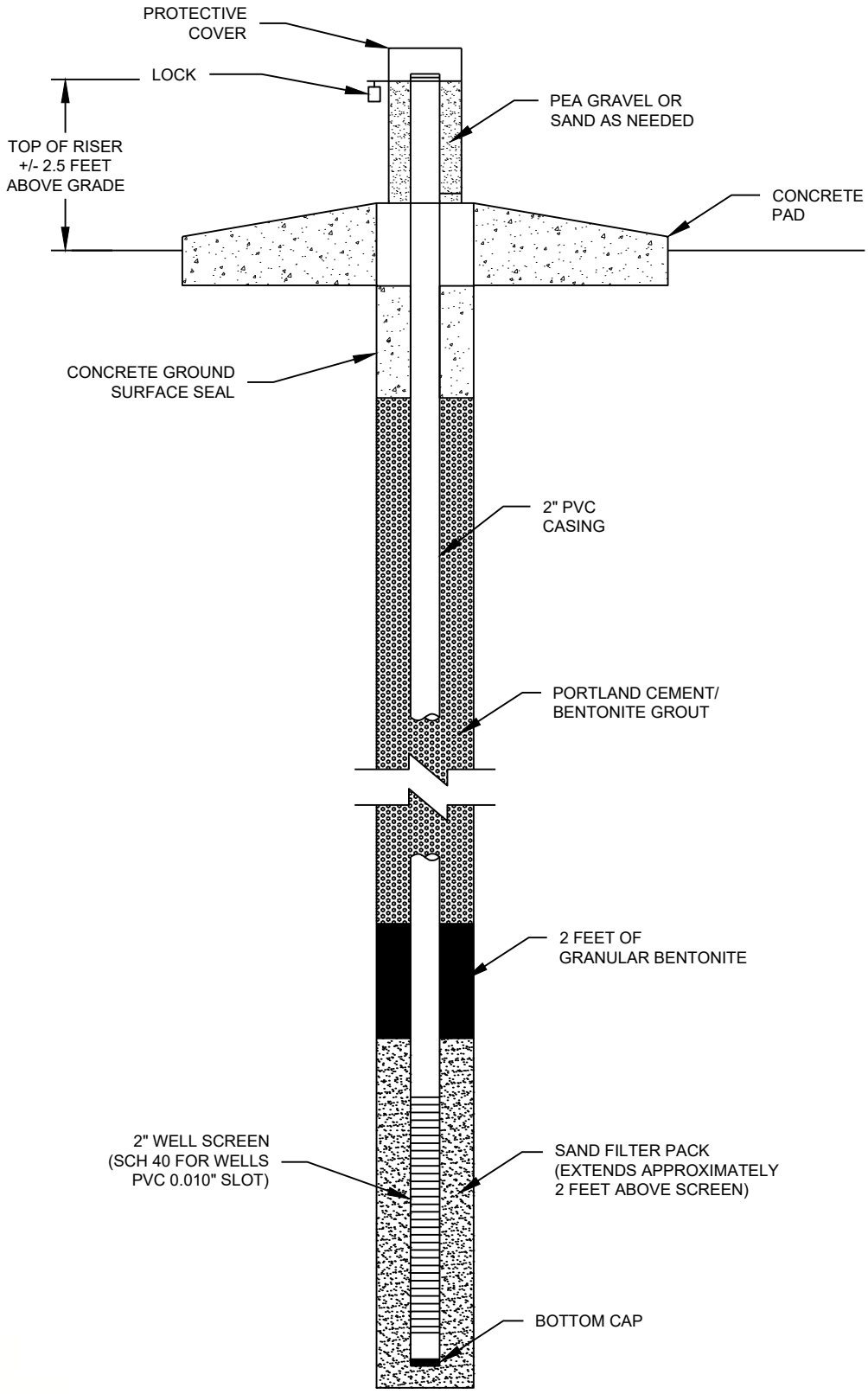
**Water Level Collection Summary Form - Bailly Generating Station, Chesterton, Indiana**
**Project No.: 191-21569**

Date: Inspector:

Arrival Time: Signature:

Leaving Time: Weather Conditions:

| Sample Point ID | WL Time | Ref Point | Depth to Water (ft btoc) | Sounded Well Depth | Locked? | Labeled? | PVC Cap? | Surface Seal OK? | Notes |
|---|---|---|---|---|---|---|---|---|---|
| GAMW-01 | | PVC | | | | | | | |
| GAMW-01B | | PVC | | | | | | | |
| GAMW-02 | | PVC | | | | | | | |
| GAMW-03 | | PVC | | | | | | | |
| GAMW-04 | | PVC | | | | | | | |
| GAMW-05 | | PVC | | | | | | | |
| GAMW-06 | | PVC | | | | | | | |
| GAMW-07 | | PVC | | | | | | | |
| GAMW-08 | | PVC | | | | | | | |
| GAMW-08B | | PVC | | | | | | | |
| GAMW-09 | | PVC | | | | | | | |
| GAMW-10 | | PVC | | | | | | | |
| GAMW-11 | | PVC | | | | | | | |
| GAMW-11B | | PVC | | | | | | | |
| GAMW-11C | | PVC | | | | | | | |
| GAMW-12 | | PVC | | | | | | | |
| GAMW-13 | | PVC | | | | | | | |
| GAMW-14 | | PVC | | | | | | | |
| GAMW-15 | | PVC | | | | | | | |
| GAMW-16 | | PVC | | | | | | | |
| GAMW-17 | | PVC | | | | | | | |
| GAMW-17B | | PVC | | | | | | | |
| GAMW-18 | | PVC | | | | | | | |
| MW-102 | | PVC | | | | | | | |
| MW-103 | | PVC | | | | | | | |
| MW-104 | | PVC | | | | | | | |
| MW-105 | | PVC | | | | | | | |
| MW-106 | | PVC | | | | | | | |
| MW-112 | | PVC | | | | | | | |
| MW-113 | | PVC | | | | | | | |
| MW-114 | | PVC | | | | | | | |
| MW-115 | | PVC | | | | | | | |
| MW-116 | | PVC | | | | | | | |
| Lake Level | | - | | NA | | | | | |




CLIENT
NIPSCO LLC

PROJECT
GROUNDWATER MONITORING PROGRAM

CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2016-07-08 |
| DESIGNED | RWC |
| PREPARED | JSP |
| REVIEWED | |
| APPROVED | |

TITLE
**TYPICAL MONITORING WELL CONSTRUCTION DIAGRAM**

| PROJECT NO. | SUBTITLE | REV. | FIGURE |
|---|---|---|---|
| 164-8171 | A | 0 | 1 |

# CHAIN-OF-CUSTODY Analytical Request Document

Pace Analytical®

Chain-of-Custody is a LEGAL DOCUMENT - Complete all relevent fields

**LAB USE ONLY- Affix Workorder/Login Label Here or List Pace Workorder Number or MTJL Log-in Number Here**

**ALL SHADED AREAS are for LAB USE ONLY**

| | |
|---|---|
| Company: | Billing Information: |
| Address: | |
| Report To: | Email To: |
| Copy To: | Site Collection Info/Address: |
| Customer Project Name/Number: | State: County/City: Time Zone Collected: [ ] PT [ ] MT [ ] CT [ ] ET |
| Phone: Email: | Site/Facility ID #: Compliance Monitoring? [ ] Yes [ ] No |
| Collected By (print): | Purchase Order #: Quote #: DW PWS ID #: DW Location Code: |
| Collected By (signature): | Turnaround Date Required: Immediately Packed on Ice: [ ] Yes [ ] No |
| Sample Disposal: [ ] Dispose as appropriate [ ] Return [ ] Archive: _____ [ ] Hold:_____ | Rush: [ ] Same Day [ ] Next Day [ ] 2 Day [ ] 3 Day [ ] 4 Day [ ] 5 Day (Expedite Charges Apply) Field Filtered (if applicable): [ ] Yes [ ] No Analysis: _____ |

* Matrix Codes (Insert in Matrix box below): Drinking Water (DW), Ground Water (GW), Wastewater (WW), Product (P), Soil/Solid (SL), Oil (OL), Wipe (WP), Air (AR), Tissue (TS), Bioassay (B), Vapor (V), Other (OT)

Container Preservative Type **

Lab Project Manager:

** Preservative Types: (1) nitric acid, (2) sulfuric acid, (3) hydrochloric acid, (4) sodium hydroxide, (5) zinc acetate, (6) methanol, (7) sodium bisulfate, (8) sodium thiosulfate, (9) hexane, (A) ascorbic acid, (B) ammonium sulfate, (C) ammonium hydroxide, (D) TSP, (U) Unpreserved, (O) Other _____

Analyses

Lab Profile/Line:

Lab Sample Receipt Checklist:

| | |
|---|---|
| Custody Seals Present/Intact | Y N NA |
| Custody Signatures Present | Y N NA |
| Collector Signature Present | Y N NA |
| Bottles Intact | Y N NA |
| Correct Bottles | Y N NA |
| Sufficient Volume | Y N NA |
| Samples Received on Ice | Y N NA |
| VOA - Headspace Acceptable | Y N NA |
| USDA Regulated Soils | Y N NA |
| Samples in Holding Time | Y N NA |
| Residual Chlorine Present | Y N NA |
| Cl Strips: _____ | |
| Sample pH Acceptable | Y N NA |
| pH Strips: _____ | |
| Sulfide Present | Y N NA |
| Lead Acetate Strips: _____ | |

LAB USE ONLY:
Lab Sample # / Comments:

| Customer Sample ID | Matrix * | Comp / Grab | Collected (or Composite Start) Date | Collected (or Composite Start) Time | Composite End Date | Composite End Time | Res Cl | # of Ctns |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
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Customer Remarks / Special Conditions / Possible Hazards:

Type of Ice Used: Wet Blue Dry None

Packing Material Used:

Radchem sample(s) screened (<500 cpm): Y N NA

SHORT HOLDS PRESENT (<72 hours): Y N N/A

Lab Tracking #:

Samples received via: FEDEX UPS Client Courier Pace Courier

Lab Sample Temperature Info:
Temp Blank Received: Y N NA
Therm ID#: _____
Cooler 1 Temp Upon Receipt: _____oC
Cooler 1 Therm Corr. Factor: _____oC
Cooler 1 Corrected Temp: _____oC
Comments:

| Relinquished by/Company: (Signature) | Date/Time: | Received by/Company: (Signature) | Date/Time: |
|---|---|---|---|
| Relinquished by/Company: (Signature) | Date/Time: | Received by/Company: (Signature) | Date/Time: |
| Relinquished by/Company: (Signature) | Date/Time: | Received by/Company: (Signature) | Date/Time: |

MTJL LAB USE ONLY

Table #:
Acctnum:
Template:
Prelogin:
PM:
PB:

Trip Blank Received: Y N NA
HCL MeOH TSP Other

Non Conformance(s): YES / NO

Page: _____
of: _____


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# Appendix F

**APPENDIX F**

# QUALITY ASSURANCE PROJECT PLAN CLOSURE APPLICATION

*Bailly Generating Station*
*Chesterton, IN*

Submitted to:

**Northern Indiana Public Service Company LLC**
801 East 86th Avenue
Merrillville, IN 46410

Submitted by:

**Golder Associates Inc.**
670 North Commercial Street, Suite 103
Manchester, NH 03101
+1 603 668-0880

191-21569

February 2021

# LIST OF ACRONYMS

| Acronym | Definition |
|---|---|
| AO | Agreed Order |
| AOC | Area of Concern |
| BGS | Bailly Generating Station |
| Golder | Golder Associates Inc. |
| ASTM | American Society for Testing and Materials |
| CCR | Coal Combustion Residuals |
| CO | Consent Order |
| COPC | Contaminants of Potential Concern |
| COPEC | Contaminants of Potential Ecological Concern |
| DQO | Data Quality Objective |
| EDD | Electronic Data Deliverable |
| EPA | Environmental Protection Agency |
| ERA | Ecological Risk Assessment |
| FTP | File Transfer Protocol |
| GC/ECD | Gas chromatography/electron capture detection |
| GC/MS | Gas chromatography/mass spectrometry |
| GIS | Geographical Information System |
| HASEP | Health, Safety, and Environmental Plan |
| HHRA | Human Health Risk Assessment |
| ICPES | Inductively Coupled Plasma Emission Spectroscopy |
| ICPMS | Inductively Coupled Plasma Mass Spectrometry |
| ID | Identification |
| IDEM | Indiana Department of Environmental Management |
| IDW | Investigation Derived Waste |
| LCS | Laboratory Control Sample |
| LCSD | Laboratory Control Sample Duplicate |
| MDC | Minimum Detectable Concentration |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| NCR | Nonconformance Report |
| NIPSCO LLC | Northern Indiana Public Service Company LLC |
| OSHA | Occupational Safety and Health Administration |
| PC | Personal Computer |
| PE | Performed Evaluation |
| PID | Photoionization Detector |
| PM | Project Manager |
| QA/QC | Quality Assurance/Quality Control |
| QAM | Quality Assurance Manual |
| QAPP | Quality Assurance Project Plan |
| RFI | RCRA Facility Investigation |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| RER | Relative Error Ratio |
| SOP | Standard Operating Procedure |
| SPLP | Synthetic Precipitation Leaching Procedure |
| SRM | Standard Reference Material |
| SWMU | Solid Waste Management Unit |
| SVOCs | Semi-volatile Organic Compounds |
| USGS | United States Geological Survey |
| WP | RFI Work Plan |

# Table of Contents

**TABLES**

**FIGURES**



**APPENDICES**

# 1.0 PROJECT DESCRIPTION

In accordance with an Indiana Department of Environmental Management (IDEM)-approved closure application, Northern Indiana Public Service Company LLC (NIPSCO LLC) will perform closure by removal of four surface impoundments at the Bailly Generating Station (BGS or Site) located in Chesterton, Indiana including Primary Settling Pond No. 1, Secondary Settling Pond No. 1, Primary Settling Pond No. 2, and Boiler Slag Pond. Following closure, NIPSCO LLC will implement a post-closure groundwater monitoring program, which will include a stand-alone Sampling and Analysis Plan (SAP) and a Quality Assurance Project Plan (QAPP).

This QAPP presents the organization, planned activities and specific quality assurance and quality control (QA/QC) procedures to support the post-closure groundwater monitoring program. Specific protocols for sampling, sample handling and storage, chain of custody and laboratory and field analyses will be described. All QA/QC procedures will be structured in accordance with applicable technical standards including U.S. Environmental Protection Agency's (EPA's) requirements, regulations, and IDEM guidance and technical standards.

This QAPP has been prepared in accordance with the U.S. EPA Region V RCRA QAPP Instructions, April 1998 and incorporates guidance of the U.S. EPA Requirement for Quality Assurance Project Plans; U.S. EPA QA/G5, EPA/240/R-02/009, dated December 2002; Guidance for the Data Quality Objectives Process; U.S. EPA QA/G4, August 2000, Test Methods for the Evaluation of Solid Waste: Physical/Chemical Methods, 3rd Edition (EPA SW-846, 1986), and Indiana State Solid Waste regulations (329 IAC Rule 10).

## 1.1 Introduction

Golder Associates Inc. (Golder) has prepared this QAPP for NIPSCO LLC. This document has been appended to the Coal Combustion Residual Surface Impoundment Closure Application, Bailly Generating Station, Northern Indiana Public Service Company LLC, Merrillville, Indiana, dated December 2020, prepared by Wood Environment & Infrastructure Solutions, Inc (Wood). The Closure Application discusses much of the background for the planned closure by removal program and is referenced throughout this QAPP.

### 1.1.1 Overall Project Objectives and Decision Statements

The objectives of the closure program are to excavate and remove source materials from the four impoundments and then monitor groundwater to assess the presence or absence, as well as the nature and extent, of groundwater impacts associated with the impoundments to determine changes in groundwater quality and flow direction. Overall objectives of the data collection effort will be to:

- Monitor groundwater quality during the post-closure period
- Verify groundwater gradients, flow direction, flow rates, and potential areas of discharge

Target parameter and reporting limit goals for the QAPP are summarized in Tables 1.1. Associated specific objectives for field and laboratory data collection are tabulated in Section 1.4 of this QAPP.

### 1.1.2 Project Status/Phase

The Closure Application has been designed to allow collection of sufficient samples to meet program objectives. The field assessment will include the following activities:

- Measurement of water levels in 21 post-closure monitoring wells and 12 piezometers

- Collection of groundwater samples from 21 monitoring wells
- Analyses of groundwater for selected metals and inorganics

### 1.1.3 QAPP Preparation Guidelines

This QAPP has been prepared in accordance with U.S. EPA Region 5 RCRA QAPP Instructions (April 1998), and IDEM's Office of Land Quality (OLQ) Quality Assurance Project Plan Guidance.

### 1.1.4 Current Conditions

The Closure Application provides a discussion of the current facility operations, waste management practices, and relies on data collected as regulated by the CCR Rule.

## 1.2 Project Objectives and Intended Data Usages

The project objective is to provide defensible results to assess groundwater conditions and to support additional project needs (e.g., remediation system design and monitoring). Data will be screened against developed and accepted environmental benchmarks determined to be appropriate for this Site.

### 1.2.1 Project Target Parameters

NIPSCO LLC proposes a monitoring parameter list that is appropriate to the site environmental, industrial (e.g., adjacent to ArcelorMittal Steel Mill), and geological background conditions; historical Site investigation findings; impoundment waste management history; and current monitoring provisions of the CCR Rule. From the perspective of evaluating potential post-closure impacts to water quality, the results generated from this approach will be amenable to applying either statistical-based (e.g., intra-well or inter-well) or standards-based comparisons. Consistent with the CCR Rule monitoring requirements, the post-closure monitoring parameter list will include:

| | |
|---|---|
| Field-based Water Quality Parameters | pH, specific conductivity (SC), temperature, turbidity, oxidation-reduction potential (ORP) |
| 40 CFR, Part 257 Appendix III Detection Monitoring Parameters | Boron, calcium, chloride, fluoride, sulfate, total dissolved solids (TDS), pH |
| 40 CFR, Part 257 Appendix IV Assessment Monitoring Parameters | Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, selenium, thallium, radium 226 and 228 (combined) |

Analytes and their method detection limits (MDLs) and reporting limits (RLs) in milligrams per liter (mg/l) for this program are listed below in Table 1-1. The RL and MDL are not applicable for radium. Radium results will have a sample-specific minimum detectable concentration (MDC).

**Table 1-1: Target Analyte Metals and Inorganics**

| Analyte Description | CAS Number | RL | MDL |
|---|---|---|---|
| Antimony | 7440-36-0 | 0.00100 | 0.000160 |
| Arsenic | 7440-38-2 | 0.00100 | 0.000490 |
| Barium | 7440-39-3 | 0.00100 | 0.00110 |
| Beryllium | 7440-41-7 | 0.00020 | 0.0000530 |
| Boron | 7440-42-8 | 0.100 | 0.0110 |
| Cadmium | 7440-43-9 | 0.00020 | 0.0000610 |
| Calcium | 7440-70-2 | 1.00 | 0.240 |
| Chromium | 7440-47-3 | 0.00200 | 0.000600 |
| Cobalt | 7440-48-4 | 0.00100 | 0.0000210 |
| Lead | 7439-92-1 | 0.00100 | 0.000110 |
| Lithium | 7439-93-2 | 0.00800 | 0.000290 |
| Mercury | 7439-97-6 | 0.000200 | 0.0000900 |
| Molybdenum | 7439-98-7 | 0.00100 | 0.000230 |
| Selenium | 7782-49-2 | 0.00100 | 0.000250 |
| Thallium | 7440-28-0 | 0.00100 | 0.0000740 |
| Total Dissolved Solids | STL00242 | 10.0 | 7.40 |
| Chloride | 16887-00-6 | 0.25 | 0.130 |
| Fluoride | 16984-48-8 | 0.0500 | 0.00900 |
| Sulfate | 14808-79-8 | 0.25 | 0.130 |
| Combined Radium 226 + 228 | STL02186 | NA | NA |

## 2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

NIPSCO LLC holds responsibility for all phases of the post-closure groundwater monitoring program. NIPSCO LLC has contracted Golder to perform the groundwater monitoring program, prepare the reports, and perform

subsequent studies, if required. Golder will provide project management support to NIPSCO LLC. The various quality assurance, field, laboratory, and management responsibilities of key project personnel are provided in the flowing sections.

## 2.1 Project Organization Chart

Figure 1 presents the lines of authority specific to this post-closure monitoring program.

## 2.2 Management Responsibilities

### 2.2.1 NIPSCO LLC Project Manager

The NIPSCO LLC project manager (PM), to be identified prior to closure and post-closure plan approval by IDEM, will be responsible for implementing the project and has the authority to commit the resources necessary to meet project objectives and requirements. Their primary function is to ensure that technical, financial, and scheduling objectives are achieved successfully. The NIPSCO LLC PM will review the work performed on each task to verify its quality, responsiveness, and timeliness. The NIPSCO LLC PM is ultimately responsible for the preparation and quality of interim and final reports and he will approve all reports before submission to IDEM. He/she will represent the company and project team at agency meetings and public involvement activities.

### 2.2.2 IDEM Project Manager

The IDEM Project Manager, to be identified prior to closure and post-closure plan approval by IDEM, will be responsible for communicating with NIPSCO LLC and providing direction and clarification of post-closure related activities, as necessary. The IDEM PM will be the point of contact for all communication with IDEM.

### 2.2.3 Golder Program Manager

The Golder Program Manager, Mr. Mark Haney will report to NIPSCO LLC's PM. Mr. Haney will act as the direct line of communication between Golder and NIPSCO LLC and is responsible for all Golder post-closure activities completed on behalf of NIPSCO LLC under the approved closure application. Project quality, accountability, and leadership responsibility throughout all phases of the project will be vested in the Golder Program Manager. He is the primary focal point for control of the project activities. Mr. Haney will be supported by QA personnel, who will provide reviews, guidance, and technical advice on project execution issues. The project team, consisting of supervisory, health and safety, and technical personnel, will support Mr. Haney so that the project meets professional standards, is safely executed, and complies with applicable laws, regulations, statutes, and industry codes. Individuals of the project team are responsible for fulfilling appropriate portions of the project QA program, in accordance with assignments made by Mr. Haney. Mr. Haney is responsible for satisfactory completion of the project QA program. He may assign specific responsibilities to other members of the project staff. Mr. Haney will notify NIPSCO LLC of any long-term changes in core personnel. Mr. Haney is responsible to NIPSCO LLC that the project meets the IDEM closure application approval technical objectives and quality requirements. Mr. Haney will direct the preparation of interim and final reports to IDEM as required under the closure application approval.

### 2.2.4 Golder Technical Coordinator

The Golder Technical Coordinator, Mr. James Peace, will report directly to the Golder Program Manager and will assume the responsibilities of project management in his absence. Mr. Peace will provide the overall day-to-day programmatic guidance to the field team, subcontract laboratory and driller, and support staff and will verify that post-closure monitoring-related documents, procedures, and project activities meet Golder standards for quality. He will assist Mr. Haney in developing detailed work schedules and will monitor field activities. In addition, he will fill a key role in the interpretation and reporting of findings in the post-closure monitoring reports.

### 2.2.5 Quality Assurance Coordinator

The Golder QA manager, Ms. Danielle Sylvia Cofelice, reports directly to Mr. Haney and is responsible for ensuring that Golder procedures for this project are being followed. Ms. Sylvia Cofelice has assisted Mr. Haney with the preparation of the QAPP. She will provide direction and oversight for the laboratory program and will be responsible for data validation and data quality assessment.

## 2.3 Laboratory Responsibilities

Pace Analytical Services (Pace), Indianapolis, IN and/or Greensburg, PA will be responsible for all analytical work. Ms. Tina Sayer is the Pace Program Manager for all NIPSCO LLC work with Pace. Ms. Sayer coordinates NIPSCO LLC work within the Pace laboratories and ensures that appropriate resources are committed and that project requirements are understood and met. Ms. Sayer will communicate as needed with Golder and will be responsible for providing bottles and supplies, monitoring progress in the laboratory and overseeing production and final review of all reports. NIPSCO LLC maintains contractual relationships with additional laboratories (i.e., ALS) and as necessary due to capacity, response time or other conditions, may replace Pace with ALS or another laboratory. If such change is made, Golder will provide this QAPP to the replacement lab with the caveat that the replacement lab must adhere to all other conditions of the QAPP.

## 2.4 Field Technical Staff

### 2.4.1 Field Team Leader and Health and Safety Officer

Golder will identify the field team leader prior to mobilizing to the field. This person will be the field lead geologist/engineer and field team leader for this project, as well as the Health and Safety Officer. The field team leader will coordinate field mobilization activities and be on-site during sampling activities. He/she will oversee all phases of work at the Site that generates data. Specific responsibilities include:

- Daily coordination with NIPSCO LLC personnel regarding field activities and logistical issues
- Management and supervision of all field personnel, including subcontractors
- Implementing QC requirements for field measurements and documentation of field activities
- Adhering to work schedules as established by the Project Director
- Communicating with the laboratory for timely delivery of supplies
- Advising the laboratory of any changes to scheduled sample submittals
- Performing the sampling in accordance with approved procedures and methodologies, that QA/QC samples have been collected as required, and that sampling forms, labels, chain-of-custody forms, and custody seals have been prepared correctly
- Directing the packaging and delivering or shipping samples to the laboratory
- Identifying any problems at the field team level, resolving issues in consultation with Mr. Peace and Mr. Haney
- Contributing to required reports
- The field team leader will provide as appropriate daily or weekly updates to Mr. Peace and Mr. Haney regarding progress and will report on any technical or logistical issues that arise

- Maintaining and implementing the site-specific Health, Safety, and Environmental Plan (HASEP)
- Approving any changes in the HASEP due to modifications of procedures or newly proposed site activities related to the RFI Workplan
- Providing health and safety issues coordination between the Golder Project Director, the NIPSCO LLC Project Manager, and other contractors on the project
- Resolving outstanding safety issues which arise during the conduct of site work
- Assigning health and safety-related duties to qualified field team individuals
- Checking that before personnel work on Site, acceptable medical examinations are current
- Checking the acceptability of health and safety training
- Issuing authorization, in cooperation with the project manager, to proceed with work after a STOP WORK action has been issued on Site

### 2.4.2 Additional Field Technical Staff

The Field Team will be composed of technical staff drawn from Golder's pool of company resources. The technical team staff will be utilized to gather and analyze data, and to prepare various task reports and support materials. All the designated technical team members are experienced professionals who possess the degree of specialization and technical competences required to perform the required work effectively and efficiently. Specific individual responsibilities will include:

- Provision of day-to-day assistance on technical issues in specific areas of expertise
- Maintaining field logs and transferring data for permanent storage
- Coordination and oversight of technical efforts of subcontractors assisting the field team
- Identifying problems at the field team level, resolving difficulties in consultation with the PM, implementing and documenting corrective action procedures, and providing communication between team members and upper management
- Participating in preparation of the final report

Mr. Jeffrey Neumeier, NIPSCO LLC Environmental Coordinator, will provide on-site coordination and logistical support to Golder to facilitate the field sampling program.

## 2.5 Special Training Requirements and Certification

All Golder and subcontractor field personnel on-site shall have completed OSHA training in accordance with the Code of Federal Regulations (CFR) in 40CFR 1910.120 and will have been trained regarding the requirements stated in this QAPP, and the Golder HASEP. Field auditors will require knowledge of this QAPP, Field Sampling Plan, and the Site activities to provide a complete review of field procedures.

# 3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective for this program is to provide defensible results to assess groundwater conditions and to support additional project needs (e.g., remediation system design and monitoring). To meet this objective,

procedures for field sampling, laboratory analysis, COC and reporting have been developed and will be implemented that will result in data of known and acceptable quality. All aspects of the sampling and testing will adhere to rigorous QA/QC procedures.

The parameters that will be used to assess measurement data quality are precision, accuracy, representativeness, comparability, completeness, and sensitivity. These parameters are discussed in the following sections. Media-specific evaluation criteria for these parameters may be specified in the analytical method, developed by the laboratory based on their historical performance or contained in EPA guidance for data validation. Table 3-1 summarizes the quality assurance measures that will be used to evaluate measurement data quality. Data quality objectives (DQOs) are established for these on method and matrix specific bases.

**Table 3-1: Measurement Data Quality Evaluation Parameters**

| Data Quality Indicator | QA Parameter |
|---|---|
| Precision | Field Duplicate<br>Laboratory Duplicate<br>Laboratory Spike Duplicate Matrix Spike Duplicate |
| Accuracy | Standard Reference Materials<br>Matrix Spike<br>Surrogate Spikes<br>Initial Calibration Standards and Blanks Laboratory Control Samples<br>Trip Blank<br>Field Blank<br>Method Blank |
| Representativeness | Holding Times and Preservation Chain of Custody<br>Field Blanks<br>Method Blanks |
| Comparability | Method Detection Limits<br>Method Reporting Limits<br>Sample Collection Methods Laboratory Analytical Methods |
| Completeness | Sample Collection Records<br>Reported Valid Results vs. Requested Data Qualifiers<br>Laboratory Deliverables |
| Sensitivity | Method Detection and Reporting Limits Compared to Project Toxicity Benchmarks |

## 3.1 Precision

Precision is the measure of the reproducibility among individual measurements of the same property, usually under similar conditions, such as multiple measurements of the same sample. Both sampling and laboratory precision will be evaluated using field duplicates; laboratory precision will also be evaluated using matrix spike/matrix spike duplicates (MS/MSDs), laboratory duplicates, and Laboratory Control Samples/Laboratory Control Sample Duplicates (LCS/LCSDs).

Precision for this program will be assessed by duplicate analyses for all parameters. The precision of measurements in environmental samples can be affected by the nearness of a chemical concentration to the

method detection limit, relative percent difference (RPD) may be high for small absolute differences, or by sample non-homogeneity. The equations to be used for precision are found in Section 11 of this QAPP.

Field duplicates, which reflect the overall precision of the sampling and analysis scheme, will be collected at a rate of one duplicate per 10 field samples for each matrix. Table 6-1 includes precision control limits for field parameters. Precision related to sample collection in the field will be monitored as the concentration difference between field duplicates. The DQO for RPD between field duplicates for samples with analyte concentrations greater than five times the reporting limit (RL) will be less than or equal to 30% for aqueous samples. The DQO for absolute concentration difference between samples with concentrations less than five times the RL will be less than or equal to the corresponding RL. If these DQO goals are not met, Golder will investigate possible causes and will discuss the results of the investigation and any effect on data usability in the data quality evaluation report.

Laboratory precision for metals analyses will be evaluated through replicate analyses of one per 20 field samples. All sample batches that do not include matrix spikes will have duplicate laboratory control sample analyses to demonstrate precision. Tables 3-2 through 3-4 include precision control limits that will be applied to evaluate laboratory performance and data quality. For sample results less than five times the RL, the precision control limit is the absolute concentration difference should be less than the RL.

## 3.2 Accuracy

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Accuracy may be expressed as the percent difference between two measured values, as a percentage of the true or reference value, or as a percent recovery in those cases where spiked samples are analyzed.

Accuracy criteria for reference materials and calibration verification are specified in the analytical methods. Accuracy measurements for spiked samples can be affected by sample non-homogeneity when the compound spiked is already present in the sample as collected. In general, accuracy criteria are not applicable for matrix spikes unless the amount spiked is equal to or greater than 25% of the native concentration of that chemical.

Accuracy may also be affected by the presence of target analytes in laboratory or field blanks. Inadvertent contamination of field samples may cause false positives or bias sample results.

MS/MSD and LCS/LCSD samples are not required for total dissolved solids of radium. Tables 3-2 through 3-4 provide accuracy and precision objectives for this Closure Application.

**Table 3-2: QC Objectives for the Analyses of Metals by Inductively Coupled Plasma Mass Spectrometry**

| Method | Analyte | Accuracy Water (% R) | Precision Water (% RPD) |
|---|---|---|---|
| SW846 6010C | Boron | 75-125 | 20 |
| | Calcium | 75-125 | 20 |
| | Lithium | 75-125 | 20 |
| SW846 6020A | Antimony | 75-125 | 20 |
| | Arsenic | 75-125 | 20 |
| | Barium | 75-125 | 20 |
| | Beryllium | 75-125 | 20 |
| | Cadmium | 75-125 | 20 |
| | Chromium | 75-125 | 20 |
| | Cobalt | 75-125 | 20 |
| | Lead | 75-125 | 20 |
| | Molybdenum | 75-125 | 20 |
| | Selenium | 75-125 | 20 |
| | Thallium | 75-125 | 20 |

**Table 3-3: QC Objectives for the Analyses of Mercury**

| Method | Analyte | Accuracy Water (% R) | Precision Water (% RPD) |
|---|---|---|---|
| SW846 7470A | Mercury | 75-125 | 20 |

**Table 3-4: QC Objectives for the Analyses of Anions, Ion Chromatography**

| Method | Analyte | Accuracy Water (% R) | Precision Water (% RPD) |
|---|---|---|---|
| SW846 9056A | Chloride | 80-120 | 15 |
| | Fluoride | 80-120 | 15 |
| | Sulfate | 80-120 | 15 |

## 3.3 Completeness

Completeness is the measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness will be evaluated for each method, matrix, and analyte combination to prevent misinterpretation of the data and to meet the needs of the sampling program.

The DQO for completeness for all components of this project is 90%. Data that have been qualified as estimated because the quality control criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness.

## 3.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represents an environmental condition, characteristic of a population, parameter variations at a sampling point, or a process condition. Consideration of field conditions, sampling locations, numbers of samples, and analyses conducted are all required to ensure representativeness.

For this project, the parameters selected for analysis have been identified as metals and organics potentially associated with coal-fired utility generation. Representativeness will be ensured by compliance with the plans for both field and laboratory activities.

To achieve acceptable representativeness, sample results must not be affected by conditions that would lead to false positives or false negatives. Representativeness will also be evaluated through field and laboratory QA measures, including COC records, holding time and preservation, and field and method blanks.

## 3.5 Decision Rule

During future evaluation of post-closure groundwater monitoring data, NIPSCO LLC may use appropriate risk screening criteria, cleanup objectives, and points of compliance under current and reasonably expected future land use scenarios. NIPSCO LLC and Golder will review groundwater results considering the nature of the constituents detected, background concentrations, potential human exposure and present ecological habitats and communities, if any. Golder will develop appropriate Site-specific criteria based on remediation goals and screening levels or benchmarks.

Golder may use the following Site-specific clean-up and risk screening levels, including but not limited to:

- IDEM Remediation Closure Guide (RCG) Commercial/Industrial Screening Levels (2020)
- U.S. EPA Maximum Containment Levels (MCLs)
- Great Lakes Screening Criteria (GLI) = Tier I and Tier II Criteria for the Great Lakes System Not Adopted into Rules and Calculated Using Methodologies at 327 IAC 2-1.5-11; 13-14
- Calculated background groundwater concentration levels

## 3.6 Comparability

Comparability expresses the confidence with which one data set can be evaluated in relation to another data set. For this corrective action, comparability of data will be established using project-defined sampling and analytical methods and reporting limits and formats that are consistent with standard practices and with comparable

monitoring programs. The use of common, traceable calibration and reference materials from the National Institute of Standards and Technology or other established sources will allow comparability of analytical results to those from other studies.

## 3.7 Sensitivity

A critical component of this post-groundwater monitoring program is the analytical sensitivity. To the extent feasible, analytical sensitivities as provided in Table 1.1 are consistent with potential screening criteria for human health, ecological risk and corrective measures requirements as included in the guidance cited in Section 3.5.

The MDL is defined as the minimum concentration at which a given target analyte can be measured and reported with 99% confidence that the analyte concentration is greater than zero. Laboratory RLs are defined as the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. Laboratory MDLs and RLs have been used to evaluate the method sensitivity and/or applicability prior to the acceptance of a method for this program.

The sample-specific MDL and RL will be reported by the laboratory and will take into account any factors relating to the sample analysis that might decrease or increase these values (e.g., dilution factor, percent moisture, sample volume, sparge volume). In the event that the MDL and RL are elevated for a sample due to matrix interferences and subsequent dilution or reduction in the sample aliquot, the data will be evaluated by Golder and the laboratory to determine if an alternative course of action is required or possible.

## 3.8 Level of Quality Control Effort

Field and method blanks, field and laboratory duplicates, laboratory control samples, standard reference materials, matrix spike samples and surrogates are among those quality assurance samples critical to data quality assessment. Except where specified, the DQO goals for quality assurance parameters discussed below are not intended to be used as criteria for acceptance or rejection of data, but rather as guidance to indicate when further evaluation of data quality is needed. A summary of Method Quality Objectives (MQOs) related to these DQOs may be found in Tables 6-2 through 6-7.

### 3.8.1 Field Quality Control

Field quality control samples used to evaluate data quality are described below. The frequency of their collection is summarized in Table 3-5. Acceptance criteria for laboratory duplicates are given in Section 3.1. No analytes should be detected above the RL in field blanks.

Field Blanks

The field or equipment blank is a sample of reagent grade, analyte free, water poured into, over, or pumped through the sampling equipment (and if applicable, homogenization container), collected in a sample container, and transported to the laboratory for analysis in the same manner as environmental samples. These blanks are used to assess the effectiveness of equipment decontamination procedures and the potential for false positives for target analytes. Equipment blanks are prepared in accordance with American Standard Testing Method (ASTM) D 5088-90 (Practice for Decontamination of Field Equipment Used at Non-Radioactive Waste Sites) protocol and are used to monitor the effectiveness of the decontamination process. The frequency of collection of equipment rinsate blanks depends on the type of sampling and the equipment used. The equipment rinsate blank shall be analyzed for the same parameters as requested for the environmental samples collected at the sampling location.

Duplicates

Duplicate samples are collected to monitor the precision of the field sampling and analytical process as well as to provide information regarding the homogeneity of the sample matrix. One duplicate sample will be collected for every 10 samples.

**Table 3-5: Summary of Field QC Samples**

| Field QC Sample | Frequency | Comments |
|---|---|---|
| Field Duplicate | 1 duplicate per 10 field samples of each matrix | Groundwater |
| Field or Equipment Blank | 1 equipment blank per sample team per day based on sampling method using disposable equipment.<br>1 equipment blank per 10 samples with non- disposable sampling equipment.<br><br>1 field blank per 10 samples with dedicated sampling equipment. | Groundwater sampling with pumps and disposable tubing |
| Matrix Spike/Matrix Spike Duplicates (MS/MSD) | 1 per 20 samples matrix & matrix spike duplicates per media on a sequential basis. | Groundwater |

### 3.8.2 Laboratory Quality Control

Pace has written procedures addressing internal QA/QC. These procedures are detailed in the laboratory Quality Assurance Manuals, which are attached as Appendices A and B to this document. Pace QA/QC Coordinators are required to ensure that all personnel engaged in sample handling and analysis tasks have appropriate training.

Specific laboratory quality control measures are required to determine the precision and accuracy of the analyses and to demonstrate the absence of interferences or contamination by glassware or reagents. Laboratory quality control measures will, at a minimum, be consistent with specific method requirements. Requirements for the frequency of laboratory quality control samples, acceptance criteria and corrective action requirements are summarized in Tables 6-2 through 6-7.

If laboratory DQO goals are not met, the laboratory will investigate the cause of the DQO exceedances and include a discussion of the exceedances and any impact on data usability in the case narrative. If the cause of the DQO exceedances is determined to be laboratory error, the laboratory will re-prepare and/or reanalyze the sample as appropriate. This procedure is further detailed in Section 12.0

Recovery of analytes and surrogate compounds spiked into a sample matrix that do not meet the DQO s must be reflective of the sample matrix rather than laboratory procedural bias. All matrix-related recovery problems must be adequately documented in the laboratory report and raw data. Compliance with these DQOs will be assessed by comparison if analyte and surrogate recovery in the sample matrix to laboratory performance on method blanks and blank spikes, and through the data validation and verification process.

Laboratory Control Samples (LCS)

The LCS is a sample of analyte-free water spiked with known concentrations of all analytes listed in the QC acceptance criteria tables for each method. Each analyte in the LCS is to be spiked at a level less than or equal to the midpoint of the analyte calibration curve.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The MS is an aliquot of an environmental sample spiked with known concentrations of target analytes. The spiking occurs prior to sample preparation and analysis. Each analyte in the MS shall be spiked at a concentration less than or equal to the midpoint of the analyte calibration curve.

MS/MSD sets are prepared for organic analyses to provide measure of analytical precision and accuracy. Precision is evaluated for metals analysis by laboratory duplicates, so the MSD is not required.

Although the results of the project MS/MSDs are not used to control the analytical process, they are used to evaluate sample bias due to matrix.

Method Blank

The method blank is a sample of analyte-free matrix to which all reagents are added in the same volumes or proportions as are used in sample processing. The method blank monitors the presence or absence of contaminants originating from the laboratory and is required for each analysis and/or extraction batch. Method blanks for waters will be prepared from deionized laboratory water.

Internal Standards

Internal standards are measured amounts of certain compounds added after sample preparation or extraction. They are used in an internal standard calibration method to correct sample results for analysis efficiency. Internal standards shall be added to environmental samples, blanks, standards, and QC samples, in accordance with method requirements.

# 4.0 SAMPLING PROCEDURES

Golder selected sampling procedures to generate data of the requisite quality for the impoundment post-closure activities. A Site-specific Sampling and Analysis Plan (SAP) is provided as Appendix E to the Closure Application.

Site-specific sample identification numbers will be assigned prior to sample collection. Samples will be assigned unique field identifiers that provide information on the well location and whether the sample is a primary or QC sample. The sample/QA/QC naming conventions are detailed in Section 3.3 of the SAP and are summarized below. An example of the Site-specific sample number will consist of the following:

- Sample: GAMW-01-MMDDYY (two-digit month/day/year)
- MS: GAMW-01-MS-MMDDYY (matrix spike)
- MSD: GAMW-01-MSD-MMDDYY (matrix spike duplicate)
- FDNN-MMDDYY (Field Duplicate – NN is event blank number))
- FBNN-MMDDYY (Field Blank – NN is event blank number)

The laboratory will provide sample containers and will be certified clean, with traceability to specific certificate(s) from the commercial source. Bottle, preservation requirements and holding times are presented in Table 4-1.

**Table 4-1: Sample Containers, Preservatives and Holding Times**

| Analysis | Container and Volume | Preservative | Holding Time |
|---|---|---|---|
| pH, Specific Conductance, temperature, ORP, turbidity | Flow-through cell | None | 15 minutes (field analysis) |
| Mercury (total) | Plastic, 250 mL | HNO3 to pH<2 | 28 days |
| Metals (total) except mercury | Plastic, 250 mL | HNO3 to pH<2 | 6 months |
| Total Dissolved Solids (TDS) | Plastic, 500 mL | None | 7 days |
| Fluoride, Chloride, Sulfate | Plastic, 250 mL | None | 28 days |
| Radium 226/228 | Plastic, 2 x 1 Liter | HNO3 to pH<2 | 6 months |

Sample Labels:

Each sample will have an adhesive plastic or waterproof paper label affixed to the container and will be labeled at the time of collection. The following information will be recorded on the container label with a permanent marker at the time of collection:

- Project name
- Sample identification
- Date and time of sample collection
- Preservative type (if applicable)
- Initials of sampler
- Laboratory analysis requested

Shipment:

Samples to be shipped to the laboratory will be properly packaged in individual plastic bags and cushioned with bubble wrap to prevent damage. They will be placed in a cooler with a signed Chain of Custody (COC) form, ice (double bagged), a temperature blank, and shall be cooled to less than four degrees plus or minus two degrees Celsius (4° ± 2° C).

Samples may be shipped in coolers using an overnight courier, courier employed by the analytical laboratory, or delivered to the lab by field personnel. The shipping procedures for water samples will include the following steps:

- Place packing material (e.g., bubble wrap, etc.) in the bottom of a waterproof cooler

- Seal bottles in clear plastic bags and wrap each sample bottle using bubble wrap; place sample bottles in cooler and introduce packing material around and between bottles to prevent the bottles from touching each other or the sides of the cooler
- Place a temperature blank in the cooler
- Double-bag ice plastic bags and pack in the cooler on and around bottles
- Fill the cooler with packing material
- Sign and date the COC form and place paperwork in plastic bags and attach with masking tape or duct tape to the inside lid of the cooler
- Tape the drain shut
- Close the cooler and secure the lid by taping the cooler completely around with strapping tape at two locations
- Place the lab address on top of the cooler
- Put "This Side Up" labels and "Fragile" labels on the cooler
- Affix custody seals on the front right and back left corners of the cooler, sign, and date the seals, cover seals with wide, clear tape
- Attach shipping papers to the cooler

If samples are to be hand-delivered to the laboratory by field personnel, they should be sealed in plastic bags and placed securely in a cooler with double-bagged ice and with packaging material to protect them from breakage. A temperature blank is required. COC paperwork should be completed and dated, but it will not be necessary to affix custody seals or shipping labels on the cooler.

Upon shipment, the laboratory will be notified that a sample shipment is scheduled to arrive. An effort will be made to provide the laboratory with a one-week advance notice of sample shipment.

Each shipping container will be clearly marked with a sticker containing the originator's address. Any coolers that are not hand delivered will be shipped priority for overnight delivery. Coolers that are not hand delivered to the laboratory will have a custody seal affixed to the shipping container so that the shipping container cannot be opened without breaking the custody seal.

Shipments of samples from the field to the laboratory will typically occur within 48 hours of collection. Samples requiring analyses with short holding times will be identified and designated as such on the chain-of-custody forms and will be shipped on the date of collection, if possible.

# 5.0 CUSTODY PROCEDURES

Adherence to proper documentation and COC procedures is critical for data defensibility and quality. Samples and associated data must be traceable from the point of collection to the final reported laboratory results.

## 5.1 Field Documentation and Custody Procedures

Golder will use field forms and logbooks for data collection at the Site including the following information:

- Daily Drilling Summary
- Tailgate Safety Meetings
- Boring log and monitoring well information and associated sample collection points
- Groundwater Sampling Forms (Low-flow)

The field team will scan the field forms and logbook pages. Electronic data will be transferred either daily or weekly, depending on volume of data collected, via a password protected File Transfer Protocol Site (FTP) to the data management team for import into a commercially-available environmental management system called EQuIS®. Data will be backed up periodically to a secure remote server.

Field team members will also keep a daily record of significant events, observations, and measurements in bound field logbooks. The sampling documentation will contain information on each sample collected, and will include at a minimum the following information:

- Project name
- Field personnel on-Site
- Facility visitors
- Weather conditions
- Field observations and any deviations from the Facility Investigation Plan (Work Plan)
- Maps, listing of photographs taken, and/or drawings
- Date and time sample collected
- Sampling method and description of activities
- Identification or serial numbers of instruments or equipment used
- Deviations from the QAPP
- Conferences associated with field investigation activities

In general, sufficient information will be recorded during sampling to permit reconstruction of the event without relying on the memory of the field personnel.

The books will be permanently bound and durable for adverse field conditions. All pages will be numbered consecutively. All pages will remain intact, and no page will be removed for any reason. Notes will be taken in indelible waterproof, blue or black ink. Errors will be corrected by crossing out with a single line, dating, and initialing. The front and inside of each field logbook will be marked with the project name, number, and logbook number. The field logbooks will be stored in the project files when not in use and upon completion of each sampling event.

Sample collection checklists will be prepared prior to each sampling program. The checklist will include location designations, types of samples to be collected, and whether any QC samples are to be collected.

## 5.2 Chain of Custodies

Once collected, samples are considered to be in one's custody if they are: (1) in the custodian's possession or view; (2) in a secured location (under lock) with restricted access; or (3) in a container that is secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s).

Chain-of-custody records are used to document sample collection and shipment to a laboratory for analysis. The COC is an integral component of the sampling process and represents the permanent record of sample holding and shipment. COC(s) will be completed and sent with the samples for each shipment. If multiple coolers are sent to a single laboratory on a single day, forms will be completed and sent with each cooler.

The COC record will identify the contents of each shipment and maintain the custodial integrity of the samples. A locked seal will be placed across the front and back of each cooler containing samples when coolers are ready for shipment. All custody seals will be signed and dated. The chain-of-custody form will be cross-checked for errors and signed.

The Golder field representative will sign the "relinquished by" box and note the date, time, and air bill (if applicable). Until the samples are delivered, the custody of the samples will be the responsibility of the Golder field representative and will be kept in a secured area that is restricted to authorized personnel. A laboratory representative will check samples with their respective chain-of-custody form(s) into the laboratory, and the form will be signed and dated appropriately. The Golder field representative or staff member will retain one copy of the signed chain-of-custody form for the project files. The original chain-of-custody form will be returned to the Golder Project Manager (PM) with the analytical results to go into the project files.

## 5.3 Laboratory Sample Custody Laboratory Receipt and Log-In

The COC form will be signed on receipt by the laboratory to complete the custody chain. The condition of the samples upon receipt by the laboratory will be documented on a cooler receipt log or sample condition upon receipt form (prepared by the lab). This form will note sample integrity, preservation, temperature, custody seal condition, and will note any discrepancies between information on the sample labels and that on the chain-of-custody form.

Each sample will be logged into the laboratory system by assigning it a unique sample number. This number and the field sample identification number will be recorded on the laboratory report. Samples will be stored and analyzed according to specified EPA Methods. The original chain-of-custody form will be returned to the Golder PM for permanent storage.

Laboratory Sample Handling

Field samples may be held at the laboratory to form an analytical batch consisting of a maximum of 20 field samples that are of the same matrix or of similar composition, with the constraint that the method extraction and analysis holding times are not exceeded or jeopardized. Unless prevented by matrix, associated QC samples, including equipment blanks, duplicates, and project specific MS/MSDs, are to be extracted and analyzed with the field samples.

Groundwater samples shall be stored in limited access, temperature-controlled areas (refrigerators and coolers 4° ± 2°C, freezers less than 0° C), which are monitored for temperature during business days. All of the cold storage areas shall be monitored by thermometers which have been calibrated with a certified reference standard (the

laboratory Quality Assurance Manual (QAM) may be referenced for details regarding their sample storage policies and procedures – see Appendix A and B).

The sample holding time begins with the date (and time for samples with holding times less than 48 hours) the sample is collected and continues until the date and time the sample analysis is complete. Sample type, sample preservation, container type, volume requirements, analytical methods, and extraction and analysis holding times are summarized on Table 4-1. Samples not preserved or analyzed in accordance with these requirements may necessitate expediting the analysis (in the event the holding time is reduced) or possible resampling and reanalysis. The laboratory PM shall be responsible for prioritizing work to assure that holding times and project commitments are met. Any discrepancies will be noted on the appropriate form, and the Golder PM, or designee, will be immediately notified.

If not entirely consumed during analysis, organic analytical samples shall be stored, at least, until the analysis holding time has expired. All other analytical samples shall be kept for at least 90 days after submittal of the laboratory report. After these dates, the laboratory may dispose of all analytical samples according to local, state, and federal regulations. Unless otherwise notified by Golder, samples may be disposed 90 days after submittal if the specified laboratory report has been provided to Golder.

Analytical data records will be retained by the laboratory and in the Golder central project files. For all analyses, the data reporting requirements will include those items necessary to complete data validation, including copies of all raw data. The hardcopy deliverable requirements are specified in the Appendices of this QAPP.

All instrument data shall be fully restorable at the laboratory from electronic backup. Laboratories will be required to maintain all records relevant to project analyses for a minimum of seven years.

## 5.4 Final Evidence Files

The final evidence file will be the central repository for all documents, which constitute evidence relevant to sampling and analysis activities as described by this QAPP and includes all relevant records, reports, logs, field forms, and subcontractor reports. Golder will be responsible for the custody of the evidence files and maintain the contents of the files for the duration of the project. The files will include at a minimum:

- Field logbooks
- Field data
- Laboratory data deliverables
- Data validation reports
- Data assessment reports
- Progress reports, QA reports, interim project reports
- All original custody documentation (COC forms, airbills, etc.)
- Copies of all communications with IDEM (letters, e-mails, telephone logs)

# 6.0 CALIBRATION PROCEDURES AND FREQUENCY

## 6.1 Field Instrument Calibration

Field instruments will be calibrated daily in accordance with the manufacturer's instructions. A log will be kept of the calibration check activities for all field instruments by the field personnel. It will include the date of the calibration check, description of the check standard, the reading obtained, and the initials of the person performing the calibration check. The standards used for calibration will be commercially prepared solutions and gases obtained from reputable vendors. Expiration of solutions and gases will be checked, and they will be discarded when expiration dates are reached. Field Sampling Team will perform all calibrations of the field equipment in accordance with manufacturers' recommendations. Calibration procedures for field instrumentation are described in SAP of the Closure Application. Calibration will be done at least daily.

Table 6-1 details field calibration and quality assurance requirements for this program.

**Table 6-1: Calibration and Quality Assurance Requirements for Field Analyses**

| Method | Applicable Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW9050A | Conductance | Calibration with KCl standard | Once per day at beginning of testing | ± 5% | If calibration is not achieved, check meter, standards, and probe; recalibrate |
| | | Field duplicate | 10% of field samples | ±5% | Correct problem, repeat measurement |
| SW9040C | pH (water) | 2-point calibration with pH buffers | Once per day | ± 0.05 pH units for every buffer | If calibration is not achieved, check meter, buffer solutions, and probe; replace if necessary; repeat calibration |
| | | pH 7 buffer | At each sample location | ± 0.1 pH units | Correct problem, recalibrate |
| | | Field duplicate | 10% of field samples | ± 0.1 pH units | Correct problem, repeat measurement |
| E170.1 | Temperature | Field duplicate | 10% of field samples | ± 1.0ºC | Correct problem, repeat measurement |
| E180.1 | Turbidity | Calibration with one standard per instrument range used | Once per day at beginning of testing | ± 5 units, 0-100 range ± 0.5 units, 0-0.2 range ± 0.2 units, 0-1 range | If calibration is not achieved, check meter; replace if necessary, recalibrate |
| | | Field duplicate | 10% of field samples | RPD 20% | Correct problem, repeat measurement |

| Method | Applicable Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| ASTM D1498 | Oxidation-reduction potential | Sensitivity verification | Daily | ORP should decrease when pH is increased | If ORP increases, correct the polarity of electrodes. If ORP still does not decrease, clean electrodes and repeat procedure |
| | | Calibration with one standard | Once per day | Two successive readings ± 10 millivolts | Correct problem, recalibrate |
| | | Field duplicate | 10% of field samples | ± 10 millivolts | Correct problem, repeat measurement |
| E360.1 | Dissolved oxygen | Field duplicate | 10% of field samples | RPD < 20% | Correct problem, repeat measurement |

All corrective actions shall be documented, and the records shall be maintained by Golder.

## 6.2 Laboratory Instrument Calibration

All the methods cited for this program have specific calibration requirements. In addition, those methods which rely on mass spectrometry (volatile and semi-volatile organics and metals by ICP/mass spectrometry) define instrument tuning requirements which must be satisfied prior to sample analyses.

Tables 6-2 through 6-7 detail the laboratory calibration and quality assurance requirements for each method.

**Table 6-2: Analytical Quality Control Requirements for the Analyses of Metals by EPA Method 6010C**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| Initial calibration (minimum 1 standard and a blank) | Daily initial calibration prior to sample analysis | If more than one standard is used, correlation coefficient must be 0.995 | If applicable, correct problem and repeat initial calibration |
| Initial calibration verification (second source) | Daily after initial calibration | All analytes within ±10% of expected value | Correct problem then repeat initial calibration |
| Calibration verification (Instrument Check Standard) | After every 10 samples and at the end of the analysis sequence | All analyte(s) within ±10% of expected value and RSD of replicate integrations <5% | Repeat calibration and reanalyze all samples since last successful calibration |
| Calibration blank | After every calibration verification | No analytes detected above RL | Correct problem then analyze calibration blank and previous 10 samples |
| Low level calibration check standard (at or below RL) | Once per analytical batch prior to sample analysis unless multi-point (3+) calibration with low std at or below RL is performed | All analyte(s) with ± 50% of expected value | Correct problem then reanalyze |
| Linear range calibration (high) check standard | Every three months | Analyte within ± 10% of expected value | Correct problem then reanalyze or re-set linear range |
| Method blank | One per analytical batch | No analytes detected above RL | No corrective action taken if MB > RL if samples are ND or if sample conc. > 10x the MB contaminant level. If any samples have analytes detected at < 10x the blank, correct problem then re-prep and analyze method blank and affected samples processed with the contaminated blank |
| Interference check solution (ICS) | At the beginning of an analytical run | Within ±20% of expected value | Terminate analysis; correct problem; reanalyze ICS; reanalyze all affected samples |

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| LCS for the analyte | One LCS per analytical batch | QC acceptance criteria, 80%-120% of expected results | Correct problem then reanalyze<br>If still out, re-prep and reanalyze the LCS and all samples in the affected NIPSCO LLC batch |
| Dilution test | Each new sample matrix, at least once per analytical batch (only applicable for analytes with concentrations >50X MDL) | Fivefold (1+4) dilution must agree within ±10% of the original determination | Perform post digestion spike addition |
| Post digestion spike addition | When dilution test fails or<br>if an analyte's concentration for all samples in a batch is less than 50X MDL | Recovery within 75-125% of expected results | Check for instrumental problem then reanalyze post digestion spike addition if appropriate |
| MS | One MS per every 20 NIPSCO LLC project samples per matrix | QC acceptance criteria, 75-125% of expected results | none |
| MDL study | Once per 12-month period | Detection limits established shall be < the RLs | none |

**Table 6-3: Analytical Quality Control Requirements for the Analyses of Metals by EPA Method 6020A**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action° |
|---|---|---|---|
| MS tuning sample | Prior to initial calibration and calibration verification | SW6020A paragraph 5.8 | Retune instrument then reanalyze tuning solution |
| Initial calibration (minimum 1 standard and a blank) | Daily initial calibration prior to sample analysis | If more than one standard is used, correlation coefficient must be 0.995 | If applicable, correct problem and repeat initial calibration |
| Calibration blank | Before beginning a sample run, after every 10 samples and at end of the analysis sequence | No analytes detected above RL | Correct problem then analyze calibration blank and previous 10 samples |
| Initial Calibration verification (Second source standard) | After initial calibration before beginning a sample run — at a concentration other than used for calibration | All analytes within ±10% of expected value | Correct problem then repeat initial calibration |
| Continuing Calibration verification | After every 10 samples and at the end of the analysis sequence | All analytes within ±10% of expected value | Correct problem then repeat calibration and reanalyze all samples since last successful calibration |
| Low level calibration check standard (at or below RL) | Once per analytical batch prior to sample analysis unless multi-point (3+) calibration with low std at or below RL is performed | All analyte(s) with ± 50% of expected value | Correct problem then reanalyze |
| Linear range calibration (high) check standard | Every three months | Analyte within ± 10% of expected value | Correct problem then reanalyze or re-set linear range |
| Method blank | One per analytical batch | No analytes detected above RL | Correct problem re-prep and analyze method blank and all samples processed with the contaminated blank |

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action° |
|---|---|---|---|
| Interference check solutions (ICS-A and ICS-AB) | At the beginning and end of an analytical run or once during a 12-hour period, whichever is more frequent | ICS-A: All non-spiked analytes < RL unless they are a verified trace impurity from one of the spiked analytes ICS-AB: Within ±20% of true value | Terminate analysis; locate and correct problem; reanalyze ICS; reanalyze all affected samples |
| LCS for the analyte | One LCS per analytical batch | QC acceptance criteria, 80-120% of expected results. | Correct problem then reanalyze |
| Dilution test | Each matrix in an analytical batch (only applicable for analytes with concentrations >100X MDL) | Five-fold (1+4) dilution must agree within ±10% of the original determination | Perform post digestion spike addition |
| Post digestion spike addition | When dilution test fails or if an analyte's concentration for all samples in a batch is less than 100x MDL | Recovery within 75-125% of expected results | Dilute the sample; reanalyze post digestion spike addition |
| MS | One MS per every NIPSCO LLC project samples per matrix | QC acceptance criteria, 75-125% of expected results. | none |
| Internal Standards (ISs) | Every sample | IS intensity within 30-120% of intensity of the IS in the initial calibration | Perform corrective action as described in method SW6020A, Section 8.3 |
| IDL study | Every three months | Detection limits established shall be <1 the RLs in Table 7.2.16-1 | none |
| MDL study | Every 12 months | | |

All corrective actions associated with NIPSCO LLC project work shall be documented, and all records shall be maintained by the laboratory.

**Table 6-4: Analytical Quality Control Requirements for the Analyses of Mercury by EPA Methods 7470A/7471B**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| Initial multipoint calibration (minimum 5 standards and a blank) | Daily initial calibration prior to sample analysis | Correlation coefficient >0.995 for linear regression | Correct problem then repeat initial calibration |
| Second-source calibration check standard | Once per initial daily multipoint calibration | Analyte within ±10% of expected value | Correct problem then repeat initial calibration |
| Calibration blank | Once per initial daily multipoint calibration | No analyte detected above RL | Correct problem then reanalyze calibration blank and all samples associated with blank |
| Calibration verification | After every 10 samples and at the end of the analysis sequence | The analyte within ±20% of expected value | Correct problem then repeat calibration and reanalyze all samples since last successful calibration |
| Method blank | One per analytical batch | No analytes detected above RL | No corrective action taken if MB > RL if samples are ND or if sample conc. > 10x the MB contaminant level. If any samples have analytes detected at < 10x the blank, correct problem then reprep and analyze method blank and all affected samples processed with the contaminated blank |
| LCS for the analyte | One LCS per analytical batch | QC acceptance criteria, 80-120% of expected results | Correct problem then reanalyze. If still out, re-prep and reanalyze the LCS and all samples in the affected AFCEE batch |
| Dilution Test | Each matrix in an analytical batch (only applicable for samples with concentrations >25X MDL) | Five-fold (1+4) dilution must agree within ±10% of the original determination | None |
| MS/MSD | One MS per every 20 NIPSCO LLC project samples per matrix | QC acceptance criteria, 75-125% of expected results | None |

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| MDL study | Once per 12-month period | Detection limits established shall be < the RLs | None |

All corrective actions associated with NIPSCO LLC project work shall be documented, and all records shall be maintained by the laboratory.

**Table 6-5: Analytical Quality Control Requirements for the Analyses of Anions, Ion Chromatography 9056A_28D**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| Laboratory control standard/ Initial calibration verification | Daily initial calibration prior to sample analysis | Analyte within ±10% of expected value | Correct problem then repeat initial calibration |
| Calibration blank | Prior sample analysis, following every 10 samples, and at the end of the analytical set | No analyte detected above RL | Correct problem then reanalyze calibration blank and all samples associated with blank |
| Calibration verification | After every 10 samples and at the end of the analysis sequence | The analyte within ±20% of expected value | Correct problem then repeat calibration and reanalyze all samples since last successful calibration |
| Duplicate sample | One per every 10 samples or per sample set, whichever is greater | <20% RSD for samples greater than RL | Re-prepare & re-analyze sample and duplicate once. Visually check sample for homogeneity. Discuss in narrative. |
| MS/MSD | One MS per every 20 NIPSCO LLC project samples per matrix | QC acceptance criteria, 80-120% of expected results | None |

All corrective actions associated with NIPSCO LLC project work shall be documented, and all records shall be maintained by the laboratory.

**Table 6-6: Analytical Quality Control Requirements for the Analyses of Total Dissolved Solids by EPA method 2540C_Calcd**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| Initial porcelain capsule check before analysis | Repeat weight measurement for 3 capsules per batch | Duplicate determination should agree within 5% of their average | Replace capsule |
| Analysis replicates | Triplicates every batch | RSD <20% | Re-run affected samples if possible or qualify data if re-run not possible. |
| Accuracy check laboratory fortified blank (LFB) containing NaCl 10 g/L | Once per batch | NaCl within ±20% of expected value | Re-run fresh LFB, if fails, re-run affected samples. |
| Laboratory blank | Once per batch | <2 mg/L | Investigate problem; reanalyze samples. |

All corrective actions associated with NIPSCO LLC project work shall be documented, and all records shall be maintained by the laboratory.

**Table 6-7: Analytical Quality Control Requirements for the Analyses of Radium 226 and 228 by EPA Methods 903.1 (Radium 226), EPA 904.0 (Radium 228)**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| Method Blank | 1 per batch of 20 (or 5% frequency) | No detects above MDC | Correct problem and reanalyze affected samples if possible or qualify data if re-run not possible. |
| Blank Spikes | 1 per batch of 20 (or 5% frequency) | QC acceptance criteria 70-130% of expected results | Correct problem and reanalyze affected samples if possible or qualify data if re-run not possible. |
| Laboratory Duplicate | Minimum frequency of 10% | RER <3 | Reanalyze affected samples once. If still high discuss in laboratory narrative. |
| Tracer/Carrier Limits | All blanks, QC samples, and samples | QC acceptance criteria of 40-110% of expected results | No corrective action taken if recovered above QC acceptance criteria and result is <MDC. Otherwise, correct problem then reanalyze associated samples. |

All corrective actions associated with NIPSCO LLC project work shall be documented, and all records shall be maintained by the laboratory.

# 7.0 INTERNAL QUALITY CONTROL CHECKS

## 7.1 Field Quality Control Checks

QC requirements and criteria for the field measurements are provided in Table 6-1 of this document. Assessment of field sampling precision and bias will be made by collecting field duplicates and equipment blanks. Collection of samples will be in accordance with the SAP provided in the Closure Application (Appendix E).

## 7.2 Laboratory Quality Control Checks

Each Pace lab has QC programs in place to ensure the reliability and validity of the analyses conducted and the data reported. All analytical procedures to be used for this program are documented in SOPs, as included in Appendices A and B to this QAPP.

All analysts supporting the NIPSCO LLC program will have completed a demonstration of proficiency by meeting method criteria for accuracy and precision criteria through replicate preparation and analyses of check standards. Other internal QC checks required are method-specific and have been included in Tables 6-2 through 6-7 of this document. Those tables also provide required corrective actions when QC criteria are not met.

All data will be properly recorded and stored by the laboratory. Data package requirements, as listed in Appendices, will allow Golder to reconstruct the reported results and QC measurements from raw data. All samples for which QC results indicate noncompliance will be reanalyzed by the laboratory if sufficient volume is available.

# 8.0 PERFORMANCE AND SYSTEM AUDITS

System audits and performance audits of field and laboratory activities may be performed to check compliance with the sampling and analytical directives. These audits will verify that sampling and analysis activities are performed in accordance with the established procedures. The QA Coordinator will be responsible for these audits.

## 8.1 Field Audits

### 8.1.1 Internal Field Audits

At the beginning of the project, the Golder Field Team Leader or Project Manager will conduct a thorough audit of field calibration, sampling, decontamination, and documentation procedures to verify that all staff are compliant with the requirements of the Closure Application, SAP, and this QAPP.

Field audits shall be performed by Golder field staff daily by a cross-checking the field logs, the Sample Collection Logs, the chain-of-custody, and the sample containers. Daily cross checking confirms sample identity, sample integrity, and sampling procedures and will be completed by the sampler prior to shipping the samples. Additionally, the field logs and the chain-of-custody will be sent to the Golder QA/QC Manager or Project Manager by facsimile for additional verification. NIPSCO LLC staff may conduct field audits at any time during the program.

### 8.1.2 External Field Audits

External field audits may be conducted by the IDEM Program Manager or his designee at any time. These audits may or may not be announced.

## 8.2 Laboratory Audits

### 8.2.1 Internal Laboratory Audits

Laboratory performance and system audits are addressed in the laboratory QAMs. Pace internal audits consist of general audits and specific procedure audits. A general audit is an overview of the whole laboratory from sample receipt to sample disposal for compliance with the QAM. A specific technical audit is a detailed in-depth review of an actual method or procedure. Internal audits are conducted on a scheduled basis both by the individual laboratory QC Managers and by Pace Corporate QA managers.

After the general and/or specific audits have been conducted, the laboratory QA manager completes a laboratory audit record form. Any issues, observations, and findings are discussed with the Laboratory Manager. The Laboratory Manager, Laboratory QA Manager, and other laboratory staff as necessary, suggest and implement corrective actions. The results of the audit are kept on file along with any corrective action taken. If, because of the audit, there is uncertainty as to the validity or correctness of a test result, immediate corrective action will be taken, and the client notified in writing.

Pace internal audits also involve the preparation and analysis of blind QC samples submitted through Pace's Corporate Quality Assurance Program. Results of these are used to evaluate the ongoing performance of the laboratory.

### 8.2.2 External Laboratory Audits

NIPSCO LLC maintains a formal laboratory audit program for their contracted laboratories. Independent environmental QA professionals are retained to support the NIPSCO LLC Laboratory Coordinator by conducting comprehensive system and performance audits. NIPSCO LLC has audited the Pace Indianapolis facility and determined that staff and instrumentation resources, procedures and systems are in place to provide data of the requisite quality for this program. Pace’s Greensburg, PA laboratory has been audited by state and federal agency auditors and hold appropriate certifications. Each lab routinely participates in performance testing programs.

# 9.0 PREVENTATIVE MAINTENANCE

## 9.1 Field Instrument Preventative Maintenance

In accordance with the QA program, Golder shall maintain an inventory of field instruments and equipment. The frequency and types of maintenance will be based on the manufacturer's recommendations and/or previous experience with the equipment.

The Golder Field Team Leader will be responsible for the preparation, documentation, and implementation of the preventative maintenance program. Golder anticipates using rental equipment and will periodically switch out pieces of equipment to allow the required maintenance while not sacrificing productivity. The Golder Project Manager, or designee, shall maintain the equipment calibration records received from the rental company and be responsible for verifying compliance with this section.

## 9.2 Laboratory Preventative Maintenance

In accordance with the QA program, the laboratories shall maintain an inventory of instruments and equipment and the frequency of maintenance will be based on the manufacturer's recommendations and/or previous experience with the equipment.

The laboratory preventative maintenance program, as detailed in their QA Plan, is organized to maintain proper instrument and equipment performance, and to prevent instruments and equipment from failing during use. The program considers instrumentation, equipment and parts that are subject to wear, deterioration or other changes in operational characteristics, the availability of spare parts, and the frequency at which maintenance is required. Any equipment that has been overloaded, mishandled, gives suspect results, or has been determined to be defective will be taken out of service, tagged with the discrepancy noted, and stored in a designated area until the equipment has been repaired. After repair, the equipment will be tested to ensure that it is in proper operational condition. The client will be promptly notified in writing if defective equipment casts doubt on the validity of analytical data.

Laboratory Group Supervisors will be responsible for the preparation, documentation, and implementation of the preventative maintenance program. All maintenance records will be checked according to the schedule on an annual basis and recorded by the responsible individual. The laboratory QA Officer, or designee, shall be responsible for verifying compliance.

# 10.0 SPECIFIC ROUTINE PROCEDURES TO EVALUATE DATA PRECISION, ACCURACY AND COMPLETENESS

As part of the data validation process, results for quality assurance measurements will be compared to the data quality objectives as presented in Section 3. In addition, the data will be reviewed for evidence of matrix interferences that may have biased results, cross contamination from field or laboratory activities, and any deviations from sampling and storage requirements that may have affected the integrity of the sample. The following calculations will be conducted as the first step of evaluating data quality for precision, accuracy, and completeness.

## 10.1 Precision

The relative percent difference between field duplicates, laboratory duplicates and matrix spike/matrix spike duplicates will be calculated as measures of precision.

$$RPD = \frac{\text{measured value} - \text{measured duplicate value}}{((\text{measured value} + \text{measured duplicate value})/2)} \times 100$$

Results that fall outside of the program objectives will be evaluated for evidence of possible sample non-homogeneity or possible bias from sampling or laboratory activities.

## 10.2 Accuracy

For calibration verification and continuing calibration check standards and laboratory control samples, recoveries are calculated in accordance with the following equation:

% Recovery = Measured Concentration X 100 Known concentration

Surrogate spike recoveries are calculated according to a comparable equation:

% Recovery = Measured concentration x 100

Expected concentration based on known amount added

Matrix spike recoveries will be calculated in accordance with the equation below:

Percent recovery = (amount in spike sample — amount in sample) x 100 Known amount added

## 10.3 Completeness

Completeness will be calculated as follows:

$$\text{Completeness} = \frac{\text{number of valid measurements}}{\text{total number of data points planned}} \times 100$$

Completeness will be calculated on an analysis basis. Although the program goal is greater than 90% completeness, professional judgment will be applied to evaluate the impact of any data gaps on the overall objectives of the program.

## 10.4 Assessment of Data

Data collected during the CCR groundwater monitoring program will be used to evaluate the nature and extent of possible impacts to Site groundwater. The QC results associated with each analytical parameter will be compared to the objectives of Section 3 in this QAPP. EPA guidance for data verification (EPA 2004) and for data usability in risk assessment (EPA 1992) will serve as the basis for final recommendations on data acceptance for decision making purposes.

Elements considered in this data usability report will include:

- Compliance of sampling methods with the SAP
- Compliance of analyses with QAPP methods and QC requirements
- Completeness of sampling effort
- Completeness of laboratory analyses
- Resolution of corrective action requirements
- Detection limits achieved
- Validation findings
- Specific needs for human health and ecological risk assessments, if needed
- Specific needs for remedial options

Golder will prepare a data usability report, incorporating the findings of the validation effort and other supporting information. This assessment will evaluate data on a matrix specific, analyte-specific, and location specific basis. The potential impact of any sampling discrepancies or data qualifications (rejected or estimated) on the intended uses for risk assessment will be discussed, with recommendations for further actions if necessary and appropriate.

# 11.0 CORRECTIVE ACTION

Any NIPSCO LLC or Golder project team member may initiate the field corrective action process. This process consists of identifying a problem, acting to eliminate the problem, documenting the corrective action, monitoring the effectiveness of the corrective action, and verifying that the problem has been eliminated. Although not all inclusive, examples of corrective actions for field measurements may include the following:

- Repetition of a measurement to check the error
- Resample the groundwater monitoring well if the container breaks
- Check for all proper adjustments for ambient conditions such as temperature
- Check of batteries
- Calibration checks
- Recalibration
- Replace instruments or measurement devices
- Stop work (if necessary)
- Revisions to information submitted on chain-of-custody forms
- Amendment of sampling procedures or Work Plans

Technical staff and project personnel will be responsible for reporting all technical or QA non-conformances or suspected deficiencies of any activity or issued document by reporting the situation to the PM and the QA/QC Coordinator on a Nonconformance Report (NCR). The QA/QC Coordinator will be responsible for assessing the suspected deficiency based on the potential for the situation to impact the quality of the data.

The Field Team Leader, or a designee, will be responsible for correcting equipment malfunctions throughout the field sampling effort and resolving situations in the field that may result in nonconformance or noncompliance with the QAPP. All corrective measures will be immediately documented in the field logbook, and sample alteration forms will be completed.

Additional corrective actions, if necessary, will be determined by the Project Manager. The Project Manager has the authority to initiate stop work orders, if necessary, and is responsible for ensuring that a corrective action for a nonconformance is initiated.

If appropriate, the Project Manager will be responsible for ensuring that no additional work that is dependent on the nonconforming activity is performed until the corrective action(s) is completed.

**Laboratory**

All laboratories are required to comply with the standard operating procedures previously submitted to the Project QA/QC Manager. The laboratory project managers will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this QAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

The Project QA/QC Manager will be notified immediately if any QC sample exceeds the project-specified control limits. The analyst will identify and correct the anomaly before continuing with the sample analysis. The

Laboratory Project Manager will document the corrective action taken in a memorandum submitted to the Project QA/QC Manager within five days of the initial notification. A narrative describing the anomaly, the steps taken to identify and correct it, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, re-extraction) will be submitted with the data package using a corrective action form. Copies of each laboratory's corrective action forms are found in their Quality Assurance Manuals.

# 12.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality assurance reports to management include verbal status reports and written reports on field sampling activities, laboratory processes, data validation reports and final project reports. These reports shall be the responsibility of the QA/QC Manager.

Progress reports will be prepared by the Field Team Leader following each sampling event. The Project QA/QC Manager will also prepare progress reports after the sampling is completed and samples have been submitted for analysis, when information is received from the laboratory, and when analysis is complete. The status of the samples and analysis will be indicated with emphasis on any deviations from the QAPP. A data report will be written after validated data are available for each sampling event. These reports will be delivered electronically to the Golder and NIPSCO LLC project managers.

# 13.0 DATA REDUCTION, VALIDATION AND REPORTING

This section describes the Data Management Plan (DMP) used by project staff responsible for field sampling, laboratory analysis, data validation, data evaluation and interpretation, and report preparation. Procedurally, all data generated by field and laboratory activities will be reduced and validated prior to reporting, including those data necessary for inclusion in both quarterly progress and investigation findings reports.

## 13.1 Data Reduction

Data reduction is the process by which original data (e.g., analytical measurements) are converted or reduced to a specified format or unit to facilitate analysis of the data.

### 13.1.1 Field Data Reduction Procedures

Golder will obtain RFI field measurements with instruments that provide direct readings for the parameters of interest (e.g., pH, specific conductivity). Field data will be recorded in a Site- and project-specific field logbook and/or field form immediately after measurements are made.

### 13.1.2 Laboratory Data Reduction Procedures

Laboratory data reduction requires that all aspects of sample preparation that could affect the test result, such as sample volume analyzed or dilutions required, be considered in the final result. It is the laboratory analyst's responsibility to reduce the data, which are subjected to further review by the Laboratory Project Manager, the Project Manager, the Project QA/QC Coordinator, and independent reviewers, if applicable. Data reduction may be performed manually or electronically. If data reduction is performed electronically, the user must demonstrate that the software is valid and free from unacceptable error.

## 13.2 Data Validation

### 13.2.1 Procedures Used to Validate Field Data

The Field Team Leader or designee will perform a review of field data and records as soon as reasonably possible following the completion of field activities and demobilization to confirm that they are complete and accurate including:

- Field Log Information
- Field Groundwater Measurement Results
- Groundwater Sample Collection Log
- Daily Sample Checklist
- Chain-of-Custody
- Sampling Methodology
- Instrument Selection and Use Including Calibration and Standardization
- Field Deviations
- Sampling Limitations

The sampling team member responsible for filing out the field forms and/or entering data into the logbook will sign the document(s). The Field Team leader will review and initial the field form and/or logbook to verify that the sample team followed the recording procedures.

### 13.2.2 Procedures Used to Validate Laboratory Data Laboratory Validation

Prior to submitting analytical data to Golder, the laboratory must verify compliance with the method requirements. The laboratory will follow their Quality Assurance Manual (QAM), Standard Operating Procedures (SOPs), and this project Quality Assurance Project Plan (QAPP) for all sample analyses. The laboratory will also be responsible for the oversight of the data quality for all analyses. The laboratory QA Officer will address and resolve any sample integrity issues, discrepancies with the chain of custody, or concerns with the analysis.

For each level, the review process shall be documented, signed, and dated by the reviewer. Each step of this review process shall include the evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review

The first level of review, by the analyst, shall include QC review, method compliance, and documentation accuracy. For data that are manually processed, all steps in the computation shall be provided including equations used and the source of input parameters such as response factors, dilution factors, and calibration constants, and shall be initialed and dated by the analyst and attached to the data sheets. For data entered into the computer, the analyst shall verify the sample specific and project specific information (i.e., project numbers, sample numbers, units, dilution factors).

The second level of review shall be performed by a supervisor, another analyst, or data review specialist. The function of this review is to provide an independent, complete peer review of the analytical data. This review shall include the review of QC performance, method compliance, documentation, calibrations, and identifications.

A third level of review is performed by the laboratory Program Manager, QA Officer, or designee. This review shall provide a total overview of the data package to ensure its compliance with project requirements. All errors and nonconformances noted shall be corrected and/or documented.

Complete review of raw data and all records may be conducted on randomly selected data packages by the laboratory QA Manager or designee. Every hardcopy data deliverable in the selected package shall be reviewed to ensure compliance with all requirements and review performance.

Non-conformance reports (NCRs) will be required for any errors noted. In all cases, an NCR shall be issued with the name of the individual reporting the issue, a description of the noncompliance issue, the corrective action taken, the date the issue was discovered, and the affected project samples. All employees are responsible for reporting the nonconformance. The appropriate supervisor is responsible for assuring that the corrective actions are taken.

### 13.2.3 Independent Data Validation

The Golder QA Coordinator, or designee, will review the definitive analytical chemistry data provided by the subcontract laboratory for the groundwater samples to Stage 2A as defined by Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA-540-R-08-005, January 2009). As provided by a Stage 2A review, the sample-related QC for the samples will be reviewed for compliance with the measurement performance criteria defined in this QAPP. Specifically, the sample holding times, frequency of QC samples, method blanks, surrogate recoveries, LCS recoveries, MS/MSD recoveries, and field quality control samples such as trip blanks and field duplicates will be evaluated relative to the specific QC criteria presented in the QAPP and the current laboratory QC limits.

Should data quality deficiencies be identified, the data reviewer will qualify the results following USEPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic Data Review (USEPA, 2017) and USEPA CLP National Functional Guidelines for Inorganic Superfund Data Review (USEPA, 2017), as applicable to the analytical methods utilized. Professional judgement will be used to account for any differences in QC criteria between the analytical methods used and the CLP methods underlying the Functional Guidelines. The data reviewer will prepare a summary of findings to be used as an input into the data usability evaluation.

## 13.3 Data Reporting

### 13.3.1 Field Data Reporting

Field data will be documented in field logbooks and/or field forms. These data will be incorporated into tables for the report.

### 13.3.2 Laboratory Data Reporting

Hard-copy data reports submitted to Golder will include at a minimum the following deliverables:

- A case narrative, discussing analytical problems, if any, and referencing or describing the preparation and analytical procedures and instrumentation used. In addition, the samples associated with the deliverable should be listed.
- Chain of Custody forms.
- Cross reference of laboratory IDs to Field IDs.

- Sample log-in/receipt records.
- Sample preparation records.
- Tabulated results, including final dilution volume of sample extracts, concentrations of compounds of interest, sample specific method detection limits and reporting limits.
- All data qualification codes assigned by the laboratory, their description, and explanations for all departures from the analytical protocols.
- Initial and continuing calibration summaries, data, and associated calculations.
- Method blanks associated with each sample, quantifying all compounds of interest identified in these blanks.
- Recovery assessments and replicate sample summaries, including surrogate and matrix spike recoveries and precision for sample duplicate analyses.
- Internal standard area and retention time summaries.
- GC Retention time summaries.
- Laboratory control samples associated with each sample, quantifying all compounds of interest.
- Copies of instrument run logs.
- Labeled chromatograms and integration tables for all samples, standards, blanks, and QC analyses.
- Copies of instrument tunes.

## 13.4 Data Management and Analysis

Golder will use EQuIS® (Environmental Quality Information System) to electronically manage groundwater quality, water level elevation, field information, and geological data. EQuIS® is an enterprise wide environmental data management system written in the Microsoft NET Framework and is hosted at Golder in a Microsoft SQL Server environment. Only authorized Golder personnel have access to the database.

EQuIS® uses a variety of tools and business rules to enforce data quality and provides links to many third-party tools commonly used for data visualizations and data analysis (e.g. GIS, Surfer, EVS/MVS®). Golder will acquire, check, and load the laboratory analytical data into EQuIS® for secure tracking and reporting of data.

The laboratory analytical data will be acquired, checked, and loaded into EQuIS® using the following methods:

- Field samples will be collected following the procedures outlined in the SOPs and converted to PDF file format and stored on the network project directory.
- Monitoring well information will be imported into the project-specific EQuIS® database application.
- Samples will be delivered to the laboratory for analytical testing. Copies of the COC and field sample forms will be sent by overnight courier or scanned to electronic copy and e-mailed to the Golder Project Manager.
- Survey information will be imported and managed in the EQuIS® data management system.
- Following sample analysis, the laboratory will produce and e-mail Electronic Data Deliverables (EDDs) to the Golder Project Manager. Golder will upload the EDDs into EQuIS® via the EQuIS® Data Processor (EDP)

along with additional information from the field forms. The data added to the EDDs will include, but are not limited to:

- Sample location codes
- Sample matrix codes
- Sample type codes
- Parent sample codes for replicate samples
- Sample delivery group codes

Golder personnel will check the information (e.g., time stamps for proper format and test information) and revise, as necessary. The EQuIS® EDP will check the EDDs for common laboratory errors, such as chronological event errors, duplicate rows, orphan samples, and inconsistencies with the EQuIS® system's valid value tables. Once the data are checked and reviewed, Golder will upload the EDD packages into the database. The data will then be available to be queried and reported by EQuIS® Enterprise or EQuIS® Professional.

Golder may perform data analysis using several different tools, including Geographical Information System (GIS). These tools will allow Golder to quantify both nature and extent of contamination at the site as well as statistical significance of existing sample data and potential future sample locations.

## 13.5 Data Presentation Format

EQuIS® Enterprise is a read-only web-based reporting function through which data will be processed and reported through a set of customizable pre-designed functions. EQuIS® Professional provides additional format functionality, such as cross-tabbing, trend graphs and isopleths for export to different formats, including Microsoft Excel®. Golder will use a combination of these tools to present analytical result data tables and trend graphs for the Work Plan reports.

Additionally, Golder may use EVS/MVS® modeling to evaluate the distribution of chemicals in groundwater. Three-dimensional simulations of chemical distribution, along with chemical mass estimates, will be useful to help evaluate potential future assessment needs and/or remedial measures, if needed.

Specifically, the use of EVS/MVS® will provide the following items in an efficient manner:

- Visual understanding of chemical distribution
- Potential source areas and volumes to focus remedial technology evaluations
- Information for assessment of future end use options, if applicable

## 13.6 Project Filing Procedures

Field and analytical data, and associated reports generated by Golder and its subcontractors in performance of the work will be maintained in the Golder Manchester, New Hampshire office. Golder will maintain the records in accordance with our standard document control protocols.

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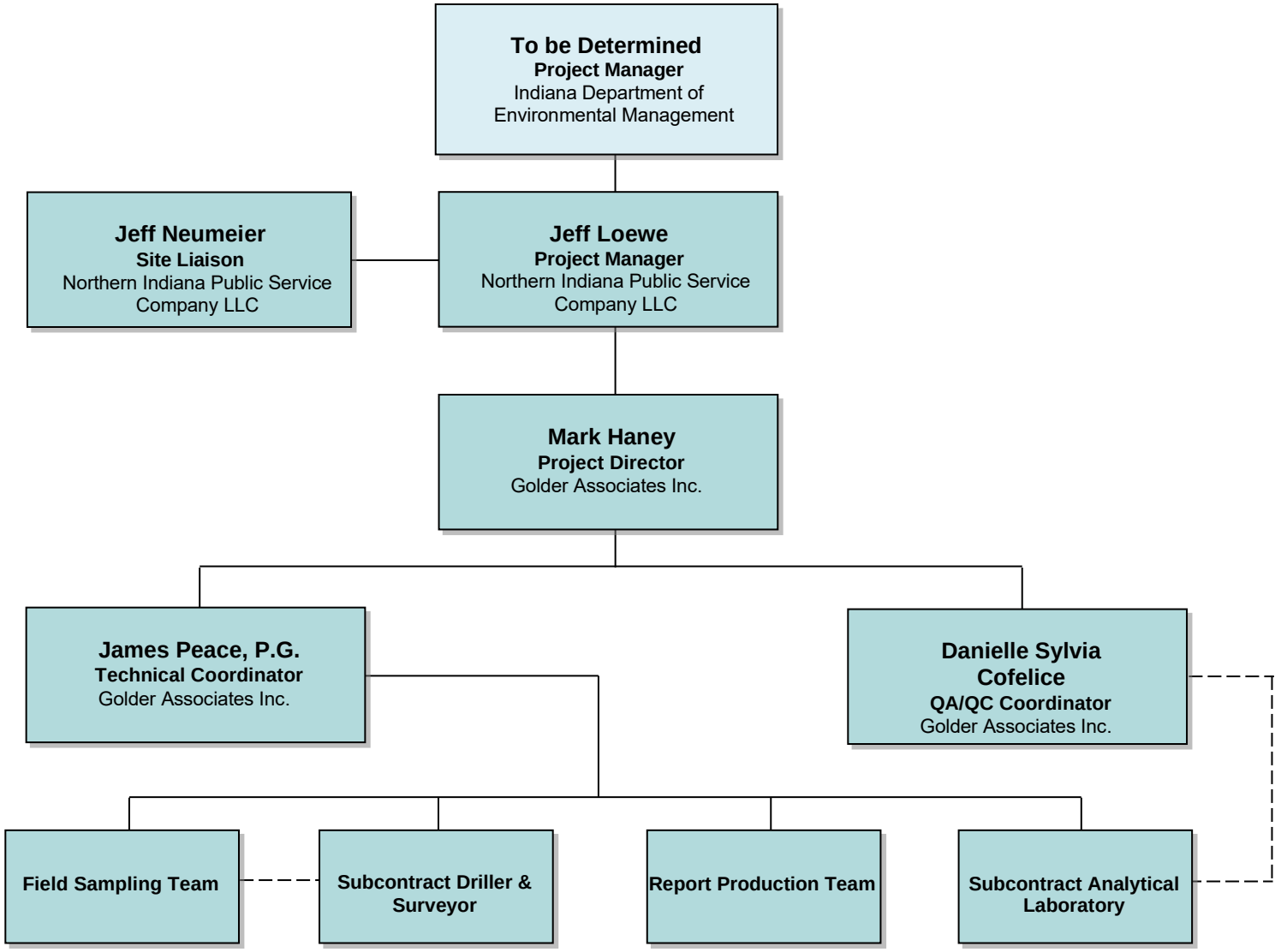
# Figures

**NIPSCO LLC BGS**
**CLOSURE APPLICATION**
**QUALITY ASSURANCE PROJECT PLAN**
**Project Organization Chart**
**Figure 1**

Project No.: 191-21569

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**APPENDIX A**

# Pace Indianapolis, Indiana Quality Assurance Manual


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### ENV-MAN-IND1-0001 Quality Manual

### QM Approval

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Elizabeth Schrage (008534) | Manager - Quality | 31 Jan 2020, 10:41:35 AM | Approved |

### Management Approval

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Kelly Jones (005070) | Manager | 31 Jan 2020, 10:50:41 AM | Approved |
| Scott Bryan (003661) | Quality Analyst 3 | 31 Jan 2020, 11:26:14 AM | Approved |
| Felicia Walker (005354) | Manager | 31 Jan 2020, 11:52:22 AM | Approved |
| Anne Troyer (008754) | Quality Analyst 3 | 31 Jan 2020, 12:17:51 PM | Approved |
| Joyce Sarapata (008874) | Supervisor | 31 Jan 2020, 12:53:26 PM | Approved |
| Sarah Potts (007977) | Manager | 31 Jan 2020, 01:07:01 PM | Approved |
| Melanie Booms (005590) | Project Manager 1 | 31 Jan 2020, 01:55:14 PM | Approved |
| Timothy Pinckert (003677) | Manager | 03 Feb 2020, 09:22:20 AM | Approved |
| Rachel Wrede (008235) | Manager | 03 Feb 2020, 09:22:46 AM | Approved |
| Steven Sayer (004775) | General Manager 2 | 03 Feb 2020, 09:22:52 AM | Approved |
| Jeffrey Worm (005618) | Scientist Team Lead | 03 Feb 2020, 09:47:00 AM | Approved |
| Richard Bowman (009334) | Systems Administrator | 03 Feb 2020, 11:05:03 AM | Approved |
| Jennifer Rice (005579) | Supervisor | 03 Feb 2020, 03:35:28 PM | Approved |
| Karl Anderson (004767) | Regional Director - Operations | 03 Feb 2020, 03:59:58 PM | Approved |

**TITLE PAGE**

# LABORATORY QUALITY MANUAL

## Prepared for:

Pace Analytical Services, LLC
7726 Moller Road
Indianapolis, IN 46268
Phone: 317-228-3100

Pace Analytical Services, LLC
5560 Corporate Exchange Ct. SE
Grand Rapids, MI 49512
Phone: 616-975-4500

Pace Analytical Services, LLC
4860 Blazer Parkway
Dublin, OH 43017
Phone: 614-486-5421

# Manual Approval Signatories

Approval of this manual by managerial personnel is recorded on the Signature Manifest located before the Title Page of this manual.

The individuals listed below represent the management team that was in place on the effective date of this version of the manual for the following location:

Pace Analytical Services, LLC
7726 Moller Road
Indianapolis, IN 46268
Phone: 317-228-3100

Each of the following individuals is a signatory for the manual for the location listed above. The application of their signature to the manual signifies their commitment to communicate, implement, and uphold the requirements, policies and procedures specified in this manual and their commitment to continuously improve the effectiveness of the quality management system based on customer feedback and internal assessment.

| Name[1] | Title | Address[2] | Phone[2] |
|---|---|---|---|
| Karl Anderson | Regional Director – Operations | | |
| Steve Sayer | General Manager | | |
| Beth Schrage | Quality Manager | | |
| Kelly Jones | Manager – Client Services | | |
| Felicia Walker | Manager – Metals Department | | |
| Tim Pinckert | Manager – Semivolatiles Department | | |
| Rachel Wrede[3] | Manager – Volatiles Department | | |
| Sarah Potts | Manager – Wet Chemistry Department | | |
| Anne Troyer[3] | Quality Assurance Analyst | | |
| Rick Bowman | Systems Administrator | | |
| Scott Bryan | Quality Assurance Analyst/Safety Officer | | |

*[1] Members of the local management team are subject to change during the life-cycle of this document version.*
*[2] Include if different from the physical address and phone number of the facility.*
*[3] This individual serves as an Acting Technical Manager for TNI for one or more fields of accreditation.*

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|---|---|---|---|
| Karl Anderson | Regional Director – Operations | 7726 Moller Rd., Indianapolis, IN 46268 | 317-228-3100 |
| Steve Sayer | General Manager | 7726 Moller Rd., Indianapolis, IN 46268 | 317-228-3100 |
| Beth Schrage | Quality Manager | 7726 Moller Rd., Indianapolis, IN 46268 | 317-228-3100 |
| Jennifer Rice[3] | Supervisor | | |
| Jeff Worm[3] | Scientist – Team Lead | | |
| Rick Bowman | Systems Administrator | 7726 Moller Rd., Indianapolis, IN 46268 | 317-228-3100 |
| Melanie Booms | Project Manager/Safety Officer | | |

*[1] Members of the local management team are subject to change during the life-cycle of this document version.*
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Pace Analytical Services, LLC
4860 Blazer Parkway
Dublin, OH 43017
Phone: 614-486-5421

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|---|---|---|---|
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| Steve Sayer | General Manager | 7726 Moller Rd., Indianapolis, IN 46268 | 317-228-3100 |
| Beth Schrage | Quality Manager | 7726 Moller Rd., Indianapolis, IN 46268 | 317-228-3100 |
| Joyce Sarapata | Supervisor | | |
| Rick Bowman | Systems Administrator | 7726 Moller Rd., Indianapolis, IN 46268 | 317-228-3100 |
| Scott Bryan | Quality Assurance Analyst/Safety Officer | 7726 Moller Rd., Indianapolis, IN 46268 | 317-228-3100 |

[1] *Members of the local management team are subject to change during the life-cycle of this document version.*
[2] *Include if different from the physical address and phone number of the facility.*

# Table of Contents

# 1.0 PURPOSE AND SCOPE

## 1.1 Purpose

This quality manual (manual) outlines the quality management system and management structure of the laboratories and service centers affiliated with Pace Analytical Services, LLC (PAS). A laboratory is defined by PAS as any PAS facility, however named, that provides testing, sampling, or field measurement services. When the term 'laboratory" is used in this manual, the term refers to all locations listed on the Title Page of this manual and in Section 4.1.3 unless otherwise specified.

The PAS quality management system is also referred to as the quality program throughout this document. In this context, the phrase "quality management system" and "quality program" are synonymous.

The quality management system is the collection of policies and processes established by PAS management to consistently meet customer requirements and expectations, and to achieve the goals to provide PAS customers with high quality, cost-effective, analytical measurements and services.

The quality management system is also intended to establish conformance[1] and compliance with the current versions of the following international and national quality system standards:

- ISO/IEC 17025: *General requirements for the competence of testing and calibration laboratories*
- NELAC/TNI Standard Volume 1: *Management and Technical Requirements for Laboratories Performing Environmental Analysis*

[1]The statement of conformity to these Standards pertains only to testing and sampling activities carried out by the laboratory at its physical address, in temporary or mobile facilities, in-network, or by laboratory personnel at a customer's facility.

In addition to the international and national standards, the quality management system is designed to achieve regulatory compliance with the various federal and state programs for which the laboratory provides compliance testing and/or holds certification or accreditation. When federal or state requirements do not apply to all PAS locations, the requirements for compliance are provided in addendum to this manual or in other documents that supplement the manual. Customer-specific project and program requirements are not included in the manual in order to maintain client confidentiality.

- A list of accreditation and certifications held by each laboratory associated with this manual is provided in Appendix A.
- A list of analytical testing capabilities offered by each laboratory associated with this manual is provided in Appendix B.

## 1.2 Scope and Application

This manual applies to each of the PAS locations listed on the Title Page and in Section 4.1.3.

The manual was prepared from a quality manual template (template) created by PAS corporate quality personnel. The template outlines the minimum requirements PAS management considers necessary for every PAS laboratory, regardless of scope of services or number of personnel, established in order to maintain a quality management system that achieves the objectives of PAS's Quality Policy (See 4.2.2). In this regard, the template is the mechanism used by the corporate officers (a.k.a. 'top management') to communicate their expectations and commitment for the PAS quality program to all PAS personnel.

The laboratory also has the responsibility to comply with federal and state regulatory and program requirements for which it provides analytical services and holds certification or accreditation. When those requirements are more stringent than the template, the requirements for compliance are provided in addendum to this manual or in other documents that supplement the manual. This document structure maintains consistency in the presentation of the quality management system across the network while providing the laboratory a mechanism to describe and achieve compliance requirements on a program basis.

### 1.2.1 Quality Manual Template

The quality manual template is developed by the Corporate Quality Director with contribution and input from corporate quality personnel and the corporate officers. Approval of the template by the corporate officers (aka "top management") confirms their commitment to develop and maintain a quality management system appropriate for the analytical services offered by the organization and to communicate their expectations of the quality program to all personnel.

The template and instructions for use of the template are released by corporate quality personnel to quality assurance manager(s) responsible for each laboratory (Local QA). Local QA uses the template to prepare the laboratory's manual by following the instructions provided. Since the template provides the minimum requirements by which all PAS locations must abide, the laboratory may not alter the font, structure or content of the template except where specified by instruction to do so. As previously stated, program specific requirements are provided in addendum or in documents that supplement this manual.

The template is reviewed by corporate quality personnel every two years and updated if needed. More frequent review and revision may be necessary to manage change, to maintain conformance and compliance to relevant standards, or to meet customer expectations.

See standard operating procedure (SOP) ENV-SOP-CORQ-00015 *Document Management and Control* for more information.

### 1.2.2 Laboratory Quality Manual

The manual is approved and released to personnel under the authority of local management. The manual is reviewed annually and location specific information is updated, if needed. More frequent review and revision may be necessary when there are significant changes to the organizational structure, capabilities, and resources of the laboratory. Review and revision of the manual is overseen by local QA. If review indicates changes to the main body of the manual are necessary to maintain conformance and compliance to relevant standards, or to meet customer expectations, local QA will notify corporate quality personnel to initiate review and/or revision of the template.

See SOP ENV-SOP-CORQ-00015 *Document Management and Control* for more information.

### 1.2.3 References to Supporting Documents

The template and the manual include references to other laboratory documents that support the quality management system such as policies and standard operating procedures (SOPs). These references include the document's document control number and may include the document title.

This information is subject to change. For example, an SOP may be converted to a policy or the document's title may change. For these types of administrative changes, the manual and template are updated to reflect the editorial change during the document's next scheduled review/revision cycle or the next time a new version of the document is released, whichever is sooner.

Local QA maintains a current list of controlled documents used at each PAS location to support the quality management system. This list, known as the Master List, lists each document used by document control number, title, version, effective date, and reference to any document(s) that the current version supersedes. When there is a difference between the template and/or manual and the Master List, the document information in the Master List takes precedence. The current Master List is readily available to personnel for their use and cross-reference. Parties external to the laboratory should contact the laboratory for the most current version.

## 2.0 REFERENCES

References used to prepare this manual include:

- "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act." Federal Register, 40 CFR Part 136, most current version.
- "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods." SW-846.
- "Methods for Chemical Analysis of Water and Wastes", EPA 600-4-79-020, 1979 Revised 1983, U.S. EPA.
- U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis, current version.
- U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis, current version.
- "Standard Methods for the Examination of Water and Wastewater." Current Edition APHA-AWWA-WPCF.
- "Annual Book of ASTM Standards", Section 4: Construction, Volume 04.04: Soil and Rock; Building Stones, American Society of Testing and Materials.
- "Annual Book of ASTM Standards", Section 11: Water and Environmental Technology, American Society of Testing and Materials.
- "NIOSH Manual of Analytical Methods", U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, most current version.
- "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water", U.S. EPA, Environmental Monitoring and Support Laboratory – Cincinnati (Sep 1986).
- Quality Assurance of Chemical Measurements, Taylor, John K.; Lewis Publishers, Inc. 1987.
- Methods for Non-conventional Pesticides Chemicals Analysis of Industrial and Municipal Wastewater, Test Methods, EPA-440/1-83/079C.
- Environmental Measurements Laboratory (EML) Procedures Manual, HASL-300, US DOE, February, 1992.
- Requirements for Quality Control of Analytical Data, HAZWRAP, DOE/HWP-65/R1, July, 1990.

- Quality Assurance Manual for Industrial Hygiene Chemistry, AIHA, most current version.
- National Environmental Laboratory Accreditation Conference (NELAC) Standard- most current version.
- ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories- most current version.

  The following are implemented by normative reference to ISO/IEC 17025:

  - ISO/IEC Guide 99, *International vocabulary of metrology –Basic and general concepts and associated terms*
  - ISO/IEC 17000, *Conformity assessment – Vocabulary and general principles*
- Department of Defense Quality Systems Manual (QSM), most current version.
- TNI (The NELAC Institute) Standard- most current version applicable to each lab.
- UCMR Laboratory Approval Requirements and Information Document, most current version.
- US EPA Drinking Water Manual, most current version.

# 3.0 TERMS AND DEFINITIONS

Refer to Appendix C for terms, acronyms, and definitions used in this manual and in other documents used by the laboratory to support the quality management system.

# 4.0 MANAGEMENT REQUIREMENTS

## 4.1 Organization

### 4.1.1 Legal Identity

Pace Analytical Services, LLC is authorized under the State of Minnesota to do business as a limited liability company.

#### 4.1.1.1 Change of Ownership

If there is a change of ownership, if a location goes out of business, or if the entire organization ceases to exist, Pace Analytical Services, LLC ensures that regulatory authorities are notified of the change within the time-frame required by each state agency for which the location is certified or accredited.

Requirements for records and other business information are addressed in the ownership transfer agreement or in accordance with appropriate regulatory requirements, whichever takes precedence.

### 4.1.2 Compliance Responsibility

Laboratory management has the responsibility and authority to establish and implement procedures and to maintain sufficient resources necessary to assure its activities are carried out in such a way to meet the compliance requirements of the quality management system.

### 4.1.3 Scope of the Quality Management System

The quality management system applies to work carried out at each location covered by this manual including permanent facilities, at sites away from its permanent facilities, or in associated temporary or mobile facilities.

The permanent and mobile facilities to which this manual applies include:

| | |
|---|---|
| Name | Pace Analytical Services, LLC |
| Address: | 7726 Moller Road |
| City, State, Zip | Indianapolis, IN 46268 |
| Phone Number | 317-228-3100 |
| Service Type: | Laboratory |

| | |
|---|---|
| Name | Pace Analytical Services, LLC |
| Address: | 5560 Corporate Exchange Ct. SE |
| City, State, Zip | Grand Rapids, MI 49512 |
| Phone Number | 616-975-4500 |
| Service Type: | Laboratory |

| | |
|---|---|
| Name | Pace Analytical Services, LLC |
| Address: | 4860 Blazer Parkway |
| City, State, Zip | Dublin, OH 43017 |
| Phone Number | 614-486-5421 |
| Service Type: | Laboratory |

### 4.1.4 Organization History and Information

Founded in 1978, Pace Analytical Services, LLC (PAS) is a privately held scientific services firm operating one of the largest full service contract laboratory and service center networks in the United States. The company's network offer inorganic, organic and radiochemistry testing capabilities; specializing in the analysis of trace level contamination in air, drinking water, groundwater, wastewater, soil, biota, and waste.

With over 90 laboratories and services centers in the contiguous US and in Puerto Rico, the network provides project support for thousands of industry, consulting, engineering and government professionals.

Pace delivers the highest standard of testing and scientific services in the market. We offer the most advanced solutions in the industry, backed by truly transparent data, a highly trained team, and the service and support that comes from four decades of experience.

#### 4.1.4.1 Organization Structure

Each location maintains a local management structure under the oversight and guidance of corporate personnel. Local management is responsible for making day-to-day decisions regarding the operations of the facility, implementing the quality management system, upholding the requirements of the quality program, and for supervision of personnel.

Local management is provided by a General Manager (GM), Quality Manager (QM), Client Services Manager (CSM), Information Technology (IT) Manager, and/or Department Managers (DM), however named.

Some locations may also have any one of the following management positions: Operations Manager (OM), Technical Director (TD), or Technical Manager (TM). When the location does not have a TD or TM, technical management is provided jointly by the GM, QM, DM, and DS.

The GM, however named reports to a Senior General Manager (SGM), who is responsible for the management of multiple laboratories and service centers within a geographical region, and who reports directly to the Chief Operating Officer (COO). The QM has indirect reporting relationship to the Corporate Director of Quality.

Refer to the organization charts provided in Appendix D to view the management structure, reporting relationships, and the interrelationships between positions.

### 4.1.5 Management Requirements

#### 4.1.5.1 Personnel

The laboratory is staffed with administrative and technical personnel who perform and verify work under the supervision of managerial personnel.

- Technical personnel include analysts and technicians that generate or contribute to the generation of analytical data and managerial personnel that oversee day to day supervision of laboratory operations, including the reporting of analytical data and results, monitoring QA/QC performance, and monitoring the validity of analysis to maintain data integrity and reliability.
- Administrative personnel support the day-to-day activities of the laboratory.
- IT personnel maintain the information technology systems and software used at the laboratory.
- Client services personnel include project managers and support staff that manage projects.
- Managerial personnel make day-to-day and longer term decisions regarding the operations of the facility, supervise personnel, implement the quality management system and uphold the requirements of the quality program.

All personnel regardless of responsibilities are expected to carry out their duties in accordance with the policies and processes outlined in this manual and in accordance with standard operating procedures (SOPs) and other quality system documents. The laboratory's policies and procedures are designed for impartiality and integrity. When these procedures are fully implemented, personnel remain free from undue pressure and other influences that adversely impact the quality of their work or data.

#### 4.1.5.1.1 Key Personnel

Key personnel include the management positions that have the authority and responsibility to plan, direct, and control, activities of the division (corporate) or the laboratory.

The following tables list key personnel positions by PAS job title and the position's primary deputy:

**Key Personnel: Corporate**

| Key Personnel | Primary Deputy |
|---|---|
| Chief Executive Officer | Chief Operating Officer |
| Chief Operating Officer | Chief Executive Officer |
| Chief Compliance Officer | Quality Director |
| Corporate Quality Director | Chief Compliance Officer |
| Health and Safety Director | Chief Compliance Officer |
| IT Director | LIMS Administrator, however named. |

**Key Personnel: Laboratory**

| Key Personnel | Primary Deputy |
|---|---|
| General Manager | Regional Director of Operations or as designated |
| Quality Manager | Corporate Quality Manager |
| Client Services Manager | General Manager |
| Local IT | Corporate IT Director or as designated. |
| Department Manager | General Manager |

Some state certification programs require the agency to be notified when there has been a change in key personnel. Program-specific requirements and time-frames for notification by agency, are tracked and upheld by local QA, when these requirements apply.

### 4.1.5.2 Roles and Responsibilities

The qualifications, duties, and responsibilities for each position are detailed in job descriptions maintained by PAS's corporate Human Resource's Department (HR).

The following summaries briefly identify the responsibility of key personnel positions in relation to the quality management system.

**Chief Executive Officer (CEO):** The CEO has overall responsibility for performance of the organization and endorses the quality program. Working with corporate and laboratory management, the CEO provides the leadership and resources necessary for PAS locations to achieve the goals and objectives of the quality management system and quality policy statement.

**Chief Operating Officer (COO):** The COO oversees all aspects of operations management including, strategic planning, budget, capital expenditure, and management of senior management personnel. In this capacity, the COO provides leadership and resources necessary to help top management at each PAS location achieve the goals and objectives of the quality management system and quality policy statement.

**Chief Compliance Officer (CCO):** The CCO oversees the quality assurance and environmental health and safety programs (HSE) for each business unit. The CCO is responsible for planning and policy development for these groups to ensure regulatory compliance and to manage risk. The position provides leadership and guidance necessary for all PAS locations to achieve the goals and objectives of the quality and HSE programs.

The CCO also serves as the Ethics Officer (ECO). The ECO develops the Ethics and Data Integrity Policy and Training Program, and provides oversight for reporting and investigation of ethical misconduct to maintain employee confidentiality during the process. The ECO provide guidance and instruction for follow-up actions necessary to remedy the situation and deter future recurrence.

**Corporate Director of Quality:** The Corporate Director of Quality is responsible for developing and maintaining the PAS quality program under guidance and assistance from the CEO, COO, and CCO. This position helps develop corporate quality policy and procedure and analyzes metric data and other performance indicators to assess and communicate the effectiveness of the quality program to top management. The position provides leadership and guidance for implementation of the quality program across all PAS locations.

**Corporate Director of Information Technology:** The Corporate Director of IT oversees the systems and processes of information technology used to support the quality program. These systems include Laboratory Information Management Systems (LIMS); data acquisition, reduction, and reporting software; virus-protection, communication tools, and ensuring the integrity and security of electronic data.

**Regional Director – Operations:** The Regional Director of Operations has full responsibility for administrative and operations management and performance of a group of PAS laboratories and service centers. Working with the COO and local laboratory management, the Regional Director of Operations provides leadership, guidance and resources, including allocation of personnel, necessary to achieve the goals of PAS quality program.

**General Manager (GM):** The GM is responsible for the overall performance and administrative and operations management of a PAS location and associated service center(s). This position is responsible to provide leadership and resources, including allocation and supervision of personnel, necessary for the location to implement and achieve the goals of the PAS quality program. In this capacity, the position assures laboratory personnel are trained on and understand the structure and components of the quality program defined in this manual as well as the policies and procedures in place to implement the quality management system.

The GM of NELAC/TNI Accredited laboratories are also responsible for the designation of technical personnel to serve as acting technical managers for TNI for the fields of accreditation held by the laboratory (See Section 4.1.5.2.1) and for notifying the accreditation body (AB) of any extended absence or reassignment of these designations.

**Quality Manager (QM):** The QM oversees and monitors implementation of the quality management system and communicates deviations to laboratory management. The QM is independent of the operation activities for which they provide oversight and has the authority to carry out the roles and responsibilities of their position without outside influence.

Additionally, in accordance with the TNI Standard, the QM:

- serves as the focal point for QA/QC and oversees review of QC data for trend analysis;
- evaluates data objectively and perform assessments without outside influence;
- has documented training and experience in QA/QC procedures and the laboratory's quality system;
- has a general knowledge of the analytical methods offered by the laboratory;
- coordinates and conducts internal systems and technical audits;
- notifies laboratory management of deficiencies in the quality system;
- monitors corrective actions;
- provides support to technical personnel and may serve as the primary deputy for the acting TNI Technical Manager(s).

**Client Services Manager (CSM):** The CSM oversees project management personnel. This position is responsible for training and management of client facing staff that serve as the liaison between PAS and the customer to ensure that projects are successfully managed to meet the expectations and needs of PAS customers. This position is also responsible for sharing positive and negative customer feedback with laboratory management so that this information may be used to improve the quality program.

**Systems Administrator:** Local Systems Administrators are responsible for maintaining the IT systems used to support the quality program, ensuring the integrity and security of electronic data. These systems include Laboratory Information Management Systems (LIMS); data acquisition, reduction, and reporting software; virus-protection, and communication systems.

**Department Manager (DM):** The DM is responsible for administrative and operations management and implementation of the quality management system in the work area he/she oversees. These responsibilities include but are not limited to: training and supervision of personnel, monitoring work activity to maintain compliance with this manual, SOPs, policies and other instructional documents that support the quality management system; method development, validation and the establishment and implementation of SOPs to assure regulatory compliance and suitability for intended purpose; monitoring QA/QC performance, proper handling and reporting of nonconforming work, purchasing of supplies and equipment adequate for use, maintaining instrumentation and equipment in proper working

order and calibration, and general maintenance of administrative and technical processes and procedures established by the laboratory.

**Technical Director (TD):** The TD provides technical oversight and guidance to laboratory personnel. Responsibilities may include but are not limited to: research and development, method development and validation, development of standard operating procedures, proposal and contract review. The TD may also be responsible for QA/QC trend analysis, technical training, and technology improvement.

#### 4.1.5.2.1 Acting Technical Manager (TNI Accreditation):

For PAS locations that are NELAC/TNI accredited:

The TNI Standard specifies requirements for the qualification and duties of technical personnel with managerial responsibility. These requirements are associated in the Standard to the designation 'technical manager(s), however named'. These responsibilities may be assigned to multiple individuals and are not associated with any specific job title.

For PAS, these TNI requirements for personnel that provide technical oversight correlate with PAS's job descriptions for Department Manager or Supervisor. However, the duties may be assigned to any PAS employee that meets the TNI specified qualifications.

Personnel assigned this designation retain their PAS assigned job title. The job title may be appended with *"acting as technical manager for TNI"* and the technology or field of accreditation for which the employee is approved, if necessary.

When TNI Accreditation Bodies (AB) refer to these employees as 'technical manager' or 'technical director' on the official certificate or the scope of accreditation, this reference is referring to their approval to carry out duties of the 'technical manager, however named' as specified in the TNI Standard.

In accordance with the TNI Standard, the acting Technical Manager(s) for TNI are responsible for monitoring the performance of QC/QA in the work areas they oversee.

If the absence of any employee that is approved as acting technical manager for TNI exceeds 15 calendar days, the duties and responsibilities specified in the TNI Standard are reassigned to another employee that meets the qualifications for the technology or field of accreditation or they are assigned to the position's deputy, the Quality Manager.

### 4.1.5.3 Conflict of Interest

A conflict of interest is a situation where a person has competing interests. Laboratory management looks for potential conflict of interest and undue pressures

that might arise in work activities and then includes countermeasures in policies and procedures to mitigate or eliminate the conflict.

See policy COR-POL-0004 *Ethics Policy* for more information.

#### 4.1.5.4 Confidentiality

Laboratory management is committed to preserving the confidentiality of PAS customers and confidentiality of business information.

Procedures used by the laboratory to maintain confidentiality include:

- A Confidentiality Agreement which all employees are required to sign at the time of employment and abide by its conditions throughout employment;
- Record retention and disposal procedures that assure confidentiality is maintained;
- Physical access controls and encryption of electronic data; and
- Protocol for handling Confidential Business Information (CBI).

Client information obtained or created during work activities is considered confidential and is protected from intentional release to any person or entity other than the client or the client's authorized representative information provided to PAS, except when the laboratory is required by law to release confidential information to another party, such as a regulatory agency or for litigation purposes. In which case, the laboratory will notify the client of the release of information and the information provided.

The terms of client confidentiality are included in PAS Standard Terms and Conditions (T&C). With the acceptance of PAS Terms and Conditions and/or the implicit contract for analytical services that occurs when the client sends samples to the laboratory for testing, the client authorizes PAS to release confidential information when required.

See policy COR-POL-0004 *Ethics Policy* for more information.

#### 4.1.5.5 Communication

Management ensures that appropriate communication processes are established within the laboratory and that communication takes place regarding the effectiveness of the management system.

##### 4.1.5.5.1 Workplace Communication

Good communication in the workplace is necessary to assure work is done correctly, efficiently, and in accordance with client expectations.

Instructions for how to carry out work activities are communicated to personnel via written policy, standard operating procedures, and standard work instructions.

Information about laboratory performance (positive and negative) and ideas for improvement are communicated using various communication channels such as face to face meetings, video conferencing, conference calls, email, memoranda, written reports, and posters.

#### 4.1.5.5.2 External Communication

Communication with external parties such as customers, vendors, business partners, and regulatory agencies takes place every day.

Laboratory management ensures personnel learn to communicate in professional and respectful ways in order to build strong relationships, and learn to communicate effectively to avoid misunderstanding.

## 4.2 Quality Management System

### 4.2.1 Quality Management System Objectives

The objectives of the laboratory's quality management system are to provide clients with consistent, exemplary professional service, and objective work product that is of known and documented quality that meets their requirements for data usability and regulatory compliance.

Objective work product is analytical services, data, test results, and information that is not influenced by personal feeling or opinions. The quality of being objective is also known as 'impartiality'.

#### 4.2.1.1 Impartiality

The laboratory achieves and maintains impartiality by implementing and adhering to the policies and processes of the quality management system, which are based on industry accepted standards and methodologies.

The laboratory's procedures for handling nonconforming work (See 4.9), corrective and preventive actions (See 4.12) and management review (See 4.15) are the primary mechanisms used to identify risk to impartiality and to prompt actions necessary to eliminate or reduce the threat when risk to impartiality is suspected or confirmed.

#### 4.2.1.2 Risk and Opportunity Assessment

Risks are variables that make achieving the goals and objectives of the quality management system uncertain. An opportunity is something that has potentially positive consequences for the laboratory.

Laboratory personnel manage risks and opportunities on a daily basis by carrying out the processes that make up the quality management system. Some of the ways in which the quality management system is designed to identify, minimize, or eliminate risk on a daily basis include but are not limited to:

- Capability and capacity reviews of each analytical service request to assure the laboratory can meet the customer's requirements;

- Maintenance of accreditation and certification for test methods in multiple states and programs to cover a broad range of jurisdiction for regulatory compliance;
- SOPs and other controlled instructional documents provided to personnel to eliminate variability in process. These documents include actions to counter risk factors inherent in the process and are reviewed on a regular basis for on-going suitability and relevancy;
- Participation in proficiency testing programs and auditing activities to verify on-going competency and comparability in performance;
- Provision of on-the-job training and established protocol for quality control (QC) corrective action for nonconforming events;
- An established program for ethics, and data integrity;
- Tiered data review process;
- Culture of continuous improvement;
- Monitoring activities to assess daily and long term performance; and
- Annual critical review of the effectiveness the quality management system.

PAS also promotes a continuous improvement culture based on the principles of lean manufacturing. These principles include 3P (Process, Productivity, Performance) and Kaizen. 3P is a platform used by Pace to share best practices and to promote standardization across the network to achieve operational excellence. Kaizen is a team based process used to implement tools and philosophies of lean to reduce waste and achieve flow with the purpose of improving both external and internal customer satisfaction. PAS's lean programs and activities help to mitigate risk because they generate a collective understanding of vulnerabilities and utilize group-effort to develop and implement solutions at all levels.

Risk and opportunities may also be formally identified using specific risk and opportunity assessment methods such as SWOT Analysis (Strength, Weakness, Opportunity, Threats) and 3-Stage Impact/Probability Grids.

#### 4.2.1.3 Communication of the Quality Management System

This manual is the primary mechanism used by laboratory management to communicate the quality management system to laboratory personnel.

To assure personnel understand and implement the quality program outlined in the manual:

- All laboratory personnel are required to sign a Read and Acknowledgement Statement to confirm the employee has: 1) been informed of the manual by laboratory management, 2) has access to the manual, 3) has read the manual 4) understands the content of the manual, and 5) agrees to abide by the requirements, policies and procedures therein.

- Personnel are informed that the manual provides the "what" of the quality management system. The "how to" implementation of the quality management system is provided in policies, SOPs, standard work instructions, and other controlled instructional documents.

### 4.2.2 Quality Policy Statement

The quality policy of the laboratory is to provide customers with data of known and documented quality fit for their intended purpose. The laboratory achieves this policy by implementing the quality management system defined in this manual, by following industry accepted protocol for analytical testing and quality assurance and quality control (QA/QC) activities, by conformance with published and industry accepted testing methodologies, and by compliance with international and national standards for the competency and/or accreditation of testing laboratories.

Intrinsic to this policy statement is each of the following principles:

- The laboratory will provide customers with reliable, consistent, and professional service. This is accomplished by making sure the laboratory has the resources necessary to maintain capability and capacity; that staff are trained and competent to perform the tasks they are assigned; that client-facing staff are trained and prepared to find solutions to problems and to assist customers with their needs for analytical services. Customer feedback, both positive and negative, is shared with personnel and used to identify opportunities for improvement.
- The laboratory maintains a quality program that complies with applicable, state, federal, industry standards for analytical testing and competency.

  ISO/IEC 17025 and the TNI (The NELAC Institute) Standard are used by PAS to establish the minimum requirements of the PAS quality program.

  ISO/IEC 17025 is a competency standard that outlines the general requirements for the management system for calibration and testing laboratories. It is the primary quality system standard from which other quality system standards, such as the TNI Standard, are based. The TNI Standards are consensus standards that provide management and technical requirements for laboratories performing environmental analysis.
- Laboratory management provides training to personnel so that all personnel are familiar with the quality management system outlined in this manual and that they understand that implementation of the quality management system is achieved by adherence to the organization's policies and procedures.
- Laboratory management continuously evaluates and improves the effectiveness of the quality management system by responding to customer feedback, and other measures of performance, such as but not limited to: the results of internal/external audits, proficiency testing, metrics, trend reports, and annual and periodic management reviews.

#### 4.2.2.1 Ethics Policy / Data Integrity Program

PAS has established a comprehensive ethics and data integrity program that is communicated to all PAS employees to ensure that they understand what is expected

of them. The program is designed to promote a mindset of ethical behavior and professional conduct that is applied to all work activities.

The key elements of the PAS Ethics / Data Integrity Program include:

- Ethics Policy (COR-POL-0004);
- Ethics Compliance Officer;
- Standardized data integrity training course taken by all new employees on hire and a yearly refresher data integrity training course for all existing employees;
- Policy Acknowledgement Statements that all PAS personnel, including contract and temporary, are required to sign at the time of employment and again during annual refresher training to document the employee's commitment and obligation to abide by the company's standards for ethics, data integrity and confidentiality;
- SOPs that provide instructions for how to carry out a test method or process to assure tasks are done correctly and consistently by each employee;
- On the Job Training;
- Data integrity monitoring activities which include, but are not limited to, secondary and tertiary data review, internal technical and system audits, raw data audits, data mining scans, and proficiency testing; and
- Confidential reporting process for alleged ethics and data integrity issues.

All laboratory managers are expected to provide a work environment where personnel feel safe and can report unethical or improper behavior in complete confidence without fear of retaliation. Retaliation against any employee that reports a concern is not tolerated.

PAS has engaged Lighthouse Services, Inc. to provide personnel with an anonymous reporting process available to them 24 hours a day/7 days per week. The alert line may be used by any employee to report possible violations of the company's ethics and data integrity program. When using the reporting process, the employee does need to specify the location of concern and when reporting by email, also include the company name. Messages are collected, documented, reviewed, and will be followed up on by the Ethics Compliance Officer to resolve the matter. Investigations concerning data integrity are kept confidential.

**Lighthouse Compliance Alert Lines:**

| | |
|---|---|
| English Speaking US & Canada | (844) 940-0003 |
| Spanish Speaking North America | (800) 216-1288 |
| Internet | www/lighthouse-services.com/pacelabs |
| Email | reports@lighthouse-services.com |

#### 4.2.3 Management Commitment: Quality Management System

Evidence of management's commitment for the development, maintenance, and on-going improvement of the quality management system is provided by the application of their signature of approval to this manual. Their signature confirms they understand their responsibility to implement the quality management system outlined in this manual, to communicate the quality program to personnel, and to uphold requirements of the program during work activities.

#### 4.2.4 Management Commitment: Customer Service

Management communicates the importance of meeting customer and regulatory requirements to personnel by training personnel on the quality management system outlined in this manual, implementing the quality management system outlined in this manual, and upholding these requirements for all work activities.

#### 4.2.5 Supporting Procedures

Documents that support this manual and quality management system are referenced throughout this manual. The structure of the document management system is outlined in SOP ENV-SOP-CORQ-0015 *Document Management and Control* and summarized in the following subsections.

##### 4.2.5.1 Quality Management System Document Structure

Documents associated with the quality management system are classified into document types that identify the purpose of the document and establish how the document is managed and controlled.

Document types are ranked to establish which documents takes precedence when there is an actual or perceived conflict between documents and to establish the hierarchal relationships between documents. The ranking system also provides information to document writers and reviewers to assure downline documents are in agreement with documents of higher rank. Project-specific documents are not ranked because client-specific requirements are not incorporated into general use documents in order to maintain client confidentiality.

**PAS Quality Management System Documents: Internal**

| Document Type | Purpose |
|---|---|
| Quality Manual | Outlines the laboratory's quality management system and structure and how it works for a system including policy, goals, objectives and detailed explanation of the system and the requirements for implementation of system. Includes roles and responsibilities, relationships, procedures, systems and other information necessary to meet the objectives of the system described. |
| Policy | Provide requirements and rules for a PAS process and is used to set course of actions and to guide and influence decisions. Policy describes the "what", not the "how". |
| Standard Operating Procedure | Provide written and consistent set of instructions or steps for execution of a routine process, method, or set of tasks performed by PAS. Includes both fundamental and operational elements for implementation of the systems described in PAS manual(s). Assures that activities are performed properly in accordance with applicable requirements. Designed to ensure consistency, protect HSE of employees and environment, prevent failure in the process and ensure compliance with company and regulatory requirements. SOPs describes the "how" based on policy. |

| Document Type | Purpose |
|---|---|
| Standard Work Instruction | Provide step by step visual and/or written instruction to carry out a specific task to improve competency, minimize variability, reduce work injury and strain, or to boost efficiency and quality of work (performance). SWI are associated with an SOP unless the task described is unrelated to generation of or contribution to environmental data or analytical results. |
| Template | Pre-formatted document that serves as a starting point for a new document. |
| Guide | Provide assistance to carry out a task. Most often used for software applications. |
| Form | Used for a variety of purposes such as to provide a standardized format to record observations, to provide information to supplement an SOP. |

**PAS Quality Management System Documents: External**

| Document Type | Purpose |
|---|---|
| Certificate | Lists parameters, methods, and matrices for which the laboratory is certified/accredited to perform within the jurisdiction of the issuing regulatory agency or accreditation body. |
| Reference Document | Provide information, protocol, instructions, and/or requirements. Examples include quality system standards such as ISO/IEC, TNI, DoD and published referenced methods such as Standard Methods, ASTM, SW846, EPA, and federal and state regulatory bodies. |
| Project Document | Provides requirements necessary to meet individual client expectations for intended use of data. Examples include: project quality assurance plans (QAPP), client program technical specifications, contracts, and other agreements. |

**Document Hierarchy**

| Rank | Document |
|---|---|
| 1 | Reference Documents |
| 2 | Corporate Manual |
| 3 | Corporate Policy |
| 4 | Corporate SOP |
| 5 | Corporate SWI, Templates & Forms |
| 6 | Laboratory Manual |
| 7 | Laboratory SOP |
| 8 | Laboratory SWI, Templates, & Forms |
| NA | Project Documents |

### 4.2.6 Roles and Responsibilities

The roles and responsibilities of technical management and of the Quality Manager are provided in section 4.1.5.2.

### 4.2.7 Change Management

When significant changes to the quality management system are planned, these changes are managed by corporate quality personnel to assure that the integrity of the quality management system is maintained.

## 4.3 Document Control

### 4.3.1 General

The laboratory's procedures for document control are provided in SOP ENV-SOP-CORQ-0015 *Document Management and Control.*

The documents that support the quality management system include internally generated documents such as manuals, policies, standard operating procedures, standard work instructions, forms, guides, and templates and external source documents such as but not limited to, regulations, standards, reference methods, manuals, and project-specific documents.

The laboratory uses electronic document management software (eDMS)to administer SOPs and other training documents. eDMS automates the process for unique document identification, version control, approval, access, and archival.

### 4.3.2 Document Approval and Issue

Documents that are part of the quality management system are reviewed by qualified personnel and approved by laboratory management prior by to release for general use.

Local QA maintains a master list of controlled documents used at the laboratory. The master list includes the document control number, document title, and current revision status and is made available to personnel for their reference.

Only the approved versions of documents are available to personnel for use. The eDMS system does not allow user access to draft versions of documents except to personnel assigned to work on the draft. eDMS also restricts access to archived documents except to authorized users, such as local QA, in order to prevent the use of obsolete documents.

See SOP ENV-SOP-CORQ-0015 *Document Management and Control* for more information.

### 4.3.3 Document Review and Change

Unless a more frequent review is required by regulatory, certification or accreditation program, the laboratory formally reviews documents at least every two years to ensure the document remains current, appropriate, and relevant.

Documents are also informally reviewed every time the document is used. Personnel are expected to refer to and follow instructions in controlled documents when they carry out their work activities. Consequently, any concerns or problems with the document should be caught and brought to the attention of laboratory management on an on-going basis.

Documents are revised whenever necessary to ensure the document remains usable and correct. Older document versions and documents no longer needed are made obsolete and archived for historical purposes.

The laboratory does not allow manual-edits to documents. If an interim change is needed pending re-issue of the document, the interim change is communicated to those that use the document using a formal communication channel, such as SOP Change in Progress form, email, or memorandum.

The document review, revision, and archival process is managed by local QA at the location from which the document was released using the procedures established in SOP ENV-SOP-CORQ-0015 *Document Management and Control.*

## 4.4 Analytical Service Request, Tender, and Contract Review

The laboratory's management and/or client service personnel perform thorough reviews of requests and contracts for analytical services to verify the laboratory has the capability, capacity, and resources

necessary to successfully meet the customer's needs. These review procedures are described in laboratory SOP ENV-SOP-IND1-0011 *Review of Analytical Requests*.

The procedures in this SOP(s) are established to ensure that:

- The laboratory understands the purpose of data collection in order to ensure the test methods requested are appropriate for the intended use of the data and capable of meeting the client's data quality objectives;
- The laboratory and any subcontractor has the capability, capacity, and resources to meet the project requirements and expectations within the requested time frame for delivery of work product;
- Any concerns that arise from review are discussed and resolved with the client; and
- The results of review and any correspondence with the client related to this process and/or any changes made to the contract are recorded and retained for historical purposes.

Capability review confirms that the in-network laboratories and any potential subcontractors hold required certification/accreditation for the test method, matrix, and analyte and verifies the laboratory can achieve the client's target compound list and data quality objectives (DQOs) for analytical sensitivity and reporting limits, QA/QC protocol, and hardcopy test report and electronic data deliverable (EDD) formats.

Capacity review verifies that the in-network laboratories and any potential subcontractors are able to handle the sample load and deliver work production within the delivery time-frame requested.

Resource review verifies that the laboratory and any potential subcontractors have adequate qualified personnel with the skills and competency to perform the test methods and services requested and sufficient and proper equipment and instrumentation needed to perform the services requested.

## 4.5 Subcontracting and In-Network Work Transfer

The terms 'subcontract' and "subcontracting" refers to work sent to a business external to PAS Analytical Services, LLC (PAS) and the term 'subcontractor' refers to these external businesses, which are also called vendors.

Work transferred within the PAS network is referred to as interregional work orders (IRWO) and network laboratories are referred to as IRWO or network laboratory.

The network of PAS laboratories offers comprehensive analytical capability and capacity to ensure PAS can meet a diverse range of client needs for any type of project. If the laboratory receives a request for analytical services and it cannot fulfill the project specifications, the laboratory's client services team will work with the client to place the work within the PAS network. When it is not possible to place the work within network, the laboratory will, with client approval, subcontract the work to a subcontractor that has the capabilities to meet the project specifications and can meet the same commitment agreed to between the laboratory and the client. Some client programs require client consent even for IRWO work transfer, and when this applies, the client services team obtains consent as required. The laboratory retains the record of client notification and their consent in the project record for historical purposes.

Whenever work is transferred to a subcontractor or an IRWO laboratory, the laboratory responsible for management of the project verifies each of these qualifications:

- The subcontractor or IRWO laboratory has the proper accreditation/certifications required for the project and these are current; and
- The use of the subcontractor or IRWO laboratory is approved by the client and/or regulatory agency, when approval is required. Record of approval is retained in the project record.

When possible, the laboratory selects subcontractors that maintain a quality management system similar to PAS and that complies with ISO/IEC 17025 and the TNI Standard(s).

PAS also evaluates and pre-qualifies subcontractors as part of company's procurement program. The complete list of approved vendors is maintained by the corporate procurement department and is made available to all PAS locations. Pre-qualification of a subcontractor does not replace the requirement for the subcontracting laboratory to verify the capability, capacity, and resources of any selected subcontractor on a project-specific basis to confirm the subcontractor can meet the client's needs.

For both subcontracting and in-network work transfer, the project specifications are always communicated to the subcontractor or the IRWO laboratory by the project manager so that the laboratory performing the work is aware of and understands these requirements.

The procedures for subcontracting are outlined in laboratory SOP ENV-SOP-IND1-0005 *Subcontracting Samples*.

## 4.6 Purchasing Services and Supplies

Vendors that provide services and supplies to the laboratory are prequalified by corporate procurement personnel to verify the vendor's capability to meet the needs of PAS. These needs include but are not limited to: competitive pricing, capacity to fill purchase orders, quality of product, customer service, and business reputation and stability. The records of vendor evaluation and the list of approved vendors is maintained by the corporate procurement department.

The laboratory may purchase goods and services from any supplier on the approved vendor list.

The specifications (type, class, grade, tolerance, purity, etc.) of supplies, equipment, reagents, standard reference materials and other consumables used in the testing process are specified in SOPs. The SOP specifications are based on the governing requirements of the approved reference methods and any additional program driven regulatory specification, such as drinking water compliance. All requisitions for materials and consumables are approved by the department supervisor to confirm the purchase conforms with specified requirements. After approval the requisition is handled by the laboratory's designated purchasing agent. On receipt, the product is inspected and verified before use, when applicable.

The laboratory's procedure for the purchase of services and supplies is specified in laboratory SOP ENV-SOP-IND1-0084 *Purchasing, Receipt, and Storage of Laboratory Supplies*.

## 4.7 Customer Service

Project details and management is handled by the laboratory's customer service team. Each customer is assigned a Project Manager (PM) that is responsible for review of contract requirements and handling laboratory to customer communication about the project status.

#### 4.7.1 Commitment to Meet Customer Expectations

The laboratory cooperates and works closely with our customers to ensure their needs are met and to establish their confidence in the laboratory's capability to meet their needs for analytical services and expectations for service.

Each customer's project is handled by a project manager (PM) that is the customer's primary point of contact. The PM gathers information from the customer to ensure the details of their request are understood. After samples are received, the PM monitors the progress of the project and alerts the customer of any delays or excursions that may adversely impact data usability. Laboratory supervisors are expected to keep the PM informed of project status and any delays or major issues, so that the PM can keep the client informed.

PAS also has a team of subject matter experts (SME) available to provide customers with advice and guidance and any other assistance needed. SME are selected by top management based on their knowledge, experience, and qualifications.

The laboratory encourages customers to visit the laboratory to learn more about the laboratory's capabilities, observe performance and to meet laboratory personnel.

PAS customers expect confidentiality. Laboratory personnel will not divulge or release information to a third party without proper authorization unless the information is required for litigation purposes. See Section 4.1.5.4 of this manual and policy COR-POL-0004 *Ethics Policy* for more information on the laboratory's policy for client confidentiality.

#### 4.7.2 Customer Feedback

The laboratory actively seeks positive and negative feedback from customers through surveys and direct communication. Information from the client about their experience working with the laboratory and their satisfaction with work product is used to enhance processes and practices and to improve decision making. Customer feedback is communicated to laboratory management and corporate personnel in monthly reports and analyzed yearly during management review (See 4.15) to identify risk and opportunity. Corrective, preventive, or continuous improvement actions are taken based on nature of and/or feedback trends.

Also see sections 4.9, 4.10, 4.11, 4.12, 4.14, and 4.15 for more information about how customer feedback is managed by the laboratory and used to enhance the quality management system.

### 4.8 Complaints

Complaints provide opportunities to improve processes and build stronger working relationships with our clients.

The laboratory's complaint resolution process includes three steps. First, handle and resolve the complaint to mutual satisfaction. Second, perform corrective action to prevent recurrence (See 4.11). Third, record and track the complaint and use these records for risk and opportunity assessment and preventive action (See 4.12)

### 4.9 Nonconforming Work

#### 4.9.1 Definition of Nonconforming Work

Nonconforming work is work that does not conform to customer requirements, standard specifications, laboratory policies and procedures, or that does not meet acceptance criteria.

The discovery of non-conforming work comes from various sources which include, but are not limited to:

- results of quality control samples and instrument calibrations;
- quality checks on consumables and materials;
- general observations of laboratory personnel;
- data review;
- proficiency testing;
- internal and external audits;
- complaints and feedback;
- management review and reports; and
- regulatory and certification and accreditation actions.

The way in which the laboratory handles nonconforming work depends on the significance and impact (risk) of the issue. Some issues may simply require correction, others may require investigation, corrective action (See 4.11) and/or data recall (See 4.16). Data and test results associated with nonconforming QC and acceptance criteria are qualified or non-conformances are noted in the final analytical report to apprise the data user of the situation. (See 5.10)

Nonconforming work also includes unauthorized departure from laboratory policies, procedures and test methods. Authorized departures are explained in the following subsections. Situations that do not conform to these conditions are considered unauthorized departure(s).

#### 4.9.1.1 Authorized Departure from SOP

An authorized departure from a test method SOP is one that has been reviewed and approved by the Department Manager, Technical Manager, Acting Technical Manager for TNI, Quality Manager, or the General Manager. Review is conducted to confirm the departure does not conflict with regulatory compliance requirements for which the data will be used or does not adversely affect data integrity. The departure may originate from client request or may be necessary to overcome a problem.

Departure requests are reviewed and pre-approved by the local Quality Manager. Documentation of SOP departures and approval decisions are retained by the laboratory as evidence that the departure was authorized. When necessary, approved departures from test method SOPs are noted in the final test report to advise the data user of any ramification to data quality.

#### 4.9.1.2 Authorized Departure from Test Methods (Method Modifications)

When test results are associated to a published reference test method, the laboratory's test method SOP must be consistent with the test method. If the test method is mandated for use by a specific regulatory program such as drinking water or wastewater or a certification or accreditation program, such as TNI/NELAC, the SOP must also comply with or include these requirements. If the procedures in the SOP are modified from the test method, these modifications must be clearly identified

in the SOP. The conditions under which the laboratory may establish an SOP that is modified from these reference documents, and what is considered a modification are specified in ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification*. Modifications that do not meet the requirements of this SOP (ENV-SOP-CORQ-0011) are unauthorized.

#### 4.9.1.3 Stop Work Authority

Stop Work Authority provides laboratory personnel with the responsibility and obligation to stop work when there is a perceived unsafe condition or behavior that may result in an unwanted event.

All laboratory and corporate personnel have the authority to stop work when needed to preserve data integrity or safety of workers.

Once a stop work order has been initiated and the reason for doing so is confirmed valid; laboratory management is responsible for immediate correction and corrective action (see section 4.11) before resumption of work.

## 4.10 Continuous Improvement

The laboratory's quality management system is designed to achieve continuous improvement through the implementation of the quality policy and objectives outlined in this manual. Information about the laboratory's activities and performance is gained from many sources such as customer feedback, audits, QC, trend analysis, business analytics, management reports, proficiency testing, and management systems review. This information is subsequently used during the laboratory's corrective action (see section 4.11) and preventive action (see section 4.12) processes and to establish goals and objectives during annual review of the management system (see section 4.15).

PAS also promotes a continuous improvement culture based on the principles of lean manufacturing. These principles include 3P (Process, Productivity, Performance) and Kaizen. 3P is a platform used by Pace to share best practices and standardization across the network to achieve operational excellence. Kaizen is a team based process used to implement tools and philosophies of lean to reduce waste and achieve flow with the purpose of improving both external and internal customer satisfaction.

## 4.11 Corrective Action

Corrective action is the process used to eliminate the cause of a detected nonconformity. It is not the same as a correction. A correction is an action taken to fix an immediate problem. The goal of the corrective action process is to find the underlying cause(s) of the problem and to put in place fixes to prevent the problem from happening again. The corrective action process, referred to as CAPA by PAS, is one of the most effective tools used by the laboratory to prevent nonconforming work, identify risk and opportunity, and improve service to our customers.

The laboratory has two general processes for corrective action:

Day-to-day quality control (QC) and acceptance criteria exceptions (nonconformance) are handled as corrections. These events do not usually include formal methods for root cause analysis; instead the reason for the failure is investigated through troubleshooting or other measures. Required actions for correction of routine nonconformance are specified in laboratory SOPs. When correction is not performed, cannot be performed, or is not successful, test results associated with the nonconforming

work are qualified in the final test report. Documentation of the nonconformance and correction performed are included in the analytical record.

A formal 7 step corrective action process is used when there is a problem or departure from the quality management system, technical activities, or when the extent of a single problem has significant impact on data, regulatory compliance or customer needs. These problems are identified through various activities such as but not limited to: quality control trends, internal and external audits, management review, customer feedback, and general observation.

The laboratory's 7 Step CAPA Process includes:

1) Define the Problem
2) Define the Scope of the Problem
3) Contain the Problem
4) Root Cause Analysis
5) Plan Corrective Action
6) Implement Corrective Action
7) Follow Up / Effectiveness Check

The formal CAPA process may be initiated by any employee. Once the process is initiated it is overseen and coordinated by laboratory management. The CAPA process is documented using an electronic or paper-based system. The CAPA record includes tracking information, dates, individuals involved, those responsible for action plan implementation and follow-up, and timelines and due dates.

For more information about the laboratory's procedure for corrective action, see laboratory SOP ENV-SOP-IND1-0020 *Corrective and Preventive Actions.* Additional explanation about certain aspects of the laboratory's corrective action process are outlined in the next three subsections.

### 4.11.1 Root Cause Analysis

Root cause analysis (RCA) is the process of investigation used by the laboratory to identify the underlying cause(s) of the problem. Once causal factors are identified, ways to mitigate the causal factors are reviewed and corrective action(s) most likely to eliminate the problem are selected.

The laboratory uses different methods to conduct this analysis. The most common approach is 5-Why, but fishbone diagrams, or even brainstorming may be appropriate depending on the situation. The method used is documented in the CAPA record.

### 4.11.2 Effectiveness Review

Monitoring corrective actions for effectiveness is shared by laboratory supervisors and quality assurance personnel. Effectiveness means the actions taken were sustainable and appropriate. Sustainable means the change is still in place. Appropriate means the action(s) taken prevented recurrence of the problem since the time corrective action was taken.

The time-frame in which effectiveness review takes place depends on the event and is recorded in the CAPA record with any addition actions that need to be taken.

Corrective action trends are also monitored by laboratory management and used to identify opportunities for preventive action or to gain lessons learned when actions taken were not adequate to solve the problem. See Section 4.12 (Preventive Action) and 4.15 (Management Review) for more information.

#### 4.11.3 Additional Audits

When non-conformances or other problems cast doubt on compliance with the laboratory's policies, procedures, or compliance to regulatory requirements; laboratory management schedules a special audit of the area of activity in accordance with Section 4.14.1 as soon as possible. These special audits are used to determine the scope of the problem and to provide information for the CAPA process. Additional full-scale audits are done when a serious issue or risk to the laboratory's business is identified.

### 4.12 Preventive Action

Preventive action is an action taken to eliminate the cause of a potential nonconformity and to achieve improvement. Preventive action is a forward thinking process designed to prevent problems opposed to reacting to them after they have occurred (corrective action).

Some examples of preventative action include, but are not limited to:

- Scheduled instrument maintenance (Preventative maintenance)
- Addition of Staff and Equipment
- Professional Development Activities
- Implementation of New Technology

The laboratory looks for opportunities for preventive action from a variety of sources including but not limited to: employee ideas, customer feedback, input from business partners, trend analysis, business analytics, management reviews, proficiency testing results, lean management events, and risk-benefit analysis.

The process for preventive actions follows the same 7 step process for corrective action except "problem" is replaced with "opportunity", "root cause analysis" is replaced with "benefit analysis", and "corrective action" is replaced with "preventive action".

Laboratory management evaluates the success of preventive actions taken in any given year during annual management review. See Section 4.15 for more information.

#### 4.12.1 Change Management

Preventive actions may sometimes result in significant changes to processes and procedures used by the laboratory. Laboratory management evaluates the risks and benefits of change and includes in its implementation of change process, actions to minimize or eliminate any risk. The types of changes for which risk are considered and managed include: infrastructure change, change in analytical service offerings, certification or accreditation status, instrumentation, LIMS changes, and changes in key personnel.

For more information about the laboratory's procedures for preventive action see laboratory SOP ENV-SOP-IND1-0020 *Corrective and Preventive Actions.*

### 4.13 Control of Records

A record is a piece of evidence about the past, especially an account of an act or occurrence kept in writing or some other permanent form. Laboratory records document laboratory activities and

provide evidence of conformity to the requirements established in the quality management system. These records may be hardcopy or electronic on any form of media.

### 4.13.1 General Requirements

#### 4.13.1.1 Procedure

The laboratory's procedures for control of records are provided in laboratory SOP ENV-SOP-IND1-0047 *Data Backup and Records Archival.*

The procedures in the SOP are established to assure quality and technical records are identified, retained, indexed, and filed to allow for retrieval during the entire retention time frame. During storage, records are kept secure and protected from deterioration. At the end of the retention time, the records are disposed of properly in order to maintain client confidentiality and to protect the interests of the company.

In general, laboratory records fall into three categories: quality, technical, and administrative.

Examples of each are provided in the following table:

| Record Type | Includes Records of: |
|---|---|
| Quality | Documents: Document Types listed in SOP ENV-SOP-CORQ-016<br>Audits: Internal and External<br>Certificates and Scopes of Accreditation<br>Corrective & Preventive Action<br>Management Review<br>Data Investigations<br>Method Validation<br>Instrument Verification<br>Training Records |
| Technical | Raw Data<br>Logbooks<br>Certificates of Traceability<br>Analytical Record<br>Test Reports & Project Information<br>Technical Training Records & Demonstration of Capability |
| Administrative | Personnel Records<br>Finance/Business |

#### 4.13.1.2 Record Legibility and Storage

Records are designed to be legible and to clearly identify the information recorded. Manual entries are made in indelible ink; automated entries are in a typeface and of sufficient resolution to be read. The records identify laboratory personnel that performed the activity or entered the information.

Records are archived and stored in a way that they can be retrieved. Access to archived records is controlled and managed.

For records stored electronically, the capability to restore or retrieve the electronic record is maintained for the entire retention period. Hardcopy records are filed and stored in a suitable environment to protect from damage, deterioration, or loss. Hardcopy records may be scanned to PDF for retention. Scanned records must be checked against the hardcopy to verify the scan is complete and legible.

Records are kept for a minimum of 10 years unless otherwise specified by the client or regulatory program.

The date from which retention time is calculated depends on the record. In general, the retention time of technical records of original observation and measurement is calculated from the date the record is created. If the technical record is kept in a chronological logbook, the date of retention may be calculated from the date the logbook is archived. The retention time of test reports and project records, which are considered technical records, is calculated from the date the test report was issued. The retention time of quality records is usually calculated from the date the record is archived.

Refer to the laboratory's record management SOP for more information.

#### 4.13.1.3 Security

The laboratory is a secure facility and access to records is restricted to laboratory personnel.

#### 4.13.1.4 Electronic Records

The data systems used to store electronic records are backed up in accordance with laboratory SOP ENV-SOP-IND1-0047 *Data Backup and Records Archival.* Access to archived records stored electronically is maintained by personnel responsible for management of the electronic system.

### 4.13.2 Technical Records

In addition to the requirements identified in subsections 4.13.1.1 through 4.13.1.4, the requirements in the following subsections also apply to technical records.

#### 4.13.2.1 Description

Technical records are the accumulation of data and information generated from the analytical process. These records may include forms, worksheets, workbooks, checklists, notes, raw data, calibration records, final test reports, and project records. The accumulated records need to provide sufficient detail to historically reconstruct the process and identify the personnel that performed the tasks associated with a test result.

#### 4.13.2.2 Real Time Recordkeeping

Personnel are instructed and expected to always record observations, data, and calculations at the time they are made. Laboratory managers are responsible to assure that data entries, whether made electronically or on hardcopy, are relevant and complete.

#### 4.13.2.3 Error Correction

Errors in records must never be erased, deleted or made illegible. Use of correction fluid, such as white-out is prohibited. In hardcopy records, the error is corrected by a single line through the original entry and the new entry recorded alongside or footnoted to allow for readability. Corrections are initialed and dated by the person

making the correction. If the correction is not self-explanatory, a reason for the correction is recorded.

For electronic records, equivalent measures of error correction or traceability of changes is maintained. For example, audit trails provide records of change.

Maintenance of proper practices for error correction is monitored through the tiered data review process described in Section 5.9.3. Laboratory records are reviewed throughout the data review process. Individuals performing these reviews flag errors that are not properly corrected and bring these to the attention of the department manager or supervisor of the work area in which the record was generated so that the problem may be addressed and corrected with the individual(s) that made the improper correction.

## 4.14 Audits

The laboratory performs internal systems and technical audits to assess compliance to this manual and to other laboratory procedures, such as policy, SOP and SWI. Since the processes in this manual are based on the relevant quality system standards and regulatory and accreditation/certification program requirements the laboratory provides services for, the internal audits also assess on-going compliance to these programs.

The laboratory is also audited by external parties such as regulatory agencies, customers, consultants and non-government assessment bodies (NGAB).

Information from internal and external audits is used by laboratory management to address compliance concerns and opportunities where improvement will increase the reliability of data.

Deficiencies, observations, and recommendations from audits are managed by local QA using the laboratory's formal CAPA process. See Section 4.11 for more information.

### 4.14.1 Internal Audit

The laboratory's internal audit program is managed by local QA in accordance with a pre-determined audit schedule established at the beginning of each calendar year. The schedule is prepared to assure that all areas of the laboratory are reviewed over the course of the year. Conformance to the schedule is reported to both laboratory management and corporate quality personnel in a monthly QA report prepared by the Quality Manager.

Although the Quality Manager creates the audit schedule, it is the shared responsibility of local QA and laboratory managers to assure the schedule is maintained. Laboratory supervisors cooperate with QA to provide the auditors with complete access to the work area, personnel, and records needed.

Internal audits are performed by personnel approved by the Quality Manager. In general, personnel may not audit their own activities unless it can be demonstrated that an effective and objective audit will be carried out. The auditor must be trained, qualified, and familiar enough with the objectives, principles, and procedures of laboratory operations to be able to perform a thorough and effective evaluation.

The laboratory's internal audit program includes:

- System Audits & Method Audits: The purpose of these audits is to determine if daily practice is consistent with laboratory's SOPs and if SOPs are compliant with adjunct

policy and procedures. Auditing techniques include analyst interviews and observation and records review. These audits are performed per the pre-determined schedule.

- Raw Data / Final Test Report Audits: The purpose of these audits is to review raw data and/or final test reports to verify the final product is consistent with customer/project requirements and compliant with SOPs and reference methods. Test results should be properly qualified when necessary, should be accurate, and should be of known and documented quality. The reviews should also identify opportunities for improvement and best practices.

- Special Audits: Special audits are those performed ad hoc to follow up on a specific issue such as a client complaint, negative feedback, concerns of data integrity or ethics, or a problem identified through other audits. Special audits may be scheduled or unscheduled. Unscheduled internal audits are conducted whenever doubts are cast on the laboratory's compliance with regulatory requirements or its own policies and procedures. These unscheduled internal audits may be conducted at any time and may be performed without an announcement to laboratory personnel.

When observations and findings from any audit (internal or external) cast doubt on the validity of the laboratory's testing results, the laboratory takes immediate action to investigate the problem and take corrective action. (Also see 4.11 and 4.16)

The laboratory's internal audit program and auditing procedures are further described in laboratory SOP ENV-SOP-IND1-0018 *Internal and External Audits*.

#### 4.14.1.1 Corporate Compliance Audit

The laboratory may also be audited by corporate quality personnel to assess the laboratory's compliance to the company's quality management program and to evaluate the effectiveness of implementation of the policies and procedures that make up the quality management system. The purpose of the compliance audit is to identify risks and opportunities and to assist laboratory management in achieving the goals and objectives of the company's quality program.

## 4.15 Management Review

The laboratory's management team formally reviews the management system on an annual basis to assess for on-going suitability and effectiveness and to establish goals, objectives, and action plans for the upcoming year.

At a minimum, the following topics are reviewed and discussed:

- The on-going suitability of policies and procedures including HSE (Health, Safety and Environment) and waste management;

- Reports from managerial and supervisory personnel including topics discussed at regular management meetings held throughout the year;

- The outcome of recent internal audits;

- Corrective and preventive actions;

- Assessments by external bodies;

- The results of proficiency tests;
- Changes in the volume and type of the work;
- Customer and personnel feedback, including complaints;
- Recommendations for improvement / preventive actions made since last review;
- Internal and external issues of relevance and risk identification;
- A review of the status of actions from prior management reviews; and
- Other relevant factors, such as quality control activities, resources, and staff training.

The discussion and results of this review are documented in a formal report prepared by laboratory management. This report includes a determination of the effectiveness of the management system and its processes; goals and objectives for improvements in the coming year with timelines and responsibilities, any other need for change. See laboratory SOP ENV-SOP-CORQ-0005 *Management Review* for more information.

Goals and action items from annual management systems review are shared with employees to highlight focus areas for improvement in addition to areas in which the laboratory has excelled.

### 4.16 Data Integrity

The laboratory's procedures for data integrity reviews are described in SOP ENV-SOP-CORQ-0010 *Data Recall*.

Customers whose data are affected by these events are notified in a timely manner, usually within 30 days of discovery. Some accreditation programs also require notification to the accreditation body (AB) within a certain time-frame from date of discovery when the underlying cause of the issue impacts accreditation. The laboratory follows any program or project-specific client requirements for notification, when applicable.

## 5.0 TECHNICAL REQUIREMENTS

### 5.1 General

Many factors contribute to the correctness and reliability of the technical work performed by the laboratory. These factors are fall under these general categories:

- Human Performance
- Facility and Environmental Conditions
- Test Method Performance and Validation
- Measurement Traceability
- Handling of Samples

The impact of each of these factors varies based on the type of work performed. To minimize negative effects from each these factors, the laboratory takes into account the contribution from each of these categories when developing test method and process (administrative) SOPs, evaluating personnel qualifications and competence, and in the selection of equipment and supplies.

## 5.2 Personnel

### 5.2.1 Personnel Qualifications

The laboratory's program for personnel management is structured to ensure personnel are selected, qualified, and competent to perform the roles and responsibilities of their position based on education, experience, and training.

Qualifications, duties, responsibilities, and authorities of each position are specified in job descriptions maintained by corporate HR (See Section 5.2.4). These job descriptions provide the general basis for the selection of personnel for hire and are used by the laboratory to communicate to personnel the duties, responsibilities, and authorities of their position.

The term "personnel" refers to individuals employed by the laboratory directly as full-time, part-time, or temporary employees and individuals employed by the laboratory by contract through an employment agency. The term "personnel" is used interchangeably with the term "employee" throughout this manual. For purposes of this manual, these terms are equivalent.

The personnel management program is structured to establish and maintain records for each of the following:

- Selection of personnel;
- Training of personnel;
- Supervision of personnel;
- Authorization of personnel; and
- Monitoring Competence of personnel.

#### 5.2.1.1 Competence

Competence is the ability to apply a skill or series of skills to complete a task or series of tasks correctly within defined expectations.

Competence for technical personnel, authorized by PAS to provide opinion and interpretation of data to customers, also includes the demonstrated ability to:

- Apply knowledge, experience, and skills needed to safely and properly use equipment, instrumentation, and materials required to carry out testing and other work activities in accordance with manufacturer specifications and laboratory SOPs;
- Understand and apply knowledge of general regulatory requirements necessary to achieve regulatory compliance in work product; and
- Understand the significance of departures and deviations from procedure that may occur during the analytical testing process and the capability and initiative to troubleshoot and correct the problem, document the issue, and to properly qualify the data and analytical results.

The laboratory's requirements for the competence of personnel (education, qualification, work experience, technical skills, and responsibilities) are specified in job descriptions created by management and kept by human resources (HR). The job description provides the basis for the selection of personnel for each position.

An employee is considered competent when he/she has completed documented required training.

The policies and standard operating procedures (SOPs) for the following topics are established by management as minimum required training for all personnel:

- Ethics and Data Integrity
- Quality Manual
- Safety Manual
- Technical Process and Procedure relevant to their job tasks
- Successful Demonstration of Capability (DOC) – Analytical Personnel Only

Records of training and qualification provide the record of competence for the individual. Qualification records may include but are not limited to diploma, transcripts, and curriculum vitae (CV).

The on-going competence of each employee is monitored by laboratory management through on-the-job performance. Analytical employees are also required to successfully complete another demonstration capability for each test method performed on an annual basis.

### 5.2.2 Training

Training requirements are outlined in policies COR-POL-0023 *Mandatory Training Policy*. COR-POL-0004 *Ethics Policy*, and laboratory SOP ENV-SOP-IND1-0027 *Employee Orientation and Training*. Additional training requirements may also be specified in other documents, such as manuals.

#### 5.2.2.1 Training Program and Goals

The laboratory's training program includes 4 elements:

- Identification of Training Needs
- Training Plan Development and Execution
- Documentation and Tracking
- Evaluation of Training Effectiveness

Laboratory management establishes goals and training needs for individual employees based on their role, education, experience, and on-the-job performance.

Training needs for all employees are based on business performance measures that include but are not limited to:

- Quality Control Trends
- Process Error / Rework Trends
- Proficiency Testing Results
- Internal & External Audit Performance

- Management Review Goals

Training is delivered using various methods that incorporate techniques that appeal to the main learning styles: visual, aural, linguistic, and kinesthetic. Techniques include on-the-job, instructor-led, self-study, eLearning, and blended.

The employee's direct supervisor is responsible for oversight of the employee's training plan and for providing adequate time to the employee to complete training assignments. Both the supervisor and employee are responsible to make sure the employee's training status and training records are current and complete.

The laboratory's QA department monitors the training status of personnel and provides the status to the General Manager (GM or AGM) at least monthly or more frequently, if necessary. The status report is used by laboratory management to identify overdue training assignments, the reasons for the gaps, and to make arrangements for completion.

The following subsections highlight specific training requirements:

#### 5.2.2.1.1 New Hire Training

New hire training requirements apply to new personnel and to existing employee's starting in a new position or different work area.

Required new hire training includes each of the following:

- Ethics and Data Integrity (See 5.2.2.1.3)
- Quality Manual / Quality Management System (See 5.2.2.1.4)
- Safety Manual and any training requirements specified in the manual.
- Policies & SOPs relevant to their job tasks
- Technical personnel that test samples must also successfully complete an initial demonstration of capability (IDOC) for the test methods performed before independently testing customer samples. (See 5.2.2.1.5). Independent testing means handling of client samples without direct supervision of the work activity by the supervisor or a qualified trainer.

All required training must be current and complete before the employee is authorized to work independently. Until then, the employee's direct supervisor is responsible for review and acceptance of the employee's work product.

#### 5.2.2.1.2 On-Going Training

Personnel receive on-going training in each of the following topics:

- Ethics and Data Integrity (See 5.2.2.1.3)
- Quality Manual / Quality Management System (See 5.2.2.1.4)

- Safety Training
- Changes to Policies & SOPs
- Specialized Training
- Technical personnel that carry out testing must also successfully complete continuing demonstration of capability (DOC) for all test methods performed on an annual basis. (See 5.2.2.1.5)

Personnel are expected to maintain their training status and records of training current and complete and to complete training assignments in a timely manner.

#### 5.2.2.1.3 Ethics and Data Integrity Training

Initial data integrity training is provided to all new personnel and refresher data integrity training is provided to all employees on an annual basis. Personnel are required to acknowledge they understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences including immediate termination, debarment, or civil/criminal prosecution.

The initial data integrity training and the annual refresher training is documented with a signature attendance sheet or other form of documentation to provide evidence that the employee has participated in training on this topic and understands their obligations related to data integrity.

The following topics and activities are covered:

- Policy for honesty and full disclosure in all analytical reporting;
- Prohibited Practices;
- How and when to report data integrity issues;
- Record keeping. The training emphasizes the importance of proper written documentation on the part of the analyst;
- Training Program, including discussion regarding all data integrity procedures;
- Data integrity training documentation;
- In-depth procedures for data monitoring; and
- Specific examples of breaches of ethical behavior such as improper data manipulations, adjustments of instrument time clocks, and inappropriate changes in concentrations of standards.

All PAS personnel, including contract and temporary, are required to sign an "Attestation of Ethics and Confidentiality" at the time of

employment and during annual refresher training. This document clearly identifies inappropriate and questionable behavior. Violations of this document result in serious consequences, including termination and prosecution, if necessary.

Also see SOP-ENV-COR-POL-0004 *Ethics Policy* for more information.

#### 5.2.2.1.4 Management System Documents Training

PAS Manuals, policies, and SOPs are the primary documents used by regulatory bodies and PAS customers to verify the laboratory's capability, competency, and compliance with their requirements and expectations.

In addition to on-the-job training, employees must have a signed Read and Acknowledgement Statement on record for the laboratory Quality Manual and the policies and SOPs relating to his/her job responsibilities. This statement, when signed by the employee electronically or on paper, confirms that the employee has received, read, and understands the contents of the document, that the employee agrees to follow the document when carrying out their work tasks, and that the employee understands that unauthorized change to procedures in an SOP is not allowed except in accordance with the SOP departure policy (See 4.9.1.1) and SOP ENV-CORQ-0016 *Standard Operating Procedures and Standard Work Instructions* for more information.

#### 5.2.2.1.5 Demonstration of Capability (DOC)

Technical personnel must also complete an initial demonstration of capability (IDOC) prior to independent work on client samples analyzed by the test methods they perform. After successful IDOC, the employee must demonstrate continued proficiency (DOC) for the test method on an annual basis. If more than a year has passed since the employee last performed the method; then capability must be re-established with an IDOC.

Demonstration of capability (IDOC and DOC) is based on the employee's capability to achieve acceptable precision and accuracy for each analyte reported by the laboratory for the test method using the laboratory's test method SOP.

Records of IDOC and DOC are kept in the employee's training file.

For more information, see laboratory SOP ENV-SOP-IND1-0027 *Employee Orientation and Training.*

### 5.2.2.2 Effectiveness of Training

The results of the performance measures used to identify training needs are the same measures used by the laboratory to measure effectiveness of the training program.

Improvements in key performance measures suggest the training program is successful. (See 5.2.2.1)

Effectiveness of individual employee training is measured by their demonstrated ability to comprehend the training material and apply the knowledge and skills gained to their job task. Measurements include but are not limited to:

- Testing of the employee's knowledge of the quality management system, policies, and technical and administrative procedures through various mechanisms, such as quizzes, observation, and interviews.
- Demonstrated ability to convey information correctly and factually in written and verbal communication to internal and external parties.
- Demonstrated ability to carry out tasks in accordance with SOPs and other work instructions.
- Demonstrated ability to make sound decisions based on guidance and information available.
- Demonstrated initiative to seek help or guidance when the employee is unsure of how to proceed.

### 5.2.3 Personnel Supervision

Every employee is assigned a direct supervisor, however named, who is responsible for their supervision. Supervision is the set of activities carried out by the supervisor to oversee the progress and productivity of the employees that report to them.

General supervisory responsibilities may include but are not limited to:

- Hiring Employees
- Training Employees
- Performance Management
- Development, oversight, and execution of personnel training plans
- Monitoring personnel work product to assure the work is carried out in accordance with this quality manual, policies, SOPs, and other documents that support the quality management system.

### 5.2.4 Job Descriptions

Job Descriptions that define the required education, qualifications, experience, skills, roles and responsibilities, and reporting relationships for each PAS position are established by top management and kept by corporate HR. The job descriptions apply to employees who are directly employed by PAS, part-time, temporary, technical and administrative and by those that are under contract with PAS through other means.

The job descriptions include the education, expertise, and experience required for the position and the responsibilities and duties, including any supervisory or managerial duties assigned to the position.

#### 5.2.5 Authorization of Technical Personnel

Laboratory management authorizes technical personnel to perform the technical aspects of their position after it has been verified that the employee meets the qualifications for the position, has successfully completed required training, and the employee has demonstrated capability. After initial authorization, technical personnel are expected to maintain a current and complete training record, demonstrate on-going capability at least annually for each test method performed, and produce reliable results through accurate analysis of certified reference materials, proficiency testing samples, and/or routine quality control samples in order to remain authorized to continue to perform their duties.

Records to support authorization including education, experience, training, and other evaluations are kept by the laboratory.

### 5.3 Accommodations and Facilities

#### 5.3.1 Facilities

The laboratory is designed to appropriately support the performance of procedures and to not adversely affect measurement integrity or safety. Access to the laboratory is controlled by various measures, such as card access, locked doors, and main entry. Visitors to the laboratory are required to sign-in and to be escorted by laboratory personnel during their visit. A visitor is any person that is not an employee of the laboratory.

#### 5.3.2 Environmental Conditions

The laboratory is equipped with energy sources, lighting, heating, and ventilation necessary to facilitate proper performance of calibrations and tests. The laboratory ensures that housekeeping, electromagnetic interference, humidity, line voltage, temperature, sound and vibration levels are appropriately controlled to ensure the integrity of specific measurement results and to prevent adverse effects on accuracy or increases in the uncertainty of each measurement.

Environmental conditions are monitored, controlled, and recorded as required by the relevant specifications, methods, and procedures. Laboratory operations are stopped if it is discovered that the laboratory's environmental conditions jeopardize the analytical results.

#### 5.3.3 Separation of Incompatible Activities

The layout and infrastructure of each work area including air handling systems, power supplies, and gas supplies of each laboratory work area is specifically designed for the type of analytical activity performed. Effective separation between incompatible work activities is maintained. For example, sample storage, preparation, and chemical handling for volatile organic analysis (VOA) is kept separate from semi-volatile organic analysis (SVOA).

The laboratory separates samples known or suspected to contain high concentration of analytes from other samples to avoid the possibility for cross-contamination. If contamination is found, the source of contamination is investigated and resolved in accordance with laboratory SOPs.

#### 5.3.4 Laboratory Security

Security is maintained by controlled access to the building and by surveillance of work areas by authorized personnel. Access is controlled to each area depending on the required

personnel, the sensitivity of the operations performed, and possible safety concerns. The main entrance is kept unlocked during normal business hours for visitors, and is continuously monitored by laboratory staff. All visitors must sign a visitor's log and a staff member must accompany them during their stay.

#### 5.3.5 Good Housekeeping

The laboratory ensures good housekeeping practices in work areas to maintain a standard of cleanliness necessary for analytical integrity and personnel health and safety. Minimally, these measures include regular cleaning of the work area. Where necessary, areas are periodically monitored to detect and resolve specific contamination and/or possible safety issues.

### 5.4 Test Methods

#### 5.4.1 General Requirements

The laboratory uses test methods and procedures that are appropriate for the scope of analytical services the laboratory offers.

Instructions on the use and operation of equipment and sample handling, preparation, and analysis of samples are provided in SOPs. The instructions in SOPs may be supplemented with other documents including but not limited to, standard work instructions (SWI), manuals, guides, project documents and reference documents.

These documents are managed using the procedures described in SOP ENV-SOP-CORQ-0015 *Document Management and Control* and SOP ENV-SOP-CORQ-0016 *Standard Operating Procedures and Standard Work Instructions.*

Deviations to test method and SOPs are allowed under certain circumstances. See sections 4.9.1.1 and 4.9.1.2 for more information.

#### 5.4.2 Method Selection

The test methods and protocols used by the laboratory are selected to meet the needs of the customer and to conform with regulatory requirements, if applicable.

In general, the test methods offered are industry accepted methods published by international, regional, or national standards. The laboratory bases its procedure on the latest approved edition of a method unless it is not appropriate or possible to do so or unless regulatory requirements allow otherwise.

The laboratory confirms that it can perform the test method and achieve desired outcome before analyzing samples (see section 5.4.5). If there is a change in the published analytical method, then the confirmation is repeated.

When a customer does not specify the test method(s) to be used, the laboratory may suggest test methods that are appropriate for the intended use of the data and the type of samples to be tested. The laboratory will also inform customers when test methods requested are considered inappropriate for their purpose and/or out of date. This discourse takes place during review of analytical requests (See Section 4.4).

### 5.4.3 Laboratory Developed Methods

A laboratory developed method is a method developed from scratch (no published source method), a procedure that modifies the chemistry from the source method, or a procedure that exceeds the scope and application of the source method.

Laboratory developed methods must be validated prior to use (see section 5.4.5) and the procedure documented in a test method SOP.

The requirements for non-standard methods (Section 5.4.4) also apply to laboratory developed methods.

### 5.4.4 Non-standard Methods

A non-standard method is a method that is not published or approved for use by conventional industry standards for the intended purpose of the data. Non-standard methods must be validated prior to use (see section 5.4.5) and the procedure developed and documented in a test method SOP.

At a minimum, the following information must be included in the procedure:

- Title / Identification of Method;
- Scope and Application;
- Description of the type of item to be analyzed;
- Parameters or quantities and ranges to be determined;
- Apparatus and equipment, including technical performance requirements;
- Reference standards and reference materials required;
- Environmental conditions required and any stabilization period needed
- Description of the procedure, including:
    - Affixing identification marks, handling, transporting, storing and preparing of items;
    - Checks to be made before the work is started;
    - Verifying equipment function and, where required, calibrating and/or adjusting the equipment before each use;
    - Method of recording the observations and results;
    - Any safety measures to be observed;
    - Criteria and/or requirements for approval/rejection of data;
    - Data to be recorded and method of analysis and presentation; and
    - Uncertainty or procedure for estimating uncertainty.

Use of a non-standard method for testing must be agreed upon with the customer. The agreement, which is retained by the laboratory in the project record, must include the specifications of the client's requirements, the purpose of testing, and their authorization for use of the non-standard method.

### 5.4.5 Method Validation

#### 5.4.5.1 Validation Description

Validation is the process of conformation and the provision of objective evidence that the stated requirements for a specific method/procedure are fulfilled.

The laboratory's requirements and procedures for method validation are outlined in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.*

#### 5.4.5.2 Validation Summary

All test methods offered by the laboratory are validated before use to confirm the procedure works and the data and results achieved meet the goals for the method. The extent of validation performed is based on technology and other factors as defined in the validation SOP (ENV-SOP-CORQ-0011).

Results of validation are retained are kept in accordance with the laboratory's SOP ENV-SOP-IND1-0047 *Data Backup and Records Archival* for retention of technical records.

The need to repeat validation is assessed by laboratory management when there are changes to the test method.

#### 5.4.5.3 Validation of Customer Need

Laboratory management reviews the results of test method validation, which include accuracy, precision, sensitivity, selectivity, linearity, repeatability, reproducibility, and robustness, against general customer needs to ensure the laboratory's procedure for the test method will meet those needs.

The review procedure is detailed in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.*

The following subsections highlight some of these concepts:

##### 5.4.5.3.1 Accuracy

Accuracy is the degree to which the result of a measurement, calculation, or specification conforms to the correct value of a standard. When the result recovers within a specified range from the known value (control limit); the result generated using the laboratory's test method SOP is considered accurate.

##### 5.4.5.3.2 Precision

Precision refers to the closeness of two or more measurements to each other. It is generally measured by calculating the relative percent difference (RPD) or relative standard deviation (RSD) from results of separate analysis of the same sample. Precision provides information about repeatability, reproducibility, and robustness of the laboratory's procedure.

#### 5.4.5.3.3 Limits of Detection (LOD)

The LOD is the minimum result which can be reliably differentiated from a blank with a predetermined confidence level. The LOD establishes the limit of method sensitivity and is also known as the detection limit (DL) or the method detection limit (MDL).

Values below the LOD cannot be reliably measured and are not reported by the laboratory unless otherwise specified by regulatory program or test method. If reported, values below the LOD are qualified as estimated.

The LOD is established during method validation and after major changes to the analytical system or procedure that affect sensitivity are made.

The laboratory's procedure for LOD determination is detailed in laboratory SOP ENV-SOP-IND1-0009 *Determination of Detection and Quantitation Limits*. The SOP complies with 40 CFR 136 Appendix B or the current industry approved and accepted guidance for this process.

#### 5.4.5.3.4 Limits of Quantitation (LOQ) and Reporting Limit (RL)

The LOQ is the minimum level, concentration, or quantity of a target analyte that can be reported with a specified degree of confidence. The LOQ is established at the same time as the LOD. The laboratory's procedure for determination and verification of the LOQ is detailed in laboratory SOP ENV-SOP-IND1-0009 *Determination of Detection and Quantitation Limits*.

The Lowest Limit of Quantitation (LLOQ) is the value of the lowest calibration standard. The LOQ establishes the routine limit of quantitation.

The LOQ and LLOQ represent quantitative sensitivity of the test method.

- The LOQ must always be equal to or greater than the LLOQ and the LLOQ must always be greater than the LOD.
- Any reported value (detect or non-detect) less than the LLOQ is a qualitative value.

The RL is the value to which the presence of a target analyte is reported as detected or not-detected. The RL is project-defined based on project data quality objectives (DQO). In the absence of project specific requirements, the RL is usually set to the LOQ or the LLOQ.

For more information, refer to laboratory SOP ENV-SOP-IND1-0009 *Determination of Detection and Quantitation Limits*.

#### 5.4.5.3.5 Linearity

Linearity is a mathematical concept applied to calibration models that employ multiple points to establish a calibration range used for quantitative analysis. Linearity is measured differently based on the calibration model. The accuracy of the linear regression and non-linear curves is verified by checking percent error or relative standard error (RSE), which is the process of refitting calibration data back to the model to determine if the results are accurate. For linear curves that use average calibration or response factor, error is measured by relative standard difference (RSD).

Linearity also establishes the range of quantitation for the test method used which directly impacts the sensitivity of the test method and uncertainty in measurement results. As previously noted, the LLOQ establishes the lower limit of quantitation. Similarly, the upper range of linearity establishes the upper limit of quantitation. In general, results outside of this range are considered qualitative values. However, some inorganic methods allow for extension of the linear range above the upper limit of quantitation when accuracy at this value is verified.

Linearity can also be used to establish repeatability, reproducibility, and robustness of the laboratory's test method. When linearity is demonstrated using a specific calibration model during method validation, then use of this same calibration model to achieve linearity on a day to day basis confirms the laboratory's method is repeatable, reproducible, and robust.

#### 5.4.5.3.6 Demonstration of Capability (DOC)

The DOC performed during method validation confirms that the test method demonstrates acceptable precision and accuracy. The procedure used for DOC for method validation is the same as described in section 5.2.2.1.5 for demonstration of analyst capability.

### 5.4.6 Measurement Uncertainty

The laboratory provides an estimate of uncertainty in testing measurements when required or on client request. In general, the uncertainty of the test method is reflected in the control limits used to evaluate QC performance. (See 5.9.1.1.10).

When measurement uncertainty cannot be satisfied through control limits, the laboratory will provide a reasonable estimation of uncertainty. A reasonable estimation is based on knowledge of method performance and previous experience. When estimating the analytical uncertainty, all uncertainty components which are of importance in the given situation are taken into account.

### 5.4.7 Control of Data

The laboratory has policies and processes in place to assure that reported data is free from calculation and transcription errors, that quality control is reviewed and evaluated before data is reported, and to address manual calculation and integration.

#### 5.4.7.1 Calculations, Data Transfer, Reduction and Review

Whenever possible, calculations, transfer of data, and data reduction are performed using validated software programs. (See 5.4.7.2)

If manual calculations are necessary, the results of these calculations are verified during the data review process outlined in section 5.9.3.

##### 5.4.7.1.1 Manual Integration

The laboratory's policy and procedures for manual integration are provided in SOP ENV-SOP-CORQ-0006 *Manual Integration*.

This SOP includes the conditions under which manual integration is allowed and the requirements for documentation.

Required documentation of manual integration includes:

- complete audit trail to permit reconstruction of before and after results;
- identification of the analyst that performed the integration and the reason the integration was performed; and
- the individual(s) that reviewed the integration and verified the integration was done and documented in compliance with the SOP.

#### 5.4.7.2 Use of Computers and Automated Acquisition

Whenever possible the laboratory uses software and automation for the acquisition, processing, recording, reporting, storage, and/or retrieval of data.

Software applications developed by PAS are validated by corporate IT for adequacy before release for general use. Commercial off-the-shelf software is considered sufficiently validated when the laboratory follows the manufacturer's or vendor's manual for set-up and use. Records of validation are kept by the corporate information technology (IT) group or by the local laboratory, whichever group performed the validation.

The laboratory's process for the protection of data stored in electronic systems includes:

- Individual user names and passwords for Laboratory Information Management Systems (LIMS) and auxiliary systems used to store or process data.
- Employee Training in Computer Security Awareness

- Validation of spreadsheets used for calculations to verify formulas and logic yield correct results and protection of these cells to prevent unauthorized change.
- Operating system and file access safeguards
- Protection from Computer Viruses
- Regular system backup; and testing of retrieved data

The laboratory's process for software development and testing process includes:

- Verification the software application works as expected and is adequate for use and fulfills compliance requirements, such as the need to record date/time of data generation.
- Change control to assure requests for changes are reviewed and approved by management before the change is made.
- Communication channels to assure all staff are aware of changes made.
- Version Control and maintenance of historical records.

## 5.5 Equipment

### 5.5.1 Availability of Equipment

The laboratory is furnished with all equipment and instrumentation necessary to perform the tests offered in compliance with the specifications of the test method and to achieve the accuracy and sensitivity required.

### 5.5.2 Calibration

Equipment and instrumentation is checked prior to use to verify it performs within tolerance for its intended application.

Laboratory management is made aware of the status of equipment and instrumentation and any needs for either on a daily basis. This information is obtained during laboratory Lean Daily Management (LDM) walkthroughs that are conducted as part of the laboratory's lean program.

#### 5.5.2.1 Support Equipment

The laboratory confirms support equipment is in proper working order and meets the specifications for general laboratory use prior to placement in service and with intermediate checks thereafter. Equipment that does not meet specifications is removed from service until repaired or replaced. Records of repair and maintenance activities are maintained.

Procedures used to carry out and record these checks are outlined laboratory SOP ENV-SOP-IND1-0086 *Support Equipment*.

#### 5.5.2.2 Analytical Instruments

Analytical instruments are checked prior to placement in service in accordance with SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.* After the

initial service date, the calibration of instruments and verification calibration is performed in accordance with local test method SOPs.

The calibration procedures in the test method SOPs comply with the requirements for acceptable calibration practices outlined in corporate document ENV-SOT-CORQ-0026 *Calibration Procedures*, the reference methods, and any applicable regulatory or program requirements.

### 5.5.3 Equipment Use and Operation

Equipment is operated and maintained by laboratory personnel that are trained on the test method SOP. Up-to-date instructions and procedures for the use and maintenance of analytical equipment are included in SOPs and/or supplemental documents such as standard work instructions (SWI), maintenance logbooks, or instrument manuals which are made readily accessible in the work area to all laboratory personnel.

### 5.5.4 Equipment Identification

The laboratory uniquely identifies equipment by serial number or any other unique ID system, when practical.

### 5.5.5 Equipment Lists and Records

#### 5.5.5.1 Equipment List

The laboratory maintains a master list of equipment that includes equipment description, manufacturer, model, associated methods, and the year it was placed into service. The date of purchase is tracked by the procurement record. The equipment list(s) for each location covered by this manual is provided in Appendix E.

#### 5.5.5.2 Equipment Records

In addition to the equipment list, the laboratory maintains records of equipment that include:

- Verification that equipment conforms with specifications.
- Calibration records including dates, results, acceptance criteria, and next calibration date, if scheduled.
- Maintenance plan and records
- Records of damage, malfunction, or repair

The laboratory follows an equipment maintenance program designed to optimize performance and to prevent instrument failure which is described in laboratory SOPs, instrument maintenance logbooks, or instrument user manuals.

The maintenance program includes routine maintenance activities which are performed as recommended by the manufacturer at the frequency recommended and non-routine maintenance, which is performed to resolve specific problems such as loss of sensitivity or repeated failure of instrument performance checks and quality control samples.

Maintenance is performed by laboratory personnel or by outside service providers.

All maintenance activities performed by laboratory personnel are recorded by the individual(s) that performed the activity at the time the maintenance was performed in an instrument maintenance log.

The maintenance record minimally includes the date of maintenance, the initials of the person(s) performing maintenance, the problem encountered, a description of the activity performed, and evidence of return to analytical control. When maintenance is performed by an external vendor, the laboratory staples the service record into hardcopy maintenance logs or scans the record for easy retrieval. The laboratory provides unrestricted access to instrument maintenance logs in order to promote good instrument maintenance and recordkeeping practices.

If an instrument must be moved, the laboratory will use safe practices for handling and transport to minimize damage and contamination.

### 5.5.6 Out of Service Protocol

Equipment that has been subjected to overloading, mishandling, gives suspect results, has been shown to be defective, or is performing outside of specified limits is taken out of service. The equipment is either removed from the work area or labeled to prevent accidental use until it has been repaired and verified to perform correctly.

When analytical equipment is taken out of service, the laboratory examines the potential effect it may have had on previous analytical results to identify any non-conforming work. (See section 4.9).

### 5.5.7 Calibration Status

The laboratory labels support equipment to indicate calibration status, whenever practicable, or otherwise maintains the calibration status in a visible location in the work area. These procedures are described in laboratory SOP ENV-SOP-IND1-0086 *Support Equipment*.

The calibration status of analytical instruments is documented in the analytical record. Analysts verify on-going acceptability of calibration status prior to use and with instrument performance check standards. These procedures are described in test method SOPs.

### 5.5.8 Returned Equipment Checks

When equipment or instruments are sent out of the laboratory for service, the laboratory ensures that the function and calibration status of the equipment is checked and shown to be satisfactory before the equipment is returned to service. These procedures are outlined in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.*

### 5.5.9 Intermediate Equipment Checks

The laboratory performs intermediate checks on equipment to verify the on-going calibration status. For example, most test methods require some form of continuing calibration verification check and these procedures are included in the test method SOP. Periodic checks of support equipment are also performed.

### 5.5.10 Safeguarding Equipment Integrity

The laboratory safeguards equipment integrity using a variety of mechanisms that include but are not limited to:

- Adherence to manufacturer's specifications for instrument use so that settings do not exceed manufacturer's recommendations or stress the performance of the equipment.
- Established maintenance programs.
- Transparent maintenance records and unrestricted access to maintenance logs.
- Validation and approval of software before use.
- Audits to confirm instrument settings are consistent with SOPs.
- On-the-job training for safe and proper use of laboratory equipment.

## 5.6 Measurement Traceability

### 5.6.1 General

Measurement traceability refers to a property of a measurement result whereby the result can be related to a reference through an unbroken chain of calibration, each contributing to the measurement uncertainty. Traceability requires an established calibration of equipment used during testing including support equipment. The laboratory assures this equipment is calibrated prior to being put into service and that the reference standard and materials used for calibration are traceable to the international standard of units (SI) or national measurement standard.

When strict traceability to SI units cannot be made, the laboratory establishes traceability with the use of reference standards and equipment obtained from competent suppliers that provide calibration certificates and/or certificates of analysis (COA).

### 5.6.2 Equipment Correction Factors

When correction factors are used to adjust results the laboratory will assure that results in computer software are also updated. For example, if the direct instrument or reading output must be corrected based on preparation factor or concentration factors, laboratory management will assure the corrected result is also updated in the software, whenever possible.

### 5.6.3 Specific Requirements

#### 5.6.3.1 Requirements for Calibration Laboratories

The laboratory does not offer calibration services to customers.

#### 5.6.3.2 Requirements for Testing Laboratories

The laboratory has procedures in place to verify equipment is calibrated prior to being put into service (See 5.5.2), and ensures the reference standard and materials used for calibration are traceable to the international standard of units (SI) or national measurement standard. When strict traceability to SI units cannot be made, the laboratory establishes traceability with the use of reference standards and equipment obtained from competent suppliers that provide calibration certificates and/or certificates of analysis (COA).

### 5.6.4 Reference Standards and Reference Materials

#### 5.6.4.1 Reference Standards

The laboratory uses reference standards of measurement to verify adequacy of working weights and thermometers. The working weight is the weight(s) used for daily balance calibration checks and the working thermometers are used for temperature measurements on a daily basis.

The measurements from working weights and thermometers are compared to measurement taken by the reference standard which is traceable to SI or a national standard. The reference weights and thermometers are used solely for verification purposes unless the laboratory can prove that daily use does not adversely affect performance of the reference standard.

The laboratory performs intermediate checks of the working weights at least annually.

Working thermometers are checked against the reference thermometer annually (glass) or quarterly (digital).

The calibration of liquid in glass reference thermometers is verified every 5 years and the calibration of digital reference thermometers is verified bi-annually by an ISO/IEC 17025 accredited calibration laboratory or service provider that provides traceability to a national standard.

The calibration of the reference weight(s) is verified every 5 years by an ISO/IEC 17025 accredited calibration laboratory.

See laboratory ENV-SOP-IND1-0086 *Support Equipment* for more information about this process.

#### 5.6.4.2 Reference Materials

The laboratory purchases chemical reference materials used as analytical standards and reagents from vendors that are accredited to ISO 17034 or Guide 34. Purchased reference materials must be received with a Certificate of Analysis (COA), where available. If a reference material cannot be purchased with a COA, it must be verified by analysis and comparison to a certified reference material and/or there must be a demonstration of capability for characterization. COA are reviewed for adequacy and retained by the laboratory for future reference.

The laboratory procedure for traceability and use of these materials is provided in laboratory SOP ENV-SOP-IND1-0031 *Standard and Reagent Management and Traceability*.

This SOP includes each of the following requirements:

- Procedures for documentation of receipt and tracking. The record of entry includes name of the material, the lot number, receipt date, and expiration date.
- Storage conditions and requirements. Reference materials must be stored separately from samples, extracts, and digestates.

- Requirements to assure that preparations of intermediate or working solutions are recorded and assigned a unique identification number for tracking. Records of preparation include the lot number of the stock standard(s) used, the type and lot number of the solvent, the formulation, date, expiration date, and the preparer's initials. The lot number of the working standards is recorded in the analytical record to provide traceability to the standard preparation record. The preparation record provides traceability to the COA, which is traceable to SI or the national measurement standard.

- A requirement that the expiration dates of prepared standards may not exceed the expiration date of the parent standard. Standards, reference materials, and reagents are not used after their expiration dates unless their reliability is thoroughly documented and verified by the laboratory. If a standard exceeds its expiration date and is not re-certified, the laboratory removes the standard and/or clearly designates it as acceptable for qualitative/troubleshooting purposes only. All prepared standards, reference materials, and reagents are verified to meet the requirements of the test method through routine analysis of quality control samples.

- The second source materials used for verification of instrument calibration are obtained from a different manufacturer or different lot from the same manufacturer.

- Procedures to check reference materials for degradation and replacement of material if degradation or evaporation is suspected.

- Procedures for labeling. At a minimum the container must identify the material, the ID of the material and the expiration date. Original containers should also be labeled with date opened.

#### 5.6.4.3 Intermediate Checks

Checks to confirm the calibration status of standards and materials are described in laboratory SOPs. These checks include use of second source standards and reference materials reserved only for the purpose of calibration checks.

#### 5.6.4.4 Transport and Storage

The laboratory handles and transports reference standards and materials in a manner that protects the integrity of the materials. Reference standard and material integrity is protected by separation from incompatible materials and/or minimizing exposure to degrading environments or materials. Standards and reference materials are stored separately from samples, extracts, and digestates. All standards are stored according to the manufacturer's recommended conditions. Temperatures colder than the manufacturer's recommendation are acceptable if it does not compromise the integrity of the material (e.g. remains in liquid state and does not freeze solid). In the event a standard is made from more than a single source with different storage conditions, the standard will be stored according to the conditions specified in the analytical method.

See the applicable analytical SOPs for specific reference material storage and transport protocols.

## 5.7 Sampling

Sampling refers to the field collection of samples for analytical testing.

Subsampling refers to a measured portion of sample used for analysis. Procedures are included SOP ENV-SOP-IND1-0028 *Sample Homogenization, Subsampling, and Compositing* to assure the portion used for testing is representative of the field collected sample.

The requirements in the following subsections apply when field sampling is performed by the laboratory.

### 5.7.1 Sampling Plans and SOPs

When the laboratory performs field collection of samples, sampling is carried out in accordance with a written sample plan prepared by the customer or by the laboratory and by relevant sampling SOPs. These documents are made readily accessible at the sampling location. Sampling plans and SOPs are, whenever reasonable, based on appropriate governing methods and addresses the factors to be controlled to ensure the validity of the analytical results.

### 5.7.2 Customer Requested Deviations

When the customer requires deviations, additions, or exclusions from the documented laboratory sampling plan and/or procedure, the laboratory records the client's change request in detail with the sampling record, communicates the change to sampling personnel, and may include this information in the final test report.

### 5.7.3 Recordkeeping

The laboratory assures the sampling record includes the sampling procedure used, any deviations from the procedure, the date and time of sampling, the identification of the sampler, environmental conditions (if relevant), and the sampling location.

## 5.8 Sample Management & Handling

### 5.8.1 Procedures

The laboratory's procedures for sample management and handling are outlined in laboratory SOP ENV-SOP-IND1-0001 *Sample Management*.

The procedures in this SOP are established to maintain the safe handling and integrity of samples from receipt, transport, storage, to disposal and during all processing steps in-between; to maintain client confidentiality, and to protect the interests of PAS and its customers.

#### 5.8.1.1 Chain of Custody

All samples received by the laboratory must be accompanied with a Chain of Custody (COC) record. The COC provides information about the samples collected and submitted for testing and it documents the possession of samples from time of collection to receipt by the laboratory.

The COC record must minimally include the following information:

- Client name, address, phone number
- Project Reference
- Client Sample Identification (Client ID)
- Date, Time, and Location of Sampling
- Samplers Name or Initials
- Matrix of samples
- Type of container, and total number of containers collected for each sample
- Preservatives, if applicable
- Analyses Requested
- Any special instructions
- The date, time, and signature documenting each sample transfer from the time of collection to receipt in the laboratory. When the COC is transported inside the cooler, independent couriers do not sign the COC. Shipping manifests and/or air bills are the records of possession during transport.

A complete and legible COC is required. If the laboratory observes that the COC is incomplete or illegible, the client is contacted for resolution. The COC must be filled out in indelible ink. Personnel correct errors by drawing a single line through the original entry so the entry is not obscured, entering the correct information, and initialing and dating the change.

#### 5.8.1.2 Legal Chain of Custody

Legal chain of custody is a chain of custody protocol used for evidentiary or legal purposes. The protocol is followed by the laboratory when requested by customer or where mandated by a regulatory program.

Legal chain of custody (COC) protocol establishes an intact, continuous record of the physical possession*, storage, and disposal of "samples" which includes sample aliquots and sample extracts/digestates/distillates.

Legal COC records account for all time periods associated with the samples, and identify all individuals who physically handled individual samples. Legal COC begins at the point established by legal authority, which is usually at the time the sample containers are provided by the laboratory for sample collection or when sample collection begins.

*A sample is in someone's custody if:

- It is in one's physical possession;
- It is in one's view after being in one's physical possession;
- It has been in one's physical possession and then locked or sealed so that no one can tamper with it; and/or

- It is kept in a secure area, restricted to authorized personnel only.

Refer to laboratory SOP ENV-SOP-IND1-0051 *Internal Chain-of-Custody* for more information.

### 5.8.2 Unique Identification

Each sample is assigned a unique identification number by the laboratory (Lab ID) after the sample has been checked and accepted by the laboratory in accordance with the laboratory's sample acceptance policy (See 5.8.3). The Lab ID is affixed to the sample container using a durable label.

The unique identification of samples also applies to subsamples, and prepared samples, such as extracts, digestates, etc.

The lab ID is linked to the field ID (client ID) in the laboratory's record. Both IDs are linked to the testing activities performed on the sample and the documentation records of the test.

For additional information, see 5.8.4.

### 5.8.3 Sample Receipt Checks and Sample Acceptance Policy

The laboratory checks the condition and integrity of samples at the time of receipt and compares the labels on the sample containers to the COC record. Any problem or discrepancy is recorded. If the problem impacts the suitability of the sample for analysis or if the documentation is incomplete, the client is notified for resolution. Decisions and instructions from the client are documented in the project record.

#### 5.8.3.1 Sample Receipt Checks

The following checks are performed:

- Verification that the COC is complete and legible.
- Verification that each sample's container label includes the client sample ID, the date and time of collection and the preservative, if applicable, in indelible ink.
- The container type and preservative, if applicable, is appropriate for each test requested.
- Adequate volume is received for each test requested.
- Visual inspection for damage or evidence of tampering.
- Visual inspection for presence of headspace in VOA vials. (VOA = volatile organic analysis).
- Thermal Preservation: For chemical testing methods for which thermal preservation is required, temperature on receipt is acceptable if the measurement is above freezing but $\leq$6°C. For samples that are hand-delivered to the laboratory immediately after sample collection, there must be evidence that the chilling process has begun, such as arrival on ice. The requirements for thermal preservation vary based on the scope of testing performed. For example, for microbiology, temperature on receipt is acceptable if the measurement is <10°C. Refer to the laboratory's SOP for sample receipt for more information.

- Chemical Preservation, if applicable
- Holding Time: Sample receiving personnel are trained to recognize tests with holding time ≤48 hours and to expedite the login of these samples. When samples are received out of hold, the laboratory will notify the client and request instruction. If the decision is made to proceed with analysis, the final test report will include documentation of this instruction. Samples that include tests with a holding time of 15 minutes or less from collection are processed without client approval and final test report is qualified.

#### 5.8.3.2 Sample Acceptance Policy

The laboratory maintains a sample acceptance policy in accordance with regulatory guidelines to clearly establish the circumstances in which sample receipt is accepted or rejected. When receipt does not meet acceptance criteria for any one of these conditions, the laboratory must document the noncompliance, contact the customer, and either reject the samples or fully document any decisions to proceed with testing. In accordance with regulatory specifications, receipt conditions that do not meet criteria are documented in the final test report.

All samples received must meet each of the following:

- Be listed on a complete and legible COC.
- Be received in properly labeled sample containers.
- Be received in appropriate containers that identify preservative, if applicable.
- The COC must include the date and time of collection for each sample.
- The COC must include the test requested for each sample.
- Be received within holding time. Any samples received beyond the holding time will not be processed without prior customer approval. An exception to this policy is made for tests with a 15 minute holding time, such as pH, residual chlorine, and ferrous iron. Those tests are performed without customer approval and the data is qualified.
- Have sufficient sample volume to proceed with the analytical testing. If insufficient sample volume is received, analysis will not proceed without customer approval.
- Be received within appropriate temperature ranges (not frozen but ≤6°C) unless program requirements or customer contractual obligations mandate otherwise. The cooler temperature is recorded directly on the COC. For samples that are hand-delivered to the laboratory immediately after sample collection, there must be evidence that the chilling process has begun, such as arrival on ice. If samples arrive that are not compliant with these temperature requirements, the customer will be notified. The analysis will NOT proceed unless otherwise directed by the customer. If less than 72 hours remain in the hold time for the analysis, the analysis may be started while the customer is contacted to avoid missing the hold time.

### 5.8.4 Sample Control and Tracking

The samples are controlled and tracked using the Laboratory Information Management System (LIMS). The LIMS stores information about the samples and the project. The process of entering information into the LIMS is called login and these procedures are described in laboratory SOP ENV-SOP-IND1-0001 *Sample Management*. After login, a label is generated and affixed to each sample container. Information on this label, such as the lab ID, links the sample container to the information in LIMS.

At a minimum, the following information is entered during login:

- Client Name and Contact Information;
- The laboratory ID linked to the client ID;
- Date and time of sample collection;
- Date and time of sample receipt;
- Matrix of sample;
- Tests Requested.

### 5.8.5 Sample Storage, Handling, and Disposal

The laboratory procedures for sample storage, handling and disposal are detailed in laboratory SOPs ENV-SOP-IND1-0001 *Sample Management* and ENV-SOP-IND1-0004 *Waste Handling and Management.*

#### 5.8.5.1 Sample Storage

The samples are stored according to method and regulatory requirements as per test method SOPs. Samples are stored away from all standards, reagents, or other potential sources of contamination and stored in a manner that prevents cross contamination. Volatile samples are stored separately from other samples. All sample fractions, extracts, leachates, and other sample preparation products are stored in the same manner as actual samples or as specified by the analytical method.

Refrigerated storage areas are maintained at ≤6°C (but not frozen) and freezer storage areas are maintained at <-10°C (unless otherwise required per method or program). The temperature of each storage area is checked and documented at least once each day of use. If the temperature falls outside the acceptable limits, then corrective actions are taken and appropriately documented.

The laboratory is operated under controlled access protocols to ensure sample and data integrity. Visitors must register at the front desk and be properly escorted at all times. Samples are taken to the appropriate storage location immediately after sample receipt and login procedures are completed. All sample storage areas have limited access. Samples are removed from storage areas by designated personnel and returned to the storage areas as soon as possible after the required sample quantity has been taken.

#### 5.8.5.2 Sample Retention and Disposal

The procedures used by the laboratory for sample retention and disposal are detailed in laboratory SOP ENV-SOP-IND1-0004 *Waste Handling and Management*.

In general, unused sample volume and prepared samples such as extracts, digestates, distillates and leachates are retained by the laboratory for the period of time necessary to protect the interests of the laboratory and the customer.

Samples may be stored at ambient temperature when all analyses are complete, the hold time is expired, the report has been delivered, and/or when allowed by the customer or program. Samples requiring storage beyond the minimum sample retention time due to special requests or contractual obligations may be stored at ambient temperature unless the laboratory has sufficient capacity to store them refrigerated or frozen and their presence does not compromise the integrity of other samples.

After this period expires, non-hazardous samples are properly disposed of as non-hazardous waste. The preferred method for disposition of hazardous samples is to return the excess sample to the customer.

## 5.9 Assuring the Quality of Test Results

### 5.9.1 Quality Control (QC) Procedures

The laboratory monitors the validity and reliability of test results using quality control (QC) samples that are prepared and analyzed concurrently with field samples in the same manner as field samples. See the glossary for definition of preparation and analytical batch.

The results of QC performed during the testing process are used by the laboratory to assure the results of analysis are consistent, comparable, accurate, and/or precise within a specified limit. When the results are not within acceptance criteria or expectations for method performance, correction and corrective action(s) are taken. These actions may include retesting samples or reporting data with qualification to alert the end user of the situation.

Other QC measures performed include the use of certified reference materials (see 5.6.4), participation in interlaboratory proficiency testing (see 5.9.1.2), verification that formulae used for reduction of data and calculation of results is accurate (see 5.9.3), on-going monitoring of environmental conditions that could impact test results (see 5.3.2), and evaluation and verification of method selectivity and sensitivity (see 5.4.5).

QC results are also used by the laboratory to monitor statistical trends in performance over time and to establish acceptance criteria when no method or regulatory criteria exist (see 5.9.1.4).

#### 5.9.1.1 Essential QC

Although the general principles of QC for the testing process apply to all testing, the QC protocol used for each test depends on the type of test performed.

QC protocol used by the laboratory to monitor the validity of the test are specified in test method SOPs. The SOP includes QC type, frequency, acceptance criteria, corrective actions, and procedures for reporting of nonconforming work.

These requirements in the SOP conform to the reference method and any applicable regulations or certification and accreditation program requirement for which results of the test are used. When a project requires more stringent QC protocol than specified in the SOP, project specification is followed.

The following are examples of essential QC for Chemistry:

#### 5.9.1.1.1 Second-Source Standard (ICV/QCS)

The second-source standard is obtained from a different vendor than the standards used for calibration or is a different standard lot from the same vendor. It is a positive control used to verify the accuracy of a new calibration. This check is referred to in test method and quality system standards as the Initial Calibration Verification (ICV) or Quality Control Sample (QCS). The second source standard is analyzed immediately after the calibration and before analysis of any samples. When the ICV is not within acceptance criteria, a problem with the purity or preparation of the standards may be indicated.

#### 5.9.1.1.2 Continuing Calibration Verification (CCV)

CCV is analyzed to determine if the analytical response has significantly changed since initial calibration. If the response of the CCV is within criteria, the initial calibration is considered valid. If not, there is a problem that requires further investigation. Actions taken are technology and method specific.

#### 5.9.1.1.3 Method Blank (MB) / Other Blanks

A method blank is a negative control used to assess for contamination during the prep/analysis process. The MB consists of a clean matrix, similar to the associated samples, that is known to be free of analytes of interest. The MB is processed along with and under the same conditions as the associated samples to include all steps of the analytical procedure.

In general, contamination is suspected when the target analyte is detected in the MB above the reporting limit. Some programs may require evaluation of the MB to ½ the reporting limit or to the detection limit (LOD). When contamination is evident, the source is investigated and corrections are taken to reduce or eliminate it. Analytical results associated with a MB that does not meet criteria are qualified in the final test report when applicable.

Other types of blanks that serve as negative controls in the process may include:

- Trip Blanks (VOA)
- Storage Blanks
- Equipment Blanks
- Field Blanks

- Calibration Blanks
- Cleanup Blanks
- Instrument Blanks

#### 5.9.1.1.4 Laboratory Control Sample (LCS)

The LCS is positive control used to evaluate the performance of the total analytical system, including all preparation and analytical steps. The LCS is spiked by the laboratory with a known amount of analyte. The spike is a standard solution that is pre-made or prepared from a certified reference standard.

When the percent recovery (%R) of the LCS is within the established control limit, sufficient accuracy has been achieved. If not, the source of the problem is investigated and corrected and the procedure may be repeated. Analytical results associated with LCS that does not meet criteria are qualified in the final test report when applicable.

#### 5.9.1.1.5 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)

Matrix spikes measure the effect the sample matrix has on precision and accuracy of the determinative test method. The MS and MSD are replicates of a client sample that are spiked with a known amount of target analyte.

Due to the heterogeneity of matrices even of the same general matrix type, matrix spike results mostly provide information on the effect of the matrix to the client whose sample was used and on samples of the same matrix from the same sampling site. Therefore, MS should be client-specific when the impact of matrix on accuracy and precision is a project data quality objective. When there is not a client-specified MS for any sample in the batch, the laboratory randomly selects a sample from the batch; the sample selected at random is called a "batch" matrix spike.

The MS/MSD results for percent recovery and relative percent difference are checked against control limits. Because the performance of matrix spikes is matrix-dependent, the result of the matrix spike is not used to determine the acceptability of the test batch.

#### 5.9.1.1.6 Sample Duplicate (SD)

A sample duplicate is a second replicate of sample that is prepared and analyzed in the laboratory along another replicate. The SD is used to measure precision.

The relative percent difference between replicates is evaluated against the method or laboratory derived criteria for relative percent difference (RPD), when this criterion is applicable. If RPD is not met, associated test results are reported with qualification.

#### 5.9.1.1.7 Surrogates

Surrogates, when required, are compounds that mimic the chemistry of target analytes but are not expected to occur naturally in real world samples. Surrogates are added to each sample and matrix QC samples (MS, MSD, SD) at known concentration to measure the impact of the matrix on the accuracy of method performance. Surrogates are also added to the positive and negative control samples (MB, LCS) to evaluate performance in a clean matrix, and included in the calibration standards and calibration check standards.

The percent recovery of surrogates is evaluated against method-specified limits or statistically derived in-house limits. Project-specific limits and/or program-specific limits are used when required. Results with surrogate recovery out of limits in samples are reported with qualification. Samples with surrogate failures can also be re-extracted and/or re-analyzed to confirm that the out-of-control value was caused by the matrix of the sample and not by some other systematic error.

#### 5.9.1.1.8 Internal Standards

Internal Standards are compounds not expected to occur naturally in field samples. They are added to every standard and sample at a known concentration prior to analysis for the purpose of adjusting the response factor used in quantifying target analytes. The laboratory follows specific guidelines for the treatment of internal standard recoveries and further information can be found in the applicable laboratory SOP.

#### 5.9.1.1.9 QC Acceptance Criteria and Control Limits

The QC acceptance criteria are specified in test method SOPs. The criteria in the SOP are based on the requirements in the published test method or regulatory program. When there are no established acceptance criteria, the laboratory develops acceptance criteria in accordance with recognized industry standards.

Some methods and programs require the laboratory to develop and use control limits for LCS, MS/MSD and surrogate evaluation. Laboratory-developed limits are referred to as "in-house" control limits or statistical control limits. Statistical control limits represent ± 3 Standard Deviations (99% confidence level) from the average recovery of at least 20 data points generated using the same preparation and analytical procedure in a similar matrix.

See laboratory SOP ENV-SOP-IND1-0039 *Control Chart Generation* for more information.

#### 5.9.1.2 Proficiency Testing (PT)

The laboratory participates in proficiency testing (PT) studies to measure performance of the test method and to identify or solve analytical problems. PT samples measure laboratory performance through the analysis of unknown samples provided by an external source.

The PT samples are obtained from accredited proficiency testing providers (PTP) and handled as field samples which means they are included in the laboratory's normal analytical processes and do not receive extraordinary attention due to their nature.

The laboratory does not share PT samples with other laboratories, does not communicate with other laboratories regarding current PT sample results during the duration of the study, and does not attempt to obtain the assigned value of any PT sample from the PT provider.

The laboratory initiates an investigation and corrective action plan whenever PT results are deemed unacceptable by the PT provider.

The frequency of PT participation is based on the certification and accreditation requirements held by the laboratory.

### 5.9.2 QC Corrective Action

When the results of QC are not within acceptance criteria or expectations for method performance, correction and corrective action(s) are taken per the specifications in the test method SOP. These actions may include retesting or reporting of data with qualification to alert the end user of the situation.

### 5.9.3 Data Review

The laboratory uses a tiered system for data review. The tiered process provides sequential checks to verify data transfer is complete; manual calculations, if performed, are correct, manual integrations are appropriate and documented, calibration and QC requirements are met, appropriate corrective action was taken when required, test results are properly qualified, process and test method SOPs were followed, project specific requirements were met, when applicable, and the test report is complete.

The sequential process includes three tiers referred to as primary review, secondary review, and administrative/completeness review.

Detailed procedures for the data review process are described in laboratory SOP ENV-SOP-IND1-0023 *Data Review Process*. The general expectations for the tiered review process are described in the following sections:

#### 5.9.3.1 Primary Review

Primary review is performed by the individual that performed the analytical testing. All laboratory personnel are responsible for review of their work product to assure it is complete, accurate, documented, and consistent with policy and SOPs.

Checks performed during primary review include but are not limited to:

- Verification that data transfer and acquisition is complete

- Manual calculations, if performed, are documented and accurate
- Manual integrations, if performed, are documented and comply with SOP ENV-SOP-CORQ-006 *Manual Integration*
- Calibration and QC criteria were met, and/or proper correction and corrective actions were taken, and data and test results associated with QC and criteria exceptions are properly qualified
- Work is consistent with SOPs and any other relevant instructional document such as SWI, program requirements, or project QAPP

#### 5.9.3.2 Secondary Review

Secondary review is performed by qualified peer or supervisor. Secondary review is essentially a repeat of the checks performed during primary review by another person. In addition to the checks of primary review, secondary review includes chromatography review to check the accuracy of analyte identification.

#### 5.9.3.3 Completeness Review

Completeness review is an administrative review performed prior to release of the test report to the customer. Completeness review verifies that the final test report is complete and meets project specification. This review also assures that information necessary for the client's interpretation of results are explained in the case narrative, if applicable, or qualified in the test report.

#### 5.9.3.4 Data Audits

In addition to the 3 tier data review process, test reports may be audited by local QA to verify compliance with SOPs and to check for data integrity, technical accuracy, and regulatory compliance. These audits are not usually done prior to issuance of the test report to the customer. The reports chosen for the data audits are selected at random.

If any problems with the data or test results are found during the data audit, the impact of the nonconforming work is evaluated using the process described in Section 4.9.

Also see Section 4.14 for internal audits.

## 5.10 Reporting

### 5.10.1 General Requirements

The laboratory reports the results of testing in a way that assures the results are clear and unambiguous. All data and results are reviewed prior to reporting to assure the results reported are accurate and complete.

Test results are summarized in test reports that include all information necessary for the customer's interpretation of the test results. Additional information necessary to clarify the data or disclose nonconformance, exceptions, or deviations that occurred during the analytical process are also reported to the customer in the test report.

The specifications for test reports and electronic data deliverables (EDD) are established between the laboratory and the customer at the time the request for analytical services is

initiated. The report specifications include the test report format, protocol for the reporting limit (RL) and conventions for the reporting of results less than the limit of quantitation (LOQ). Information about review of analytical service requests is provided in Section 4.4.

### 5.10.2 Test Reports: Required Items

Test Reports are prepared by the laboratory at the end of the testing process. The format of the report depends on the level of reporting requested by the customer. The laboratory offers a variety of standardized test report formats and can also provide custom test report formats, when necessary.

The level of detail required in the test report depends on the customer's needs for data verification, validation, and usability assessments that occur after the laboratory releases the test report to the customer. The test report formats offered by the laboratory provide gradient levels of detail to meet the unique needs of each customer. The laboratory project manager helps the customer select the test report format that best meets their needs. When a specific report format or protocol is required for regulatory or program compliance, the laboratory project manager must ensure the test report selected meets those requirements.

Every test report issued by the laboratory includes each of the following items:

a) Title

b) Name and phone number of a point of contact from the laboratory issuing the report.

c) Name and address of the laboratory where testing was performed. When testing is done at multiple locations within network (IRWO), the report must clearly identify which network laboratory performed each test and must include the physical address of each laboratory.

d) Unique identification of the test report, an identifier on each page of the report, and clear identification of the end of the report.

e) The name and address of the customer

f) Identification of test methods used

g) Cross reference between client sample identification number (Sample ID) and the laboratory's identification number for the sample (Lab ID) to provide unambiguous identification of samples.

h) The date of receipt of samples, condition of samples on receipt, and identification of any instance where receipt of the samples did not meet sample acceptance criteria.

i) Date and times of sample collection, receipt, preparation, and analysis.

j) Test results and units of measurement.

k) Qualifiers appended to results, when required.

l) Name, title, signature of the person(s) authorizing release of the test report and date of release.

m) A statement that the results in the test report relate only to the items tested.

n) Statement that the test report may not be reproduced except in full without written approval from the laboratory.

### 5.10.3 Test Reports: Supplemental Items

#### 5.10.3.1 Supplemental Requirements

The following items are included in the test report when required or relevant:

a) Explanation of departure from test method SOPs including, what the departure was and why it was necessary.

b) Statistical methods used. (Required for Whole Effluent Toxicity)

c) For solid samples, specification that results are reported on a dry weight or wet weight basis.

d) Signed Affidavit, when required by client or regulatory agency.

e) A statement of compliance / non-compliance with requirements or specifications (client, program, or standard) that includes identification of test results that did not meet acceptance criteria.

f) When requested by the client, statement of estimated measurement uncertainty. In general, for environmental testing, estimated uncertainty of measurement is extrapolated from LCS control limits. Control limits incorporate the expected variation of the data derived from the laboratory's procedure. When the control limits are specified by the test method or regulatory program, the control limits represent the expected variation of the test method and/or matrices for which the test method was designed.

g) Opinions and Interpretations (See Section 5.10.5).

h) If a claim of accreditation/certification is included in the test report, identification of any test methods or analytes for which accreditation/certification is not held by the laboratory. The fields of accreditation/certification vary between agencies and it cannot be presumed that because accreditation/certification is not held that it is offered or required.

i) Certification Information, including certificate number and issuing body.

#### 5.10.3.2 Test Reports: Sampling Information

The following items are included in the test report when samples are collected by the laboratory or when this information is necessary for the interpretation of test results:

a) Date of Sampling.

b) Unambiguous identification of material samples.

c) Location of sampling including and diagrams, sketches, or photographs.

d) Reference to the sampling plan and procedures used.

e) Details of environmental conditions at time of sample that may impact test results.

f) Any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned.

g) Results of field measurements, if requested.

### 5.10.4 Calibration Certificates

The laboratory does not perform calibration activities for its customers and calibration certificates are not offered or issued.

### 5.10.5 Opinions and Interpretations

The laboratory provides objective data and information to its customers of sufficient detail for their interpretation and decision making. Objective data and information is based solely on fact and does not attempt to explain the meaning (interpret) or offer a view or judgment (opinion). Sometimes the customer may request the laboratory provide opinion or interpretation to assist them with their decisions about the data.

When opinions and interpretations are included in the test report, the laboratory will document the basis upon which the opinions and interpretations have been made and clearly identify this content as opinion or interpretation in the test report.

Examples of opinion and interpretation include but are not limited to:

- The laboratory's viewpoint on how a nonconformance impacts the quality of the data or usability of results.
- The laboratory's judgment of fulfillment of contractual requirements.
- Recommendations for how the customer should use the test results and information.
- Suggestions or guidance to the customer for improvement.

When opinions or interpretations are verbally discussed with the customer, the content of these conversations is summarized by the laboratory and kept in the project record.

### 5.10.6 Subcontractor Reports

When analytical work has been subcontracted to an organization external to PAS, the test report from the subcontractor is included in its entirety as an amendment to the final test report.

Note: Test results for analytical work performed within the PAS network may be merged into a single test report. The merged test report issued clearly identifies the location and address of each network laboratory that performed testing and which tests they performed. (See 5.10.2)

### 5.10.7 Electronic Transmission of Results

When test results and/or reports are submitted to the customer through electronic transmission, the procedures established in this manual are followed for confidentiality and protection of data.

### 5.10.8 Format of Test Reports

The test formats offered by the laboratory are designed to accommodate each type of analytical test method carried out by the laboratory and to minimize the possibility of misunderstanding or misuse of analytical results. The format of electronic data deliverables (EDD) follows the specifications for the EDD.

### 5.10.9 Amendments to Test Reports

Test reports that are revised or amended by the laboratory after date of release of the final test report to the customer are issued as a new test report that is clearly identified as an amendment or revision and that includes a reference to the originally issued final test report.

Changes made to test results and data before the final test report is issued to the customer are not amendments or revisions, these are corrections to errors found during the laboratory's data verification and review process.

The laboratory's procedure for report amendments and revision are outlined in laboratory SOP ENV-SOP-IND1-0048 *Final Report and Data Deliverable Content*.

## 6.0 REVISION HISTORY

This Version:

| Section | Description of Change |
|---|---|
| All | This version is a complete rewrite of the document this version supersedes. |

This document supersedes the following documents:

| Document Number | Title | Version |
|---|---|---|
| ENV-MAN-CORQ-0001 | Quality Assurance Manual | 01 |

# 7.0 APPENDICES

## 7.1 Appendix A: Certification / Accreditation Listing

The certifications / accreditation lists provided in this manual represent those that were held by the named location on the effective date of this manual. This information is subject to change without notice and must not be considered valid proof of certification or accreditation status. Current certificates are maintained by Local QA and a copy of the certificate is posted to PAS's eDMS Portal for access by all PAS employees. External parties should contact the laboratory for the most current information.

### 7.1.1 PAS-Indianapolis and PAS-Grand Rapids

| Indianapolis Laboratory Certifications | | | |
|---|---|---|---|
| **Accrediting Authority** | **Program Category** | **Accrediting Agency** | **Accreditation #** |
| Illinois (Secondary TNI) | Hazardous Waste | IL-EPA | 200074 |
| Illinois (Secondary TNI) | Non-Potable Water | IL-EPA | 200074 |
| Indiana | Drinking Water | IN-SDH | C-49-06 |
| Kansas (Primary TNI) | Hazardous Waste | KS-DHE | E-10177 |
| Kansas (Primary TNI) | Non-Potable Water | KS-DHE | E-10177 |
| Kentucky | UST | KY-DEP | 80226 |
| Kentucky | Wastewater | KY-DEP | KY98019 |
| Michigan | Drinking Water | MI-DEQ/EGLE | 9050 |
| Ohio | VAP-Hazardous Waste | OH-EPA | CL0065 |
| Ohio | VAP-Non-Potable Water | OH-EPA | CL0065 |
| Oklahoma | Non-Potable Water | OK-DEQ | 9204 |
| Oklahoma | Solids | OK-DEQ | 9204 |
| Texas (Secondary TNI) | Non-Potable Water | TX-CEQ | T104704355 |
| Texas (Secondary TNI) | Solid Chemical Mat. | TX-CEQ | T104704355 |
| USDA | Foreign Soil Permit | USDA | P330-19-00257 |
| West Virginia | Hazardous Waste | WV-DEP | 330 |
| West Virginia | Non-Potable Water | WV-DEP | 330 |
| Wisconsin | Non-Potable Water | WI-DNR | 999788130 |
| Wisconsin | Potable Water | WI-DNR | 999788130 |
| **Grand Rapids Laboratory Certifications** | | | |
| **Accrediting Authority** | **Program Category** | **Accrediting Agency** | **Accreditation #** |
| Minnesota (Primary TNI) | Non-Potable Water | MDH | 026-999-161 |
| Michigan | Drinking Water | MI-EGLE | 0034 |

## 7.2 Appendix B: Capability Listing

The capabilities listed in this Appendix were held by the location referenced on the effective date of this manual. This information is subject to change without notice. External parties should contact the laboratory for the most current information regarding laboratory capabilities and certifications.

Table Legend:

- DW = Drinking Water
- NPW = Non-Potable Water
- SCM = Solid and Chemical Materials
- Waste = Non-Aqueous Phase Liquid (NAPL), Oil

### 7.2.1 PAS-Indianapolis

| Parameter | Method | Matrices | | | |
|---|---|---|---|---|---|
| | | DW | NPW | SCM | Waste |
| Specific Conductance | EPA 120.1/SM 2510B | | x | | |
| Mercury, Low-Level | EPA 1631E | | x | | |
| Oil and Grease, HEM/SGT-HEM | EPA 1664A | | x | | |
| Turbidity | EPA 180.1 | | x | | |
| ICP Metals | EPA 200.7 | x | x | | |
| ICP Metals | SW 6010B | | x | x | x |
| ICP-MS Metals | EPA 200.8 | x | x | | |
| ICP-MS Metals | SW 6020 | | x | x | x |
| Apparent Color | SM 2120B | | x | | |
| Acidity | SM 2310B | | x | | |
| Alkalinity | SM 2320B | | x | | |
| Hardness | SM 2340B | | x | | |
| Mercury | EPA 245.1 | x | x | | |
| Mercury | SW 7470A | | x | | |
| Mercury | SW 7471A | | | x | x |
| Total Solids | SM 2540B | | x | x | x |
| Total Dissolved Solids | SM 2540C | | x | | |
| Total Suspended Solids | SM 2540D | | x | | |
| Total Volatile Solids | SM 2540E | | x | | |
| Settleable Solids | SM 2540F | | x | | |
| Percent Moisture/Percent Solids/Total Volatile Solids | SM 2540G | | | x | x |
| Anions | EPA 300.0 | x | x | | |

| Parameter | Method | Matrices | | | |
|---|---|---|---|---|---|
| | | DW | NPW | SCM | Waste |
| Anions | SW 9056A | | x | x | |
| Cyanide | EPA 335.4 | x | x | | |
| Cyanide | SM 4500CN-E/SW 9012A | | x | x | x |
| Cyanide, Amenable | EPA 335.4 | | x | | |
| Cyanide, Amenable | SM 4500CN-G/SW 9012A | | x | x | x |
| Cyanide, Free | SW 9014/OIA 1677 | | x | x | |
| Cyanide, Available | OIA 1677 | | x | x | |
| Hexavalent Chromium | SM 3500Cr-B | | x | | |
| Hexavalent Chromium | SW 7196A | | x | x | x |
| Ferrous Iron | Hach 8146 | | x | | |
| Ammonia | EPA 350.1/SM 4500NH3-G | | x | x | |
| Total Kjeldahl Nitrogen | EPA 351.2 | | x | x | |
| Nitrogen, Nitrate/Nitrite | EPA 353.2 | x | x | x | |
| Total Phosphorus | EPA 365.1 | | x | x | |
| Chemical Oxygen Demand (COD) | EPA 410.4 | | x | | |
| Total Recoverable Phenolics | EPA 420.4/SW 9066 | | x | x | |
| Chloride | SM 4500Cl-E | | x | | |
| Residual Chlorine | SM 4500Cl-G | | x | | |
| Fluoride | SM 4500F-C | | x | | |
| pH | SM 4500H+-B | | x | | |
| pH | SW 9045C | | | x | x |
| Orthophosphate as P | SM 4500P-E | | x | | |
| Sulfide | SM 4500S2- D | | x | | |
| Sulfate | SW 9038/ASTM D516 | | x | | |
| Biochemical Oxygen Demand (BOD) | SM 5210B | | x | | |
| Total Organic Carbon (TOC) | SM 5310C | | x | | |
| Anionic Surfactants (MBAS) | SM 5540C | | x | | |
| Volatile Organic Compounds (VOCs) | EPA 524.2 | x | | | |
| Volatile Organic Compounds (VOCs) | EPA 624.1 | | x | | |
| Volatile Organic Compounds (VOCs) | SW 8260C | | x | x | x |
| Polynuclear Aromatic Hydrocarbons (PAHs) | SW 8270C SIM | | x | x | |
| Semivolatile Organic Compounds (SVOCs) | EPA 625.1 | | x | | |

| Parameter | Method | Matrices | | | |
|---|---|---|---|---|---|
| | | DW | NPW | SCM | Waste |
| Semivolatile Organic Compounds (SVOCs) | SW 8270C | | x | x | x |
| Organochlorine Pesticides | EPA 608.3 | | x | | |
| Organochlorine Pesticides | SW 8081B | | x | x | x |
| Polychlorinated Biphenyls (PCBs) | EPA 608.3 | | x | | |
| Polychlorinated Biphenyls (PCBs) | SW 8082A | | x | x | x |
| EDB and DBCP | SW 8011 | | x | | |
| Diesel Range Organics (DRO/ERO) | SW 8015D | | x | x | |
| Gasoline Range Organics (GRO) | SW 8015D | | x | x | |
| Alcohols and Glycols | SW 8015D | | x | x | |
| Organophosphorus Pesticides | SW 8141B | | x | x | |
| Chlorinated Herbicides | SW 8151A | | x | x | |
| Flash Point | EPA 1010A | | | x | x |
| Toxicity Characteristic Leaching Procedure (TCLP) | SW 1311 | | x | x | x |
| Synthetic Precipitation Leaching Procedure (SPLP) | SW 1312 | | x | x | x |
| Free Liquids (Paint Filter Test) | SW 9095 | | | x | x |
| Dissolved Gases | RSK 175 | | x | | |

### 7.2.2 PAS-Grand Rapids

| Parameter | Method | Matrices | | | |
|---|---|---|---|---|---|
| | | DW | NPW | SCM | Waste |
| Apparent Color | SM 2120B | | x | | |
| Turbidity | SM 2130B | | x | | |
| Hexavalent Chromium | SM 3500Cr-B/SW 7196A | | x | | |
| Ferrous Iron | SM 3500Fe-B | | x | | |
| Nitrogen, Nitrate/Nitrite | SM 4500NO3-F | x | x | | |
| Orthophosphate as P | SM 4500P-E | | x | | |
| Sulfite | SM 4500SO3-B | | x | | |
| Biochemical Oxygen Demand (BOD) | SM 5210B | | x | | |
| Carbon Dioxide | SM 4500CO2-C | | x | | |
| Fecal Coliform | SM 9222D | x | x | | |
| Total Coliform | SM 9223B | x | x | | |
| True Color | NCASI 71.01 | | x | | |

## 7.3 Appendix C: Glossary

This glossary provides common terms and definitions used in the laboratory. **It is not intended to be a complete list of all terms and definitions used.** The definitions have been compiled mostly from the TNI Standard and DoD QSM. Although this information has been reproduced with care, errors cannot be entirely excluded. Definitions for the same term also vary between sources. When the meaning of a term used in a laboratory document is different from this glossary or when the glossary does not include the term, the term and definition is included or defined in context in the laboratory document.

| Term | Definition |
|---|---|
| 3P Program | PAS-The continuous improvement program used by PAS that focuses on Process, Productivity, and Performance. |
| Acceptance Criteria | TNI- Specified limits placed on characteristics of an item, process, or service defined in requirement documents. |
| Accreditation | TNI- The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.<br>DoD- Refers to accreditation in accordance with the DoD ELAP. |
| Accreditation Body (AB) | TNI- The organization having responsibility and accountability for environmental laboratory accreditation and which grants accreditation under this program.<br>DoD- Entities recognized in accordance with the DoD-ELAP that are required to operate in accordance with ISO/IEC 17011, *Conformity assessment: General requirements for accreditation bodies accrediting conformity assessment bodies.* The AB must be a signatory, in good standing, to the International Laboratory Accreditation Cooperation (ILAC) mutual recognition arrangement (MRA) that verifies, by evaluation and peer assessment, that its signatory members are in full compliance with ISO/IEC 17011 and that its accredited laboratories comply with ISO/IEC 17025. |
| Accuracy | TNI- The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator. |
| Activity, Absolute | TNI- Rate of nuclear decay occurring in a body of material, equal to the number of nuclear disintegrations per unit time. NOTE: Activity (absolute) may be expressed in becquerels (Bq), curies (Ci), or disintegrations per minute (dpm), and multiples or submultiples of these units. |
| Activity, Areic | TNI- Quotient of the activity of a body of material and its associated area. |
| Activity, Massic | TNI- Quotient of the activity of a body of material and its mass; also called specific activity. |
| Activity, Volumic | TNI- Quotient of the activity of a body of material and its volume; also called activity concentration. NOTE: In this module [TNI Volume 1, Module 6], unless otherwise stated, references to activity shall include absolute activity, areic activity, massic activity, and volumic activity. |
| Activity Reference Date | TNI- The date (and time, as appropriate to the half-life of the radionuclide) to which a reported activity result is calculated. NOTE: The sample collection date is most frequently used as the Activity Reference Date for environmental measurements, but different programs may specify other points in time for correction of results for decay and ingrowth. |
| Aliquot | DoD- A discrete, measured, representative portion of a sample taken for analysis. |
| American Society for Testing and Materials (ASTM) | An international standards organization that develops and publishes voluntary consensus standards for a wide range of materials, products, systems and services. |
| Analysis | DoD- A combination of sample preparation and instrument determination. |
| Analysis Code (Acode) | All the set parameters of a test, such as Analytes, Method, Detection Limits and Price. |
| Analysis Sequence | A compilation of all samples, standards and quality control samples run during a specific amount of time on a particular instrument in the order they are analyzed. |
| Analyst | TNI- The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. |

| | |
|---|---|
| Analyte | TNI- A substance, organism, physical parameter, property, or chemical constituent(s) for which an environmental sample is being analyzed.<br>DoD- The specific chemicals or components for which a sample is analyzed; it may be a group of chemicals that belong to the same chemical family and are analyzed together. |
| Analytical Method | DoD- A formal process that identifies and quantifies the chemical components of interest (target analytes) in a sample. |
| Analytical Uncertainty | TNI- A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. |
| Aliquot | DoD- A discrete, measured, representative portion of a sample taken for analysis. |
| Annual (or Annually) | Defined by PAS as every 12 months ± 30 days. |
| Assessment | TNI - The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its system to defined criteria (to the standards and requirements of laboratory accreditation).<br>DoD- An all-inclusive term used to denote any of the following: audit, performance evaluation, peer review, inspection, or surveillance conducted on-site. |
| Atomic Absorption Spectrometer | Instrument used to measure concentration in metals samples. |
| Atomization | A process in which a sample is converted to free atoms. |
| Audit | TNI- A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. |
| Batch | TNI- Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same quality systems matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours or the time-frame specified by the regulatory program. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed 20 samples. |
| Batch, Radiation Measurements (RMB) | TNI- An RMB is composed of 1 to 20 environmental samples that are counted directly without preliminary physical or chemical processing that affects the outcome of the test (e.g., non-destructive gamma spectrometry, alpha/beta counting of air filters, or swipes on gas proportional detectors). The samples in an RMB share similar physical and chemical parameter, and analytical configurations (e.g., analytes, geometry, calibration, and background corrections). The maximum time between the start of processing of the first and last in an RMB is 14 calendar days. |
| Bias | TNI- The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). |
| Blank | TNI and DoD- A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results (See Method Blank).<br>DoD- Blank samples are negative control samples, which typically include field blank samples (e.g., trip blank, equipment (rinsate) blank, and temperature blank) and laboratory blank samples (e.g., method blank, reagent blank, instrument blank, calibration blank, and storage blank). |
| Blind Sample | A sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process. |
| BNA (Base Neutral Acid compounds) | A list of semi-volatile compounds typically analyzed by mass spectrometry methods. Named for the way they can be extracted out of environmental samples in an acidic, basic or neutral environment. |
| BOD (Biochemical Oxygen Demand) | Chemical procedure for determining how fast biological organisms use up oxygen in a body of water. |

| | |
|---|---|
| Calibration | TNI- A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. 1) In calibration of support equipment, the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI); 2) In calibration according to test methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications. |
| Calibration Curve | TNI- The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. |
| Calibration Method | A defined technical procedure for performing a calibration. |
| Calibration Range | DoD- The range of values (concentrations) between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low-level calibration check standard and the high standard establish the linear calibration range, which lies within the linear dynamic range. |
| Calibration Standard | TNI- A substance or reference material used for calibration. |
| Certified Reference Material (CRM) | TNI- Reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. |
| Chain of Custody | An unbroken trail of accountability that verifies the physical security of samples, data, and records. |
| Chain of Custody Form (COC) | TNI- Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and type of containers; the mode of collection, the collector, time of collection; preservation; and requested analyses. |
| Chemical Oxygen Demand (COD) | A test commonly used to indirectly measure the amount of organic compounds in water. |
| Client (referred to by ISO as Customer) | Any individual or organization for whom items or services are furnished or work performed in response to defined requirements and expectations. |
| Code of Federal Regulations (CFR) | A codification of the general and permanent rules published in the Federal Register by agencies of the federal government. |
| Comparability | An assessment of the confidence with which one data set can be compared to another. Comparable data are produced through the use of standardized procedures and techniques. |
| Completeness | The percent of valid data obtained from a measurement system compared to the amount of valid data expected under normal conditions. The equation for completeness is:<br><br>% Completeness = (Valid Data Points/Expected Data Points)*100 |
| Confirmation | TNI- Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: second-column confirmation; alternate wavelength; derivatization; mass spectral interpretation; alternative detectors; or additional cleanup procedures.<br>DoD- Includes verification of the identity and quantity of the analyte being measured by another means (e.g., by another determinative method, technology, or column). Additional cleanup procedures alone are not considered confirmation techniques. |
| Conformance | An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. |
| Congener | A member of a class of related chemical compounds (e.g., PCBs, PCDDs). |
| Consensus Standard | DoD- A standard established by a group representing a cross-section of a particular industry or trade, or a part thereof. |
| Continuing Calibration Blank (CCB) | A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method. |
| Continuing Calibration Check Compounds (CCC) | Compounds listed in mass spectrometry methods that are used to evaluate an instrument calibration from the standpoint of the integrity of the system. High variability would suggest leaks or active sites on the instrument column. |
| Continuing Calibration Verification | DoD- The verification of the initial calibration. Required prior to sample analysis and at periodic intervals. Continuing calibration verification applies to both external and internal standard calibration techniques, as well as to linear and non-linear calibration models. |
| Continuing Calibration Verification (CCV) Standard | Also referred to as a Calibration Verification Standard (CVS) in some methods, it is a standard used to verify the initial calibration of compounds in an analytical method. CCVs are analyzed at a frequency determined by the analytical method. |

| | |
|---|---|
| Continuous Emission Monitor (CEM) | A flue gas analyzer designed for fixed use in checking for environmental pollutants. |
| Continuous Improvement Plan (CIP) | The delineation of tasks for a given laboratory department or committee to achieve the goals of that department. |
| Contract Laboratory Program (CLP) | A national network of EPA personnel, commercial labs, and support contractors whose fundamental mission is to provide data of known and documented quality. |
| Contract Required Detection Limit (CRDL) | Detection limit that is required for EPA Contract Laboratory Program (CLP) contracts. |
| Contract Required Quantitation Limit (CRQL) | Quantitation limit (reporting limit) that is required for EPA Contract Laboratory Program (CLP) contracts. |
| Control Chart | A graphic representation of a series of test results, together with limits within which results are expected when the system is in a state of statistical control (see definition for Control Limit) |
| Control Limit | A range within which specified measurement results must fall to verify that the analytical system is in control. Control limit exceedances may require corrective action or require investigation and flagging of non-conforming data. |
| Correction | DoD- Action taken to eliminate a detected non-conformity. |
| Corrective Action | DoD- The action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence. A root cause analysis may not be necessary in all cases. |
| Corrective and Preventative Action (CAPA) | The primary management tools for bringing improvements to the quality system, to the management of the quality system's collective processes, and to the products or services delivered which are an output of established systems and processes. |
| Critical Value | TNI- Value to which a measurement result is compared to make a detection decision (also known as critical level or decision level). NOTE: The Critical Value is designed to give a specified low probability $\alpha$ of false detection in an analyte-free sample, which implies that a result that exceeds the Critical Value, gives high confidence $(1 - \alpha)$ that the radionuclide is actually present in the material analyzed. For radiometric methods, $\alpha$ is often set at 0.05. |
| Customer | DoD- Any individual or organization for which products or services are furnished or work performed in response to defined requirements and expectations. |
| Data Integrity | TNI- The condition that exists when data are sound, correct, and complete, and accurately reflect activities and requirements. |
| Data Quality Objective (DQO) | Systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use or end user. |
| Data Reduction | TNI- The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more usable form. |
| Definitive Data | DoD- Analytical data of known quantity and quality. The levels of data quality on precision and bias meet the requirements for the decision to be made. Data that is suitable for final decision-making. |
| Demonstration of Capability (DOC) | TNI- A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision.<br>DoD- A procedure to establish the ability of the analyst to generate analytical results by a specific method that meet measurement quality objectives (e.g., for precision and bias). |
| Department of Defense (DoD) | An executive branch department of the federal government of the United States charged with coordinating and supervising all agencies and functions of the government concerned directly with national security. |
| Detection Limit (DL) | DoD- The smallest analyte concentration that can be demonstrated to be different than zero or a blank concentration with 99% confidence. At the DL, the false positive rate (Type 1 error) is 1%. A DL may be used as the lowest concentration for reliably reporting a detection of a specific analyte in a specific matrix with a specific method with 99% confidence. |
| Detection Limit (DL) for Safe Drinking Water Act (SDWA) Compliance | TNI- Laboratories that analyze drinking-water samples for SDWA compliance monitoring must use methods that provide sufficient detection capability to meet the detection limit requirements established in 40 CFR 141. The SDWA DL for radioactivity is defined in 40 CFR Part 141.25.c as the radionuclide concentration, which can be counted with a precision of plus or minus 100% at the 95% confidence level ($1.96\sigma$ where $\sigma$ is the standard deviation of the net counting rate of the sample). |
| Deuterated Monitoring Compounds (DMCs) | DoD- SIM specific surrogates as specified for GC/MS SIM analysis. |
| Diesel Range Organics (DRO) | A range of compounds that denote all the characteristic compounds that make up diesel fuel (range can be state or program specific). |

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| Digestion | DoD- A process in which a sample is treated (usually in conjunction with heat and acid) to convert the target analytes in the sample to a more easily measured form. |
| Document Control | The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed. |
| Documents | DoD- Written components of the laboratory management system (e.g., policies, procedures, and instructions). |
| Dry Weight | The weight after drying in an oven at a specified temperature. |
| Duplicate (also known as Replicate or Laboratory Duplicate) | The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results of duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. |
| Electron Capture Detector (ECD) | Device used in GC methods to detect compounds that absorb electrons (e.g., PCB compounds). |
| Electronic Data Deliverable (EDD) | A summary of environmental data (usually in spreadsheet form) which clients request for ease of data review and comparison to historical results. |
| Eluent | A solvent used to carry the components of a mixture through a stationary phase. |
| Elute | To extract, specifically, to remove (absorbed material) from an absorbent by means of a solvent. |
| Elution | A process in which solutes are washed through a stationary phase by movement of a mobile phase. |
| Environmental Data | DoD- Any measurements or information that describe environmental processes, locations, or conditions; ecological or health effects and consequences; or the performance of environmental technology. |
| Environmental Monitoring | The process of measuring or collecting environmental data. |
| Environmental Protection Agency (EPA) | An agency of the federal government of the United States which was created for the purpose of protecting human health and the environment by writing and enforcing regulations based on laws passed by Congress. |
| Environmental Sample | A representative sample of any material (aqueous, non-aqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required. Environmental samples can generally be classified as follows:<br>• Non Potable Water (Includes surface water, ground water, effluents, water treatment chemicals, and TCLP leachates or other extracts)<br>• Drinking Water - Delivered (treated or untreated) water designated as potable water<br>• Water/Wastewater - Raw source waters for public drinking water supplies, ground waters, municipal influents/effluents, and industrial influents/effluents<br>• Sludge - Municipal sludges and industrial sludges.<br>• Soil - Predominately inorganic matter ranging in classification from sands to clays.<br>• Waste - Aqueous and non-aqueous liquid wastes, chemical solids, and industrial liquid and solid wastes |
| Equipment Blank | A sample of analyte-free media used to rinse common sampling equipment to check effectiveness of decontamination procedures. |
| Extracted Internal Standard Analyte | Isotopically labeled analogs of analytes of interest added to all standards, blanks and samples analyzed. Added to samples and batch QC samples prior to the first step of sample extraction and to standards and instrument blanks prior to analysis. Used for isotope dilution methods. |
| Facility | A distinct location within the company that has unique certifications, personnel and waste disposal identifications. |
| False Negative | DoD- A result that fails to identify (detect) an analyte or reporting an analyte to be present at or below a level of interest when the analyte is actually above the level of interest. |
| False Positive | DoD- A result that erroneously identifies (detects) an analyte or reporting an analyte to be present above a level of interest when the analyte is actually present at or below the level of interest. |
| Field Blank | A blank sample prepared in the field by filling a clean container with reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. |
| Field Measurement | Determination of physical, biological, or radiological properties, or chemical constituents that are measured on-site, close in time and sPAS to the matrices being sampled/measured, following accepted test methods. This testing is performed in the field outside of a fixed-laboratory or outside of an enclosed structure that meets the requirements of a mobile laboratory. |
| Field of Accreditation | TNI- Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation. |

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| Field of Proficiency Testing (FoPT) | TNI- Matrix, technology/method, analyte combinations for which the composition, spike concentration ranges and acceptance criteria have been established by the PTPEC. |
| Finding | TNI- An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement.<br>DoD- An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive, negative, or neutral and is normally accompanied by specific examples of the observed condition. The finding must be linked to a specific requirement (e.g., this standard, ISO requirements, analytical methods, contract specifications, or laboratory management systems requirements). |
| Flame Atomic Absorption Spectrometer (FAA) | Instrumentation used to measure the concentration of metals in an environmental sample based on the fact that ground state metals absorb light at different wavelengths. Metals in a solution are converted to the atomic state by use of a flame. |
| Flame Ionization Detector (FID) | A type of gas detector used in GC analysis where samples are passed through a flame which ionizes the sample so that various ions can be measured. |
| Gas Chromatography (GC) | Instrumentation which utilizes a mobile carrier gas to deliver an environmental sample across a stationary phase with the intent to separate compounds out and measure their retention times. |
| Gas Chromatograph/ Mass Spectrometry (GC/MS) | In conjunction with a GC, this instrumentation utilizes a mass spectrometer which measures fragments of compounds and determines their identity by their fragmentation patterns (mass spectra). |
| Gasoline Range Organics (GRO) | A range of compounds that denote all the characteristic compounds that make up gasoline (range can be state or program specific). |
| Graphite Furnace Atomic Absorption Spectrometry (GFAA) | Instrumentation used to measure the concentration of metals in an environmental sample based on the absorption of light at different wavelengths that are characteristic of different analytes. |
| High Pressure Liquid Chromatography (HPLC) | Instrumentation used to separate, identify and quantitate compounds based on retention times which are dependent on interactions between a mobile phase and a stationary phase. |
| Holding Time | TNI- The maximum time that can elapse between two specified activities.<br>40 CFR Part 136- The maximum time that samples may be held prior to preparation and/or analysis as defined by the method and still be considered valid or not compromised.<br>For sample prep purposes, hold times are calculated using the time of the start of the preparation procedure.<br>DoD- The maximum time that may elapse from the time of sampling to the time of preparation or analysis, or from preparation to analysis, as appropriate. |
| Homogeneity | The degree to which a property or substance is uniformly distributed throughout a sample. |
| Homologue | One in a series of organic compounds in which each successive member has one more chemical group in its molecule than the next preceding member. For instance, methanol, ethanol, propanol, butanol, etc., form a homologous series. |
| Improper Actions | DoD- Intentional or unintentional deviations from contract-specified or method-specified analytical practices that have not been authorized by the customer (e.g., DoD or DOE). |
| Incremental Sampling Method (ISM) | Soil preparation for large volume (1 kg or greater) samples. |
| In-Depth Data Monitoring | TNI- When used in the context of data integrity activities, a review and evaluation of documentation related to all aspects of the data generation process that includes items such as preparation, equipment, software, calculations, and quality controls. Such monitoring shall determine if the laboratory uses appropriate data handling, data use and data reduction activities to support the laboratory's data integrity policies and procedures. |
| Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) | Analytical technique used for the detection of trace metals which uses plasma to produce excited atoms that emit radiation of characteristic wavelengths. |
| Inductively Coupled Plasma- Mass Spectrometry (ICP/MS) | An ICP that is used in conjunction with a mass spectrometer so that the instrument is not only capable of detecting trace amounts of metals and non-metals but is also capable of monitoring isotopic speciation for the ions of choice. |
| Infrared Spectrometer (IR) | An instrument that uses infrared light to identify compounds of interest. |

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| Initial Calibration (ICAL) | The process of analyzing standards, prepared at specified concentrations, to define the quantitative response relationship of the instrument to the analytes of interest. Initial calibration is performed whenever the results of a calibration verification standard do not conform to the requirements of the method in use or at a frequency specified in the method. |
| Initial Calibration Blank (ICB) | A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method. This blank is specifically run in conjunction with the Initial Calibration Verification (ICV) where applicable. |
| Initial Calibration Verification (ICV) | DoD- Verifies the initial calibration with a standard obtained or prepared from a source independent of the source of the initial calibration standards to avoid potential bias of the initial calibration. |
| Injection Internal Standard Analyte | Isotopically labeled analogs of analytes of interest (or similar in physiochemical properties to the target analytes but with a distinct response) to be quantitated. Added to all blanks, standards, samples and batch QC after extraction and prior to analysis. |
| Instrument Blank | A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. |
| Instrument Detection Limits (IDLs) | Limits determined by analyzing a series of reagent blank analyses to obtain a calculated concentration. IDLs are determined by calculating the average of the standard deviations of three runs on three non-consecutive days from the analysis of a reagent blank solution with seven consecutive measurements per day. |
| Interference, spectral | Occurs when particulate matter from the atomization scatters incident radiation from the source or when the absorption or emission from an interfering species either overlaps or is so close to the analyte wavelength that resolution becomes impossible. |
| Interference, chemical | Results from the various chemical processes that occur during atomization and later the absorption characteristics of the analyte. |
| Internal Standard | TNI and DoD- A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method. |
| International Organization for Standardization (ISO) | An international standard-setting body composed of representatives from various national standards organizations. |
| Intermediate Standard Solution | Reference solutions prepared by dilution of the stock solutions with an appropriate solvent. |
| International System of Units (SI) | The coherent system of units adopted and recommended by the General Conference on Weights and Measures. |
| Ion Chromatography (IC) | Instrumentation or process that allows the separation of ions and molecules based on the charge properties of the molecules. |
| Isomer | One of two or more compounds, radicals, or ions that contain the same number of atoms of the same element but differ in structural arrangement and properties. For example, hexane (C6H14) could be n-hexane, 2-methylpentane, 3-methylpentane, 2,3-dimethylbutane, 2,2-dimethylbutane. |
| Laboratory | A body that calibrates and/or tests. |
| Laboratory Control Sample (LCS) | TNI- (also known as laboratory fortified blank (LFB), spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to evaluate the performance of all or a portion of the measurement system. |
| Laboratory Duplicate | Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. |
| Laboratory Information Management System (LIMS) | DoD- The entirety of an electronic data system (including hardware and software) that collects, analyzes, stores, and archives electronic records and documents. |
| Learning Management System (LMS) | A web-based database used by the laboratories to track and document training activities. The system is administered by the corporate training department and each laboratory's learn centers are maintained by a local administrator. |
| Legal Chain-of-Custody Protocols | TNI- Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain-of-Custody (COC) Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory. |

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| Limit(s) of Detection (LOD) | TNI- The minimum result, which can be reliably discriminated from a blank with predetermined confidence level.<br>DoD- The smallest concentration of a substance that must be present in a sample in order to be detected at the DL with 99% confidence. At the LOD, the false negative rate (Type II error) is 1%. A LOD may be used as the lowest concentration for reliably reporting a non-detect of a specific analyte in a specific matrix with a specific method at 99% confidence. |
| Limit(s) of Quantitation (LOQ) | TNI- The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.<br>DoD- The smallest concentration that produces a quantitative result with known and recorded precision and bias. For DoD/DOE projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard and within the calibration range. |
| Linear Dynamic Range | DoD- Concentration range where the instrument provides a linear response. |
| Liquid chromatography/ tandem mass spectrometry (LC/MS/MS) | Instrumentation that combines the physical separation techniques of liquid chromatography with the mass analysis capabilities of mass spectrometry. |
| Lot | TNI- A definite amount of material produced during a single manufacturing cycle, and intended to have uniform character and quality. |
| Management | Those individuals directly responsible and accountable for planning, implementing, and assessing work. |
| Management System | System to establish policy and objectives and to achieve those objectives. |
| Manager (however named) | The individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual. |
| Matrix | TNI- The substrate of a test sample. |
| Matrix Duplicate | TNI- A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision. |
| Matrix Spike (MS) (spiked sample or fortified sample) | TNI- A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. |
| Matrix Spike Duplicate (MSD) (spiked sample or fortified sample duplicate) | TNI- A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. |
| Measurement Performance Criteria (MPC) | DoD- Criteria that may be general (such as completion of all tests) or specific (such as QC method acceptance limits) that are used by a project to judge whether a laboratory can perform a specified activity to the defined criteria. |
| Measurement Quality Objective (MQO) | TNI- The analytical data requirements of the data quality objectives are project- or program-specific and can be quantitative or qualitative. MQOs are measurement performance criteria or objectives of the analytical process. Examples of quantitative MQOs include statements of required analyte detectability and the uncertainty of the analytical protocol at a specified radionuclide activity, such as the action level. Examples of qualitative MQOs include statements of the required specificity of the analytical protocol, e.g., the ability to analyze for the radionuclide of interest given the presence of interferences. |
| Measurement System | TNI- A method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s).<br>DoD- A test method, as implemented at a particular laboratory, and which includes the equipment used to perform the sample preparation and test and the operator(s). |
| Measurement Uncertainty | DoD- An estimate of the error in a measurement often stated as a range of values that contain the true value within a certain confidence level. The uncertainty generally includes many components which may be evaluated from experimental standard deviations based on repeated observations or by standard deviations evaluated from assumed probability distributions based on experience or other information. For DoD/DOE, a laboratory's Analytical Uncertainty (such as use of LCS control limits) can be reported as the minimum uncertainty. |
| Method | TNI- A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed. |
| Method Blank | TNI- A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. |

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| Method Detection Limit (MDL) | TNI- One way to establish a Detection Limit; defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. |
| Method of Standard Additions | A set of procedures adding one or more increments of a standard solution to sample aliquots of the same size in order to overcome inherent matrix effects. The procedures encompass the extrapolation back to obtain the sample concentration. |
| Minimum Detectable Activity (MDA) | TNI- Estimate of the smallest true activity that ensures a specified high confidence, 1 – β, of detection above the Critical Value, and a low probability β of false negatives below the Critical Value. For radiometric methods, β is often set at 0.05. NOTE 1: The MDS is a measure of the detection capability of a measurement process and as such, it is an a priori concept. It may be used in the selection of methods to meet specified MQOs. Laboratories may also calculate a "sample specific" MDA, which indicates how well the measurement process is performing under varying real-world measurement conditions, when sample-specific characteristics (e.g., interferences) may affect the detection capability. However, the MDA must never be used instead of the Critical Value as a detection threshold. NOTE 2: For the purpose of this Standard, the terms MDA and minimum detectable concentration (MDC) are equivalent. |
| MintMiner | Program used by PAS to review large amounts of chromatographic data to monitor for errors or data integrity issues. |
| Mobile Laboratory | TNI- A portable enclosed structure with necessary and appropriate accommodation and environmental conditions for a laboratory, within which testing is performed by analysts. Examples include but are not limited to trailers, vans, and skid-mounted structures configured to house testing equipment and personnel. |
| National Environmental Laboratory Accreditation Conference (NELAC) | See definition of The NELAC Institute (TNI). |
| National Institute of Occupational Safety and Health (NIOSH) | National institute charged with the provision of training, consultation and information in the area of occupational safety and health. |
| National Institute of Standards and Technology (NIST) | TNI- A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States national metrology institute (or NMI). |
| National Pollutant Discharge Elimination System (NPDES) | A permit program that controls water pollution by regulating point sources that discharge pollutants into U.S. waters. |
| Negative Control | Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. |
| Nitrogen Phosphorus Detector (NPD) | A detector used in GC analyses that utilizes thermal energy to ionize an analyte. With this detector, nitrogen and phosphorus can be selectively detected with a higher sensitivity than carbon. |
| Nonconformance | An indication or judgment that a product or service has not met the requirement of the relevant specifications, contract, or regulation; also the state of failing to meet the requirements. |
| Not Detected (ND) | The result reported for a compound when the detected amount of that compound is less than the method reporting limit. |
| Operator Aid | DoD- A technical posting (such as poster, operating manual, or notepad) that assists workers in performing routine tasks. All operator aids must be controlled documents (i.e., a part of the laboratory management system). |
| Performance Based Measurement System (PBMS) | An analytical system wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner. |
| Physical Parameter | TNI- A measurement of a physical characteristic or property of a sample as distinguished from the concentrations of chemical and biological components. |
| Photo-ionization Detector (PID) | An ion detector which uses high-energy photons, typically in the ultraviolet range, to break molecules into positively charged ions. |
| Polychlorinated Biphenyls (PCB) | A class of organic compounds that were used as coolants and insulating fluids for transformers and capacitors. The production of these compounds was banned in the 1970's due to their high toxicity. |
| Positive Control | Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. |
| Post-Digestion Spike | A sample prepared for metals analyses that has analytes spike added to determine if matrix effects may be a factor in the results. |

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| Power of Hydrogen (pH) | The measure of acidity or alkalinity of a solution. |
| Practical Quantitation Limit (PQL) | Another term for a method reporting limit. The lowest reportable concentration of a compound based on parameters set up in an analytical method and the laboratory's ability to reproduce those conditions. |
| Precision | TNI- The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. |
| Preservation | TNI and DoD- Any conditions under which a sample must be kept in order to maintain chemical, physical, and/or biological integrity prior to analysis. |
| Primary Accreditation Body (Primary AB) | TNI- The accreditation body responsible for assessing a laboratory's total quality system, on-site assessment, and PT performance tracking for fields of accreditation. |
| Procedure | TNI- A specified way to carry out an activity or process. Procedures can be documented or not. |
| Proficiency Testing (PT) | TNI- A means to evaluate a laboratory's performance under controlled conditions relative to a given set of criteria, through analysis of unknown samples provided by an external source. |
| Proficiency Testing Program (PT Program) | TNI- The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. |
| Proficiency Testing Provider (PT Provider) | TNI- A person or organization accredited by a TNI-approved Proficiency Testing Provider Accreditor to operate a TNI-compliant PT Program. |
| Proficiency Testing Provider Accreditor (PTPA) | TNI- An organization that is approved by TNI to accredit and monitor the performance of proficiency testing providers. |
| Proficiency Testing Reporting Limit (PTRL) | TNI- A statistically derived value that represents the lowest acceptable concentration for an analyte in a PT sample, if the analyte is spiked into the PT sample. The PTRLs are specified in the TNI FoPT tables. |
| Proficiency Testing Sample (PT) | TNI- A sample, the composition of which is unknown to the laboratory, and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria. |
| Proficiency Testing (PT) Study | TNI- a) Scheduled PT Study: A single complete sequence of circulation and scoring of PT samples to all participants in a PT program. The study must have the same pre-defined opening and closing dates for all participants; b) Supplemental PT Study: A PT sample that may be from a lot previously released by a PT Provider that meets the requirements for supplemental PT samples given in Volume 3 of this Standard [TNI] but that does not have a pre-determined opening date and closing date. |
| Proficiency Testing Study Closing Date | TNI- a) Scheduled PT Study: The calendar date by which all participating laboratories must submit analytical results for a PT sample to a PT Provider; b) Supplemental PT Study: The calendar date a laboratory submits the results for a PT sample to the PT Provider. |
| Proficiency Testing Study Opening Date | TNI- a) Scheduled PT Study: The calendar date that a PT sample is first made available to all participants of the study by a PT Provider; b) Supplemental PT Study: The calendar date the PT Provider ships the sample to a laboratory. |
| Protocol | TNI- A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) that must be strictly followed. |
| Qualitative Analysis | DoD- Analysis designed to identify the components of a substance or mixture. |
| Quality Assurance (QA) | TNI- An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client. |
| Quality Assurance Manual (QAM) | A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. |
| Quality Assurance Project Plan (QAPP) | A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. |
| Quality Control (QC) | TNI- The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. |
| Quality Control Sample (QCS) | TNI- A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. |

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| Quality Manual | TNI- A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. |
| Quality System | TNI and DoD- A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance and quality control activities. |
| Quality System Matrix | TNI and DoD- These matrix definitions shall be used for purposes of batch and quality control requirements and may be different from a field of accreditation matrix:<br>• **Air and Emissions**: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device<br>• **Aqueous**: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts.<br>• **Biological Tissue**: Any sample of a biological origin such as fish tissue, shellfish or plant material. Such samples shall be grouped according to origin.<br>• **Chemical Waste**: A product or by-product of an industrial process that results in a matrix not previously defined.<br>• **Drinking Water**: Any aqueous sample that has been designated a potable or potentially potable water source.<br>• **Non-aqueous liquid**: Any organic liquid with <15% settleable solids<br>• **Saline/Estuarine**: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.<br>• **Solids**: Includes soils, sediments, sludges, and other matrices with >15% settleable solids. |
| Quantitation Range | DoD- The range of values (concentrations) in a calibration curve between the LOQ and the highest successively analyzed initial calibration standard used to relate instrument response to analyte concentration. The quantitation range (adjusted for initial sample volume/weight, concentration/dilution and final volume) lies within the calibration range. |
| Quantitative Analysis | DoD- Analysis designed to determine the amounts or proportions of the components of a substance. |
| Random Error | The EPA has established that there is a 5% probability that the results obtained for any one analyte will exceed the control limits established for the test due to random error. As the number of compounds measured increases in a given sample, the probability for statistical error also increases. |
| Raw Data | TNI- The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. |
| Reagent Blank (method reagent blank) | A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. |
| Reagent Grade | Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society. |
| Records | DoD- The output of implementing and following management system documents (e.g., test data in electronic or hand-written forms, files, and logbooks). |
| Reference Material | TNI- Material or substance one or more of whose property values are sufficiently homogenized and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. |
| Reference Method | TNI- A published method issued by an organization generally recognized as competent to do so. (When the ISO language refers to a "standard method", that term is equivalent to "reference method"). When a laboratory is required to analyze by a specified method due to a regulatory requirement, the analyte/method combination is recognized as a reference method. If there is no regulatory requirement for the analyte/method combination, the analyte/method combination is recognized as a reference method if it can be analyzed by another reference method of the same matrix and technology. |
| Reference Standard | TNI- Standard used for the calibration of working measurement standards in a given organization or at a given location. |

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| Relative Percent Difference (RPD) | A measure of precision defined as the difference between two measurements divided by the average concentration of the two measurements. |
| Reporting Limit (RL) | The level at which method, permit, regulatory and customer-specific objectives are met. The reporting limit may never be lower than the Limit of Detection (i.e., statistically determined MDL). Reporting limits are corrected for sample amounts, including the dry weight of solids, unless otherwise specified. There must be a sufficient buffer between the Reporting Limit and the MDL.<br>DoD- A customer-specified lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix. |
| Reporting Limit Verification Standard (RLVS) | A standard analyzed at the reporting limit for an analysis to verify the laboratory's ability to report to that level. |
| Representativeness | A quality element related to the ability to collect a sample reflecting the characteristics of the part of the environment to be assessed. Sample representativeness is dependent on the sampling techniques specified in the project work plan. |
| Requirement | Denotes a mandatory specification; often designated by the term "shall" or "must". |
| Retention Time | The time between sample injection and the appearance of a solute peak at the detector. |
| Revocation | TNI- The total or partial withdrawal of a laboratory's accreditation by an accreditation body. |
| Sample | Portion of material collected for analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis. |
| Sample Condition Upon Receipt Form (SCURF) | Form used by sample receiving personnel to document the condition of sample containers upon receipt to the laboratory (used in conjunction with a COC). |
| Sample Delivery Group (SDG) | A unit within a single project that is used to identify a group of samples for delivery. An SDG is a group of 20 or fewer field samples within a project, received over a period of up to 14 calendar days. Data from all samples in an SDG are reported concurrently. |
| Sample Receipt Form (SRF) | Letter sent to the client upon login to show the tests requested and pricing. |
| Sample Tracking | Procedures employed to record the possession of the samples from the time of sampling until analysis, reporting and archiving. These procedures include the use of a chain-of-custody form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples. |
| Sampling | TNI- Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure. |
| Selected Ion Monitoring (SIM) | A mode of analysis in mass spectrometry where the detector is set to scan over a very small mass range, typically one mass unit. The narrower the range, the more sensitive the detector.<br>DoD- Using GC/MS, characteristic ions specific to target compounds are detected and used to quantify in applications where the normal full scan mass spectrometry results in excessive noise. |
| Selectivity | TNI- The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. |
| Sensitivity | TNI- The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. |
| Serial Dilution | The stepwise dilution of a substance in a solution. |
| Shall (also Must) | Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification as long as the requirement is fulfilled. |
| Should (also May) | Denotes a guideline or recommendation whenever noncompliance with the specification is permissible. |
| Signal-to-Noise Ratio (S/N) | DoD- A measure of signal strength relative to background noise. The average strength of the noise of most measurements is constant and independent of the magnitude of the signal. Thus, as the quantity being measured (producing the signal) decreases in magnitude, S/N decreases and the effect of the noise on the relative error of a measurement increases. |
| Source Water | TNI- When sampled for drinking water compliance, untreated water from streams, rivers, lakes, or underground aquifers, which is used to supply private and public drinking water supplies. |
| Spike | A known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes. |
| Standard (Document) | TNI- The document describing the elements of a laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. |

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| Standard (Chemical) | Standard samples are comprised of a known amount of standard reference material in the matrix undergoing analysis. A standard reference material is a certified reference material produced by US NIST and characterized for absolute content, independent of analytical test method. |
| Standard Blank (or Reagent Blank) | A calibration standard consisting of the same solvent/reagent matrix used to prepare the calibration standards without the analytes. It is used to construct the calibration curve by establishing instrument background. |
| Standard Method | A test method issued by an organization generally recognized as competent to do so. |
| Standard Operating Procedure (SOP) | TNI- A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. |
| Standard Reference Material (SRM) | A certified reference material produced by the US NIST or other equivalent organization and characterized for absolute content, independent of analytical method. |
| Statement of Qualifications (SOQ) | A document that lists information about a company, typically the qualifications of that company to compete on a bid for services. |
| Stock Standard | A concentrated reference solution containing one or more analytes prepared in the laboratory using an assayed reference compound or purchased from a reputable commercial source. |
| Storage Blank | DoD- A sample of analyte-free media prepared by the laboratory and retained in the sample storage area of the laboratory. A storage blank is used to record contamination attributable to sample storage at the laboratory. |
| Supervisor | The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses. |
| Surrogate | DoD- A substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes. |
| Suspension | TNI- The temporary removal of a laboratory's accreditation for a defined period of time, which shall not exceed 6 months or the period of accreditation, whichever is longer, in order to allow the laboratory time to correct deficiencies or area of non-conformance with the Standard. |
| Systems Audit | An on-site inspection or assessment of a laboratory's quality system. |
| Target Analytes | DoD- Analytes or chemicals of primary concern identified by the customer on a project-specific basis. |
| Technical Director | Individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory. |
| Technology | TNI- A specific arrangement of analytical instruments, detection systems, and/or preparation techniques. |
| Test | A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate. |
| Test Method | DoD- A definitive procedure that determines one or more characteristics of a given substance or product. |
| Test Methods for Evaluating Solid Waste, Physical/ Chemical (SW-846) | EPA Waste's official compendium of analytical and sampling methods that have been evaluated and approved for use in complying with RCRA regulations. |
| Test Source | TNI- A radioactive source that is tested, such as a sample, calibration standard, or performance check source. A Test Source may also be free of radioactivity, such as a Test Source counted to determine the subtraction background, or a short-term background check. |
| The NELAC Institute (TNI) | A non-profit organization whose mission is to foster the generation of environmental data of known and documented quality through an open, inclusive, and transparent process that is responsive to the needs of the community. Previously known as NELAC (National Environmental Laboratory Accreditation Conference). |
| Total Petroleum Hydrocarbons (TPH) | A term used to denote a large family of several hundred chemical compounds that originate from crude oil. Compounds may include gasoline components, jet fuel, volatile organics, etc. |
| Toxicity Characteristic Leaching Procedure (TCLP) | A solid sample extraction method for chemical analysis employed as an analytical method to simulate leaching of compounds through a landfill. |

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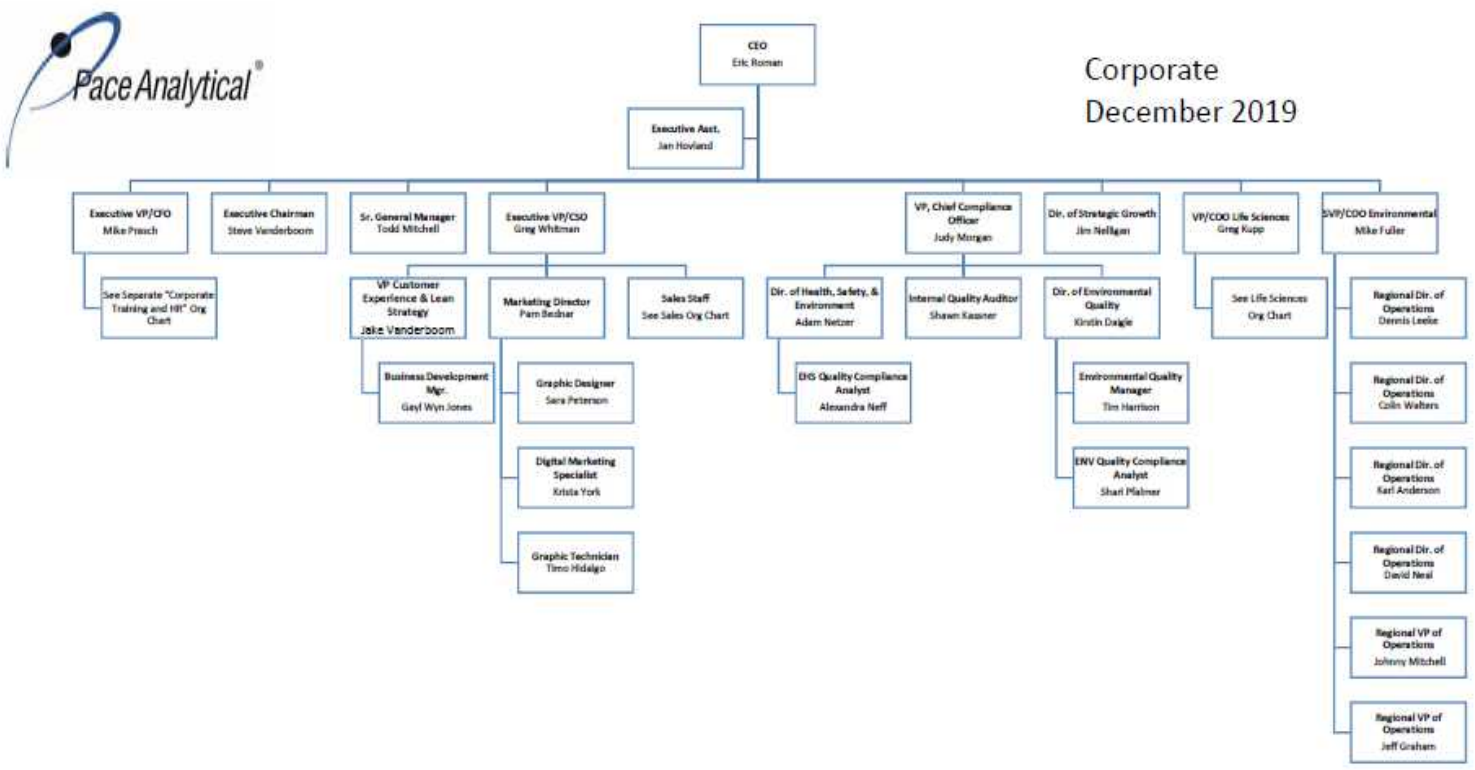
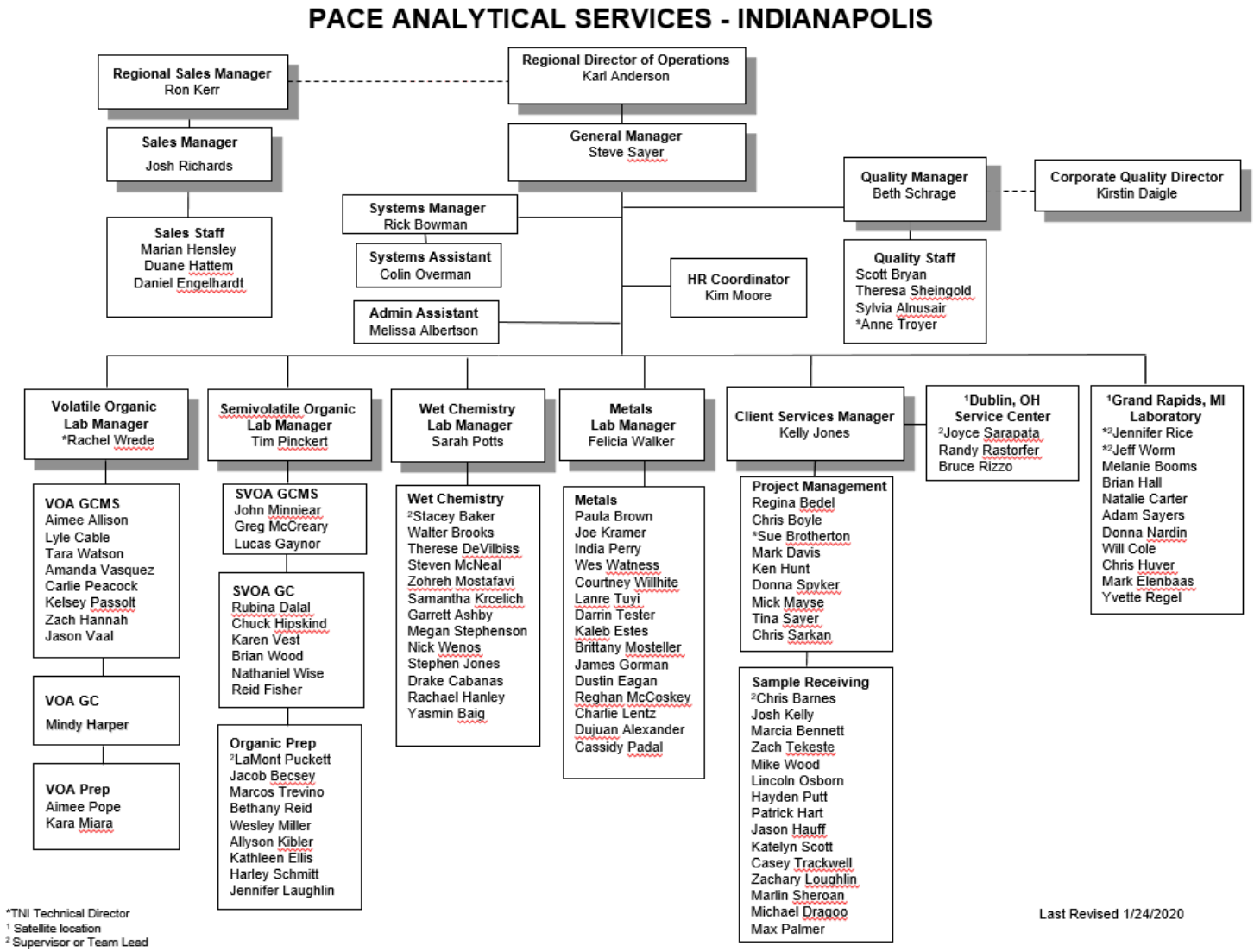
| Traceability | TNI- The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical conditions or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. |
| Training Document | A training resource that provides detailed instructions to execute a specific method or job function. |
| Trip Blank | This blank sample is used to detect sample contamination from the container and preservative during transport and storage of the sample. A cleaned sample container is filled with laboratory reagent water and the blank is stored, shipped, and analyzed with its associated samples. |
| Tuning | A check and/or adjustment of instrument performance for mass spectrometry as required by the method. |
| Ultraviolet Spectrophotometer (UV) | Instrument routinely used in quantitative determination of solutions of transition metal ions and highly conjugated organic compounds. |
| Uncertainty, Counting | TNI- The component of Measurement Uncertainty attributable to the random nature of radioactive decay and radiation counting (often estimated as the square root of observed counts (MARLAP). Older references sometimes refer to this parameter as Error, Counting Error or Count Error (c.f., Total Uncertainty). |
| Uncertainty, Expanded | TNI- The product of the Standard Uncertainty and a coverage factor, k, which is chosen to produce an interval about the result that has a high probability of containing the value of the measurand (c.f., Standard Uncertainty). NOTE: Radiochemical results are generally reported in association with the Total Uncertainty. Either if these estimates of uncertainty can be reported as the Standard Uncertainty (one-sigma) or as an Expanded Uncertainty (k-sigma, where k > 1). |
| Uncertainty, Measurement | TNI- Parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand. |
| Uncertainty, Standard | TNI- An estimate of the Measurement Uncertainty expressed as a standard deviation (c.f., Expanded Uncertainty). |
| Uncertainty, Total | TNI- An estimate of the Measurement Uncertainty that accounts for contributions from all significant sources of uncertainty associated with the analytical preparation and measurement of a sample. Such estimates are also commonly referred to as Combined Standard Uncertainty or Total Propagated Uncertainty, and in some older references as the Total Propagated Error, among other similar items (c.f., Counting Uncertainty). |
| Unethical actions | DoD- Deliberate falsification of analytical or quality control results where failed method or contractual requirements are made to appear acceptable. |
| United States Department of Agriculture (USDA) | A department of the federal government that provides leadership on food, agriculture, natural resources, rural development, nutrition and related issues based on public policy, the best available science, and effective management. |
| United States Geological Survey (USGS) | Program of the federal government that develops new methods and tools to supply timely, relevant, and useful information about the Earth and its processes. |
| Unregulated Contaminant Monitoring Rule (UCMR) | EPA program to monitor unregulated contaminants in drinking water. |
| Validation | DoD- The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. |
| Verification | TNI- Confirmation by examination and objective evidence that specified requirements have been met. In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. |
| Voluntary Action Program (VAP) | A program of the Ohio EPA that gives individuals a way to investigate possible environmental contamination, clean it up if necessary and receive a promise from the State of Ohio that no more cleanup is needed. |
| Whole Effluent Toxicity (WET) | The aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's wastewater (effluent). |

## 7.4 Appendix D: Organization Chart(s)

### 7.4.1 PAS-Corporate



### 7.4.2 PAS-Indianapolis/Grand Rapids/Dublin



## 7.5 Appendix E: Equipment Listing

The equipment listed represents equipment held by each location on the effective date of this manual. This information is subject to change without notice. External parties should contact the location for the most current information.

### 7.5.1 PAS-Indianapolis and PAS-Grand Rapids

**Pace Analytical - Indianapolis Equipment/Instrumentation List**

| INSTRUMENT | MANUFACTURER | MODEL NUMBER | DETECTOR | AUTOSAMPLER | SERVICE ANALYSIS | YEAR |
|---|---|---|---|---|---|---|
| GC/MS | Agilent | 6890 | MS 5973 | Centurion W/S | 8260/624 VOC | 2003 |
| GC/MS | Agilent | 6890 | MS 5973 | Centurion | 8260/624/524.2 VOC | 2007 |
| GC/MS | Agilent | 6890 | MS 5973 | Centurion W/S | 8260/624 VOC | 2003 |
| GC/MS | Agilent | 6850N | MS 5975 | Centurion | 8260/624/524.2 VOC | 2007 |
| GC/MS | Agilent | 6890 | MS 5973 | Centurion W/S | 8260/624 VOC | 2004 |
| GC/MS | Agilent | 6850N | MS 5975 | Centurion | 8260/624 VOC | 2010 |
| GC/MS | Agilent | 6890 | MS 5973 | Archon | 8260/624 VOC | 2010 |
| GC/MS | Agilent | 6890N | MS 5975 | Centurion | 8260/624/524.2 VOC | 2010 |
| GC/MS | Hewlett-Packard | 6890 | MS 5973 | 7683 | 8270 PAH SIM | 2000 |
| GC/MS (2) | Agilent | 7890 | MS 5975 | 7683 | 8270/625 BNA | 2008 |
| GC/MS (2) | Agilent | 6890 | MS 5975 | 7683 | 8270 PAH SIM | 2009 |
| GC/MS (3) | Agilent | 6890 | MS 5973 | 7683 | 8270/625 BNA | 2008 |
| GC/MS | Agilent | 7890 | MS 5975 | 7683 | 8270 PAH SIM | 2009 |
| GC/MS (2) | Hewlett-Packard | 5890 | MS 5971 | 7673 | Solvent Screen | 2007 |
| GC/MS | Agilent | 7890B | MS 5977 | 7693 | 8270/PAH SIM | 2017 |
| GC/MS | Agilent | 7890B | MS 5977 | 7693 | 8270/PAH SIM | 2018 |
| Gas Chromatograph | Agilent | 6890 | FID | 7683 | 8015 Alcohols | 2006 |
| Gas Chromatograph | Hewlett-Packard | 6890 | FID | 6890 | 8015 Glycols | 2008 |
| Gas Chromatograph | Agilent | 7890A | FID | 7693 | 8015 DRO/ERO | 2009 |
| Gas Chromatograph | Agilent | 7890A | Dual ECD | 7693 | 8082/608 PCBs/8011 EDB/DBCP | 2009/2013 |
| Gas Chromatograph | Hewlett-Packard | 5890 | FID | 6890 | Benzene | 2006 |
| Gas Chromatograph | Hewlett-Packard | 5890 | FID | 8100 | 8015 GRO | 2011 |
| Gas Chromatograph | Hewlett-Packard | 5890 | FID | EST LGX50 | RSK175 Dissolved gases | 2006 |
| Gas Chromatograph | Agilent | 6890N | FID | Archon | 8015 GRO | 2008 |
| Gas Chromatograph | Agilent | 6890 | Dual NPD | 7683 | Pesticides | 2008 |
| Gas Chromatograph (2) | Agilent | 6890 | Dual ECD | 7683 | PCBs | 2008 |
| Gas Chromatograph | Hewlett-Packard | 6890 | Dual ECD | 7683 | Herbicides | 2008 |
| Gas Chromatograph | Agilent | 7890 | Dual ECD | 7693 | Pesticides | 2010 |
| Microwave Extractors (2) | CEM | 230/60 | n/a | n/a | soil extraction | 2008/2011 |
| Spe-Dex | Horizon | 4790 | n/a | n/a | 1664A Oil & Grease | 2008 |
| Trace ICP (2) | Thermo Scientific | ICAP 6500 | n/a | ASX520 | 6010/200.7 Metals | 2008/2011 |
| Trace ICP | Thermo Scientific | ICAP 6500 | n/a | ESI SC-4 FAST | 6010/200.7 Metals | 2011 |
| ICP/MS | Agilent | 7700 | n/a | ASX520 | 6020/200.8 Metals | 2012 |
| ICP/MS | Agilent | 7800 | n/a | ASX520 | 6020/200.8 Metals | 2018 |
| Mercury Analyzer | CETAC | M-6100 | n/a | ASX520 | 7470/7471/245 Mercury | 2012/2010 |
| Mercury Analyzer | Teledyne Leeman | M-7600 | n/a | ASX520 | 7470/7471/245 Mercury | 2016 |
| Low-Level Mercury Analyzer (2) | CETAC | M-8000 | n/a | ASX520/ASX560 | Low-Level Mercury | 2015/2018 |
| Auto Analyzer (2) | Lachat | Quick Chem | n/a | n/a | NO3,Cl,Phenol, NH3,TKN | 2010/2012 |
| Titrosampler | Metrohm | 855 | n/a | n/a | Alkalinity, Acidity | 2014 |
| Automated Flash Point | Tanaka | APM-8 | n/a | n/a | flash point | 2010 |
| Spectrophotometer | Hach | DR5000 | n/a | n/a | Sulfate,Cr6+,Fe2+, PO4 | 2007 |
| Spectrophotometer | Thermo | AquaMatePlus | n/a | n/a | Surfactants, COD | 2005 |
| Turbidimeter | Hach | 2100P | n/a | n/a | Turbidity | 2006 |
| pH/ISE Meter (2) | Accumet | AR25/XL25 | n/a | n/a | pH, Fluoride, Redox | 2003/2010 |
| pH/ISE Meter | Thermo Orion Star | A214 | n/a | n/a | pH, Fluoride, Redox | 2013 |
| Conductivity Meter | Oakton | CON 700 | n/a | n/a | Conductivity | 2016 |
| Dissolved Oxygen/pH Meter | Hach | HQ440d | n/a | n/a | BOD, cBOD | 2014 |
| BOD Analyzer | Thermo | AutoEz | n/a | n/a | BOD, cBOD | 2013 |
| TOC Analyzer | Shimadzu | TOC-Vwp | n/a | n/a | TOC, DOC | 2008 |
| Discrete Analyzer | Smart Chem | 200 | n/a | n/a | Cyanide, Phosphorus | 2006 |
| Flow Analyzer | OIA | FS3100 | n/a | n/a | Free and Available Cyanide | 2018 |
| Ion Chromatograph | Dionex | ICS2100 | n/a | AS-AP | Cl-, F-, SO4-, Br-, NO3/NO2 | 2013 |
| Ion Chromatograph (3) | Dionex | AQUION | n/a | AS-AP | Cl-, F-, SO4-, Br-, NO3/NO2 | 2019 |
| **Pace Analytical - Grand Rapids Equipment/Instrumentation List** | | | | | | |
| pH/ISE Meter (2) | Accumet | AB150 | n/a | n/a | pH | 2017 |
| BOD Meter and Probe | Hach | HQ40d | n/a | n/a | BOD, cBOD | 2017 |
| FIA Analyzer | OIA | FS-3100 | n/a | n/a | Nitrate and Nitrite | 2017 |
| Spectrophotometer | Shimadzu | UV-1800 | n/a | n/a | Cr6+,Fe2+, PO4, Color | 2017 |
| Turbidimeter | Hach | 2100N | n/a | n/a | Turbidity | 2017 |

**APPENDIX B**

# Pace Greensburg, Pennsylvania Quality Assurance Manual


## Document Information

**Document Number:** ENV-MAN-IND1-0001 **Revision:** 02

**Document Title:** Quality Manual

**Department(s):** Quality

## Date Information

**Effective Date:** 03 Feb 2020

## Notes

**Document Notes:**

All Dates and Times are listed in: Central Time Zone

## Signature Manifest

**Document Number:** ENV-MAN-PITTS-0001 **Revision:** 01

**Title:** Quality Manual

All dates and times are in Central Time Zone.

**ENV-MAN-PITTS-0001**

### QM Approval

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Charlotte Washlaski (003467) | Manager - Quality | 20 Feb 2020, 11:35:54 AM | Approved |

### Management Approval

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Ruth Welsh (003453) | General Manager 1 | 20 Feb 2020, 11:24:03 AM | Approved |
| Charlotte Washlaski (003467) | Manager - Quality | 20 Feb 2020, 11:36:07 AM | Approved |
| Patrick McLoughlin (003466) | Manager | 20 Feb 2020, 02:33:07 PM | Approved |
| Aaron Kerr (003454) | Scientist 2 | 24 Feb 2020, 09:03:31 AM | Approved |
| Mark Mikesell (003456) | Manager | 25 Feb 2020, 03:19:04 PM | Approved |
| Colin Walters (005945) | Regional Director - Operations | 26 Feb 2020, 07:39:36 AM | Approved |

**TITLE PAGE**

# LABORATORY QUALITY MANUAL

## Prepared for:

Pace Analytical Energy Services, LLC.
220 William Pitt Way
Pittsburgh, PA 15238
Phone: 412-826-5245

# Manual Approval Signatories

Approval of this manual by managerial personnel is recorded on the Signature Manifest located before the Title Page of this manual.

The individuals listed below represent the management team that was in place on the effective date of this version of the manual for the following location:

Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: 412-826-5245

Each of the following individuals is a signatory for the manual for the location listed above. The application of their signature to the manual signifies their commitment to communicate, implement, and uphold the requirements, policies and procedures specified in this manual and their commitment to continuously improve the effectiveness of the quality management system based on customer feedback and internal assessment.

| Name[1] | Title | Address[2] | Phone[2] |
|---|---|---|---|
| Colin Walters | Senior General Manager | | 724-433-5223 |
| Ruth Welsh | Assistant General Manager | | |
| Charlotte Washlaski | Manager-Quality/ Safety Officer | | |
| Aaron Kerr | IT | | |
| Mark Mikesell | Manager-Lab Services[3] | | |
| Patrick McLoughlin | Manager- Lab Services | | |
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*[1] Members of the local management team are subject to change during the life-cycle of this document version.*
*[2] Include if different from the physical address and phone number of the facility.*
*[3] This individual serves as an Acting Technical Manager for TNI for one or more fields of accreditation.*

# Table of Contents

# 1.0 PURPOSE AND SCOPE

## 1.1 Purpose

This quality manual (manual) outlines the quality management system and management structure of the laboratories and service centers affiliated with Pace Analytical Services, LLC (PAS). A laboratory is defined by PAS as any PAS facility, however named, that provides testing, sampling, or field measurement services. When the term 'laboratory" is used in this manual, the term refers to all locations listed on the Title Page of this manual and in Section 4.1.3 unless otherwise specified.

The PAS quality management system is also referred to as the quality program throughout this document. In this context, the phrase "quality management system" and "quality program" are synonymous.

The quality management system is the collection of policies and processes established by PAS management to consistently meet customer requirements and expectations, and to achieve the goals to provide PAS customers with high quality, cost-effective, analytical measurements and services.

The quality management system is also intended to establish conformance[1] and compliance with the current versions of the following international and national quality system standards:

- ISO/IEC 17025: *General requirements for the competence of testing and calibration laboratories*
- NELAC/TNI Standard Volume 1: *Management and Technical Requirements for Laboratories Performing Environmental Analysis*

[1]The statement of conformity to these Standards pertains only to testing and sampling activities carried out by the laboratory at its physical address, in temporary or mobile facilities, in-network, or by laboratory personnel at a customer's facility.

In addition to the international and national standards, the quality management system is designed to achieve regulatory compliance with the various federal and state programs for which the laboratory provides compliance testing and/or holds certification or accreditation. When federal or state requirements do not apply to all PAS locations, the requirements for compliance are provided in addendum to this manual or in other documents that supplement the manual. Customer-specific project and program requirements are not included in the manual in order to maintain client confidentiality.

- A list of accreditation and certifications held by each laboratory associated with this manual is provided in Appendix A.
- A list of analytical testing capabilities offered by each laboratory associated with this manual is provided in Appendix B.

## 1.2 Scope and Application

This manual applies to each of the PAS locations listed on the Title Page and in Section 4.1.3.

The manual was prepared from a quality manual template (template) created by PAS corporate quality personnel. The template outlines the minimum requirements PAS management considers necessary for every PAS laboratory, regardless of scope of services or number of personnel, to establish in order to maintain a quality management system that achieves the objectives of PAS's Quality Policy (See 4.2.2). In this regard, the template is the mechanism used by the corporate officers (a.k.a. 'top

management') to communicate their expectations and commitment for the PAS quality program to all PAS personnel.

The laboratory also has the responsibility to comply with federal and state regulatory and program requirements for which it provides analytical services and holds certification or accreditation. When those requirements are more stringent than the template, the requirements for compliance are provided in addendum to this manual or in other documents that supplement the manual. This document structure maintains consistency in the presentation of the quality management system across the network while providing the laboratory a mechanism to describe and achieve compliance requirements on a program basis.

### 1.2.1 Quality Manual Template

The quality manual template is developed by the Corporate Quality Director with contribution and input from corporate quality personnel and the corporate officers. Approval of the template by the corporate officers (aka "top management") confirms their commitment to develop and maintain a quality management system appropriate for the analytical services offered by the organization and to communicate their expectations of the quality program to all personnel.

The template and instructions for use of the template are released by corporate quality personnel to quality assurance manager(s) responsible for each laboratory (Local QA). Local QA uses the template to prepare the laboratory's manual by following the instructions provided. Since the template provides the minimum requirements by which all PAS locations must abide, the laboratory may not alter the font, structure or content of the template except where specified by instruction to do so. As previously stated, program specific requirements are provided in addendum or in documents that supplement this manual.

The template is reviewed by corporate quality personnel every two years and updated if needed. More frequent review and revision may be necessary to manage change, to maintain conformance and compliance to relevant standards, or to meet customer expectations.

See standard operating procedure (SOP) ENV-SOP-CORQ-00015 *Document Management and Control* for more information.

### 1.2.2 Laboratory Quality Manual

The manual is approved and released to personnel under the authority of local management. The manual is reviewed annually and location specific information is updated, if needed. More frequent review and revision may be necessary when there are significant changes to the organizational structure, capabilities, and resources of the laboratory. Review and revision of the manual is overseen by local QA. If review indicates changes to the main body of the manual are necessary to maintain conformance and compliance to relevant standards, or to meet customer expectations, local QA will notify corporate quality personnel to initiate review and/or revision of the template.

See SOP ENV-SOP-CORQ-00015 *Document Management and Control* for more information.

### 1.2.3 References to Supporting Documents

The template and the manual include references to other laboratory documents that support the quality management system such as policies and standard operating procedures (SOPs).

These references include the document's document control number and may include the document title.

This information is subject to change. For example, an SOP may be converted to a policy or the document's title may change. For these types of administrative changes, the manual and template are updated to reflect the editorial change during the document's next scheduled review/revision cycle or the next time a new version of the document is released, whichever is sooner.

Local QA maintains a current list of controlled documents used at each PAS location to support the quality management system. This list, known as the Master List, lists each document used by document control number, title, version, effective date, and reference to any document(s) that the current version supersedes. When there is a difference between the template and/or manual and the Master List, the document information in the Master List takes precedence. The current Master List is readily available to personnel for their use and cross-reference. Parties external to the laboratory should contact the laboratory for the most current version.

## 2.0 REFERENCES

References used to prepare this manual include:

- "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act." Federal Register, 40 CFR Part 136, most current version.
- "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods." SW-846.
- "Methods for Chemical Analysis of Water and Wastes", EPA 600-4-79-020, 1979 Revised 1983, U.S. EPA.
- U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis, current version.
- U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis, current version.
- "Standard Methods for the Examination of Water and Wastewater." Current Edition APHA-AWWA-WPCF.
- "Annual Book of ASTM Standards", Section 4: Construction, Volume 04.04: Soil and Rock; Building Stones, American Society of Testing and Materials.
- "Annual Book of ASTM Standards", Section 11: Water and Environmental Technology, American Society of Testing and Materials.
- "NIOSH Manual of Analytical Methods", U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, most current version.
- "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water", U.S. EPA, Environmental Monitoring and Support Laboratory – Cincinnati (Sep 1986).
- Quality Assurance of Chemical Measurements, Taylor, John K.; Lewis Publishers, Inc. 1987.
- Methods for Non-conventional Pesticides Chemicals Analysis of Industrial and Municipal Wastewater, Test Methods, EPA-440/1-83/079C.

- Environmental Measurements Laboratory (EML) Procedures Manual, HASL-300, US DOE, February, 1992.
- Requirements for Quality Control of Analytical Data, HAZWRAP, DOE/HWP-65/R1, July, 1990.
- Quality Assurance Manual for Industrial Hygiene Chemistry, AIHA, most current version.
- National Environmental Laboratory Accreditation Conference (NELAC) Standard- most current version.
- ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories- most current version.

  The following are implemented by normative reference to ISO/IEC 17025:

  - ISO/IEC Guide 99, *International vocabulary of metrology –Basic and general concepts and associated terms*
  - ISO/IEC 17000, *Conformity assessment – Vocabulary and general principles*
- Department of Defense Quality Systems Manual (QSM), most current version.
- TNI (The NELAC Institute) Standard- most current version applicable to each lab.
- UCMR Laboratory Approval Requirements and Information Document, most current version.
- US EPA Drinking Water Manual, most current version.

# 3.0 TERMS AND DEFINITIONS

Refer to Appendix C for terms, acronyms, and definitions used in this manual and in other documents used by the laboratory to support the quality management system.

# 4.0 MANAGEMENT REQUIREMENTS

## 4.1 Organization

### 4.1.1 Legal Identity

Pace Analytical Services, LLC is authorized under the State of Minnesota to do business as a limited liability company.

#### 4.1.1.1 Change of Ownership

If there is a change of ownership, if a location goes out of business, or if the entire organization ceases to exist, Pace Analytical Services, LLC ensures that regulatory authorities are notified of the change within the time-frame required by each state agency for which the location is certified or accredited.

Requirements for records and other business information are addressed in the ownership transfer agreement or in accordance with appropriate regulatory requirements, whichever takes precedence.

### 4.1.2 Compliance Responsibility

Laboratory management has the responsibility and authority to establish and implement procedures and to maintain sufficient resources necessary to assure its activities are carried out in such a way to meet the compliance requirements of the quality management system.

### 4.1.3 Scope of the Quality Management System

The quality management system applies to work carried out at each location covered by this manual including permanent facilities, at sites away from its permanent facilities, or in associated temporary or mobile facilities.

The permanent and mobile facilities to which this manual applies includes:

| | |
|---|---|
| Name | Pace Analytical Energy Services, LLC |
| Address: | 220 William Pitt Way |
| City, State, Zip | Pittsburgh, PA 15238 |
| Phone Number | 412-826-5245 |
| Service Type: | Laboratory |

### 4.1.4 Organization History and Information

Founded in 1978, Pace Analytical Services, LLC (PAS) is a privately held scientific services firm operating one of the largest full service contract laboratory and service center networks in the United States. The company's network offer inorganic, organic and radiochemistry testing capabilities; specializing in the analysis of trace level contamination in air, drinking water, groundwater, wastewater, soil, biota, and waste.

With over 90 laboratories and services centers in the contiguous US and in Puerto Rico, the network provides project support for thousands of industry, consulting, engineering and government professionals.

Pace delivers the highest standard of testing and scientific services in the market. We offer the most advanced solutions in the industry, backed by truly transparent data, a highly trained team, and the service and support that comes from four decades of experience.

#### 4.1.4.1 Organization Structure

Each location maintains a local management structure under the oversight and guidance of corporate personnel. Local management is responsible for making day-to-day decisions regarding the operations of the facility, implementing the quality management system, upholding the requirements of the quality program, and for supervision of personnel.

Local management is provided by a General Manager (GM) or Assistant (AGM), Quality Manager (QM), Client Services Manager (CSM), Information Technology (IT) Manager, Department Managers (DM) and/or Department Supervisors (DS), however named.

Some locations may also have any one of the following management positions: Senior Quality Manager (SQM), Operations Manager (OM), Technical Director (TD), or Technical Manager (TM). When the location does not have a TD or TM, technical management is provided jointly by the GM, QM, DM, and DS.

The GM (or AGM), however named reports to a Senior General Manager (SGM), who is responsible for the management of multiple laboratories and service centers within a geographical region, and who reports directly to the Chief Operating Officer (COO). The QM and SQM have indirect reporting relationship to the Corporate Director of Quality.

Refer to the organization charts provided in Appendix D to view the management structure, reporting relationships, and the interrelationships between positions.

### 4.1.5 Management Requirements

#### 4.1.5.1 Personnel

The laboratory is staffed with administrative and technical personnel who perform and verify work under the supervision of managerial personnel.

- Technical personnel include analysts and technicians that generate or contribute to the generation of analytical data and managerial personnel that oversee day to day supervision of laboratory operations. Including the reporting of analytical data and results, monitoring QA/QC performance, and monitoring the validity of analysis to maintain data integrity and reliability.
- Administrative personnel support the day-to-day activities of the laboratory.
- IT personnel maintain the information technology systems and software used at the laboratory.
- Client services personnel include project managers and support staff that manage projects.
- Managerial personnel make day-to-day and longer term decisions regarding the operations of the facility, supervise personnel, implement the quality management system and uphold the requirements of the quality program.

All personnel regardless of responsibilities are expected to carry out their duties in accordance with the policies and processes outlined in this manual and in accordance with standard operating procedures (SOPs) and other quality system documents. The laboratory's policies and procedures are designed for impartiality and integrity. When these procedures are fully implemented, personnel remain free from undue pressure and other influences that adversely impact the quality of their work or data.

##### 4.1.5.1.1 Key Personnel

Key personnel include the management positions that have the authority and responsibility to plan, direct, and control, activities of the division (corporate) or the laboratory.

The following tables list key personnel positions by PAS job title and the position's primary deputy:

**Key Personnel: Corporate**

| Key Personnel | Primary Deputy |
|---|---|
| Chief Executive Officer | Chief Operating Officer |
| Chief Operating Officer | Chief Executive Officer |
| Chief Compliance Officer | Quality Director |
| Corporate Quality Director | Chief Compliance Officer |
| Health and Safety Director | Chief Compliance Officer |
| IT Director | LIMS Administrator, however named. |

**Key Personnel: Laboratory**

| Key Personnel | Primary Deputy |
|---|---|
| Senior General Manager | Chief Operating Officer or as designated. |
| General Manager / Assistant GM | Senior General Manager |
| Quality Manager | Corporate Quality Manager or as designated. |
| Client Services Manager | General Manager |
| Local IT | Corporate IT Director or as designated. |
| Department Manager | General Manager |
| Senior Quality Manager[1] | Corporate Quality Manager |
| Technical Director[1]/Manager[1] Acting Technical Manager TNI | Quality Manager |
| Operations Manager[1] | General Manager or Assistant GM. |

[1] *Position may not be staffed at each location.*

Some state certification programs require the agency to be notified when there has been a change in key personnel. Program-specific requirements and time-frames for notification by agency, are tracked and upheld by local QA, when these requirements apply.

#### 4.1.5.2 Roles and Responsibilities

The qualifications, duties, and responsibilities for each position are detailed in job descriptions maintained by PAS's corporate Human Resource's Department (HR).

The following summaries briefly identify the responsibility of key personnel positions in relation to the quality management system.

**Chief Executive Officer (CEO):** The CEO has overall responsibility for performance of the organization and endorses the quality program. Working with corporate and laboratory management, the CEO provides the leadership and resources necessary for PAS locations to achieve the goals and objectives of the quality management system and quality policy statement.

**Chief Operating Officer (COO):** The COO oversees all aspects of operations management including, strategic planning, budget, capital expenditure, and management of senior management personnel. In this capacity, the COO provides leadership and resources necessary to help top management at each PAS location achieve the goals and objectives of the quality management system and quality policy statement.

**Chief Compliance Officer (CCO):** The CCO oversees the quality assurance and environmental health and safety programs (HSE) for each business unit. The CCO is responsible for planning and policy development for these groups to ensure regulatory compliance and to manage risk. The position provides leadership and guidance necessary for all PAS locations to achieve the goals and objectives of the quality and HSE programs.

The CCO also serves as the Ethics Officer (ECO). The ECO develops the Ethics and Data Integrity Policy and Training Program, and provides oversight for reporting and investigation of ethical misconduct to maintain employee confidentiality during the process. The ECO provide guidance and instruction for follow-up actions necessary to remedy the situation and deter future recurrence.

**Corporate Director of Quality:** The Corporate Director of Quality is responsible for developing and maintaining the PAS quality program under guidance and assistance from the CEO, COO, and CCO. This position helps develop corporate quality policy and procedure and analyzes metric data and other performance indicators to assess and communicate the effectiveness of the quality program to top management. The position provides leadership and guidance for implementation of the quality program across all PAS locations.

**Corporate Director of Information Technology:** The Corporate Director of IT oversees the systems and processes of information technology used to support the quality program. These systems include Laboratory Information Management Systems (LIMS); data acquisition, reduction, and reporting software; virus-protection, communication tools, and ensuring the integrity and security of electronic data.

**Senior General Manager (SGM):** The SGM has full responsibility for administrative and operations management and performance of a group of PAS laboratories and service centers. Working with the COO and local laboratory management, the SGM provides leadership, guidance and resources, including allocation of personnel, necessary to achieve the goals of PAS quality program.

**General Manager (GM) / Assistant General Manager (AGM):** The GM or AGM is responsible for the overall performance and administrative and operations management of a PAS location and associated service center(s). This position is responsible to provide leadership and resources, including allocation and supervision of personnel, necessary for the location to implement and achieve the goals of the PAS quality program. In this capacity, the position assures laboratory personnel are trained on and understand the structure and components of the quality program defined in this manual as well as the policies and procedures in place to implement the quality management system.

The GM/AGM of NELAC/TNI Accredited laboratories are also responsible for the designation of technical personnel to serve as acting technical managers for TNI for the fields of accreditation held by the laboratory (See Section 4.1.5.2.2) and for notifying the accreditation body (AB) of any extended absence or reassignment of these designations.

**Quality Manager (QM):** The QM oversees and monitors implementation of the quality management system and communicates deviations to laboratory management. The QM is independent of the operation activities for which they provide oversight and has the authority to carry out the roles and responsibilities of their position without outside influence.

Additionally, in accordance with the TNI Standard, the QM:

- serves as the focal for QA/QC and oversees review of QC data for trend analysis;
- evaluates data objectively and perform assessments without outside influence;
- has document training and experience in QA/QC procedures and the laboratory's quality system;

- has a general knowledge of the analytical methods offered by the laboratory;
- coordinates and conducts internal systems and technical audits;
- notifies laboratory management of deficiencies in the quality system;
- monitors corrective actions;
- provides supports to technical personnel and may serve as the primary deputy for the acting TNI Technical Manager(s).

**Client Services Manager (CSM):** The CSM oversees project management personnel. This position is responsible for training and management of client facing staff that serve as the liaison between PAS and the customer to ensure that projects are successfully managed to meet the expectations and needs of PAS customers. This position is also responsible for sharing positive and negative customer feedback with laboratory management so that this information may be used to improve the quality program.

**Local IT Manager, however named:** Local IT managers are responsible for maintaining the IT systems used to support the quality program. These systems include Laboratory Information Management Systems (LIMS); data acquisition, reduction, and reporting software; virus-protection, communication tools, and ensuring the integrity and security of electronic data.

**Department Manager (DM):** The DM is responsible for administrative and operations management and implementation of the quality management system in the work area he/she oversees. These responsibilities include but are not limited to: training and supervision of personnel, monitoring work activity to maintain compliance with this manual, SOPs, policies and other instructional documents that support the quality management system; method development, validation and the establishment and implementation of SOPs to assure regulatory compliance and suitability for intended purpose; monitoring QA/QC performance, proper handling and reporting of nonconforming work, purchasing of supplies and equipment adequate for use, maintaining instrumentation and equipment in proper working order and calibration, and general maintenance of administrative and technical processes and procedures established by the laboratory.

**Senior Quality Manager (SQM):** The SQM provides support to the quality manager and assists the quality manager with implementation of the quality management system for one or more site locations.

**Technical Director (TD):** The TD provides technical oversight and guidance to laboratory personnel. Responsibilities may include but are not limited to: research and development, method development and validation, development of standard operating procedures, proposal and contract review. The TD may also be responsible for QA/QC trend analysis, technical training, and technology improvement.

**Operations Manager (OM):** The OM is responsible for management of production and/or other duties assigned by the GM or SGM.

#### 4.1.5.2.1 Acting Technical Manager (TNI Accreditation):

For PAS locations that are NELAC/TNI accredited:

The TNI Standard specifies requirements for the qualification and duties of technical personnel with managerial responsibility. These requirements are associated in the Standard to the designation 'technical manager(s), however named'. These responsibilities may be assigned to multiple individuals and are not associated with any specific job title.

For PAS, these TNI requirements for personnel that provide technical oversight correlate with PAS's job descriptions for Department Manager or Supervisor. However, the duties may be assigned to any PAS employee that meets the TNI specified qualifications.

Personnel assigned this designation retain their PAS assigned job title. The job title may be appended with *"acting as technical manager for TNI"* and the technology or field of accreditation for which the employee is approved, if necessary.

When TNI Accreditation Bodies (AB) refer to these employees as 'technical manager' or 'technical director' on the official certificate or the scope of accreditation, this reference is referring to their approval to carry out duties of the 'technical manager, however named' as specified in the TNI Standard.

In accordance with the TNI Standard, the acting Technical Manager(s) for TNI are responsible for monitoring the performance of QC/QA in the work areas they oversee.

If the absence of any employee that is approved as acting technical manager for TNI exceeds 15 calendar days, the duties and responsibilities specified in the TNI Standard are reassigned to another employee that meets the qualifications for the technology or field of accreditation or they are assigned to the position's deputy, the quality manager.

### 4.1.5.3 Conflict of Interest

A conflict of interest is a situation where a person has competing interests. Laboratory management looks for potential conflict of interest and undue pressures that might arise in work activities and then includes countermeasures in policies and procedures to mitigate or eliminate the conflict.

See policy COR-POL-0004 *Ethics Policy* for more information.

### 4.1.5.4 Confidentiality

Laboratory management is committed to preserving the confidentiality of PAS customers and confidentiality of business information.

Procedures used by the laboratory to maintain confidentiality include:

- A Confidentiality Agreement which all employees are required to sign at the time of employment and abide by the conditions of throughout employment;
- Record retention and disposal procedures that assure confidentiality is maintained;
- Physical access controls and encryption of electronic data; and
- Protocol for handling Confidential Business Information (CBI).

Client information obtained or created during work activities is considered confidential and is protected from intentional release to any person or entity other than the client or the client's authorized representative information provided to PAS, except when the laboratory is required by law to release confidential information to another party, such as a regulatory agency or for litigation purposes. In which case, the laboratory will notify the client of the release of information and the information provided.

The terms of client confidentiality are included in PAS Standard Terms and Conditions (T&C). With the acceptance of PAS Terms and Conditions and/or the implicit contract for analytical services that occurs when the client sends samples to the laboratory for testing, the client authorizes PAS to release confidential information when required.

See policy COR-POL-0004 *Ethics Policy* for more information.

#### 4.1.5.5 Communication

Communication is defined as the imparting or exchanging of news and information. Effective (good) communication occurs when the person(s) you are exchanging information with actively gets the point and understands it.

##### 4.1.5.5.1 Workplace Communication

Good communication in the workplace is necessary to assure work is done correctly, efficiently, and in accordance with client expectations.

Instructions for how to carry out work activities are communicated to personnel via written policy, standard operating procedures, and standard work instructions.

Information about laboratory performance (positive and negative) and ideas for improvement are communicated using various communication channels such as face to face meetings, video conferencing, conference calls, email, memoranda, written reports, and posters.

##### 4.1.5.5.2 External Communication

Communication with external parties such as customers, vendors, business partners, and regulatory agencies takes place every day.

Laboratory management ensure personnel learn to communicate in professional and respectful ways in order to build strong relationships, and learn to communicate effectively to avoid misunderstanding.

## 4.2 Quality Management System

### 4.2.1 Quality Management System Objectives

The objectives of the laboratory's quality management system are to provide clients with consistent, exemplary professional service, and objective work product that is of known and documented quality that meets their requirements for data usability and regulatory compliance.

Objective work product is analytical services, data, test results, and information that is not influenced by personal feeling or opinions. The quality of being objective is also known as 'impartiality'.

#### 4.2.1.1 Impartiality

The laboratory achieves and maintains impartiality by implementing and adhering to the policies and processes of the quality management system, which are based on industry accepted standards and methodologies.

The laboratory's procedures for handling nonconforming work (See 4.9), corrective and preventive actions (See 4.11) and management review (See 4.15) are the primary mechanisms used to identify risk to impartiality and to prompt actions necessary to eliminate or reduce the threat when risk to impartiality is suspected or confirmed.

#### 4.2.1.2 Risk and Opportunity Assessment

Risks are variables that make achieving the goals and objectives of the quality management system uncertain. An opportunity is something that has potential positive consequences for the laboratory.

Laboratory personnel manage risks and opportunities on a daily basis by carrying out the processes that make up the quality management system. Some of the ways in which the quality management system is designed to identify, minimize, or eliminate risk on a daily basis include but are not limited to:

- Capability and capacity reviews of each analytical service request to assure the laboratory can meet the customer's requirements;
- Maintenance of accreditation and certification for test methods in multiple states and programs to cover a broad range of jurisdiction for regulatory compliance;
- SOPs and other controlled instructional documents are provided to personnel to eliminate variability in process. These documents include actions to counter risk factors inherent in the process and are reviewed on a regular basis for on-going suitability and relevancy;
- Participation in proficiency testing programs and auditing activities to verify on-going competency and comparability in performance;

- Provision of on-the-job training and established protocol for quality control (QC) corrective action for nonconforming events;
- An established program for ethics, and data integrity;
- Tiered data review process;
- Culture of continuous improvement;
- Monitoring activities to assess daily and long term performance; and
- Annual critical review of the effectiveness of the quality management system.

PAS also promotes a continuous improvement culture based on the principles of lean manufacturing. These principles include 3P (Process, Productivity, Performance) and Kaizen. 3P is a platform used by Pace to share best practices and standardization across the network to achieve operational excellence. Kaizen is a team based process used to implement tools and philosophies of lean to reduce waste and achieve flow with the purpose of improving both external and internal customer satisfaction. PAS's lean programs and activities help to mitigate risk because they generate a collective understanding of vulnerabilities and utilize group-effort to develop and implement solutions at all levels.

Risk and opportunities may also be formally identified using specific risk and opportunity assessment methods such as SWOT Analysis (Strength, Weakness, Opportunity, Threats) and 3-Stage Impact/Probability Grids.

#### 4.2.1.3 Communication of the Quality Management System

This manual is the primary mechanism used by laboratory management to communicate the quality management system to laboratory personnel.

To assure personnel understand and implement the quality program outlined in the manual:

- All laboratory personnel are required to sign a Read and Acknowledgement Statement to confirm the employee has: 1) been informed of the manual by laboratory management, 2) has access to the manual, 3) has read the manual 4) understands the content of the manual, and 5) agrees to abide by the requirements, policies and procedures therein.
- Personnel are informed that the manual provides the "what" of the quality management system. The "how to" implementation of the quality management system is provided in policy, SOPs, standard work instructions, and other controlled instructional documents.

### 4.2.2 Quality Policy Statement

The quality policy of the laboratory is to provide customers with data of known and documented quality fit for their intended purpose. The laboratory achieves this policy by implementing the quality management system defined in this manual, by following industry accepted protocol for analytical testing and quality assurance and quality control (QA/QC) activities, by conformance with published and industry accepted

testing methodologies, and by compliance with international and national standards for the competency and/or accreditation of testing laboratories.

Intrinsic to this policy statement is each of the following principles:

- The laboratory will provide customers with reliable, consistent, and professional service. This is accomplished by making sure the laboratory has the resources necessary to maintain capability and capacity; that staff are trained and competent to perform the tasks they are assigned; that client-facing staff are trained and prepared to find solutions to problems and to assist customers with their needs for analytical services. Customer feedback, both positive and negative, is shared with personnel and used to identify opportunities for improvement.
- The laboratory maintains a quality program that complies with applicable, state, federal, industry standards for analytical testing and competency.

  ISO/IEC 17025 and the TNI (The NELAC Institute) Standard is used by PAS to establish the minimum requirements of the PAS quality program.

  ISO/IEC 17025 is a competency standard that outlines the general requirements for the management system for calibration and testing laboratories. It is the primary quality system standard from which other quality system standards, such as the TNI Standard, are based. The TNI Standard are consensus standards that provides management and technical requirements for laboratories performing environmental analysis.
- Laboratory management provides training to personnel so that all personnel are familiar with the quality management system outlined in this manual and that they understand that implementation of the quality management system is achieved by adherence to the organization's policies and procedures.
- Laboratory management continuously evaluates and improves the effectiveness of the quality management system by responding to customer feedback, and other measures of performance, such as but not limited to: the results of internal/external audits, proficiency testing, metrics, trend reports, and annual and periodic management reviews.

#### 4.2.2.1 Ethics Policy / Data Integrity Program

PAS has established a comprehensive ethics and data integrity program that is communicated to all PAS employees in order that they understand what is expected of them. The program is designed to promote a mindset of ethical behavior and professional conduct that is applied to all work activities.

The key elements of the PAS Ethics / Data Integrity Program include:

- Ethics Policy (COR-POL-0004);
- Ethics Compliance Officer;
- Standardized data integrity training course taken by all new employees on hire and a yearly refresher data integrity training course for all existing employees;

- Policy Acknowledgement Statements that all PAS personnel, including contract and temporary, are required to sign at the time of employment and again during annual refresher training to document the employee's commitment and obligation to abide by the company's standards for ethics, data integrity and confidentiality;
- SOPs that provide instructions for how to carry out a test method or process to assure tasks are done correctly and consistently by each employee;
- On the Job Training;
- Data integrity monitoring activities which include, but are not limited to, secondary and tertiary data review, internal technical and system audits, raw data audits, data mining scans, and proficiency testing; and
- Confidential reporting process for alleged ethics and data integrity issues.

All laboratory managers are expected to provide a work environment where personnel feel safe and can report unethical or improper behavior in complete confidence without fear of retaliation. Retaliation against any employee that reports a concern is not tolerated.

PAS has engaged Lighthouse Services, Inc. to provide personnel with an anonymous reporting process available to them 24 hours a day/7 days per week. The alert line may be used by any employee to report possible violations of the company's ethics and data integrity program. When using the reporting process, the employee does need to specify the location of concern and when reporting by email, also include the company name. Messages are collected, documented, reviewed, and will be followed up on by the Ethics Compliance Officer to resolve the matter. Investigations concerning data integrity are kept confidential.

**Lighthouse Compliance Alert Lines:**

| | |
|---|---|
| English Speaking US & Canada | (844) 940-0003 |
| Spanish Speaking North America | (800) 216-1288 |
| Internet | www/lighthouse-services.com/pacelabs |
| Email | reports@lighthouse-services.com |

### 4.2.3 Management Commitment: Quality Management System

Evidence of management's commitment for the development, maintenance, and on-going improvement of the quality management system is provided by the application of their signature of approval to this manual. Their signature confirms they understand their responsibility to implement the quality management system outlined in this manual, to communicate the quality program to personnel, and to uphold requirements of the program during work activities.

### 4.2.4 Management Commitment: Customer Service

Management communicates the importance of meeting customer and regulatory requirements to personnel by training personnel on the quality management system outlined in this manual,

implementing the quality management system outlined in this manual, and upholding these requirements for all work activities.

### 4.2.5 Supporting Procedures

Documents that support this manual and quality management system are referenced throughout this manual. The structure of the document management system is outlined in SOP ENV-SOP-CORQ-0015 *Document Management and Control* and summarized in the following subsections.

#### 4.2.5.1 Quality Management System Document Structure

Documents associated with the quality management system are classified into document types that identify the purpose of the document and establish how the document is managed and controlled.

Document types are ranked to establish which documents takes precedence when there is an actual or perceived conflict between documents and to establish the hierarchal relationships between documents. The ranking system also provides information to document writers and reviewers to assure downline documents are in agreement with documents of higher rank. Project specific documents are not ranked because client specific requirements are not incorporated into general use documents in order to maintain client confidentiality.

**PAS Quality Management System Documents: Internal**

| Document Type | Purpose |
|---|---|
| Quality Manual | Outlines the laboratory's quality management system and structure and how it works for a system including policy, goals, objectives and detailed explanation of the system and the requirements for implementation of system. Includes roles and responsibilities, relationships, procedures, systems and other information necessary to meet the objectives of the system described. |
| Policy | Provide requirements and rules for a PAS process and is used to set course of actions and to guide and influence decisions. Policy describes the "what", not the "how". |
| Standard Operating Procedure | Provide written and consistent set of instructions or steps for execution of a routine process, method, or set of tasks performed by PAS. Includes both fundamental and operational elements for implementation of the systems described in PAS manual(s). Assures that activities are performed properly in accordance with applicable requirements. Designed to ensure consistency, protect EHS of employees and environment, prevent failure in the process and ensure compliance with company and regulatory requirements. SOPs describes the "how" based on policy. |
| Standard Work Instruction | Provide step by step visual and/or written instruction to carry out a specific task to improve competency, minimize variability, reduce work injury and strain, or to boost efficiency and quality of work (performance). SWI are associated with an SOP unless the task described is unrelated to generation of or contribution to environmental data or analytical results. |
| Template | Pre-formatted document that serves as a starting point for a new document. |
| Guide | Provide assistance to carry out a task. Most often used for software applications. |
| Form | Used for a variety of purposes such as to provide a standardized format to record observations, to provide information to supplement an SOP. |

**PAS Quality Management System Documents: External**

| | |
|---|---|
| Certificate | Lists parameters, methods, and matrices for which the laboratory is certified/accredited to perform within the jurisdiction of the issuing regulatory agency or accreditation body. |
| Reference Document | Provide information, protocol, instructions, and/or requirements. Issued by the specifier. Examples include quality system standards such as ISO/IEC, TNI, DoD and published referenced methods such as Standard Methods, ASTM, SW846, EPA, and federal and state regulatory bodies. |
| Project Document | Provides requirements necessary to meet individual client expectations for intended use of data. Examples include: project quality assurance plans (QAPP), client-program technical specifications, contracts, and other agreements. |

**Document Hierarchy**

| Rank | Document |
|---|---|
| 1 | Reference Documents |
| 2 | Corporate Manual |
| 3 | Corporate Policy |
| 4 | Corporate SOP |
| 5 | Corporate SWI, Templates & Forms |
| 6 | Laboratory Manual |
| 7 | Laboratory SOP |
| 8 | Laboratory SWI, Templates, & Forms |
| NA | Project Documents[1] |

#### 4.2.6 Roles and Responsibilities

The roles and responsibilities of technical management and of the quality manager are provided in section 4.1.5.1.2.

#### 4.2.7 Change Management

When significant changes to the quality management system are planned, these changes are managed by corporate quality personnel to assure that the integrity of the quality management system is maintained.

### 4.3 Document Control

#### 4.3.1 General

The laboratory's procedures for document control are provided in SOP ENV-SOP-CORQ-0015 *Document Management and Control.*

The documents that support the quality management system include internally generated documents such as manuals, policies, standard operating procedures, standard work instructions, forms, guides, and templates and external source documents such as but not limited to, regulations, standards, reference methods, manuals, and project-specific documents.

The laboratory uses electronic document management software (eDMS) to carry out the procedures of the SOP. eDMS automates the process for unique document identification, version control, approval, access, and archival.

### 4.3.2 Document Approval and Issue

Documents that are part of the quality management system are reviewed by qualified personnel and approved by laboratory management prior by to release for general use.

Local QA maintains a master list of controlled documents used at the laboratory. The master list includes the document control number, document title, and current revision status and is made available to personnel for their reference.

Only the approved versions of documents are available to personnel for use. The eDMS system does not allow user access to draft versions of documents except to personnel assigned to work on the draft. eDMS also restricts access to archived documents except to authorized users, such as local QA, in order to prevent the use of obsolete documents.

See SOP ENV-SOP-CORQ-0015 *Document Management and Control* for more information.

### 4.3.3 Document Review and Change

Unless a more frequent review is required by regulatory, certification or accreditation program, the laboratory formally reviews documents at least every two years to ensure the document remains current, appropriate, and relevant.

Documents are also informally reviewed every time the document is used. Personnel are expected to refer to and follow instructions in controlled documents when they carry out their work activities. Consequently, any concerns or problems with the document should be caught and brought to the attention of laboratory management on an on-going basis.

Documents are revised whenever necessary to ensure the document remains usable and correct. Older document versions and documents no longer needed are made obsolete and archived for historical purposes.

The laboratory does not allow hand-edits to documents. If an interim change is needed pending re-issue of the document, the interim change is communicated to those that use the document using a formal communication channel, such as SOP Change in Progress form, email, or memorandum.

The document review, revision, and archival process is managed by local QA at the location from which the document was released using the procedures established in SOP ENV-SOP-CORQ-0015 *Document Management and Control.*

## 4.4 Analytical Service Request, Tender, and Contract Review

The laboratory's management and/or client service personnel perform thorough reviews of requests and contracts for analytical services to verify the laboratory has the capability, capacity, and resources necessary to successfully meet the customer's needs. These review procedures are described in laboratory SOP ENV-SOP-PITTS-0037 *Review of Analytical Requests.*

The procedures in this SOP(s) are established to ensure that:

- The laboratory understands the purpose of data collection in order to ensure the test methods requested are appropriate for the intended use of the data and capable of meeting the client's data quality objectives;

- The laboratory and any subcontractor has the capability, capacity, and resources to meet the project requirements and expectations within the requested time frame for delivery of work product;
- Any concerns that arise from review are discussed and resolved with the client; and
- The results of review and any correspondence with the client related to this process and/or any changes made to the contract are recorded and retained for historical purposes.

Capability review confirms that the in-network laboratories and any potential subcontractors hold required certification/accreditation for the test method, matrix, and analyte and verifies the laboratory can achieve the client's target compound list and data quality objectives (DQOs) for analytical sensitivity and reporting limits, QA/QC protocol, and hardcopy test report and electronic data deliverable (EDD) formats.

Capacity review verifies that the in-network laboratories and any potential subcontractors are able to handle the sample load and deliver work production within the delivery time-frame requested.

Resource review verifies that the laboratory and any potential subcontractors have adequate qualified personnel with the skills and competency to perform the test methods and services requested and sufficient and proper equipment and instrumentation needed to perform the services requested.

## 4.5 Subcontracting and In-Network Work Transfer

The terms 'subcontract' and "subcontracting" refers to work sent to a business external to PAS Analytical Services, LLC (PAS) and the term 'subcontractor' refers to these external businesses, which are also called vendors.

Work transferred within the PAS network is referred to as interregional work orders (IRWO) and network laboratories are referred to as IRWO or network laboratory.

The network of PAS laboratories offers comprehensive analytical capability and capacity to ensure PAS can meet a diverse range of client needs for any type of project. If the laboratory receives a request for analytical services and it cannot fulfill the project specifications, the laboratory's client services team will work with the client to place the work within the PAS network. When it is not possible to place the work within network, the laboratory will, with client approval, subcontract the work to a subcontractor that has the capabilities to meet the project specifications and can meet the same commitment agreed on between the laboratory and the client. Some client programs require client consent even for IRWO work transfer, and when this applies, the client services team obtains consent as required. The laboratory retains the record of client notification and their consent in the project record for historical purposes.

Whenever work is transferred to a subcontractor or an IRWO laboratory, the laboratory responsible for management of the project verifies each of these qualifications:

- The subcontractor or IRWO laboratory has the proper accreditation/certifications required for the project and these are current; and
- The use of the subcontractor or IRWO laboratory is approved by the client and/or regulatory agency, when approval is required. Record of approval is retained in the project record.

When possible, the laboratory selects subcontractors that maintain a quality management system similar to PAS and that complies with ISO/IEC 17025 and the TNI Standard(s).

PAS also evaluates and pre-qualifies subcontractors as part of company's procurement program. The complete list of approved vendors is maintained by the corporate procurement department and is made available to all PAS locations. Pre-qualification of a subcontractor does not replace the requirement for the placing laboratory to verify the capability, capacity, and resources of any selected subcontractor on a project-specific basis to confirm the subcontractor can meet the client's needs.

For both subcontracting and in-network work transfer, the project specifications are always communicated to the subcontractor or the IRWO laboratory by the project manager so that the laboratory performing the work is aware of and understands these requirements.

The procedures for subcontracting are outlined in laboratory SOP ENV-SOP-PITTS-0025 *Subcontracting*.

## 4.6 Purchasing Services and Supplies

Vendors that provide services and supplies to the laboratory are prequalified by corporate procurement personnel to verify the vendor's capability to meet the needs of PAS. These needs include but are not limited to: competitive pricing, capacity to fill purchase orders, quality of product, customer service, and business reputation and stability. The records of vendor evaluation and the list of approved vendors is maintained by the corporate procurement department.

The laboratory may purchase goods and services from any supplier on the approved vendor list.

The specifications (type, class, grade, tolerance, purity, etc.) of supplies, equipment, reagents, standard reference materials and other consumables used in the testing process are specified in SOPs. The SOP specifications are based on the governing requirements of the approved reference methods and any additional program driven regulatory specification, such as drinking water compliance. All requisitions for materials and consumables are approved by the department supervisor to confirm the purchase conforms with specified requirements. After approval the requisition is handled by the laboratory's designated purchasing agent. On receipt, the product is inspected and verified before use, when applicable.

The laboratory's procedure for the purchase of services and supplies is specified in laboratory SOP ENV-SOP-PITTS-0013 *Purchasing of Lab Supplies*.

## 4.7 Customer Service

Project details and management is handled by the laboratory's customer service team. Each customer is assigned a Project Manager (PM) that is responsible for review of contract requirements and handling laboratory to customer communication about the project status.

### 4.7.1 Commitment to Meet Customer Expectations

The laboratory cooperates and works closely with our customers to ensure their needs are met and to establish their confidence in the laboratory's capability to meet their needs for analytical services and expectations for service.

Each customer's project is handled by a project manager (PM) that is the customer's primary point of contact. The PM gathers information from the customer to ensure the details of their request are understood. After samples are received, the PM monitors the progress of the project and alerts the customer of any delays or excursions that may adversely impact data usability. Laboratory supervisors are expected to keep the PM informed of project status and any delays or major issues, so that the PM can keep the client informed.

PAS also has a team of subject matter experts (SME) available to provide customers with advice and guidance and any other assistance needed. SME are selected by top management based on their knowledge, experience, and qualifications.

The laboratory encourages customers to visit the laboratory to learn more about the laboratory's capabilities, observe performance and to meet laboratory personnel.

PAS customers expect confidentiality. Laboratory personnel will not divulge or release information to a third party without proper authorization unless the information is required for litigation purposes. See Section 4.1.5.3 of this manual and policy COR-POL-0004 *Ethics Policy* for more information on the laboratory's policy for client confidentiality.

### 4.7.2 Customer Feedback

The laboratory actively seeks positive and negative feedback from customers through surveys and direct communication. Information from the client about their experience working with the laboratory and their satisfaction with work product is used to enhance processes and practices and to improve decision making. Customer feedback is communicated to laboratory management and corporate personnel in monthly reports and analyzed yearly during management review (See 4.15) to identify risk and opportunity. Corrective, preventive, or continuous improvement actions are taken based on nature of and/or feedback trends.

Also see sections 4.9, 4.10, 4.11, 4.12, 4.14, and 4.15 for more information about how customer feedback is managed by the laboratory and used to enhance the quality management system.

## 4.8 Complaints

Complaints provide opportunities to improve processes and build stronger working relationships with our clients.

The laboratory's complaint resolution process includes three steps. First, handle and resolve the complaint to mutual satisfaction. Second, perform corrective action to prevent recurrence (See 4.11). Third, record and track the complaint and use these records for risk and opportunity assessment and preventive action (See 4.12)

## 4.9 Nonconforming Work

### 4.9.1 Definition of Nonconforming Work

Nonconforming work is work that does not conform to customer requirements, standard specifications, laboratory policies and procedures, or that does not meet acceptance criteria.

The discovery of non-conforming work comes come from various sources which include, but are not limited to:

- results of quality control samples and instrument calibrations;
- quality checks on consumables and materials;
- general observations of laboratory personnel;
- data review;
- proficiency testing;
- internal and external audits;

- complaints and feedback;
- management review and reports; and
- regulatory and certification and accreditation actions.

The way in which the laboratory handles nonconforming work depends on the significance and impact (risk) of the issue. Some issues may simply require correction, others may require investigation, corrective action (See 4.11) and/or data recall (See 4.16). When the laboratory releases data and test results associated with nonconforming QC and acceptance criteria test results are qualified or non-conformances are noted in the final analytical report to apprise the data user of the situation. (See 5.10)

Nonconforming work also includes unauthorized departure from laboratory policies, procedures and test methods. Authorized departures are explained in the following subsections. Situations that do not conform to these conditions are considered unauthorized departure(s).

#### 4.9.1.1 Authorized Departure from SOP

An authorized departure from a test method SOP is one that has been reviewed and approved by the Department Manager, Technical Manager, Acting Technical Manager for TNI, Quality Manager, or the General Manager. Review is conducted to confirm the departure does not conflict with regulatory compliance requirements for which the data will be used or does not adversely affect data integrity. The departure may originate from client request or may be necessary to overcome a problem.

An authorized departure from administrative or process-oriented SOP is typically necessary to correct an error in the SOP. These departure requests are reviewed and pre-approved by the local QA Manager. Documentation of SOP departures and approval decisions are retained by the laboratory as evidence that the departure was authorized. When necessary, approved departures from test method SOPs are noted in the final test report to advise the data user of any ramification to data quality.

#### 4.9.1.2 Authorized Departure from Test Methods (Method Modifications)

When test results are associated to a published reference test method, the laboratory's test method SOP must be consistent with the test method. If the test method is mandated for use by a specific regulatory program such as drinking water or wastewater or a certification or accreditation program, such as TNI/NELAC, the SOP must also comply with or include these requirements. If the procedures in the SOP are modified from the test method, these modifications must be clearly identified in the SOP. The conditions under which the laboratory may establish an SOP that is modified from these reference documents, and what is considered a modification are specified in ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification*.

Modifications that do not meet the requirements of this SOP (ENV-SOP-CORQ-0011) are unauthorized. Client requests to deviate from the test method are handled as client requests to depart from the test method SOP since it is the SOP that the laboratory follows when performing work.

#### 4.9.1.3 Stop Work Authority

Stop Work Authority provides laboratory personnel with the responsibility and obligation to stop work when there is a perceived unsafe condition or behavior that may result in an unwanted event.

All laboratory and corporate personnel have the authority to stop work when needed to preserve data integrity or safety of workers.

Once a stop work order has been initiated and the reason for doing so is confirmed valid; laboratory management is responsible for immediate correction and corrective action (see section 4.10) before resumption of work.

## 4.10 Continuous Improvement

The laboratory's quality management system is designed to achieve continuous improvement through the implementation of the quality policy and objectives outlined in this manual. Information about the laboratory's activities and performance is gained from many sources such as customer feedback, audits, QC, trend analysis, business analytics, management reports, proficiency testing, and management systems review. This information is subsequently used during the laboratory's corrective action (see section 4.11) and preventive action (see section 4.12) processes and to establish goals and objectives during annual review of the management system (see section 4.15).

PAS also promotes a continuous improvement culture based on the principles of lean manufacturing. These principles include 3P (Process, Productivity, Performance) and Kaizen. 3P is a platform used by Pace to share best practices and standardization across the network to achieve operational excellence. Kaizen is a team based process used to implement tools and philosophies of lean to reduce waste and achieve flow with the purpose of improving both external and internal customer satisfaction.

## 4.11 Corrective Action

Corrective action is process used to eliminate the cause of a detected nonconformity. It is not the same as a correction. A correction is an action taken to fix an immediate problem. The goal of the corrective action process is to find the underlying cause(s) of the problem and to put in place fixes to prevent the problem from happening again. The corrective action process, referred to as CAPA by PAS, is one of the most effective tools used by the laboratory to prevent nonconforming work, identify risk and opportunity, and improve service to our customers.

The laboratory has two general processes for corrective action:

The process used for actions taken in response to day to day quality control (QC) and acceptance criteria exceptions (nonconformance) that occur during the day to day testing process are called corrections. These events do not usually include formal methods for cause analysis; instead the reason for the failure is investigated through troubleshooting or other measures. Required actions for correction of routine nonconformance is specified in laboratory SOPs. When corrective action is not taken, cannot be taken, or is not successful, test results associated with the nonconforming work are qualified in the final test report. Documentation of the nonconformance and corrective action taken is documented in the analytical record.

A formal 7 step corrective action process is used when there is a problem or departure from the quality management system, technical activities, or when the extent of a single problem has significant

impact on data, regulatory compliance or customer needs. These problems are identified through various activities such as but not limited to: quality control trends, internal and external audits, management review, customer feedback, and general observation.

The laboratory's 7 Step CAPA Process includes:

1) Define the Problem
2) Define the Scope of the Problem
3) Contain the Problem
4) Root Cause Analysis
5) Plan Corrective Action
6) Implement Corrective Action
7) Follow Up / Effectiveness Check

The formal CAPA process may be initiated by any employee. Once the process is initiated it is overseen and coordinated by laboratory management. The CAPA process is documented using an electronic or paper-based system. The CAPA record includes tracking information, dates, individuals involved, those responsible for action plan implementation and follow-up, and timelines and due dates.

For more information about the laboratory's procedure for corrective action, see laboratory SOP ENV-SOP-PITTS-0004 *Corrective Action*. Additional explanation about certain aspects of the laboratory's corrective action process are outlined in the next three subsections.

### 4.11.1 Root Cause Analysis

Root cause analysis (RCA) is the process of investigation used by the laboratory to identify the underlying cause(s) of the problem. Once causal factors are identified, ways to mitigate the causal factors are reviewed and corrective action(s) most likely to eliminate the problem are selected.

The laboratory uses different methods to conduct this analysis. The most common approach is 5-Why, but fishbone diagrams, or even brainstorming may be appropriate depending on the situation. The method used is documented in the CAPA record.

### 4.11.2 Effectiveness Review

Monitoring corrective actions for effectiveness is shared by laboratory supervisors and quality assurance personnel. Effectiveness means the actions taken were sustainable and appropriate. Sustainable means the change is still in place. Appropriate means the action(s) taken prevented recurrence of the problem since the time corrective action was taken.

The time-frame in which effectiveness review takes place depends on the event and is recorded in the CAPA record with any addition actions that need to be taken.

Corrective action trends are also monitored by laboratory management and used to identify opportunities for preventive action or to gain lessons learned when actions taken were not adequate to solve the problem. See Section 4.12 (Preventive Action) and 4.15 (Management Review) for more information.

### 4.11.3 Additional Audits

When non-conformances or other problems cast doubt on compliance with the laboratory's policies, procedures, or compliance to regulatory requirements; laboratory management

schedules a special audit of the area of activity in accordance with Section 4.14.1 as soon as possible. These special audits are used to determine the scope of the problem and to provide information for the CAPA process. Additional full-scale audits are done when a serious issue or risk to the laboratory's business is identified.

## 4.12 Preventive Action

Preventive action is an action taken to eliminate the cause of a potential nonconformity and to achieve improvement. Preventive action is a forward thinking process designed to prevent problems opposed to reacting to them (corrective action).

Some examples of preventative action include, but are not limited to:

- Scheduled instrument maintenance (Preventative maintenance)
- Addition of Staff and Equipment
- Professional Development Activities
- Implementation of New Technology

The laboratory looks for opportunities for preventive action from a variety of sources including but not limited to: employee idea's, customer feedback, business partners input, trend analysis, business analytics, management reviews, proficiency testing results, lean management events, and risk-benefit analysis.

The process for preventive actions follows the same 7 step process for corrective action except "problem" is replaced with "opportunity", "cause analysis" is replaced with "benefit analysis", and "corrective action" is replaced with "preventive action".

Laboratory management evaluates the success of preventive actions taken in any given year during annual management review. See Section 4.15 for more information.

### 4.12.1 Change Management

Preventive actions may sometimes result in significant changes to processes and procedures used by the laboratory. Laboratory management evaluates the risks and benefits of change and includes in its implementation of change process, actions to minimize or eliminate any risk. The types of changes for which risk are considered and managed include: infrastructure change, change in analytical service offerings, certification or accreditation status, instrumentation, LIMS changes, and changes in key personnel.

For more information about the laboratory's procedures for preventive action see laboratory SOP ENV-SOP-PITTS-0038 *Management of Change*.

## 4.13 Control of Records

A record is a piece of evidence about the past, especially an account of an act or occurrence kept in writing or some other permanent form. Laboratory records document laboratory activities and provide evidence of conformity to the requirements established in the quality management system. These records may be hardcopy or electronic on any form of media.

### 4.13.1 General Requirements

#### 4.13.1.1 Procedure

The laboratory's procedures for control of records is provided in laboratory SOP for Data and Records Archival.

The procedures in the SOP are established to assure quality and technical records are identified, retained, indexed, and filed to allow for retrieval during the entire retention time frame. During storage, records are kept secure and protected from deterioration. At the end of the retention time, the records are disposed of properly in order to maintain client confidentiality and to protect the interests of the company.

In general, laboratory records fall into three categories: quality, technical, and administrative.

Examples of each are provided in the following table:

| Record Type | Includes Records of: |
|---|---|
| Quality | Documents: Document Types listed in SOP ENV-SOP-CORQ-016<br>Audits: Internal and External<br>Certificates and Scopes of Accreditation<br>Corrective & Preventive Action<br>Management Review<br>Data Investigations<br>Method Validation<br>Instrument Verification<br>Training Records |
| Technical | Raw Data<br>Logbooks<br>Certificates of Traceability<br>Analytical Record<br>Test Reports & Project Information<br>Technical Training Records & Demonstration of Capability |
| Administrative | Personnel Records<br>Finance/Business |

#### 4.13.1.2 Record Legibility and Storage

Records are designed to be legible and to clearly identify the information recorded. Manual entries are made in indelible ink; automated entries are in a typeface and of sufficient resolution to be read. The records identify laboratory personnel that performed the activity or entered the information.

Records are archived and stored in a way that they are retrieved. Access to archived records is controlled and managed.

For records stored electronically, the capability to restore or retrieve the electronic record is maintained for the entire retention period. Hardcopy record are filed and stored in a suitable environment to protect from damage, deterioration, or loss. Hardcopy records may be scanned to PDF for retention. Scanned records must be checked against the hardcopy to verify the scan is complete and legible.

Records are kept for a minimum of 10 years unless otherwise specified by the client or regulatory program.

The date from which retention time is calculated depends on the record. In general, the retention time of technical records of original observation and measurement is calculated from the date the record is created. If the technical record is kept in a chronological logbook, the date of retention may be calculated from the date the logbook is archived. The retention time of test reports and project records, which are considered technical records, is calculated from the date the test report was issued. The retention time of quality records is usually calculated from the date the record is archived.

Refer to the laboratory's record management SOP for more information.

#### 4.13.1.3 Security

The laboratory is a secure facility and access to records is restricted to laboratory personnel.

#### 4.13.1.4 Electronic Records

The data systems used to store electronic records is backed up in accordance with laboratory SOP ENV-SOP-PITTS-0033 *Horizon LIMS*. Access to archived records stored electronically is maintained by personnel responsible for management of the electronic system.

### 4.13.2 Technical Records

In addition to the requirements identified in subsections 4.13.1.1 through 4.13.1.4, the requirements in the following subsections also apply to technical records.

#### 4.13.2.1 Description

Technical records are the accumulation of data and information generated from the analytical process. These records may include forms, worksheets, workbooks, checklists, notes, raw data, calibration records, final test reports, and project record. The accumulated record essentially needs to provide sufficient detail to historically reconstruct the process and identify the personnel that performed the tasks associated with a test result.

#### 4.13.2.2 Real Time Recordkeeping

Personnel are instructed and expected to always record observations, data, and calculations at the time they are made. Laboratory managers are responsible to assure that data entries, whether made electronically or on hardcopy, are identifiable to the task.

#### 4.13.2.3 Error Correction

Errors in records must never erased, deleted or made illegible. Use of correction fluid, such as white-out is prohibited. In hardcopy records, the error is corrected by a single-strike through the original entry and the new entry recorded alongside or footnoted to allow for readability. Corrections are initialed and dated by the person making the correction. If the correction is not self-explanatory, a reason for the correction is recorded.

For electronic records, equivalent measures of error correction or traceability of changes made is kept. For example, audit trails provide records of change.

Maintenance of proper practices for error correction is monitored through the tiered data review process described in Section 5.9.3. Laboratory records are reviewed throughout the data review process. Individuals performing these reviews flag errors that are not properly corrected and bring these to the attention of the department manager or supervisor of the work area in which the record was generated so that the problem may be addressed and corrected with the individual(s) that did not make the correction properly.

## 4.14 Audits

The laboratory performs internal systems and technical audits to assess compliance to this manual and to other laboratory procedures, such as policy, SOP and SWI. Since the processed in this manual are based on the relevant quality system standards and regulatory and accreditation/certification program requirements the laboratory provides services for, the internal audits also assess on-going compliance to these programs.

The laboratory is also audited by external parties such as regulatory agencies, customers, consultants and non-government assessment bodies (NGAB).

Information from internal and external audits is used by laboratory management to address compliance concerns and opportunities where improvement will increase the reliability of data.

Deficiencies, observations and recommendations from audits are managed by local QA using the laboratory's formal CAPA process. See Section 4.11 for more information.

### 4.14.1 Internal Audit

The laboratory's internal audit program is managed by local QA in accordance with a pre-determined audit schedule established at the beginning of each calendar year. The schedule is prepared to assure that all areas of the laboratory are reviewed over the course of the year. Conformance to the schedule is reported to both laboratory management and corporate quality personnel in a monthly QA report prepared by the quality manager.

Although the QA Manager creates the audit schedule, it is the shared responsibility of local QA and laboratory managers to assure the schedule is maintained. Laboratory supervisors cooperate with QA to provide the auditors with complete access to the work area, personnel, and records needed.

Internal audits are performed by personnel approved by the quality manager. In general, personnel may not audit their own activities unless it can be demonstrated that an effective and objective audit will be carried out. The auditor must be trained, qualified, and familiar enough with the objectives, principles, and procedures of laboratory operations to be able to perform a thorough and effective evaluation.

The laboratory's internal audit program includes:

- System Audits & Method Audits: The purpose of these audits is to determine if daily practice is consistent with laboratory's SOPs and if SOPs are compliant with adjunct policy and procedures. Auditing techniques includes analyst interviews and observation and records review. These audits are performed per the pre-determined schedule.

- Raw Data / Final Test Report Audits: The purpose of these audits is to review raw data and/or a final test reports to verify the final product is consistent with customer/project requirements and supported as compliant to SOPs, reference methods, with test results that are properly qualified when necessary, accurate, and of known and documented quality. The reviews should also identify opportunities for improvement and best practices.

- Special Audits: Special audits are those performed ad hoc to follow up on specific a specific issue such as a client complaint, negative feedback, concerns of data integrity or ethics, or a problem identified through other audits. Special audits may be scheduled or unscheduled. Unscheduled internal audits are conducted whenever doubts are cast on the laboratory's compliance with regulatory requirements or its own policies and procedures. These unscheduled internal audits may be conducted at any time and may be performed without an announcement to laboratory personnel.

When observations and findings from any audit (internal or external) cast doubt on the validity of the laboratory's testing results, the laboratory takes immediate action to initiate investigate the problem and take corrective action. (Also see 4.11 and 4.16)

The laboratory's internal audit program and auditing procedures are further described in laboratory SOP ENV-SOP-PITTS-0006 *Internal Audits*.

#### 4.14.1.1 Corporate Compliance Audit

The laboratory may also be audited by corporate quality personnel to assess the laboratory's compliance to the company's quality management program and to evaluate the effectiveness of implementation of the policies and procedures that make up the quality management system. The purpose of the compliance audit is to identify risks and opportunities and to assist laboratory management achieve the goals and objectives of the company's quality program.

## 4.15 Management Review

The laboratory's management team formally reviews the management system on an annual basis to assess for on-going suitability and effectiveness and to establish goals, objectives, and action plans for the upcoming year.

At a minimum, following topics are reviewed and discussed:

- The on-going suitability of policies and procedures including HSE (Health, Safety and Environment) and waste management;

- Reports from managerial and supervisory personnel including topics discussed at regular management meetings held throughout the year;

- The outcome of recent internal audits;

- Corrective and preventive actions;

- Assessments by external bodies;

- The results of interlaboratory comparisons or proficiency tests;

- Changes in the volume and type of the work;
- Customer and personnel feedback, including complaints;
- Effectiveness of improvements / preventive actions made since last review;
- Internal and external issues of relevance and risk identification;
- A review of the status of actions from prior management reviews; and
- Other relevant factors, such as quality control activities, resources, and staff training.

The discussion and results of this review are documented in a formal report prepared by laboratory management. This report includes a determination of the effectiveness of the management system and its processes; goals and objectives for improvements in the coming year with timelines and responsibilities, any other need for change. See laboratory SOP ENV-SOP-CORQ-0005 for more information.

Goals and action items from annual management systems review are shared with employees to highlight focus areas for improvement in addition to areas in which the laboratory has excelled.

### 4.16 Data Integrity

The laboratory's procedures for data integrity reviews are described in SOP ENV-SOP-CORQ-0010 *Data Recall*.

Customers whose data are affected by these events are notified in a timely manner, usually within 30 days of discovery. Some accreditation programs also require notification to the accreditation body (AB) within a certain time-frame from date of discovery when the underlying cause of the issue impacts accreditation. The laboratory follows any program or project specific client notification requirements for notification, when applicable.

## 5.0 TECHNICAL REQUIREMENTS

### 5.1 General

Many factors contribute to the correctness and reliability of the technical work performed by the laboratory. These factors are fall under these general categories:

- Human Performance
- Facility and Environmental Conditions
- Test Method Performance and Validation
- Measurement Traceability
- Handling of Samples

The impact of each of these factors varies based on the type of work performed. To minimize negative effects from each these factors, the laboratory takes into account the contribution from each of these categories when developing test method and process (administrative) SOPs, evaluating personnel qualifications and competence, and in the selection of equipment and supplies used.

## 5.2 Personnel

### 5.2.1 Personnel Qualifications

The laboratory's program for personnel management is structured to ensure personnel are selected, qualified, and competent to perform the roles and responsibilities of their position based on education, experience, and training.

Qualifications, duties, responsibilities, and authorities of each position are specified in job descriptions maintained by corporate HR (See Section 5.2.4). These job descriptions provide the general basis for the selection of personnel for hire and are used by the laboratory to communicate to personnel the duties, responsibilities, and authorities of their position.

The term "personnel" refers to individuals employed by the laboratory directly as full-time, part-time, or temporary, and individuals employed by the laboratory by contract, such as through an employment agency. The term "personnel" is used interchangeably with the term "employee" throughout this manual. For purposes of this manual, these terms are equivalent.

The personnel management program is structured to establish and maintain records for each of the following:

- Selection of personnel;
- Training of personnel;
- Supervision of personnel;
- Authorization of personnel; and
- Monitoring Competence of personnel.

#### 5.2.1.1 Competence

Competence is the ability to apply a skill or series of skills to complete a task or series of tasks correctly within defined expectations.

Competence for technical personnel authorized by PAS to provide opinion and interpretation of data to customers also includes the demonstrated ability to:

- Apply knowledge, experience, and skills needed to safely and properly use equipment, instrumentation, and materials required to carry out testing and other work activities in accordance with manufacturer specifications and laboratory SOPs;
- Understand and apply knowledge of general regulatory requirements necessary to achieve regulatory compliance in work product; and
- Understand the significance of departures and deviations from procedure that may occur during the analytical testing process and the capability and initiative to troubleshoot and correct the problem, document the situation and decision making process, and to properly qualify the data and analytical results.

The laboratory's requirements for the competence of personnel (education, qualification, work experience, technical skills, and responsibilities) are specified in job descriptions created by management and kept by human resources (HR). The job description provides the basis for the selection of personnel for each position.

An employee is considered competent when he/she has completed required training.

The policies and standard operating procedures (SOPs) for the following topics are established by management as minimum required training for all personnel:

- Ethics and Data Integrity
- Quality Manual
- Safety Manual
- Quality Management System
- Technical Process and Procedure relevant to their job tasks
- Successful Demonstration of Capability (DOC) – Analytical Personnel Only

Personnel are initially authorized competent to independently carry out their assigned duties when required training is complete and documented.

Records of training and qualification provide the record of competence for the individual. Qualification records may include but are not limited to diploma, transcripts, and curriculum vitae (CV).

The on-going competence of each employee is monitored by laboratory management through on-the-job performance. Analytical employees are also required to successfully complete another demonstration capability for each test method performed on an annual basis.

### 5.2.2 Training

Training requirements are outlined in policies COR-POL-0023 *Mandatory Training Policy*. COR-POL-0004 *Ethics Policy*, and laboratory SOP ENV-SOP-PITTS-0014 *Employee Orientation and Training*. Additional training requirements may also be specified in other documents, such as manuals

#### 5.2.2.1 Training Program and Goals

The laboratory's training program includes 4 elements:

- Identification of Training Needs
- Training Plan Development and Execution
- Documentation and Tracking
- Evaluation of Training Effectiveness

Laboratory management establishes goals and training needs for individual employees based on their role, education, experience, and on-the-job performance.

Training needs for all employees are based on business performance measures that include but are not limited to:

- Quality Control Trends
- Process Error / Rework Trends

- Proficiency Testing Results
- Internal & External Audit Performance
- Management Review Goals

Training is delivered using various methods that incorporate techniques that appeal to the main learning styles: visual, aural, linguistic, and kinesthetic. Techniques include, on-the-job, instructor-led, self-study, eLearning, and blended.

The employee's direct supervisor is responsible for oversight of the employee's training plan and for providing adequate time to the employee to complete training assignments. Both the supervisor and employee are responsible to make sure the employee's training status and training records are current and complete.

The laboratory's QA department monitors the training status of personnel and provides the status to the General Manager (GM or AGM) at least monthly or more frequently, if necessary. The status report is used by laboratory management to identify overdue training assignments, the reasons for the gaps, and to make arrangements for completion.

The following subsections highlight specific training requirements:

#### 5.2.2.1.1 New Hire Training

New hire training requirements apply to new personnel and to existing employee's starting in a new position or different work area.

Required new hire training includes each of the following:

- Ethics and Data Integrity (See 5.2.2.1.3)
- Quality Manual / Quality Management System (See 5.2.2.1.4)
- Safety Manual and any training requirements specified in the manual.
- Policies & SOPs relevant to their job tasks
- Technical personnel that test samples must also successfully complete an initial demonstration of capability (IDOC) for the test methods performed before independently testing customer samples. (See 5.2.2.1.5). Independent testing means handling of client samples without direct supervision of the work activity by the supervisor or a qualified trainer.

All required training must be current and complete before the employee is authorized to work independently. Until then, the employee's direct supervisor is responsible for review and acceptance of the employee's work product.

#### 5.2.2.1.2 On-Going Training

Personnel receive on-going training in each of the following topics:

- Ethics and Data Integrity (See 5.2.2.1.3)
- Quality Manual / Quality Management System (See 5.2.2.1.4)
- Safety Training
- Changes to Policies & SOPs
- Specialized Training
- Technical employees that carry of testing must also successfully complete on-going demonstration of capability (ODOC) for all test methods performed on an annual basis. (See 5.2.2.1.5)

Personnel are expected to maintain their training status and records of training current and complete and to complete training assignments in a timely manner.

#### 5.2.2.1.3 Ethics and Data Integrity Training

Data integrity training is provided to all new personnel and refresher data integrity training is provided to all employees on an annual basis. Personnel are required to acknowledge they understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences including immediate termination, debarment, or civil/criminal prosecution.

The initial data integrity training and the annual refresher training is documented with a signature attendance sheet or other form of documentation to provide evidence that the employee has participated in training on this topic and understand their obligations related to data integrity.

The following topics and activities are covered:

- Policy for honesty and full disclosure in all analytical reporting;
- Prohibited Practices;
- How and when to report data integrity issues;
- Record keeping. The training emphasizes the importance of proper written documentation on the part of the analyst with respect to those cases where analytical data may be useful, but are in one sense or another partially nonconforming;
- Training Program, including discussion regarding all data integrity procedures;
- Data integrity training documentation;
- In-depth procedures for data monitoring; and
- Specific examples of breaches of ethical behavior such as improper data manipulations, adjustments of instrument time

clocks, and inappropriate changes in concentrations of standards.

All PAS personnel, including contract and temporary, are required to sign an "Attestation of Ethics and Confidentiality" at the time of employment and during annual refresher training. This document clearly identifies inappropriate and questionable behavior. Violations of this document result in serious consequences, including prosecution and termination, if necessary.

Also see SOP-ENV-COR-POL-0004 *Ethics Policy* for more information.

#### 5.2.2.1.4 Management System Documents Training

PAS Manuals, policies, and SOPs are the primary documents used by regulatory bodies and PAS customers to verify the laboratory's capability, competency. and compliance with their requirements and expectations.

In addition to on-the-job training, employees must have a signed Read and Acknowledgement Statement on record for the laboratory quality manual, and the policies and SOPs relating to his/her job responsibilities. This statement when signed by the employee electronically or by wet signature, confirms that the employee has received, read, and understands the content of the document, that the employee agrees to follow the document when carrying out their work tasks; and the employee understands that unauthorized change to procedures in an SOP is not allowed except in accordance with the SOP departure policy (See 4.9.9.1) and SOP ENV-CORQ-0016 *Standard Operating Procedures and Standard Work Instructions* for more information.

#### 5.2.2.1.5 Demonstration of Capability (DOC)

Technical employees must also complete an initial demonstration of capability (IDOC) prior to independent work on client samples analyzed by the test methods they perform. After successful IDOC, the employee must demonstrate continued proficiency (CDOC) for the test method on an annual basis. If more than a year has passed since the employee last performed the method; then capability must be re-established with an IDOC.

Demonstration of capability (IDOC and DOC) is based on the employee's capability to achieve acceptable precision and accuracy for each analyte reported by the laboratory for the test method using the laboratory's test method SOP.

Records of IDOC and ODOC are kept in the employee's training file.

For more information, see laboratory SOP ENV-SOP-PITTS-0014.

#### 5.2.2.2 Effectiveness of Training

The results of the performance measures used to identify training needs are the same measures used by the laboratory to measure effectiveness of the training program. Improvement in key performance measures suggest the training program is successful. (See 5.2.2.1)

Effectiveness of individual employee training is measured by their demonstrated ability to comprehend the training material and apply knowledge and skills gained to their job task. Measurements include but are not limited to:

- Testing of the employee's knowledge of the quality management system, policies, and technical and administrative procedures through various mechanisms, such as quizzes, observation, and interviews.
- Demonstrated ability to convey information correctly and factually in written and verbal communication to internal and external parties.
- Demonstrated ability to carry out tasks in accordance with SOPs and other work instructions.
- Demonstrated ability to make sound decisions based on guidance and information available.
- Demonstrated initiative to seek help or guidance when the employee is unsure of how to proceed.

### 5.2.3 Personnel Supervision

Every employee is assigned a direct supervisor, however named, who is responsible for their supervision. Supervision is the set of activities carried out by the supervisor to oversee the progress and productivity of the employees that report to them.

General supervisory responsibilities may include but are not limited to:

- Hiring Employees
- Training Employees
- Performance Management
- Development, oversight, and execution of personnel training plans
- Monitoring personnel work product to assure the work is carried out in accordance with this quality manual, policies, SOPs, and other documents that support the quality management system.

### 5.2.4 Job Descriptions

Job Descriptions that define the required education, qualifications, experience, skills, roles and responsibilities, and reporting relationships for each PAS position are established by top management and kept by corporate HR. PAS laboratories use these job descriptions as the source of positions and job titles for the laboratory. The job descriptions apply to employees who are directly employed by PAS, part-time, temporary, technical and administrative and by those that are under contract with PAS through other means.

The job descriptions include the education, expertise, and experience required for the position and the responsibilities and duties, including any supervisory or managerial duties assigned to the position.

#### 5.2.5 Authorization of Technical Personnel

Laboratory management authorizes technical personnel to perform the technical aspects of their position after it has been verified that the employee meets the qualifications for the position, has successfully completed required training, and the employee has demonstrated capability. After initial authorization, technical personnel are expected to maintain a current and complete training record, demonstrate on-going capability at least annually for each test method performed, and produce reliable results through accurate analysis of certified reference materials, proficiency testing samples, and/or routine quality control samples in order to remain authorized to continue to perform their duties.

Records to support authorization including, education, experience, training, and other evaluations are kept by the laboratory.

### 5.3 Accommodations and Facilities

#### 5.3.1 Facilities

The laboratory is designed to support the correct performance of procedures and to not adversely affect measurement integrity or safety. Access to the laboratory is controlled by various measures, such as card access, locked doors, main entry. Visitors to the laboratory are required to sign-in and to be escorted by laboratory personnel during their visit. A visitor is any person that is not an employee of the laboratory.

#### 5.3.2 Environmental Conditions

The laboratory is equipped with energy sources, lighting, heating, and ventilation necessary to facilitate proper performance of calibrations and tests. The laboratory ensures that housekeeping, electromagnetic interference, humidity, line voltage, temperature, sound and vibration levels are appropriately controlled to ensure the integrity of specific measurement results and to prevent adverse effects on accuracy or increases in the uncertainty of each measurement.

Environmental conditions are monitored, controlled, and recorded as required by the relevant specifications, methods, and procedures. Laboratory operations are stopped if it is discovered that the laboratory's environmental conditions jeopardize the analytical results.

#### 5.3.3 Separation of Incompatible Activities

The layout and infrastructure of each work area including air handling systems, power supplies, and gas supplies of each laboratory work area is specifically designed for the type of analytical activity performed. Effective separation between incompatible work activities is maintained. For example, sample storage, preparation, and chemical handling for volatile organic analysis (VOA) is kept separate from semi-volatile organic (SVOA).

The laboratory separates samples known or suspected to contain high concentration of analytes from other samples to avoid the possibility for cross-contamination. If contamination is found, the source of contamination is investigated and resolved in accordance with laboratory SOPs.

#### 5.3.4 Laboratory Security

Security is maintained by controlled access to the building and by surveillance of work areas by authorized personnel. Access is controlled to each area depending on the required personnel, the sensitivity of the operations performed, and possible safety concerns. The main entrance is kept unlocked during normal business hours for visitors, and is continuously monitored by laboratory staff. All visitors must sign a visitor's log, and a staff member must accompany them during the duration of their stay.

#### 5.3.5 Good Housekeeping

The laboratory ensures good housekeeping practices in work areas to maintain a standard of cleanliness necessary for analytical integrity and personnel health and safety. Minimally, these measures include regular cleaning of the work area. Where necessary, areas are periodically monitored to detect and resolve specific contamination and/or possible safety issues.

### 5.4 Test Methods

#### 5.4.1 General Requirements

The laboratory uses test methods and procedures that are appropriate for the scope of analytical services the laboratory offers.

Instructions on the use and operation of equipment and sample handling, preparation, and analysis of samples are provided in SOPs. The instructions in SOPs may be supplemented with other documents including but not limited to, standard work instructions (SWI), manuals, guides, project documents and reference documents.

These documents are managed using the procedures described in SOP ENV-SOP-CORQ-0015 *Document Management and Control* and SOP ENV-SOP-CORQ-0016 *Standard Operating Procedures and Standard Work Instructions.*

Deviations to test method and SOPs are allowed under certain circumstances. See sections 4.9.1.1 and 4.9.1.2 for more information.

#### 5.4.2 Method Selection

The test methods and protocols used by the laboratory are selected to meet the needs of the customer, are appropriate for the item tested and intended use of the data, and to conform with regulatory requirements when regulatory requirements apply.

In general, the test methods offered are industry accepted methods published by international, regional, or national standards. The laboratory bases its procedure on the latest approved edition of a method unless it is not appropriate or possible to do so or unless regulatory requirements specify otherwise.

The laboratory confirms that it can perform the test method and achieve desired outcome before analyzing samples (see section 5.4.5). If there is a change in the published analytical method, then the confirmation is repeated.

When a customer does not specify the test method(s) to be used, the laboratory may suggest test methods that are appropriate for the intended use of the data and the type of samples to be tested. The laboratory will also inform customers when test methods requested are

considered inappropriate for their purpose and/or out of date. This discourse takes place during review of analytical service requests (See Section 4.4).

### 5.4.3 Laboratory Developed Methods

A laboratory developed method is a method developed from scratch (no published source method), a procedure that modifies the chemistry from the source method, or a procedure that exceeds the scope and application of the source method.

Laboratory developed methods must be validated prior to use (see section 5.4.5) and the procedure documented in a test method SOP.

The requirements for non-standard methods (Section 5.4.4) also apply to laboratory developed methods.

### 5.4.4 Non-standard Methods

A non-standard method is a method that is not published or approved for use by conventional industry standards for the intended purpose of the data. Non-standard methods must be validated prior to use (see section 5.4.5) and the procedure developed and documented in a test method SOP.

At a minimum, the following information must be included in the procedure:

- Title / Identification of Method;
- Scope and Application;
- Description of the type of item to be analyzed;
- Parameters or quantities and ranges to be determined;
- Apparatus and equipment, including technical performance requirements;
- Reference standards and reference materials required;
- Environmental conditions required and any stabilization period needed
- Description of the procedure, including:
    - Affixing identification marks, handling, transporting, storing and preparing of items;
    - Checks to be made before the work is started;
    - Verifying equipment function and, where required, calibrating and/or adjusting the equipment before each use;
    - Method of recording the observations and results;
    - Any safety measures to be observed;
    - Criteria and/or requirements for approval/rejection;
    - Data to be recorded and method of analysis and presentation; and
    - Uncertainty or procedure for estimating uncertainty.

Use of a non-standard method for testing must be agreed upon with the customer. The agreement, which is retained by the laboratory in the project record, must include the

specifications of the client's requirements, the purpose of testing, and their authorization for use of the non-standard method.

### 5.4.5 Method Validation

#### 5.4.5.1 Validation Description

Validation is the process of conformation and the provision of objective evidence that the stated requirements for a specific method/procedure are fulfilled.

The laboratory's requirements and procedures for method validation are outlined in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.*

#### 5.4.5.2 Validation Summary

All test methods offered by the laboratory are validated before use to confirm the procedure works and the data and results achieved meet the goals for the method. The extent of validation performed is based on technology and other factors as defined in the validation SOP (ENV-SOP-CORQ-0011).

The need to repeat validation is assessed by laboratory management when there are changes to the test method.

#### 5.4.5.3 Validation of Customer Need

Laboratory management reviews the results of test method validation, which include accuracy, precision, sensitivity, selectivity, linearity, repeatability, reproducibility, robustness, and cross-sensitivity, against general customer needs to ensure the laboratory's procedure for the test method will meet those needs.

The review procedure is detailed in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.*

The following subsections highlight some of these concepts:

##### 5.4.5.3.1 Accuracy

Accuracy is the degree to which the result of a measurement, calculation, or specification conforms to the correct value or a standard. When the result recovers within a range from the known value (control limit); the result generated using the laboratory's test method SOP is considered accurate.

##### 5.4.5.3.2 Precision

Precision refers to the closeness of two or more measurements to each other. It is generally measured by calculating the relative percent difference (RPD) or relative standard deviation (RSD) from results of separate analysis of the same sample. Precision provides information about repeatability, reproducibility, and robustness of the laboratory's procedure.

#### 5.4.5.3.3 Limits of Detection (LOD) (Chemistry)

The LOD is the minimum result which can be reliably discriminated from a blank with a predetermined confidence level. The LOD establishes the limit of method sensitivity and is also known as the detection limit (DL) or the method detection limit (MDL).

Values below the LOD cannot be reliably measured and are not reported by the laboratory unless otherwise specified by regulatory program or test method.

The LOD is established during method validation and after major changes to the analytical system or procedure that affect sensitivity are made.

The laboratory's procedure for LOD determination is detailed in laboratory SOP ENV-SOP-PITTS-0009. The SOP complies with 40 CFR 136 Appendix B or the current industry approved and accepted guidance for this process.

#### 5.4.5.3.4 Limits of Quantitation (LOQ) and Reporting Limit (RL)

The LOQ is the minimum level, concentration, or quantity of a target analyte that can be reported with a specified degree of confidence. The LOQ is established at the same time as the LOD. The laboratory's procedure for determination and verification of the LOQ is detailed in laboratory SOP ENV-SOP-PITTS-0009.

The LLOQ is the value of the lowest calibration standard. The LOQ establishes the lower limit of quantitation.

The LOQ and LLOQ represent quantitative sensitivity of the test method.

- The LOQ must always be equal to or greater than the LLOQ and the LLOQ must always be greater than the LOD.
- Any reported value (detect or non-detect) less than the LLOQ is a qualitative value.

The RL is the value to which the presence of a target analyte is reported as detected or not-detected. The RL is project-defined based on project data quality objectives (DQO). In the absence of project specific requirements, the RL is usually set to the LOQ or the LLOQ. Depending on the relationship of the RL to the LLOQ or LOQ, both the RL value may be or quantitative.

For more information, refer to laboratory SOP ENV-SOP-PITTS-0009.

#### 5.4.5.3.5 Linearity

Linearity is a mathematical concept applied to calibration models that employ multiple points to establish a calibration range used for quantitative analysis. Linearity is measured differently based on the calibration model. In general, if linearity is demonstrated than the slope of the response of standards are sufficiently close to one another. The accuracy of the linear regression and non-linear curves is verified by checking percent error or relative standard error (RSE), which is the process of refitting calibration data back to the model to determine if the results are accurate. For linear curves that use average calibration or response factor, error is measured by relative standard difference (RSD).

Linearity also establishes the range of quantitation for the test method used which directly impacts the sensitivity of the test method and uncertainty in measurement results. As previously noted, the LLOQ establishes the lower limit of quantitation. Similarly, the upper range of linearity establishes the upper limit of quantitation. In general, results outside of this range are considered qualitative values. However, some inorganic methods allow for extension of the linear range above the upper limit of quantitation when accuracy at this value is verified.

Linearity can also be used to establish repeatability, reproducibility, and robustness of the laboratory's test method. When linearity is demonstrated using a specific calibration model during method validation, then use of this same calibration model to achieve linearity on a day to day basis confirms the laboratory's method is repeatable, reproducible, and robust.

#### 5.4.5.3.6 Demonstration of Capability (DOC)

The DOC performed during method validation confirms that the test method acceptable precision and accuracy. The procedure used for DOC for method validation is the same as described in section 5.2.2.1.5 for demonstration of analyst capability.

### 5.4.6 Measurement Uncertainty

The laboratory provides an estimate of uncertainty in testing measurements when required or on client request. In general, the uncertainty of the test method is reflected in the control limits used to evaluate QC performance. (See 5.9.1.1.10). ISO/IEC supports this concept with language that reads when a well-recognized test method specifies limits to the values of the major source of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory has satisfied the requirements on analytical uncertainty by following the test method and reporting instructions.

When measurement uncertainty cannot be satisfied through control limits, the laboratory will provide a reasonable estimation of uncertainty. A reasonable estimation is based on knowledge of method performance and previous experience. When estimating the analytical

uncertainty, all uncertainty components which are of importance in the given situation are taken into account.

### 5.4.7 Control of Data

The laboratory has policies and processes in place to assure that reported data is free from calculation and transcription errors, that quality control is reviewed and evaluated before data is reported, and to address manual calculation and integration.

#### 5.4.7.1 Calculations, Data Transfer, Reduction and Review

Whenever possible, calculations, transfer of data, and data reduction are performed using validated software programs. (See 5.4.7.2)

If manual calculations are necessary, the results of these calculations are verified during the data review process outlined in section 5.9.3.

##### 5.4.7.1.1 Manual Integration

The laboratory's policy and procedures for manual integration are provided in SOP ENV-SOP-CORQ-0006 *Manual Integration*.

This SOP includes the conditions under which manual integration is allowed and the requirements for documentation.

Required documentation of manual integration includes:

- complete audit trail to permit reconstruction of before and after results;
- identification of the analyst that performed the integration and the reason the integration was performed; and
- the individual(s) that reviewed the integration and verified the integration was done and documented in compliance with the SOP.

#### 5.4.7.2 Use of Computers and Automated Acquisition

Whenever possible the laboratory uses software and automation for the acquisition, processing, recording, reporting, storage, and/or retrieval of data.

Software applications developed by PAS are validated by corporate IT for adequacy before release for general use. Commercial off the shelf software is considered sufficiently validated when the laboratory follows the manufacturer or vendor's manual for set-up and use. Records of validation are kept by the corporate information technology (IT) group or by the local laboratory, whichever group performed the validation.

The laboratory's process for the protection of data stored in electronic systems include:

- Individual user names and passwords for Laboratory Information Management Systems (LIMS) and auxiliary systems used to store or process data.

- Employee Training in Computer Security Awareness
- Validation of spreadsheets used for calculations to verify formulas and logic yield correct results and protection of these cells to prevent unauthorized change.
- Operating system and file access safeguards
- Protection from Computer Viruses
- Regular system backup; and testing of retrieved data

The laboratory's process for software development and testing process includes:

- Verification the software application works as expected and is adequate for use and fulfills compliance requirements, such as the need to record date/time of data generation.
- Change control to assure requests for changes are reviewed and approved by management before the change is made.
- Communication channels to assure all staff are aware of changes made.
- Version Control and maintenance of historical records.

## 5.5 Equipment

### 5.5.1 Availability of Equipment

The laboratory is furnished with all equipment and instrumentation necessary to correctly perform the tests offered in compliance with the specifications of the test method and to achieve the accuracy and sensitivity required.

### 5.5.2 Calibration

Equipment and instrumentation is checked prior to use to verify it performs within tolerance for its intended application.

Laboratory management is made aware of the status of equipment and instrumentation and any needs for either on a daily basis. This information is obtained during laboratory walkthroughs (LDM) that are conducted as part of the laboratory's lean program.

#### 5.5.2.1 Support Equipment

The laboratory confirms support equipment is in proper working order and meets the specifications for general laboratory use prior to placement in service and with intermediate checks thereafter. Equipment that does not meet specifications is removed from service until repaired or replaced. Records of repair and maintenance activities are maintained.

Procedures used to carry out and record these checks are outlined laboratory SOP ENV-SOP-PITTS-0008 *Support Equipment*.

#### 5.5.2.2 Analytical Instruments

Analytical instruments are checked prior to placement in service in accordance with SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.* After the

initial service date, the calibration of instruments and verification calibration is performed in accordance with local test method SOPs.

The calibration procedures in the test method SOPs comply with the requirements for acceptable calibration practices outlined in corporate document ENV-SOT-CORQ-0026 *Acceptable Calibration Practices*, the reference methods, and any applicable regulatory or program requirements.

### 5.5.3 Equipment Use and Operation

Equipment is operated and maintained by laboratory personnel that are trained on the test method SOP. Up-to-date instructions and procedures for the use and maintenance of analytical equipment are included in SOPs and/or supplemental documents such as standard work instructions (SWI) or instrument manuals which are made readily accessible in the work area to all laboratory personnel.

### 5.5.4 Equipment Identification

The laboratory uniquely identifies equipment by serial number or any other unique ID system, when practical. The identifier is included in the equipment list maintained by QA.

### 5.5.5 Equipment Lists and Records

#### 5.5.5.1 Equipment List

The laboratory maintains a master list of equipment that includes information about the equipment including a description, manufacturer, serial number, date placed in service, condition when received, identity, and the current location in the laboratory. The date of purchase is tracked by the procurement record. The equipment list(s) for each location covered by this manual is provided in Appendix F.

#### 5.5.5.2 Equipment Records

In addition to the equipment list, the laboratory maintains records of equipment that include:

- Verification that equipment conforms with specifications.
- Calibration records including dates, results, acceptance criteria, and next calibration dates.
- Maintenance plan and records
- Records of damage, malfunction, or repair

The laboratory follows an equipment maintenance program designed to optimize performance and to prevent instrument failure which is described in laboratory SOP ENV-SOP-PITTS-0005 *Equipment Maintenance* or individual test method SOPs.

The maintenance program includes routine maintenance activities which are performed as recommended by the manufacturer at the frequency recommended and non-routine maintenance, which is performed to resolve a specific problem such as degradation of peak resolution, shift in calibration relationship, loss of sensitivity, or repeat failure of instrument performance checks and quality control samples.

Maintenance is performed by laboratory personnel or by outside service providers.

All maintenance activities performed by laboratory personnel are recorded by the individual(s) that performed the activity at the time the maintenance was performed in an instrument maintenance log.

The maintenance record minimally includes the date of maintenance, the initials of the person(s) performing maintenance, a description of the activity performed, why (when the maintenance is non-routine), and the return to analytical control. When maintenance is performed by an external vendor, the laboratory staples the service record into hardcopy maintenance logs or scans the record easy retrieval. The laboratory provides unrestricted access to instrument maintenance logs in order to promotes good instrument maintenance and recordkeeping practices.

If an instrument must be moved, the laboratory will use safe practices for handling and transport to minimize damage and contamination.

### 5.5.6 Out of Service Protocol

Equipment that has been subjected to overloading, mishandling, gives suspect results, has been shown to be defective, or is performing outside of specified limits is taken out of service and either removed from the work area or labeled to prevent accidental use until it has been repaired and verified to perform correctly.

When analytical equipment is taken out of service, the laboratory examines the potential effect it may have had on previous analytical results to identify any non-conforming work. (See section 4.9).

### 5.5.7 Calibration Status

The laboratory labels support equipment to indicate calibration status, whenever practicable or otherwise maintains the calibration status in a visible location in the work area. These procedures are described in laboratory SOP ENV-SOP-PITTS-0007.

The calibration status of analytical instruments is documented in the analytical record. Analysts verify on-going acceptability of calibration status prior to use and with instrument performance check standards. These procedures are described in test method SOPs.

### 5.5.8 Returned Equipment Checks

When equipment or instrument is sent out of the laboratory for service, the laboratory ensures that the function and calibration status of the equipment is checked and shown to be satisfactory before the equipment is returned to service. These procedures are outlined in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.*

### 5.5.9 Intermediate Equipment Checks

The laboratory performs intermediate checks on equipment to verify the on-going calibration status. For example, most test method require some form of continuing calibration verification check and these procedures are included in the test method SOP. Periodic checks of support equipment are also performed; see appendix E for more information.

#### 5.5.10 Safeguarding Equipment Integrity

The laboratory safeguards equipment integrity using a variety of mechanisms that include but are not limited to:

- Adherence to manufacture's specification for instrument use so that settings do not exceed manufacturer's recommendation or stress the performance of the equipment.
- Established maintenance programs.
- Transparent maintenance records and unrestricted access to maintenance logs.
- Validation and approval of software before use.
- Audits to confirm instrument settings are consistent with SOPs.
- On-the-job training for safe and proper use of laboratory equipment.

### 5.6 Measurement Traceability

#### 5.6.1 General

Measurement traceability refers to a property of a measurement result whereby the result can be related to a reference through an unbroken chain of calibration, each contributing to the measurement uncertainty. Traceability requires an established calibration hierarchy of equipment (instruments) used during testing including equipment used for subsidiary measurements. The laboratory assures this equipment is calibrated prior to being put into service and that the reference standard and materials used for calibration are traceable to the international standard of units (SI) or national measurement standard.

When strict traceability to SI units cannot be made, the laboratory establishes traceability with the use of reference standards and equipment obtained from competent supplier that provide calibration certificates and/or certificates of analysis (COA).

#### 5.6.2 Equipment Correction Factors

When correction factors are used to adjust results the laboratory will assure that results in computer software are also updated. For example, if the direct instrument or reading output must be corrected based on preparation factor or concentration factors, laboratory management will assure the corrected result is also updated in the software, whenever possible.

#### 5.6.3 Specific Requirements

##### 5.6.3.1 Requirements for Calibration Laboratories

The laboratory does not offer calibration services to customers.

##### 5.6.3.2 Requirements for Testing Laboratories

The laboratory has procedures in place to verify equipment is calibrated prior to being put into service. (See 5.5.2) and ensures the reference standard and materials used for calibration are traceable to the international standard of units (SI) or national measurement standard. When strict traceability to SI units cannot be made, the laboratory establishes traceability with the use of reference standards and equipment obtained from competent suppliers that provide calibration certificates and/or certificates of analysis (COA).

### 5.6.4 Reference Standards and Reference Materials

#### 5.6.4.1 Reference Standards

The laboratory uses reference standards of measurement to verify adequacy of working weights and thermometers. The working weight is the weight(s) used for daily balance calibration checks and the working thermometers are used for temperature measurements on a daily basis.

Intermediate checks of the working reference measurement standards are performed to verify adequacy between calibration from an external calibration laboratory. The measurements from working weights and thermometers are compared to measurement taken by the reference standard which is traceable to SI or a national standard. The reference weights and thermometers are used solely for verification purposes unless the laboratory can prove that daily use does not adversely affect performance of the reference standard.

The laboratory performs intermediate checks of the working weights at least annually.

Working thermometers (glass and digital) are checked against the reference thermometer prior to placement in service to establish a correction factor and then rechecked annually (glass) or quarterly (digital) thereafter.

The calibration of liquid in glass reference thermometers is verified every 5 years and the calibration of digital reference thermometers is verified annually by an ISO/IEC 17025 accredited calibration laboratory or service provider that provides traceability to a national standard.

The calibration of the reference weight(s) is verified every 5 years by an ISO/IEC 17025 accredited calibration laboratory.

If criteria for the intermediate checks or recertification is not acceptable, the impact on previously reported results is evaluated using the process for evaluation of nonconforming work (See 4.9)

See laboratory SOP ENV-SOP-PITTS-0007 for more information about this process.

#### 5.6.4.2 Reference Materials

The laboratory purchases chemical reference materials used (also known as stock standards) from vendors that are accredited to ISO 17034 or Guide 34. Purchased reference materials must be received with a Certificate of Analysis (COA) where available. If a reference material cannot be purchased with a COA, it must be verified by analysis and comparison to a certified reference material and/or there must be a demonstration of capability for characterization. COA are reviewed for adequacy and retained by the laboratory for future reference.

The laboratory procedure for traceability and use of these materials is provided in laboratory SOP ENV-SOP-PITTS-0010.

This SOP includes each of the following requirements:

- Procedures for documentation of receipt and tracking. The record of entry includes name of the material, the lot number, receipt date, and expiration date.
- Storage conditions and requirements. Reference materials must be stored separately from samples, extracts, and digestates.
- Requirements to assure that preparations of intermediate or working solutions are recorded and assigned a unique identification number for tracking. Records of preparation include the lot number of the stock standard(s) used, the type and lot number of the solvent, the formulation, date, expiration date, and the preparer's initials. The lot number of the working standards is recorded in the analytical record to provide traceability to the standard preparation record. The preparation record provides traceability to the COA, which is traceable to SI or the national measurement standard.
- A requirement that the expiration dates of prepared standards may not exceed the expiration date of the parent standard. Standards, reference materials, and reagents are not used after their expiration dates unless their reliability is thoroughly documented and verified by the laboratory. If a standard exceeds its expiration date and is not re-certified, the laboratory removes the standard and/or clearly designates it as acceptable for qualitative/troubleshooting purposes only. All prepared standards, reference materials, and reagents are verified to meet the requirements of the test method through routine analyses of quality control samples.
- The second source materials used for verification of instrument calibration are obtained from a different manufacturer or different lot from the same manufacturer.
- Procedures to check reference materials for degradation and replacement of material if degradation or evaporation is suspected.
- Procedures for labeling. At a minimum the container must identify the material, the ID of the material and the expiration date. Original containers should also be labeled with date opened.

#### 5.6.4.3 Intermediate Checks

Checks to confirm the calibration status of standards and materials are described in laboratory SOPs. These checks include use of second source standards and reference materials reserved only for the purpose of calibration checks.

#### 5.6.4.4 Transport and Storage

The laboratory handles and transports reference standards and materials in a manner that protects the integrity of the materials. Reference standard and material integrity is protected by separation from incompatible materials and/or minimizing exposure to degrading environments or materials. Standards and reference materials are stored separately from samples, extracts, and digestates. All standards are stored according to the manufacturer's recommended conditions. Temperatures colder than the manufacturer's recommendation are acceptable if it does not compromise the integrity of the material (e.g. remains in liquid state and does not freeze solid). In the

event a standard is made from more than a single source with different storage conditions, the standard will be stored according to the conditions specified in the analytical method.

See the applicable analytical SOPs for specific reference material storage and transport protocols.

## 5.7 Sampling

Sampling refers to the field collection of samples and to subsamples taken by the laboratory for analysis from the field collected sample.

Subsampling procedures are included in each test method SOP or a stand-alone SOP to assure the aliquot used for testing is representative of the field collected sample.

The requirements in the following subsections apply when field sampling is performed by the laboratory.

### 5.7.1 Sampling Plans and SOPs

When the laboratory performs field collection of samples, sampling is carried out in accordance with a written sample plan prepared by the customer or by the laboratory and by relevant sampling SOPs. These documents are made readily accessible at the sampling location. Sampling plans and SOPs are, whenever reasonable, based on appropriate governing methods and addresses the factors to be controlled to ensure the validity of the analytical results.

### 5.7.2 Customer Requested Deviations

When the customer requires deviations, additions, or exclusions from the documented laboratory sampling plan and/or procedure, the laboratory records the client's change request in detail with the sampling record, communicates the change to sampling personnel, and includes this information in the final test report.

### 5.7.3 Recordkeeping

The laboratory assures the sampling record includes the sampling procedure used, any deviations from the procedure, the date and time of sampling, the identification of the sampler, environmental conditions (if relevant), and the sampling location.

## 5.8 Sample Management & Handling

### 5.8.1 Procedures

The laboratory's procedures for sample management and handling are outlined in laboratory SOP ENV-SOP-PITTS-0027.

The procedures in these SOPs are established to maintain the safe handling and integrity of samples from transport, storage, to disposal and during all processing steps in-between; to maintain client confidentiality, and to protect the interests of PAS and its customers.

#### 5.8.1.1 Chain of Custody

All samples received by the laboratory must be accompanied with a Chain of Custody (COC) record. The COC provides information about the samples collected and

submitted for testing and documents the possession of samples from time of collection to receipt by the laboratory.

The COC record must minimally include the following information:

- Client name, address, phone number
- Project Reference
- Client Sample Identification (Client ID)
- Date, Time, and Location of Sampling
- Samplers Name or Initials
- Matrix
- Type of container, and total number collected each sample
- Preservatives
- Analyses Requested
- Mode of collection
- Any special instructions
- The date and time and signature of each sample transfer from time of collection to receipt in the laboratory. When the COC is transported inside the cooler, independent couriers do not sign the COC. Shipping manifests and/or air bills are the records of possession during transport.

A complete and legible COC is required. If the laboratory observes that the COC is incomplete or illegible, the client is contacted for resolution. The COC must be filled out in indelible ink. Personnel correct errors by drawing a single line through the initial entry so the entry is not obscured, entering the correct information, and initialing, and dating the change.

#### 5.8.1.2 Legal Chain of Custody

Legal chain of custody is a chain of custody protocol used for evidentiary or legal purposes. The protocol is followed by the laboratory when requested by customer or where mandated by a regulatory program.

Legal chain of custody (COC) protocol establishes an intact, continuous record of the physical possession*, storage, and disposal of "samples" which includes, sample aliquots, and sample extracts/digestates/distillates.

Legal COC records account for all time periods associated with the samples, and identifies all individuals who physically handled individual samples. Legal COC begins at the point established by legal authority, which is usually at the time the sample containers are provided by the laboratory for sample collect or when sample collection begins.

*A sample is in someone's custody if:

- It is in one's physical possession;

- It is in one's view after being in one's physical possession;
- It has been in one's physical possession and then locked or sealed so that no one can tamper with it; and/or
- It is kept in a secure area, restricted to authorized personnel only.

Refer to laboratory SOP ENV-SOP-PITTS-0028 for more information.

### 5.8.2 Unique Identification

Each sample is assigned a unique identification number by the laboratory (Lab ID) after the sample has been checked and accepted by the laboratory in accordance with the laboratory's sample acceptance policy (See 5.8.3). The Lab ID is affixed to the sample container using a durable label.

The unique identification of samples also applies to subsamples, and prepared samples, such as extracts, digestates, etc.

The lab ID is linked to the field ID (client ID) in the laboratory's record. Both IDs are linked to the testing activities performed on the sample and the documentation records of the test.

Also see 5.8.4.

### 5.8.3 Sample Receipt Checks and Sample Acceptance Policy

The laboratory checks the condition and integrity of samples on receipt and compares the labels on the sample containers to the COC record. Any problem or discrepancy is recorded. If the problem impacts the suitability of the sample for analysis or if the documentation is incomplete, the client is notified for resolution. Decisions and instructions from the client are maintained in the project record.

#### 5.8.3.1 Sample Receipt Checks

The following checks are performed:

- Verification that the COC is complete and legible.
- Verification that each sample's container label includes the client sample ID, the date and time of collection and the preservative in indelible ink.
- The container type and preservative is appropriate for each test requested.
- Adequate volume is received for each test requested.
- Visual inspection for damage or evidence of tampering.
- Visual inspection for presence of headspace in VOA vials. (VOA = volatile organic analysis).
- Thermal Preservation: For chemical testing methods for which thermal preservation is required, temperature on receipt is acceptable if the measurement is above freezing but <6°C. For samples that are hand-delivered to the laboratory immediately after sample collection, there must be evidence that the chilling process has begun, such as arrival on ice. The requirements for thermal preservation vary based on the scope of testing performed. For example, for

microbiology, temperature on receipt is acceptable if the measurement is <10°C. Refer to the laboratory's SOP for sample receipt for more information.

- Chemical Preservation
- Holding Time: Sample receiving personnel are trained to recognize tests with tests where the holding time is 48 hours or less and to expedite the log-in of these samples. Except for tests with immediate holding times (15 minutes from time of collection or less), when samples are received out of hold, the laboratory will notify the client and request instruction. If the decision is made to proceed with analysis, the final test report will include notation of this instruction.

#### 5.8.3.2 Sample Acceptance Policy

The laboratory maintains a sample acceptance policy in accordance with regulatory guidelines to clearly establish the circumstances in which sample receipt is accepted or rejected. When receipt does not meet acceptance criteria for any one of these conditions, the laboratory must document the noncompliance, contact the customer, and either reject the samples or fully document any decisions to proceed with testing. In accordance with regulatory specifications, test results associated with receipt conditions that do not meet criteria are qualified in the final test report.

All samples received must meet each of the following:

- Be listed on a complete and legible COC.
- Be received in properly labeled sample containers.
- Be received in appropriate containers that identify preservative.
- The COC must include the date and time of collection for each sample.
- The COC must include the test requested for each sample.
- Be in appropriate sample containers with clear documentation of the preservatives used.
- Be received within holding time. Any samples received beyond the holding time will not be processed without prior customer approval.
- Have sufficient sample volume to proceed with the analytical testing. If insufficient sample volume is received, analysis will not proceed without customer approval.
- Be received within appropriate temperature ranges (not frozen but ≤6°C) unless program requirements or customer contractual obligations mandate otherwise. The cooler temperature is recorded directly on the COC. Samples that are delivered to the laboratory immediately after collection are considered acceptable if there is evidence that the chilling process has been started. For example, by the arrival of the samples on ice. If samples arrive that are not compliant with these temperature requirements, the customer will be notified. The analysis will NOT proceed unless otherwise directed by the customer. If less than 72 hours remain in the hold time for the analysis, the analysis may be started while the customer

is contacted to avoid missing the hold time. Data associated with any deviations from the above sample acceptance policy requirements will be appropriately qualified.

### 5.8.4 Sample Control and Tracking

The samples are controlled and tracked using the Laboratory Information Management System (LIMS). The LIMS stores information about the samples and project. The process of entering information into the LIMS is called login and these procedures are described in laboratory SOP ENV-SOP-PITTS-0033. After log-in, a label is generated and affixed to each sample container. Information on this label, such as the lab ID, links the sample container to the information in LIMS.

At a minimum, the following information is entered during log-in:

- Client Name and Contact Information;
- The laboratory ID linked to the client ID;
- Date and time of sample collection;
- Date and time of sample receipt;
- Matrix;
- Tests Requested.

### 5.8.5 Sample Storage, Handling, and Disposal

The laboratory procedures for sample storage, handling and disposal are detailed in laboratory SOPs ENV-SOP-PITTS-0027 and ENV-SOP-PITTS-0023.

#### 5.8.5.1 Sample Storage

The samples are stored according to method and regulatory requirements as per test method SOPs. Samples are stored away from all standards, reagents, or other potential sources of contamination and stored in a manner that prevents cross contamination. Volatile samples are stored separately from other samples. All sample fractions, extracts, leachates, and other sample preparation products are stored in the same manner as actual samples or as specified by the analytical method.

Refrigerated storage areas are maintained at ≤6°C (but not frozen) and freezer storage areas are maintained at <-10°C (unless otherwise required per method or program). The temperature of each storage area is checked and documented at least once for each day of use. If the temperature falls outside the acceptable limits, then corrective actions are taken and appropriately documented.

The laboratory is operated under controlled access protocols to ensure sample and data integrity. Visitors must register at the front desk and be properly escorted at all times. Samples are taken to the appropriate storage location immediately after sample receipt and login procedures are completed. All sample storage areas have limited access. Samples are removed from storage areas by designated personnel and returned to the storage areas as soon as possible after the required sample quantity has been taken.

#### 5.8.5.2 Sample Retention and Disposal

The procedures used by the laboratory for sample retention and disposal are detailed in laboratory SOP ENV-SOP-PITTS-0023.

In general, unused sample volume and prepared samples such as extracts, digestates, distillates and leachates (samples) are retained by the laboratory for the period of time necessary to protect the interests of the laboratory and the customer.

Samples may be stored at ambient temperature when all analyses are complete, the hold time is expired, the report has been delivered, and/or when allowed by the customer or program. Samples requiring storage beyond the minimum sample retention time due to special requests or contractual obligations may be stored at ambient temperature unless the laboratory has sufficient capacity and their presence does not compromise the integrity of other samples.

After this period expires, non-hazardous samples are properly disposed of as non-hazardous waste. The preferred method for disposition of hazardous samples is to return the excess sample to the customer.

## 5.9 Assuring the Quality of Test Results

### 5.9.1 Quality Control (QC) Procedures

The laboratory monitors the validity and reliability of test results using quality control (QC) samples that are prepared and analyzed concurrently with field samples in the same manner as field samples. QC results are always associated to and reported with the field samples they were prepared and analyzed with from the same preparation or analytical batch. See the glossary for definition of preparation and analytical batch.

The results of QC performed during the testing process are used by the laboratory to assure the results of analysis are consistent, comparable, accurate, and/or precise within a specified limit. When the results are not within acceptance criteria or expectations for method performance, correction and corrective action(s) are taken. These actions may include retesting or reporting of data with qualification to alert the end user of the situation.

Other QC measures performed include the use of certified reference materials (see 5.6.2), participation in interlaboratory proficiency testing (see 5.9.1.1), verification that formulae used for reduction of data and calculation of results is accurate (see 5.9.3), on-going monitoring of environmental conditions that could impact test results (see 5.3.2), and evaluation and verification of method selectivity and sensitivity (see 5.4.5).

QC results are also used by the laboratory to monitor performance statistical trends over time and to establish acceptance criteria when no method or regulatory criteria exist. (see 5.9.1.4).

#### 5.9.1.1 Essential QC

Although the general principles of QC for the testing process apply to all testing, the QC protocol used for each test depends on the type of test performed.

QC protocol used by the laboratory to monitor the validity of the test are specified in test method SOPs. The SOP includes QC type, frequency, acceptance criteria, corrective actions, and procedures for reporting of nonconforming work.

These requirements in the SOP conform to the reference method and any applicable regulations or certification and accreditation program requirement for which results of the test are used. When a project requires more stringent QC protocol than specified in the SOP, project specification is followed. When the project requires less stringent QC protocol, the project specification may be followed as an authorized departure from the SOP when the project specifications meet the requirements in the mandated method and any regulatory compliance requirements for which the data will be used.

The following are examples of essential QC for Chemistry:

#### 5.9.1.1.1 Second Source Standard (ICV/QCS)

The second source standard is a standard obtained from a different vendor than the vendor of the standards used for calibration. It is a positive control used to verify the accuracy of a new calibration relative to the purity of the standards used for calibration. This check is referred to in test method and quality system standards as the initial calibration verification (ICV) or quality control sample (QCS). The second source standard is analyzed immediately after the calibration and before analysis of any samples. When the ICV is not within acceptance criteria, a problem with the purity or preparation of the standards may be indicated.

#### 5.9.1.1.2 Continuing Calibration Verification (CCV)

CCV is to determine if the analytical response has significantly changed since initial calibration. If the response of the CCV is within criteria, the calibration is considered valid. If not, there is a problem that requires further investigation. Actions taken are technology and method specific.

#### 5.9.1.1.3 Method Blank (MB) / Other Blanks

A method blank is a negative control used to assess for contamination during the prep/analysis process. The MB consists of a clean matrix, similar to the associated samples that is known to be free of analytes of interest. The MB is processed with and carried through all preparation and analytical steps as the associated samples.

In general, contamination is suspected when the target analyte is detected in the MB above the reporting limit. Some programs may require evaluation of the MB to ½ the reporting limit or the detection limit. When contamination is evident, the source is investigated and corrections are taken to reduce or eliminate it. Analytical results associated with MB that does not meet criteria are qualified in the final test report.

Other types of blanks that serve as negative controls in the process may include:

- Trip Blanks (VOA)
- Storage Blanks
- Equipment Blanks
- Field Blanks
- Calibration Blanks
- Cleanup Blanks
- Instrument Blanks

#### 5.9.1.1.4 Laboratory Control Sample (LCS)

The LCS is positive control used to measure the accuracy of process in a blank matrix. The LCS is spiked by the laboratory with a known amount of analyte. The spike is a standard solution that is pre-made or prepared from a certified reference standard. The LCS is processed with and carried through all preparation and analytical steps as the associated samples.

When the percent recovery (%R) of the LCS is within the established control limit, sufficient accuracy has been achieved. If not, the source of the problem is investigated and corrected and the procedure may be repeated. Analytical results associated with LCS that does not meet criteria are qualified in the final test report.

#### 5.9.1.1.5 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)

Matrix spikes measures the effect the sample matrix has on precision and accuracy of the determinative test method. The MS and MSD are replicates of a client sample that is spiked with known amount of target analyte.

Due to the heterogeneity of matrices even of the same general matrix type, matrix spike results mostly provide information on the effect of the matrix to the client whose sample was used and on samples of the same matrix from the same sampling site. Therefore, MS should be client-specific when the impact of matrix on accuracy and precision is a project data quality objective. When there is not a client-specified MS for any sample in the batch, the laboratory randomly selects a sample from the batch; the sample selected at random is called a "batch" matrix spike.

The MS/MSD results for percent recovery and relative percent difference are checked against control limits. Because the performance of matrix spikes is matrix-dependent, the result of the matrix spike is not used to determine the acceptability of the test.

#### 5.9.1.1.6 Sample Duplicate (SD)

A sample duplicate is a second replicate of sample that is prepared and analyzed in the laboratory along another replicate. The SD is used to measure precision.

The relative percent difference between replicates are evaluated against the method or laboratory derived criteria for relative percent difference (RPD), when this criterion is applicable. If RPD is not met, associated test results are reported with qualification.

#### 5.9.1.1.7 Surrogates

Surrogates are compounds that mimic the chemistry of target analytes but are not expected to occur naturally in real world samples. Surrogates are added to each sample and matrix QC samples (MS, MSD, SD) at known concentration to measure the impact of the matrix on the accuracy of method performance. Surrogates are also added to the positive and negative control samples (MB, LCS) to evaluate performance in a clean matrix, and included in the calibration standards and calibration check standards.

The percent recovery of surrogates is evaluated against method-specified limits or statistically derived in-house limits. Project-specific limits and/or program-specific limits are used when required. Results with surrogate recovery out of limits in samples are reported with qualification. Samples with surrogate failures can also be re-extracted and/or re-analyzed to confirm that the out-of-control value was caused by the matrix of the sample and not by some other systematic error.

#### 5.9.1.1.8 Internal Standards

Internal Standards are compounds not expected to occur naturally in field samples. They are added to every standard and sample at a known concentration prior to analysis for the purpose of adjusting the response factor used in quantifying target analytes. The laboratory follows specific guidelines for the treatment of internal standard recoveries and further information can be found in the applicable laboratory SOP.

#### 5.9.1.1.9 QC Acceptance Criteria and Control Limits

The QC acceptance criteria are specified in test method SOPs. The criteria in the SOP are based on the requirements in the published test method or regulatory program. When there are no established acceptance criteria, the laboratory develops acceptance criteria in accordance with recognized industry standards.

Some methods and programs require the laboratory to develop and use control limits for LCS, MS/MSD and surrogate evaluation. In laboratory developed limits are referred to as "in-house" control limits. In-house control limits represent ± 3 Standard Deviations (99% confidence level) from the average recovery of at least 20 data points generated using the same preparation and analytical procedure in a similar matrix.

#### 5.9.1.2 Proficiency Testing (PT)

The laboratory participates in interlaboratory proficiency testing (PT) studies to measure performance of the test method and to identify or solve analytical problems. PT samples measure laboratory performance through the analysis of unknown samples provided by an external source.

The PT samples are obtained from accredited proficiency testing providers (PTP) and handled as field samples which means they are included in the laboratory's normal analytical processes and do not receive extraordinary attention due to their nature.

The laboratory does not share PT samples with other laboratories, does not communicate with other laboratories regarding current PT sample results during the duration of the study, and does not attempt to obtain the assigned value of any PT sample from the PT provider.

The laboratory initiates an investigation and corrective action plan whenever PT results are deemed unacceptable by the PT provider.

The frequency of PT participation is based on the certification and accreditation requirements held by the laboratory.

### 5.9.2 QC Corrective Action

When the results of QC are not within acceptance criteria or expectations for method performance, correction and corrective action(s) are taken per the specifications in the test method SOP. These actions may include retesting or reporting of data with qualification to alert the end user of the situation.

### 5.9.3 Data Review

The laboratory uses a tiered system for data review. The tiered process provides sequential checks to verify data transfer is complete; manual calculations, if performed, are correct, manual integrations are appropriate and documented, calibration and QC requirements are met, appropriate corrective action was taken when required, test results are properly qualified, process and test method SOPs were followed, project specific requirements were met, when applicable, and the test report is complete.

The sequential process includes three tiers referred to as primary review, secondary review, and administrative/completeness review.

Detailed procedures for the data review process are described in laboratory SOP ENV-SOP-PITTS-0003. The general expectations for the tiered review process are described in the following sections:

#### 5.9.3.1 Primary Review

Primary review is performed by the individual that performed the task. All laboratory personnel are responsible for review of their work product to assure it is complete, accurate, documented, and consistent with policy and SOPs.

Checks performed during primary review include but are not limited to:

- Verification that data transfer and acquisition is complete

- Manual calculations, if performed, are documented and accurate
- Manual integrations, if performed, are documented and comply with SOP ENV-SOP-CORQ-006 *Manual Integration*
- Calibration and QC criteria were met, and/or proper correction and corrective actions were taken, and data and test results associated with QC and criteria exceptions are properly qualified
- Work is consistent with SOPs and any other relevant instructional document such as SWI, program requirements, or project QAPP.

#### 5.9.3.2 Secondary Review

Secondary review is performed by qualified peer or supervisor. Secondary review is essentially a repeat of the checks performed during primary review by another person. In addition to the checks of primary review, secondary review includes chromatography review to check the accuracy of quantitative analyte identification.

#### 5.9.3.3 Completeness Review

Completeness review is an administrative review performed prior to release of the test report to the customer. Completeness review verifies that the final test report is complete and meets project specification. This review also assures that information necessary for the client's interpretation of results are explained in the case narrative or footnoted in the test report.

#### 5.9.3.4 Data Audits

In addition to the 3 tier data review process, test reports may be audited by local QA to verify compliance with SOPs and to check for data integrity, technical accuracy, and regulatory compliance. These audits are not usually done prior to issuance of the test report to the customer. The reports chosen for the data audits are selected at random.

If any problems with the data or test results are found during the data audit, the impact of the nonconforming work is evaluated using the process described in Section 4.9.

Also see Section 4.14 for internal audits.

## 5.10 Reporting

### 5.10.1 General Requirements

The laboratory reports results of testing in a way that assures the results are clear, and unambiguous. All data and results are reviewed prior to reporting to assure the results reported are accurate and complete.

Test results are summarized in test reports that include all information necessary for the customer's interpretation of the test results. Additional information necessary to clarify the data or disclose nonconformance, exceptions, or deviations that occurred during the analytical process are also reported to the customer in the test report.

The specifications for test reports and electronic data deliverables (EDD) are established between the laboratory and the customer at the time the request for analytical services is initiated. The report specifications include the test report format, protocol for the reporting limit (RL), conventions for the reporting of results less than the limit of quantitation (LOQ), and specification for the use of project or program specific data qualifiers. Information about review of analytical service requests is provided in Section 4.4.

### 5.10.2 Test Reports: Required Items

Test Reports are prepared by the laboratory at the end of the testing process. The format of the report depends on the level of reporting requested by the customer. The laboratory offers a variety of standardized test report formats and can also provide custom test report formats, when necessary.

The level of detail required in the test report depends on the customer's needs for data verification, validation, and usability assessments that occur after the laboratory releases the test report to the customer. The test report formats offered by the laboratory provide gradient levels of detail to meet the unique needs of each customer. The laboratory project manager helps the customer select the test report format that best meets their needs. When a specific report format or protocol is required for a regulatory or program compliance, the laboratory project manager must ensure the test report selected meets those requirements.

Every test report issued by the laboratory includes each of the following items:

a) Title

b) Name and phone number of a point of contact from the laboratory issuing the report.

c) Name and address of the laboratory where testing was performed. When testing is done at multiple locations within network (IRWO), the report must clearly identify which network laboratory performed each test and must include the physical address of each laboratory.

d) Unique identification of the test report and an identifier on each page of the report to link each page to the test report and clear identification of the end of the report.

e) The name and address of the customer

f) Identification of test methods used

g) Cross reference between client sample identification number (Sample ID) and the laboratory's identification number for the sample (Lab ID) to provide unambiguous identification of samples.

h) The date of receipt of samples, condition of samples on receipt, and identification of any instance where receipt of the samples did not meet sample acceptance criteria.

i) Date and times of sample collection, receipt, preparation, and analysis.

j) Test results and units of measurement, and qualification of results associated with QC criteria exceptions, and identification of reported results outside of the calibration range.

k) Name, title, signature of the person(s) authorizing release of the test report and date of release.

l) A statement that the results in the test report relate only to the items tested.

m) Statement that the test report may not be reproduced except in full without written approval from the laboratory.

### 5.10.3 Test Reports: Supplemental Items

#### 5.10.3.1 Supplemental Requirements

The following items are included in the test report when required or relevant:

a) Explanation of departure from test method SOPs including, what the departure was and why it was necessary.

b) Statistical methods used. (Required for Whole Effluent Toxicity)

c) For solid samples, specification that results are reported on a dry weight or wet weight basis.

d) Signed Affidavit, when required by client or regulatory agency.

e) A statement of compliance / non-compliance with requirements or specifications (client, program, or standard) that includes identification of test results that did not meet acceptance criteria.

f) When requested by the client, statement of estimated measurement uncertainty. In general, for environmental testing, estimated uncertainty of measurement is extrapolated from LCS control limits. Control limits incorporate the expected variation of the data derived from the laboratory's procedure. When the control limits are specified by the test method or regulatory program, the control limits represent the expected variation of the test method and/or matrices for which the test method was designed.

g) Opinions and Interpretations.

h) If a claim of accreditation/certification is included in the test report, identification of any test methods or analytes for which accreditation/certification is not held by the laboratory if the accrediting body offers accreditation/certification for the test method/analyte. The fields of accreditation/certification vary between agencies and it cannot be presumed that because accreditation/certification is not held that it is offered or required.

i) Certification Information, including certificate number and issuing body.

#### 5.10.3.2 Test Reports: Sampling Information

The following items are included in the test report when samples are collected by the laboratory or when this information is necessary for the interpretation of test results:

a) Date of Sampling.

b) Unambiguous identification of material samples.

c) Location of sampling including and diagrams, sketches, or photographs.

d) Reference to the sampling plan and procedures used.

e) Details of environmental conditions at time of sample that may impact test results.

f) Any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned.

### 5.10.4 Calibration Certificates

The laboratory does not perform calibration activities for its customers and calibration certificates are not offered or issued.

### 5.10.5 Opinions and Interpretations

The laboratory provides objective data and information to its customers of sufficient detail for their interpretation and decision making. Objective data and information is based solely on fact and does not attempt to explain the meaning (interpret) or offer a view or judgement (opinion). Sometimes the customer may request the laboratory provide opinion or interpretation to assist them with their decisions about the data.

When opinions and interpretations are included in the test report, the laboratory will document the basis upon which the opinions and interpretations have been made and clearly identify this content as opinion or interpretation in the test report.

Examples of opinion and interpretation include but are not limited to:

- The laboratory's viewpoint on how a nonconformance impacts the quality of the data or usability of results.
- The laboratory's judgment of fulfillment of contractual requirements.
- Recommendations for how the customer should use the test results and information.
- Suggestions or guidance to the customer for improvement.

When opinions or interpretations are verbally discussed with the customer, the content of these conversations is summarized by the laboratory and kept in the project record.

### 5.10.6 Subcontractor Reports

When analytical work has been subcontracted to an organization external to PAS, the test report from the subcontractor is included in its entirety as an amendment to the final test report.

Note: Test results for analytical work performed within the PAS network may be are merged into a single test report. The test report issued clearly identifies the location and address of each network location that performed testing and which tests they performed. (See 5.10.2)

### 5.10.7 Electronic Transmission of Results

When test results and/or reports are submitted to the customer through electronic transmission, follow the procedures established in this manual for confidentiality and protection of data.

### 5.10.8 Format of Test Reports

The test formats offered by the laboratory are designed to accommodate each type of analytical test method carried out by the laboratory and to minimize the possibility of misunderstanding or misuse of analytical results. The format of electronic data deliverables (EDD) follow the specifications for the EDD.

### 5.10.9 Amendments to Test Reports

Test reports that are revised or amended by the laboratory after date of release of the final test report to the customer are issued as a new test report that is clearly identified as an amendment or revision and that includes a reference to the originally issued final test report.

The customer is the organization doing business with PAS external to PAS.

Changes made to test results and data before the final test report is issued to the customer are not amendments or revisions, these are corrections to errors found during the laboratory's data verification and review process,

The laboratory's procedure for report amendments and revision are outlined in laboratory SOP ENV-SOP-PITTS-0033.

## 6.0 REVISION HISTORY

This Version: ENV-MAN-PITTS-0001 Rev 01

| Section | Description of Change |
|---|---|
| All | This version is a complete rewrite of the document this version supersedes. |

This document supersedes the following documents:

| Document Number | Title | Version |
|---|---|---|
| ENV-MAN-PITTS-0001 | Quality Manual | 00 |

# 7.0 APPENDICES

## 7.1 Appendix A: Certification / Accreditation Listing

The certifications / accreditation lists provided in this manual represent those that were held by the named location on the effective date of this manual. This information is subject to change without notice and must not be considered valid proof of certification or accreditation status. Current certificates are maintained by Local QA and a copy of the certificate is posted to PAS's eDMS Portal for access by all PAS employees. External parties should contact the laboratory for the most current information.

### 7.1.1 PAS-Pittsburgh

| Authority | Certificate Number |
|---|---|
| Pennsylvania | 02-00538 |
| Connecticut | PH-0263 |
| Virginia | 8122 |
| New Hampshire | 299415 |
| New Jersey | PA026 |
| New York | 11815 |
| South Carolina | 89009003 |
| Texas | T104704453 |
| West Virginia | 395 |

## 7.2 Appendix B: Capability Listing

The capabilities listed in this Appendix were held by the location referenced on the effective date of this manual. This information is subject to change without notice. External parties should contact the laboratory for the most current information.

Table Legend:

- DW = Drinking Water
- NPW = Non-Potable Water
- SCM = Solid and Chemical Materials
- Waste = Non-Aqueous Phase Liquid (NAPL), Oil
- Tissue = Biota and Tissue

### 7.2.1 PAS-Pittsburgh

| Parameter | Method | Matrices | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Air | DW | NPW | SCM | Waste | Tissue | Product | |
| Anions by IC | 9056 | | | x | | | | | |
| Cations by IC | Dionex Tech Note 10 | | | x | x | | | | |
| TOC | 9060 and 5310C | | | x | | | | | |
| pH | SM4500 H+B | | | x | | | | | |
| Low Level Volatile Fatty Acids | AM23G | | | x | x | | | | |
| VOC's in Vapor | AM4.02 | x | | | | | | | |
| Organic Compunds in Vapor (Light hydrocarbons, Chlorinated volatiles, GRO, DRO) | AM4.02 | x | | | | | | | |
| Hydrogen by Bubble Strip | SM9/AM20GAx | x | | | | | | | |
| Light Hydrocarbons by Bubble Strip | SM9/AM20GAx | | | x | | | | | |
| Methane, Ethane, Ethene, Propane, Propene, iso-Butane, n-Butane, Acetylene | PM01/AM20GAx | | | x | | | | | |
| Methane, Ethane, Ethene, Propane, Propene, iso-Butane, n-Butane | RSK175M | | | x | | | | | |
| Permanent Gases (Oxygen, Nitrogen, Carbon Dioxide, Carbon Monoxide) | PM01/AM20GAx | | | x | | | | | |
| Permanent Gases by Bubble Strip | PM01/AM20GAx | x | | | | | | | |
| Permanent Gases in Vapor | SM9/AM20GAx | x | | | | | | | |
| TIC | PM01/AM20GAx | | | x | | | | | |
| Whole Oil (C3-C36) | ASTM D3328 | | | | | | | x | |
| Full Scan (C8-C40) | ASTM D5739 (GC/MS) | | | x | x | | | x | |

| Parameter | Method | Matrices | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Air | DW | NPW | SCM | Waste | Tissue | Product | |
| Organic Lead and Lead Scavengers | GC-ECD | | | | | | | x | |
| PIANO (C3-C12) | GC/MS | | | x | x | | | x | |
| Carbon Specific Isotope Analysis (CSIA) | AM24 | | | x | | | | | |
| Methane, Ethane, Ethene, Propane, iso-Butane, n-Butane | ASTM D8028 | | | x | | | | | |
| Parent and Alkylated PAHs | 8270 Modified | | | X | | | | x | |
| Oxygenated Blending Agents | EPA 1624 Modified | | | | | | | x | |
| Oxygenates on Product (GC/MS SIM) | 1625 Modified | | | | | | | x | |

## 7.3 Appendix C: Glossary

This glossary provides common terms and definitions used in the laboratory. **It is not intended to be a complete list of all terms and definitions used.** The definitions have been compiled mostly from the TNI Standard and DoD QSM. Although this information has been reproduced with care, errors cannot be entirely excluded. Definitions for the same term also vary between sources. When the meaning of a term used in a laboratory document is different from this glossary or when the glossary does not include the term, the term and definition is included or defined in context in the laboratory document.

| Term | Definition |
|---|---|
| 3P Program | PAS-The continuous improvement program used by PAS that focuses on Process, Productivity, and Performance. |
| Acceptance Criteria | TNI- Specified limits placed on characteristics of an item, process, or service defined in requirement documents. |
| Accreditation | TNI- The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.<br>DoD- Refers to accreditation in accordance with the DoD ELAP. |
| Accreditation Body (AB) | TNI- The organization having responsibility and accountability for environmental laboratory accreditation and which grants accreditation under this program.<br>DoD- Entities recognized in accordance with the DoD-ELAP that are required to operate in accordance with ISO/IEC 17011, *Conformity assessment: General requirements for accreditation bodies accrediting conformity assessment bodies.* The AB must be a signatory, in good standing, to the International Laboratory Accreditation Cooperation (ILAC) mutual recognition arrangement (MRA) that verifies, by evaluation and peer assessment, that its signatory members are in full compliance with ISO/IEC 17011 and that its accredited laboratories comply with ISO/IEC 17025. |
| Accuracy | TNI- The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator. |
| Activity, Absolute | TNI- Rate of nuclear decay occurring in a body of material, equal to the number of nuclear disintegrations per unit time. NOTE: Activity (absolute) may be expressed in becquerels (Bq), curies (Ci), or disintegrations per minute (dpm), and multiples or submultiples of these units. |
| Activity, Areic | TNI- Quotient of the activity of a body of material and its associated area. |
| Activity, Massic | TNI- Quotient of the activity of a body of material and its mass; also called specific activity. |
| Activity, Volumic | TNI- Quotient of the activity of a body of material and its volume; also called activity concentration. NOTE: In this module [TNI Volume 1, Module 6], unless otherwise stated, references to activity shall include absolute activity, areic activity, massic activity, and volumic activity. |
| Activity Reference Date | TNI- The date (and time, as appropriate to the half-life of the radionuclide) to which a reported activity result is calculated. NOTE: The sample collection date is most frequently used as the Activity Reference Date for environmental measurements, but different programs may specify other points in time for correction of results for decay and ingrowth. |
| Aliquot | DoD- A discrete, measured, representative portion of a sample taken for analysis. |
| American Society for Testing and Materials (ASTM) | An international standards organization that develops and publishes voluntary consensus standards for a wide range of materials, products, systems and services. |
| Analysis | DoD- A combination of sample preparation and instrument determination. |
| Analysis Code (Acode) | All the set parameters of a test, such as Analytes, Method, Detection Limits and Price. |
| Analysis Sequence | A compilation of all samples, standards and quality control samples run during a specific amount of time on a particular instrument in the order they are analyzed. |
| Analyst | TNI- The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. |

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| Analyte | TNI- A substance, organism, physical parameter, property, or chemical constituent(s) for which an environmental sample is being analyzed.<br>DoD- The specific chemicals or components for which a sample is analyzed; it may be a group of chemicals that belong to the same chemical family and are analyzed together. |
| Analytical Method | DoD- A formal process that identifies and quantifies the chemical components of interest (target analytes) in a sample. |
| Analytical Uncertainty | TNI- A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. |
| Aliquot | DoD- A discrete, measured, representative portion of a sample taken for analysis. |
| Annual (or Annually) | Defined by PAS as every 12 months ± 30 days. |
| Assessment | TNI - The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its system to defined criteria (to the standards and requirements of laboratory accreditation).<br>DoD- An all-inclusive term used to denote any of the following: audit, performance evaluation, peer review, inspection, or surveillance conducted on-site. |
| Atomic Absorption Spectrometer | Instrument used to measure concentration in metals samples. |
| Atomization | A process in which a sample is converted to free atoms. |
| Audit | TNI- A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. |
| Batch | TNI- Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same quality systems matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours or the time-frame specified by the regulatory program. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed 20 samples. |
| Batch, Radiation Measurements (RMB) | TNI- An RMB is composed of 1 to 20 environmental samples that are counted directly without preliminary physical or chemical processing that affects the outcome of the test (e.g., non-destructive gamma spectrometry, alpha/beta counting of air filters, or swipes on gas proportional detectors). The samples in an RMB share similar physical and chemical parameter, and analytical configurations (e.g., analytes, geometry, calibration, and background corrections). The maximum time between the start of processing of the first and last in an RMB is 14 calendar days. |
| Bias | TNI- The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). |
| Blank | TNI and DoD- A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results (See Method Blank).<br>DoD- Blank samples are negative control samples, which typically include field blank samples (e.g., trip blank, equipment (rinsate) blank, and temperature blank) and laboratory blank samples (e.g., method blank, reagent blank, instrument blank, calibration blank, and storage blank). |
| Blind Sample | A sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process. |
| BNA (Base Neutral Acid compounds) | A list of semi-volatile compounds typically analyzed by mass spectrometry methods. Named for the way they can be extracted out of environmental samples in an acidic, basic or neutral environment. |
| BOD (Biochemical Oxygen Demand) | Chemical procedure for determining how fast biological organisms use up oxygen in a body of water. |

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| Calibration | TNI- A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. 1) In calibration of support equipment, the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI); 2) In calibration according to test methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications. |
| Calibration Curve | TNI- The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. |
| Calibration Method | A defined technical procedure for performing a calibration. |
| Calibration Range | DoD- The range of values (concentrations) between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low-level calibration check standard and the high standard establish the linear calibration range, which lies within the linear dynamic range. |
| Calibration Standard | TNI- A substance or reference material used for calibration. |
| Certified Reference Material (CRM) | TNI- Reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. |
| Chain of Custody | An unbroken trail of accountability that verifies the physical security of samples, data, and records. |
| Chain of Custody Form (COC) | TNI- Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and type of containers; the mode of collection, the collector, time of collection; preservation; and requested analyses. |
| Chemical Oxygen Demand (COD) | A test commonly used to indirectly measure the amount of organic compounds in water. |
| Client (referred to by ISO as Customer) | Any individual or organization for whom items or services are furnished or work performed in response to defined requirements and expectations. |
| Code of Federal Regulations (CFR) | A codification of the general and permanent rules published in the Federal Register by agencies of the federal government. |
| Comparability | An assessment of the confidence with which one data set can be compared to another. Comparable data are produced through the use of standardized procedures and techniques. |
| Completeness | The percent of valid data obtained from a measurement system compared to the amount of valid data expected under normal conditions. The equation for completeness is:<br><br>% Completeness = (Valid Data Points/Expected Data Points)*100 |
| Confirmation | TNI- Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: second-column confirmation; alternate wavelength; derivatization; mass spectral interpretation; alternative detectors; or additional cleanup procedures.<br>DoD- Includes verification of the identity and quantity of the analyte being measured by another means (e.g., by another determinative method, technology, or column). Additional cleanup procedures alone are not considered confirmation techniques. |
| Conformance | An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. |
| Congener | A member of a class of related chemical compounds (e.g., PCBs, PCDDs). |
| Consensus Standard | DoD- A standard established by a group representing a cross-section of a particular industry or trade, or a part thereof. |
| Continuing Calibration Blank (CCB) | A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method. |
| Continuing Calibration Check Compounds (CCC) | Compounds listed in mass spectrometry methods that are used to evaluate an instrument calibration from the standpoint of the integrity of the system. High variability would suggest leaks or active sites on the instrument column. |
| Continuing Calibration Verification | DoD- The verification of the initial calibration. Required prior to sample analysis and at periodic intervals. Continuing calibration verification applies to both external and internal standard calibration techniques, as well as to linear and non-linear calibration models. |
| Continuing Calibration Verification (CCV) Standard | Also referred to as a Calibration Verification Standard (CVS) in some methods, it is a standard used to verify the initial calibration of compounds in an analytical method. CCVs are analyzed at a frequency determined by the analytical method. |

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| Continuous Emission Monitor (CEM) | A flue gas analyzer designed for fixed use in checking for environmental pollutants. |
| Continuous Improvement Plan (CIP) | The delineation of tasks for a given laboratory department or committee to achieve the goals of that department. |
| Contract Laboratory Program (CLP) | A national network of EPA personnel, commercial labs, and support contractors whose fundamental mission is to provide data of known and documented quality. |
| Contract Required Detection Limit (CRDL) | Detection limit that is required for EPA Contract Laboratory Program (CLP) contracts. |
| Contract Required Quantitation Limit (CRQL) | Quantitation limit (reporting limit) that is required for EPA Contract Laboratory Program (CLP) contracts. |
| Control Chart | A graphic representation of a series of test results, together with limits within which results are expected when the system is in a state of statistical control (see definition for Control Limit) |
| Control Limit | A range within which specified measurement results must fall to verify that the analytical system is in control. Control limit exceedances may require corrective action or require investigation and flagging of non-conforming data. |
| Correction | DoD- Action taken to eliminate a detected non-conformity. |
| Corrective Action | DoD- The action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence. A root cause analysis may not be necessary in all cases. |
| Corrective and Preventative Action (CAPA) | The primary management tools for bringing improvements to the quality system, to the management of the quality system's collective processes, and to the products or services delivered which are an output of established systems and processes. |
| Critical Value | TNI- Value to which a measurement result is compared to make a detection decision (also known as critical level or decision level). NOTE: The Critical Value is designed to give a specified low probability $\alpha$ of false detection in an analyte-free sample, which implies that a result that exceeds the Critical Value, gives high confidence $(1 - \alpha)$ that the radionuclide is actually present in the material analyzed. For radiometric methods, $\alpha$ is often set at 0.05. |
| Customer | DoD- Any individual or organization for which products or services are furnished or work performed in response to defined requirements and expectations. |
| Data Integrity | TNI- The condition that exists when data are sound, correct, and complete, and accurately reflect activities and requirements. |
| Data Quality Objective (DQO) | Systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use or end user. |
| Data Reduction | TNI- The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more usable form. |
| Definitive Data | DoD- Analytical data of known quantity and quality. The levels of data quality on precision and bias meet the requirements for the decision to be made. Data that is suitable for final decision-making. |
| Demonstration of Capability (DOC) | TNI- A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision.<br>DoD- A procedure to establish the ability of the analyst to generate analytical results by a specific method that meet measurement quality objectives (e.g., for precision and bias). |
| Department of Defense (DoD) | An executive branch department of the federal government of the United States charged with coordinating and supervising all agencies and functions of the government concerned directly with national security. |
| Detection Limit (DL) | DoD- The smallest analyte concentration that can be demonstrated to be different than zero or a blank concentration with 99% confidence. At the DL, the false positive rate (Type 1 error) is 1%. A DL may be used as the lowest concentration for reliably reporting a detection of a specific analyte in a specific matrix with a specific method with 99% confidence. |
| Detection Limit (DL) for Safe Drinking Water Act (SDWA) Compliance | TNI- Laboratories that analyze drinking-water samples for SDWA compliance monitoring must use methods that provide sufficient detection capability to meet the detection limit requirements established in 40 CFR 141. The SDWA DL for radioactivity is defined in 40 CFR Part 141.25.c as the radionuclide concentration, which can be counted with a precision of plus or minus 100% at the 95% confidence level ($1.96\sigma$ where $\sigma$ is the standard deviation of the net counting rate of the sample). |
| Deuterated Monitoring Compounds (DMCs) | DoD- SIM specific surrogates as specified for GC/MS SIM analysis. |
| Diesel Range Organics (DRO) | A range of compounds that denote all the characteristic compounds that make up diesel fuel (range can be state or program specific). |

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| Digestion | DoD- A process in which a sample is treated (usually in conjunction with heat and acid) to convert the target analytes in the sample to a more easily measured form. |
| Document Control | The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed. |
| Documents | DoD- Written components of the laboratory management system (e.g., policies, procedures, and instructions). |
| Dry Weight | The weight after drying in an oven at a specified temperature. |
| Duplicate (also known as Replicate or Laboratory Duplicate) | The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results of duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. |
| Electron Capture Detector (ECD) | Device used in GC methods to detect compounds that absorb electrons (e.g., PCB compounds). |
| Electronic Data Deliverable (EDD) | A summary of environmental data (usually in spreadsheet form) which clients request for ease of data review and comparison to historical results. |
| Eluent | A solvent used to carry the components of a mixture through a stationary phase. |
| Elute | To extract, specifically, to remove (absorbed material) from an absorbent by means of a solvent. |
| Elution | A process in which solutes are washed through a stationary phase by movement of a mobile phase. |
| Environmental Data | DoD- Any measurements or information that describe environmental processes, locations, or conditions; ecological or health effects and consequences; or the performance of environmental technology. |
| Environmental Monitoring | The process of measuring or collecting environmental data. |
| Environmental Protection Agency (EPA) | An agency of the federal government of the United States which was created for the purpose of protecting human health and the environment by writing and enforcing regulations based on laws passed by Congress. |
| Environmental Sample | A representative sample of any material (aqueous, non-aqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required. Environmental samples can generally be classified as follows:<br>• Non Potable Water (Includes surface water, ground water, effluents, water treatment chemicals, and TCLP leachates or other extracts)<br>• Drinking Water - Delivered (treated or untreated) water designated as potable water<br>• Water/Wastewater - Raw source waters for public drinking water supplies, ground waters, municipal influents/effluents, and industrial influents/effluents<br>• Sludge - Municipal sludges and industrial sludges.<br>• Soil - Predominately inorganic matter ranging in classification from sands to clays.<br>• Waste - Aqueous and non-aqueous liquid wastes, chemical solids, and industrial liquid and solid wastes |
| Equipment Blank | A sample of analyte-free media used to rinse common sampling equipment to check effectiveness of decontamination procedures. |
| Extracted Internal Standard Analyte | Isotopically labeled analogs of analytes of interest added to all standards, blanks and samples analyzed. Added to samples and batch QC samples prior to the first step of sample extraction and to standards and instrument blanks prior to analysis. Used for isotope dilution methods. |
| Facility | A distinct location within the company that has unique certifications, personnel and waste disposal identifications. |
| False Negative | DoD- A result that fails to identify (detect) an analyte or reporting an analyte to be present at or below a level of interest when the analyte is actually above the level of interest. |
| False Positive | DoD- A result that erroneously identifies (detects) an analyte or reporting an analyte to be present above a level of interest when the analyte is actually present at or below the level of interest. |
| Field Blank | A blank sample prepared in the field by filling a clean container with reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. |
| Field Measurement | Determination of physical, biological, or radiological properties, or chemical constituents that are measured on-site, close in time and sPAS to the matrices being sampled/measured, following accepted test methods. This testing is performed in the field outside of a fixed-laboratory or outside of an enclosed structure that meets the requirements of a mobile laboratory. |
| Field of Accreditation | TNI- Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation. |

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| Field of Proficiency Testing (FoPT) | TNI- Matrix, technology/method, analyte combinations for which the composition, spike concentration ranges and acceptance criteria have been established by the PTPEC. |
| Finding | TNI- An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement.<br>DoD- An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive, negative, or neutral and is normally accompanied by specific examples of the observed condition. The finding must be linked to a specific requirement (e.g., this standard, ISO requirements, analytical methods, contract specifications, or laboratory management systems requirements). |
| Flame Atomic Absorption Spectrometer (FAA) | Instrumentation used to measure the concentration of metals in an environmental sample based on the fact that ground state metals absorb light at different wavelengths. Metals in a solution are converted to the atomic state by use of a flame. |
| Flame Ionization Detector (FID) | A type of gas detector used in GC analysis where samples are passed through a flame which ionizes the sample so that various ions can be measured. |
| Gas Chromatography (GC) | Instrumentation which utilizes a mobile carrier gas to deliver an environmental sample across a stationary phase with the intent to separate compounds out and measure their retention times. |
| Gas Chromatograph/ Mass Spectrometry (GC/MS) | In conjunction with a GC, this instrumentation utilizes a mass spectrometer which measures fragments of compounds and determines their identity by their fragmentation patterns (mass spectra). |
| Gasoline Range Organics (GRO) | A range of compounds that denote all the characteristic compounds that make up gasoline (range can be state or program specific). |
| Graphite Furnace Atomic Absorption Spectrometry (GFAA) | Instrumentation used to measure the concentration of metals in an environmental sample based on the absorption of light at different wavelengths that are characteristic of different analytes. |
| High Pressure Liquid Chromatography (HPLC) | Instrumentation used to separate, identify and quantitate compounds based on retention times which are dependent on interactions between a mobile phase and a stationary phase. |
| Holding Time | TNI- The maximum time that can elapse between two specified activities.<br>40 CFR Part 136- The maximum time that samples may be held prior to preparation and/or analysis as defined by the method and still be considered valid or not compromised.<br>For sample prep purposes, hold times are calculated using the time of the start of the preparation procedure.<br>DoD- The maximum time that may elapse from the time of sampling to the time of preparation or analysis, or from preparation to analysis, as appropriate. |
| Homogeneity | The degree to which a property or substance is uniformly distributed throughout a sample. |
| Homologue | One in a series of organic compounds in which each successive member has one more chemical group in its molecule than the next preceding member. For instance, methanol, ethanol, propanol, butanol, etc., form a homologous series. |
| Improper Actions | DoD- Intentional or unintentional deviations from contract-specified or method-specified analytical practices that have not been authorized by the customer (e.g., DoD or DOE). |
| Incremental Sampling Method (ISM) | Soil preparation for large volume (1 kg or greater) samples. |
| In-Depth Data Monitoring | TNI- When used in the context of data integrity activities, a review and evaluation of documentation related to all aspects of the data generation process that includes items such as preparation, equipment, software, calculations, and quality controls. Such monitoring shall determine if the laboratory uses appropriate data handling, data use and data reduction activities to support the laboratory's data integrity policies and procedures. |
| Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) | Analytical technique used for the detection of trace metals which uses plasma to produce excited atoms that emit radiation of characteristic wavelengths. |
| Inductively Coupled Plasma- Mass Spectrometry (ICP/MS) | An ICP that is used in conjunction with a mass spectrometer so that the instrument is not only capable of detecting trace amounts of metals and non-metals but is also capable of monitoring isotopic speciation for the ions of choice. |
| Infrared Spectrometer (IR) | An instrument that uses infrared light to identify compounds of interest. |

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| Initial Calibration (ICAL) | The process of analyzing standards, prepared at specified concentrations, to define the quantitative response relationship of the instrument to the analytes of interest. Initial calibration is performed whenever the results of a calibration verification standard do not conform to the requirements of the method in use or at a frequency specified in the method. |
| Initial Calibration Blank (ICB) | A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method. This blank is specifically run in conjunction with the Initial Calibration Verification (ICV) where applicable. |
| Initial Calibration Verification (ICV) | DoD- Verifies the initial calibration with a standard obtained or prepared from a source independent of the source of the initial calibration standards to avoid potential bias of the initial calibration. |
| Injection Internal Standard Analyte | Isotopically labeled analogs of analytes of interest (or similar in physiochemical properties to the target analytes but with a distinct response) to be quantitated. Added to all blanks, standards, samples and batch QC after extraction and prior to analysis. |
| Instrument Blank | A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. |
| Instrument Detection Limits (IDLs) | Limits determined by analyzing a series of reagent blank analyses to obtain a calculated concentration. IDLs are determined by calculating the average of the standard deviations of three runs on three non-consecutive days from the analysis of a reagent blank solution with seven consecutive measurements per day. |
| Interference, spectral | Occurs when particulate matter from the atomization scatters incident radiation from the source or when the absorption or emission from an interfering species either overlaps or is so close to the analyte wavelength that resolution becomes impossible. |
| Interference, chemical | Results from the various chemical processes that occur during atomization and later the absorption characteristics of the analyte. |
| Internal Standard | TNI and DoD- A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method. |
| International Organization for Standardization (ISO) | An international standard-setting body composed of representatives from various national standards organizations. |
| Intermediate Standard Solution | Reference solutions prepared by dilution of the stock solutions with an appropriate solvent. |
| International System of Units (SI) | The coherent system of units adopted and recommended by the General Conference on Weights and Measures. |
| Ion Chromatography (IC) | Instrumentation or process that allows the separation of ions and molecules based on the charge properties of the molecules. |
| Isomer | One of two or more compounds, radicals, or ions that contain the same number of atoms of the same element but differ in structural arrangement and properties. For example, hexane (C6H14) could be n-hexane, 2-methylpentane, 3-methylpentane, 2,3-dimethylbutane, 2,2-dimethylbutane. |
| Laboratory | A body that calibrates and/or tests. |
| Laboratory Control Sample (LCS) | TNI- (also known as laboratory fortified blank (LFB), spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to evaluate the performance of all or a portion of the measurement system. |
| Laboratory Duplicate | Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. |
| Laboratory Information Management System (LIMS) | DoD- The entirety of an electronic data system (including hardware and software) that collects, analyzes, stores, and archives electronic records and documents. |
| Learning Management System (LMS) | A web-based database used by the laboratories to track and document training activities. The system is administered by the corporate training department and each laboratory's learn centers are maintained by a local administrator. |
| Legal Chain-of-Custody Protocols | TNI- Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain-of-Custody (COC) Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory. |

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| Limit(s) of Detection (LOD) | TNI- The minimum result, which can be reliably discriminated from a blank with predetermined confidence level.<br>DoD- The smallest concentration of a substance that must be present in a sample in order to be detected at the DL with 99% confidence. At the LOD, the false negative rate (Type II error) is 1%. A LOD may be used as the lowest concentration for reliably reporting a non-detect of a specific analyte in a specific matrix with a specific method at 99% confidence. |
| Limit(s) of Quantitation (LOQ) | TNI- The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.<br>DoD- The smallest concentration that produces a quantitative result with known and recorded precision and bias. For DoD/DOE projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard and within the calibration range. |
| Linear Dynamic Range | DoD- Concentration range where the instrument provides a linear response. |
| Liquid chromatography/ tandem mass spectrometry (LC/MS/MS) | Instrumentation that combines the physical separation techniques of liquid chromatography with the mass analysis capabilities of mass spectrometry. |
| Lot | TNI- A definite amount of material produced during a single manufacturing cycle, and intended to have uniform character and quality. |
| Management | Those individuals directly responsible and accountable for planning, implementing, and assessing work. |
| Management System | System to establish policy and objectives and to achieve those objectives. |
| Manager (however named) | The individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual. |
| Matrix | TNI- The substrate of a test sample. |
| Matrix Duplicate | TNI- A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision. |
| Matrix Spike (MS) (spiked sample or fortified sample) | TNI- A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. |
| Matrix Spike Duplicate (MSD) (spiked sample or fortified sample duplicate) | TNI- A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. |
| Measurement Performance Criteria (MPC) | DoD- Criteria that may be general (such as completion of all tests) or specific (such as QC method acceptance limits) that are used by a project to judge whether a laboratory can perform a specified activity to the defined criteria. |
| Measurement Quality Objective (MQO) | TNI- The analytical data requirements of the data quality objectives are project- or program-specific and can be quantitative or qualitative. MQOs are measurement performance criteria or objectives of the analytical process. Examples of quantitative MQOs include statements of required analyte detectability and the uncertainty of the analytical protocol at a specified radionuclide activity, such as the action level. Examples of qualitative MQOs include statements of the required specificity of the analytical protocol, e.g., the ability to analyze for the radionuclide of interest given the presence of interferences. |
| Measurement System | TNI- A method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s).<br>DoD- A test method, as implemented at a particular laboratory, and which includes the equipment used to perform the sample preparation and test and the operator(s). |
| Measurement Uncertainty | DoD- An estimate of the error in a measurement often stated as a range of values that contain the true value within a certain confidence level. The uncertainty generally includes many components which may be evaluated from experimental standard deviations based on repeated observations or by standard deviations evaluated from assumed probability distributions based on experience or other information. For DoD/DOE, a laboratory's Analytical Uncertainty (such as use of LCS control limits) can be reported as the minimum uncertainty. |
| Method | TNI- A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed. |
| Method Blank | TNI- A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. |

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| Method Detection Limit (MDL) | TNI- One way to establish a Detection Limit; defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. |
| Method of Standard Additions | A set of procedures adding one or more increments of a standard solution to sample aliquots of the same size in order to overcome inherent matrix effects. The procedures encompass the extrapolation back to obtain the sample concentration. |
| Minimum Detectable Activity (MDA) | TNI- Estimate of the smallest true activity that ensures a specified high confidence, 1 – β, of detection above the Critical Value, and a low probability β of false negatives below the Critical Value. For radiometric methods, β is often set at 0.05. NOTE 1: The MDS is a measure of the detection capability of a measurement process and as such, it is an a priori concept. It may be used in the selection of methods to meet specified MQOs. Laboratories may also calculate a "sample specific" MDA, which indicates how well the measurement process is performing under varying real-world measurement conditions, when sample-specific characteristics (e.g., interferences) may affect the detection capability. However, the MDA must never be used instead of the Critical Value as a detection threshold. NOTE 2: For the purpose of this Standard, the terms MDA and minimum detectable concentration (MDC) are equivalent. |
| MintMiner | Program used by PAS to review large amounts of chromatographic data to monitor for errors or data integrity issues. |
| Mobile Laboratory | TNI- A portable enclosed structure with necessary and appropriate accommodation and environmental conditions for a laboratory, within which testing is performed by analysts. Examples include but are not limited to trailers, vans, and skid-mounted structures configured to house testing equipment and personnel. |
| National Environmental Laboratory Accreditation Conference (NELAC) | See definition of The NELAC Institute (TNI). |
| National Institute of Occupational Safety and Health (NIOSH) | National institute charged with the provision of training, consultation and information in the area of occupational safety and health. |
| National Institute of Standards and Technology (NIST) | TNI- A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States national metrology institute (or NMI). |
| National Pollutant Discharge Elimination System (NPDES) | A permit program that controls water pollution by regulating point sources that discharge pollutants into U.S. waters. |
| Negative Control | Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. |
| Nitrogen Phosphorus Detector (NPD) | A detector used in GC analyses that utilizes thermal energy to ionize an analyte. With this detector, nitrogen and phosphorus can be selectively detected with a higher sensitivity than carbon. |
| Nonconformance | An indication or judgment that a product or service has not met the requirement of the relevant specifications, contract, or regulation; also the state of failing to meet the requirements. |
| Not Detected (ND) | The result reported for a compound when the detected amount of that compound is less than the method reporting limit. |
| Operator Aid | DoD- A technical posting (such as poster, operating manual, or notepad) that assists workers in performing routine tasks. All operator aids must be controlled documents (i.e., a part of the laboratory management system). |
| Performance Based Measurement System (PBMS) | An analytical system wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner. |
| Physical Parameter | TNI- A measurement of a physical characteristic or property of a sample as distinguished from the concentrations of chemical and biological components. |
| Photo-ionization Detector (PID) | An ion detector which uses high-energy photons, typically in the ultraviolet range, to break molecules into positively charged ions. |
| Polychlorinated Biphenyls (PCB) | A class of organic compounds that were used as coolants and insulating fluids for transformers and capacitors. The production of these compounds was banned in the 1970's due to their high toxicity. |
| Positive Control | Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. |
| Post-Digestion Spike | A sample prepared for metals analyses that has analytes spike added to determine if matrix effects may be a factor in the results. |

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| Power of Hydrogen (pH) | The measure of acidity or alkalinity of a solution. |
| Practical Quantitation Limit (PQL) | Another term for a method reporting limit. The lowest reportable concentration of a compound based on parameters set up in an analytical method and the laboratory's ability to reproduce those conditions. |
| Precision | TNI- The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. |
| Preservation | TNI and DoD- Any conditions under which a sample must be kept in order to maintain chemical, physical, and/or biological integrity prior to analysis. |
| Primary Accreditation Body (Primary AB) | TNI- The accreditation body responsible for assessing a laboratory's total quality system, on-site assessment, and PT performance tracking for fields of accreditation. |
| Procedure | TNI- A specified way to carry out an activity or process. Procedures can be documented or not. |
| Proficiency Testing (PT) | TNI- A means to evaluate a laboratory's performance under controlled conditions relative to a given set of criteria, through analysis of unknown samples provided by an external source. |
| Proficiency Testing Program (PT Program) | TNI- The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. |
| Proficiency Testing Provider (PT Provider) | TNI- A person or organization accredited by a TNI-approved Proficiency Testing Provider Accreditor to operate a TNI-compliant PT Program. |
| Proficiency Testing Provider Accreditor (PTPA) | TNI- An organization that is approved by TNI to accredit and monitor the performance of proficiency testing providers. |
| Proficiency Testing Reporting Limit (PTRL) | TNI- A statistically derived value that represents the lowest acceptable concentration for an analyte in a PT sample, if the analyte is spiked into the PT sample. The PTRLs are specified in the TNI FoPT tables. |
| Proficiency Testing Sample (PT) | TNI- A sample, the composition of which is unknown to the laboratory, and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria. |
| Proficiency Testing (PT) Study | TNI- a) Scheduled PT Study: A single complete sequence of circulation and scoring of PT samples to all participants in a PT program. The study must have the same pre-defined opening and closing dates for all participants; b) Supplemental PT Study: A PT sample that may be from a lot previously released by a PT Provider that meets the requirements for supplemental PT samples given in Volume 3 of this Standard [TNI] but that does not have a pre-determined opening date and closing date. |
| Proficiency Testing Study Closing Date | TNI- a) Scheduled PT Study: The calendar date by which all participating laboratories must submit analytical results for a PT sample to a PT Provider; b) Supplemental PT Study: The calendar date a laboratory submits the results for a PT sample to the PT Provider. |
| Proficiency Testing Study Opening Date | TNI- a) Scheduled PT Study: The calendar date that a PT sample is first made available to all participants of the study by a PT Provider; b) Supplemental PT Study: The calendar date the PT Provider ships the sample to a laboratory. |
| Protocol | TNI- A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) that must be strictly followed. |
| Qualitative Analysis | DoD- Analysis designed to identify the components of a substance or mixture. |
| Quality Assurance (QA) | TNI- An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client. |
| Quality Assurance Manual (QAM) | A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. |
| Quality Assurance Project Plan (QAPP) | A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. |
| Quality Control (QC) | TNI- The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. |
| Quality Control Sample (QCS) | TNI- A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. |

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| Quality Manual | TNI- A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. |
| Quality System | TNI and DoD- A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance and quality control activities. |
| Quality System Matrix | TNI and DoD- These matrix definitions shall be used for purposes of batch and quality control requirements and may be different from a field of accreditation matrix:<br>• **Air and Emissions**: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device<br>• **Aqueous**: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts.<br>• **Biological Tissue**: Any sample of a biological origin such as fish tissue, shellfish or plant material. Such samples shall be grouped according to origin.<br>• **Chemical Waste**: A product or by-product of an industrial process that results in a matrix not previously defined.<br>• **Drinking Water**: Any aqueous sample that has been designated a potable or potentially potable water source.<br>• **Non-aqueous liquid**: Any organic liquid with <15% settleable solids<br>• **Saline/Estuarine**: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.<br>• **Solids**: Includes soils, sediments, sludges, and other matrices with >15% settleable solids. |
| Quantitation Range | DoD- The range of values (concentrations) in a calibration curve between the LOQ and the highest successively analyzed initial calibration standard used to relate instrument response to analyte concentration. The quantitation range (adjusted for initial sample volume/weight, concentration/dilution and final volume) lies within the calibration range. |
| Quantitative Analysis | DoD- Analysis designed to determine the amounts or proportions of the components of a substance. |
| Random Error | The EPA has established that there is a 5% probability that the results obtained for any one analyte will exceed the control limits established for the test due to random error. As the number of compounds measured increases in a given sample, the probability for statistical error also increases. |
| Raw Data | TNI- The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. |
| Reagent Blank (method reagent blank) | A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. |
| Reagent Grade | Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society. |
| Records | DoD- The output of implementing and following management system documents (e.g., test data in electronic or hand-written forms, files, and logbooks). |
| Reference Material | TNI- Material or substance one or more of whose property values are sufficiently homogenized and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. |
| Reference Method | TNI- A published method issued by an organization generally recognized as competent to do so. (When the ISO language refers to a "standard method", that term is equivalent to "reference method"). When a laboratory is required to analyze by a specified method due to a regulatory requirement, the analyte/method combination is recognized as a reference method. If there is no regulatory requirement for the analyte/method combination, the analyte/method combination is recognized as a reference method if it can be analyzed by another reference method of the same matrix and technology. |
| Reference Standard | TNI- Standard used for the calibration of working measurement standards in a given organization or at a given location. |

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| Relative Percent Difference (RPD) | A measure of precision defined as the difference between two measurements divided by the average concentration of the two measurements. |
| Reporting Limit (RL) | The level at which method, permit, regulatory and customer-specific objectives are met. The reporting limit may never be lower than the Limit of Detection (i.e., statistically determined MDL). Reporting limits are corrected for sample amounts, including the dry weight of solids, unless otherwise specified. There must be a sufficient buffer between the Reporting Limit and the MDL.<br>DoD- A customer-specified lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix. |
| Reporting Limit Verification Standard (RLVS) | A standard analyzed at the reporting limit for an analysis to verify the laboratory's ability to report to that level. |
| Representativeness | A quality element related to the ability to collect a sample reflecting the characteristics of the part of the environment to be assessed. Sample representativeness is dependent on the sampling techniques specified in the project work plan. |
| Requirement | Denotes a mandatory specification; often designated by the term "shall". |
| Retention Time | The time between sample injection and the appearance of a solute peak at the detector. |
| Revocation | TNI- The total or partial withdrawal of a laboratory's accreditation by an accreditation body. |
| Sample | Portion of material collected for analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis. |
| Sample Condition Upon Receipt Form (SCURF) | Form used by sample receiving personnel to document the condition of sample containers upon receipt to the laboratory (used in conjunction with a COC). |
| Sample Delivery Group (SDG) | A unit within a single project that is used to identify a group of samples for delivery. An SDG is a group of 20 or fewer field samples within a project, received over a period of up to 14 calendar days. Data from all samples in an SDG are reported concurrently. |
| Sample Receipt Form (SRF) | Letter sent to the client upon login to show the tests requested and pricing. |
| Sample Tracking | Procedures employed to record the possession of the samples from the time of sampling until analysis, reporting and archiving. These procedures include the use of a chain-of-custody form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples. |
| Sampling | TNI- Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure. |
| Selected Ion Monitoring (SIM) | A mode of analysis in mass spectrometry where the detector is set to scan over a very small mass range, typically one mass unit. The narrower the range, the more sensitive the detector.<br>DoD- Using GC/MS, characteristic ions specific to target compounds are detected and used to quantify in applications where the normal full scan mass spectrometry results in excessive noise. |
| Selectivity | TNI- The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. |
| Sensitivity | TNI- The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. |
| Serial Dilution | The stepwise dilution of a substance in a solution. |
| Shall | Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification as long as the requirement is fulfilled. |
| Should | Denotes a guideline or recommendation whenever noncompliance with the specification is permissible. |
| Signal-to-Noise Ratio (S/N) | DoD- A measure of signal strength relative to background noise. The average strength of the noise of most measurements is constant and independent of the magnitude of the signal. Thus, as the quantity being measured (producing the signal) decreases in magnitude, S/N decreases and the effect of the noise on the relative error of a measurement increases. |
| Source Water | TNI- When sampled for drinking water compliance, untreated water from streams, rivers, lakes, or underground aquifers, which is used to supply private and public drinking water supplies. |
| Spike | A known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes. |
| Standard (Document) | TNI- The document describing the elements of a laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. |

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| Standard (Chemical) | Standard samples are comprised of a known amount of standard reference material in the matrix undergoing analysis. A standard reference material is a certified reference material produced by US NIST and characterized for absolute content, independent of analytical test method. |
| Standard Blank (or Reagent Blank) | A calibration standard consisting of the same solvent/reagent matrix used to prepare the calibration standards without the analytes. It is used to construct the calibration curve by establishing instrument background. |
| Standard Method | A test method issued by an organization generally recognized as competent to do so. |
| Standard Operating Procedure (SOP) | TNI- A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. |
| Standard Reference Material (SRM) | A certified reference material produced by the US NIST or other equivalent organization and characterized for absolute content, independent of analytical method. |
| Statement of Qualifications (SOQ) | A document that lists information about a company, typically the qualifications of that company to compete on a bid for services. |
| Stock Standard | A concentrated reference solution containing one or more analytes prepared in the laboratory using an assayed reference compound or purchased from a reputable commercial source. |
| Storage Blank | DoD- A sample of analyte-free media prepared by the laboratory and retained in the sample storage area of the laboratory. A storage blank is used to record contamination attributable to sample storage at the laboratory. |
| Supervisor | The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses. |
| Surrogate | DoD- A substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes. |
| Suspension | TNI- The temporary removal of a laboratory's accreditation for a defined period of time, which shall not exceed 6 months or the period of accreditation, whichever is longer, in order to allow the laboratory time to correct deficiencies or area of non-conformance with the Standard. |
| Systems Audit | An on-site inspection or assessment of a laboratory's quality system. |
| Target Analytes | DoD- Analytes or chemicals of primary concern identified by the customer on a project-specific basis. |
| Technical Director | Individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory. |
| Technology | TNI- A specific arrangement of analytical instruments, detection systems, and/or preparation techniques. |
| Test | A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate. |
| Test Method | DoD- A definitive procedure that determines one or more characteristics of a given substance or product. |
| Test Methods for Evaluating Solid Waste, Physical/ Chemical (SW-846) | EPA Waste's official compendium of analytical and sampling methods that have been evaluated and approved for use in complying with RCRA regulations. |
| Test Source | TNI- A radioactive source that is tested, such as a sample, calibration standard, or performance check source. A Test Source may also be free of radioactivity, such as a Test Source counted to determine the subtraction background, or a short-term background check. |
| The NELAC Institute (TNI) | A non-profit organization whose mission is to foster the generation of environmental data of known and documented quality through an open, inclusive, and transparent process that is responsive to the needs of the community. Previously known as NELAC (National Environmental Laboratory Accreditation Conference). |
| Total Petroleum Hydrocarbons (TPH) | A term used to denote a large family of several hundred chemical compounds that originate from crude oil. Compounds may include gasoline components, jet fuel, volatile organics, etc. |
| Toxicity Characteristic Leaching Procedure (TCLP) | A solid sample extraction method for chemical analysis employed as an analytical method to simulate leaching of compounds through a landfill. |

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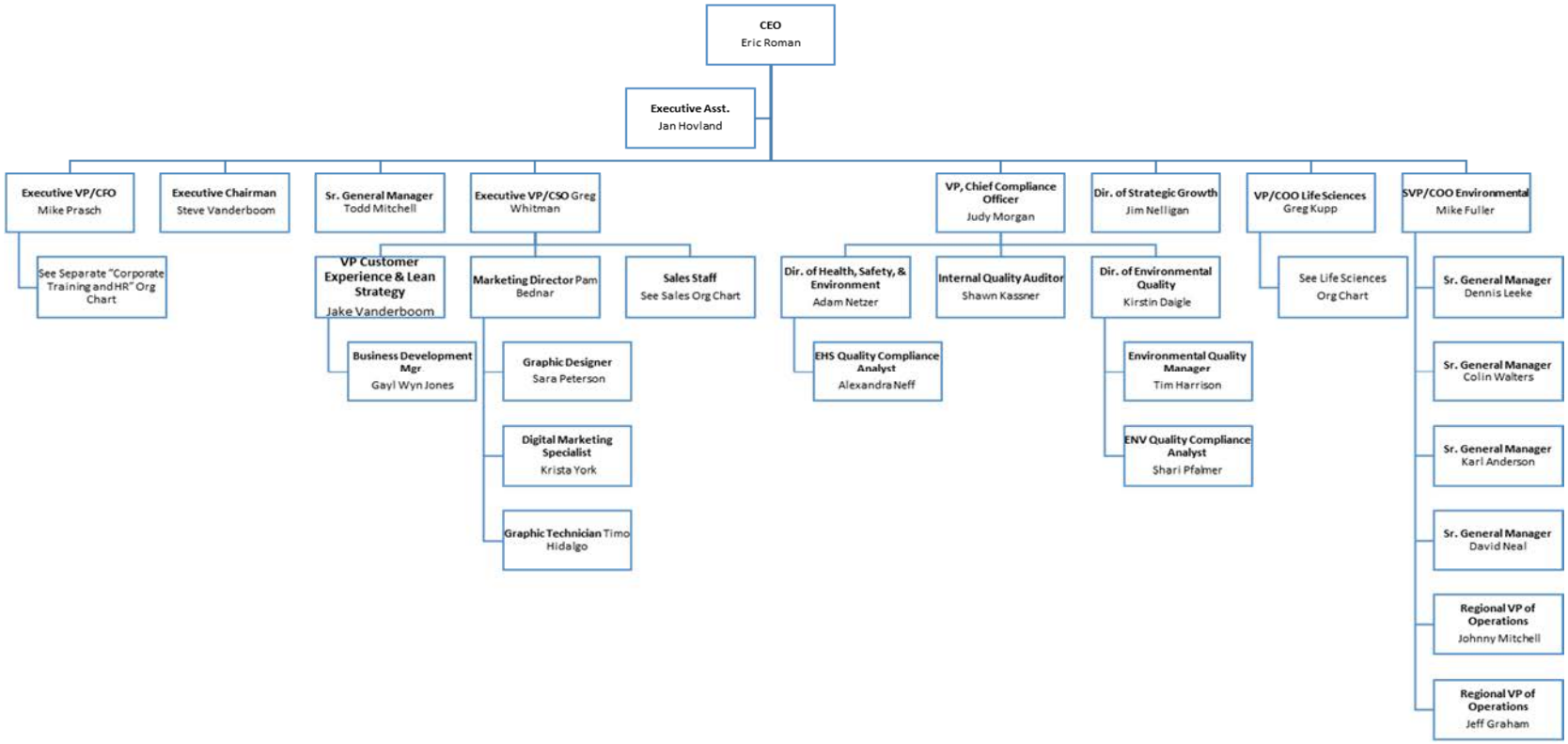
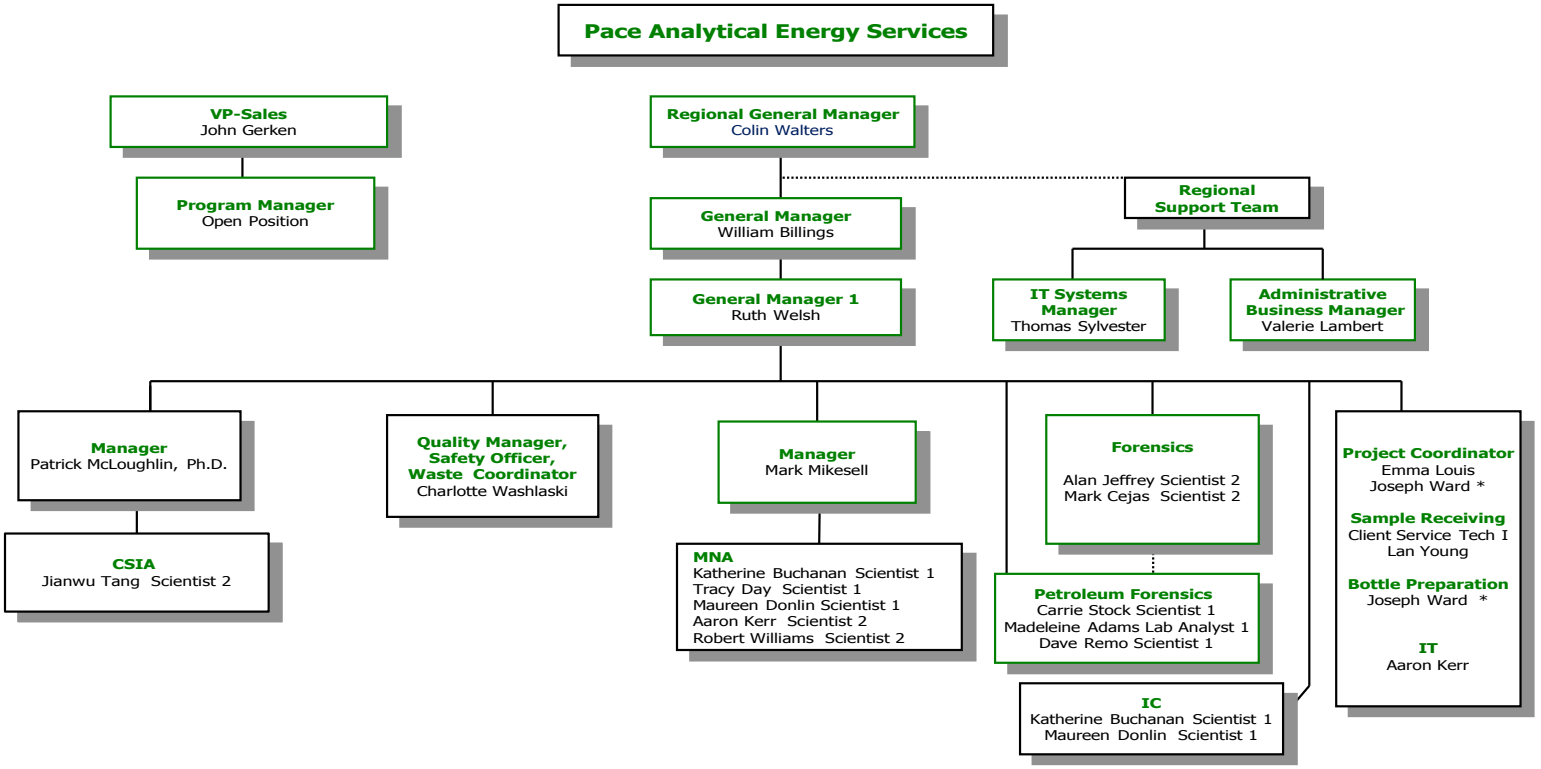
| Traceability | TNI- The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical conditions or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. |
| Training Document | A training resource that provides detailed instructions to execute a specific method or job function. |
| Trip Blank | This blank sample is used to detect sample contamination from the container and preservative during transport and storage of the sample. A cleaned sample container is filled with laboratory reagent water and the blank is stored, shipped, and analyzed with its associated samples. |
| Tuning | A check and/or adjustment of instrument performance for mass spectrometry as required by the method. |
| Ultraviolet Spectrophotometer (UV) | Instrument routinely used in quantitative determination of solutions of transition metal ions and highly conjugated organic compounds. |
| Uncertainty, Counting | TNI- The component of Measurement Uncertainty attributable to the random nature of radioactive decay and radiation counting (often estimated as the square root of observed counts (MARLAP). Older references sometimes refer to this parameter as Error, Counting Error or Count Error (c.f., Total Uncertainty). |
| Uncertainty, Expanded | TNI- The product of the Standard Uncertainty and a coverage factor, k, which is chosen to produce an interval about the result that has a high probability of containing the value of the measurand (c.f., Standard Uncertainty). NOTE: Radiochemical results are generally reported in association with the Total Uncertainty. Either if these estimates of uncertainty can be reported as the Standard Uncertainty (one-sigma) or as an Expanded Uncertainty (k-sigma, where k > 1). |
| Uncertainty, Measurement | TNI- Parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand. |
| Uncertainty, Standard | TNI- An estimate of the Measurement Uncertainty expressed as a standard deviation (c.f., Expanded Uncertainty). |
| Uncertainty, Total | TNI- An estimate of the Measurement Uncertainty that accounts for contributions from all significant sources of uncertainty associated with the analytical preparation and measurement of a sample. Such estimates are also commonly referred to as Combined Standard Uncertainty or Total Propagated Uncertainty, and in some older references as the Total Propagated Error, among other similar items (c.f., Counting Uncertainty). |
| Unethical actions | DoD- Deliberate falsification of analytical or quality control results where failed method or contractual requirements are made to appear acceptable. |
| United States Department of Agriculture (USDA) | A department of the federal government that provides leadership on food, agriculture, natural resources, rural development, nutrition and related issues based on public policy, the best available science, and effective management. |
| United States Geological Survey (USGS) | Program of the federal government that develops new methods and tools to supply timely, relevant, and useful information about the Earth and its processes. |
| Unregulated Contaminant Monitoring Rule (UCMR) | EPA program to monitor unregulated contaminants in drinking water. |
| Validation | DoD- The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. |
| Verification | TNI- Confirmation by examination and objective evidence that specified requirements have been met. In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. |
| Voluntary Action Program (VAP) | A program of the Ohio EPA that gives individuals a way to investigate possible environmental contamination, clean it up if necessary and receive a promise from the State of Ohio that no more cleanup is needed. |
| Whole Effluent Toxicity (WET) | The aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's wastewater (effluent). |

## 7.4 Appendix D: Organization Chart(s)

### 7.4.1 PAS - Corporate December 2019



### 7.4.2 PAS-Pittsburgh




Last Revised – February 4, 2020
Last Reviewed – February 4, 2020

* holds safety responsibilities as well

## 7.5 Appendix E: Equipment Listing

The equipment listed represents equipment were held by each location on the effective date of this manual. This information is subject to change without notice. External parties should contact the location for the most current information.

### 7.5.1 PAS-Pittsburgh

**Equipment List: PAS-Pittsburgh**

| Description | Manufacturer | Model | Serial Number | Service Date | Condition | Location | Internal ID | Manual Location |
|---|---|---|---|---|---|---|---|---|
| EDON IC | Dionex | ISC 2000 | 8120223 | 03/04/2009 | Working | 213 | 7024 | PDF on desktop |
| EDON Autosampler | Dionex | AS-AP | 14092562 | 10/23/2014 | Working | 213 | NA | CD |
| EDON IC | Dionex | ISC2100 | 14092120 | 10/23/2014 | Working | 213 | 7036 | CD |
| EDON GC | Varian | 3400 | 10272 | Unknown | Not in service | 220 | NA | CD |
| Dissolved Gases GC | ThermoFisher | Trace Ultra | 620120045 | 04/01/2012 | Working | 213 | 7025 | CD |
| Autosampler | ThermoFisher | TriPlus RSH | 241284 | 04/01/2012 | Working | 213 | 7026 | PDF on desktop |
| VOC GC | Agilent | 6890 GC | US00042429 | 09/2018 | Working | 221 | 7048 | CD on data station |
| VOC Autosampler | Tekmar | 7000/7050 | 91099014/91346016 | 1995 | Working | 221 | NA | Rm 221 Bookshelf |
| VOC GC | Hewlett Packard | 5890 SeriesII | 3336A3505 | Unknown | Working | 220 | NA | Rm 221 Bookshelf |
| VOC GC | Agilent | 6890 | NA | Unknown | Not in service | Storage | 7049 | Rm221 Bookshelf |
| Dissolved Gases GC | ThermoFisher | Trace Ultra | 620120028 | 04/18/2012 | Working | 221 | 7019 | Data station PDF |
| Dissolved Gases Autosampler | ThermoFisher | TriPlus Headspace | 237682 | 04/18/2012 | Working | 221 | 7020 | Data station PDF |
| RISK GC | GOW MAC | Series 580 | 580-200 | 1995 | Working | 220 | NA | With GC |
| Dissolved Gases GC | Proprietary | GC | N/A | 12/2005 | Working | 220 | NA | Rm 221 Bookshelf |
| RISK Autosampler | Tekmar | 7000/7050 | 92220011/92220006 | 04/2018 | Not in service | 220 | 7051 | Rm 221 Bookshelf |
| VOC Autosampler | Tekmar | 7000/7050 | 95025019/95025018 | 07/2016 | Working | 220 | NA | Rm 221 Bookshelf |
| GC (4) | Proprietary | NA | NA | 12/1998 | 3 In Service | 220/221 | NA | Bookshelf |
| Analytical Balance | Ohaus | DV215CD | 1128122704 | Unknown | Working | 213 | NA | Room 213 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Anion Autosampler | Dionex | AS-40 | 97050241 | 01/16/2009 | Working | 213 | NA | On-Line |
| IC | Dionex | ICS3000DC | 08120559 | 01/16/2009 | Working | 213 | 7023 | On-Line |
| Cation Autosampler | Dionex | AS-DV | 160911290 | 10/17/2016 | Working | 213 | NA | On-Line |
| IC | Dionex | ICS3000DP | 08120254 | 01/16/2009 | Working | 213 | 7023 | On-Line |
| TOC Analyzer | Aurora | 1030 | J025730751 | 02/01/2017 | Working | 213 | 7022 | On Instrument |
| TOC Autosampler | Aurora | 1088 | E019788198 | 02/01/2017 | Working | 213 | NA | On Instrument |
| CSIA Autosampler | Tekmar | AquaTek 70 | US06151001 | Unknown | Working | 426-428 | 7014 | J drive (CSIA/Manuals) |
| CSIA Autosampler | Tekmar | AquaTek 70 | US07003004 | Unknown | Working | 424 | 7029 | J drive (CSIA/Manuals) |
| CSIA Purge &Trap | Tekmar | Velocity XPT | 6335001 | Unknown | Working | 424 | NA | J drive (CSIA/Manuals) |
| CSIA Pre Concentrator | Entech | 7100A | 1304 | Unknown | Working | 424 | NA | J drive (CSIA/Manuals) |
| CSIA GC | ThermoFisher | Trace Ultra | 200510408 | Unknown | Working | 424 | 7030 | J drive (CSIA/Manuals) |
| CSIA Combustion Interface | ThermoFisher | Combustion III | 111201-175 | Unknown | Working | 424 | NA | Room 426 drawer under chlorine autosampler |
| Reactor | ThermoFisher | TC Reactor OD | 1085260-349 | Unknown | Working | 424 | NA | Unknown |
| Mass Spectrometer | ThermoFisher | Delta V plus Isotope Ratio | 8018 | Unknown | Workiing | 424 | NA | Room 426 drawer under chlorine autosampler |
| Concentrator | Tekmar | Velocity | US6047001 | Unknown | Working | 426-428 | 7015 | J drive (CSIA/Manuals) |
| Mass Spectrometer | ThermoFisher | Delta V plus Isotope Ratio | 08607D | Unknown | Working | 426-428 | NA | Room 426 drawer under chlorine autosampler |
| Interface | Thermo | Conflo IV Interface | 1222750-179 | Unknown | Working | 426-428 | NA | Room 426 drawer under chlorine autosampler |
| Interface | Thermo | GC Isolink Interface | 1229600-147 | Unknown | Working | 426-428 | NA | Room 426 drawer under chlorine autosampler |
| Gas Chromatograph | Agilent | 7890A | CN11311133 | Unknown | Working | 426-428 | NA | Room 426 drawer under |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | chlorine autosampler |
| Autosampler | Tekmar | Aquatek 100 | US11305020 | Unknown | Working | 426-428 | NA | J drive (CSIA/Manuals) |
| Autosampler | Tekmar | Stratum | US1130000 | Unknown | Working | 426-428 | NA | Room 426 drawer under chlorine autosampler |
| Gas Chromatograph | Agilent | 6890N | US10226064 | Unknown | Working | 424 | 7011 | Room 426 drawer under chlorine autosampler |
| Gas Chromatograph | Agilent | 5976N NSD | US63810430 | Unknown | Working | 424 | NA | Room 426 drawer under chlorine autosampler |
| Autosampler | Agilent | G1888 Headspace Autosampler | IT40220036 | Unknown | Working | 426-428 | NA | J drive (CSIA/Manuals) |
| Autosampler | Agilent | G4513A | CN12090144 | Unknown | Working | 426-428 | NA | J drive (CSIA/Manuals) |
| Autosampler | Entech | 7032AQ | 1032 | Unknown | Working | 424 | NA | J drive (CSIA/Manuals |
| Canister Cleaner | Entech | 3100A | 110 | Unknown | Working | 424 | NA | J drive (CSIA/Manuals |
| Evacuation Chamber | Entech | B33ER-0118 | B33ER-0118 | Unknown | Working | 424 | 7031 | J drive (CSIA/Manuals |
| Gas Chromatograph | Agilent | 7890A | CN12121090 | Unknown | Working | 426-428 | 7006 | Room 426 drawer under chlorine autosampler |
| Mass Spectrometer | Agilent | 5975C MSD | US12157802 | Unknown | Working | 426-428 | NA | Room 426 drawer under chlorine autosampler |
| High Capacity Gas Purifier | Supelco | 29541-U | 1312955/1A-22 | Unknown | Working | 424 | NA | J drive (CSIA/Manuals |
| Centrifuge | Eppendorf | 5810R | 581101849 | Unknown | Not in Use | Cage | 7002 | J drive (CSIA/Manuals |
| GC/MS | Agilent | 7890A/5975 | CN12091092 | Unknown | Working | 126 | 7007 | Online |
| GC/MS | Agilent | 6890/5975 | US00008852 | Unknown | Working | 126 | | Online |
| GC/MS | Agilent | 6890/5975 | US00006875 | Unknown | Working | 126 | | Online |
| Autosampler | Tekmar | AquaTek 100 | US11348004 | Unknown | Working | 126 | 7012 | Online |
| Purge and Trap | Tekmar | Stratum | US11327002 | Unknown | Working | 126 | 7013 | Online |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Gas Chromatograph | Agilent | 6890N | US10347026 | Unknown | Working | 126 | 7018 | Online |
| Gas Chromatograph | Agilent | 6890 | US00001417 | Unknown | Working | 126 | 7005 | Online |
| Gas Chromatograph | Agilent | 5890 | Unknown | Unknown | Working | 126 | NA | Online |
| Concentrator | Zymark | TurboVap | 04770 | Unknown | Working | 127 | NA | Online |
| Concentrator | Zymark | TurboVap | 04756 | Unknown | Working | 127 | NA | Online |
| Evaporator | Zymark | TurboVap LV | 04384 | Unknown | Working | 127 | NA | Online |
| Balance | Sargent-Welsh | SWT-603D | T0121781 | Unknown | Working | 126 | NA | Online |
| Oven | Fisher | 550-126 | 1.51107E+12 | Unknown | Working | 126 | NA | Online |
| GC | Agilent | 7890A | CN10741050 | Unknown | Working | 126 | 7057 | Online |
| MS | Agilent | 5975 | US10494609 | Unknown | Working | 126 | 7057 | Online |
| Autosampler | Agilent | 7693 | CN18040069 | Unknown | Working | 126 | 7057 | Online |
| Autosampler | Agilent | 7683 | CN50932285 | Unknown | Working | 126 | 7018 | Online |
| Autosampler | Agilent | 7683 | US14907665 | Unknown | Working | 126 | NA | Online |
| Autosampler | Agilent | 7683 | Unknown | Unknown | Working | 126 | 7005 | Online |
| Autosampler | Agilent | Unknown | CN12090158 | Unknown | Working | 126 | 7007 | Online |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# Appendix G

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# POST-CLOSURE CARE INSPECTION FORM
# CCR SURFACE IMPOUNDMENT CLOSURE
# BAILLY GENERATING STATION

| ITEM | RESPONSE | | | REPAIR/ MAINTENANCE REQUIRED | | | OBSERVATIONS/COMMENTS |
|---|---|---|---|---|---|---|---|
| | YES | NO | NA | YES | NO | NA | |
| **PRIMARY SETTLEMENT POND NO.1** | | | | | | | |
| **Final Soil Backfill** | | | | | | | |
| Pollinator habitat quality – e.g. stressed or missing? | | | | | | | |
| Vegetation other than pollinator habitat present? | | | | | | | |
| Erosion rills/gullies present? | | | | | | | |
| Settlement/subsidence present? | | | | | | | |
| Accumulated surface water present? | | | | | | | |
| Slope stability issues? | | | | | | | |
| Evidence of burrowing animals? | | | | | | | |
| **Surface Water Management System** | | | | | | | |
| Storm Water Collection Ditch | | | | | | | |
| Pollinator habitat quality – e.g. stressed or missing? | | | | | | | |
| Vegetation other than pollinator habitat present? | | | | | | | |
| Erosion issues? | | | | | | | |
| Sediment issues? | | | | | | | |
| Obstructions/blockages present? | | | | | | | |
| Evidence of burrowing animals? | | | | | | | |
| Culvert | | | | | | | |
| Culvert quality – e.g. present and/or crushed? | | | | | | | |
| Obstructions/blockages present? | | | | | | | |
| **Access Roads** | | | | | | | |
| Erosion issues? | | | | | | | |
| Surface quality – e.g. missing, broken, etc.? | | | | | | | |
| **Groundwater Monitoring System** | | | | | | | |
| Monitoring wells/piezometers in god condition? | | | | | | | |
| Protective casings present and in good condition? | | | | | | | |
| Protective casing locked? | | | | | | | |
| Concrete pads in good condition? | | | | | | | |
| Locks in good working condition? | | | | | | | |
| Monitoring well labels present and legible? | | | | | | | |
| **Miscellaneous** | | | | | | | |
| Pollinator habitat needs to be mowed? | | | | | | | |
| Site benchmarks and other survey control in good condition? | | | | | | | |

| ITEM | RESPONSE | | | REPAIR/ MAINTENANCE REQUIRED | | | OBSERVATIONS/COMMENTS |
|---|---|---|---|---|---|---|---|
| | YES | NO | NA | YES | NO | NA | |
| PRIMARY SETTLEMENT POND NO.1 | | | | | | | |
| **COMMENTS** | | | | | | | |

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# POST-CLOSURE CARE INSPECTION FORM
# CCR SURFACE IMPOUNDMENT CLOSURE
# BAILLY GENERATING STATION

| ITEM | RESPONSE | | | REPAIR/ MAINTENANCE REQUIRED | | | OBSERVATIONS/COMMENTS |
|---|---|---|---|---|---|---|---|
| | YES | NO | NA | YES | NO | NA | |
| **SECONDARY SETTLEMENT POND NO. 1** | | | | | | | |
| **Final Soil Backfill** | | | | | | | |
| Pollinator habitat quality – e.g. stressed or missing? | | | | | | | |
| Vegetation other than pollinator habitat present? | | | | | | | |
| Erosion rills/gullies present? | | | | | | | |
| Settlement/subsidence present? | | | | | | | |
| Accumulated surface water present? | | | | | | | |
| Slope stability issues? | | | | | | | |
| Evidence of burrowing animals? | | | | | | | |
| **Surface Water Management System** | | | | | | | |
| Storm Water Collection Ditch | | | | | | | |
| Pollinator habitat quality – e.g. stressed or missing? | | | | | | | |
| Vegetation other than pollinator habitat present? | | | | | | | |
| Erosion issues? | | | | | | | |
| Sediment issues? | | | | | | | |
| Obstructions/blockages present? | | | | | | | |
| Evidence of burrowing animals? | | | | | | | |
| Culvert | | | | | | | |
| Culvert quality – e.g. present and/or crushed? | | | | | | | |
| Obstructions/blockages present? | | | | | | | |
| **Access Roads** | | | | | | | |
| Erosion issues? | | | | | | | |
| Surface quality – e.g. missing, broken, etc.? | | | | | | | |
| **Groundwater Monitoring System** | | | | | | | |
| Monitoring wells in good condition? | | | | | | | |
| Protective casings present and in good condition? | | | | | | | |
| Protective casing locked? | | | | | | | |
| Concrete pads in good condition? | | | | | | | |
| Locks in good working condition? | | | | | | | |
| Monitoring well labels present and legible? | | | | | | | |
| **Miscellaneous** | | | | | | | |
| Pollinator habitat needs to be mowed? | | | | | | | |
| Site benchmarks and other survey control in good condition? | | | | | | | |

| ITEM | RESPONSE | | | REPAIR/ MAINTENANCE REQUIRED | | | OBSERVATIONS/COMMENTS |
|---|---|---|---|---|---|---|---|
| | YES | NO | NA | YES | NO | NA | |
| SECONDARY SETTLEMENT POND NO. 1 | | | | | | | |
| **COMMENTS** | | | | | | | |

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# POST-CLOSURE CARE INSPECTION FORM
# CCR SURFACE IMPOUNDMENT CLOSURE
# BAILLY GENERATING STATION

| ITEM | RESPONSE | | | REPAIR/ MAINTENANCE REQUIRED | | | OBSERVATIONS/COMMENTS |
|---|---|---|---|---|---|---|---|
| | YES | NO | NA | YES | NO | NA | |
| **PRIMARY SETTLEMENT POND NO.2** | | | | | | | |
| **Final Soil Backfill** | | | | | | | |
| Pollinator habitat quality – e.g. stressed or missing? | | | | | | | |
| Vegetation other than pollinator habitat present? | | | | | | | |
| Erosion rills/gullies present? | | | | | | | |
| Settlement/subsidence present? | | | | | | | |
| Accumulated surface water present? | | | | | | | |
| Slope stability issues? | | | | | | | |
| Evidence of burrowing animals? | | | | | | | |
| **Surface Water Management System** | | | | | | | |
| Storm Water Collection Ditch | | | | | | | |
| Pollinator habitat quality – e.g. stressed or missing? | | | | | | | |
| Vegetation other than pollinator habitat present? | | | | | | | |
| Erosion issues? | | | | | | | |
| Sediment issues? | | | | | | | |
| Obstructions/blockages present? | | | | | | | |
| Evidence of burrowing animals? | | | | | | | |
| Culvert | | | | | | | |
| Culvert quality – e.g. present and/or crushed? | | | | | | | |
| Obstructions/blockages present? | | | | | | | |
| **Access Roads** | | | | | | | |
| Erosion issues? | | | | | | | |
| Surface quality – e.g. missing, broken, etc.? | | | | | | | |
| **Groundwater Monitoring System** | | | | | | | |
| Monitoring wells in good condition? | | | | | | | |
| Protective casings present and in good condition? | | | | | | | |
| Protective casing locked? | | | | | | | |
| Concrete pads in good condition? | | | | | | | |
| Locks in good working condition? | | | | | | | |
| Monitoring well labels present and legible? | | | | | | | |
| **Miscellaneous** | | | | | | | |
| Pollinator habitat needs to be mowed? | | | | | | | |
| Site benchmarks and other survey control in good condition? | | | | | | | |

| ITEM | RESPONSE | | | REPAIR/ MAINTENANCE REQUIRED | | | OBSERVATIONS/COMMENTS |
|---|---|---|---|---|---|---|---|
| | YES | NO | NA | YES | NO | NA | |
| PRIMARY SETTLEMENT POND NO.2 | | | | | | | |
| **COMMENTS** | | | | | | | |

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# POST-CLOSURE CARE INSPECTION FORM
# CCR SURFACE IMPOUNDMENT CLOSURE
# BAILLY GENERATING STATION

| ITEM | RESPONSE | | | REPAIR/ MAINTENANCE REQUIRED | | | OBSERVATIONS/COMMENTS |
|---|---|---|---|---|---|---|---|
| | YES | NO | NA | YES | NO | NA | |
| **BOILER SLAG POND** | | | | | | | |
| **Final Soil Backfill** | | | | | | | |
| Pollinator habitat quality – e.g. stressed or missing? | | | | | | | |
| Vegetation other than pollinator habitat present? | | | | | | | |
| Erosion rills/gullies present? | | | | | | | |
| Settlement/subsidence present? | | | | | | | |
| Accumulated surface water present? | | | | | | | |
| Slope stability issues? | | | | | | | |
| Evidence of burrowing animals? | | | | | | | |
| **Access Roads** | | | | | | | |
| Storm Water Collection Ditch | | | | | | | |
| Pollinator habitat quality – e.g. stressed or missing? | | | | | | | |
| Vegetation other than pollinator habitat present? | | | | | | | |
| Erosion issues? | | | | | | | |
| Sediment issues? | | | | | | | |
| Obstructions/blockages present? | | | | | | | |
| Evidence of burrowing animals? | | | | | | | |
| Culvert | | | | | | | |
| Culvert quality – e.g. present and/or crushed? | | | | | | | |
| Obstructions/blockages present? | | | | | | | |
| **Access Roads** | | | | | | | |
| Erosion issues? | | | | | | | |
| Surface quality – e.g. missing, broken, etc.? | | | | | | | |
| **Groundwater Monitoring System** | | | | | | | |
| Monitoring wells in good condition? | | | | | | | |
| Protective casings present and in good condition? | | | | | | | |
| Protective casing locked? | | | | | | | |
| Concrete pads in good condition? | | | | | | | |
| Locks in good working condition? | | | | | | | |
| Monitoring well labels present and legible? | | | | | | | |
| **Miscellaneous** | | | | | | | |
| Pollinator habitat needs to be mowed? | | | | | | | |
| Site benchmarks and other survey control in good condition? | | | | | | | |

| ITEM | RESPONSE | | | REPAIR/ MAINTENANCE REQUIRED | | | OBSERVATIONS/COMMENTS |
|---|---|---|---|---|---|---|---|
| | YES | NO | NA | YES | NO | NA | |
| **BOILER SLAG POND** | | | | | | | |
| **COMMENTS** | | | | | | | |

# Appendix H

# SOLID WASTE CLOSURE PLAN
## *for* RWS I, II, & III, C/D SITE, *and* NON-MSWLF FACILITIES

## I. GENERAL INFORMATION

**A. Facility Name:** Bailly Generating Station

**B. Facility Location:** 246 Bailly Station Road

Chesterton, Indiana 46304

**C. Facility County:** Porter

**D. Facility Solid Waste Permit No.:** NA

**E. Total Fill Acreage (See Instructions):** 16.5

## II. CLOSURE ACTIVITIES (Provide a description of the steps that will be used to partially close, if applicable, and finally close the facility. See instructions for items that should be included.)

For each of the four CCR surface impoundments, the steps required to implement closure include the following general construction activities:

**A.** Mobilization, demolition, installation of erosion and sediment control.
**B.** Removal of free and interstitial water from CCR material.
Treatment of interstitial and contact water.
**C.** Excavation, conditioning the CCR material, (if required), loading of CCR material.
**D.** Transport of excavated materials (including CCR material and permitted components of the bottom liner system) to the NIPSCO Rollin M. Schahfer Generating Station (RMSGS) onsite landfill.
**E.** Grade former surface impoundment embankment materials to establish the final design surface contours.
**F.** Develop soil cover borrow area(s).
Furnish, transport, place, grade, and compact the soil borrow material to aid in establishing the final design surface contours.
Installing storm water management controls.
**G.** Furnish, transport, place, and grade topsoil
**H.** Seeding

The closure of the surface impoundments will be performed as a closure by removal including the previously listed construction activities.

After completion of the CCR material excavation, the perimeter embankment soil material will be graded and augmented with cover soil material, as required, to construct the final surface contours and grades shown on the drawings presented in Appendix A of the Closure Application. The contours and grades are designed to also include surface water controls and storm water management. A minimum of six inches of topsoil material will be placed on top of the cover soil material. This soil material/topsoil configuration following the removal of the CCR materials is being used in lieu of the typical final cover cap system used for an in-place closure method. As such, the closure costs provided will be for the soil material and topsoil configuration.

**III. LABOR, MATERIALS, & TESTING** (Provide a listing of items necessary to close the facility. For items that will vary depending upon the number of acres to be closed, the quantities should be indicated on a per acre basis.)

| A. Item | B. Quantity | C. Units |
|---|---|---|
| Cover soil material | 103,000 | Cubic yards |
| Topsoil material | 22,500 | Cubic yards |
| Fill for ramp | 10,000 | Cubic yards |
| Silt fence | 6,000 | Linear feet |
| Construction fencing | 4,000 | Linear feet |
| Rock check dams | 50 | Each |
| Insituform 36-inch dia. pipe | 550 | Linear feet |
| Insituform manhole | 20 | Linear feet |
| Erosion control matting | 37,500 | Square yards |
| Seeding | 21.5 | Acres |

## IV. EXPECTED YEAR OF CLOSURE

A. Expected Year of Closure (begin closure in 2021) 2024

B. Total Time Required to Close Facility
(See instructions) 3 years

C. Time Required for Intermediate Steps in Closure (Provide a description of intermediate closure activities and the time required. See instructions.)

**Not Applicable. Total acreage of the surface impoundments is 16.5 acres and closure of the entire Bailly surface impoundments area will be completed sequentially.**

## V. COST PER ACRE FOR FINAL COVER & VEGETATION

Note: CCR material will be removed and soil material overlain by topsoil will be placed. Thus, no final cover system is being installed.

A. What Percent of Final Cover and topsoil is Available from Areas that are Controlled, and Will be Controlled through Post-Closure by the Permittee?

1. % of final cover **(soil material to construct the final design grades)** 0%

2. Describe location of sources The off-site soil material will be obtained by the contractor performing the surface impoundments closure activities from a borrow source(s) in strict accordance with the technical specifications and approval of NIPSCO.

3. % of topsoil 0%

4. Describe location of sources The off-site topsoil material will be obtained by the contractor performing the surface impoundments closure activities from a borrow source(s) in strict accordance with the technical specifications and approval of NIPSCO.

B. Cost Per Acre for Acquisition, Placement, & Compaction of Two Feet of Final Cover

NOTE: The costs provided in Section B are for the acquisition, placement, and compaction of the volume of soil material required to create the final surface contours and grades shown on the drawings presented in Appendix A of the Closure Application. This is not a final cover system and the information is provided to fit this form as close as possible.

1. Acquisition

   a. Quantity of clay **(soil material)** needed per acre (cy/acre) 6,242

   b. Excavation unit cost ($/cy) (if obtained on-site) Included in c.

   c. Purchase unit cost ($/cy) (if obtained off-site) $39

| | |
|---|---|
| d. Delivery unit cost ($/cy) (if obtained off-site) | Included in c. |
| e. Acquisition cost ($/acre) Line 1a*Line 1b* (or) Line 1a* (Line 1c + Line 1d) | $243,438 |
| 2. Placement and Compaction | |
| a. Placement/spreading unit cost | Included in 1. |
| b. Compaction unit cost ($/cy) | Included in 1. |
| c. Placement and Compaction Cost ($/acre) Line 1a* (Line 2a + Line 2b) | Included in 1. |
| 3. Testing | |
| a. Soil classification (if soil source is of variable quality)($/Acre) | Included in 1. |
| b. Survey control for cover thickness and proper slopes ($/acres | Included in 1. |
| c. Density testing ($/acre) | Included in 1. |
| d. Testing Cost ($/acre) Line 3a + Line 3b + Line 3c | Included in 1. |
| 4. Clay Cover Cost ($/acre) Line 1e+ Line 2c + Line 3d | Same as 1e. |

## C. Cost Per Acre for Acquisition & Placement of Topsoil

| | |
|---|---|
| 1. Acquisition | |
| a. Quantity of topsoil needed per acre (cy/acre) | 806 |
| b. Excavation unit cost ($/cy) | Included in 1c. |
| c. Purchase unit cost ($/cy) | $45 |
| d. Delivery unit cost ($/cy) | Included in 1c. |

e. Acquisition cost ($/acre)
Line 1a*Line 1b* (or)
Line 1a* (Line 1e + Line 1d) — $36,270

2. Placement

a. Spreading unit cost ($/cy) — Included in 1c.

b. Placement cost ($/acre) — Included in 1c.

3. Topsoil Cost ($/acre)
Line 1e+ Line 2b — Same as 1e.

## D. Cost Per Acre to Establish Vegetation

1. Vegetation

a. Seeding unit cost ($/acre) — $6,500

b. Fertilization unit cost ($/acre) — Included in 1a.

c. Mulching unit cost ($/acre) — Included in 1a.

d. Vegetation Establishment Cost ($/acre)
Line 1a + Line 1b + Line 1c — $6,500

## E. Cost Per Acre to Certify Closure

1. Registered Professional Engineer

a. Initial review of closure plan (hrs) — 40

b. Total number of inspections — 8

c. Inspection time required (hrs/visit) — 16

d. Total inspection time (hrs)
Line 1b*Line 1c — 128

e. Prepare final documentation (hrs) — 40

f. Total engineer time (hrs)
Line 1a + Line 1d + Line 1e — 208

g. Engineer unit labor cost ($/hr) — $125

h. Professional engineer cost ($)
Line 1f*Line1g — $26,000

i. Area of site permitted for filling (acres) — 16.5

j. Closure Certification Cost ($/acre)
Line 1h/Line1i $1,576

**F. Other Costs Per Acre for Final Cover and Vegetation**

1. Other Costs ($/acre) $0

**G. Total of Items B through F** (Must not be less than $5,000) **$287,784**

**VI. OTHER CLOSURE COSTS** (Give these on a total facility basis rather than per acre.)

A. Notification of Property Deed 2,500

B. Other Costs

Cost for items such as drainage features, installation of gas vents, etc., should be delineated in this section.

| 1. Activity | Cost |
|---|---|
| Mobilization, field surveying, demolition | $1,576,611 |
| Site preparation, erosion control | $1,435,760 |
| Dewatering, water treatment | $5,470,650 |
| CCR Removal, excavate and load | $3,867,150 |
| Hauling CCR to the onsite RMSGS landfill, site controls | $5,349,850 |
| Blast furnace slag and geomembrane removal and disposal | $3,460,543 |
| Site restoration | $1,172,698 |
| **2. Total of Other Costs ($)** | $22,333,762 |

C. Total (Add costs from Sections A. and B.) $22,335,762

**VII. CLOSURE COST ESTIMATE** (Multiply Item I.E. by Item V.G. and then add Item (VI.C.): **$27,084,198**

*A contingency greater than 10 percent is included in the costs.

## VIII. ADDITIONAL INFORMATION REQUIRED FOR FACILITIES PROVIDING FINANCIAL ASSURANCE ON AN INCREMENTAL BASIS

A. Will Closure Financial Assurance be Provided on an Incremental Basis? (If the answer to this question is no, skip to Item IX.) **NO**

B. Map of Areas of Waste Deposition (Attach a copy of the facility's final contour map which shows the maximum areas of waste deposition on a yearly basis for the remaining life of the facility.)
**NOT APPLICABLE**

C. Maximum Areas of Waste Deposition & Closure Costs (Fill in the following table for each remaining year of the facility's life.)

**NOT APPLICABLE**

| Year | Max. Area of Waste Deposition (cumulative acres) (end of year) | Closure Cost w/o Partial Closure ($) | Area Partially Closed (cumulative acres) (start of year) | Increm. Closure ($) |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

## IX. ENGINEER CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the persons who managed the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I further certify that I am authorized to submit this information.

**Signature:** RIAQ **Date:** 1/20/2021

**Name:** Richard A. Isaac

**Address:** 8469 Kingsley Drive

Reynoldsburg, Ohio 43068

**Telephone No.:** (614) 440-9923

**Professional Engineer Registration No.:** Indiana 11700594

# SOLID WASTE POST-CLOSURE PLAN
## *for* RWS I, II, & III, C/D SITE, *and* NON-MSWLF FACILITIES

## I. GENERAL INFORMATION

**A. Facility Name:** Bailly Generating Station

**B. Facility Location:** 246 Bailly Station Road

Chesterton, Indiana 46304

**C. Facility County:** Porter

**D. Facility Solid Waste Permit No.:** NA

## II. POST-CLOSURE CONTACT PERSON

**A. Name:** Jeff Neumeier

**B. Address:** 246 Bailly Station Road

Chesterton, Indiana 46304

**C. Telephone No.:** (219) 787-7337 (Bailly Generating Station Office)

(219) 873-7337 (Michigan City Generating Station Office)

(219) 680-7098 (Mobile)

**D. E-Mail Address:** JNeumeier@nisource.com

**III. GROUNDWATER MONITORING ACTIVITIES** (Provide a description of planned groundwater monitoring activities including the frequency of the activities. See instructions.)

The post-closure groundwater monitoring program includes 20 existing and one proposed groundwater wells that will monitor groundwater quality near the surface impoundments shown in the following table:

| | Monitoring Well Locations | Top of Casing Elevation (ft-msl) | Screen Interval | | | Well Diameter (inches) |
|---|---|---|---|---|---|---|
| | | | Top (ft-bgs) | | Bottom (ft-bgs) | |
| Background | PC-GAMW-01 | 624.53 | 13 | | 23 | 2 |
| | PC-GAMW-01B | 623.76 | 27 | | 32 | 2 |
| Downgradient | PC-GAMW-02 | 624.20 | 13 | | 23 | 2 |
| | PC-GAMW-03 | 624.35 | 13 | | 23 | 2 |
| | PC-GAMW-04 | 624.12 | 13 | | 23 | 2 |
| | PC-GAMW-06 | 626.97 | 17 | | 27 | 2 |
| | PC-GAMW-07 | 629.04 | 19 | | 29 | 2 |
| | PC-GAMW-08 | 624.35 | 15 | | 25 | 2 |
| | PC-GAMW-08B | 623.73 | 30 | | 40 | 2 |
| | PC-GAMW-10 | 631.94 | 21 | | 31 | 2 |
| | PC-GAMW-11 | 625.04 | 14 | | 24 | 2 |
| | PC-GAMW-11C | 625.16 | 29 | | 34 | 2 |
| | PC-GAMW-12R | TBD | 15 | | 25 | 2 |
| | PC-GAMW-13 | 625.34 | 13 | | 23 | 2 |
| | PC-GAMW-14 | 624.32 | 13 | | 23 | 2 |
| | PC-GAMW-16 | 629.92 | 20 | | 30 | 2 |
| | PC-GAMW-17 | 623.96 | 14.5 | | 24.5 | 2 |
| | PC-GAMW-17B | 624.12 | 28.5 | | 33.5 | 2 |
| | PC-GAMW-18 | 626.87 | 20 | | 30 | 2 |
| | PC-MW-105 | 622.05 | 8 | | 18 | 2 |
| | PC-MW-112 | 628.07 | 17 | | 27 | 2 |

**Notes:**

Locations surveyed in US State Plane Indiana West Zone NAD 1983, NAVD 1988 (ft)

ft-bgs = feet below ground surface

ft-msl = feet above mean sea level

TBD = to be determined

Post-closure monitoring frequency will be as follows:

NIPSCO LLC will begin post-closure monitoring during the first calendar quarter after completion of the impoundment closure construction activities and submittal of the Closure Certification Report by the certifying engineer. NIPSCO LLC will perform quarterly post-closure monitoring for a minimum of eight consecutive quarters (i.e., two years) to assess 1) changes in groundwater quality and 2) potential changes in groundwater flow direction, both related to conditions associated with closure activities (i.e., source removal, emplacement of a low permeability cover system, surface water [precipitation run-on] diversion). The two-year quarterly monitoring period is necessary to assist NIPSCO LLC with refining the Conceptual

Site Model that will be used to assess whether additional groundwater monitoring or management activities are required, if any.

Following the initial two-year quarterly monitoring events, NIPSCO LLC will continue post-closure groundwater monitoring on a semi-annual basis for parameters appropriate to detect/assess changes in groundwater quality because of completed closure activities. NIPSCO LLC will maintain consistency with the ongoing semi-annual CCR Rule monitoring program, for which sampling is currently conducted primarily in April and October. The initial semi-annual event will be scheduled for the earlier of either April or October following the final two-year quarterly monitoring event. NIPSCO LLC will continue semi-annual groundwater monitoring for a minimum of 28 years (30-years total), or a shorter duration and/or frequency if changes in regulations allow. If groundwater concentrations do not meet the groundwater benchmarks, NIPSCO LLC will continue groundwater monitoring beyond the nominal 30 years.

Consistent with the CCR Rule monitoring requirements, the post-closure monitoring parameter list will include:

| | |
|---|---|
| Field-based water quality parameters | pH, specific conductivity, temperature, turbidity, oxidation-reduction potential |
| 40 CFR, Part 257 Appendix III Detection Monitoring Parameters | Boron, calcium, chloride, fluoride, sulfate, total dissolved solids, pH |
| 40 CFR, Part 257 Appendix IV Assessment Monitoring Parameters | Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, selenium, thallium, radium 226 and 228 (combined) |

A detailed discussion of the groundwater monitoring program for the former surface impoundments is presented in Section 9.1 in the Closure Application.

## IV. MAINTENANCE ACTIVITIES (Provide a description of planned maintenance activities and the frequency at which they will be performed. See instructions.)

Inspections will be performed biannually for the following items:

- Final cover area
- Surface water management system
- Groundwater monitoring program
- Site benchmarks and other survey control integrity.

The maintenance activities will depend on the issues observed during the biannual inspections throughout the post-closure care period. The post-closure care plan addresses how the identified issues will be handled in a general sense, with specific remedial efforts determined based on the severity of each identified issue. A schedule for addressing identified issues will be included in the inspection report, again, determined based on the severity of each identified issue.

The maintenance activity for each specific issue will be performed as soon as practical. Initiation of maintenance activities and length of time required to address each issue will vary depending on the issue severity. For example, replacing a missing or broken lock on a groundwater monitoring well protective casing can be performed in a much shorter timeframe than repairing erosion gullies/rills or settlement in the final cover area.

A detailed discussion of the post-closure inspection/maintenance activities for the former surface impoundments is presented in Section 9.2 and Section 9.3, respectively in the Closure Application.

**V. POST-CLOSURE COST ESTIMATE** (See instructions. Note that these estimates are to be presented for the entire post-closure care period rather than on a year basis.)

**A. <u>Cost for Semi-Annual Inspections and Reports</u>**

1. Inspection

| | |
|---|---|
| a. Number of inspections during post-closure period (semi-annual inspections for 30 years) | 60 |
| b. Inspector time required (hrs/insp) | 8 |
| c. Inspector unit cost ($/hr) | $95 |
| d. Inspection cost ($) Line 1a*Line 1b*Line 1c | $45,600 |

2. Report Preparation

| | |
|---|---|
| a. Number of reports during post-closure period | 60 |
| b. Cost per report ($/hr) | $1,200 |
| c. Report cost ($) Line 2a*Line 2b | $72,000 |

| | |
|---|---|
| 3. Inspection and Report Cost ($) | $117,600 |

**B. <u>Cost for Maintenance of Final Cover and Vegetation</u>**

The cost for cover maintenance and vegetation shall be 10% of the cost per Acre calculated for final cover and vegetation in the closure plan.

1. Final Cover Maintenance

| | |
|---|---|
| a. 10% of the cost for placement of final cover and Vegetation (as determined in Item V.G. of the Closure Plan)($/Acre) | $28,620 |
| b. Total area of site permitted for filling (acres) | 16.5 |
| c. Cover Maintenance Cost ($) Line 1a*Line 1b | $472,230 |

## C. Cost for Vegetation Control

Certain areas are required to be mowed per regulation. See instructions.

1. Mowing

| | |
|---|---|
| a. Mowing frequency (visits/30 years) | 60 |
| b. Area to be mowed (acres/visit) | 16.5 |
| c. Mowing unit cost ($/acre) | $150 |
| d. Vegetation Control Cost ($)<br>Line 1a*Line 1b*Line 1c | $148,500 |

## D. Cost for Maintenance of Access Control & Benchmarks

1. Access Control Maintenance

| | |
|---|---|
| a. Access control maintenance frequency (visits/30 years) | NA |
| b. Amount of fence needing replacement (linear feet/visit) | NA |
| c. Fence unit cost ($/linear foot) | NA |
| d. Fence Cost ($)<br>Line 1a*Line 1b*Line 1c | The access control to the former surface impoundments is via the perimeter security fence around the entire BGS facility; therefore, no access control maintenance is required |
| e. Other ($)<br>(Specify) None | NA |
| f. Access Control Maintenance Cost ($)<br>Line 1d + Line 1e | NA |

| | |
|---|---|
| 2. Benchmark Maintenance Cost (if any)($) | $5,000 |
| 3. Access Control & Benchmark Repair Cost ($)<br>Line 1f + Line 2 | $5,000 |

## E. Cost for Leachate Collection System Monitoring and Maintenance

1. Leachate Collection System Inspection

   a. Inspection frequency (insp/30 years) NA

   b. Inspection time required (hrs/insp) NA

   c. Inspection unit labor cost ($/hr) NA

   d. Inspection Cost ($)
   Line 1a*Line 1b*Line 1c NA

2. Leachate Collection System Maintenance

   a. Number of pumps replaced during post-closure (pumps/30 years) NA

   b. Pump unit cost ($/pump) NA

   c. Other ($) NA
   (Specify) _____
   _____
   _____

   d. Leachate System Maintenance ($)
   (Line 2a*Line 2b) + Line 2c NA

3. Leachate Collection Monitoring and Maintenance Cost ($)
   Line 1d + Line 2d NA

## F. Cost for Methane Control System Monitoring and Maintenance

1. Methane Control System Monitoring

   a. Gas monitoring frequency (visits/30 years) NA

   b. Time required to monitor (hrs/visit) NA

   c. Contract lab technician unit labor cost ($/hr) NA

   d. Gas Monitoring Cost ($)
   Line 1a*Line 1b*Line 1c NA

2. Gas Monitoring Well Maintenance

   a. Maintenance frequency (visits/30 years) NA

| | |
|---|---|
| b. Monitoring wells needing maintenance per visit | NA |
| c. Maintenance time required (hrs/well) | NA |
| d. Unit labor cost ($/hr) | NA |
| e. Monitoring and Well Maintenance Cost ($) Line 2a*Line 2b*Line 2c*Line 2d | NA |
| 3. Gas Monitoring and Maintenance Cost ($) Line 1d + Line 2e | NA |

## G. Cost for Groundwater Monitoring System Maintenance

| | |
|---|---|
| 1. Monitoring Well Maintenance | |
| a. Maintenance frequency (visits/30 years) | 5 |
| b. Number of monitoring wells needing maintenance per visit | 1 |
| c. Maintenance time required (hrs/well) | 10 |
| d. Unit labor cost ($/hr) | $70 |
| e. Monitoring Well Maintenance Cost ($) Line 1a*Line 1b*Line 1c*Line 1d | $3,500 |
| 2. Monitoring Well and Parts Replacement | |
| a. Number of wells needing replacement during post-closure period | 5 |
| b. Existing monitoring well sealing unit cost ($/well) | $1,500 |
| c. New monitoring well construction unit cost ($/well) | $3,800 |
| d. Monitoring Well Replacement Cost ($) Line 2a*(Line 2b + Line 1c) | $26,500 |
| e. Number of pumps needing replacement during post-closure period | 10 |
| f. Pump unit cost ($/pump) | $500 |
| g. Pump Cost ($) | $5,000 |

| | |
|---|---|
| Line 2e*Line 2f | |
| 3. Groundwater Monitoring System Maintenance Cost ($)<br>Line 1e + Line 2d + Line 2g | $35,000 |

**H. Cost for Groundwater Monitoring**

| | |
|---|---|
| 1. Groundwater Monitoring | |
| a. Number of required monitoring wells | 21 |
| b. Monitoring frequency<br>(semi-annual sampling for 30 years) | 60 |
| c. Sampling and analysis ($/well) | $970.77 |
| d. Groundwater Monitoring Cost ($)<br>Line 1a*Line 1b*Line 1c | $1,223,170 |

**I. Cost for Leachate Hauling**

| | |
|---|---|
| 1. Leachate Pumping & Hauling | |
| a. Leachate removal frequency<br>(visits/30 years) | NA |
| b. Quantity to be managed off-site<br>(gallons/visit) | NA |
| c. Truck capacity (gallons | NA |
| d. Number of loads/visit<br>Line 1b/Line 1c<br>(round up to the nearest integer) | NA |
| e. Pumping and transportation<br>unit cost( $/load) | NA |
| f. Leachate Hauling Cost ($)<br>Line 1a*Line 1d*Line 1e | NA |

**J. Cost for Leachate Disposal**

| | |
|---|---|
| 1. Leachate Treatment | |
| a. Volume of leachate requiring<br>Disposal (gallons | NA |
| b. Disposal unit cost ($/gal) | NA |

c. Leachate Disposal Cost ($)
Line 1a*Line 1b — NA

## K. Other Costs

Any costs not included in the above items should be included here. These might include drainage ditch, access road, and sedimentation pond maintenance, lift station power costs, etc.

| 1. Activity | Cost |
|---|---|
| Maintenance of storm water control structures e.g., storm water pond, surface water diversions/ditches/channels, etc.: assume one repair to the storm water pond and surface water diversions/ditches/channels e.g., replace turf reinforcing mat, fix erosion rills/gullies, revegetation, fix/replace rock check dams, etc. during the first five years following completion of the closure activities and once every ten years for the remaining 25 years of the post-closure care period. | $26,000 |

2. Total of Other Costs ($) — $26,000

## L. Total Post-Closure Cost Estimate ($) — $2,027,500

(Total of preceding categories)

*A contingency greater than 10 percent is included in the costs.

## VI. SIGNATORY CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the persons who managed the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I further certify that I am authorized to submit this information.

**Signature:** RIAD **Date:** 1/20/2021

**Name:** Richard A. Isaac

**Address:** 8469 Kingsley Drive

Reynoldsburg, Ohio 43068

**Telephone No.:** (614) 440-9923

**Professional Engineer Registration No.:** Indiana 11700594

**ATTACHMENT 2**

# Example Soil Boring Log (GAMW-01)

# BOREHOLE LOG: GAMW-01



PROJECT: NIPSCO Bailly
PROJECT NO.: 164-8171
HOLE DEPTH: 23
DEPTH TO BEDROCK:

BOREHOLE LOCATION: N/A
COORDINATES: N: 2327313.72 E: 2945093.535
GROUND SURFACE ELEV.: 621.26
TOP OF CASING ELEV.: 624.53
DATUM: Indiana West Zone NAD 83

DRILLING METHOD: Direct Push
CORING METHOD:
DRILL RIG: Geoprobe 7720DT
START DATE/TIME: 6/6/2016
END DATE/TIME: 6/6/2016

| Depth Elev. | LITHOLOGY DESCRIPTION | Graphical Log | SAMPLE INFORMATION: Sample No. Or Run No. | Type | PID (ppm) | Soil Rec./Att. Or Core Rec. % | Soil Sample Description Or Discontinuity Data (Depth, Dip, Angle From Core Axis, Type, and Surface Description) | Well Graphic | Well Construction Information |
|---|---|---|---|---|---|---|---|---|---|
| 620.0 | light brown to black fine to medium SAND, some silt, trace gravel | | 1 | DP | | 2 / 4 | 0-2.8': SAND, trace gravel, fine to medium, poorly-graded; brown; non-cohesive, dry, loose. (SP)<br>2.8-3.5': SAND, fine, poorly-graded; light brown, orange mottling; non-cohesive, moist, dense. (SP)<br>3.5-3.75': SAND, some silt, fine, poorly-graded; black; non-cohesive, moist, dense. (SP)<br>3.75-4': SAND, fine; light brown; non-cohesive, dry, loose. (SP) | | Bentonite grout mix 0-9 ft-bgs |
| | | | 2 | DP | | 3.8 / 4 | 4-5.4': SAND, trace fine rounded gravel, fine to medium, poorly-graded; light brown; non-cohesive, moist, dense. (SP)<br>5.4-6.3': SAND, fine to medium, poorly-graded; orange; non-cohesive, moist, dense. (SP)<br>6.3-8': SAND, fine to medium, poorly-graded; light tan, orange mottling. (SP) | | |
| 615.0 | orange to light brown fine to medium SAND, some silt, trace gravel | | 3 | DP | | 2.1 / 4 | 8-10.1': SAND, fine to medium, poorly-graded; light brown, dark brown streaking; non-cohesive, moist, dense. (SP)<br>10.1-12': SAND, fine to medium, poorly-graded; light brown, orange mottling; non-cohesive, moist, dense. (SP) | | Bentonite chips 9-11 ft-bgs |
| 610.0 | | | 4 | DP | | 3.8 / 4 | 12-13.3': SAND, little fine subrounded gravel, fine to medium, poorly-graded; orange to light brown; non-cohesive, dry, loose. (SP)<br>13.3-16': SAND, fine to medium, poorly-graded; orange; non-cohesive, wet, dense. (SP) | | Filter Pack #5 Sand 11-23 ft-bgs<br>2 PVC Screen slot 0.010 13-23 ft-bgs |
| 605.0 | | | 5 | DP | | 2.6 / 4 | 16-19.25': SAND, fine to medium, poorly-graded; light orange; non-cohesive, wet, dense. (SP)<br>19.25-19.3': SAND and SILT, poorly-graded; black; non-cohesive, wet, dense. (SM)<br>19.3-19.75': SAND, fine to medium, poorly-graded; light brown, black streaking; non-cohesive, wet, dense. (SP)<br>19.75-19.8': SAND and SILT, poorly-graded; black; non-cohesive, wet, dense. (SM)<br>19.8-20': SAND, fine to medium, poorly-graded; light brown, black streaking; non-cohesive, wet, dense. (SP) | | |
| 600.0 | light brown to black fine to medium SAND, some silt | | 6 | DP | | 3 / 3 | 20-23': SAND, 3-inch black sand and silt band, fine to medium, poorly-graded; brown; non-cohesive, wet, dense. (SP) | | |

LITHOLOGY LEGEND

USCS Poorly-graded Sand (SP)

DRILLING COMPANY: Earth Exploration
DRILLER: Zach
DRILL RIG: Geoprobe 7720DT

LOGGED BY: DSD
CHECKED BY: JMR
DATE: 3/22/17

wsp

NIPSCO RMSGS 164171 NIPSCO CCR BAILLY.GPJ GOLDER NH 2011.GDT 7/24/23

wsp.com

| | |
|---|---|
| **From:** | HARMLESS, MARTY |
| **To:** | McCormick, Debra J |
| **Subject:** | SW Program ID 64-014 FW: NIPSCO LLC Bailly Generating Station Post-Closure Groundwater Monitoring Well Network Device Installation Plan Revision 1 |
| **Date:** | Tuesday, July 2, 2024 2:45:09 PM |
| **Attachments:** | NIPSCO LLC Bailly Generating Station Post-Closure Groundwater Monitoring Well Network Device Installation Plan Revision 1.msg |

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Can you please enter into the VFC?