REMEDIAL INVESTIGATION & INTERIM REMEDIAL MEASURES WORK PLAN

Commercial Property
286-330 NYS West Route 59
Portion of Parcel ID: 57.19-1-10.1
Town of Clarkstown (Nanuet), Rockland County, New York
NYSDEC Site ID: C344091

Prepared for:

Thruway Plaza of Rockland Inc.
c/o Lynmark Group
106 Airport Executive Park
Nanuet, New York 10954

Prepared by:

DYNAMIC EARTH

826 Newtown Yardley Road, Suite 201
Newtown, Pennsylvania 18940

Christopher J. Zieger, LSRP
Senior Principal

Summer Hammouda
Project Manager

Dynamic Earth Project No. 1685-22-01023
July 19, 2024

TABLE OF CONTENTS

LIST OF ATTACHMENTS

TABLES

FIGURES

APPENDICES

EXECUTIVE SUMMARY

Dynamic Earth, LLC (Dynamic Earth) was retained by Thruway Plaza of Rockland, Inc. to prepare a *Remedial Investigation & Interim Remedial Measures Work Plan* to detail the anticipated remedial investigation and remedial measures necessary to address the groundwater impacts identified at the property located at 286-330 NYS West Route 59 (Portion of Parcel ID 57.19-1-10.0) in the Town of Clarkstown (Nanuet), Rockland County, New York (hereinafter referred to as the "Site").

The Site is defined as a 0.039-acre portion of a larger 6.5-acre parcel and corresponds with the tenant leasehold space within the former building that was demolished in 2022. The Site formerly operated as a dry-cleaning facility under Charles' French Cleaners, Nanuet Cleaners, Outstanding Cleaners and/or Lake Cleaners between 1992 and 2013. Currently, the Site is developed with asphalt-paved parking/driveway areas, concrete sidewalks/curbing and landscaped areas associated with the surrounding commercial operations which operate on the parcel. The overall parcel is currently developed with four commercial buildings and is occupied by Dunkin Donuts, QuickChek, Taco Bell/KFC and cell towers.

Due diligence environmental investigations conducted by others identified chlorinated volatile organic compounds (CVOCs) associated with former dry-cleaning operations, including tetrachloroethene (PCE), trichloroethene (TCE), 1,2-dichloroethane, cis-1,2-dichloroethene and vinyl chloride, in select groundwater samples at concentrations exceeding the New York State Department of Environmental Conservation (NYSDEC) Ambient Water Quality Standards (AWQS). Accordingly, on June 20, 2024, a Brownfield Cleanup Agreement (BCA) was executed between the NYSDEC and Thruway Plaza of Rockland, Inc. to memorialize Site eligibility in the Brownfield Cleanup Program (BCP).

To further evaluate subsurface conditions and determine the extent of known groundwater impacts, Dynamic Earth proposes the completion of the following remedial investigation (RI) activities:

- installation and subsequent sampling of four permanent overburden and one permanent bedrock monitor wells; and
- installation of soil borings and subsequent soil sample collection to evaluate all regulated compounds within the boundaries of the Site.

In conjunction with the above-referenced RI activities, Dynamic Earth proposes the completion of interim remedial measures (IRMs) to reduce/eliminate receptor exposure and to further contain the movement of contaminants in groundwater. The IRMs will include the injection of groundwater amendments including emulsified vegetable oil (EVO), a sodium bicarbonate pH buffer, sodium ascorbate water amendment and an inoculation of bacterial cultures, to reduce contaminant concentrations to levels appropriate for monitored natural attenuation (MNA) at the Site.

1.0 INTRODUCTION

Dynamic Earth, LLC (Dynamic Earth) was retained to prepare a *Remedial Investigation & Interim Remedial Measures Workplan* to detail the anticipated supplemental investigation and interim remediation of groundwater impacts identified at the property located at 286-330 NYS West Route 59 (Portion of Parcel ID 57.19-1-10.0) in the Town of Clarkstown (Nanuet), Rockland County, New York (hereinafter referred to as the "Site").

The Site is comprised of a 0.039-acre portion of a larger 6.5-acre parcel and corresponds to the tenant leasehold space within the former building that was demolished in 2022. The Site formerly operated as a dry-cleaning facility under Charles' French Cleaners, Nanuet Cleaners, Outstanding Cleaners and/or Lake Cleaners between 1992 and 2013. On June 20, 2024, a BCA was executed between the NYSDEC and Thruway Plaza of Rockland, Inc. to memorialize that the Site was eligible to participate in the BCP under Site No. C344091. A *Parcel Location Map* and *Site and AOC Location Plan* are included as Figures 1 and 2, respectively.

1.1 Purpose & Scope

This report documents the findings and conclusions of the investigation activities conducted at the Site to date by others and outlines anticipated remedial investigation (RI) activities and interim remedial measures (IRMs) to be implemented. Specifically, Dynamic Earth will document the procedures necessary to delineate the extent of the chlorinated volatile organic compounds (CVOCs) identified by others in groundwater, evaluate subsurface soil conditions within the Site's boundaries, and conduct bioremediation injections to limit the further migration of groundwater impacts.

All tasks will be performed in accordance with the New York State Department of Environmental Conservation (NYSDEC) Law and the DER-10 Technical Guidance for Site Investigation and Remediation. The Site will be investigated and remediated by a Qualified Environmental Professional (QEP), as defined in paragraph 1.3(b)49 of DER-10. Specifically, the QEP for the Site will be Christopher J. Zieger, who is a Licensed Site Remediation Professional (LSRP) in the State of New Jersey.

1.2 NYSDEC Remediation Standards

Dynamic Earth will compare laboratory analytical data results for all soil samples collected to the NYSDEC Unrestricted Use Soil Cleanup Objectives (UUSCOs) and Restricted Use Soil Cleanup Objective (RUSCOs) which included the Protection of Public Health (Residential, Restricted Residential, Commercial, and Industrial) Soil Cleanup Objectives (SCOs), Protection of Ecological Resources Soil Cleanup Objectives (PERSCOs) and Protection of Groundwater Soil Cleanup Objectives (PGWSCOs). The laboratory analytical data results for all groundwater samples collected will be compared to the NYSDEC Ambient Water Quality Standards (AWQS).

1.3 Anticipated NYSDEC Remedial Timeframes

The regulatory timeframes for completion of the remedial investigation and remedial action for the Site are set forth in the BCA executed for the Site on June 20, 2024. As the Brownfield Cleanup Program requires NYSDEC Project Manager approval and public participation comment periods as a component of the remedial program, the following timeframes are projected and subject to change accordingly.

Required Submissions	Estimated Timeframe
Submission of Citizen Public Participation Plan	July 10, 2024*
Submission of Remedial Investigation and Interim Remedial Measures Work Plan	July 19, 2024
Submission of Final Remedial Investigation Report	February 28, 2025
Submission of Remedial Action Work Plan	February 28, 2025
Submission of Final Engineering Report	March 31, 2027
Submission of Site Management Plan	March 31, 2027
NYSDEC Certificate of Completion Issuance	April 30, 2027
*Submitted to NYSDEC under separate cover on July 10, 2024.	

1.4 Health and Safety Protocols

A Site-Specific Health and Safety Plan (HASP) is provided in Appendix A. A Community Air Monitoring Program (CAMP) is included within the Site-Specific HASP to document the continuous monitoring activities to be required during ground intrusive activities (i.e., soil boring and monitor well installations) and the periodic monitoring of volatile organic compounds (VOCs) during non-intrusive activities, such as the collection of soil and/or groundwater samples from existing monitor wells.

1.5 Quality Assurance/Quality Control Protocols

A Site-Specific Quality Assurance Project Plan (QAPP) is provided in Appendix B. Samples collected during Dynamic Earth's investigation and remediation will be transported under proper chain of custody procedures to Pace Laboratories (Pace, New York Lab Certification #11634). Analytical results and quality assurance/quality control (QA/QC) data establishing proper holding times, handling, analytical methodology and detection limits in accordance with NYSDEC protocol will be included within subsequent submissions. At this stage, Dynamic Earth does not anticipate the need for a designated Quality Assurance Officer (QAO), as the Site is small and non-complex, and does not require non-routine analytical methods or sampling techniques.

2.0 PHYSICAL SETTING

2.1 Site Description/Land Use

The Site is comprised of 0.039 acres and corresponds to the former drycleaning tenant leasehold space within the former commercial strip center. The structure was demolished in 2022. The Site formerly operated as a dry-cleaning facility under the names Charles' French Cleaners, Nanuet Cleaners, Outstanding Cleaners and/or Lake Cleaners between 1992 and 2013.

On July 12, 2024, Dynamic Earth conducted an inspection of the Site to evaluate current Site conditions. Currently, the Site is developed with asphalt-paved parking/driveway areas, concrete sidewalks/curbing and landscaped areas associated with the surrounding commercial operations which operate on Parcel ID: 57.19-1-10.1. No access restrictions were observed, and no sensitive ecological/human health receptors were observed on or within the immediate Site vicinity.

2.2 Site Topography & Drainage Patterns

Topography at the Site is relatively flat with an average elevation of approximately 400 feet above mean sea level (msl). Overland stormwater is anticipated to flow to the west towards stormwater inlets and a rain garden located adjacent to the Site.

2.3 Geology

The Site is situated in the Newark Lowlands Physiographic Province of New York. Based on the Surficial Geologic Map of New York – Lower Hudson Sheet dated 1989, the Site is underlain by Till (t) which consists of variable textures from boulders to silt, usually poorly sorted sand-rich diamictite, permeability varies with compaction, deposited beneath glacier ice. Thickness ranges from 1-50 meters. Based on information obtained from the Geologic Map of New York Lower Hudson Sheet dated 1995, bedrock at the Site was identified as the Newark Group; primarily the Brunswick Formation, characterized as undivided sandstone, conglomerate, sand, stone, siltstone, mudstone and arkose. Thickness ranges from 0.0 to 2,100 meters. Information obtained from the United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) Web Soil Survey indicates that surface soils at the Site consist of Urban Land (UX) which is comprised of surfaces covered by pavement, concrete, buildings, and other structures underlain by disturbed and natural soil materials.

2.3.1 Site-Specific Soils

Based on information obtained in previous Site investigations by others, subsurface materials encountered at the Site generally consisted of brown silty medium to fine grained sand with some clay to a maximum depth explored of 28 feet bgs. Trace amounts of asphalt, gravel, sand and red brick were observed in select borings to a depth of approximately eight feet bgs.

2.4 Hydrogeology

Based on information obtained in previous Site investigations, groundwater was encountered between 16.8 and 22.6 feet bgs. Groundwater was determined to flow northwest. The bedrock aquifer underlying the Site is the Newark basin aquifer.

3.0 PROJECT BACKGROUND & TECHNICAL OVERVIEW

3.1 Site History

Historically, the Site was undeveloped until the early 1960s when the former commercial building was constructed. Between 1992 and 2017, the Site was occupied by a drycleaning facility operating under Charles' French Cleaners, Nanuet Cleaners, Outstanding Cleaners and Lake Cleaners. The former commercial building housing the former drycleaner and gas station were demolished in 2022. The Site has been redeveloped with asphalt-paved driveway driveway/parking areas, and landscaping since this time.

3.2 Previous Investigation Summary

Dynamic Earth reviewed the following previously conducted environmental reports prepared for the Site and/or overall parcel:

- *Phase I Environmental Site Assessment* prepared by Melik-Tully & Associates (MTA) dated January 11, 2021;
- *Groundwater Baseline Investigation* prepared by MTA dated January 12, 2021;
- *Phase I Environmental Site Assessment Report* prepared by LCS, Inc. dated February 20, 2022;
- *Limited and Focused Subsurface Investigation Report* prepared by Subsurface Investigations Geology, D.P.C. (SIG) dated March 30, 2022; and
- *Supplemental Limited and Focused Subsurface Investigation Report* prepared by SIG dated May 23, 2022.

Copies of these reports are available for review in the document repository established for this Site, located at the Nanuet Public Library.

3.2.1 Due Diligence Summary

The Phase I Environmental Site Assessment (ESA) reports conducted for Parcel ID: 57.19-1-10.1 identified former drycleaning operations as a recognized environmental condition (REC) requiring further investigation. A detailed summary of investigation activities conducted to date associated with this REC is included in Section 3.3 below. No additional RECs were identified on the Site within the Phase I ESA reports.

The former Exxon Gas Station was identified as a historic recognized environmental condition (HREC) for the larger parcel. Five underground storage tanks (USTs) were removed in 1991, including one 1,000-gallon fuel oil UST, one 1,000-gallon UST of unknown content, one 3,000-gallon gasoline UST and two 6,000-gallon gasoline USTs. Petroleum hydrocarbon contamination was identified in soil and groundwater in the vicinity of the former pump islands when the former USTs were removed. Spill No. 9104896 was assigned, and the USTs/associated piping were removed in August 1991. A No Further Action designation was issued by the NYSDEC for Spill No. 910486 associated with the Exxon Gas Station on July 25, 2002. No further investigation is required for this former discharge.

3.2.2 Site Investigation Summary

Subsurface investigations included the collection of soil and groundwater samples to evaluate historic Site operations as a drycleaning facility. A limited investigation was initially conducted in 2021 which included the installation of five soil borings (BL-1 through BL-5) and five temporary wellpoints (TW-1 through TW-5). Soil samples in the vicinity of the former drycleaner were collected and analyzed semi-volatile organic compounds (SVOCs) and volatile organic compounds (VOCs). Additional soil samples collected from the former UST locations were analyzed for SVOCs, VOCs, metals, pesticides and polychlorinated biphenyls (PCBs). One groundwater sample was collected and analyzed for VOCs. Soil analytical data results did not identify compounds at concentrations exceeding the Unrestricted Use Soil Cleanup Objectives (UUSSCOs) or Protection of Groundwater Soil Cleanup Objectives (PGWSCOs) in any of the samples collected. Similarly, groundwater analytical data results did not identify compounds above the Ambient Water Quality Standards (AWQS) in any of the samples collected.

A secondary investigation was conducted in 2022 by SIG, which included the collection of 25 soil samples and 22 groundwater samples analyzed for VOCs. With the exception of acetone, which is acknowledged by the United States Environmental Protection Agency (USEPA) as a known common laboratory contaminant, no exceedances of the UUSCOs were identified in the soil samples. Chlorinated VOCs associated with former dry-cleaning operations including tetrachloroethene (PCE), trichloroethene (TCE), 1,2-dichloroethane, cis-1,2-dichloroethene and vinyl chloride were identified in select groundwater samples exceeding the AWQS. Toluene, a compound commonly associated with petroleum impacts, was also identified in three temporary wellpoints at concentrations exceeding the AWQS. SIG concluded that the toluene detections may have been a result of laboratory contamination.

While the horizontal and vertical extent of chlorinated VOC impacts has not been fully defined, the groundwater contaminant distribution illustrated that the chlorinated VOC impacts in groundwater are localized in the center of the Site's overall parcel proximate to the former dry cleaner leasehold area. Further investigation and remedial efforts were recommended. The maximum concentrations identified by others in Site groundwater are documented on Table 1. A *Groundwater Sample Location & Contaminant Concentration Plan* depicting previous sample locations and their associated analytical data results is included as Figure 3.

3.3 NYSDEC Brownfield Cleanup Program

On June 20, 2024, a Brownfield Cleanup Agreement (BCA) was executed between the NYSDEC and Thruway Plaza of Rockland, Inc. to memorialize that the Site was eligible to participate in the Brownfield Cleanup Program (BCP) under Site No. C344091. The goal of the BCP is to encourage private-sector cleanup of brownfields and to promote their redevelopment as a means to revitalize economically blighted communities. The Site's BCP boundaries were limited to a 0.039-acre portion of the Site based on the results of the groundwater sampling detailed above, corresponding to the boundary of the former dry-cleaner leasehold.

4.0 REMEDIAL INVESTIGATION WORK PLAN OBJECTIVES

As noted above, the extent of the area of concern (AOC) is Site-wide (0.039-acres) and corresponds to the former dry-cleaner leasehold. The objective of the RI is to delineate the extent of CVOC groundwater contamination associated with AOC-1: Former Dry-Cleaning Operations and to evaluate subsurface soil quality for all regulated compounds to ensure no residual soil contamination remains. Accordingly, the sections below document anticipated delineation and characterization activities to be conducted on- and off-Site. Please note that this plan is preliminary and contingent upon the approval of the NYSDEC. In the event that additional investigation and/or remediation is required, Dynamic Earth will revise the Remedial Investigation Work Plan accordingly.

4.1 Monitoring Well Installation Activities

Dynamic Earth anticipates that the remedial investigation can be completed with the installation and subsequent groundwater sampling of four overburden monitoring wells and one bedrock monitoring well. These wells will be installed within the CVOC plume source area, downgradient, and side-gradient locations to evaluate current groundwater quality and to delineate the extent of groundwater impacts vertically and horizontally.

Dynamic Earth will mobilize to the Site with a New York-licensed well driller to install four overburden monitoring wells to maximum depths of 25 feet below ground surface (bgs) or refusal. The overburden wells will be constructed using a two-inch diameter PVC riser and 0.010-inch slotted screen material. Overburden wells will be installed utilizing no more than five to ten feet of screen to span the water bearing zone. One bedrock monitoring well will be installed to a maximum depth of 50 feet bgs and will be double cased with steel penetrating a minimum of ten feet into competent bedrock. The bedrock well will be constructed using a four-inch diameter outer steel casing to the top of bedrock and two-inch diameter PVC riser and slotted screen. Bedrock wells will be installed utilizing no more than ten feet of screen to span the water bearing zone based on field observations.

Hollow-stem auger/air rotary drilling equipment will be utilized to complete the well installations. Following the installation of the monitoring wells, the wells will be developed to remove any sediments or drilling debris in the well casings and well completion reports will be submitted to the NYSDEC. Proposed monitor well locations are depicted on the *Proposed Groundwater & Soil Sample Location Plan* included as Figure 4.

4.1.1 Management of Investigation Derived Wastes

Waste generated during RI activities, including soil cuttings and development/purge water, will be managed in accordance with NYSDEC solid and hazardous waste rules and regulations (6 NYCRR Parts 360, 364 and 370). Specifically, all development water and soil cuttings generated during monitor well installation activities will be placed in appropriately labeled 55-gallon steel drums, and stored in a location that will not disrupt Site operations, pending off-Site disposal at a facility licensed to accept such waste.

4.2 Monitoring Well Sampling Activities

Two weeks following completion of the monitoring well installations, Dynamic Earth will conduct monitoring well sampling activities using low flow purging and sampling methods. Up to five groundwater samples will be collected from the monitoring wells and submitted to a New York-certified laboratory for VOC analysis based on the results of the prior investigations conducted by others. In addition, QA/QC samples, including one trip blank, one field blank, one duplicate and one matrix spike/matrix spike duplicate will also be prepared and submitted for laboratory analysis.

In the event that the results of the groundwater sampling activities identify groundwater impacts which require further delineation, the installation of temporary wellpoints will be conducted to facilitate the collection of additional groundwater samples. The NYSDEC Project Manager will be notified prior to any subsequent mobilizations for coordination and approval.

4.3 Soil Characterization & Evaluation Activities

As required by NYSDEC, a soil evaluation for all regulated compounds is required as a component of the Brownfield Cleanup Program (BCP). As the previous sampling conducted by SIG did not include an investigation beyond the contaminants of concern (i.e., VOCs), Dynamic Earth will install two soil borings within the Site boundary to facilitate the collection of up to two discrete soil samples.

All soil encountered during boring installation and/or monitor well installation activities will be field screened using a photoionization detector (PID). If evidence of soil impacts is identified, soil samples will be collected from the six-inch depth interval exhibiting evidence of impacts. Soil samples will be submitted to an NYSDEC-certified laboratory and analyzed for the NYSDEC initial soil cleanup objectives (SCO) priority list, per- and polyfluorinated alkyl substances (PFAS) and 1,4-dioxane.

In the event that contaminants are identified in soil, additional investigation activities may be required. Proposed boring locations are depicted on the *Proposed Groundwater & Soil Sample Location Plan* included as Figure 4.

4.4 RI Sample Collection and Analyses Summary

The below table summarizes the proposed sample locations and analyses to be conducted during the RI:

Proposed Sample Location	Matrix	Sample Depth (ft) or Water Bearing Zone	Analytical Parameters	USEPA Sampling Method	Rationale
MW-1	Groundwater	Overburden	VOCs	Method 8260D	Source Area Confirmation
MW-1BR	Groundwater	Bedrock	VOCs	Method 8260D	Vertical Delineation
MW-2	Groundwater	Overburden	VOCs	Method 8260D	Horizontal Delineation
MW-3	Groundwater	Overburden	VOCs	Method 8260D	Horizontal Delineation
MW-4	Groundwater	Overburden	VOCs	Method 8260D	Horizontal Delineation

S-1	Soil	TBD	TCL/TAL 1,4-Dioxane PFAS	Method 8260 Method 8270 Method 8081 Method 8082 Method 6010 Method 6020 Method 7471 Method 1633	Initial Characterization
S-2	Soil	TBD	TCL/TAL 1,4-Dioxane PFAS	Method 8260 Method 8270 Method 8081 Method 8082 Method 6010 Method 6020 Method 7471 Method 1633	Initial Characterization
FB	Aqueous	N/A	TCL/TAL 1,4-Dioxane PFAS	Method 8260 Method 8270 Method 8081 Method 8082 Method 6010 Method 6020 Method 7471 Method 1633	QA/QC*
TB	Aqueous	N/A	VOCs	Method 8260D	QA/QC*
DUP	Groundwater	TBD	VOCs	Method 8260D	QA/QC**
MS/MS DUP	Groundwater	TBD	VOCs	Method 8260D	QA/QC***

Notes:
- TBD: To be determined based on results of field screening evaluations. If evidence of soil impacts is identified, soil samples will be collected from the six-inch depth interval exhibiting the same. Otherwise, soil samples will be collected from the six-inch interval above observed groundwater.
- N/A: Not Applicable
* Field Blank and Trip Blank – one per sample event
** Duplicate – one per 20 samples
*** Matrix Spike/Matrix Spike Duplicate – one per 20 samples

5.0 INTERIM REMEDIAL WORK PLAN OBJECTIVES

In conjunction with the proposed RI activities detailed in Section 4.0, Dynamic Earth proposes completion of the following interim remedial measures (IRMs) to reduce/eliminate receptor exposure and to further contain the movement of contaminants in groundwater

5.1 Pre-Injection Baseline Sampling

As discussed above, four overburden monitor wells will be installed within the CVOC plume source area, downgradient locations and side-gradient locations to a maximum depth of 25 feet below ground surface or refusal. Dynamic Earth proposed the sampling of these monitor wells to evaluate current groundwater conditions and determine the extent of groundwater impacts identified by others.

In order to measure the effectiveness of the interim remedial measures (IRM), groundwater sampling events will be necessary. Dynamic Earth assumes the groundwater sampling activities described in Section 4.2 above will be completed approximately two weeks prior to the commencement of the IRMs and as such, can be utilized as the pre-injection baseline sampling event in advance of bioremediation injections. To supplement the analyses required to further evaluate and delineate groundwater impacts, groundwater samples will also be analyzed for nitrate, chloride, sulfate and total organic carbon (TOC). Along with laboratory analyses, field measurements will be collected during this sampling event, including oxidation reduction potential (ORP), pH, dissolved oxygen (DO) and temperature. A slug test will also be performed to estimate transmissivity and hydraulic conductivity in advance of the injection events.

The analytical data results of this sampling event will be utilized to establish a pre-injection baseline and will subsequently be compared against analytical data results of the post-injection sampling event to determine whether additional action is necessary.

5.2 Interim Remedial Measures – Groundwater Injections

To reduce/eliminate receptor exposure, further contain the movement of contaminants in groundwater and to reach a goal of reducing current concentrations of contaminants of concern to levels appropriate for monitored natural attenuation (MNA) at the Site, Dynamic Earth and a remediation contractor will mobilize to the Site for up to six days to install temporary injection points and subsequently inject emulsified vegetable oil (EVO) with a sodium bicarbonate pH buffer additive, sodium ascorbate water amendment and an inoculation of TSI-DC bacterial culture containing a microbial culture known to degrade chlorinated compounds all the way through and including vinyl chloride. The remedial material will be delivered via direct push injection methods into overburden formations at the Site. Approximately 2,583 pounds of EVO will be injected with 10 liters of TSI-DC across an estimated 4,200 square foot injection area. These materials would be diluted with approximately 2,835 gallons of water and delivered to at least 42 direct push injection locations. The proposed injection area is depicted on Figure 4.

The injection borings will be advanced by direct push to depths ranging from 23 to 26.5 feet bgs with delivery of the remedial material from 12 feet below grade. Delivery volumes at each point could vary depending upon final dilution volume and number of points targeted. A potable water holding tank (typically 1,000-gallons in capacity) will be provided and staged by the EVO dilution system in order to bulk and stage potable water.

5.3 Post Injection Groundwater Sampling

Approximately two months after the completion of the groundwater injections, Dynamic Earth will remobilize to the Site to collect groundwater samples from the Site monitor well network in order to evaluate groundwater quality post-remedial injections. The groundwater samples will be submitted to an NYSDEC-certified laboratory for VOCs, nitrate, chloride, sulfate and TOC analyses. Along with the laboratory analyses, field measurements will be collected during this sampling event, including oxidation reduction potential (ORP), pH, dissolved oxygen (DO) and temperature.

6.0 RECEPTOR EVALUATION

Nearby receptors as documented in the sections below are depicted on Figure 5. A Qualitative Exposure Assessment (QEA) will be prepared as a component of the Remedial Investigation Report to describe the nature and size of the population currently exposed to the contamination associated with the Site, to document anticipated future land/groundwater use, to identify foreseeable exposure pathways and to evaluate contaminant fate and transport.

6.1 Land Use

Dynamic Earth evaluated land use within a half mile radius of the Site including proximity of the Site to sensitive human and ecological receptors. No residential properties, schools or parks are located on or adjacent to the Site. The nearest residential property is located approximately 509 feet to the south, with larger residential developments located approximately 610 feet to the south, 1,857 feet to the east and 2,719 feet to the northwest. Dynamic Earth knows of no proposed changes to land use at the Site or surrounding properties in which the municipality has approved.

6.2 Groundwater

Dynamic Earth conducted a well search using the NYSDEC Water Well Information Search tool to evaluate the locations of public/private drinking water supply wells within a half-mile radius of the Site. The results of the initial survey did not identify any potable wells within the applicable search radius. Additionally, Dynamic Earth evaluated major infrastructure (i.e., storm drains, sewers, tunnels, subways, etc.) on- and off-Site to determine whether such infrastructure may influence contaminant migration. At this time, no such infrastructure was identified as a preferential pathway for the migration of groundwater and associated potential vapor impacts.

6.3 Vapor Intrusion

A limited evaluation into the potential for vapor intrusion concerns was conducted by Dynamic Earth based on the known extent of the groundwater contaminant plume. The only potential receptor identified was the nearest building (QuickChek), which was subsequently installed with a passive vapor intrusion mitigation system (VIMS) during redevelopment activities as a precautionary measure. No additional potential receptors were identified; however, further evaluation of the vapor intrusion pathway will be conducted following receipt of the analytical data results to be obtained during RI activities.

6.4 Ecological

The purpose of the ecological receptor evaluation is to determine if any environmentally sensitive natural resources, other than groundwater, are present on or adjacent to the Site or area of concern, and to determine if said resources may be impacted by contamination from the Site or area of concern. Based on information obtained from the National Wetlands Inventory and NYSDEC Environmental Resource Mapper, no state or national wetlands were identified on or adjacent to the Site. The nearest wetlands are located approximately 2,600 feet to the east and 1,300 feet to the northeast of the Site. No impacts from the Site are anticipated to migrate to these receptors. The nearest surface water bodies are the Nauraushaun Brook located 2,500 feet to the east and 1,400 feet to the northeast, and the Pascack Brook located 2,000 feet to the west. Based on contaminant concentrations and groundwater flow direction, Dynamic Earth does not anticipate the migration of groundwater impacts to these bodies of water. As the Site is a point source of contamination (i.e., dry cleaner), with no widespread soil contamination, and no ecological receptors on or in the vicinity of the Site, a fish and wildlife resource impact analysis is not anticipated to be necessary.

7.0 REPORTING & SCHEDULE OF ACTIVITIES

The following implementation schedule is proposed to complete the investigation and subsequent remediation of the impacts identified on-Site in accordance with the requirements of the executed BCA:

Required Tasks	Estimated Start Date	Estimated Completion Date
Submission of Citizen Public Participation Plan	N/A	July 10, 2024*
Submission of Remedial Investigation & Interim Remedial Measures Work Plan	N/A	July 19, 2024
Soil Sampling and Evaluation Services	September 30, 2024	October 31, 2024
Remedial Investigation of Groundwater	September 30, 2024	October 31, 2024
Interim Remedial Measures (Injections & Post-Injection Sampling)	November 1, 2024	December 31, 2024
Submission of Remedial Investigation Report	N/A	February 28, 2025
Submission of Remedial Action Work Plan	N/A	February 28, 2025
Monitored Natural Attenuation Groundwater Monitoring	March 1, 2025	March 1, 2027
Submission of Site Management Plan	N/A	March 31, 2027
Submission of Final Engineering Report	N/A	March 31, 2027
NYSDEC Certificate of Completion Issuance	N/A	April 30, 2027
*Submitted to NYSDEC under separate cover on July 10, 2024.		

The above-listed scope of work and associated timeframe is projected at this time and are subject to the approval of the NYSDEC BCP Project Manager.

8.0 CITIZEN PARTICIPATION ACTIVITIES

The Citizen Participation Plan (CPP), which details citizen participation activities, is under review by NYSDEC BCP Project Manager. Once approved, the CPP will be finalized and distributed to the document repository for public review. A fact sheet will be distributed to the Site Contact List by the NYSDEC BCP Project Manager which will detail the proposed RI activities as documented herein. Additionally, the fact sheet will announce a 30-day public comment period for the RI/IRM Work Plan.

A list of the names, contact information and roles of the principal personnel who will participate in the investigation activities described herein, including the project manager, contractor and subcontractor contacts, is included in Appendix C. Qualifications of these personnel are included as Appendix D. In the event that the principal personnel designated for the project change, information for new personnel will be submitted to the NYSDEC BCP Project Manager for approval.

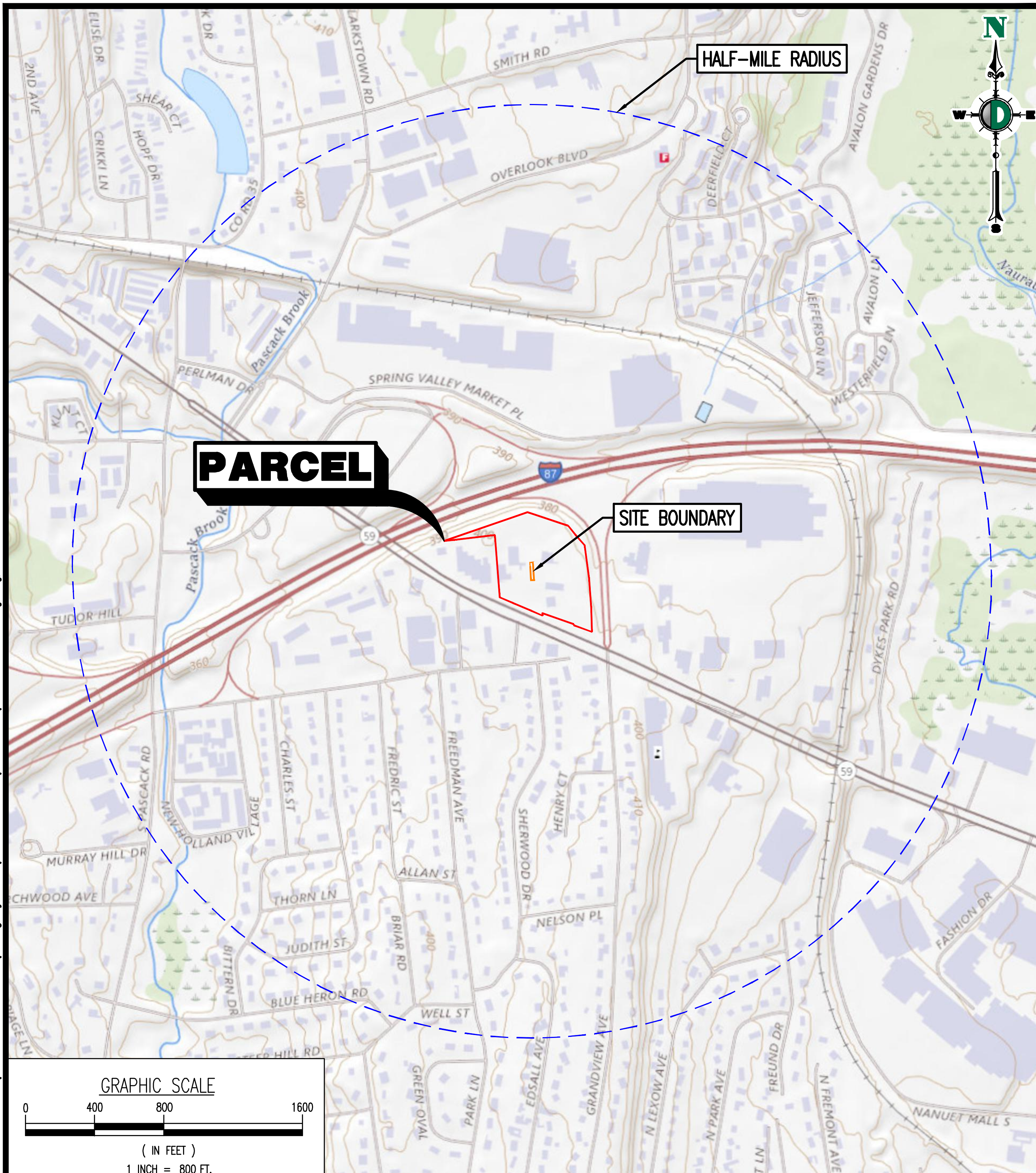
Tables

Table 1: Groundwater Analytical Data Summary
Thruway Plaza of Rockland Associates
286-330 NYS West Route 59
Town of Clarkstown (Nanuet), Rockland County, New York
Dynamic Earth Project No. 1685-22-01023

Analytes > AWQS	Detections > AWQS	Max Detection (ppb)	AWQS (ppb)
Tetrachloroethene (PCE)	1	154	5
Toluene	2	8.24	5
Trichloroethene (TCE)	1	9.73	5

AWQS - Ambient Water Quality Standards
ppb - parts per billion

Figures



DYNAMIC EARTH, LLC

1904 Main Street - Lake Como, NJ 07719
T: 732.280.0830 - F: 732.974.3521
www.dynamic-earth.com

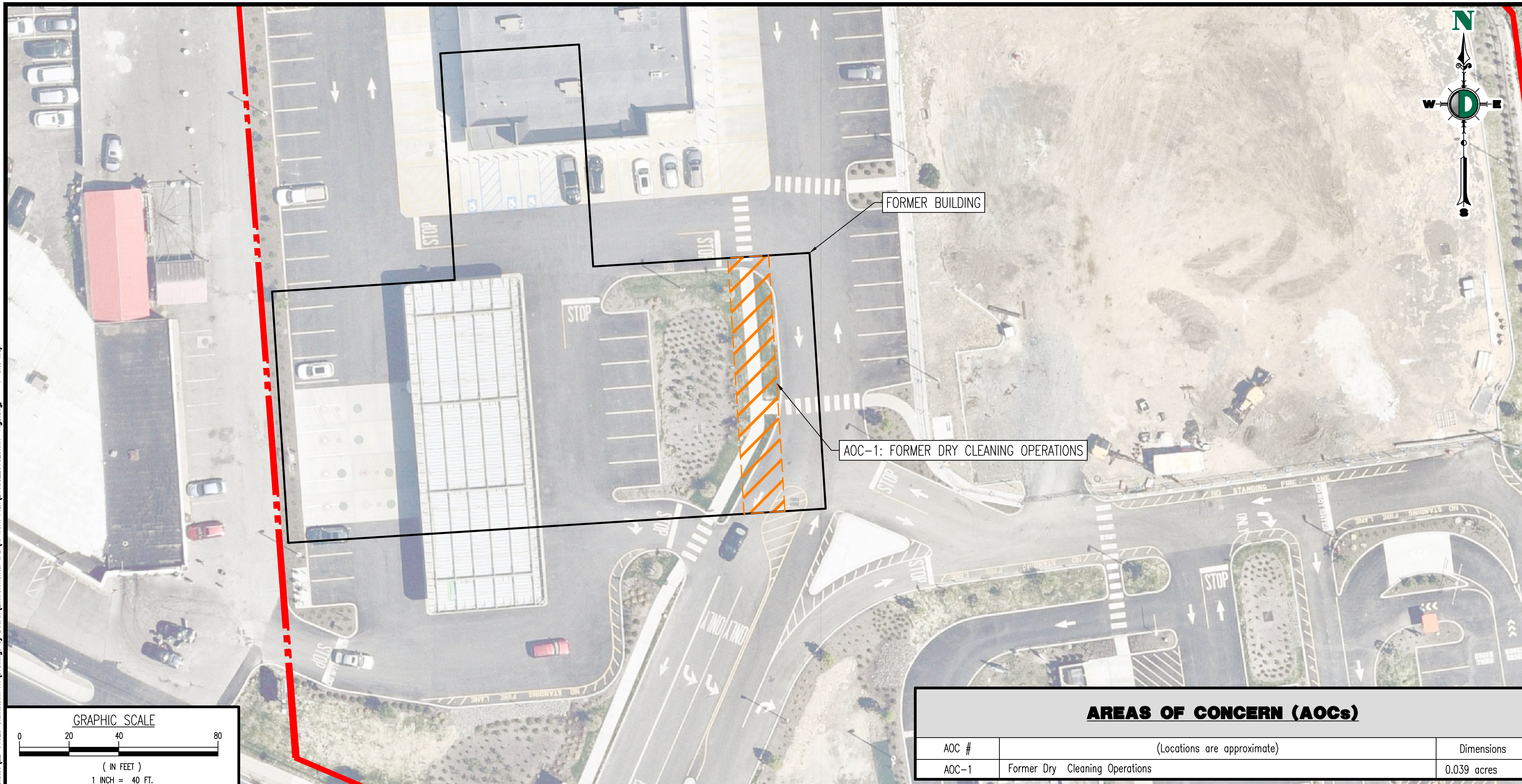
TITLE: **FIGURE 1: PARCEL LOCATION MAP**

PROJECT: THRUWAY PLAZA OF ROCKLAND, INC. C/O LYNMARK GROUP
COMMERCIAL PROPERTY
TAX LOT 57.19-1-10.1
286 - 330 NYS ROUTE 59
TOWNSHIP OF CLARKSTOWN, ROCKLAND COUNTY, NEW YORK

SCALE: (H) 1"=800'
(V)

JOB No:
(1685) 22-01023

Plotted: 07/19/24 - 3:19 PM, By: shennessey, - Product Ver: 24.3e (LMS Tech)
File: C:\EARTH Projects\1685 Thruway Plaza of Rockland Associates\22-01023 Clarkstown NY\Drawings by Dearth\Environmental CAD\RI Work Plan\E16852201023RIWP-Fig1.dwg, ---> SITE LOC MAP



GRAPHIC SCALE

0 20 40 80

(IN FEET)
1 INCH = 40 FT.

AREAS OF CONCERN (AOCs)

AOC #	(Locations are approximate)	Dimensions
AOC-1	Former Dry Cleaning Operations	0.039 acres

SCALE: (H) 1"=40' (V)

JOB No: (1685) 22-01023

SHEET No: 1 OF 1

DRAWN BY: JED/NMM

DESIGNED BY: AC

CHECKED BY: SH

DATE: 12/08/2023

TITLE: **FIGURE 2: SITE AND AOC LOCATION MAP**

PROJECT: **THRUWAY PLAZA OF ROCKLAND, INC. C/O LYNMARK GROUP**
COMMERCIAL PROPERTY
TAX LOT 57.19-1-10.1
286-330 NYS ROUTE 59
TOWNSHIP OF CLARKSTOWN (NANUET), ROCKLAND COUNTY, NEW YORK

Rev. # 0

DEC Client Code: 1685

LEGEND:

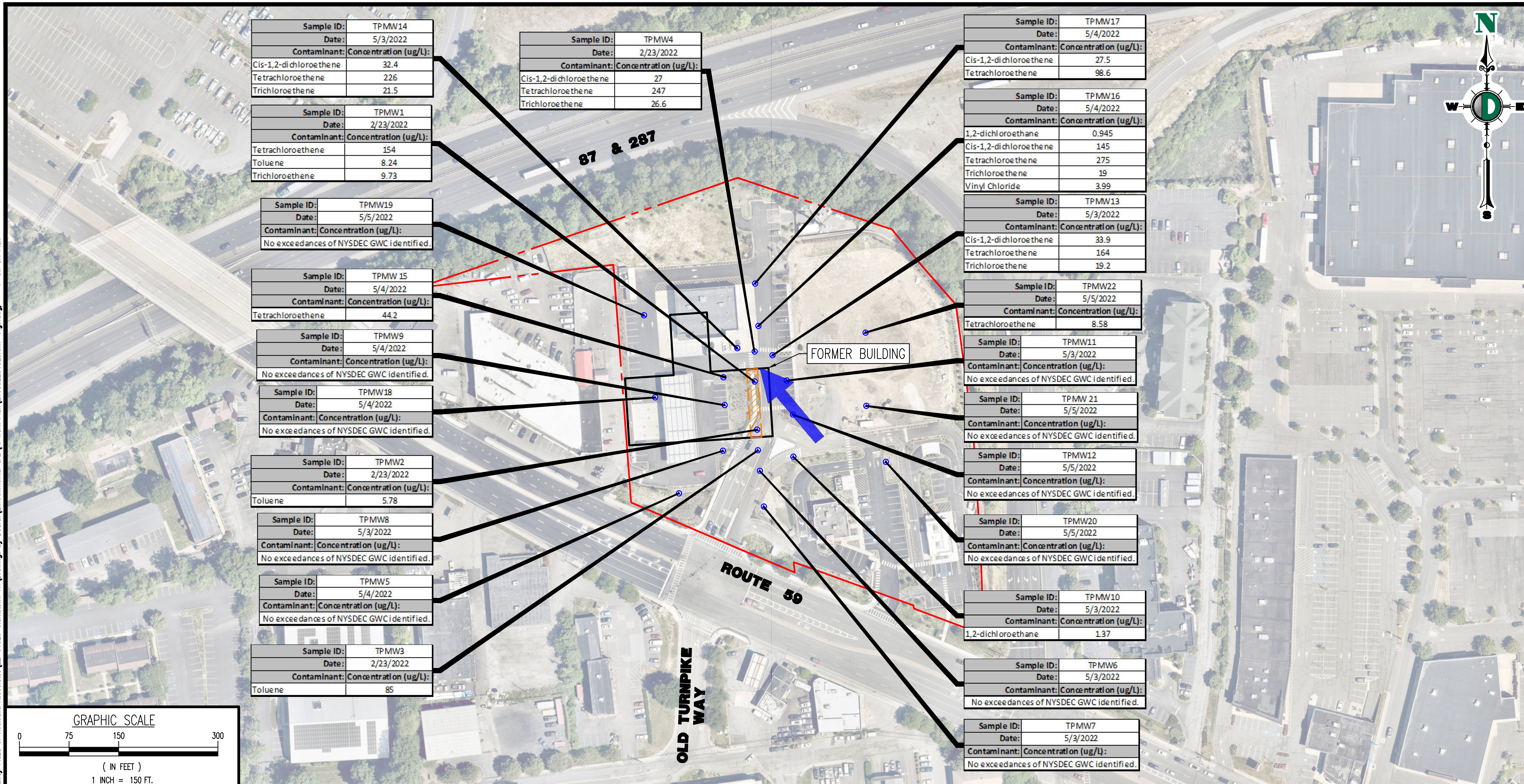
PARCEL BOUNDARY (APPROXIMATE)

BROWNFIELD CLEANUP PROGRAM SITE BOUNDARY

NOTE: THE AERIAL IMAGE DEPICTED ON THIS PLAN WAS PROVIDED BY NEARMAPS ON 09/14/2023. THE CONDITIONS OF THE SITE AND SURROUNDING AREAS MAY HAVE CHANGED SINCE THE DATE OF AERIAL PHOTOGRAPHY AND THEREFORE THIS PLAN MAY NOT ACCURATELY REFLECT ALL CURRENT EXISTING CONDITIONS.

DYNAMIC EARTH, LLC
1904 Main Street
Lake Como, NJ 07719
T: 732.974.0198 - F: 732.974.3521
www.dynamicec.com

Plotted: 07/19/24 - 3:53 PM, By: shennessey, - Product Ver: 24.3s (LMS Tech)
File: O:\EARTH Projects\1685 Thruway Plaza of Rockland Associates\22-01023 Clarkstown NY\Drawings by Dearth\Environmental CAD\RI Work Plan\E16852201023RIWP-Fig2.dwg, ---> Site Map



Sample ID:	TPMW14
Date:	5/3/2022
Contaminant:	Concentration (ug/L):
Cis-1,2-dichloroethene	32.4
Tetrachloroethene	226
Trichloroethene	21.5

Sample ID:	TPMW4
Date:	2/23/2022
Contaminant:	Concentration (ug/L):
Cis-1,2-dichloroethene	27
Tetrachloroethene	247
Trichloroethene	26.6

Sample ID:	TPMW1
Date:	2/23/2022
Contaminant:	Concentration (ug/L):
Tetrachloroethene	154
Toluene	8.24
Trichloroethene	9.73

Sample ID:	TPMW19
Date:	5/5/2022
Contaminant:	Concentration (ug/L):
No exceedances of NYSDEC GWC identified.	

Sample ID:	TPMW 15
Date:	5/4/2022
Contaminant:	Concentration (ug/L):
Tetrachloroethene	44.2

Sample ID:	TPMW9
Date:	5/4/2022
Contaminant:	Concentration (ug/L):
No exceedances of NYSDEC GWC identified.	

Sample ID:	TPMW18
Date:	5/4/2022
Contaminant:	Concentration (ug/L):
No exceedances of NYSDEC GWC identified.	

Sample ID:	TPMW2
Date:	2/23/2022
Contaminant:	Concentration (ug/L):
Toluene	5.78

Sample ID:	TPMW8
Date:	5/3/2022
Contaminant:	Concentration (ug/L):
No exceedances of NYSDEC GWC identified.	

Sample ID:	TPMW5
Date:	5/4/2022
Contaminant:	Concentration (ug/L):
No exceedances of NYSDEC GWC identified.	

Sample ID:	TPMW3
Date:	2/23/2022
Contaminant:	Concentration (ug/L):
Toluene	85

Sample ID:	TPMW17
Date:	5/4/2022
Contaminant:	Concentration (ug/L):
Cis-1,2-dichloroethene	27.5
Tetrachloroethene	98.6

Sample ID:	TPMW16
Date:	5/4/2022
Contaminant:	Concentration (ug/L):
1,2-dichloroethane	0.945
Cis-1,2-dichloroethene	145
Tetrachloroethene	275
Trichloroethene	19
Vinyl Chloride	3.99

Sample ID:	TPMW13
Date:	5/3/2022
Contaminant:	Concentration (ug/L):
Cis-1,2-dichloroethene	33.9
Tetrachloroethene	164
Trichloroethene	19.2

Sample ID:	TPMW22
Date:	5/5/2022
Contaminant:	Concentration (ug/L):
Tetrachloroethene	8.58

Sample ID:	TPMW11
Date:	5/3/2022
Contaminant:	Concentration (ug/L):
No exceedances of NYSDEC GWC identified.	

Sample ID:	TPMW 21
Date:	5/5/2022
Contaminant:	Concentration (ug/L):
No exceedances of NYSDEC GWC identified.	

Sample ID:	TPMW12
Date:	5/5/2022
Contaminant:	Concentration (ug/L):
No exceedances of NYSDEC GWC identified.	

Sample ID:	TPMW20
Date:	5/5/2022
Contaminant:	Concentration (ug/L):
No exceedances of NYSDEC GWC identified.	

Sample ID:	TPMW10
Date:	5/3/2022
Contaminant:	Concentration (ug/L):
1,2-dichloroethane	1.37

Sample ID:	TPMW6
Date:	5/3/2022
Contaminant:	Concentration (ug/L):
No exceedances of NYSDEC GWC identified.	

Sample ID:	TPMW7
Date:	5/3/2022
Contaminant:	Concentration (ug/L):
No exceedances of NYSDEC GWC identified.	

SCALE: (H) 1"=150' (V)

JOB No: (1685) 22-01023

SHEET No: 1 OF 1

DRAWN BY: JED/NMM

DESIGNED BY: AC

CHECKED BY: SH

DATE: 12/08/2023

TITLE:

FIGURE 3: GROUNDWATER SAMPLE LOCATION AND CONTAMINANT CONCENTRATION PLAN

PROJECT: **THRUWAY PLAZA OF ROCKLAND, INC. C/O LYNMARK GROUP**
COMMERCIAL PROPERTY
TAX LOT 57.19-1-10.1
286-330 NYS ROUTE 59
TOWNSHIP OF CLARKSTOWN (NANUET), ROCKLAND COUNTY, NEW YORK

Rev. # 0

DEC Client Code: 1685

LEGEND:

PARCEL BOUNDARY (APPROXIMATE)

GROUNDWATER FLOW DIRECTION (APPROXIMATE)

BROWNFIELD CLEANUP PROGRAM SITE BOUNDARY

NOTE: THE AERIAL IMAGE DEPICTED ON THIS PLAN WAS PROVIDED BY NEARMAPS ON 09/14/2023. THE CONDITIONS OF THE SITE AND SURROUNDING AREAS MAY HAVE CHANGED SINCE THE DATE OF AERIAL PHOTOGRAPHY AND THEREFORE THIS PLAN MAY NOT ACCURATELY REFLECT ALL CURRENT EXISTING CONDITIONS.

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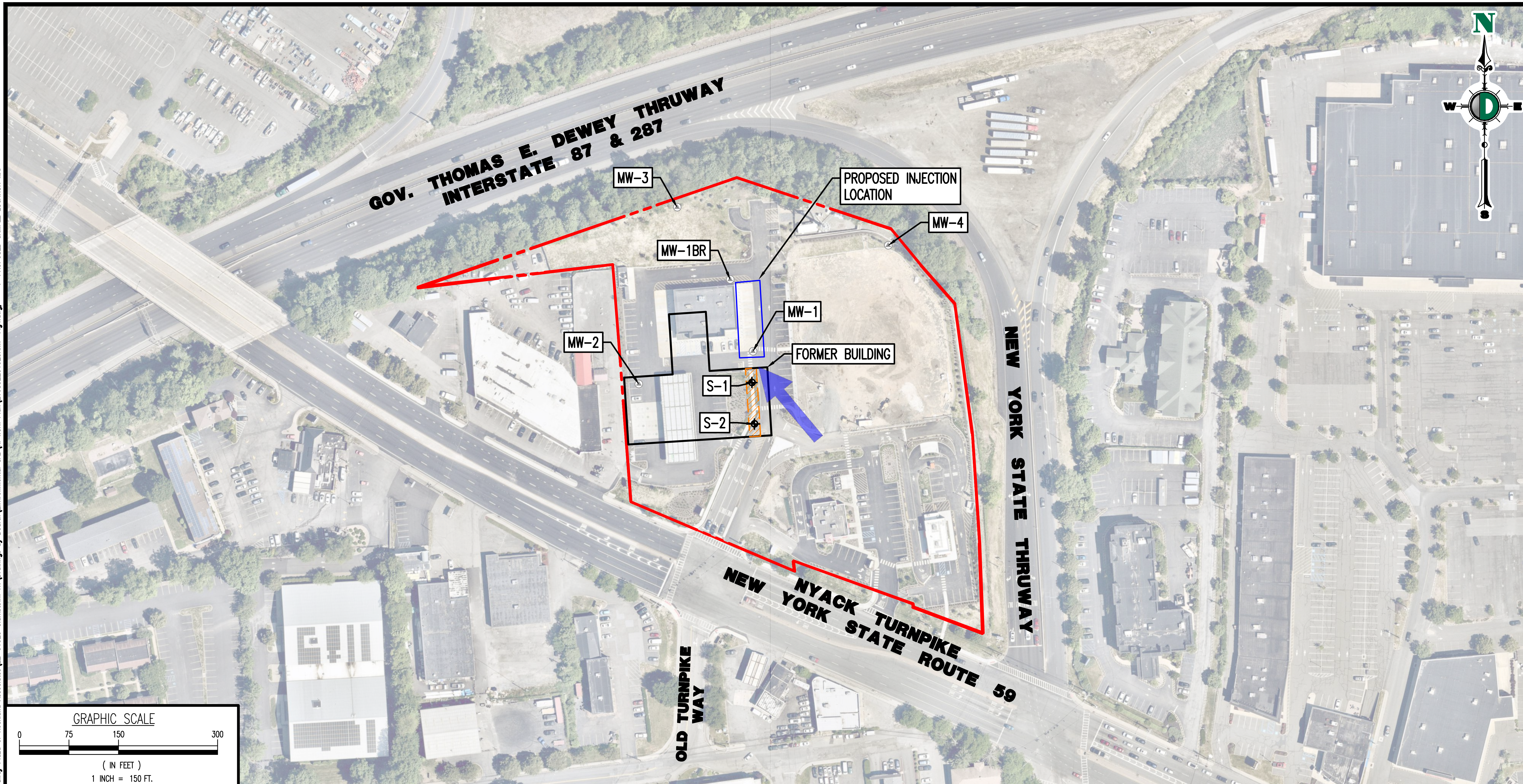

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File: \\decpc.local\earthfolders\Data\EARTH Projects\1685 Thruway Plaza of Rockland Associates\22-01023 Clarkstown NY\Drawings by Dearth\Environmental CAD\RI Work Plan\E16852201023RIWP-Fig4.dwg, ---> PROPOSED SAMPLE LOCATION MAP

SCALE: (H) 1"=150' (V)

JOB No: (1685) 22-01023

SHEET No: 1 OF 1

DRAWN BY: SPH/KMG

DESIGNED BY: AC

CHECKED BY: SH

DATE: 07/19/2024

TITLE: FIGURE 4: PROPOSED SAMPLE LOCATION MAP

PROJECT: THRUWAY PLAZA OF ROCKLAND, INC. C/O LYNMARK GROUP
COMMERCIAL PROPERTY
TAX LOT 57.19-1-10.1
286-330 NYS ROUTE 59
TOWNSHIP OF CLARKSTOWN (NANUET), ROCKLAND COUNTY, NEW YORK

Rev. # 0

DEC Client Code: 1685

LEGEND:

PARCEL BOUNDARY (APPROXIMATE)
INJECTION LOCATION (APPROXIMATE)
BROWNFIELD CLEANUP PROGRAM SITE BOUNDARY
PROPOSED MONITORING WELL SAMPLE LOCATION (APPROXIMATE)
B-X PROPOSED BORING/SAMPLE LOCATION (APPROXIMATE)
GROUNDWATER FLOW DIRECTION (APPROXIMATE)

NOTE: THE AERIAL IMAGE DEPICTED ON THIS PLAN WAS PROVIDED BY NEARMAPS ON 09/14/2023. THE CONDITIONS OF THE SITE AND SURROUNDING AREAS MAY HAVE CHANGED SINCE THE DATE OF AERIAL PHOTOGRAPHY AND THEREFORE THIS PLAN MAY NOT ACCURATELY REFLECT ALL CURRENT EXISTING CONDITIONS.

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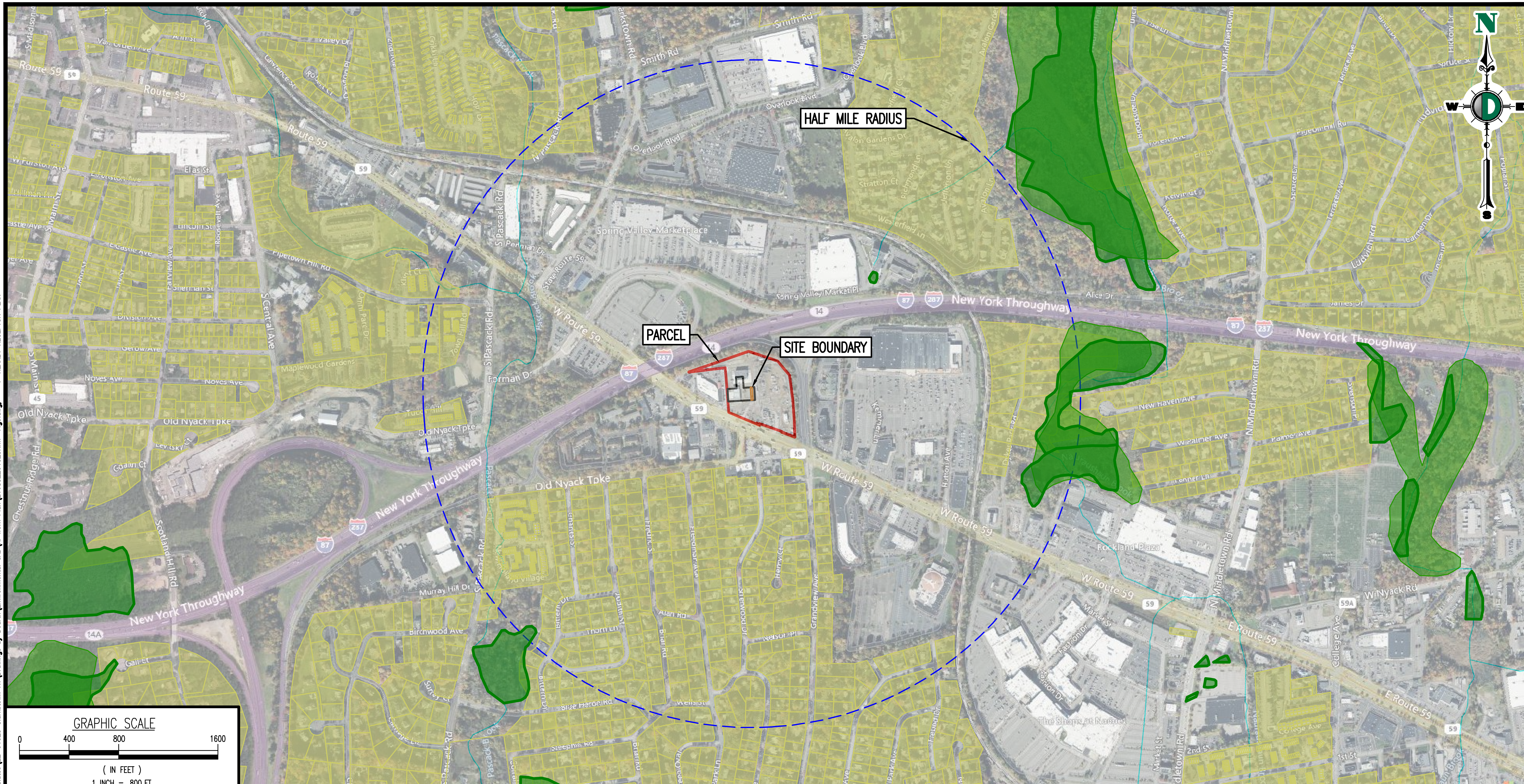

SCALE: (H) 1"=800'
(V)

JOB No: (1685) 22-01023

SHEET No: 1 OF 1

DRAWN BY: SPH/KMG

DESIGNED BY: AC

CHECKED BY: SH

DATE: 07/19/2024

TITLE:
FIGURE 5: NEARBY RECEPTOR PLAN

PROJECT: **THRUWAY PLAZA OF ROCKLAND, INC. C/O LYNMARK GROUP**
COMMERCIAL PROPERTY
TAX LOT 57.19-1-10.1
286-330 NYS ROUTE 59
TOWNSHIP OF CLARKSTOWN (NANUET), ROCKLAND COUNTY, NEW YORK

Rev. # 0

DEC Client Code: 1685

LEGEND:

PARCEL BOUNDARY (APPROXIMATE)

WATER BODIES (APPROXIMATE)

BROWNFIELD PROPERTY SITE BOUNDARY (FORMER DRY CLEANER AREA)

WETLANDS (APPROXIMATE)

RESEDENTIAL BOUNDARY (APPROXIMATE)

NATIONAL WETLANDS (APPROXIMATE)

NOTE: THE AERIAL IMAGE DEPICTED ON THIS PLAN WAS PROVIDED BY NEARMAPS ON 09/14/2023. THE CONDITIONS OF THE SITE AND SURROUNDING AREAS MAY HAVE CHANGED SINCE THE DATE OF AERIAL PHOTOGRAPHY AND THEREFORE THIS PLAN MAY NOT ACCURATELY REFLECT ALL CURRENT EXISTING CONDITIONS.

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T: 732.974.0198 - F: 732.974.3521
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File: O:\EARTH Projects\1685 Thruway Plaza of Rockland Associates\22-01023 Clarkstown NY\Drawings by Dearth\Environmental CAD\8 Work Plan\E1685220102318WP-Fig5.dwg, ---> NEARBY RECEPTOR PLAN

DYNAMIC EARTH

Appendix A
Health and Safety Plan (HASP)

SITE-SPECIFIC
HEALTH AND SAFETY PLAN

Commercial Property
286-330 NYS West Route 59
Parcel ID 57.19 -1-10.1
Town of Clarkstown (Nanuet), Rockland County, New York

Prepared for:

Thruway Plaza of Rockland Inc
c/o Lynmark Group
106 Airport Executive Park
Nanuet, New York 10954

Prepared By:

DYNAMIC EARTH

826 Newtown Yardley Road, Suite 201
Newtown, PA 18940

Project #: 1685-22-01023

July 19, 2024

FIGURES
Figure 1: Site Location Map

APPENDIX A	Safety Data Sheets
APPENDIX B	Hospital Route
APPENDIX C	HASP Acknowledgement Form

1.0 HEALTH AND SAFETY PROGRAM

This plan will be used to administer health and safety measures for activities performed by Dynamic Earth, LLC (Dynamic Earth) at the commercial property located at 286-330 NYS West Route 59 in the Town of Clarkstown (Nanuet), Rockland County, New York (hereinafter referred to as the "Site"). A copy of this plan will be on-Site and will be available for inspection and review during field activities.

The Health and Safety Plan (HASP) establishes policies and procedures to protect workers and the public from potential hazards posed by field work. All project activities will be conducted in a manner that minimizes the probability of injury or accident.

This HASP is based on the information available at the time of preparation. Unexpected conditions that may arise during the project will require a reassessment of the procedures. It is important that the need for personal protective measures be thoroughly assessed by the Project Manager and/or Health and Safety Officer prior to and during the planned field activities. Unplanned activities or changes in the hazard status in the field will initiate a review of and, when appropriate, alterations to this plan.

Any amendments to this plan must be approved in writing by the Project Manager or the Health and Safety Officer prior to implementation.

Dynamic Earth cannot guarantee the health and/or safety of all personnel entering the Site. It is not possible to evaluate and provide protection for all possible hazards that may be encountered. Adherence to the HASP will reduce, but cannot totally eliminate, the possibility for worker injuries and illness to occur.

Field personnel working at the Site will be briefed on the contents of the HASP and the potential hazards of the job before work begins and daily throughout the duration of field activities. In addition, field personnel are required to read the HASP before work begins.

2.0 SITE CHARACTERIZATION AND ANALYSIS

Site characterization provides the information needed to identify hazards and to select the procedures and equipment required to perform the work safely and protect the workers.

A Site-Specific Contingency Plan is prepared for field activities, and is part of the HASP, which will be on-Site and available for review.

2.1 SITE DESCRIPTION

Project Name:	Commercial Property
Project Number:	1685-22-01023
Site Location:	286-330 NYS Route 59 Portion of Parcel No. 57.19-1-10.1 Town of Clarkstown (Nanuet), Rockland County, New York
Site Access:	The Site is an open parking lot with no access restrictions.
Site Description:	The Site is 0.039 acres and is currently a portion of a parking lot for a larger commercial property.

A Site Location Map and Site Map includes as Figures 1 and 2.

2.2 DESCRIPTION OF TASKS/WORK PLAN

Dynamic Earth personnel may perform the following tasks during this project:

- Overburden and Bedrock Monitoring Well Installations
- Groundwater Sampling
- Groundwater Injections
- Soil Boring Installations
- Soil Sample Collection
- Contractor Oversight

2.3 DESCRIPTION OF CONTRACTORS AND RESPONSIBILITIES

The contractor(s) shall be responsible for the health and safety of their employees, subcontractors, suppliers and other parties that are performing work under the direction of the contractor. This HASP cannot be used by the contractor(s) unless authorized by the Project Manager.

The contractor shall have programs, policies and procedures in-place that satisfy the requirements of all current federal, state, and local statutes, regulations and ordinances regarding health and safety. Contractors shall supply all the necessary safety equipment for their crews. Dynamic Earth reserves the right to audit its contractors for federal, state and local regulatory compliance.

The following contractors will provide services at the Site during the project:

Service	Contractor Information
Driller	Hawk Drilling, Inc. 221 Van Syckles Road Hampton, New Jersey 08827 John Charles 908-323-2929 info@hawkdrilling.com
Remedial Injection Subconsultant	AWT Environmental Services, Inc. 32 Birch Street Old Bridge, New Jersey 08857 Joseph Postorino 732-613-1660 jpostorino@awtenv.com

2.4 PROJECT ORGANIZATION/KEY PERSONNEL

Project Manager:	Christopher Zieger Senior Principal 267-685-0276 czieger@dynamic-earth.com
Health and Safety Officer:	Christopher Zieger Senior Principal 267-685-0276 czieger@dynamic-earth.com
Senior Technical Manager:	Summer Hammouda Project Manager 732-280-0830 shammouda@dynamic-earth.com
Field/Site Manager:	Summer Hammouda Project Manager 732-280-0830 shammouda@dynamic-earth.com
Additional Field Staff:	To Be Determined

The responsibility for health and safety is shared by all members of the team. Each team member is responsible to safely complete the tasks required to fulfill the planned work activities, comply with the HASP and notify the Project Manager or Health and Safety Officer of any unsafe acts or conditions at the Site.

2.5 HAZARD EVALUATION

In general, potential hazards for a project can be classified into physical, chemical, biological and radiological hazards.

Based upon information collected during characterization and analysis of Site conditions, the following classes of hazards may be present during certain phases of the project. Detailed job hazard analyses (JHA) will be created, as appropriate, and updated to accommodate Site-specific hazards. Common hazards and control measures are shown below.

All work practices at the Site must comply with and conform to OSHA Safety and Health Procedures included in 29 CFR 1910, 29 CFR 1926 and pertinent state and local regulations.

2.5.1 Physical/Safety Hazards and Controls

PHYSICAL (SAFETY) HAZARDS AND CONTROLS		
Present	**Hazard**	**Control Measure(s)***
N	Flying debris/objects	Provide shielding and PPE
Y	Sustained loud noise	Noise protection and monitoring required
N	Steep terrain/unstable surface	Brace and shore equipment
N	Buildup of flammable /explosive gases	Provide fire extinguisher and ventilation. No spark sources within 50 ft of an excavation, heavy equipment or UST removal. Ground as appropriate.
N	Poisonous Plants (poison ivy, poison oak, poison sumac).	Avoid contact with these plants. Wear long pants and long sleeves
N	Gas cylinders	Make sure gas cylinders are properly anchored and chained. Keep cylinders away from ignition sources.
N	High pressure hose rupture	Check to see that fitting and pressure lines are in good condition/repair before using.
N	Electrical shock	Make sure third wire is properly grounded. Do not tamper with electrical wiring unless qualified to do so.
Y	Vehicle Traffic	Work in busy areas during off-peak hours; wear traffic safety vest with reflector stripe; use cones and flags to mark work areas; and contact police department if interrupting flow of traffic
Y	Moving heavy vehicles or equipment	Back up alarm required for heavy equipment. Observer remains in contact with operator and signals safe back up. Personnel to remain outside of turning radius.
N	Overhead electrical wires	Heavy equipment to remain at least 15 ft from overhead power line for power lines of 50 kV or less. For each kV > 50 increase distance 1/2 foot.
Y	Buried utilities, drums, and tanks**	To be identified and controlled by others.
N	Slip/trip/fall hazards due to muddy work areas	Use wood pallets or similar devices in muddy work areas.
Y	Back injuries	Use proper lifting techniques, or provide mechanical lifting aids.
N	Oxygen deficiency (confined space)	Dynamic personnel are not to enter confined spaces for any reason unless in compliance with confined space entry regulations.
N	Trenches/excavations	Dynamic personnel are not to enter excavation greater than 4-foot depth at any time, for any reason unless in compliance with trenching regulations.

N	Protruding objects	Flag visible objects.
N	Holes/ditches	Restrict access by tape or other visible means.

OTHER:
* For more detailed descriptions of the appropriate controls, consult OSHA Standards.
** For Underground Utilities: Follow state/local utility mark out requirements. If necessary, use a contractor to mark out work areas (e.g., ground penetrating radar and line tracing).

2.5.2 Chemical Hazards

Based on information gathered during the characterization of the Site, the following substances are suspected to be present on-Site. Refer to the representative Safety Data Sheets (SDS) for additional information regarding exposure to typical contaminants (Appendix A).

POTENTIAL CHEMICALS OF CONCERN (ADD RELEVENT INFO FROM SDS)				
CHEMICAL	**OSHA PEL[1]**	**ACGIH TLV[2]**	**IDLH[3]**	**EXPOSURE ROUTE**
Tetrachloroethene	100 ppm	25 ppm	150 ppm	Inh, Ing, Abs, Con
Trichloroethene	100 ppm	100 ppm	1,000 ppm	Inh, Ing, Abs, Con
Cis-1,2-Dichloroethene	200 ppm	200 ppm	1,000 ppm	Inh, Ing, Abs, Con
Vinyl Chloride	1 ppm	1 ppm	NA[4]	Inh, Ing, Abs, Con
1,2-Dichloroethane	NA	75 ppm	NA	Inh, Ing, Abs, Con

1. OSHA personal exposure limit based on an eight-hour time weighted average.
2. American Conference of Governmental Industrial Hygienists threshold limit value based on an eight hour-time weighted average.
3. Immediately Dangerous to Life or Health concentration based on the maximum concentration one could escape within 30 minutes without experiencing permanent or irreversible health effects.
4. NA- Information not available.

2.5.3 Toxicity

Potential hazards, proper handling precautions, signs and symptoms of over-exposure and recommended personal protective equipment (PPE) are described in the SDS. Available SDSs for potential chemicals of concern are included in Appendix A. These SDSs should be reviewed prior to conducting work at the Site.

2.5.4 Heat Stress

The Health and Safety Officer or designee shall evaluate the potential effect of heat stress on all workers at the Site prior to the start of the work day. Overexposure to temperature extremes can represent risks to personnel if simple precautions are not observed. Control measures designed to prevent heat stress include dressing properly (light weight, light colored clothing), blocking out sun or other direct heat sources and drinking plenty of water. Workers should be familiar with the following serious effects of overexposure to hot environments:

- Heat stress
- Heat exhaustion
- Heat stroke

2.5.5 Cold Stress

The Health and Safety Officer or designee shall evaluate the potential effects of cold stress on all workers at the Site prior to the start of the work day. Overexposure to temperature extremes can represent risks to personnel if simple precautions are not observed. Control measures designed to prevent cold stress include dressing properly (dry, layered clothing), the protection of feet, hands and head, taking frequent breaks in warm areas and drinking plenty of water. Workers should be familiar with the following serious effects of overexposure to cold environments:

- Hypothermia
- Frost bite

Field staff must coordinate with the Project Manager and monitor changing weather patterns to limit and control exposure in extreme winter conditions. As appropriate, the Project Manager will evaluate necessary changes to outer wear, PPE and Site maintenance (such as snow removal and treatment of icy conditions) on a project-by-project basis, and document any changes.

3.0 SITE CONTROL

3.1 SAFE WORK PRACTICES

1. Eating, drinking, chewing gum or tobacco, smoking or any practices that increases the probability of hand-to-mouth transfer and ingestion of material are forbidden at the Site.

2. Hands and face must be thoroughly washed upon leaving the work area. Individuals will shower as soon as possible after leaving the Site at the end of the day.

3. Contact with contaminated surfaces or surfaces suspected of being contaminated should be avoided while the worker is unprotected. Avoid walking through puddles, pools, mud, etc. Whenever possible, avoid kneeling, leaning or sitting on the ground. In the event that protective clothing is ripped or torn, work is to stop and the protective clothing removed and replaced. In the event of direct skin contact, the affected area is to be washed immediately with soap and water.

4. If respirators are deemed necessary, facial hair that interferes with the fit of a respirator will not be permitted. Respirators are only to be worn by authorized staff.

5. Medicine and alcohol can intensify the effects from exposure to many chemicals. Use of medications must be reported to the Project Manager or the Health and Safety Officer. Intake of alcoholic beverages during scheduled work periods is prohibited.

6. All personnel must be familiar with relevant task-specific standard operating procedures, as well as all instructions and information contained in the HASP.

7. Use of contact lenses is prohibited at the Site unless chemical goggles are worn during any operations involving potential eye contact with chemicals.

8. Personnel will receive training covering the contents of SDSs for all Site-specific contaminants, with particular emphasis on the signs and symptoms of exposure.

9. The buddy system should be employed at all times.

10. All personal protective equipment must be inspected for worn or deteriorated parts prior to use.

11. Site work will be performed during daylight hours whenever possible. Any work conducted during hours of darkness will comply with 29 CFR 1310.120(m).

3.2 COMMUNICATIONS SYSTEM

Communication between the Project Manager, Health and Safety Officer and field personnel will be through the use of mobile telephones. Mobile telephone numbers are included in Section 2.4.

3.3 Community Air Monitoring Plan (CAMP)

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. It is not intended for use in establishing action levels for worker respiratory protection but provides a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

Based on the known contaminants at the Site, real-time air monitoring for VOCs and particulate levels at the perimeter of the exclusion zone or work area will be necessary.

- Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to the installation of soil borings or monitoring wells. Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells.

- Periodic monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

3.3.1 VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown. 4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

3.3.2 Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m3 above the upwind level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m3 of the upwind level and in preventing visible dust migration.

- All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

4.0 EMPLOYEE EDUCATION AND TRAINING

All personnel working at the Site must have received Health and Safety Training for Hazardous Waste Operations (HAZWOPER) or have the equivalent training and experience as required under OSHA 29 CFR 1910.120(e).

It is the responsibility of each contractor to determine the level of training required for their employees to satisfy the requirements of HAZWOPER. If necessary, Dynamic Earth will review training records for contractors and will maintain copies of these records with the HASP.

In the event unanticipated special hazards are encountered or if there are client specific requirements, additional training will be provided to employees on an as-needed basis.

At the start of the project and weekly thereafter, the Site Manager will hold a safety briefing to include the following:

- Discuss the project status.
- Review conditions at the Site including potential hazards.
- Identify safety concerns and review corrective action measures.
- Reiterate HASP requirements and PPE levels for the Site.
- Review evacuation routes and assembly areas.

The Site Manager will document the safety briefing in the field log. Notes should include the time of the briefing, list of attendees and key information that was reviewed.

5.0 MEDICAL SURVEILLANCE PROGRAM

If deemed necessary, Dynamic Earth will implement a medical surveillance program. The need for such a program will continue to be evaluated based on the nature of the work performed by Dynamic Earth employees.

A medical surveillance program shall be instituted for the following conditions as required by 29 CFR Part 1910.120:

- Employees are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year.
- Employees who wear a respirator for 30 days or more a year.
- Employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation.
- Members of HAZMAT teams.

If a medical surveillance program is deemed necessary, medical examinations and consultations shall be made available to each covered employee on the following schedule:

- Prior to assignment and once every twelve months hereafter.
- At termination of employment or reassignment (if the employee has not had an examination within the last six months).
- Upon notification that the employee developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or the employee has been injured or exposed above the permissible exposure limits or published exposure levels.
- If a physician determines that an increased frequency of examination is medically necessary.

In the event Site-specific contaminants of concern are encountered, they will be added to the surveillance program on a case-by-case basis.

The following special requirements are needed for this Site:

- No special monitoring needed.

6.0 PERSONAL PROTECTIVE EQUIPMENT

The purpose of PPE is to protect employees against potential chemical, physical, and biological hazards. Careful selection and use of PPE will reduce and maintain employee chemical exposures at or below Permissible Exposure Limits and protect against physical and biological hazards.

The PPE required for this Site is LEVEL D.

LEVEL D PROTECTION	
Required	**Description**
Y	Hard Hat
Y	Safety Vest (Class II or III)
Y	Safety Glasses
N	Chemical Goggles
Y	Steel-Toed/Shank/Chemical Resistant Boots
N	Chemical Resistant Outer Boots
Y	Hearing Protection
Y	Vinyl or Nitrile Gloves
N	Leather Gloves (where potential for cuts and scrapes)
N	Coveralls

The Health and Safety Officer and/or Project Manager must be notified immediately if any action levels identified in Section 2.5.2 are exceeded.

The protective equipment used and protection level assigned will be reevaluated periodically by the Health and Safety Officer and/or Project Manager as more information about the Site conditions becomes available, and as field personnel are required to perform different tasks.

Personnel will upgrade or downgrade their level of protection only with concurrence of the Health and Safety Officer and/or Project Manager.

7.0 DECONTAMINATION PROCEDURES

The procedures for decontamination of equipment and personnel are essential to:

- Reduce personnel exposure to chemical hazards by removing or neutralizing contaminants.
- Prevent cross-contamination of areas at the Site.
- Prevent accidental transport of contaminated materials off site.

The following decontamination procedures shall be followed:

- Reusable field equipment and PPE will be decontaminated in accordance with standard operating procedures using a brush to remove any loose material. The equipment will be cleaned using a detergent (Alconox™ or equivalent) with a final rinse of analyte-free water. Wastes generated by decontamination activities will be disposed of properly.
- Disposable protective equipment such as nitrile gloves will be placed in heavy duty trash bags and disposed of properly.
- Heavy equipment decontamination is the responsibility of the contractor. The location of the decontamination station, as well as the decontamination procedures, will be designated by the Project Manager based on the chemical hazards and type of equipment to be cleaned.

8.0 EMERGENCY CONTINGENCY PLAN

An emergency contingency plan sets forth policies and procedures for responding to emergencies at the Site. Common causes of emergencies may be worker related or material/Site related.

Should an emergency occur, the Project Manager has overall responsibility for implementation of, and control over, the emergency response.

The following planning should be carried out prior to starting field activities:

- Identify, locate and ensure proper operation of on-Site communications (e.g., mobile telephone, two-way portable radios, etc.).
- Review any changes in conditions or on-Site operation.
- Ensure that a copy of the HASP is available on-Site.
- Check emergency equipment and supplies.
- Verify local emergency contacts, hospital routes, evacuation routes and assembly points.

8.1 NOTIFICATION/REPORTING PROCEDURES

DIAL 9-1-1 IN THE EVENT OF A MEDICAL OR OTHER EMERGENCY

Injured workers will not attempt to drive themselves to an emergency facility.

As soon as possible, the Project Manager shall be notified as to the nature of the incident (spill, injury, details of event, etc.). The Project Manager is responsible for notifying Dynamic Earth's senior management and the client (if required).

The Project Manager and/or the client is responsible for making any required notifications to the applicable regulatory agencies.

Field personnel will be responsible for documenting the incident. The Project Manager will be responsible for evaluating the root cause of the incident and will identify/implement the appropriate corrective actions.

8.2 SPILL CONTAINMENT PROCEDURES

While a spill or leak of a hazardous material is unlikely to occur based on the nature of the work, it is necessary to implement a containment procedure.

In the event of a spill or leak, the area will be cordoned off by field staff. Containment and cleanup should only be performed by properly trained personnel or contractors. All wastes generated from cleanup activities will be disposed of in a proper manner.

8.3 UNDERGROUND UTILITIES

In the event that an underground utility is damaged, notifications must be made in the appropriate order. Emergency responders will provide additional instructions. All equipment should be shut down and all personnel must evacuate to the assembly area.

Natural Gas (IN ORDER)

- 9 1 1
- UDIG NY (8 1 1 or 315-437-7394)
- Project Manager and/or Health and Safety Officer

Electric, Communications, Water and Sewer (IN ORDER)

- The operator of the applicable utility (as noted on the mark-out tickets)
- UDIG NY (8 1 1 or 315-437-7394)
- Project Manager and/or Health and Safety Officer

8.4 SAFETY EQUIPMENT LIST

The following safety equipment shall be radially available during field work. Field staff are responsible for inspecting and maintaining the safety equipment.

SAFETY EQUIPMENT	
Required	**Description**
Y	First Aid Kit
Y	TYPE ABC Fire Extinguisher
Y	Spill Kit (absorbent pads, socks, etc.)
Y	Reflective Safety Cones
Y	Photoionization Detector (PID)

8.5 EMERGENCY CONTACTS

EMERGENCY CONTACTS		
Agency/Personnel	**Phone Number**	**Contact**
Fire Department	9 1 1 845-623-9690 (non-emergency)	Nanuet Fire Department
Local Police Department	9 1 1 845-639-5800 (non-emergency)	Clarkstown Police Department
State Police Department	9 1 1 845-344-5300 (non-emergency)	New York State Police Department
Hospital	845-348-2000 (non-emergency)	Montfiore Nyack Hospital
State Environmental Agency	1-800-457-7362 (emergency hot line)	NYSDEC
National Response Center	1-800-424-8802	USEPA
Project Manager	267-685-0276	Christopher Zieger
Health and Safety Officer	267-685-0276	Christopher Zieger
Field Supervisor	732-280-0839	Summer Hammouda
Client Contact	845-356-2400	Steven Yassky

8.6 HOSPITAL ROUTE

The route to the nearby hospital for non-emergencies is included in Appendix B.

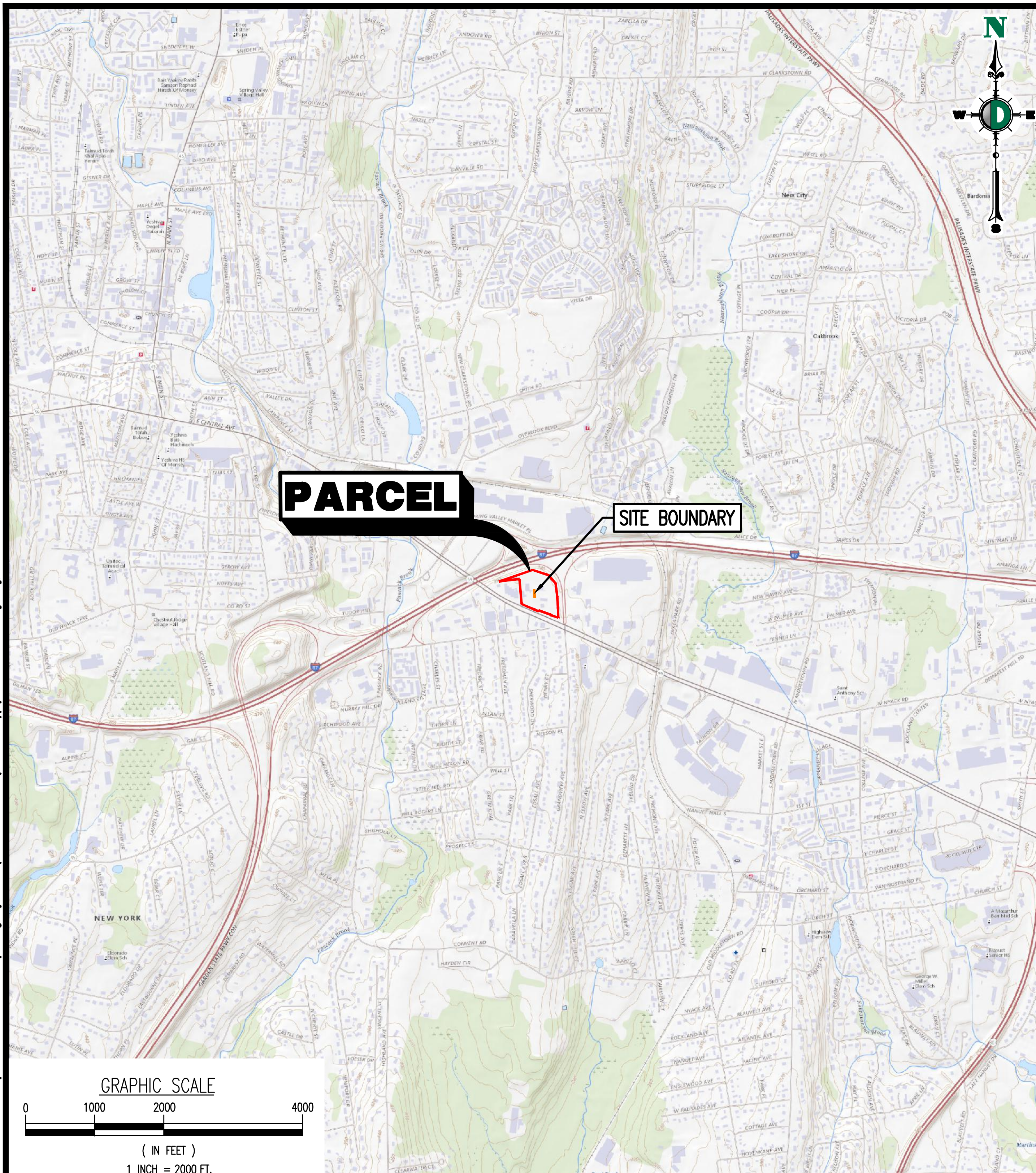
9.0 AUTHORIZATION

This Site-Specific Health and Safety Plan has been completed, reviewed and approved by the following Dynamic Earth staff.

Preparer	July 19, 2024 Date
Project Manager	July 19, 2024 Date
Health and Safety Officer	July 19, 2024 Date

All staff are required to review the HASP prior to the commencement of field work. After reviewing the plan, staff must sign the acknowledgement form included in Appendix C.

FIGURES



DYNAMIC EARTH, LLC

1904 Main Street - Lake Como, NJ 07719
T: 732.280.0830 - F: 732.974.3521
www.dynamic-earth.com

TITLE: **PARCEL LOCATION MAP**

PROJECT: THRUWAY PLAZA OF ROCKLAND ASSOCIATES
COMMERCIAL PROPERTY
TAX LOT 57.19-1-10.1
286 – 330 NYS ROUTE 59
TOWNSHIP OF CLARKSTOWN, ROCKLAND COUNTY, NEW YORK

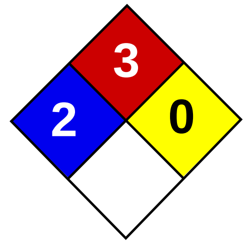
SCALE: (H) 1"=2000'
(V)

JOB No:
(1685) 22-01023

Plotted: 12/15/23 - 2:38 PM, By: rrussell, - Product Ver: 24.2a (LMS Tech)
File: C:\EARTH Projects\1685 Thruway Plaza of Rockland Associates\22-01023 Clarkstown NY\Drawings by Dearth\Environmental CAD\Brownfield App\E1685220102384-Fig1.dwg, ---> PARCEL LOC MAP

APPENDIX A
Safety Data Sheets

ScienceLab.com
Chemicals & Laboratory Equipment



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
1,2-Dichloroethane MSDS

Section 1: Chemical Product and Company Identification

Product Name: 1,2-Dichloroethane

Catalog Codes: SLD2521, SLD3721

CAS#: 107-06-2

RTECS: KH9800000

TSCA: TSCA 8(b) inventory: 1,2-Dichloroethane

CI#: Not available.

Synonym: Ethylene dichloride

Chemical Formula: C2H4CL2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{1,2-}Dichloroethane	107-06-2	100

Toxicological Data on Ingredients: 1,2-Dichloroethane: ORAL (LD50): Acute: 670 mg/kg [Rat]. 413 mg/kg [Mouse]. DERMAL (LD50): Acute: 2800 mg/kg [Rabbit]. VAPOR (LC50): Acute: 1414.2 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Extremely hazardous in case of ingestion. Very hazardous in case of eye contact (irritant), of inhalation. Hazardous in case of skin contact (irritant). Corrosive to skin and eyes on contact. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
Very hazardous in case of ingestion, of inhalation. CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified 2B (Possible for human.) by IARC. Classified 2 (Reasonably anticipated.) by NTP. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs, the nervous system, liver, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands : Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 413°C (775.4°F)

Flash Points: CLOSED CUP: 13°C (55.4°F). OPEN CUP: 18°C (64.4°F).

Flammable Limits: LOWER: 6.2% UPPER: 15.6%

Products of Combustion: These products are carbon oxides (CO, CO_2).

Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks. Slightly flammable to flammable in presence of oxidizing materials.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive to explosive in presence of oxidizing materials.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Corrosive liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep container dry. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Never add water to this product In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 10 CEIL: 75 (ppm) from ACGIH (TLV) TWA: 40 CEIL: 300 (mg/m3) from ACGIHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 98.96 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: 83.5°C (182.3°F)

Melting Point: -35.3°C (-31.5°F)

Critical Temperature: Not available.

Specific Gravity: 1.2351 (Water = 1)

Vapor Pressure: 61 mm of Hg (@ 20°C)

Vapor Density: 3.42 (Air = 1)

Volatility: Not available.

Odor Threshold: 26 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, n-octanol, acetone.

Solubility:
Easily soluble in methanol, diethyl ether, n-octanol, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 413 mg/kg [Mouse]. Acute dermal toxicity (LD50): 2800 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 1414.2 ppm 4 hour(s) [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified 2B (Possible for human.) by IARC. Classified 2 (Reasonably anticipated.) by NTP. The substance is toxic to lungs, the nervous system, liver, mucous membranes.

Other Toxic Effects on Humans:
Extremely hazardous in case of ingestion. Very hazardous in case of inhalation. Hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Passes through the placental barrier in animal. Excreted in maternal milk in human.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Ethylene dichloride : UN1184 PG: II

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: 1,2-Dichloroethane California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: 1,2-Dichloroethane Pennsylvania RTK: 1,2-Dichloroethane Massachusetts RTK: 1,2-Dichloroethane TSCA 8(b) inventory: 1,2-Dichloroethane CERCLA: Hazardous substances.: 1,2-Dichloroethane

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R11- Highly flammable. R20/22- Harmful by inhalation and if swallowed. R38- Irritating to skin. R41- Risk of serious damage to eyes. R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:17 PM

Last Updated: 05/21/2013 12:00 PM

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MATHESON TRI-GAS, INC.
150 Allen Road Suite 302
Basking Ridge, New Jersey 07920
Information: 1-800-416-2505

Emergency Contact:
CHEMTREC 1-800-424-9300
Calls Originating Outside the US:
703-527-3887 (Collect Calls Accepted)

SUBSTANCE: CIS-1,2-DICHLOROETHYLENE

TRADE NAMES/SYNONYMS:
CIS-ACETYLENE DICHLORIDE; 1,2-DICHLOROETHYLENE; C2H2CL2; MAT05125; RTECS KV9420000

CHEMICAL FAMILY: halogenated, aliphatic

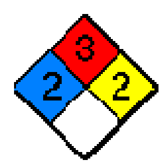
CREATION DATE: Jan 24 1989
REVISION DATE: Dec 11 2008

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: CIS-1,2-DICHLOROETHYLENE
CAS NUMBER: 156-59-2
PERCENTAGE: 100.0

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=2



EMERGENCY OVERVIEW:
COLOR: colorless
PHYSICAL FORM: liquid
ODOR: pleasant odor
MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, eye irritation, central nervous system depression
PHYSICAL HAZARDS: Flammable liquid and vapor. Vapor may cause flash fire. May react on contact with air, heat, light or water.

POTENTIAL HEALTH EFFECTS:
INHALATION:

SHORT TERM EXPOSURE: irritation, nausea, vomiting, drowsiness, symptoms of drunkenness
LONG TERM EXPOSURE: no information on significant adverse effects
SKIN CONTACT:
SHORT TERM EXPOSURE: irritation
LONG TERM EXPOSURE: same as effects reported in short term exposure
EYE CONTACT:
SHORT TERM EXPOSURE: irritation
LONG TERM EXPOSURE: same as effects reported in short term exposure
INGESTION:
SHORT TERM EXPOSURE: symptoms of drunkenness
LONG TERM EXPOSURE: no information on significant adverse effects

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: If vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.

NOTE TO PHYSICIAN: For ingestion, consider gastric lavage. Consider oxygen.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. Moderate explosion hazard. Vapor/air mixtures are explosive above flash point. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Do not scatter spilled material with high-pressure water streams. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Water may be ineffective.

FLASH POINT: 39 F (4 C) (CC)
LOWER FLAMMABLE LIMIT: 9.7%
UPPER FLAMMABLE LIMIT: 12.8%
FLAMMABILITY CLASS (OSHA): IB

6. ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL RELEASE:
Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry.

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Grounding and bonding required. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
CIS-1,2-DICHLOROETHYLENE:
1,2-DICHLOROETHYLENE (ALL ISOMERS):
200 ppm (790 mg/m3) OSHA TWA
200 ppm ACGIH TWA
200 ppm (790 mg/m3) NIOSH recommended TWA 10 hour(s)

VENTILATION: Provide local exhaust ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

MATHESON TRI•GAS
ask. . .The Gas Professionals™

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.
2000 ppm
Any supplied-air respirator operated in a continuous-flow mode.
Any powered, air-purifying respirator with organic vapor cartridge(s).
Any air-purifying respirator with a full facepiece and an organic vapor canister.
Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted organic vapor canister.
Any self-contained breathing apparatus with a full facepiece.
Any supplied-air respirator with a full facepiece.
Emergency or planned entry into unknown concentrations or IDLH conditions -
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.
Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.
Escape -
Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted organic vapor canister.
Any appropriate escape-type, self-contained breathing apparatus.
For Unknown Concentrations or Immediately Dangerous to Life or Health -
Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid
COLOR: colorless
ODOR: pleasant odor
MOLECULAR WEIGHT: 96.94
MOLECULAR FORMULA: C2-H2-CL2
BOILING POINT: 140 F (60 C)
FREEZING POINT: -114 F (-81 C)
VAPOR PRESSURE: 400 mmHg @ 41 C
VAPOR DENSITY (air=1): 3.34
SPECIFIC GRAVITY (water=1): 1.2837
WATER SOLUBILITY: insoluble
PH: Not available
VOLATILITY: Not available
ODOR THRESHOLD: Not available
EVAPORATION RATE: Not available

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available
SOLVENT SOLUBILITY:
Soluble: acetone, benzene, ether, alcohol

10. STABILITY AND REACTIVITY

REACTIVITY: May decompose on contact with air, light, moisture, heat or storage and use above room temperature. Releases toxic, corrosive, flammable or explosive gases.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.

INCOMPATIBILITIES: bases, metals, combustible materials, oxidizing materials, acids

HAZARDOUS DECOMPOSITION:
Thermal decomposition products: phosgene, halogenated compounds, oxides of carbon

POLYMERIZATION: May polymerize. Avoid contact with incompatible materials.

11. TOXICOLOGICAL INFORMATION

CIS-1,2-DICHLOROETHYLENE:
TOXICITY DATA: 13700 ppm inhalation-rat LC50
LOCAL EFFECTS:
Irritant: inhalation, skin, eye
ACUTE TOXICITY LEVEL:
Slightly Toxic: inhalation
TARGET ORGANS: central nervous system
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: respiratory disorders
MUTAGENIC DATA: Available.

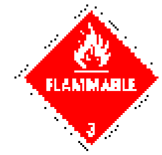
12. ECOLOGICAL INFORMATION

Not available

13. DISPOSAL CONSIDERATIONS

Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001. Dispose in accordance with all applicable regulations.

14. TRANSPORT INFORMATION



U.S. DOT 49 CFR 172.101:
PROPER SHIPPING NAME: 1,2-Dichloroethylene
ID NUMBER: UN1150
HAZARD CLASS OR DIVISION: 3
PACKING GROUP: II
LABELING REQUIREMENTS: 3

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:
SHIPPING NAME: 1,2-Dichloroethylene
UN NUMBER: UN1150
CLASS: 3
PACKING GROUP/CATEGORY: II

15. REGULATORY INFORMATION

U.S. REGULATIONS:
CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4): Not regulated.

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355 Subpart B): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355 Subpart C): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370 Subparts B and C):
ACUTE: Yes
CHRONIC: No
FIRE: Yes
REACTIVE: Yes
SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):
1,2-DICHLOROETHYLENE (ALL ISOMERS)

OSHA PROCESS SAFETY (29 CFR 1910.119): Not regulated.

STATE REGULATIONS:
California Proposition 65: Not regulated.

CANADIAN REGULATIONS:
WHMIS CLASSIFICATION: BD2

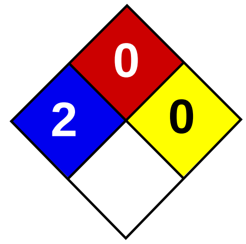
NATIONAL INVENTORY STATUS:
U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

CANADA INVENTORY (DSL/NDSL): Not determined.

16. OTHER INFORMATION

MATHESON TRI-GAS, INC. MAKES NO EXPRESS OR IMPLIED WARRANTIES, GUARANTEES OR REPRESENTATIONS REGARDING THE PRODUCT OR THE INFORMATION HEREIN, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR USE. MATHESON TRI-GAS, INC. SHALL NOT BE LIABLE FOR ANY PERSONAL INJURY, PROPERTY OR OTHER DAMAGES OF ANY NATURE, WHETHER COMPENSATORY, CONSEQUENTIAL, EXEMPLARY, OR OTHERWISE, RESULTING FROM ANY PUBLICATION, USE OR RELIANCE UPON THE INFORMATION HEREIN.



Health	2
Fire	0
Reactivity	0
Personal Protection	G

Material Safety Data Sheet
Tetrachloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Tetrachloroethylene

Catalog Codes: SLT3220

CAS#: 127-18-4

RTECS: KX3850000

TSCA: TSCA 8(b) inventory: Tetrachloroethylene

CI#: Not available.

Synonym: Perchloroethylene; 1,1,2,2-Tetrachloroethylene; Carbon bichloride; Carbon dichloride; Ankilostin; Didakene; Dilatin PT; Ethene, tetrachloro-; Ethylene tetrachloride; Perawin; Perchlor; Perclene; Perclene D; Percosolvel; Tetrachloroethene; Tetraleno; Tetralex; Tetravec; Tetroguer; Tetropil

Chemical Name: Ethylene, tetrachloro-

Chemical Formula: C2-Cl4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Tetrachloroethylene	127-18-4	100

Toxicological Data on Ingredients: Tetrachloroethylene: ORAL (LD50): Acute: 2629 mg/kg [Rat]. DERMAL (LD): Acute: >3228 mg/kg [Rabbit]. MIST(LC50): Acute: 34200 mg/m 8 hours [Rat]. VAPOR (LC50): Acute: 5200 ppm 4 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (anticipated carcinogen) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, peripheral nervous system, respiratory tract, skin, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with skin. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, metals, acids, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 25 (ppm) from OSHA (PEL) [United States] TWA: 25 STEL: 100 (ppm) from ACGIH (TLV) [United States] TWA: 170 (mg/m3) from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Ethereal.

Taste: Not available.

Molecular Weight: 165.83 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 121.3°C (250.3°F)

Melting Point: -22.3°C (-8.1°F)

Critical Temperature: 347.1°C (656.8°F)

Specific Gravity: 1.6227 (Water = 1)

Vapor Pressure: 1.7 kPa (@ 20°C)

Vapor Density: 5.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 5 - 50 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.4

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Miscible with alcohol, ether, chloroform, benzene, hexane. It dissolves in most of the fixed and volatile oils. Solubility in water: 0.015 g/100 ml @ 25 deg. C It slowly decomposes in water to yield Trichloroacetic and Hydrochloric acids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Oxidized by strong oxidizing agents. Incompatible with sodium hydroxide, finely divided or powdered metals such as zinc, aluminum, magnesium, potassium, chemically active metals such as lithium, beryllium , barium. Protect from light.

Special Remarks on Corrosivity: Slowly corrodes aluminum, iron, and zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2629 mg/kg [Rat]. Acute dermal toxicity (LD50): >3228 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5200 4 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (Some evidence.) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. May cause damage to the following organs: kidneys, liver, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Publishe Lethal Dose/Conc: LDL [Rabbit] - Route: Oral; Dose: 5000 mg/kg LDL [Dog] - Route: Oral; Dose: 4000 mg/kg LDL [Cat] - Route: Oral; Dose: 4000 mg/kg

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects(teratogenic). May affect genetic material (mutagenic). May cause cancer.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation with possible dermal blistering or burns. Symtoms may include redness, itching, pain, and possible dermal blistering or burns. It may be absorbed through the skin with possible systemic effects. A single prolonged skin exposure is not likely to result in the material being absorbed in harmful amounts. Eyes: Contact causes transient eye irritation, lacrimation. Vapors cause eye/conjunctival irritation. Symptoms may include redness and pain. Inhalation: The main route to occupational exposure is by inhalation since it is readily absorbed through the lungs. It causes respiratory tract irritation, . It can affect behavior/central nervous system (CNS depressant and anesthesia ranging from slight inebriation to death, vertigo, somnolence, anxiety, headache, excitement, hallucinations, muscle incoordination, dizziness, lightheadness, disorentiation, seizures, enotional instability, stupor, coma). It may cause pulmonary edema Ingestion: It can cause nausea, vomiting, anorexia, diarrhea, bloody stool. It may affect the liver, urinary system (proteinuria, hematuria, renal failure, renal tubular disorder), heart (arrhythmias). It may affect behavior/central nervous system with symptoms similar to that of inhalation. Chronic Potential Health Effects: Skin: Prolonged or repeated skin contact may result in excessive drying of the skin, and irritation. Ingestion/Inhalation: Chronic exposure can affect the liver(hepatitis,fatty liver degeneration), kidneys, spleen, and heart (irregular heartbeat/arrhythmias, cardiomyopathy, abnormal EEG), brain, behavior/ central nervous system/peripheral nervous system (impaired memory, numbness of extremeties, peripheral neuropathy and other

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 18.4 mg/l 96 hours [Fish (Fatthead Minnow)]. 18 mg/l 48 hours [Daphnia (daphnia)]. 5 mg/l 96 hours [Fish (Rainbow Trout)]. 13 mg/l 96 hours [Fish (Bluegill sunfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Tetrachloroethylene UNNA: 1897 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Tetrachloroethylene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Tetrachloroethylene Connecticut hazardous material survey.: Tetrachloroethylene Illinois toxic substances disclosure to employee act: Tetrachloroethylene Illinois chemical safety act: Tetrachloroethylene New York release reporting list: Tetrachloroethylene Rhode Island RTK hazardous substances: Tetrachloroethylene Pennsylvania RTK: Tetrachloroethylene Minnesota: Tetrachloroethylene Michigan critical material: Tetrachloroethylene Massachusetts RTK: Tetrachloroethylene Massachusetts spill list: Tetrachloroethylene New Jersey: Tetrachloroethylene New Jersey spill list: Tetrachloroethylene Louisiana spill reporting: Tetrachloroethylene California Director's List of Hazardous Substances: Tetrachloroethylene TSCA 8(b) inventory: Tetrachloroethylene TSCA 8(d) H and S data reporting: Tetrachloroethylene: Effective date: 6/1/87; Sunset date: 6/1/97 SARA 313 toxic chemical notification and release reporting: Tetrachloroethylene CERCLA: Hazardous substances.: Tetrachloroethylene: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects. R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. S23- Do not breathe gas/fumes/vapour/spray S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S37- Wear suitable gloves. S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:29 PM

Last Updated: 05/21/2013 12:00 PM

Science Lab.com
Chemicals & Laboratory Equipment

Health	2
Fire	1
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Trichloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Trichloroethylene

Catalog Codes: SLT3310, SLT2590

CAS#: 79-01-6

RTECS: KX4560000

TSCA: TSCA 8(b) inventory: Trichloroethylene

CI#: Not available.

Synonym:

Chemical Formula: C2HCl3

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Trichloroethylene	79-01-6	100

Toxicological Data on Ingredients: Trichloroethylene: ORAL (LD50): Acute: 5650 mg/kg [Rat]. 2402 mg/kg [Mouse]. DERMAL (LD50): Acute: 20001 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 420°C (788°F)

Flash Points: Not available.

Flammable Limits: LOWER: 8% UPPER: 10.5%

Products of Combustion: These products are carbon oxides (CO, CO_2), halogenated compounds.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/

spray. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Carcinogenic, teratogenic or mutagenic materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 50 STEL: 200 (ppm) from ACGIH (TLV) TWA: 269 STEL: 1070 (mg/m3) from ACGIH Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 131.39 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 86.7°C (188.1°F)

Melting Point: -87.1°C (-124.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.4649 (Water = 1)

Vapor Pressure: 58 mm of Hg (@ 20°C)

Vapor Density: 4.53 (Air = 1)

Volatility: Not available.

Odor Threshold: 20 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, acetone.

Solubility:
Easily soluble in methanol, diethyl ether, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity:
Extremely corrosive in presence of aluminum. Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): 2402 mg/kg [Mouse]. Acute dermal toxicity (LD50): 20001 mg/kg [Rabbit].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH. The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Passes through the placental barrier in human. Detected in maternal milk in human.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Trichloroethylene : UN1710 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Trichloroethylene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Trichloroethylene Pennsylvania RTK: Trichloroethylene Florida: Trichloroethylene Minnesota: Trichloroethylene Massachusetts RTK: Trichloroethylene New Jersey: Trichloroethylene TSCA 8(b) inventory: Trichloroethylene CERCLA: Hazardous substances.: Trichloroethylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R36/38- Irritating to eyes and skin. R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:54 PM

Last Updated: 05/21/2013 12:00 PM

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MATHESON TRI-GAS, INC.
150 Allen Road Suite 302
Basking Ridge, New Jersey 07920
Information: 1-800-416-2505

Emergency Contact:
CHEMTREC 1-800-424-9300
Calls Originating Outside the US:
703-527-3887 (Collect Calls Accepted)

SUBSTANCE: VINYL CHLORIDE

TRADE NAMES/SYNONYMS:
MTG MSDS 97; 1-CHLOROETHYLENE; 1-CHLOROETHENE; CHLOROETHYLENE; CHLOROETHENE; CHLORETHENE; CHLORETHYLENE; ETHYLENE MONOCHLORIDE; MONOCHLOROETHYLENE; MONOCHLORO ETHENE; MONOCHLOROETHENE; VINYL CHLORIDE MONOMER; VINYL CHLORIDE, INHIBITED; VINYL C MONOMER; RCRA U043; UN 1086; C2H3Cl; MAT24940; RTECS KU9625000

CHEMICAL FAMILY: halogenated, aliphatic

CREATION DATE: Jan 24 1989
REVISION DATE: Dec 11 2008

2. COMPOSITION, INFORMATION ON INGREDIENTS

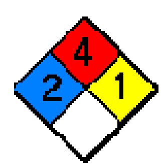
COMPONENT: VINYL CHLORIDE
CAS NUMBER: 75-01-4
PERCENTAGE: >99.9

COMPONENT: PHENOL
CAS NUMBER: 108-95-2
PERCENTAGE: <0.1

COMPONENT: INHIBITORS
CAS NUMBER: Not assigned.
PERCENTAGE: <0.1

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=4 REACTIVITY=1



EMERGENCY OVERVIEW:
COLOR: colorless
PHYSICAL FORM: gas
ODOR: faint odor, sweet odor
MAJOR HEALTH HAZARDS: harmful if swallowed, skin irritation, eye irritation, central nervous system depression, cancer hazard (in humans)
PHYSICAL HAZARDS: Flammable gas. May cause flash fire. May polymerize. Containers may rupture or explode.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: irritation, nausea, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, disorientation, joint pain, loss of coordination, hearing loss, lung congestion
LONG TERM EXPOSURE: impotence, bluish skin color, blood disorders, liver damage, cancer
SKIN CONTACT:
SHORT TERM EXPOSURE: irritation, blisters
LONG TERM EXPOSURE: irritation, blisters
EYE CONTACT:
SHORT TERM EXPOSURE: irritation, eye damage
LONG TERM EXPOSURE: irritation, eye damage
INGESTION:
SHORT TERM EXPOSURE: frostbite
LONG TERM EXPOSURE: cancer

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

SKIN CONTACT: If frostbite or freezing occur, immediately flush with plenty of lukewarm water (105-115 F; 41-46 C). DO NOT USE HOT WATER. If warm water is not available, gently wrap affected parts in blankets. Get immediate medical attention.

EYE CONTACT: Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains. Get medical attention immediately.

INGESTION: If a large amount is swallowed, get medical attention.

NOTE TO PHYSICIAN: For inhalation, consider oxygen.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. Severe explosion hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive. Electrostatic discharges may be generated by flow or agitation resulting in ignition or explosion.

EXTINGUISHING MEDIA: carbon dioxide, regular dry chemical

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Stop leak if possible without personal risk. Let burn unless leak can be stopped immediately. For smaller tanks or cylinders, extinguish and isolate from other flammables. Evacuation radius: 800 meters (1/2 mile). Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Evacuate if fire gets out of control or containers are directly exposed to fire. Evacuation radius: 500 meters (1/3 mile). Consider downwind evacuation if material is leaking.

FLASH POINT: -108 F (-78 C) (CC)
LOWER FLAMMABLE LIMIT: 3.6%
UPPER FLAMMABLE LIMIT: 33%
AUTOIGNITION: 882 F (472 C)

6. ACCIDENTAL RELEASE MEASURES

WATER RELEASE:
Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Keep out of water supplies and sewers.

OCCUPATIONAL RELEASE:
Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Keep unnecessary people away, isolate hazard area and deny entry. Remove sources of ignition. Ventilate closed spaces before entering. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Protect from physical damage. Store outside or in a detached building. Inside storage: Store in a cool, dry place. Store in a well-ventilated area. Avoid heat, flames, sparks and other sources of ignition. Grounding and bonding required. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101. See original container for storage recommendations. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
VINYL CHLORIDE:
1.0 ppm OSHA TWA
5 ppm OSHA STEL 15 minute(s)
0.5 ppm OSHA action level 8 hour(s)
1 ppm ACGIH TWA
NIOSH TWA (lowest feasible concentration)

VENTILATION: Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: For the gas: Wear appropriate chemical resistant gloves. For the liquid: Wear insulated gloves.
OSHA REGULATED SUBSTANCES: U.S. OSHA 29 CFR 1910.1017.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.
OSHA Standard:
Respirator selection should comply with 29 CFR 1910.134, 29 CFR 1910.1017, and the final rule published in the Federal Register on August 24, 2006.
NIOSH Recommendations:
At any detectable concentration -
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.
Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.
Escape -
Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted canister providing protection against the compound of concern.
Any appropriate escape-type, self-contained breathing apparatus.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: gas
COLOR: colorless
ODOR: faint odor, sweet odor
MOLECULAR WEIGHT: 62.50
MOLECULAR FORMULA: C-H2-C-H-Cl
BOILING POINT: 9 F (-13 C)
FREEZING POINT: -245 F (-154 C)
VAPOR PRESSURE: 2515.6 mmHg @ 21.1 C
VAPOR DENSITY (air=1): 2.2
SPECIFIC GRAVITY (water=1): 0.9106
WATER SOLUBILITY: 0.25%
PH: Not applicable
VOLATILITY: Not applicable
ODOR THRESHOLD: 260 ppm
EVAPORATION RATE: Not applicable
VISCOSITY: 0.01072 cP @ 20 C
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not applicable
SOLVENT SOLUBILITY:
Soluble: alcohol, ether, carbon tetrachloride, benzene

10. STABILITY AND REACTIVITY

REACTIVITY: May polymerize. Avoid contact with light or storage and use above room temperature.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat.

INCOMPATIBILITIES: metal carbide, metals, oxidizing materials, peroxides

HAZARDOUS DECOMPOSITION:
Thermal decomposition products: halogenated compounds, oxides of carbon, phosgene

POLYMERIZATION: May polymerize. Avoid contact with heat, light, air, water or incompatible materials. Closed containers may rupture violently.

11. TOXICOLOGICAL INFORMATION

VINYL CHLORIDE:
TOXICITY DATA: 18 pph/15 minute(s) inhalation-rat LC50; 500 mg/kg oral-rat LD50
CARCINOGEN STATUS: OSHA: Carcinogen; NTP: Known Human Carcinogen; IARC: Human Sufficient Evidence, Animal Sufficient Evidence, Group 1; ACGIH: A1 -Confirmed Human Carcinogen;

EC: Category 1
LOCAL EFFECTS:
Irritant: skin, eye
ACUTE TOXICITY LEVEL:
Toxic: ingestion
Relatively Non-toxic: inhalation
TARGET ORGANS: central nervous system
TUMORIGENIC DATA: Available.
MUTAGENIC DATA: Available.
REPRODUCTIVE EFFECTS DATA: Available.
ADDITIONAL DATA: Stimulants such as epinephrine may induce ventricular fibrillation. May cause birth defects.

12. ECOLOGICAL INFORMATION

ECOTOXICITY DATA:
FISH TOXICITY: 388000 ug/L 10 month(s) LETH (Mortality) Northern pike (Esox lucius)

INVERTEBRATE TOXICITY: 41.74 ug/L 72 day(s) (Residue) Mosquito (Culex pipiens quinquefasciata)

ALGAL TOXICITY: 41.74 ug/L 72 day(s) (Residue) Green algae (Oedogonium cardiacum)

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations. Hazardous Waste Number(s): D043. Dispose of in accordance with U.S. EPA 40 CFR 262 for concentrations at or above the Regulatory level. Regulatory level- 0.2 mg/L. U043.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:
PROPER SHIPPING NAME: Vinyl chloride, stabilized
ID NUMBER: UN1086
HAZARD CLASS OR DIVISION: 2.1
LABELING REQUIREMENTS: 2.1
QUANTITY LIMITATIONS:
PASSENGER AIRCRAFT OR RAILCAR: Forbidden
CARGO AIRCRAFT ONLY: 150 kg

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:
SHIPPING NAME: Vinyl chloride, stabilized
UN NUMBER: UN1086
CLASS: 2.1

15. REGULATORY INFORMATION

U.S. REGULATIONS:
CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):
Vinyl chloride: 1 LBS RQ
PHENOL: 1000 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355 Subpart B): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355 Subpart C): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370 Subparts B and C):
ACUTE: Yes
CHRONIC: Yes
FIRE: Yes
REACTIVE: Yes
SUDDEN RELEASE: Yes

SARA TITLE III SECTION 313 (40 CFR 372.65):
Vinyl chloride

OSHA PROCESS SAFETY (29 CFR 1910.119): Not regulated.

STATE REGULATIONS:
California Proposition 65:
Known to the state of California to cause the following:
Vinyl chloride
Cancer (Feb 27, 1987)

CANADIAN REGULATIONS:
WHMIS CLASSIFICATION: ABD2

NATIONAL INVENTORY STATUS:
U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

CANADA INVENTORY (DSL/NDSL): Not determined.

16. OTHER INFORMATION

MATHESON TRI-GAS, INC. MAKES NO EXPRESS OR IMPLIED WARRANTIES, GUARANTEES OR REPRESENTATIONS REGARDING THE PRODUCT OR THE INFORMATION HEREIN, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR USE. MATHESON TRI-GAS, INC. SHALL NOT BE LIABLE FOR ANY PERSONAL INJURY, PROPERTY OR OTHER DAMAGES OF ANY NATURE, WHETHER COMPENSATORY, CONSEQUENTIAL, EXEMPLARY, OR OTHERWISE, RESULTING FROM ANY PUBLICATION, USE OR RELIANCE UPON THE INFORMATION HEREIN.

APPENDIX B
Hospital Route

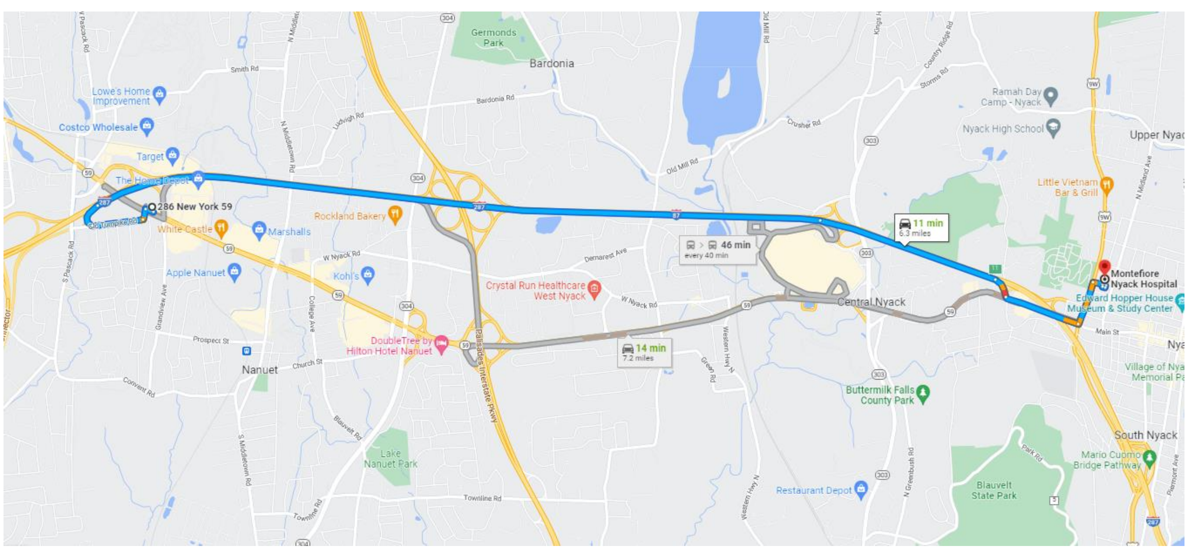
Hospital/Trauma Center

Montefiore Nyack Hospital
160 N Midland Ave, Nyack, New York 10960
(845) 348-2000

Direction to Hospital from Site:

1. Head northwest on NY-59.
2. Turn left onto Old Turnpike Way.
3. Turn right to merge onto I-287 E/I-87 S.
4. Take exit 11 towards US-9W/Nyack/South Nyack.
5. Turn left onto NY-59 E.
6. Turn left onto N Highland Ave.
7. Turn right into Montefiore Nyack Hospital.

DO NOT TRANSPORT SERIOUSLY INJURED
CALL LOCAL RESCUE



APPENDIX C
HASP Acknowledgement Form

Health & Safety Plan Acknowledgement Form

I have been informed and understand the procedures set forth in the Health & Safety Plan

Name	Signature	Company Name	Date
______________	_________________	__________________	_______
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DYNAMIC EARTH

SAFETY CONTINGENCY PLAN

Use this form for projects that do not require a full health and safety plan. Example projects include Phase I ESAs, Site visits, field work that has a low potential for physical, physical, biological, radiological or other hazards based on the characterization and analysis of the conditions at the Site. This plan can only be used for LEVEL D.

SITE DESCRIPTION:

Date:	July 19, 2024
Project Name:	Commercial Property
Project Number	1685-22-01023
Site Location:	286-330 NYS West Route 59 Portion of Parcel No. 57.19-1-10.1 Town of Clarkstown (Nanuet), Rockland County, New York
Site Access:	The Site is an open parking lot with no access restrictions.
Site Description:	The Site is 0.039 acres and is currently a portion of a parking lot for a larger commercial property.

DESCRIPTION OF TASKS:

Overburden and Bedrock Monitoring Well Installations
Groundwater Sampling
Groundwater Injections
Soil Boring Installations
Soil Sample Collection
Contractor Oversight

CONTACTS:

Agency/Personnel	Phone Number	Contact
Fire Department	9 1 1 845-623-9690 (non-emergency)	Nanuet Fire Department
Local Police Department	9 1 1 845-639-5800 (non-emergency)	Clarkstown Police Department
State Police Department	9 1 1 845-344-5300 (non-emergency)	New York State Police Department
Hospital	845-348-2000 (non-emergency)	Montfiore Nyack Hospital
State Environmental Agency	1-800-457-7362 (emergency hot line)	NYSDEC
National Response Center	1-800-424-8802	USEPA
Project Manager	267-685-0276	Christopher Zieger
Health and Safety Officer	267-685-0276	Christopher Zieger
Field Supervisor	732-280-0830	Summer Hammouda
Client Contact	845-356-2400	Steven Yassky

REQUIRED SAFETY EQUIPMENT:

Description
First Aid Kit
TYPE ABC Fire Extinguisher
Spill Kit (absorbent pads, socks, etc.)
Reflective Safety Cones
Photoionization Detector (PID)

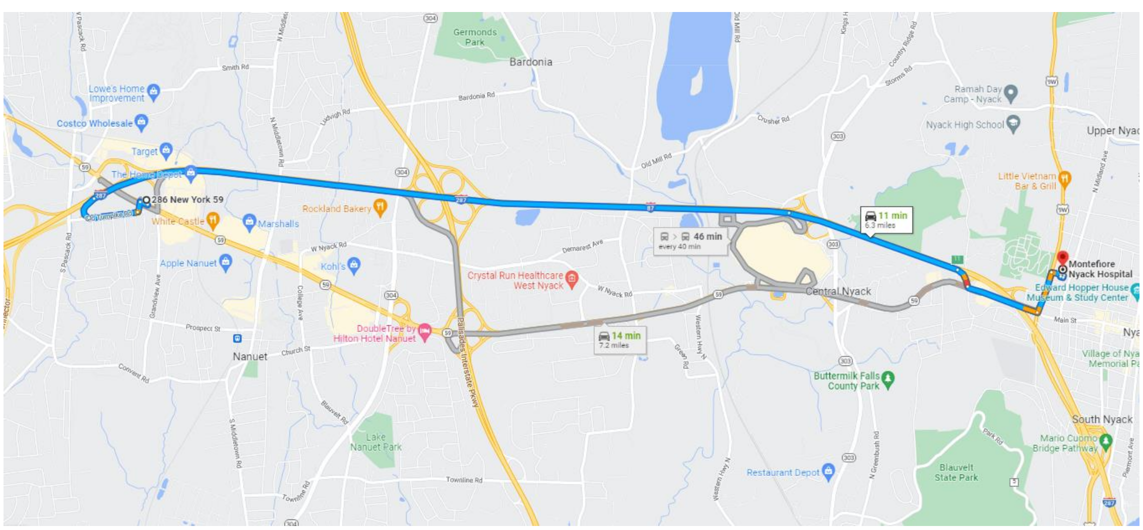
HOSPITAL ROUTE:

Montefiore Nyack Hospital
160 N Midland Ave, Nyack, New York 10960
(845) 348-2000

Direction to Hospital from Site:

1. Head northwest on NY-59.
2. Turn left onto Old Turnpike Way.
3. Turn right to merge onto I-287 E/I-87 S.
4. Take exit 11 towards US-9W/Nyack/South Nyack.
5. Turn left onto NY-59 E.
6. Turn left onto N Highland Ave.
7. Turn right into Montefiore Nyack Hospital.

DO NOT TRANSPORT SERIOUSLY INJURED
CALL LOCAL RESCUE



DYNAMIC EARTH

Appendix B
Quality Assurance Project Plan (QAPP)

QUALITY ASSURANCE PROJECT PLAN

Commercial Property
286-330 NYS West Route 59
Parcel ID 57.19-1-10.1
Town of Clarkstown, Rockland County, New York

Prepared For:
Thruway Plaza of Rockland Inc
c/o Lynmark Group
106 Airport Executive Park
Nanuet, New York 10954

Prepared By:

DYNAMIC EARTH
826 Newtown Yardly Road, Suite 201
Newtown, PA 18940

Project # 1685-22-01023

July 19, 2024

QUALITY ASSURANCE PROJECT PLAN

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

TABLES

ATTACHMENTS

QUALITY ASSURANCE PROJECT PLAN

SIGNATURE SHEET

This Quality Assurance Project Plan (QAPP) has been reviewed and approved by the following Project Manager, Technical Advisor, and Health & Safety Coordinator:

July 19, 2024

Christopher Zieger, LSRP — Date
Senior Principal
Dynamic Earth, LLC

July 19, 2024

Summer Hammouda — Date
Technical Advisor
Dynamic Earth, LLC

July 19, 2024

Christopher Zieger, LSRP — Date
Health & Safety Coordinator
Dynamic Earth, LLC

INTRODUCTION

The following Quality Assurance Project Plan (QAPP) has been prepared by Dynamic Earth, LLC (Dynamic Earth) for the proposed Remedial Investigation (RI) and Interim Remedial Measure (IRM) activities scheduled for the Commercial Property located at 286-330 NYS West Route 59, in the Town of Clarkston (Nanuet), Rockland County, New York, hereinafter referred to as the "Site."

The purpose of this plan is to define Site-specific project and data quality objectives, sample design and rationale, names and contact information for project-specific personnel, a sample summary table, sampling methodologies, standard operation procedures, sample handling and transport procedures, analytical methods, measurement of performance criteria, laboratory data deliverable formats, procedures for reviewing data, implementing corrective action procedures, quality assurance/quality control (QA/QC) procedures, and data and records management. This QAPP has been prepared in general accordance with Chapter 2 of the *Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation.*

GLOSSARY

Alteration - altering a sample collected for analysis in any way other than by adding a preservative, such as nitric acid to lower pH. Examples of alteration include, but are not limited to: filtering, settling and decanting, centrifuging and decanting and acid extracting.

ASP - Analytical Services Protocol - DEC's compilation of approved EPA laboratory methods for sample preparation, analysis and data handling procedures.

Correlation sample - a sample taken, when using a field-testing technology, to be analyzed by an ELAP-certified laboratory to determine the correlation between the laboratory and field analytical results.

Effective solubility - the theoretical aqueous solubility of an organic constituent in groundwater that is in chemical equilibrium with a separate-phase (NAPL) mixed product (product containing several organic chemicals). The effective solubility of a particular organic chemical can be estimated by multiplying its mole fraction in the product mixture by its pure-phase solubility.

AELAP - Environmental Laboratory Accreditation Program - a program conducted by the NYSDOH which certifies environmental laboratories through on-site inspections and evaluation of principles of credentials and proficiency testing. Information regarding ELAP is available at the NYSDOH Wadsworth Laboratory website.

Filtration - the filtering of a groundwater or surface water sample, collected for metals analysis, at the time of collection and prior to preservation. Filtering includes but is not limited to the use of any membrane, fabric, paper or other filter medium, irrespective of pore size, to remove particulates from suspension.

Final delineation sample - a sample taken to make a decision regarding the extent of contamination at a site during the investigation and the design of the remedy or confirmation/documentation sampling during remedial construction, which is to be analyzed by an ELAP-certified laboratory.

Intermediate sample - a sample taken during the investigation or remediation process that will be followed by another sampling event to confirm that remediation was successful or to confirm that the extent of contamination has been defined to below a level of concern.

MDL - Method detection limit - the minimum concentration of a substance that can be measured and reported with a 99 percent confidence that the analyte concentration is greater than zero and is determined from the analysis of a sample in a given matrix containing the analyte.

Minimum reporting limit - the lowest concentration at which an analyte can be detected and which can be reported with a reasonable degree of accuracy. It is the lowest concentration that can be measured, a lab-specific number, developed from minimum detection limits, and is also referred to as the practical quantitation limit (PQL).

NTU - Nephelometric Turbidity Unit - the unit by which turbidity in a sample is measured.

Preservation - preventing the degradation of a sample due to precipitation, biological action, or other physical/chemical processes between the time of sample collection and analysis. The most common examples involve refrigeration at 4 degrees Celsius and lowering sample pH by the addition of acid to keep dissolved metals in solution or to reduce the biodegradation of dissolved organic analytes.

TAL - Target analyte list - the list of inorganic compounds/elements designated for analysis as contained in the version of the EPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration in effect as of the date on which the laboratory is performing the analysis. For the purpose of this chapter, a Target Analyte List scan means the analysis of a sample for Target Analyte List compounds/elements.

Targeted compound - a contaminant for which a specific analytical method is designed to detect that potential contaminant both qualitatively and quantitatively.

TCL+30 - Target compound list plus 30 - the list of organic compounds designated for analysis (TCL) as contained in the version of the EPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration in effect as of the date on which the laboratory is performing the analysis, and up to 30 non-targeted organic compounds (plus 30) as detected by gas chromatography/mass spectroscopy (GC/MS) analysis.

TIC - Tentatively identified compound - a chemical compound that is not on the target compound list but is detected in a sample analyzed by a GC/MS analytical method. TICs are only possible with methods using mass spectrometry as the detection technique. The compound is tentatively identified using a mass spectral instrumental electronic library search and the concentration of the compound estimated.

Well development - the application of energy to a newly installed well to establish a good hydraulic connection between the well and the surrounding formation. During development, fine-grained formation material that may have infiltrated the sand pack and/or well during installation is removed, allowing water from the formation to enter the well without becoming turbid and unrepresentative of groundwater in the formation.

1.0 PROBLEM DEFINITION

The specific tasks covered by this QAPP include:

- Overseeing the installation of overburden and bedrock monitoring wells;
- Logging, and screening of soils encountered during remediation activities and within soil borings;
- Collection of soil samples;
- Temporary injection point installations;
- Sampling of groundwater; and
- Groundwater injections.

2.0 SITE SPECIFIC PROJECT & DATA QUALITY OBJECTIVES

Samples to be collected for analyses are identified in Table 1. Groundwater from the monitoring wells will be analyzed for volatile organic compounds (VOCs). Groundwater will be compared to the NYSDEC Ambient Water Quality Standard (AWQS). Soil will be compared to the NYSDEC Soil Cleanup Objectives (SCO).

Data quality objectives are provided as follows:

Sample Matrix	Objective
Groundwater	VOCs
Soil	VOCs, SVOCs, pesticides, polychlorinated biphenyls (PCBs), metals, per- and polyfluorinated alkyl substances (PFAS) and 1,4-dioxane

3.0 SAMPLE DESIGN & RATIONALE

All sampling activities conducted during Dynamic Earth's remediation activities will be collected in accordance with the techniques outlined in the *DER-10 Technical Guidance for Site Investigation and Remediation (May 2010)* and *NYSDEC Analytical Services Protocol Exhibit A (July 2005)* including preparation of field and trip blanks.

All sample analyses will be conducted in accordance with USEPA's *Test Methods for Evaluating Solid Waste* (SW-846), USEPA's *Handbook for Analytical Quality Control in Water and Wastewater Laboratories* (EPA 600/4-79-019) and applicable New York protocols. Groundwater samples will be analyzed for VOCs via USEPA Method 624 and Method 8260. Soil samples will be analyzed for VOCs via USEPA Method 8260, SVOCs via USEPA Method 8270, pesticides via USEPA Method 8081, PCBs via USEPA Method 8082, metals via USEPA Method 6010, Method 6020 and Method 7471, PFAS via USEPA Method 1633 and 1,4-dioxane via EPA Method 8270.

4.0 PROJECT SPECIFIC PERSONNEL

The following project specific personnel will be associated with the Site:

- **Project Manager:** Chris Zieger, LSRP
- **Technical Advisor:** Summer Hammouda
- **Health & Safety Coordinator:** Chris Zieger, LSRP

Resumes for project specific personnel are provided in Appendix A.
The Technical Advisor is responsible for:

- Assuring senior management that the facilities, equipment, personnel, methods, records, and controls utilized by Dynamic Earth for sample collection and analysis are consistent with the project objectives;
- Ensuring that all QA/QC policies and procedures are available to and understood by project personnel;
- Approving, enforcing and overseeing field implementation of the QA/QC and Sampling Plans;
- Appointing, training, and supervising field sampling technicians;
- Enforcing sampling equipment calibration and maintenance procedures;
- Requesting corrective action by way of reports to senior management;
- Taking corrective action for any QA-related problems and communicating action in writing to senior management and/or Owner/Engineer/Government representatives;
- Sample and sample data traceability;
- Conducting or supervising system audits of laboratory and field sampling activities;
- Examining data books, calibration of field records, forms, and other hard copy data;
- Documenting any deviation from established sampling protocol
- Interfacing with the analytical laboratory to make requests and resolve problems;
- Interfacing with the data validator and developing project-specific data usability reports;
- Reporting audit findings to senior management and the Department's representative; and
- Final data review.

The Technical Advisor will be assisted, as necessary, by qualified field sampling technicians.

5.0 ANALYTICAL LABORATORIES

Samples will be sent to the following laboratory for analyses:

Pace Analytical Laboratories (Pace)
1275 Bloomfield Avenue, Building 6
Fairfield, New Jersey 07004

Contact:	Paul B. Maide
Phone:	(973) 227-0422
Fax:	(973) 227-3145
e-Mail:	Paul.Maide@pacelabs.com

The identified laboratory is accredited pursuant to the NYSDOH Environmental Laboratory Accreditation Program (ELAP) and copies of the laboratory certifications are provided in Appendix B. The Laboratory's QA/QC Plan is on file at Dynamic Earth's and the Laboratory's offices and is available for review upon request.

6.0 SAMPLING SUMMARY PROTOCOL

A sample summary table is provided as Table 1. The location and description of all sampling activities will be recorded prior to laboratory submission. Samples will be individually tagged with unique identifiers including a sample identification number, date, time, and location of the sample; designation of the sample as a grab or composite; and the type of sample for preservation.
Samples will be individually labeled with regard to sample matrix and number as follows:

1. **Sample Matrix.** A letter will be used to denote the sample matrix. The sample matrix codes to be used for this project are as follows.

Sample Type	Codes
Groundwater Samples	MW-#
Soil Samples	S-#

2. **Sample Number Identification.** Samples will be numbered sequentially according to the identification number.

7.0 SAMPLING METHODOLOGIES & STANDARD OPERATING PROCEDURES

7.1 Sample Collection/Equipment – Aqueous Samples (Monitor Well)

Equipment required for the collection of vapor samples consists of:

- Disposable nitrile gloves,
- Appropriate sampling device (see Table 1),
- Appropriate sample containers, labels, and seals,
- Chains-of-custody, and
- Appropriate personal protective equipment (PPE).

The permanent monitor wells will be installed to confirm previously identified groundwater impacts. The monitor wells will be four- inches in diameter with a flush mount finish. The well casing should be secured to the well screen by flush-jointed threads and placed inside the borehole. At least six-inches of filter pack will be placed under the well screen in the borehole before the well screen and casing are placed in the borehole. Two weeks after the installation of the monitor wells a groundwater sample will be collected via low flow sampling.

The sampling technician will cap the sample container, attach the label and custody seal, record all pertinent data in the field log book, complete the sampling analysis request form and chain-of-custody record before taking the next sample. NOTE: *Due to the potential for cross-contamination custody seals and tape will not be placed on the cap of VOC samples*. Samples will be preserved and delivered to the off-site laboratory for analysis within the time frame specified in Table 1.

Non-disposable sampling devices will be decontaminated between sampling events (see Section 6.7).

7.2 Sample Collection/Equipment – Soil Samples

Equipment required for the collection of soil samples consists of:

- Disposable nitrile gloves,
- Appropriate sampling device (see Table 1),
- Appropriate sample containers, labels, and seals,
- Chains-of-custody, and
- Appropriate personal protective equipment (PPE).

The soil samples will be collected during the installation of the monitoring wells. All soils excavated from monitoring well installations will be field screened using a photoionization detector (PID). If evidence of soil impacts is identified, soil samples will be collected from the six-inch depth interval exhibiting evidence of soil impacts.

The sampling technician will cap the sample container, attach the label and custody seal, record all pertinent data in the field log book, complete the sampling analysis request form and chain-of-custody record before taking the next sample. NOTE: *Due to the potential for cross-contamination custody seals and tape will not be placed on the cap of VOC samples*. Samples will be preserved and delivered to the off-site laboratory for analysis within the time frame specified in Table 1.

Non-disposable sampling devices will be decontaminated between sampling events (see Section 6.7).

7.3 CONTAINER PREPARATION & CLEANING PROCEDURES

All sample bottles and containers will be supplied and pre-cleaned by the Laboratory in accordance with USEPA and applicable Analytical Services Procedure (ASP) requirements. Samples bottles will be shipped from the Laboratory to the field under custody procedures.

7.4 CONTAINERIZATION

Individual samples will be transferred from the field collection equipment/containers to the appropriate pre-cleaned bottles and containers (see Table 1) for shipment to the laboratory. After collection, all sample containers will be placed in shipping containers.

7.5 PRESERVATION & HOLDING TIMES

Sample preservation techniques and holding times will be as stated in Table 1.

7.6 SAMPLING EQUIPMENT DECONTAMINATION

All non-disposable tools which come into contact with the sample material will be decontaminated after each sampling event and before demobilization from the project site. All sampling equipment will be steam cleaned, power washed, or decontaminated in the following manner:

- Wash and scrub with low phosphate detergent (Alconox or equivalent).
- Tap water rinse.
- Repeat.
- Air Dry.

Wastewater runoff will be collected and stored pending proper off-site disposal. Any major equipment (e.g., drill rigs, excavators, etc.) used in support of sampling efforts will be decontaminated between sampling events.

8.0 FIELD DOCUMENTATION PROCEDURES

After collection and identification, the samples will be maintained under the chain-of-custody procedures outlined below.

Each person involved with the samples must understand these procedures. Samples in one's possession must be traceable from the time of collection through ultimate disposition. To maintain and document sample possession, these chain-of-custody procedures must be followed.

A sample is under custody if:

- It is in your actual possession;
- It is in your view after being in your physical possession;
- It was in your physical possession and you locked it up to prevent tampering; or
- It is in your designated and secure area.

The Technical Advisor (or his designated representative) will be responsible for monitoring all chain-of-custody activities and for collecting legally admissible copies of chain-of-custody documentation for the permanent project file. The Technical Advisor (or his designated representative) will:

- Conduct an initial review of sample labels or tags, closure tapes, and chain-of-custody record and sample split forms provided by the laboratory. The Technical Advisor (or his designated representative) will document this review for the project file.

- Review methodologies to be used for accomplishing chain-of-custody and ensure all chain-of-custody forms and record documents are properly completed.
- Monitor implementation of chain-of-custody procedures.

8.1 PREPARATION

The laboratory, with guidance or direction from the Technical Advisor (or his designated representative), will prepare labels or tags for pre-cleaned sample containers (i.e., jars, bottles, vials) prior to the transfer of these containers to the field, when possible. Labels will be made of materials which will adhere to glass containers even when wet. Tags will be designed to attach to vials or any other small container to which a label cannot easily be attached. Labels and tags (hereinafter referred to as labels) should provide space for the following information:

- Collector's name or initials,
- Sample number,
- Sampling location,
- Sampling depth (if applicable),
- Date of sampling, and
- Time of sampling.

Labels also should provide space for remarks regarding sample preservation and analyses to be performed, should samples be separated into portions in the field for different chemical analyses. Under certain circumstances, some of the information listed above may be omitted from sample labels for purposes of confidentiality. Omitted information must nevertheless be recorded in field sampler's logbooks.

The Technical Advisor (or his designated representative) will fill out all portions of sample labels when or if possible, prior to the time samples are taken. At the time of sampling, the Technical Advisor (or his designated representative) will record sample information in the logbooks and on the chain-of-custody form, noting on each any difficulties encountered during sampling. All label, logbook, and chain-of-custody form entries will be made in ink. The sample information recorded in the logbooks should be at least as detailed as that recorded on labels, and should indicate sample matrix (i.e., soil, water), preservation techniques, and sampling location in sufficient detail to allow resampling at the same location.

After containers are filled, the Technical Advisor (or his designated representative) will place the sample labels on the containers and will put the filled containers in cartons or ice chests. The Technical Advisor (or his designated representative) will maintain custody of all samples until they can be transferred to the off-site laboratory.

Prior to the transfer of samples from the field to the laboratory, the Technical Advisor (or his designated representative) will check samples and forms for correspondence, documenting any discrepancies in the custody logbook. The Technical Advisor (or his designated representative) also will prepare the samples for transport by ensuring that the potential damage to sample containers via leakage or breakage and closure tapes is minimized.

8.2 RECORDS

Sampling logbooks, the custody logbook, all chain-of-custody records, all sample split receipts, all laboratory project specific logbooks, and any other notes or records prepared by the field custodian, transporters, or laboratory personnel will become part of the project file.

9.0 FIELD INSTRUMENTATION

Dynamic Earth will utilize a MiniRae 2000 or 3000 photoionization detector (PID) during the remediation activities, or approved equivalent. The manufacturer proper use, calibration instructions, and data recording instructions for these units are included as Attachment D.

10.0 FIELD INSTRUMENT OPERATING PROCEDURES

Where appropriate, sampling equipment will be calibrated in the manner and at the intervals specified by the manufacturer (or more frequently as field conditions dictate). A record of the instrument calibration will be maintained by the Technical Advisor (or his designated representative). These records will be subject to audit by management.

The manufacturer proper use, calibration instructions, and data recording instructions for these units are included as Appendix D.

10.1 PREVENTATIVE MAINTENANCE

Preventative maintenance procedures for field equipment and laboratory instruments are discussed in the following subsections.

10.1.1 FIELD EQUIPMENT MAINTENANCE

Equipment, instruments, tools, gauges, and other items requiring preventative maintenance will be serviced in accordance with manufacturer's specified recommendations and written procedures developed by the operators.

Preventative maintenance for all equipment includes inspection before use, necessary cleaning during use, and thorough cleaning and inspection after use. Rechargeable batteries will be checked before use and recharged after use. Equipment using disposable batteries will have replacement batteries stocked at all times. Equipment failures will be repaired in the field, if possible, or returned to the manufacturer or authorized repair technician.

10.1.2 MANUFACTURER SCHEDULE

Manufacturer's procedures identify the schedule for servicing critical items in order to minimize downtime of the measurement system. It will be the responsibility of the operator to adhere to this maintenance schedule and to arrange any necessary and prompt services as required. Service to the equipment, instruments, tools, gauges, etc. will be performed by qualified personnel.

In the absence of any manufacturer's recommended maintenance criteria, a maintenance procedure will be developed by the operator based upon experience and previous use of the equipment.

10.1.3 MAINTENANCE RECORDS

Logs will be established to record maintenance and service procedures and schedules. Preventative maintenance procedures and service logs will be filed in the Dynamic Earth's field office. These records will be included in the final evidence file. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges.

Records produced for laboratory instruments will be reviewed, maintained, and filed by the operators at the laboratories and by field personnel for equipment, instruments, tools, and gauges which are used at the site. The Technical Advisor (or his designated representative) will audit these records to verify complete adherence to these procedures.

10.1.4 SPARE PARTS

A list of critical spare parts will be requested from the manufacturer and identified by the operator. These spare parts will be stored for availability and use in order to reduce equipment downtime.

10.2 LABORATORY INSTRUMENTS

Laboratory instrument maintenance will be conducted as discussed in the Subcontract Laboratory's QA/QC Manual.

10.2.1 CALIBRATION PROCEDURES AND FREQUENCIES

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

11.0 SAMPLE HANDLING & CHAIN OF CUSTODY PROCEDURES

The collected sample and its container represent a potential pathway of personnel and environmental exposure. Precautions will be taken to ensure that all the samples removed from the site are within the sample container and that no residue is on the outside of the container.

The procedure for handling samples will be as follows:

- Identify and document sample collection points.
- Complete logbook entries, sample labels, and any field record sheets with sample identification point, date, time, and names or initials of all persons handling the sample in the field.
- Place identification labels on sample containers.
- Avoid contact with the lid of the jar when filling.
- Provide sample preservation when required.
- Secure the lid on each sample.
- Carry sealed sample containers to the packaging area.
- Clean the outer surface of glass as necessary.
- Securely close the lid to the sample container; and attach properly designated label.
- Carefully pack samples for off-site analyses in coolers/packages. Custody-seal the shipping package.
- Ship to the laboratory as appropriate.

A designated laboratory custodian will receive the samples at the laboratory. Both the laboratory custodian and the transporter will sign and date the chain-of-custody forms. It will be the responsibility of the QC Supervisor (or his designated representative) to collect all chain-of-custody forms (or photocopies or microfilms of the forms) retained by transporters for inclusion in the permanent project file. The laboratory will destroy copies of the chain-of-custody forms only with the written permission of Dynamic Earth's project manager.

Upon receipt, the laboratory custodian will examine sample containers for breakage and/or broken closure tapes. The custodian will document any findings on the relevant chain-of-custody forms. The laboratory custodian also will verify that the information on the sample labels matches that on the forms. Any discrepancies will be noted on the chain-of-custody form and verbally reported to Dynamic Earth's Technical Advisor (or his/her designated representative) as soon as possible.

11.1 CHAIN OF CUSTODY FORM

A sample chain-of custody form is provided in Appendix C.

12.0 FIELD STORAGE & TRANSPORT PROCEDURES

The Technical Advisor (or his designated representative) or other designated individual will arrange transport of the samples to the laboratory following applicable regulatory procedures and regulations within the time frame specified in the Subcontract Laboratory's QA/QC Plan. Samples will be packaged in approved shipping containers (coolers) capable of maintaining the 4º C preservation and will be shipped from the site to the laboratory. Samples will be received by the laboratory within the specific holding times.

13.0 SAMPLE CONTAINER/PRESERVATION/HOLDING TIME TABLE

Sample container/preservation/holding time requirements are provided in Table 1.

14.0 ANALYTICAL METHODS

Analytical method requirements are provided in Table 1.

All sample analyses will be conducted in accordance with USEPA's *Test Methods for Evaluating Solid Waste* (SW-846), USEPA's *Handbook for Analytical Quality Control in Water and Wastewater Laboratories* (EPA 600/4-79-019) and applicable New York protocols. Groundwater samples will be analyzed for VOCs via USEPA Method 624.1 and 8260C. Soil samples will be analyzed for VOCs via USEPA Method 8260, SVOCs via USEPA Method 8270, pesticides via USEPA Method 8081, PCBs via USEPA Method 8082, metals via USEPA Method 6010, Method 6020 and Method 7471, PFAS via USEPA Method 1633 and 1,4-dioxane via EPA Method 8270.

15.0 PROJECT COMPOUNDS SUMMARY

A project compounds summary is provided in Table 1.

16.0 MEASUREMENT PERFORMANCE CRITERIA & QUALITY CONTROL SAMPLES

Quantitative (accuracy, precision, completeness, detection limits) and qualitative (representativeness and comparability) QA objectives will be as specified in USEPA SW-846, Current Edition.

The case narrative accompanying each laboratory report will summarize any QA/QC indicators outside the acceptance windows specified for the particular matrix. These summaries will be reviewed by the Technical Advisor to determine final disposition of the samples.

If all QC criteria are met, the corresponding results will be used as reported. Laboratory results which are not within acceptable QC ranges may be resampled and reanalyzed depending on the specific deficiency.

17.0 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS FOR ANALYSES

QA/QC samples will be collected by matrix at the frequency required by *Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation (May 2010)* and *NYSDEC Analytical Services Protocol (July 2005).*

All analytical data will be reviewed to assess the quality of the analytical data. Where all criteria are met, data are deemed acceptable without qualification. Where precision and accuracy goals are not met, the sample set shall be analyzed or reported with qualification in the case narrative. Some of the factors affecting this final sample disposition include:

- Project-specific QA/QC requirements,
- Availability of sufficient sample for re-analysis,
- Holding time considerations, and
- Regulatory action limits.

<u>Laboratory Responsibilities.</u> The Subcontract Laboratory will validate analytical data in accordance with its QA/QC Plan.

<u>Dynamic Earth Responsibilities.</u> The Technical Advisor or approved designee will review the laboratory data upon receipt, and indicate the meaning, extent, and effect of any laboratory-applied qualifiers, dilutions, reporting limits in excess of cleanup goals, or previously established limits; and any other issues affecting the usability of the data for its intended purpose. This review will be conducted in "real time", that is, this will be performed prior to or concurrently with Dynamic Earth's submission of laboratory data to the Owner's Representative and/or involved regulatory agencies.

17.1 ANALYTICAL DATA REPORTING

The laboratory will supply a hard copy of the analytical results, including applicable QA/QC results within the holding (turn-around) time of the sample (see Table 1). The holding time of the sample will be based on the number of days (or hours) from the verified time of sample receipt.

Category B laboratory data deliverables must include the preparation of a Data Usability Summary Report (DUSR) prepared by a party independent from the laboratory performing the analysis for all samples when Category B data deliverables are provided. This party must also be independent from any direct involvement with the project, e.g. Project Manager or property owner. The required content of a DUSR and qualifications for the person preparing the DUSR are detailed in Appendix 2B.

Category A and Category Spills laboratory data deliverables which are defined in the ASP and must be submitted for all analyses not identified as Category B.

18.0 LABORATORY DATA DELIVERABLE FORMATS TO BE USED

Data reduction is performed by individual analysts within the Subcontract Laboratory and consists of calculating concentrations in samples from the raw data obtained from the measuring instruments. The complexity of the data reduction will be dependent on the specific analytical method used and the number of discrete operations (extractions, dilutions, and concentrations) involved in obtaining a sample that can be measured.

For those methods utilizing a calibration curve, sample response will be applied to the linear regression line to obtain an initial raw result which then is factored into equations to obtain the estimate of the concentration in the original sample. Rounding will not be performed until after the final result is obtained to minimize rounding errors.

Copies of all raw data and calculations used to generate the final results will be retained on file to allow reconstruction of the data reduction process at a later date.

19.0 VERIFICATION & USABILITY PROCEDURES

The objectives for data usability are:

- To demonstrate traceability of standards to USEPA sources;
- To use standard methodology;
- To report results from similar matrices in consistent units; and
- To apply appropriate levels of quality control within the context of Subcontract Laboratory's QA/QC Manual.

20.0 CORRECTIVE ACTIONS

When a significant condition adverse to quality is noted at the project site or the laboratory, the cause of the condition will be determined and corrective action taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the project manager, Technical Advisor, and involved subcontractor management. Implementation of corrective action will be verified by documented follow-up action. All project personnel have the responsibility, as part of their normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality.

Corrective actions shall be initiated as a minimum:

- When predetermined acceptance standards are not attained (objectives for precision, accuracy, and completeness);
- When procedures or data compiled are determined to be faulty;

- When equipment or instrumentation is found faulty;
- When samples and test results cannot be traced with certainty;
- When QA requirements have been violated;
- When designated approvals have been circumvented;
- As a result of system and performance audits;
- As a result of a management assessment; or
- As a result of laboratory/inter-laboratory comparison studies.

Proposed corrective actions will be provided to project management and the Owner.

20.1 FIELD CORRECTIVE ACTION PROCEDURES

Project management and staff including the Technical Advisor, field sampling technicians, safety personnel, and document control personnel will monitor ongoing work performance in the normal course of daily responsibilities.

Project Management will audit work at the site. Items, activities, or documents ascertained to be in noncompliance with Contract requirements will be documented and corrective actions mandated through the audit report. Corrective actions will be logged, maintained, and controlled by the Project Manager.

Following identification of an adverse condition or QA problem, notification of the deficiency will be made to the Owner and the senior individual in charge of the activity found to be deficient along with recommendations for correction. A record of this notification will be attached to the audit report. Following implementation of corrective action, the senior individual in charge will report actions taken and results to the Project Manager. The Project Manager will notify the Owner when conditions adverse to quality have been corrected. A record of action taken and results also will be attached to the audit report.

The original corrective action/response and audit findings/response will be maintained in the Project Final Evidence File. Copies also will be submitted to the Owner to insure timely notification.

21.0 LABORATORY QA/QC PROCEDURES

QA non-compliance situations and QC indicators will be handled as detailed in the Subcontract Laboratory's QA/QC Manual. The case narrative accompanying each laboratory report shall summarize any QA/QC indicators outside the acceptance windows specified for the particular matrix. These summaries will be reviewed by the Technical Advisor to determine final disposition of the samples. If all QC criteria are met, the corresponding results will be used as reported. Laboratory results that are not within acceptable QC ranges will be resampled and reanalyzed.

TABLE 1
Sampling, Analyses, Container, Preservation, Hold Time Summary

Matrix Type	Location, # of samples, frequency	Analytical Parameters	Analytical Method	Container Requirements	Sample Preservation	Holding Times	Turn Around Time
Groundwater (Monitor Wells)	TBD, 5	VOCs	8260C, 624.1	3 40ml vials with PTFE-lined septum caps	HCL<2,	14 days	7 days
Groundwater (Monitor Wells – Pre & Post Injection)	TBD, 4	VOCs	8260C, 624.1	3 40ml vials with PTFE-lined septum caps	HCL<2,	14 days	7 days
Soil	TBD, 2	VOC, SVOC, Pesticides, PCBs, Metals, PFAS, 1,4-dioxane	8260, 8270, 8081, 8082, 6010, 6020, 7471, 1633	5g encores, 8oz glass jar, 8oz plastic jar	encores	14 days	7 days

Frequency of field/trip blanks – 1 set per sampling event
Frequency and type of matrix spike and matrix spike duplicate samples – 1 per 20 samples
Frequency and type of duplicate samples – 1 per sampling event

APPENDIX A
Resumes

Christopher J. Zieger, LSRP

Principal/Environmental Professional

Mr. Zieger has over 15 years of experience in environmental investigation, research, and document compilation, and is well versed in the historical and regulatory requirements of the ASTM E1527 and ASTM E1528 Standards for real estate transactions.

Mr. Zieger has coordinated and performed hundreds of environmental due diligence projects for developers, industrial and manufacturing companies, engineers, realtors, attorneys, national retail and restaurant chains, private concerns, and public agencies.

Experience Summary:

Mr. Zieger is a Licensed Site Remediation Professional (LSRP) in the State of New Jersey. He is experienced in the coordination and performance of environmental due diligence investigations including Phase I Environmental Site Assessments (ESAs) and Phase II Site Investigations, and State regulatory investigations including Preliminary Assessments; UST closure, soil and groundwater contamination delineation, Remedial Actions, and the regulatory permitting process.

Education:

- B.A., Environmental Studies, University of Pittsburgh, 2005

Certificates/Special Training:

- New Jersey Licensed Site Remediation Professional (LSRP No. 668065)
- NJDEP Subsurface Evaluator & UST Closure (License No. 483168)
- 40-Hour OSHA Hazardous Waste Operations Training with Annual Updates
- Geographic Information Systems (GIS) Certification

Areas of Expertise:

- Environmental Regulatory Compliance
- Phase I Environmental Site Assessments
- Preliminary Assessments
- Phase II Site Investigations
- UST Closure
- Regulatory Agency Interaction
- Environmental Document Reviews
- Data Collection and Assessment
- Permitting
- Report Generation and Proposal Compilation
- New Jersey ISRA Projects

Employment History:

Performing due diligence investigations (Phase I ESAs, Phase II Site Investigations, and Remedial Investigations for retail, commercial, industrial, and municipal properties throughout New Jersey, New York, Pennsylvania, Maryland, Virginia, Connecticut, Texas and Florida.

Conducting PA/SI, RI and RA activities at properties throughout New Jersey and Site Characterization Reports and Remedial Action Completion Reports in Pennsylvania.

Consulting with clients throughout the due diligence/remediation processes to effectively and efficiently reach their redevelopment/cleanup goals.

Supervising Geoprobe sampling programs to facilitate soil and groundwater sampling and analyses at commercial, industrial, municipal, and proposed residential sites.

Serving as a supervisor on UST removals throughout the northeast region and in Texas.
Interacting with regulatory agencies and implementing local, state, and federal regulations.
Preparing and issuing reports and proposals.

Managed closure of unregulated heating oil USTs at a proposed commercial parcel in Point Pleasant, New Jersey. Remedial activities included removal of impacted soil and groundwater, confirmatory soil sampling, and installation and sampling of groundwater monitor wells.

Conducted the installation of soil borings and monitor wells at a brownfields site in Rahway, New Jersey. Conducted vapor intrusion investigation at neighboring residential and commercial buildings. Oversaw soil blending remediation activities. Prepared remedial action/remedial investigation reports.

Conducted a vapor intrusion investigation including installation and sampling of sub-slab vapor points and indoor air samples at Rahway City Hall in Rahway, New Jersey.

- 2014 – Present – Dynamic Earth, LLC – Principal
- 2006 – 2013 – Whitestone Associates, Inc. – Environmental Scientist
- 2005 – Melick – Tully & Associates, PC – Environmental Scientist

Summer Hammouda

Environmental Professional/Project Manager

Summer Hammouda is an Environmental Project Manager with Dynamic Earth, LLC. She has experience in environmental investigation, research and document compilation, and is well versed in the historical and regulatory requirements of the ASTM E1527 and ASTM E1528 Standards for real estate transactions.

Ms. Hammouda is well versed in developing reports for submission to the NJDEP, including Preliminary Assessments, Site Investigation Reports, Remedial Investigation Reports, and Remedial Action Reports as well as more specialized Landfill Closure & Post-Closure Plans, LNAPL Interim Remedial Measures Reports, UST Closure Reporting, Vapor Intrusion Reporting, and more.

Education:

- Rutgers University, Bachelor of Science in Bioenvironmental Engineering, 2020

Certifications:

- 40-Hour Hazardous Waste Operations and Emergency Response Training (HAZWOPER)
- 8-Hour HAZWOPER Annual Refreshers

Areas of Expertise:

- New Jersey Department of Environmental Protection (NJDEP) Environmental Regulatory Compliance and Reporting
- New York State Department of Environmental Compliance (NYSDEC) Environmental Regulatory Compliance and Reporting
- Phase I Environmental Site Assessments
- Phase II Site Investigations
- UST Removal/Closure
- Landfill Closure & Post-Closure Operation, Monitoring & Reporting
- Vapor Intrusion Mitigation System Design & Implementation
- Construction Phase-Dewatering Permit Attainment & Groundwater Treatment System Design and Implementation
- Environmental Document Reviews
- Data Collection and Assessment
- Permitting
- Report Generation and Proposal Compilation
- Remediation Cost Estimating

Representative Experience:

- Consulted with clients throughout the due diligence/remediation processes to reach their redevelopment and cleanup goals effectively and efficiently.
- Performed due diligence investigations (Phase I ESAs/Phase II Site Investigations) and regulated investigations (Preliminary Assessments, Site/Remedial Investigations) for residential, commercial, and industrial properties throughout New York, New Jersey, and Virginia.
- Designed and/or oversaw the installation of remedial action systems (in-situ chemical injections, vapor intrusion mitigation systems, etc.)
- Supervised Geoprobe sampling programs to facilitate soil and groundwater sampling and analyses at commercial, industrial, and proposed residential sites.
- Managed numerous projects in New Jersey/New York in support of regulatory remediation and/or landfill closure activities.
- Managed construction-phase dewatering programs for periods extending upwards of six-months with over three million gallons of groundwater treated and discharged to municipal sewer systems.
- Developed fate & transport models for numerous sites to evaluate the extent of groundwater contaminant plumes and their impacts to potential receptors.
- Oversaw and managed monitoring well installations, geophysical contractors, and remedial excavation of contaminated soils.
- Conducted indoor air, ambient air, and soil gas sampling for various clients to determine mitigation requirements.
- Monitored and maintained sites with vapor intrusion mitigation systems installed.
- Created data submissions, alternative standard/ screening level memos, site investigation reports, remedial investigation reports, remedial action work plans, and remedial action reports for submission to the NJDEP.
- Coordinated with regulatory and local/municipal agencies to implement local, state, and federal regulations.

Employment History:

- 2024 – Present: Dynamic Earth, LLC – Project Manager
- 2021 – 2023: Dynamic Earth, LLC – Technical Professional
- 2020 – 2021: Arcadis, U.S. Inc. – Environmental Engineer I
- 2019 – 2020: Pfizer – Utilities and Facilities Engineering Data Analyst
- 2018 – 2019: Pfizer – Bioremediation Environmental Engineer for the American Cyanamid Superfund Site

APPENDIX B
Laboratory Certifications

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2025
Issued April 01, 2024

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. SUDIP PRADHAN
PACE ANALYTICAL SERVICES, LLC - FAIRFIELD
1275 BLOOMFIELD AVE - BLDG 6
FAIRFIELD, NJ 07004

NY Lab Id No: 11634

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Bacteriology

Coliform, Total / E. coli (Qualitative)	SM 20, 21-23 9223B (-04) (Colilert)
Heterotrophic Plate Count	SM 20, 21-23 9215B (-04)

Disinfection By-products

Bromochloroacetic acid	EPA 552.2
Dibromoacetic acid	EPA 552.2
Dichloroacetic acid	EPA 552.2
Monobromoacetic acid	EPA 552.2
Monochloroacetic acid	EPA 552.2
Trichloroacetic acid	EPA 552.2

Fuel Additives

Methyl tert-butyl ether	EPA 524.2
Naphthalene	EPA 524.2

Metals I

Arsenic, Total	EPA 200.8 Rev. 5.4
Barium, Total	EPA 200.8 Rev. 5.4
Cadmium, Total	EPA 200.8 Rev. 5.4
Chromium, Total	EPA 200.8 Rev. 5.4
Copper, Total	EPA 200.8 Rev. 5.4
Iron, Total	EPA 200.7 Rev. 4.4
Lead, Total	EPA 200.8 Rev. 5.4
Manganese, Total	EPA 200.8 Rev. 5.4
Mercury, Total	EPA 245.1 Rev. 3.0
Selenium, Total	EPA 200.8 Rev. 5.4
Silver, Total	EPA 200.8 Rev. 5.4
Zinc, Total	EPA 200.8 Rev. 5.4

Serial No.: 68856

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2025
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NY Lab Id No: 11634

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Metals II

Antimony, Total	EPA 200.8 Rev. 5.4
Beryllium, Total	EPA 200.8 Rev. 5.4
Nickel, Total	EPA 200.8 Rev. 5.4
Thallium, Total	EPA 200.8 Rev. 5.4

Metals III

Calcium, Total	EPA 200.7 Rev. 4.4
Magnesium, Total	EPA 200.7 Rev. 4.4
Sodium, Total	EPA 200.7 Rev. 4.4
Uranium (Mass)	EPA 200.8 Rev. 5.4

Microextractables

1,2,3-Trichloropropane, Low Level	EPA 504.1
1,2-Dibromo-3-chloropropane, Low Le	EPA 504.1
1,2-Dibromoethane, Low Level	EPA 504.1

Miscellaneous

Odor	SM 21-23 2150 B (-97)
Organic Carbon, Dissolved	SM 21-23 5310C (-00)
Organic Carbon, Total	SM 21-23 5310C (-00)
Surfactant (MBAS)	SM 21-23 5540C (-00)
Turbidity	EPA 180.1 Rev. 2.0

Non-Metals

Chloride	EPA 300.0 Rev. 2.1
Color	SM 21-23 2120B (-01)
Cyanide	SM 20, 21-23 4500-CN E
Fluoride, Total	EPA 300.0 Rev. 2.1
Nitrate (as N)	SM 21-23 4500-NO3 F (-00)
Nitrite (as N)	SM 21-23 4500-NO3 F (-00)

Serial No.: 68856

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2025
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CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. SUDIP PRADHAN — *NY Lab Id No: 11634*
PACE ANALYTICAL SERVICES, LLC - FAIRFIELD
1275 BLOOMFIELD AVE - BLDG 6
FAIRFIELD, NJ 07004

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Non-Metals

Sulfate (as SO4)	EPA 300.0 Rev. 2.1

Perfluorinated Alkyl Acids

Perfluorooctanesulfonic Acid (PFOS)	EPA 537
Perfluorooctanoic Acid (PFOA)	EPA 537

Trihalomethanes

Bromodichloromethane	EPA 524.2
Bromoform	EPA 524.2
Chloroform	EPA 524.2
Dibromochloromethane	EPA 524.2
Total Trihalomethanes	EPA 524.2

Volatile Aromatics

1,2,3-Trichlorobenzene	EPA 524.2
1,2,4-Trichlorobenzene	EPA 524.2
1,2,4-Trimethylbenzene	EPA 524.2
1,2-Dichlorobenzene	EPA 524.2
1,3,5-Trimethylbenzene	EPA 524.2
1,3-Dichlorobenzene	EPA 524.2
1,4-Dichlorobenzene	EPA 524.2
2-Chlorotoluene	EPA 524.2
4-Chlorotoluene	EPA 524.2
Benzene	EPA 524.2
Bromobenzene	EPA 524.2
Chlorobenzene	EPA 524.2
Ethyl benzene	EPA 524.2
Hexachlorobutadiene	EPA 524.2
Isopropylbenzene	EPA 524.2

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Volatile Aromatics

n-Butylbenzene	EPA 524.2
n-Propylbenzene	EPA 524.2
p-Isopropyltoluene (P-Cymene)	EPA 524.2
sec-Butylbenzene	EPA 524.2
Styrene	EPA 524.2
tert-Butylbenzene	EPA 524.2
Toluene	EPA 524.2
Total Xylenes	EPA 524.2

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 524.2
1,1,1-Trichloroethane	EPA 524.2
1,1,2,2-Tetrachloroethane	EPA 524.2
1,1,2-Trichloroethane	EPA 524.2
1,1-Dichloroethane	EPA 524.2
1,1-Dichloroethene	EPA 524.2
1,1-Dichloropropene	EPA 524.2
1,2,3-Trichloropropane	EPA 524.2
1,2-Dichloroethane	EPA 524.2
1,2-Dichloropropane	EPA 524.2
1,3-Dichloropropane	EPA 524.2
2,2-Dichloropropane	EPA 524.2
Bromochloromethane	EPA 524.2
Bromomethane	EPA 524.2
Carbon tetrachloride	EPA 524.2
Chloroethane	EPA 524.2
Chloromethane	EPA 524.2
cis-1,2-Dichloroethene	EPA 524.2

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Volatile Halocarbons

cis-1,3-Dichloropropene	EPA 524.2
Dibromomethane	EPA 524.2
Dichlorodifluoromethane	EPA 524.2
Methylene chloride	EPA 524.2
Tetrachloroethene	EPA 524.2
trans-1,2-Dichloroethene	EPA 524.2
trans-1,3-Dichloropropene	EPA 524.2
Trichloroethene	EPA 524.2
Trichlorofluoromethane	EPA 524.2
Vinyl chloride	EPA 524.2

Sample Preparation Methods

	SM 20, 21-23 4500-CN C (-99)

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ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Acrylates

Acrolein (Propenal)	EPA 624.1
Acrylonitrile	EPA 624.1

Bacteriology

Coliform, Fecal	SM 9222D-2015

Benzidines

3,3'-Dichlorobenzidine	EPA 625.1
Benzidine	EPA 625.1

Chlorinated Hydrocarbon Pesticides

4,4'-DDD	EPA 608.3
4,4'-DDE	EPA 608.3
4,4'-DDT	EPA 608.3
Aldrin	EPA 608.3
alpha-BHC	EPA 608.3
beta-BHC	EPA 608.3
Chlordane Total	EPA 608.3
delta-BHC	EPA 608.3
Dieldrin	EPA 608.3
Endosulfan I	EPA 608.3
Endosulfan II	EPA 608.3
Endosulfan sulfate	EPA 608.3
Endrin	EPA 608.3
Endrin aldehyde	EPA 608.3
Heptachlor	EPA 608.3
Heptachlor epoxide	EPA 608.3
Lindane	EPA 608.3
Methoxychlor	EPA 608.3

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Chlorinated Hydrocarbon Pesticides

Toxaphene	EPA 608.3

Chlorinated Hydrocarbons

1,2,4-Trichlorobenzene	EPA 625.1
2-Chloronaphthalene	EPA 625.1
Hexachlorobenzene	EPA 625.1
Hexachlorobutadiene	EPA 625.1
Hexachlorocyclopentadiene	EPA 625.1
Hexachloroethane	EPA 625.1

Demand

Biochemical Oxygen Demand	SM 5210B-2016
Carbonaceous BOD	SM 5210B-2016
Chemical Oxygen Demand	SM 5220D-2011

Haloethers

2,2'-Oxybis(1-chloropropane)	EPA 625.1
4-Bromophenylphenyl ether	EPA 625.1
4-Chlorophenylphenyl ether	EPA 625.1
Bis(2-chloroethoxy)methane	EPA 625.1
Bis(2-chloroethyl)ether	EPA 625.1

Metals I

Barium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)
Cadmium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)
Calcium, Total	EPA 200.7, Rev. 4.4 (1994)
Chromium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)

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Metals I

Copper, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)
Iron, Total	EPA 200.7, Rev. 4.4 (1994)
Lead, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)
Magnesium, Total	EPA 200.7, Rev. 4.4 (1994)
Manganese, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)
Nickel, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)
Potassium, Total	EPA 200.7, Rev. 4.4 (1994)
Silver, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)
Sodium, Total	EPA 200.7, Rev. 4.4 (1994)

Metals II

Aluminum, Total	EPA 200.7, Rev. 4.4 (1994)
Antimony, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)
Arsenic, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)
Beryllium, Total	EPA 200.7, Rev. 4.4 (1994)
Chromium VI	EPA 7196A
Mercury, Total	EPA 245.1, Rev. 3.0 (1994)
	EPA 7470A
Selenium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)
Vanadium, Total	EPA 200.7, Rev. 4.4 (1994)

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Metals II

Vanadium, Total	EPA 200.8, Rev. 5.4 (1994)
Zinc, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)

Metals III

Cobalt, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)
Molybdenum, Total	EPA 200.7, Rev. 4.4 (1994)
Thallium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 200.8, Rev. 5.4 (1994)

Mineral

Alkalinity	SM 2320B-2011
Calcium Hardness	EPA 200.7, Rev. 4.4 (1994)
Chloride	EPA 300.0, Rev. 2.1 (1993)
Sulfate (as SO4)	EPA 300.0, Rev. 2.1 (1993)

Miscellaneous

Color	SM 2120B-2011
Cyanide, Total	EPA 9014
	SM 4500-CN E-2016
non-Polar Extractable Material (TPH)	EPA 1664A
Oil and Grease Total Recoverable	EPA 1664A
Organic Carbon, Total	SM 5310C-2014
Phenols	EPA 420.1 (Rev. 1978)
	EPA 9065
Specific Conductance	SM 2510B-2011
Sulfide (as S)	SM 4500-S2- D-2011
Surfactant (MBAS)	SM 5540C-2011

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Miscellaneous

Turbidity	SM 2130 B-2011

Nitroaromatics and Isophorone

2,4-Dinitrotoluene	EPA 625.1
2,6-Dinitrotoluene	EPA 625.1
Isophorone	EPA 625.1
Nitrobenzene	EPA 625.1

Nitrosoamines

N-Nitrosodimethylamine	EPA 625.1
N-Nitrosodi-n-propylamine	EPA 625.1
N-Nitrosodiphenylamine	EPA 625.1

Nutrient

Ammonia (as N)	SM 4500-NH3 D-2011 or E-2011
Kjeldahl Nitrogen, Total	SM 4500-NH3 D-2011 or E-2011
Nitrate (as N)	EPA 300.0, Rev. 2.1 (1993)
Nitrite (as N)	EPA 300.0, Rev. 2.1 (1993)
	SM 4500-NO2 B-2011
Orthophosphate (as P)	SM 4500-P E-2011
Phosphorus, Total	SM 4500-P E-2011

Phthalate Esters

Benzyl butyl phthalate	EPA 625.1
Bis(2-ethylhexyl) phthalate	EPA 625.1
Diethyl phthalate	EPA 625.1
Dimethyl phthalate	EPA 625.1
Di-n-butyl phthalate	EPA 625.1
Di-n-octyl phthalate	EPA 625.1

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Polychlorinated Biphenyls

Aroclor 1016 (PCB-1016)	EPA 608.3
Aroclor 1221 (PCB-1221)	EPA 608.3
Aroclor 1232 (PCB-1232)	EPA 608.3
Aroclor 1242 (PCB-1242)	EPA 608.3
Aroclor 1248 (PCB-1248)	EPA 608.3
Aroclor 1254 (PCB-1254)	EPA 608.3
Aroclor 1260 (PCB-1260)	EPA 608.3

Polynuclear Aromatics

Acenaphthene	EPA 625.1
Acenaphthylene	EPA 625.1
Anthracene	EPA 625.1
Benzo(a)anthracene	EPA 625.1
Benzo(a)pyrene	EPA 625.1
Benzo(b)fluoranthene	EPA 625.1
Benzo(g,h,i)perylene	EPA 625.1
Benzo(k)fluoranthene	EPA 625.1
Chrysene	EPA 625.1
Dibenzo(a,h)anthracene	EPA 625.1
Fluoranthene	EPA 625.1
Fluorene	EPA 625.1
Indeno(1,2,3-cd)pyrene	EPA 625.1
Naphthalene	EPA 625.1
Phenanthrene	EPA 625.1
Pyrene	EPA 625.1

Priority Pollutant Phenols

2,4,5-Trichlorophenol	EPA 625.1

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Priority Pollutant Phenols

2,4,6-Trichlorophenol	EPA 625.1
2,4-Dichlorophenol	EPA 625.1
2,4-Dimethylphenol	EPA 625.1
2,4-Dinitrophenol	EPA 625.1
2-Chlorophenol	EPA 625.1
2-Methyl-4,6-dinitrophenol	EPA 625.1
2-Nitrophenol	EPA 625.1
4-Chloro-3-methylphenol	EPA 625.1
4-Nitrophenol	EPA 625.1
Pentachlorophenol	EPA 625.1
Phenol	EPA 625.1

Residue

Settleable Solids	SM 2540 F-2015
Solids, Total	SM 2540 B-2015
Solids, Total Dissolved	SM 2540 C-2015
Solids, Total Suspended	SM 2540 D-2015

Volatile Aromatics

1,2-Dichlorobenzene	EPA 624.1
1,3-Dichlorobenzene	EPA 624.1
1,4-Dichlorobenzene	EPA 624.1
Benzene	EPA 624.1
Chlorobenzene	EPA 624.1
Ethyl benzene	EPA 624.1
Styrene	EPA 624.1
Toluene	EPA 624.1
Total Xylenes	EPA 624.1

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Volatile Halocarbons

1,1,1-Trichloroethane	EPA 624.1
1,1,2,2-Tetrachloroethane	EPA 624.1
1,1,2-Trichloroethane	EPA 624.1
1,1-Dichloroethane	EPA 624.1
1,1-Dichloroethene	EPA 624.1
1,2-Dichloroethane	EPA 624.1
1,2-Dichloropropane	EPA 624.1
2-Chloroethylvinyl ether	EPA 624.1
Bromodichloromethane	EPA 624.1
Bromoform	EPA 624.1
Bromomethane	EPA 624.1
Carbon tetrachloride	EPA 624.1
Chloroethane	EPA 624.1
Chloroform	EPA 624.1
Chloromethane	EPA 624.1
cis-1,2-Dichloroethene	EPA 624.1
cis-1,3-Dichloropropene	EPA 624.1
Dibromochloromethane	EPA 624.1
Dichlorodifluoromethane	EPA 624.1
Methylene chloride	EPA 624.1
Tetrachloroethene	EPA 624.1
trans-1,2-Dichloroethene	EPA 624.1
Trichloroethene	EPA 624.1
Trichlorofluoromethane	EPA 624.1
Vinyl chloride	EPA 624.1

Sample Preparation Methods

	SM 4500-P B(5)-2011

Serial No.: 68857

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All approved analytes are listed below:

Sample Preparation Methods

SM 4500-CN B-2016 and C-2016
EPA 3010A
EPA 3005A
EPA 3510C
SM 4500-NH3 B-2011
SM 4500-N Org B-2011 or C-2011

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All approved analytes are listed below:

Acrylates

Acrolein (Propenal)	EPA 8260C
Acrylonitrile	EPA 8260C

Amines

2-Nitroaniline	EPA 8270D
	EPA 8270E
3-Nitroaniline	EPA 8270D
	EPA 8270E
4-Chloroaniline	EPA 8270D
	EPA 8270E
4-Nitroaniline	EPA 8270D
	EPA 8270E
Aniline	EPA 8270D
	EPA 8270E
Carbazole	EPA 8270D
	EPA 8270E

Benzidines

3,3'-Dichlorobenzidine	EPA 8270D
	EPA 8270E
Benzidine	EPA 8270D
	EPA 8270E

Characteristic Testing

Corrosivity (pH)	EPA 9040C
Ignitability	EPA 1010B
	EPA 1010A
TCLP	EPA 1311

Serial No.: 68858

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ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Chlorinated Hydrocarbon Pesticides

4,4'-DDD	EPA 8081B
4,4'-DDE	EPA 8081B
4,4'-DDT	EPA 8081B
Aldrin	EPA 8081B
alpha-BHC	EPA 8081B
Atrazine	EPA 8270D
	EPA 8270E
beta-BHC	EPA 8081B
Chlordane Total	EPA 8081B
delta-BHC	EPA 8081B
Dieldrin	EPA 8081B
Endosulfan I	EPA 8081B
Endosulfan II	EPA 8081B
Endosulfan sulfate	EPA 8081B
Endrin	EPA 8081B
Endrin aldehyde	EPA 8081B
Endrin Ketone	EPA 8081B
Heptachlor	EPA 8081B
Heptachlor epoxide	EPA 8081B
Lindane	EPA 8081B
Methoxychlor	EPA 8081B
Toxaphene	EPA 8081B

Chlorinated Hydrocarbons

1,2,4-Trichlorobenzene	EPA 8270D
	EPA 8270E
2-Chloronaphthalene	EPA 8270D
	EPA 8270E

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MR. SUDIP PRADHAN
PACE ANALYTICAL SERVICES, LLC - FAIRFIELD
1275 BLOOMFIELD AVE - BLDG 6
FAIRFIELD, NJ 07004

NY Lab Id No: 11634

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Chlorinated Hydrocarbons

Hexachlorobenzene	EPA 8270D
	EPA 8270E
Hexachlorobutadiene	EPA 8270D
	EPA 8270E
Hexachlorocyclopentadiene	EPA 8270D
	EPA 8270E
Hexachloroethane	EPA 8270D

Chlorophenoxy Acid Pesticides

2,4,5-TP (Silvex)	EPA 8151A
2,4-D	EPA 8151A

Haloethers

2,2'-Oxybis(1-chloropropane)	EPA 8270D
4-Bromophenylphenyl ether	EPA 8270D
4-Chlorophenylphenyl ether	EPA 8270D
Bis(2-chloroethoxy)methane	EPA 8270D
Bis(2-chloroethyl)ether	EPA 8270D

Metals I

Barium, Total	EPA 6010C
	EPA 6010D
Cadmium, Total	EPA 6010C
	EPA 6010D
Calcium, Total	EPA 6010C
	EPA 6010D
Chromium, Total	EPA 6010C
	EPA 6010D
Copper, Total	EPA 6010C

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WADSWORTH CENTER

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Metals I

Copper, Total	EPA 6010D
Iron, Total	EPA 6010C
	EPA 6010D
Lead, Total	EPA 6010C
	EPA 6010D
Magnesium, Total	EPA 6010C
	EPA 6010D
Manganese, Total	EPA 6010C
	EPA 6010D
Nickel, Total	EPA 6010C
	EPA 6010D
Potassium, Total	EPA 6010C
	EPA 6010D
Silver, Total	EPA 6010C
	EPA 6010D
Sodium, Total	EPA 6010C
	EPA 6010D
Strontium, Total	EPA 6010D

Metals II

Aluminum, Total	EPA 6010C
	EPA 6010D
Antimony, Total	EPA 6010C
	EPA 6010D
Arsenic, Total	EPA 6010C
	EPA 6010D
Beryllium, Total	EPA 6010C
	EPA 6010D

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Metals II

Chromium VI	EPA 7196A
Mercury, Total	EPA 7471B
Selenium, Total	EPA 6010C
	EPA 6010D
Vanadium, Total	EPA 6010C
	EPA 6010D
Zinc, Total	EPA 6010C
	EPA 6010D

Metals III

Cobalt, Total	EPA 6010C
	EPA 6010D
Molybdenum, Total	EPA 6010C
	EPA 6010D
Thallium, Total	EPA 6010C
	EPA 6010D

Minerals

Chloride	EPA 9056A
Fluoride, Total	EPA 9056A
Sulfate (as SO4)	EPA 9056A

Miscellaneous

Cyanide, Total	EPA 9014

Nitroaromatics and Isophorone

2,4-Dinitrotoluene	EPA 8270D
	EPA 8270E
2,6-Dinitrotoluene	EPA 8270D
	EPA 8270E

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Nitroaromatics and Isophorone

Isophorone	EPA 8270D
	EPA 8270E
Nitrobenzene	EPA 8270D
	EPA 8270E

Nitrosoamines

N-Nitrosodimethylamine	EPA 8270D
	EPA 8270E
N-Nitrosodi-n-propylamine	EPA 8270E
N-Nitrosodiphenylamine	EPA 8270D
	EPA 8270E

Nutrients

Nitrate (as N)	EPA 9056A
Nitrite (as N)	EPA 9056A

Petroleum Hydrocarbons

Diesel Range Organics	EPA 8015D
Gasoline Range Organics	EPA 8015D
Oil and Grease Total Recoverable	EPA 9071B (Solvent:Hexane)

Phthalate Esters

Benzyl butyl phthalate	EPA 8270D
	EPA 8270E
Bis(2-ethylhexyl) phthalate	EPA 8270D
	EPA 8270E
Diethyl phthalate	EPA 8270D
	EPA 8270E
Dimethyl phthalate	EPA 8270D
	EPA 8270E

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Phthalate Esters

Di-n-butyl phthalate	EPA 8270D
	EPA 8270E
Di-n-octyl phthalate	EPA 8270D
	EPA 8270E

Polychlorinated Biphenyls

Aroclor 1016 (PCB-1016)	EPA 8082A
Aroclor 1221 (PCB-1221)	EPA 8082A
Aroclor 1232 (PCB-1232)	EPA 8082A
Aroclor 1242 (PCB-1242)	EPA 8082A
Aroclor 1248 (PCB-1248)	EPA 8082A
Aroclor 1254 (PCB-1254)	EPA 8082A
Aroclor 1260 (PCB-1260)	EPA 8082A
Aroclor 1262 (PCB-1262)	EPA 8082A
Aroclor 1268 (PCB-1268)	EPA 8082A

Polynuclear Aromatic Hydrocarbons

2-Acetylaminofluorene	EPA 8270E
Acenaphthene	EPA 8270D
Acenaphthylene	EPA 8270D
	EPA 8270E
Anthracene	EPA 8270D
	EPA 8270E
Benzo(a)anthracene	EPA 8270D
	EPA 8270E
Benzo(a)pyrene	EPA 8270D
	EPA 8270E
Benzo(b)fluoranthene	EPA 8270D

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All approved analytes are listed below:

Polynuclear Aromatic Hydrocarbons

Benzo(b)fluoranthene	EPA 8270E
Benzo(g,h,i)perylene	EPA 8270D
	EPA 8270E
Benzo(k)fluoranthene	EPA 8270D
	EPA 8270E
Chrysene	EPA 8270D
	EPA 8270E
Dibenzo(a,h)anthracene	EPA 8270D
	EPA 8270E
Fluoranthene	EPA 8270D
	EPA 8270E
Fluorene	EPA 8270D
	EPA 8270E
Indeno(1,2,3-cd)pyrene	EPA 8270D
	EPA 8270E
Naphthalene	EPA 8270D
	EPA 8270E
Phenanthrene	EPA 8270D
	EPA 8270E
Pyrene	EPA 8270D
	EPA 8270E

Priority Pollutant Phenols

2,4,5-Trichlorophenol	EPA 8270D
	EPA 8270E
2,4,6-Trichlorophenol	EPA 8270D
	EPA 8270E
2,4-Dichlorophenol	EPA 8270D

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Priority Pollutant Phenols

2,4-Dichlorophenol	EPA 8270E
2,4-Dimethylphenol	EPA 8270D
	EPA 8270E
2,4-Dinitrophenol	EPA 8270D
	EPA 8270E
2-Chlorophenol	EPA 8270D
	EPA 8270E
2-Methyl-4,6-dinitrophenol	EPA 8270D
	EPA 8270E
2-Methylphenol	EPA 8270D
	EPA 8270E
2-Nitrophenol	EPA 8270D
	EPA 8270E
3-Methylphenol	EPA 8270D
	EPA 8270E
4-Chloro-3-methylphenol	EPA 8270D
	EPA 8270E
4-Methylphenol	EPA 8270D
	EPA 8270E
4-Nitrophenol	EPA 8270D
	EPA 8270E
Pentachlorophenol	EPA 8270D
	EPA 8270E
Phenol	EPA 8270D
	EPA 8270E

Semi-Volatile Organics

1,1'-Biphenyl	EPA 8270D

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Semi-Volatile Organics

1,1'-Biphenyl	EPA 8270E
1,2-Dichlorobenzene, Semi-volatile	EPA 8270D
	EPA 8270E
1,3-Dichlorobenzene, Semi-volatile	EPA 8270D
	EPA 8270E
1,4-Dichlorobenzene, Semi-volatile	EPA 8270D
	EPA 8270E
2-Methylnaphthalene	EPA 8270D
	EPA 8270E
Acetophenone	EPA 8270D
Aramite	EPA 8270E
Benzaldehyde	EPA 8270D
	EPA 8270E
Benzoic Acid	EPA 8270D
	EPA 8270E
Benzyl alcohol	EPA 8270D
	EPA 8270E
Caprolactam	EPA 8270D
	EPA 8270E
Dibenzofuran	EPA 8270D
	EPA 8270E

Volatile Aromatics

1,2,4-Trichlorobenzene, Volatile	EPA 8260C
1,2,4-Trimethylbenzene	EPA 8260D
	EPA 8260C
1,2-Dichlorobenzene	EPA 8260D
	EPA 8260C

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Volatile Aromatics

1,3,5-Trimethylbenzene	EPA 8260C
1,3-Dichlorobenzene	EPA 8260D
	EPA 8260C
1,4-Dichlorobenzene	EPA 8260D
	EPA 8260C
2-Chlorotoluene	EPA 8260D
	EPA 8260C
4-Chlorotoluene	EPA 8260D
	EPA 8260C
Benzene	EPA 8260D
	EPA 8260C
Bromobenzene	EPA 8260D
	EPA 8260C
Chlorobenzene	EPA 8260D
	EPA 8260C
Ethyl benzene	EPA 8260D
	EPA 8260C
Isopropylbenzene	EPA 8260D
	EPA 8260C
Naphthalene, Volatile	EPA 8260D
	EPA 8260C
n-Butylbenzene	EPA 8260D
	EPA 8260C
n-Propylbenzene	EPA 8260D
	EPA 8260C
p-Isopropyltoluene (P-Cymene)	EPA 8260D
	EPA 8260C

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Volatile Aromatics

sec-Butylbenzene	EPA 8260D
	EPA 8260C
Styrene	EPA 8260D
	EPA 8260C
tert-Butylbenzene	EPA 8260D
	EPA 8260C
Toluene	EPA 8260D
	EPA 8260C
Total Xylenes	EPA 8260D
	EPA 8260C

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 8260D
	EPA 8260C
1,1,1-Trichloroethane	EPA 8260D
	EPA 8260C
1,1,2,2-Tetrachloroethane	EPA 8260D
	EPA 8260C
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260D
	EPA 8260C
1,1,2-Trichloroethane	EPA 8260D
	EPA 8260C
1,1-Dichloroethane	EPA 8260D
	EPA 8260C
1,1-Dichloroethene	EPA 8260D
	EPA 8260C
1,2,3-Trichloropropane	EPA 8260D
	EPA 8260C

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Volatile Halocarbons

1,2-Dibromo-3-chloropropane	EPA 8260D
	EPA 8260C
1,2-Dibromoethane	EPA 8260D
	EPA 8260C
1,2-Dichloroethane	EPA 8260D
	EPA 8260C
1,2-Dichloropropane	EPA 8260D
	EPA 8260C
1,3-Dichloropropane	EPA 8260D
	EPA 8260C
2-Chloroethylvinyl ether	EPA 8260D
	EPA 8260C
Bromochloromethane	EPA 8260D
	EPA 8260C
Bromodichloromethane	EPA 8260D
	EPA 8260C
Bromoform	EPA 8260D
	EPA 8260C
Bromomethane	EPA 8260D
	EPA 8260C
Carbon tetrachloride	EPA 8260D
	EPA 8260C
Chloroethane	EPA 8260D
	EPA 8260C
Chloroform	EPA 8260D
	EPA 8260C
Chloromethane	EPA 8260D

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Volatile Halocarbons

Chloromethane	EPA 8260C
cis-1,2-Dichloroethene	EPA 8260D
	EPA 8260C
cis-1,3-Dichloropropene	EPA 8260D
	EPA 8260C
Dibromochloromethane	EPA 8260D
	EPA 8260C
Dibromomethane	EPA 8260D
	EPA 8260C
Dichlorodifluoromethane	EPA 8260D
	EPA 8260C
Hexachlorobutadiene, Volatile	EPA 8260D
	EPA 8260C
Methylene chloride	EPA 8260D
	EPA 8260C
Tetrachloroethene	EPA 8260D
	EPA 8260C
trans-1,2-Dichloroethene	EPA 8260D
	EPA 8260C
trans-1,3-Dichloropropene	EPA 8260D
	EPA 8260C
Trichloroethene	EPA 8260D
	EPA 8260C
Trichlorofluoromethane	EPA 8260D
	EPA 8260C
Vinyl chloride	EPA 8260D
	EPA 8260C

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Volatile Organics

1,4-Dioxane	EPA 8270D
2-Butanone (Methylethyl ketone)	EPA 8260D
	EPA 8260C
2-Hexanone	EPA 8260D
	EPA 8260C
4-Methyl-2-Pentanone	EPA 8260D
	EPA 8260C
Acetone	EPA 8260D
	EPA 8260C
Carbon Disulfide	EPA 8260D
	EPA 8260C
Cyclohexane	EPA 8260D
	EPA 8260C
Methyl cyclohexane	EPA 8260D
	EPA 8260C
Methyl tert-butyl ether	EPA 8260D
	EPA 8260C
tert-butyl alcohol	EPA 8260D
	EPA 8260C

Sample Preparation Methods

	EPA 5035A-L
	EPA 5035A-H
	EPA 3040A
	EPA 3050B
	EPA 3550C
	EPA 3060A
	EPA 9010C

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APPENDIX C
Sample Forms

APL
AQUA PRO-TECH LABORATORIES
www.aquaprotechlabs.com

1275 BLOOMFIELD AVENUE • BUILDING 6
FAIRFIELD, NEW JERSEY 07004

TEL: 973.227.0422
FAX: 973.227.2813

CHAIN OF CUSTODY

CONTAMINATION LEVEL

- ☐ LOW
- ☐ MEDIUM
- ☐ HIGH

CLIENT:	SEND REPORT TO:
ADDRESS:	ADDRESS:
PHONE:	PHONE:
E-MAIL:	SEND INVOICE TO:
PROJECT NAME:	ADDRESS:
PROJECT MGR:	SAMPLING LOCATION:
PROJECT or PO #:	SAMPLED BY:

TURN-AROUND TIME

- ☐ APL STANDARD 2 weeks
- ☐ RUSH (choose one below, may need lab approval)
  - ☐ 24 hr. date & time required ____________
  - ☐ 48 hr. date & time required ____________
  - ☐ 72 hr. date & time required ____________
  - ☐ 1 week

REPORT/ ELECTRONIC FORMAT

- ☐ RESULTS ONLY
- ☐ NJ DEP REDUCED
- ☐ NJ DEP FULL
- ☐ STATE FORMS/E2 REPORTING
- ☐ EMAIL DELIVERY
- ☐ HAZSITE EDD
- ☐ EXCEL

PWSID#____________ SRP#____________

MATRIX ABBREVIATIONS: *D - DRINKING WATER G - GROUNDWATER W - WASTEWATER S - SOIL SL - SLUDGE C - CONCRETE L - LAKE*

APL Lab ID#	Sample Source: Field ID	Date	Time	Sample Type: GRAB	Sample Type: COMP	MATRIX	No. of Bottles	Preservative	Analysis Requested

RELINQUISHED BY	PRINT ____________	SIGN ____________	DATE & TIME ____________
RECEIVED BY	PRINT	SIGN	DATE & TIME
RELINQUISHED BY	PRINT ____________	SIGN ____________	DATE & TIME ____________
RECEIVED BY	PRINT	SIGN	DATE & TIME

COMMENTS/SPECIAL INSTRUCTIONS

Cooler Temp. upon receipt at lab ____________

CERTIFICATIONS: NELAP (National Environmental Laboratory Accreditation Program) NJDEP #07010 PADEP #68-02903 NYDOH #11634

By signing this Chain of Custody Agreement, customer expressly agrees to pay APL for all charges, reasonably incurred in connection with analysis and reporting for these samples

APPENDIX D
Field Equipment Operation and Maintenance Manuals

MiniRAE 3000
User's Guide

Rev. D
April 2014
P/N 059-4020-000

FCC Information

Contains FCC ID: PI4411B

The enclosed device complies with part 15 of the FCC rules. Operation is subject to the following conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

Contents

Read Before Operating

This manual must be carefully read by all individuals who have or will have the responsibility of using, maintaining, or servicing this product. The product will perform as designed only if it is used, maintained, and serviced in accordance with the manufacturer's instructions. The user should understand how to set the correct parameters and interpret the obtained results.

CAUTION!

To reduce the risk of electric shock, turn the power off before removing the instrument cover. Disconnect the battery before removing sensor module for service. Never operate the instrument when the cover is removed. Remove instrument cover and sensor module only in an area known to be non-hazardous.

Special Notes

⚠ When the instrument is taken out of the transport case and turned on for the first time, there may be some residual organic or inorganic vapor trapped inside the detector chamber. The initial PID sensor reading may indicate a few ppm. Enter an area known to be free of any organic vapor and turn on the instrument. After running for several minutes, the residual vapor in the detector chamber will be cleared and the reading should return to zero.

⚠ The battery of the instrument discharges slowly even if it is turned off. If the instrument has not been charged for 5 to 7 days, the battery voltage will be low. Therefore, it is a good practice to always charge the instrument before using it. It is also recommended to fully charge the instrument for *at least 10 hours* before first use. Refer to this User Guide's section on battery charging for more information on battery charging and replacement.

WARNINGS

STATIC HAZARD: Clean only with damp cloth.

For safety reasons, this equipment must be operated and serviced by qualified personnel only. Read and understand instruction manual completely before operating or servicing.

Use only RAE Systems battery packs, part numbers 059-3051-000, 059-3052-000, and 059-3054-000. This instrument has not been tested in an explosive gas/air atmosphere having an oxygen concentration greater than 21%. Substitution of components may impair intrinsic safety. Recharge batteries only in non-hazardous locations.

Do not mix old and new batteries or batteries from different manufacturers.

The calibration of all newly purchased RAE Systems instruments should be tested by exposing the sensor(s) to known concentration calibration gas before the instrument is put into service.

For maximum safety, the accuracy of the instrument should be checked by exposing it to a known concentration calibration gas before each day's use.

Do not use USB/PC communication in hazardous locations.

AVERTISSEMENT

DANGER RISQUE D'ORIGINE ELECTROSTATIQUE: Nettoyer uniquement avec un chiffon humide.

Pour des raisons de sécurité, cet équipment doit être utilisé, entretenu et réparé uniquement par un personnel qualifié. Étudier le manuel d’instructions en entier avant d’utiliser, d’entretenir ou de réparer l’équipement.

Utiliser seulement l'ensemble de batterie RAE Systems, la reference 059-3051-000 au 059-3052-000 au 059-3054-000. Cet instrument n’a pas été essayé dans une atmosphère de gaz/air explosive ayant une concentration d’oxygène plus élevée que 21%. La substitution de composants peut compromettre la sécurité intrinsique. Ne charger les batteries que dans emplacements désignés non-dangereuse.

Ne pas melanger les anciennes et les nouvelles batteries, ou bien encore les batteries de differents fabriquants.

La calibration de toute instruments de RAE Systems doivent être testé en exposant l’instrument a une concentration de gaz connue par une procédure diétalonnage avant de mettre en service l’instrument pour la première fois.

Pour une securite maximale, la sensibilité du l’instrument doit être verifier en exposant l’instrument a une concentration de gaz connue par une procédure diétalonnage avant chaque utilisation journalière.

Ne pas utiliser de connection USB/PC en zone dangereuse.

Standard Contents

Instrument
Calibration Kit
Charging Cradle
AC/DC Adapter
Alkaline Battery Adapter
Data Cable
CD-ROM With User's Guide, Quick Start Guide, and related materials

General Information

The compact instrument is designed as a broadband VOC gas monitor and datalogger for work in hazardous environments. It monitors Volatile Organic Compounds (VOC) using a photoionization detector (PID) with a 9.8 eV, 10.6 eV, or 11.7 eV gas-discharge lamp. Features are:

Lightweight and Compact

- Compact, lightweight, rugged design
- Built-in sample draw pump

Dependable and Accurate

- Up to 16 hours of continuous monitoring with rechargeable battery pack
- Designed to continuously monitor VOC vapor at parts-per-million (ppm) levels

User-friendly

- Preset alarm thresholds for STEL, TWA, low- and high-level peak values.
- Audio buzzer and flashing LED display are activated when the limits are exceeded.

Datalogging Capabilities

- 260,000-point datalogging storage capacity for data download to PC

The instrument consists of a PID with associated microcomputer and electronic circuit. The unit is housed in a rugged case with a backlit LCD and 3 keys to provide easy user interface. It also has a built-in flashlight for operational ease in dark locations.

Physical Description

The main components of the portable VOC monitoring instrument include:

- Three keys for user to interact with the instrument: 3 operation/programming keys for normal operation or programming
- LCD display with back light for direct readout and calculated measurements
- Built-in flashlight for illuminating testing points in dark environments
- Buzzer and red LEDs for alarm signaling whenever exposures exceed preset limits
- Charge contacts for plugging directly to its charging station
- Gas entry and exit ports
- USB communication port for PC interface
- Protective rubber cover

Specifications

Size:	9.25" L x 3.6" W x 2.9" H
Weight:	28 oz with battery pack
Detector:	Photoionization sensor with 9.8, 10.6, or 11.7 eV UV lamp
Battery:	A 3.7V rechargeable Lithium-Ion battery pack (snap in, field replaceable, at non-hazardous location only)
	Alkaline battery holder (for 4 AA batteries)
Battery Charging:	Less than 8 hours to full charge
Operating Hours:	Up to16 hours continuous operation
Display:	Large dot matrix screen with backlight

Measurement range & resolution

Lamp	Range	Resolution
10.6 eV	0.1 ppm to 15,000 ppm	0.1 ppm
9.8 eV	0.1 ppm to 5,000 ppm	0.1 ppm
11.7 eV	0.1 ppm to 2,000 ppm	0.1 ppm

Response time (T_{90}): 2 seconds

Accuracy (Isobutylene): 10 to 2000 ppm: ±3% at calibration point.

PID Detector: Easy access to lamp and sensor for cleaning and replacement

Correction Factors: Over 200 VOC gases built in (based on RAE Systems Technical Note TN-106)

Calibration: Two-point field calibration of zero and standard reference gases

Calibration Reference: Store up to 8 sets of calibration data, alarm limits and span values

Inlet Probe: Flexible 5" tubing

Radio module: Bluetooth (2.4GHz)

Keypad: 1 operation key and 2 programming keys; 1 flashlight switch

Direct Readout: Instantaneous, average, STEL, TWA and peak value, and battery voltage

Intrinsic Safety: US and Canada: Class I, Division 1, Groups A, B, C, D

Europe: ATEX (0575 Ex II 2G Ex ia IIC/IIB T4 Gb)
KEMA 07 ATEX 0127
Complies with EN60079-0:2009, EN60079-11:2007

	IECEx CSA 10.0005 Ex ia IIC/IIB T4 Gb Complies with IEC 60079-0:2007, IEC 60079-11:2006 (IIC: 059-3051-000 Li-ion bat pack or 059-3054-000 NiMH bat pack; IIB: 059-3052-000 alkaline bat pack)
EM Interference:	Highly resistant to EMI/RFI. Compliant with EMC R&TTE (RF Modules)
Alarm Setting:	Separate alarm limit settings for Low, High, STEL and TWA alarm
Operating Mode:	Hygiene or Search mode
Alarm:	Buzzer 95dB at 30cm and flashing red LEDs to indicate exceeded preset limits, low battery voltage, or sensor failure
Alarm Type:	Latching or automatic reset
Real-time Clock:	Automatic date and time stamps on datalogged information
Datalogging:	260,000 points with time stamp, serial number, user ID, site ID, etc.
Communication:	Upload data to PC and download instrument setup from PC via USB on charging station.
Sampling Pump:	Internally integrated. Flow rate: 450 to 550 cc/min.
Temperature:	-20º C to 50º C (-4º to 122º F)
Humidity:	0% to 95% relative humidity (non-condensing)
Housing (including	Polycarbonate, splashproof and dustproof
rubber boot):	Battery can be changed without removing rubber boot.

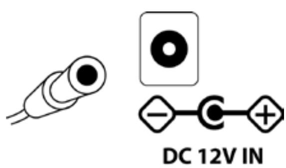
Charging The Battery

Always fully charge the battery before using the instrument. The instrument's Li-ion battery is charged by placing the instrument in its cradle. Contacts on the bottom of the instrument meet the cradle's contacts, transferring power without other connections.

Note: Before setting the instrument into its charging cradle, visually inspect the contacts to make sure they are clean. If they are not, wipe them with a soft cloth. Do not use solvents or cleaners.

Follow this procedure to charge the instrument:

1. Plug the AC/DC adapter's barrel connector into the instrument's cradle.



2. Plug the AC/DC adapter into the wall outlet.
3. Place the instrument into the cradle, press down, and lean it back. It locks in place and the LED in the cradle glow

The instrument begins charging automatically. The "Primary" LED in the cradle blinks green to indicate charging. During charging, the diagonal lines in the battery icon on the instrument's display are animated and you see the message "Charging..."

When the instrument's battery is fully charged, the battery icon is no longer animated and shows a full battery. The message "Fully charged!" is shown. The cradle's LED glows continuously green.

Note: If you see the "Battery Charging Error" icon (a battery outline with an exclamation mark inside), check that the instrument or rechargeable battery has been set into the cradle properly. If you still receive the message, check the Troubleshooting section of this guide.

Note: If the instrument or battery has been in the cradle for more than 10 hours and you see the "Battery Charging Error" icon and a message that says, "Charging Too Long," this indicates that the battery is not reaching a full charge. Try changing the battery and make sure the contacts between the instrument (or battery) are meeting the cradle. If the message is still shown, consult your distributor or RAE Systems Technical Services.

Charging A Spare Rechargeable Battery

A rechargeable Li-ion battery can be charged when it is not inside the monitor. The charging cradle is designed to accommodate both types of charging. Contacts on the bottom of the battery meet the contacts on the cradle, transferring power without other connections, and a spring-loaded capture holds the battery in place during charging.

1. Plug the AC/DC adapter into the monitor's cradle.
2. Place the battery into the cradle, with the gold-plated contacts on top of the six matching charging pins.
3. Plug the AC/DC adapter into the wall outlet.

The battery begins charging automatically. During charging, the Secondary LED in the cradle blinks green. When charging is complete, it glows steady green.

Release the battery from the cradle by pulling it back toward the rear of the cradle and tilting it out of its slot.

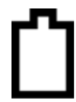
Note: If you need to replace the Li-ion battery pack, replacements are available from RAE Systems. The part number is 059-3051-000.

Note: An Alkaline Battery Adapter (part number 059-3052-000), which uses four AA alkaline batteries (Duracell MN1500), may be substituted for the Li-Ion battery.

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge and replace batteries only in areas known to be non-hazardous. Remove and replace batteries only in areas known to be non-hazardous.

Low Voltage Warning



When the battery’s charge falls below a preset voltage, the instrument warns you by beeping once and flashing once every minute, and the “empty battery” icon blinks on and off once per second. You should turn off the instrument within 10 minutes and either recharge the battery by placing the instrument in its cradle, or replace the battery with a fresh one with a full charge.

Clock Battery

An internal clock battery is mounted on one of the instrument’s printed circuit boards. This long-life battery keeps settings in memory from being lost whenever the Li-ion battery or alkaline batteries are removed. This backup battery should last approximately five years, and must be replaced by an authorized RAE Systems service technician. It is not user-replaceable.

Data Protection While Power Is Off

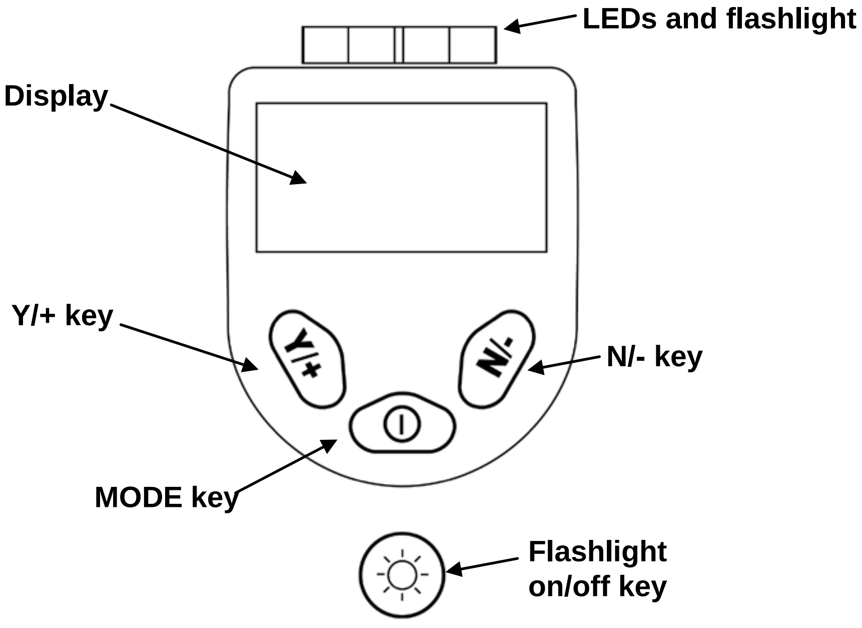
When the instrument is turned off, all the current real-time data including last measured values are erased. However, the datalog data is preserved in non-volatile memory. Even if the battery is disconnected, the datalog data will not be lost.

User Interface

The instrument's user interface consists of the display, LEDs, an alarm transducer, and four keys. The keys are:

Y/+
MODE
N/-
Flashlight on/off

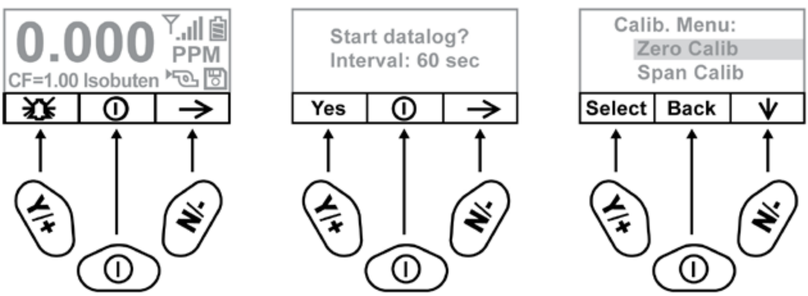
The LCD display provides visual feedback that includes the reading, time, battery condition, and other functions.



In addition to their labeled functions, the keys labeled Y/+, MODE, and N/- act as "soft keys" that control different parameters and make different selections within the instrument's menus. From menu to menu, each key controls a different parameter or makes a different selection.

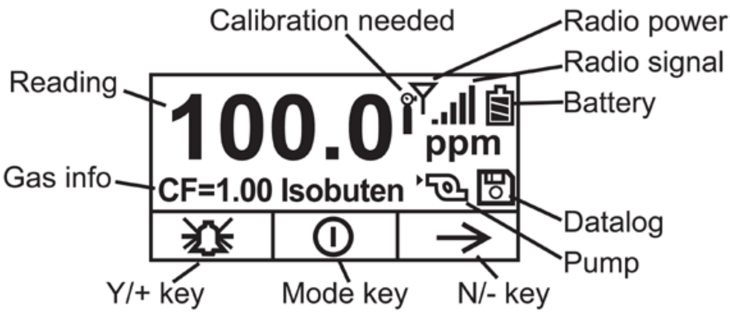
Three panes along the bottom of the display are "mapped" to the keys. These change as menus change, but at all times the left pane corresponds to the [Y/+] key, the center pane corresponds to the [MODE] key, and the right pane corresponds to the [N/-] key. Here are three examples of different menus with the relationships of the keys clearly shown:

RELATIONSHIP OF BUTTONS TO CONTROL FUNCTIONS



Display

The display shows the following information:



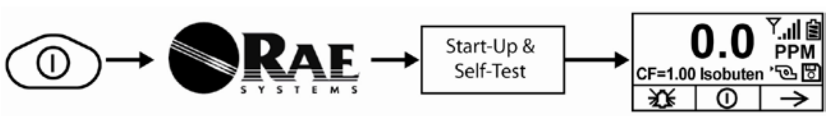
Graph	Graphic representation of concentration plotted over time
Gas info	Tells the Correction Factor and type of calibration gas
Reading	Concentration of gas as measured by the instrument
Calibration needed	Indicates that calibration should be performed
Radio power	Indicates whether radio (wireless Bluetooth) connection is on or off
Radio signal	Indicates signal strength in 5-bar bargraph
Battery	Indicates battery level in 3 bars
Pump	Indicates that pump is working
Datalog	Indicates whether datalog is on or off
Y/+	Y/+ key’s function for this screen
MODE	MODE key’s function for this screen
N/-	N/- key’s function for this screen

Operating The Instrument

The instrument is designed as a broadband VOC gas monitor and datalogger for work in hazardous environments. It gives real-time measurements and activates alarm signals whenever the exposure exceeds preset limits. Prior to factory shipment, the instrument is preset with default alarm limits and the sensor is pre-calibrated with standard calibration gas. However, you should test the instrument and verify the calibration before the first use. After the instrument is fully charged and calibrated, it is ready for immediate operation.

Turning The Instrument On

1. With the instrument turned off, press and hold [MODE].
2. When the display turns on, release the [MODE] key.



The RAE Systems logo should appear first. (If the logo does not appear, there is likely a problem and you should contact your distributor or RAE Systems Technical Support.) The instrument is now operating and performs self tests. If any tests (including sensor and memory tests fail), refer to the Troubleshooting section of this guide.

Once the startup procedure is complete, the instrument shows a numerical reading screen with icons. This indicates that the instrument is fully functional and ready to use.

Turning The Instrument Off

1. Press and hold the Mode key for 3 seconds. A 5-second countdown to shutoff begins.
2. Once the countdown stops, the instrument is off. Release the Mode key.
3. When you see “Unit off...” release your finger from the [MODE] key. The instrument is now off.

Note: You must hold your finger on the key for the entire shutoff process. If you remove your finger from the key during the countdown, the shutoff operation is canceled and the instrument continues normal operation.

Operating The Built-In Flashlight

The instrument has a built-in flashlight that helps you point the probe in dark places. Press the flashlight key to turn it on. Press it again to turn it off.

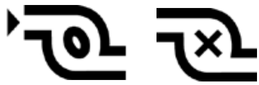
Note: Using the flashlight for extended periods shortens the battery’s operating time before it needs recharging.

Pump Status

IMPORTANT!

During operation, make sure the probe inlet and the gas outlet are free of obstructions. Obstructions can cause premature wear on the pump, false readings, or pump stalling. During normal operation, the pump icon alternately shows inflow and outflow as shown here:

During duty cycling (PID lamp cleaning), the display shows these icons in alternation:



If there is a pump failure or obstruction that disrupts the pump, you will see this icon blinking on and off:

If you see this blinking icon, consult the Troubleshooting section of this guide.

Calibration Status

The instrument displays this icon if it requires calibration:

Calibration is required (and indicated by this icon) if:

- The lamp type has been changed (for example, from 10.6 eV to 9.8 eV).
- The sensor has been replaced.
- It has been 30 days or more since the instrument was last calibrated.
- If you have changed the calibration gas type without recalibrating the instrument.

Operating Modes

Your instrument operates in different modes, depending on the model and its factory default settings. In some cases, you can change modes using a password and using the instrument’s navigation. In other cases, you must use ProRAE Studio software.

The default setting for your instrument is:

User Mode: Basic
Operation Mode: Hygiene

This is outlined in detail on page 74.

The other options, covered later in this guide, are:

User Mode: Advanced (page 78)
Operation Mode: Hygiene

User Mode: Advanced (page 82)
Operation Mode: Search

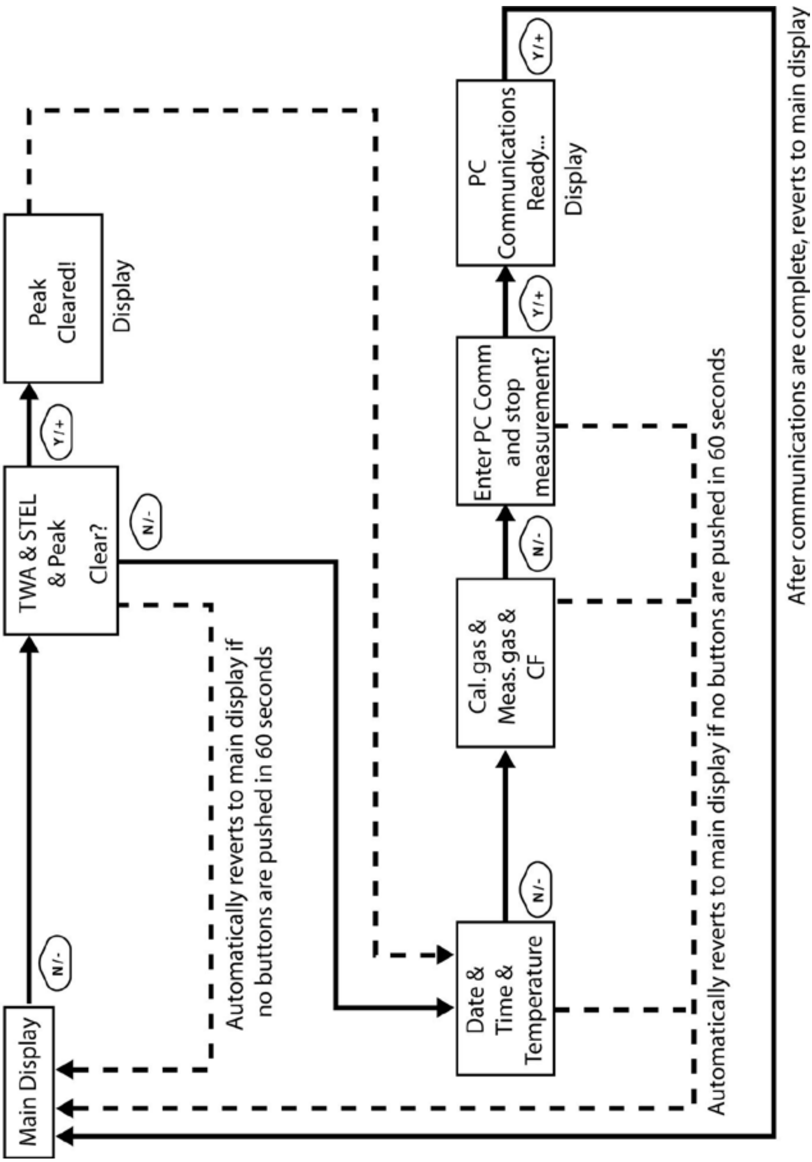
Using ProRAE Studio allows access to other options. In addition, Diagnostic Mode (page 83) is available for service technicians.

Basic User Level/Hygiene Mode (Default Settings)

The instrument is programmed to operate in Basic User Level/Hygiene Mode as its default. This gives you the most commonly needed features while requiring the fewest parameter adjustments.

Pressing [N/-] steps you from one screen to the next, and eventually return to the main display. If you do not press a key within 60 seconds after entering a display, the instrument reverts to its main display.

Note: While viewing any of these screens, you can shut off your instrument by pressing [MODE].



Note: Dashed line indicates automatic progression.

After the instrument is turned on, it runs through the start-up menu. Then the message "**Please apply zero gas…**" is displayed.

At this point, you can perform a zero air (fresh air) calibration. If the ambient air is clean, you can use that. Otherwise, use a cylinder of zero air. Refer to Zero Calibration on page 37 for a more detailed description of zero calibration.

Start zero calibration by pressing Start. You see the message "Zeroing…" followed by a 30-second countdown.

Note: You can press [MODE] to quit, bypassing the zero air calibration.

When zero calibration is complete, you see the message:

Zeroing is done!

Reading = 0.0 ppm

The instrument is now sampling and collecting data.

Note: At the Average & Peak, Date & Time & Temperature, Calibration Gas & Measurement Gas & Correction Factor, and PC Communications screens, the instrument automatically goes to the main display after 60 seconds if you do not push a key to make a selection.

Alarm Signals

During each measurement period, the gas concentration is compared with the programmed alarm limits (gas concentration alarm limit settings). If the concentration exceeds any of the preset limits, the loud buzzer and red flashing LED are activated immediately to warn you of the alarm condition.

In addition, the instrument alarms if one of the following conditions occurs: battery voltage falls below a preset voltage level, failure of the UV lamp, or pump stall.

Alarm Signal Summary

Message	Condition	Alarm Signal
HIGH	Gas exceeds "High Alarm" limit	3 beeps/flashes per second*
OVR	Gas exceeds measurement range	3 beeps/flashes per second*
MAX	Gas exceeds electronics' maximum range	3 beeps/flashes per second*
LOW	Gas exceeds "Low Alarm" limit	2 beeps/flashes per second*
TWA	Gas exceeds "TWA" limit	1 Beep/flash per second*
STEL	Gas exceeds "STEL" limit	1 Beep/flash per second*
Pump icon flashes	Pump failure	3 beeps/flashes per second
Lamp	PID lamp failure	3 beeps/flashes per second plus "Lamp" message on display
Battery icon flashes	Low battery	1 flash, 1 beep per minute plus battery icon flashes on display
CAL	Calibration failed, or needs calibration	1 beep/flash per second
NEG	Gas reading measures less than number stored in calibration	1 beep/flash per second

* Hygiene mode only. In Search mode, the number of beeps per second (1 to 7) depends upon the concentration of the sampled gas. Faster rates indicate higher concentrations.

Preset Alarm Limits & Calibration

The instrument is factory calibrated with standard calibration gas, and is programmed with default alarm limits.

Cal Gas (Isobutylene)	**Cal Span**	**unit**	**Low**	**High**	**TWA**	**STEL**
MiniRAE 3000	100	ppm	50	100	10	25

Testing The Alarm

You can test the alarm whenever the main (Reading) display is shown. Press [Y/+], and the audible and visible alarms are tested.

Integrated Sampling Pump

The instrument includes an integrated sampling pump. This diaphragm-type pump that provides a 450 to 550 cc per minute flow rate. Connecting a Teflon or metal tubing with 1/8" inside diameter to the gas inlet port of the instrument, this pump can pull in air samples from 100' (30 m) away horizontally or vertically.

Note: In Search Mode, the pump turns on when a sample measurement is started, and turns off when the sample is manually stopped.

If liquid or other objects are pulled into the inlet port filter, the instrument detects the obstruction and immediately shuts down the pump. The alarm is activated and a flashing pump icon is displayed.

You should acknowledge the pump shutoff condition by clearing the obstruction and pressing the [Y/+] key while in the main reading display to restart the pump.

Backlight

The LCD display is equipped with an LED backlight to assist in reading the display under poor lighting conditions.

Datalogging

During datalogging, the instrument displays a disk icon to indicate that datalogging is enabled. The instrument stores the measured gas concentration at the end of every sample period (when data logging is enabled). In addition, the following information is stored: user ID, site ID, serial number, last calibration date, and alarm limits. All data are retained (even after the unit is turned off) in non-volatile memory so that it can be down- loaded at a later time to a PC.

Datalogging event

When Datalogging is enabled, measurement readings are being saved. These data are stored in “groups” or “events.” A new event is created and stored each time the instrument is turned on and is set to automatic datalogging, or a configuration parameter is changed, or datalogging is interrupted. The maximum time for one event is 24 hours or 28,800 points. If an event exceeds 24 hours, a new event is automatically created. Information, such as start time, user ID, site ID, gas name, serial number, last calibration date, and alarm limits are recorded.

Datalogging sample

After an event is recorded, the unit records a shorter form of the data. When transferred to a PC running ProRAE Studio, this data is arranged with a sample number, time, date, gas concentration, and other related information.

Auto/Manual/Snapshot Datalogging

The instrument has three datalog types:

Auto	Default mode. Collects datalog information when the instrument is sampling.
Manual	Datalogging occurs only when the instrument's datalogging is manually started (see page 63 for details).
Snapshot	Datalogs only during snapshot (single-event capture, initiated by pressing [MODE]) sampling. See page 65 for details.

Note: You can only choose one datalog type to be active at a time.

Accessories

The following accessories are included with the instrument:

- An AC Adapter (Battery Charger)
- Alkaline battery adapter
- External Filter
- Organic Vapor Zeroing kit

Hard-case kits also include these accessories:

- Calibration adapter
- Calibration regulator and Flow controller

Standard Kit & Accessories

AC Adapter (Battery Charger)

WARNING

To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non-hazardous. Remove and replace battery only in area known to be non-hazardous.

Ne charger les batteries que dans emplacements designés non-dangereuses.

A battery charging circuit is built into the instrument cradle. It only needs a regular AC to 12 VDC adapter (wall-mount transformer, part number 500-0114-000) to charge the instrument.

To charge the battery inside the instrument:

1. Power off the instrument.
2. Connect the AC adapter to the DC jack on the instrument's cradle. If the instrument is off, it automatically turns on.
3. While charging, the display message shows "Charging." The Primary LED on the cradle flashes green when charging.
4. When the battery is fully charged, the LED changes to glowing green continuously, and the message "Fully charged" appears on the

display. If there is a charging error, the LED glows red continuously.

A completely discharged instrument can be charged to full capacity within 8 hours. Batteries drain slowly even if an instrument is off. Therefore, if the instrument has been in storage or has not been charged for several days or longer, check the charge before using it.

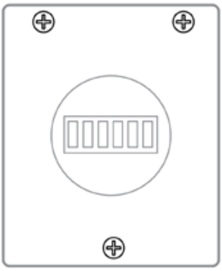
The factory-supplied battery is designed to last for 16 hours of normal operation (no alarm), for a new battery under the optimum circumstances. As the battery becomes older or is subject to adverse conditions (such as cold ambient temperature), its capacity will be significantly reduced.

Alkaline Battery Adapter

An alkaline battery adapter is supplied with each instrument. The adapter (part number 059-3052-000) accepts four AA alkaline batteries (use only Duracell MN1500) and provides approximately 12 hours of operation. The adapter is intended to be used in emergency situations when there is no time to charge the Li-ion battery pack.

To insert batteries into the adapter:

1. Remove the three Philips-head screws to open the compartment in the adapter.
2. Insert four fresh AA batteries as indicated by the polarity (+/-) markings.
3. Replace the cover. Replace the three screws.



To install the adapter in the instrument:

1. Remove the Li-ion battery pack from the instrument by sliding the tab and tilting out the battery.
2. Replace it with the alkaline battery adapter
3. Slide the tab back into place to secure the battery adapter.

IMPORTANT!

Alkaline batteries cannot be recharged. The instrument's internal circuit detects alkaline batteries and will not allow recharging. If you place the instrument in its cradle, the alkaline battery will not be recharged. The internal charging circuit is designed to prevent damage to alkaline batteries and the charging circuit when alkaline batteries are installed inside the instrument. If you try to charge an alkaline batteries installed in the instrument, the instrument's display will say, "Alkaline Battery," indicating that it will not charge the alkaline batteries.

Note: When replacing alkaline batteries, dispose of old ones properly.

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge the battery only in areas known to be non-hazardous. Remove and replace the battery only in areas known to be non-hazardous.

External Filter

The external filter is made of PTFE (Teflon®) membrane with a 0.45 micron pore size to prevent dust or other particles from being sucked into the sensor manifold, which would cause extensive damage to the instrument. It prolongs the operating life of the sensor. To install the external filter, simply connect it to the instrument's inlet tube.

Optional Accessories

Calibration Adapter

The calibration adapter for the instrument is a simple 6-inch Tygon tubing with a metal adapter on one end. During calibration, simply insert the metal adapter into the regular gas inlet probe of the instrument and the tubing to the gas regulator on the gas bottle.

Calibration Regulator

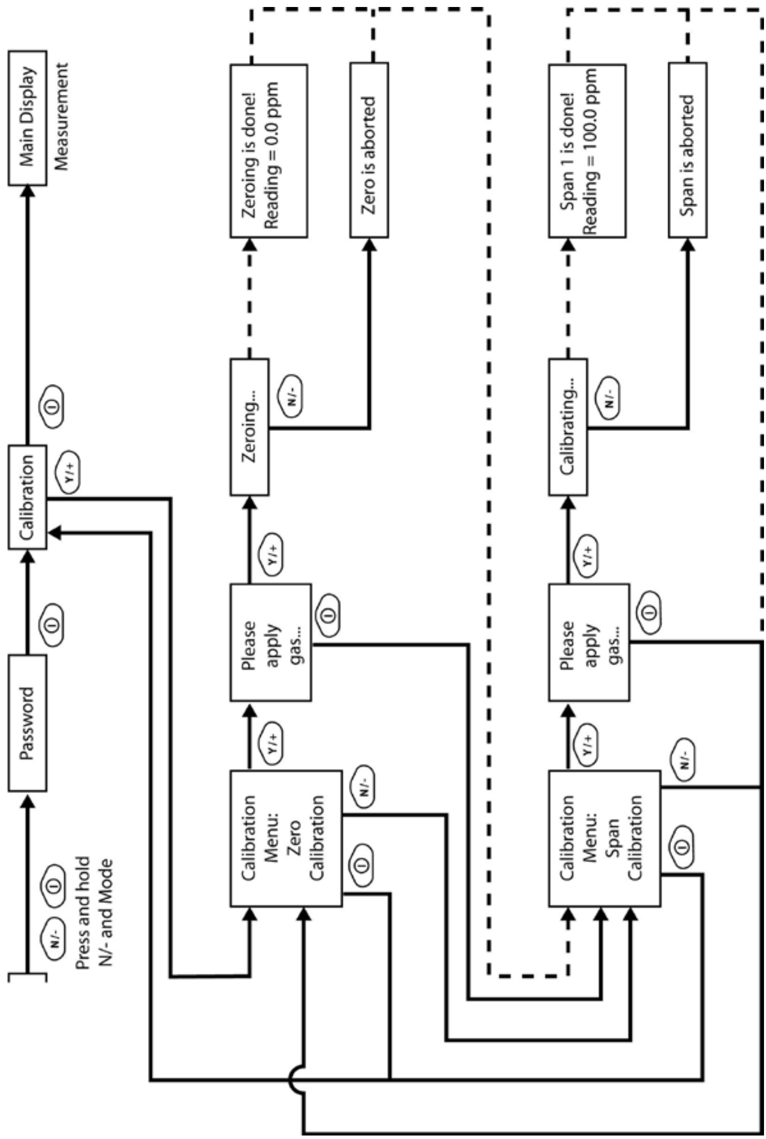
The Calibration Regulator is used in the calibration process. It regulates the gas flow rate from the Span gas cylinder into the gas inlet of the instrument during calibration process. The maximum flow rate allowed by the flow controller is about 0.5L/min (500 cc per min.). Alternatively, a demand-flow regulator or a Tedlar gas bag may be used to match the pump flow precisely.

Organic Vapor Zeroing Kit

The Organic Vapor Zeroing Kit is used for filtering organic air contaminants that may affect the zero calibration reading. To use the Organic Vapor Zeroing Kit, simply connect the filter to the inlet port of the instrument.

Standard Two-Point Calibration (Zero & Span)

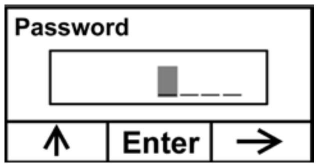
The following diagram shows the instrument's calibrations in Basic/Hygiene mode.



Note: Dashed line indicates automatic progression.

Entering Calibration

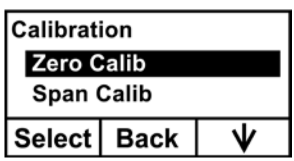
1. Press and hold [MODE] and [N/-] until you see the Password screen.



2. In Basic User Level, you do not need a password to perform calibrations. Instead of inputting a password, enter calibration by pressing [MODE].

   Note: If you inadvertently press [Y/+] and change any of the numbers, simply press [MODE] and you will be directed to the calibration menu.

The Calibration screen is now visible with Zero Calibration highlighted.



These are your options:

- Press [Y/+] to select the highlighted calibration (Zero Calib or Span Calib).
- Press [MODE] to exit calibration and return to the main display and resume measurement.
- Press [N/-] to toggle the highlighted calibration type.

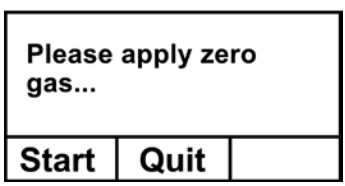
Zero (Fresh Air) Calibration

This procedure determines the zero point of the sensor calibration curve. To perform a fresh air calibration, use the calibration adapter to connect the instrument to a "fresh" air source such as from a cylinder or Tedlar bag (optional accessory). The "fresh" air is clean, dry air without organic impurities and an oxygen value of 20.9%. If such an air cylinder is not available, any clean ambient air without detectable contaminants or a charcoal filter can be used.

At the Zero Calibration menu, you can proceed to perform a Zero calibration or bypass Zero calibration and perform a Span calibration. You may also go back to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to start calibration.
- Press [MODE] to quit and return to the main calibration display.

If you have pressed [Y/+] to enter Zero calibration, then you will see this message:



1. Turn on your Zero calibration gas.
2. Press [Y/+] to start calibration.

   Note: At this point, you may press [MODE] if you decide that you do not want to initiate calibration. This will take you directly to the Calibration menu, highlighted for Span calibration.

3. Zero calibration starts a 30-second countdown and displays this message:

   Zeroing...

During the zeroing process, the instrument performs the Zero calibration automatically and does not require any action on your part.

Note: To abort the zeroing process at any time and proceed to Span calibration, press [N/-] at any time while zeroing is being performed. You will see a confirmation message that says "Zero aborted!" and then the Span calibration menu appears.

When Zero calibration is complete, you see this message:

Zeroing is done!
Reading = 0.0 ppm

The instrument will then show the Calibration menu on its display, with Span Calib highlighted.

Span Calibration

This procedure determines the second point of the sensor calibration curve for the sensor. A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure. Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar bag or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube.

At the Span Calibration menu, you perform a Span calibration. You may also go back to the Zero calibration menu or to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to enter Span calibration.
- Press [N/-] to skip Span calibration and return to Zero calibration.
- Press [MODE] to exit Span calibration and return to the top calibration menu.

If you have pressed [Y/+] to enter Span calibration, then you will see the name of your Span gas (the default is isobutylene) and the span value in parts per million (ppm). You will also see this message that prompts you:

C. Gas = Isobutene		
Span = 100 ppm		
Please apply gas 1...		
Start	**Quit**	

1. Turn on your span calibration gas.
2. Press [Y/+] to initiate calibration.

Note: You may press [MODE] if you decide that you do not want to initiate calibration. This will abort the span calibration and take you directly to the Calibration menu for Zero calibration.

3. Span calibration starts and displays this message:

   Calibrating...

During the Span calibration process, there is a 30-second countdown and the instrument performs the Span calibration automatically. It requires no actions on your part.

Note: If you want to abort the Span calibration process, press [N/-] at any time during the process. You will see a confirmation message that says "Span is aborted!" and then the Zero calibration menu appears. You can then proceed to perform a Zero calibration, perform a Span calibration, or exit to the topmost Calibration menu.

When Span calibration is complete, you see a message similar to this (the value is an example only):

Span 1 is done!
Reading = 100.0 ppm

The instrument then exits Span calibration and shows the Zero calibration menu on its display.

Note: The reading should be very close to the span gas value.

Exiting Two-Point Calibration In Basic User Level

When you are done performing calibrations, press [MODE], which corresponds with "Back" on the display. You will see the following message:

Updating settings…

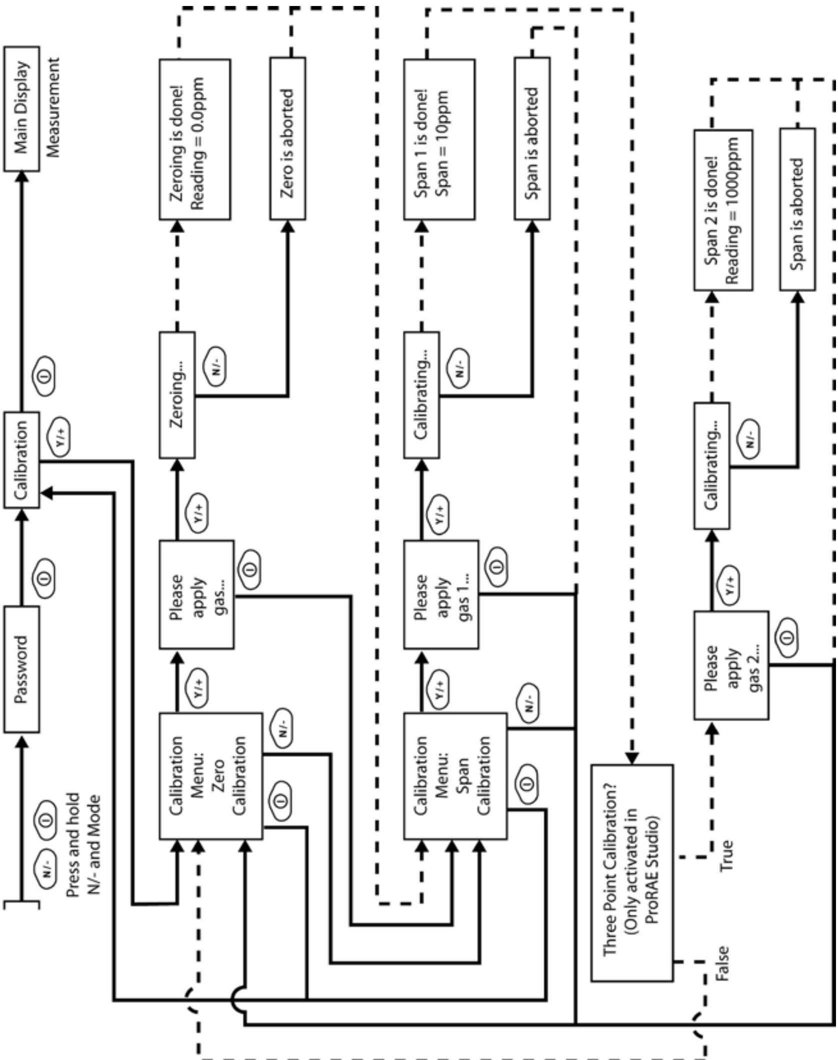
The instrument updates its settings and then returns to the main display. It begins or resumes monitoring.

Three-Point Calibration

For enhanced accuracy, it is possible to perform a second Span calibration in addition to the Zero and Span calibrations outlined in the previous section. Your instrument first must be set to allow this third calibration. This requires using ProRAE Studio software and a PC, as well as a higher concentration of calibration gas.

Note: Once the third calibration is set, you do not need to use ProRAE Studio to allow future 3-point calibrations. Also, you can only disable 3-point calibration capability by using ProRAE Studio again.

Perform the Zero and Span calibrations. After the first Span calibration (Span 1) is completed, the display a second Span calibration (Span 2) can be performed. The process is identical to the first calibration. As in the Span 1 calibration, you may exit and return to the Zero calibration screen if you choose not to perform this calibration or to abort it.



Note: Dashed line indicates automatic progression.

Span 2 Calibration

A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure.

Note: This gas should be of a higher concentration than the gas used for Span 1 calibration.

Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar bag or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube.

At the Span Calibration menu, you perform a Span calibration. You may also go back to the Zero calibration menu or to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to enter Span 2 calibration.
- Press [N/-] to skip Span calibration and return to Zero calibration.
- Press [MODE] to exit Span calibration and return to the top calibration menu.

If you have pressed [Y/+] to enter Span calibration, then you will see the name of your Span gas (the default is isobutylene) and the span value in parts per million (ppm). You will also see this message that prompts you:

Please apply gas...

4. Turn on your span calibration gas.
5. Press [Y/+] to initiate calibration.

Note: You may press [MODE] if you decide that you do not want to initiate calibration. This will take you directly to the Calibration menu for Zero calibration.

6. Span calibration starts a 30-second countdown and displays this message:

   Calibrating...

During the Span calibration process, the instrument performs the Span calibration automatically and does not require any action on your part.

Note: If you want to abort the Span calibration process, press [N/-] at any time during the process. You will see a confirmation message that says "Span is aborted!" and then the Zero calibration menu will appear. You can then proceed to perform a Zero calibration, perform a Span calibration, or exit to the topmost Calibration menu.

When Span calibration is complete, you will see a message similar to this (the value shown here is for example only):

Span 2 is done!
Reading = 1000 ppm

The instrument then exits Span calibration and shows the Zero calibration menu on its display.

Note: The reading should be very close to the span gas value.

Exiting Three-Point Calibration

When you are done performing calibrations, press [MODE], which corresponds with “Back” on the display. You will see the following message:

Updating settings…

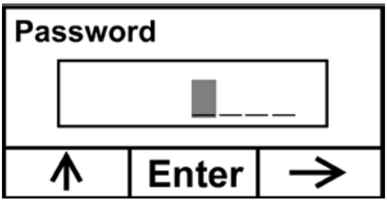
The instrument updates its settings and then returns to the main display. It begins or resumes monitoring.

Programming Mode

Programming Mode can be entered from either Hygiene Mode or Search Mode. If the current user mode is Basic, you must provide a 4-digit password to enter.

Entering Programming Mode

1. Press and hold [MODE] and [N/-] until you see the Password screen.



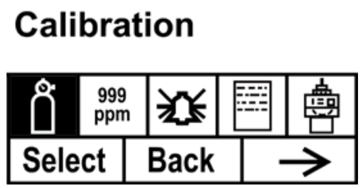
2. Input the 4-digit password:

- Increase the number from 0 through 9 by pressing [Y/+].
- Step from digit to digit using [N/-].
- Press [MODE] when you are done.

If you make a mistake, you can cycle through the digits by pressing [N/-] and then using [Y/+] to change the number in each position.

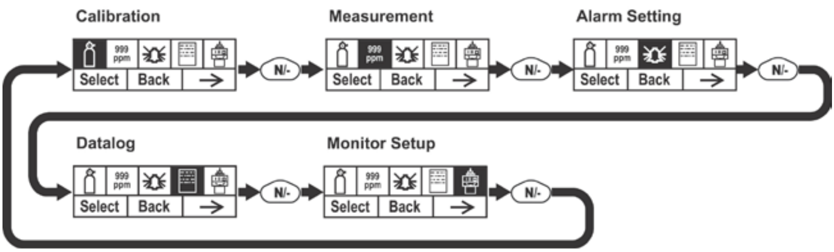
Note: The default password is 0000.

When you have successfully entered Programming Mode, you see this screen:



Note: The password can only be changed by connecting the instrument to a PC running ProRAE Studio software. Follow the instructions in ProRAE Studio to change it.

The Calibration label is shown and its icon is highlighted, but you can press [N/-] to step from one programming menu to the next, with the name of the menu shown at the top of the display and the corresponding icon highlighted. As you repeatedly press [N/-], the selection moves from left to right, and you see these screens:

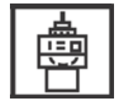


Note: When you reach Monitor Setup and press [N/-], the menu cycles back to Calibration.

Programming Mode Menus

The Programming Mode allows anyone with the password to change the instrument's settings, calibrate the instrument, modify the sensor configuration, enter user information, etc. Programming Mode has five menus. Each menu includes several sub-menus to perform additional programming functions.

This table shows the menus and sub-menus:

				
Calibration	**Measurement**	**Alarm Setting**	**Datalog**	**Monitor Setup**
Zero Calibration	Meas. Gas	High Alarm	Clear Datalog	Radio Power
Span Calibration	Meas. Unit	Low Alarm	Interval	Op Mode
		STEL Alarm	Data Selection	Site ID
		TWA Alarm	Datalog Type	User ID
		Alarm Type		User Mode
		Buzzer & Light		Date
				Time
				Pump Duty Cycle
				Pump Speed
				Temperature Unit
				Language
				Real Time Protocol
				Power On Zero
				Unit ID
				LCD Contrast

Once you enter Programming Mode, the LCD displays the first menu, Calibration. Each subsequent menu is accessed by pressing [N/-]

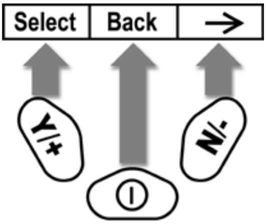
repeatedly until the desired menu is displayed. To enter a sub-menu of a menu, press [Y/+].

Exiting Programming Mode

To exit Programming Mode and return to normal operation, press [MODE] once at any of the programming menu displays. You will see "Updating Settings…" as changes are registered and the mode changes.

Navigating Programming Mode Menus

Navigating through the Programming Mode menus is easy and consistent, using a single interface format of "Select," "Back" and "Next" at the top level. The three control buttons correspond to these choices as shown:



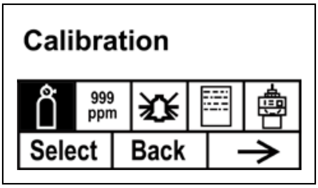
Note: Pressing [MODE] in the Programming Mode's top level causes the instrument to exit Programming Mode and return to monitoring.

The three keys perform the following functions in Programming Mode:

Key	Function in Programming Mode
[MODE]:	Exit menu when pressed momentarily or exit data entry mode
[Y/+]:	Increase alphanumerical value for data entry or confirm (yes) for a question
[N/-]:	Provides a "no" response to a question

Calibration

Two types of calibration are available: Zero (fresh air) and Span.



Select Zero or Span Calibration by pressing [N/+]. Once your choice is highlighted, press [Y/+].

Zero Calibration

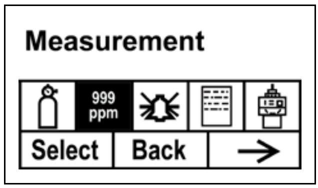
The procedure for performing a zero calibration is covered on page 35.

Span Calibration

The procedure for performing a basic span calibration is covered on page 35.

Measurement

The sub-menus for Measurement are Measurement Gas and Measurement Unit.



Meas. Gas

Measurement gases are organized in four lists:

- My List is a customized list of gases that you create. It contains a maximum of 10 gases and can only be built in ProRAE Studio on a PC and transferred to the instrument. **Note:** The first gas in the list is always isobutylene (it cannot be removed from the list).
- Last Ten is a list of the last ten gases used by your instrument. The list is built automatically and is only updated if the gas selected from Custom Gases or Library is not already in the Last Ten. This ensures that there is no repetition.
- Gas Library is a library that consists of all the gases found in RAE Systems' Technical Note TN-106 (available online at www.raesystems.com).
- Custom Gases are gases with user-modified parameters. Using ProRAE Studio, all parameters defining a gas can be modified, including the name, span value(s), correction factor, and default alarm limits.

1. Scroll through each list by pressing [N/-].
2. Press [Y/+] to select one (My List, Last Ten, Gas Library, or Custom Gases).

3. Once you are in one of the categories, press [N/-] to scroll through its list of options and [Y/+] to select one. (If you press [MODE], you exit to the next submenu.)
4. Press [Y/+] to save your choice or [N/-] to undo your selection.

Leave the sub-menu and return to the Programming Mode menus by pressing [MODE].

Meas. Unit

Standard available measurement units include:

Abbreviation	Unit	MiniRAE 3000
ppm	parts per million	Yes
ppb	parts per billion	
mg/m3	milligrams per cubic meter	Yes
ug/m3	micrograms per cubic meter	

- Scroll through the list by pressing [N/-].
- Select by pressing [Y/+].
- Save your selection by pressing [Y/+] or undo your selection by pressing [N/-].

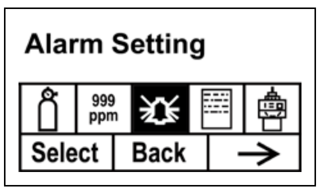
Leave the sub-menu and return to the Programming Mode menus by pressing [MODE].

Alarm Setting

During each measurement period, the gas concentration is compared with the programmed alarm limits (gas concentration alarm limit settings: Low, High, TWA and STEL). If the concentration exceeds any of the preset limits, the loud buzzer and red flashing LED are activated immediately to warn of the alarm condition.

An alarm signal summary is shown on page 27.

In this menu, you can change the High and Low alarm limits, the STEL limit, and the TWA. Press [Y/+] to to enter the Alarm Setting menu.
Note: All settings are shown in ppb (parts per billion), or µg/m^3 (micrograms per cubic meter), depending on your setting.



1. Scroll through the Alarm Limit sub-menu using the [N/-] key until the display shows the desired limit to be changed (High Alarm, Low Alarm, STEL Alarm, and TWA Alarm)
2. Press [Y/+] to select one of the alarm types. The display shows a flashing cursor on the left-most digit of the previously stored alarm limit.
3. Press [Y/+] to increase each digit's value.
4. Press [N/-] to advance to the next digit.
5. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

Press [MODE] when you are done.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

When all alarm types have been changed or bypassed, press [MODE] to exit to the Programming Menu.

High Alarm

You can change the High Alarm limit value. The value is typically set by the instrument to match the value for the current calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the High Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.
When you have completed your selections, press [MODE]. You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

Press [Y/+] to save the changes.
Press [N/-] to undo the changes and revert to the previous settings.

Low Alarm

You can change the Low Alarm limit value. The value is typically set by the instrument to match the value for the current calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the Low Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE]. You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

STEL Alarm

You can change the STEL Alarm limit value. The value is typically set by the instrument to match the value for the calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the STEL Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE]. You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

TWA Alarm

You can change the TWA (time-weighted average) Alarm limit value. The value is typically set by the instrument to match the value for the calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the TWA Alarm value:

1. Press [Y/+] to increase each digit’s value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE]. You will see two choices:

- Save
- Undo

You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

Alarm Type

There are two selectable alarm types:

Latched	When the alarm is triggered, you can manually stop the alarm. The latched setting only controls alarms for High Alarm, Low Alarm, STEL Alarm, and TWA alarm. **Note:** To clear an alarm when the instrument is set to "Latched," press [Y/+] when the main (Reading) display is shown.
Automatic Reset	When the alarm condition is no longer present, the alarm stops and resets itself.

1. Press **[N/-]** to step from one alarm type to the other.
2. Press **[Y/+]** to select an alarm type.

When you have completed your selections, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

Buzzer & Light

The buzzer and light alarms can be programmed to be on or off individually or in combination. Your choices are:

- Both on
- Light only
- Buzzer only
- Both off

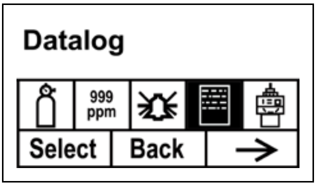
1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates your selection).
3. When you have completed your selections, press [MODE].

   You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

Datalog

The instrument calculates and stores the concentration and ID of each sample taken. In the datalog sub-menu, a user can perform the tasks and functions shown below.



1. Scroll through the Datalog sub-menu using the [N/-] key until the display shows the desired parameter to be changed:

   Clear Datalog
   Interval
   Data Selection
   Datalog Type

2. Press [Y/+] to make your selection. Exit by pressing [MODE] for Back.

Clear Datalog

This erases all the data stored in the datalog.

Note: Once the datalog is cleared, the data cannot be recovered.

Press [Y/+] to clear the datalog. The display asks, "Are you sure?"

- Press [Y/+] if you want to clear the datalog. When it has been cleared, the display shows "Datalog Cleared!"
- Press [N/-] if you do not want to clear the datalog.

The display changes, and you are taken to the next sub-menu, Interval.

Interval

Intervals are shown in seconds. The default value is 60 seconds. The maximum interval is 3600 seconds.

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

Data Selection

Data Selection allows you to select which types of data are stored and made available when you offload your datalog to a computer via ProRAE Studio software.

You can choose any or all of three types of data (you must choose at least one):

- Average
- Maximum
- Minimum

1. Press [N/-] to step from one option to the next. The highlighter indicates your choice.
2. Press [Y/+] to toggle your selection on or off (the check box indicates "on" with an "X").
3. When you have completed your selections, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

Datalog Type

The instrument has three datalog types:

Auto	Default mode. Collects datalog information when the instrument is sampling.
Manual	Datalogging occurs only when the instrument's datalogging is manually started (see below for details).
Snapshot	Datalogs only during single-event capture sampling.

Note: You can only choose one datalog type to be active at a time.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.

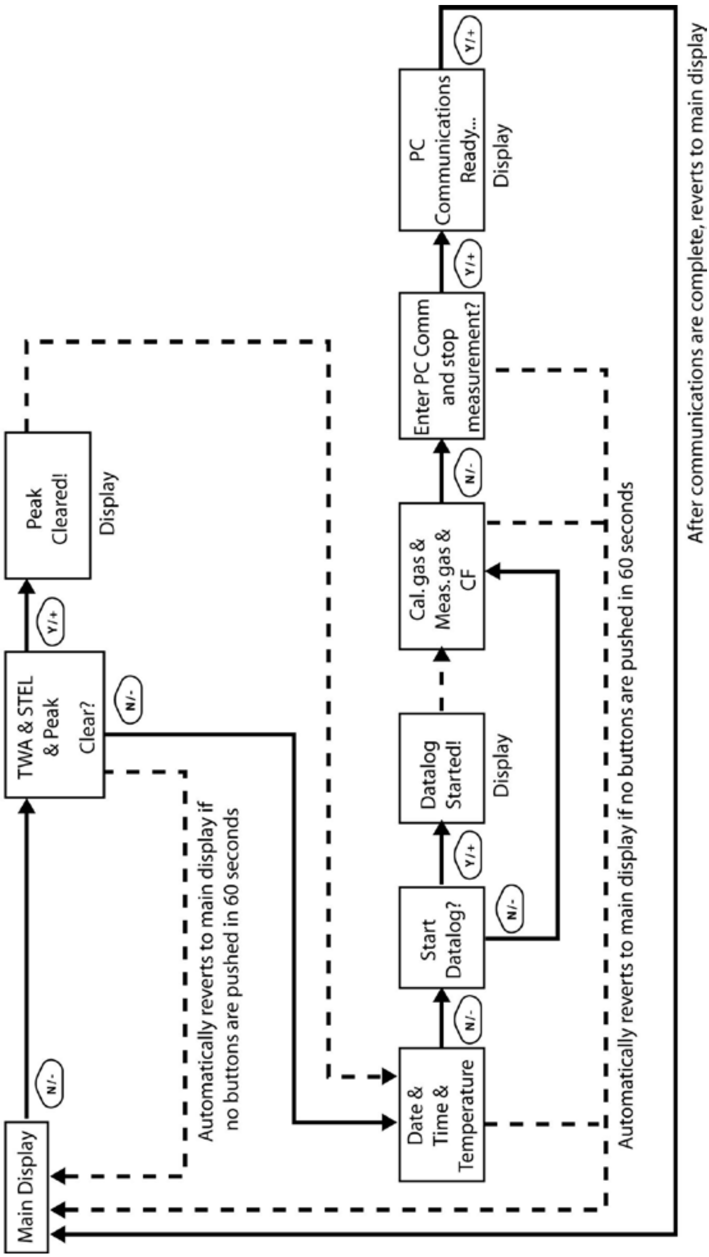
Press [N/-] to undo the changes and revert to the previous settings.

Manual Datalog

When the instrument is set to Manual Datalog, you turn datalogging on and off by stepping through the displays from the Main Display, and then pressing the keys to select datalog on/off functions.

- When you reach the screen that says "Start Datalog?" press [Y/+] to start it. You see "Datalog Started," confirming that datalogging is now on.

When you reach the screen that says "Stop Datalog?" press [Y/+] to stop it. You see "Datalog Stopped," confirming that datalogging is now off.



Note: Dashed line indicates automatic progression.

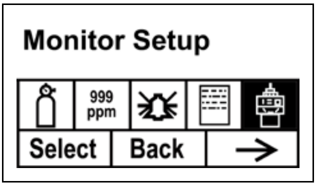
Snapshot Datalog

When the instrument is in Snapshot datalogging mode, it captures a single “snapshot” of the data at the moment of your choosing. Whenever the instrument is on and it is set to Snapshot, all you have to do is press [MODE] each time you want to capture a snapshot of the data at that instant.

When you send the data to a computer using ProRAE Studio, the data snapshots are uniquely identified by time and other parameters.

Monitor Setup

Many settings can be accessed in this menu, including setting the date and time and adjusting the pump’s on/off duty cycle.



Radio Power

The radio connection can be turned on or off.

1. Press [N/-] to step from one option to the next (on or off).
2. Press [Y/+] to make your selection (the dark circle in the “radio button” indicates that the option is selected).
3. When you have completed your selection, press [MODE].

- Press [Y/+] to accept the new radio setting (on or off).
- Press [N/-] to discard the change and move to the next sub-menu.

Op Mode

Under Monitor Setup is “Op Mode.”

Press [Y/+] to select.

You see two options (one is highlighted):

Hygiene
Search

The current mode is indicated by a dark circle within the circle in front of either Hygiene or Search.

1. Select Hygiene or Search by pressing [N/-]. The highlighting changes from one to the other each time you press [N/-].
2. Press [Y/+] to select that mode for the instrument.
3. Press [MODE] when you want to register your selection to place the instrument in the selected mode.
4. Press [Y/+] to commit the change and exit to the Monitor Setup screen, or press [N/-] to Undo (exit to the Monitor Setup screen without changing the Mode).

Site ID

Enter an 8-digit alphanumeric/character Site ID in the programming mode. This Site ID is included in the datalog report.

1. Press [Y/+] and the display shows the current site ID. Example: “RAE00001.” Note that the left-most digit flashes to indicate it is the selected one.
2. Press [Y/+] to step through all 26 letters (A to Z) and 10 numerals (0 to 9).
   Note: The last four digits must be numerals.
3. Press [N/-] to advance to the next digit. The next digit to the right flashes.

Repeat this process until all eight digits of the new site ID are entered.

Press [MODE] to exit.

If there is any change to the existing site ID, the display shows "Save?" Press [Y/+] to accept the new site ID. Press [N/-] to discard the change and move to the next sub-menu.

User ID

Enter an 8-digit alphanumeric User ID in the programming mode. This User ID is included in the datalog report.

1. Press [Y/+] and the display shows the current User ID. Example: "RAE00001." Note that the left-most digit flashes to indicate it is the selected one.
2. Press [Y/+] to step through all 26 letters (A to Z) and 10 numerals (0 to 9).
3. Press [N/-] to advance to the next digit. The next digit to the right flashes.

Repeat this process until all eight digits of the new User ID are entered.

Press [MODE] to exit.

If there is any change to the existing User ID, the display shows "Save" Press [Y/+] to accept the new site ID. Press [N/-] to discard (undo) the change and move to the next sub-menu.

User Mode

The instrument has two user modes:

Basic Basic users can only see and use a basic set of functions.
Advanced Advanced users can see all screens and perform all available functions.

Note: The default value for User Mode is Basic.

To change the User Mode:

1. Press [N/-] to step from one option to the next. The highlighting changes each time you press [N/-].
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
4. Press [Y/+] to accept the new User Mode. Press [N/-] to discard the change and move to the next sub-menu.

Date

The Date is expressed as Month/Day/Year, with two digits for each.

1. Press [Y/+] and the display shows the current date. Note that the left-most digit flashes to indicate it is selected.
2. Press [Y/+] to step through all 10 numerals (0 to 9).
3. Press [N/-] to advance to the next digit. The next digit to the right flashes.

Repeat this process until all six digits of the new date are entered.

Press [MODE] to exit.

- Press [Y/+] to save the new date.
- Press [N/-] to undo the change and move to the next sub-menu.

Time

The Time is expressed as Hours/Minutes/Seconds, with two digits for each. The time is in 24-hour (military) format.

1. Press [Y/+] and the display shows the current time. Note that the left-most digit flashes to indicate it is selected.

2. Press [Y/+] to step through all 10 numerals (0 to 9).
3. Press [N/-] to advance to the next digit. The next digit to the right flashes.

   Repeat this process until all six digits of the new time are entered.

Press [MODE] to exit.

- Press [Y/+] to save the new date.
- Press [N/-] to undo the change and move to the next sub-menu.

Duty Cycle

The pump's duty cycle is the ratio of its on time to off time. The duty cycle ranges from 50% to 100% (always on), and the period is 10 seconds. Therefore, a duty cycle of 60% means that the pump is on for 6 seconds and off for four seconds. Duty cycling is employed by the instrument to clean the PID. A lower duty cycle has a greater effect on keeping the PID clean than a higher duty cycle.

Important! Pump duty cycling is interrupted when the instrument senses a gas. The pump's duty cycle is disabled when the measurement is greater than the 2ppm threshold and is re-enabled when the reading falls below 90% of the threshold (1.8 ppm).

1. Press [Y/+] to increase the value.
2. When you have completed your selection, press [MODE].
   - Press [Y/+] to save the new duty cycle value.
   - Press [N/-] to undo the change and move to the next sub-menu.

Temperature Unit

The temperature display can be switched between Fahrenheit and Celsius units.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
   - Press [Y/+] to save the new temperature unit.
   - Press [N/-] to undo the change and move to the next sub-menu.

Pump Speed

The pump can operate at two speeds, high and low. Running at low speed is quieter and conserves a small amount of power. There is almost no difference in sampling accuracy.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
   - Press [Y/+] to save the new temperature unit.
   - Press [N/-] to undo the change and move to the next sub-menu.

Language

English is the default language, but other languages can be selected for the instrument.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
   - Press [Y/+] to save your new language choice.
   - Press [N/-] to undo it and return to the previous language selection.

Real Time Protocol

Real Time Protocol is the setting for data transmission.

The choices are:

P2M (cable)	Point to multipoint. Data is transferred from the instrument to multiple locations using a wired connection. Default data rate: 19200 bps.
P2P (cable)	Point to point. Data is transferred only between the instrument and one other location, such as a computer. Default data rate: 9600 bps.
P2M (wireless)	Point to multipoint, wireless. Data is transferred wirelessly and can be received by multiple receivers.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
   - Press [Y/+] to save the new real-time communications protocol.
   - Press [N/-] to undo the change and move to the next sub-menu.

Power On Zero

When Power On Zero is on, the instrument performs a zero calibration when it is turned on.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates your selection).
3. When you have completed your selection, press [MODE].
   - Press [Y/+] to save the change.
   - Press [N/-] to discard the change and move to the next sub-menu.

Unit ID

This three-digit number keeps data separated by instrument when more than one instrument is used in a network. If multiple sensing units are attempting to communicate with the same Host, then the units must all have a different Unit ID.

1. Press [Y/+] to step through all 10 numerals (0 to 9). If you pass the numeral you want, keep pressing [Y/+]. After it counts up to 9, it starts counting up from 0 again.
2. Press [N/-] to advance to the next digit. The next digit to the right flashes.

Repeat this process until all three digits of the Unit ID are entered.

3. Press [MODE] when you are done.
   - Press [Y/+] to save the change.
   - Press [N/-] to discard the change and move to the next sub-menu.

LCD Contrast

The display's contrast can be increased or decreased from its default setting. You may not need to ever change the default setting, but sometimes you can optimize the display to suit extreme temperature and ambient brightness/darkness conditions.

- The minimum value is 20.
- The maximum value is 60.

1. Press [Y/+] to increase the value or [N/-] to decrease the value.
2. Press [MODE] to save your selection.
   - Press [Y/+] to save your new contrast value.
   - Press [N/-] to undo it and return to the previous value.

Hygiene Mode

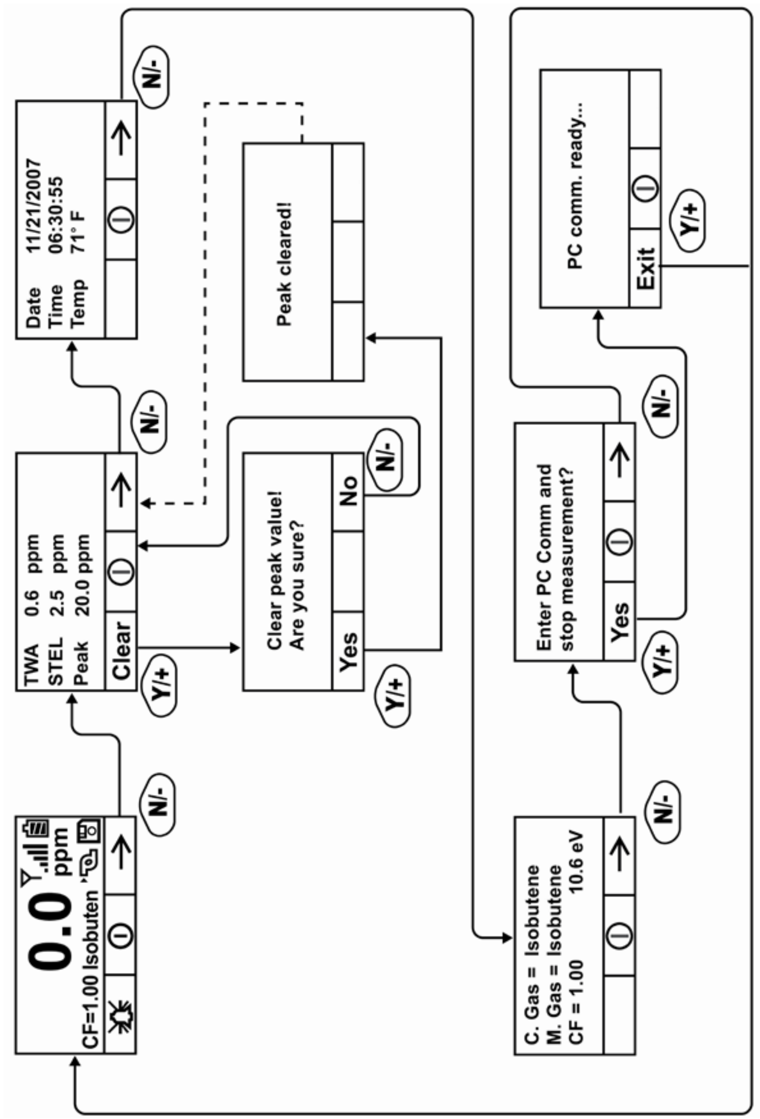
The instrument usually operates in Hygiene Mode, which provides basic functionality. However, it is possible to operate it in a second mode called Search Mode. Here are the primary differences:

Hygiene Mode: Automatic measurements, continuously running and datalogging, and calculates additional exposure values.

Search Mode: Manual start/stop of measurements and display of certain exposure values.

Basic User Level & Hygiene Mode

The default setting is navigated in the following way:



Note: Dashed line indicates automatic progression.

Pressing [N/-] steps you from screen to screen. Options include clearing the Peak value and turning on the instrument's PC Communications for data transfer to a PC.

Entering Search Mode From Hygiene Mode

In order to change the instrument’s operational mode from Hygiene Mode to Search Mode, you must enter the password-protected Programming Mode:

1. Hold [MODE] and [N/-] until you see the password screen.
2. Use [Y/+] to increment to the number you want for the first digit. (If you pass by the desired number, press [Y/+] until it cycles through to 0 again. Then press [Y/+] until you reach the desired number.)
3. Press [N/-] to advance to the next digit.
4. Again press [Y/+] to increment the number.
5. Press [N/-] to advance to the next digit.

Continue the process until all four numbers of the password have been input. Then press [MODE] to proceed.

The screen changes to icons with the label “Calibration.”

1. Press [N/-] to advance to “Monitor Setup.”
2. Press [Y/+] to select Monitor Setup.

Under Monitor Setup, you will see “Op Mode.”

Press [Y/+] to select.

You will see:

Hygiene
Search

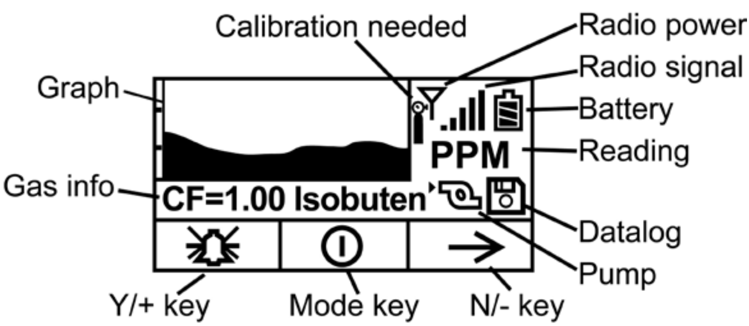
The current mode is indicated by a dark circle within the circle in front of either Hygiene or Search.

1. Select Hygiene or Search by pressing [N/-].
2. Press [Y/+] to place the instrument into the selected mode.

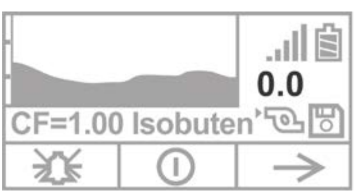
3. Press [MODE] when you want to register your selection to place the instrument in the selected mode.
4. Press [Y/+] to commit the change and exit to the Monitor Setup screen, or press [N/-] to Undo (exit to the Monitor Setup screen without changing the Mode).

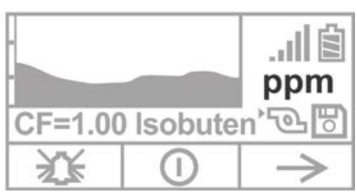
Optional Graphic Screen In Search Mode

Using ProRAE Studio, you can set your instrument to show a graphic display instead of a numeric display of ongoing data. Consult your ProRAE Studio disc for information.



During sampling, the display's readings are shown numerically, plus the graph tracks the highest readings over time. The numeric reading alternates between the value and the measurement units, as well:





Advanced User Level (Hygiene Mode Or Search Mode)

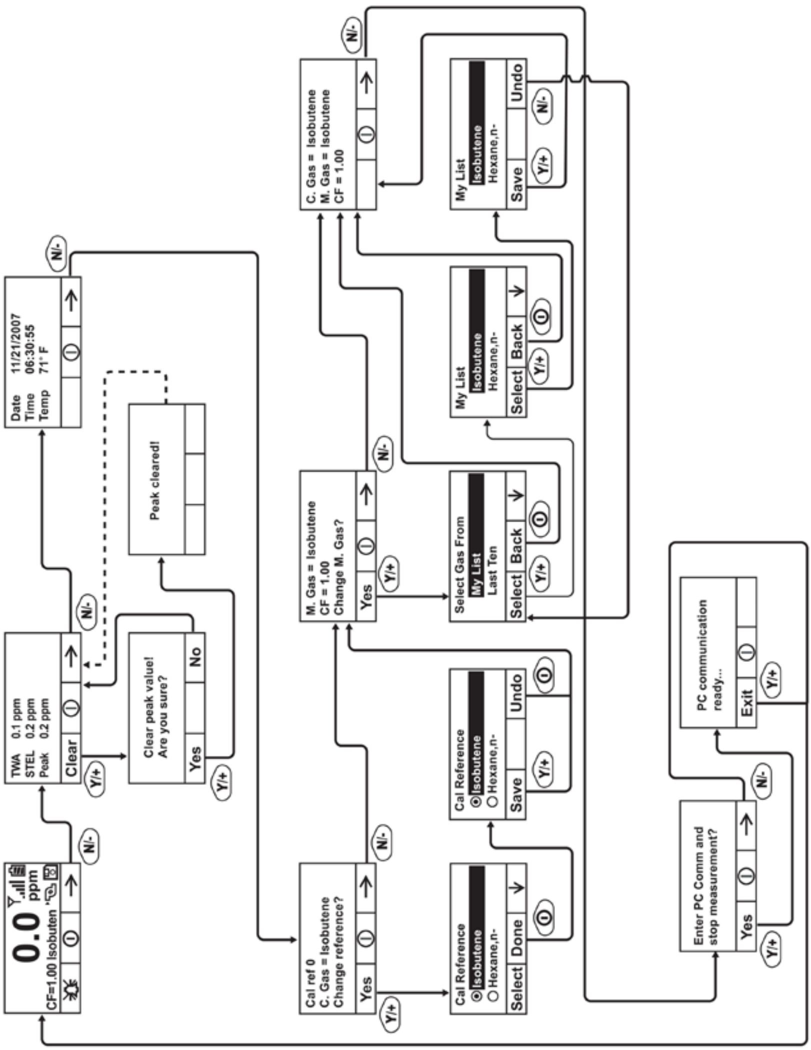
The User Mode called Advanced User Level allows a greater number of parameters to be changed than Basic User Level. It can be used with either of the Operation Modes, Hygiene Mode or Search Mode.

Advanced User Level & Hygiene Mode

With the instrument in Operation Mode: Hygiene Mode, enter User Mode: Advanced User Level (refer to the section called Monitor Mode for instructions).

Once you are in Advanced User Level and Hygiene Mode together, you can change the calibration reference and measurement gas, in addition to performing normal monitoring functions.

Pressing [N/-] progresses through the screens, while pressing [Y/+] selects options. Pressing [MODE] makes menu choices when it is shown for “Done” or “Back.” Pressing and holding [Mode] whenever the circle with a vertical line in the middle is shown activates the countdown to shutoff.

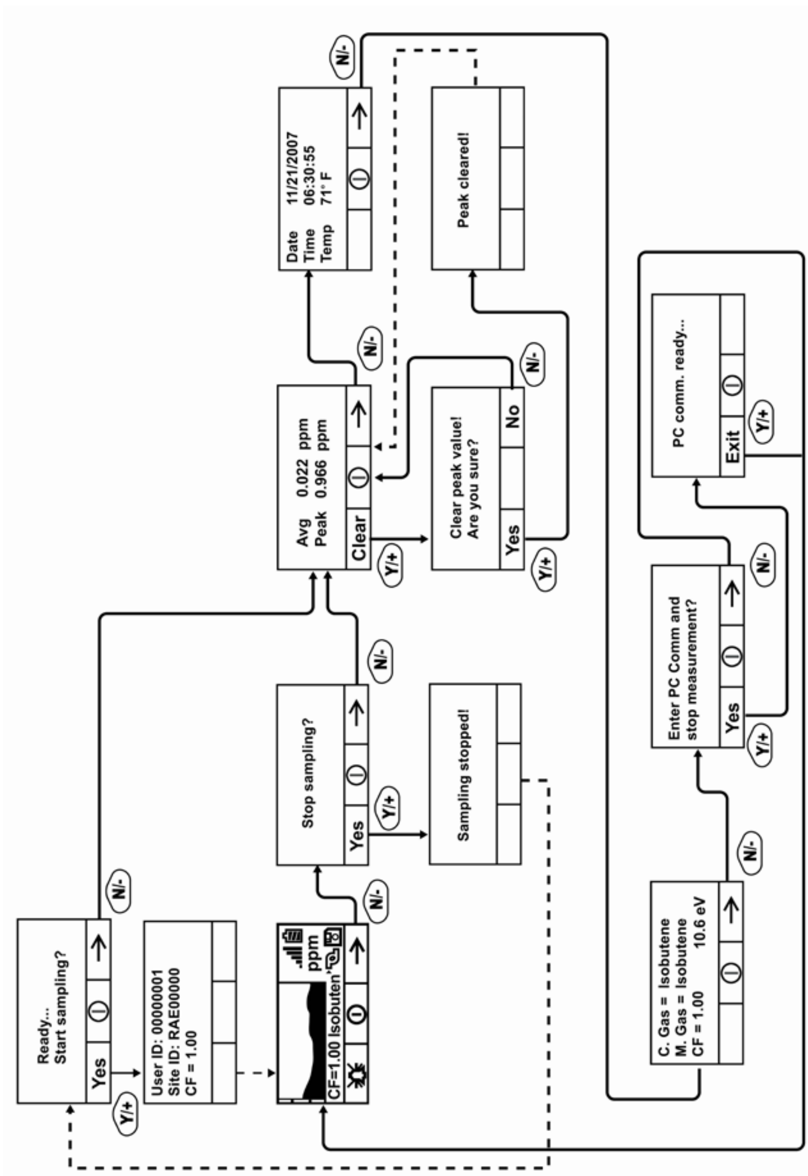


Note: Dashed line indicates automatic progression.

Basic User Level & Search Mode

With the instrument in Operation Mode: Search Mode, enter User Mode and select Basic User Level (refer to the section called User Mode for instructions).

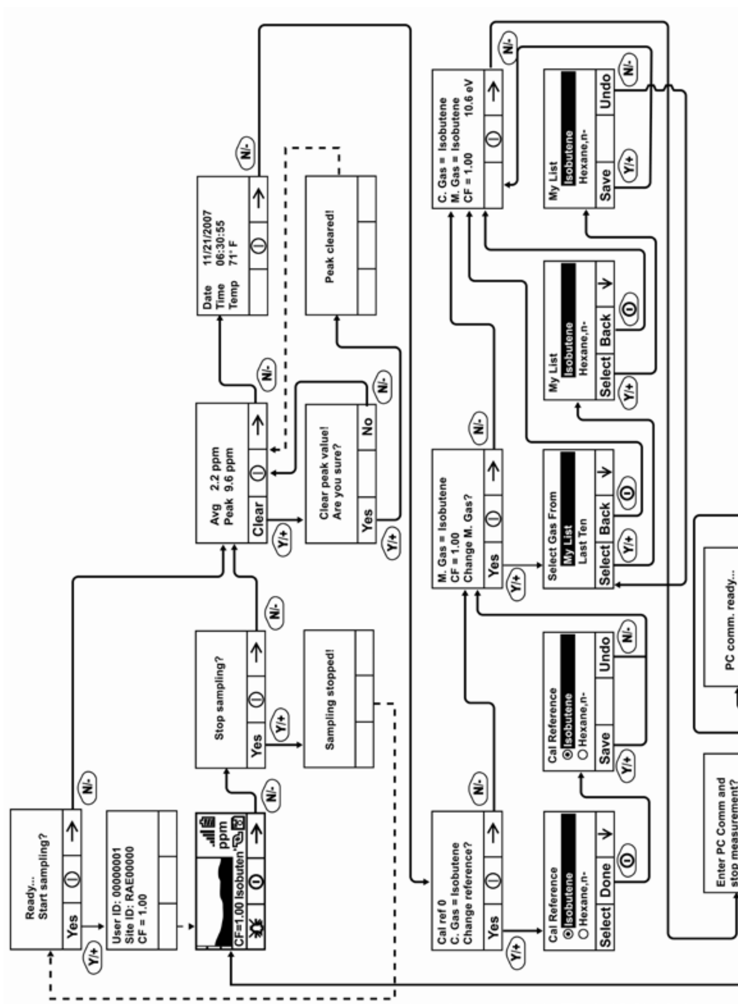
When the instrument is in Search Mode, it only samples when you activate sampling. When you see the display that says, "Ready…Start sampling?" press [Y/+] to start. The pump turns on and the instrument begins collecting data. To stop sampling, press [N/-] while the main display is showing. You will see a new screen that says, "Stop sampling?" Press [Y/+] to stop sampling. Press [N/-] if you want sampling to continue.



Note: Dashed line indicates automatic progression.

Advanced User Level & Search Mode

With the instrument in Operation Mode: Search Mode, enter User Mode and select Advanced User Level (refer to the section called Monitor Mode for instructions). Operation is similar to Basic User Level & Sampling Mode, but now allows you to change calibration and measurement reference gases. Refer to the section on measurement gases on page 52 for more details.



Note: Dashed line indicates automatic progression.

Diagnostic Mode

IMPORTANT! Diagnostic Mode is designed for servicing and manufacturing, and therefore is not intended for everyday use, even by advanced users. It provides raw data from sensors and about settings, but only allows adjustment of pump stall parameters, which should only be changed by qualified personnel.

Note: If the instrument is turned on in Diagnostic Mode and you switch to User Mode, datalog data remains in raw count form. To change to standard readings, you must restart the instrument.

Entering Diagnostic Mode

Note: To enter Diagnostic Mode, you must begin with the instrument turned off.

Press and hold [Y/+] and [MODE] until the instrument starts.

The instrument goes through a brief startup, and then displays raw data for the PID sensor. These numbers are raw sensor readings without calibration. The instrument is now in Diagnostic Mode.

Note: In Diagnostic Mode, the pump and lamp are normally on.

You can enter Programming Mode and calibrate the instrument as usual by pressing both [MODE] and [N/-] for three seconds.

You can enter Monitoring Mode by pressing [MODE] and [Y/+] together for three seconds.

Once the instrument is started up in Diagnostic Mode, you can switch between Diagnostic Mode and Monitoring Mode by pressing and holding [MODE] and [Y/+] simultaneously for two seconds.

In Diagnostic mode, you can step through parameter screens by pressing [MODE].

Adjusting The Pump Stall Threshold

If the gas inlet is blocked but the pump does not shut down, or the pump shuts down too easily with a slight blockage, the pump stall threshold value may be set too high or too low.

Use the following steps to adjust the pump stall threshold:

Pump High

In Diagnostic Mode, press the [MODE] key until "Pump High" is displayed. The display shows the maximum, minimum, and stall values for the pump at its high speed. Write down the "Max" reading.

Block the gas inlet and watch the pump current reading (labeled "I") increase. Write down its blocked reading. **Note:** If the pump current reading does not increase significantly (less than 10 counts), then there may be a leak in the gas inlet or the pump is weak or defective.

Add the two readings you wrote down. This is the average of the maximum block count and the maximum idle count. Divide that number by 2. Use the [Y/+] or [N/-] key to increase or decrease the stall value to equal that number.

Press the [MODE] key to exit this display.

Pump Low

In Diagnostic Mode, press the [MODE] key until "Pump Low" is displayed. The display shows the maximum, minimum, and stall values for the pump at its low speed. Write down the "Max" reading.

Block the gas inlet and watch the pump current reading (labeled "I") increase. Write down its blocked reading. **Note:** If the pump current reading does not increase significantly (less than 10 counts), then there may be a leak in the gas inlet or the pump is weak or defective.

Add the two readings you wrote down. This is the average of the maximum block count and the maximum idle count. Divide that number by 2. Use the [Y/+] or [N/-] key to increase or decrease the stall value to equal that number.

Press the [MODE] key to exit this display.

Exiting Diagnostic Mode

You can exit Diagnostic Mode and go directly to Programming Mode or Monitor Mode as outlined above, or you can exit Diagnostic Mode completely.

To exit Diagnostic Mode so that it cannot be re-entered without a restart:

Shut down the instrument. When it is off, restart it by holding the [MODE] key. Diagnostic Mode cannot be entered until the instrument is restarted as outlined in "Entering Diagnostic Mode."

Transferring Data To & From A Computer

Once you have connected your instrument cradle to the PC, you can can transfer data, including a download of the datalog to the computer and updates of firmware to the instrument (should this ever be necessary).

Downloading The Datalog To A PC

1. Connect the data cable to the PC and the cradle.
2. Place the instrument into its cradle. The charging LED should be illuminated.
3. Start ProRAE Studio on your PC.
4. From ProRAE Studio, select "Operation" and select Setup Connection.
5. Select the COM port to establish a communication link between the PC and the instrument.
6. To receive the datalog in the PC, select "Downlog Datalog."
7. When you see "Unit Information," click OK.

During the data transfer, the display shows a progress bar.

When the transfer is done, you will see a screen with the datalog information. You can now export this datalog for other use or printing.

Uploading Firmware To The instrument From A PC

Uploading new firmware to your instrument requires connecting the instrument and PC. Follow these steps to make the connection:

1. Connect the data cable to the PC and the cradle.
2. Place the instrument into its cradle. The charging LED should be illuminated.
3. Start RAEProgrammer 7000 on your PC.
4. From RAEProgrammer 7000, select "Operation" and select Setup Connection.
5. Select the COM port to establish a communication link between the PC and the instrument.
6. Select Operation → Download Firmware.

Once communication is established, follow the instructions that accompany RAEProgrammer 7000 and the firmware to upload the new firmware to your instrument.

Note: Check for the latest updates to ProRAEProgrammer 7000 at www.raesystems.com.

Maintenance

The major maintenance items of the instrument are:

- Battery pack
- Sensor module
- PID lamp
- Sampling pump
- Inlet connectors and filters

Note: Maintenance should be performed by qualified personnel only.

NOTE: The printed circuit board of the instrument is connected to the battery pack even if the power is turned off. Therefore, it is very important to disconnect the battery pack before servicing or replacing any components inside the instrument. Severe damage to the printed circuit board or battery may occur if the battery pack is not disconnected before servicing the unit.

Battery Charging & Replacement

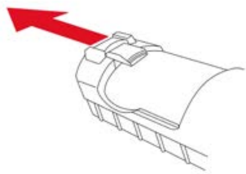
When the display shows a flashing empty battery icon, the battery requires recharging. It is recommended to recharge the instrument upon returning from fieldwork. A fully charged battery runs a instrument for 16 hours continuously. The charging time is less than 8 hours for a fully discharged battery. The battery may be replaced in the field (in areas known to be non-hazardous), if required.

WARNING!

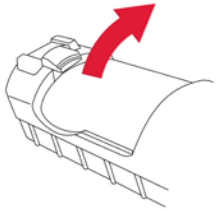
To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non-hazardous. Remove and replace battery only in areas known to be non-hazardous.

Replacing The Li-ion Battery

1. Turn off the instrument.
2. Located on the rear of the instrument is a battery tab. Slide it down to unlock the battery.



3. Remove the battery pack from the battery compartment by tilting it out.



4. Replace a fully charged spare battery pack inside the battery compartment. Make sure the battery pack is oriented properly inside the compartment.
5. Slide the capture tab back up to its locked position.

Replacing The Alkaline Battery Adapter

An alkaline battery adapter is supplied with each instrument. The adapter (part number 059-3052-000) accepts four AA alkaline batteries (use only Duracell MN1500) and provides approximately 12 hours of operation. The adapter is intended to be used in emergency situations when there is no time to charge the Li-ion battery pack.

To insert batteries into the adapter:

1. Remove the three Philips-head screws to open the compartment.
2. Insert four fresh AA batteries as indicated by the polarity (+/-) markings.
3. Replace the cover. Replace the three screws.

To install the adapter in the instrument:

1. Remove the Li-ion battery pack from the battery compartment by sliding the tab and tilting out the battery.
2. Replace it with the alkaline battery adapter
3. Slide the tab back into place to secure the battery adapter.

IMPORTANT!

Alkaline batteries cannot be recharged. The instrument's internal circuit detects alkaline batteries and will not allow recharging. If you place the instrument in its cradle, the alkaline battery will not be recharged. The internal charging circuit is designed to prevent damage to alkaline batteries and the charging circuit when alkaline batteries are installed inside the instrument.

Note: When replacing alkaline batteries, dispose of old ones properly.

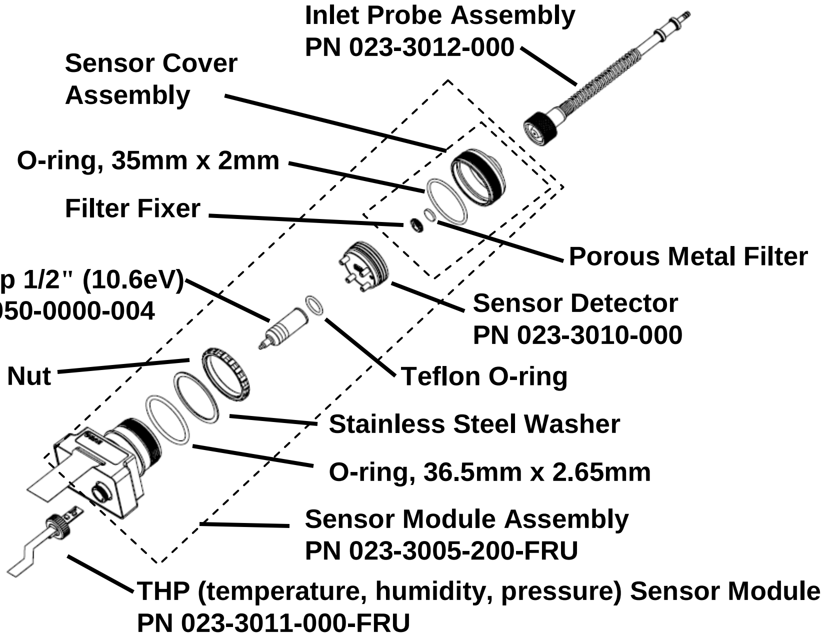
WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge the battery only in areas known to be non-hazardous. Remove and replace the battery only in areas known to be non-hazardous.

Note: The internal charging circuit is designed to prevent charging to alkaline batteries.

PID Sensor & Lamp Cleaning/Replacement

The sensor module is made of several components and is attached to the lamp-housing unit as shown below.



Sensor Components

Note: The cleaning procedure is not normally needed. Clean the PID sensor module, the lamp and the lamp housing only if:

1. The reading is inaccurate even after calibration.
2. The reading is very sensitive to air moisture.
3. A liquid has been sucked into the unit and damaged the unit.

Use of the external filter helps to prevent contamination of the sensor.

To access the sensor components and lamp, gently unscrew the lamp-housing cap, remove the sensor adapter with the gas inlet probe and the metal filter all together. Then hold the PID sensor and pull it straight out. A slight, gentle rocking motion helps release the sensor.

Cleaning The PID Sensor

Place the entire PID sensor module into GC grade methanol. It is highly recommended that an ultrasound bath to be used to clean the sensor for at least 15 minutes. Then dry the sensor thoroughly. Never touch the electrodes of the sensor by hand.
Also use a methanol-soaked cotton swab to wipe off the lamp housing where it contacts the sensor when the sensor is installed.

Turn over the sensor so that the pins point up and the sensor cavity is visible. Examine the sensor electrodes for any corrosion, damage, or bending out of alignment. The metal sensor electrode "fingers" should be flat and straight. If necessary, carefully bend the sensor fingers to ensure that they do not touch the Teflon portions and that they are parallel to each other. Make sure that the nuts on the sensor pins are snug but not overtight. If the sensor is corroded or otherwise damaged, it should be replaced.

Cleaning The Lamp Housing Or Changing The Lamp

If the lamp does not turn on, the instrument will display an error message to indicate replacement of the lamp may be required.

1. If the lamp is operational, clean the lamp window surface and the lamp housing by wiping it with GC grade methanol using a cotton swab using moderate pressure. After cleaning, hold the lamp up to the light at an angle to detect any remaining film. Repeat the process until the lamp window is clean. Never use water solutions to clean the lamp. Dry the lamp and the lamp housing thoroughly after cleaning.

   CAUTION: Never touch the window surface with the fingers or anything else that may leave a film. Never use acetone or aqueous solutions.

2. If the lamp does not turn on, remove the lamp from the lamp housing. Place the lamp O-ring onto the new lamp. Insert the new lamp, avoiding contact with the flat window surface.
3. Reinstall the PID sensor module.
4. Tighten the Lamp Housing Cap.

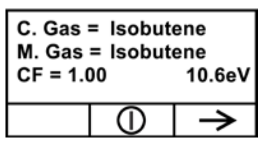
Determining The Lamp Type

The monitor can accommodate three lamp values: 10.6eV (standard), 9.8eV, and 11.7eV. The monitor automatically reads a marking on the side of the lamp to set the proper Correction Factor. There are two ways to determine the lamp type:

Remove the lamp and look for markings (bars) on the side:

- No bars: 10.6eV
- 1 bar: 11.7eV
- 2 bars: 9.8eV

Also, when the monitor is running, the lamp type is shown along with the calibration and measurement gas and Correction Factor:



Note: This screen can be accessed from the reading screen by pressing [N/-] four times.

Sampling Pump

When approaching the end of the specified lifetime of the pump, it will consume higher amount of energy and reduce its sample draw capability significantly. When this occurs, it is necessary to replace or rebuild the pump. When checking the pump flow, make sure that the inlet connector is tight and the inlet tubing is in good condition. Connect a flow meter to the gas inlet probe. The flow rate should be above 450 cc/min when there is no air leakage.

If the pump is not working properly, refer the instrument to qualified service personnel for further testing and, if necessary, pump repair or replacement.

Cleaning The Instrument

Occasional cleaning with a soft cloth is recommended. Do not use detergents or chemicals.

Visually inspect the contacts at the base of the instrument, on the battery, and on the charging cradle to make sure they are clean. If they are not, wipe them with a soft, dry cloth. Never use solvents or cleaners.

Ordering Replacement Parts

If you need replacement parts, contact your local RAE Systems distributor. A list is available online:

http://www.raesystems.com

In the U.S., you can order sensors, replacement batteries, and other accessories online at:

http://istore.raesystems.com/

Special Servicing Note

If the instrument needs to be serviced, contact either:

1. The RAE Systems distributor from whom the instrument was purchased; they will return the instrument on your behalf.

   or

2. The RAE Systems Technical Service Department. Before returning the instrument for service or repair, obtain a Returned Material Authorization (RMA) number for proper tracking of your equipment. This number needs to be on all documentation and posted on the outside of the box in which the instrument is returned for service or upgrade. Packages without RMA Numbers will be refused at the factory.

Troubleshooting

Problem	Possible Reasons & Solutions	
Cannot turn on power after charging the battery	**Reasons:**	Discharged battery. Defective battery.
	Solutions:	Charge or replace battery.
Lost password	**Solutions:**	Call Technical Support at +1 408-752-0723 or toll-free at +1 888-723-4800
Reading abnormally High	**Reasons:**	Dirty filter. Dirty sensor module. Excessive moisture and water condensation. Incorrect calibration.
	Solutions:	Replace filter. Blow-dry the sensor module. Calibrate the unit.
Reading abnormally Low	**Reasons:**	Dirty filter. Dirty sensor module. Weak or dirty lamp. Incorrect calibration.
	Solutions:	Replace filter. Remove Calibration Adapter. Calibrate the unit. Check for air leakage.
Buzzer Inoperative	**Reasons:**	Bad buzzer.
	Solutions:	Check that buzzer is not turned off. Call authorized service center.

Inlet flow too low	**Reasons:**	Pump diaphragm damaged or has debris. Flow path leaks.
	Solutions:	Check flow path for leaks; sensor module O-ring, tube connectors, Teflon tube compression fitting. Call Technical Support at +1 408-752-0723 or toll-free at +1 888-723-4800
"Lamp" message during operation	**Reasons:**	Lamp drive circuit. Weak or defective PID lamp, defective.
	Solutions:	Turn the unit off and back on. Replace UV lamp

Technical Support

To contact RAE Systems Technical Support Team:

Monday through Friday, 7:00AM to 5:00PM Pacific (US) Time
Phone (toll-free): +1 888-723-4800
Phone: +1 408-952-8461
Email: tech@raesystems.com

Life-critical after-hours support is available:

+1 408-952-8200 select option 8

RAE Systems Contacts

RAE Systems
World Headquarters
3775 N. First St.
San Jose, CA 95134-1708 USA
Phone: +1 408.952.8200
Fax: +1 408.952.8480

E-mail: customerserv@raesystems.com
Web Site: www.raesystems.com

RAE Systems Technical Support
Monday through Friday, 7:00AM to 5:00PM Pacific Time
Phone: +1.408.952.8461
Email: tech@raesystems.com

Life-critical after-hours support is available:
+1.408.952.8200 select option 9

RAE Systems Europe ApS
Kirstinehøj 23 A
DK-2770 Kastrup
Denmark
Phone: +45 86 52 51 55
Fax: +45 86 52 51 77
orders@raeeurope.com
sales@raeeurope.com
service@raesystems.com
Web: www.raesystems.dk

RAE Systems UK Ltd
D5 Culham Innovation Centre
Culham Science Centre
Abingdon, Oxon OX14 3DB
United Kingdom
Phone: +44 1865408368
Fax: +44 1235531119
Mobile: +44 7841362693
Email: raeuk@raeeurope.com

RAE Systems France
ZI des Ayats
679390 MILLERY
France
Phone: +33 4 78 46 16 65
Fax: +33 4 78 46 25 98
Email: info-france@raeeurope.com
Web: www.raesystems.fr

RAE BeNeLux BV
Hoofdweg 34C
2908 LC Capelle a/d IJssel
The Netherlands
Phone: +31 10 4426149
Fax: +31 10 4426148
Email: info@rae.nl
Web: www.rae.nl

RAE Systems Germany GmbH
Felix-Wankel-Str. 5
82152 Krailing
Germany
Phone: +49 89 20 70 40 248
Fax: +49 89 850 93 74
Email: orders@raeeurope.com

RAE Systems Spain, s.l.
Av. Remolar, 31
08820 El Prat de Llobregat
Spain
Phone: +34 933 788 352
Fax: +34 933 788 353
Mobile: +34 687 491 106
Email: mdelgado@raespain.com
Web: www.raespain.com

RAE Middle East
Lot 7, Ground Floor, Office 19
Jebel Ali Free Zone
Dubai
United Arab Emirates
Phone: +971 4 887 5562
Fax: +971 4 887 5563
Email: mesales@raesystems.com

RAE Systems (Hong Kong) Ltd.
Room 8, 6/F, Hong Leong Plaza
33 Lok Yip Road
Fanling, N.T, Hong Kong
Phone: +852.2669.0828
Fax: +852.2669.0803
Email: hksales@raesystems.com

RAE Systems Japan
403 Plaza Ochanomizu Bldg. 2-1
Surugadai Kanda Chiyoda-Ku
Tokyo, Japan
Phone: 81-3-5283-3268
Fax: 81-3-5283-3275
Email: jpsales@raesystems.com

RAE Systems Korea
#1010, DaeMyungAnsVill First,
Sang-Dong 412-2, Wonmi-Gu, Bucheon,
Kyungki-Do, Korea
Phone: 82-32-328-7123
Fax: 82-32-328-7127
Email: krsales@raesystems.com

Controlled Part of Manual

Intrinsic Safety:
US and Canada: Class I, Division 1, Groups A,B,C,D T4

Europe: ATEX (0575 Ex II 2G Ex ia IIC/IIB T4 Gb)
KEMA 07 ATEX 0127
Complies with EN60079-0:2009, EN60079-11:2007
IECEx CSA 10.0005 Ex ia IIC/IIB T4 Gb
Complies with IEC 60079-0:2007, IEC 60079-11:2006

Temperature: -20º C to 50º C (-4º to 122º F)

Humidity: 0% to 95% relative humidity (non-condensing)

Basic Operation

Turning The Instrument On

1. With the instrument turned off, press and hold [MODE].
2. When the display turns on, release the [MODE] key.

The instrument is now operating and performs self tests. Once the self tests are complete, the display shows a graph or numerical gas reading. This indicates that the instrument is fully functional and ready to use.

Turning The Instrument Off

1. Press and hold the Mode key for 3 seconds. A 5-second countdown to shutoff begins.
2. When you see "Unit off..." release your finger from the [MODE] key. The instrument is now off.

Note: You must hold your finger on the key for the entire shutoff process. If you remove your finger from the key during the countdown, the shutoff operation is canceled and the instrument continues normal operation.

Alarm Signals

During each measurement period, the gas concentration is compared with the programmed alarm limits (gas concentration alarm limit settings). If the concentration exceeds any of the preset limits, the loud buzzer and red flashing LED are activated immediately to warn you of the alarm condition.

In addition, the instrument alarms if one of the following conditions occurs: battery voltage falls below a preset voltage level, failure of the UV lamp, pump stall, or when the datalog memory is full.

Alarm Signal Summary

Message	Condition	Alarm Signal
HIGH	Gas exceeds "High Alarm" limit	3 beeps/flashes per second*
OVR	Gas exceeds measurement range	3 beeps/flashes per second*
MAX	Gas exceeds electronics' maximum range	3 beeps/flashes per second*
LOW	Gas exceeds "Low Alarm" limit	2 beeps/flashes per second*
TWA	Gas exceeds "TWA" limit	1 Beep/flash per second*
STEL	Gas exceeds "STEL" limit	1 Beep/flash per second*
Pump icon flashes	Pump failure	3 beeps/flashes per second
Lamp	PID lamp failure	3 beeps/flashes per second plus "Lamp" message on display

Battery icon flashes	Low battery	1 flash, 1 beep per minute plus battery icon flashes on display
CAL	Calibration failed, or needs calibration	1 beep/flash per second
NEG	Gas reading measures less than number stored in calibration	1 beep/flash per second

Preset Alarm Limits & Calibration

The instrument is factory calibrated with standard calibration gas, and is programmed with default alarm limits.

Cal Gas (Isobutylene)	**Cal Span**	**unit**	**Low**	**High**	**TWA**	**STEL**
ppbRAE 3000	10	ppm	10	25	10	25
MiniRAE 3000	100	ppm	50	100	10	25
MiniRAE Lite	100	ppm	50	100	10	25
UltraRAE 3000	100	ppm	50	100	10	25

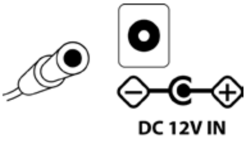
Charging The Battery

Always fully charge the battery before using the instrument. The instrument's Li-ion/NiMH battery is charged by placing the instrument in its cradle. Contacts on the bottom of the instrument meet the cradle's contacts, transferring power without other connections.

Note: Before setting the instrument into its charging cradle, visually inspect the contacts to make sure they are clean. If they are not, wipe them with a soft cloth. Do not use solvents or cleaners.

Follow this procedure to charge the instrument:

1. Plug the AC/DC adapter's barrel connector into the instrument's cradle.



2. Plug the AC/DC adapter into the wall outlet.
3. Place the instrument into the cradle, press down, and lean it back. It locks in place and the LED in the cradle glows.

Note: To release the instrument, press down and tilt the top out of the cradle and lift up.

The instrument begins charging automatically. The LED on the front of the cradle marked "Primary" blinks during charging. During charging, the diagonal lines in the battery icon on the instrument's display are animated and you see the message "Charging..."

When the instrument's battery is fully charged, the battery icon is no longer animated and shows a full battery. The message "Fully charged!" is shown and the Primary LED on the cradle glows continuously green.

Note: A spare Li-ion battery (059-3051-000) or NiMH(059-3054-000) can be charged by placing it directly in the charging port on the back of the cradle. It can be charged at the same time as the instrument. Press the battery in place, sliding it slightly toward the front of the cradle. This locks it in the cradle. To release the battery, slide it forward again and tilt it up.

Note: An Alkaline Battery Adapter (part number 059-3052-000), which uses four AA alkaline batteries (Duracell MN1500), may be substituted for the Li-Ion battery.

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge and replace batteries only in areas known to be non-hazardous. Remove and replace batteries only in areas known to be non-hazardous.

Low Voltage Warning

When the battery's charge falls below a preset voltage, the instrument warns you by beeping once and flashing once every minute, and the battery icon blinks once per second. You should turn off the instrument within 10 minutes and either recharge the battery by placing the instrument in its cradle, or replace the battery with a fresh one with a full charge.

Clock Battery

An internal clock battery is mounted on one of the instrument's printed circuit boards. This long-life battery keeps settings in memory from being lost whenever the Li-ion, NiMH, or alkaline batteries are removed. This backup battery should last approximately five years, and must be replaced by an authorized RAE Systems service technician. It is not user-replaceable.

WARNING

To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non-hazardous. Remove and replace battery only in an area known to be non-hazardous.

Replacing Rechargeable Li-Ion or NiMH Battery

Caution: Turn off the instrument before removing or replacing the battery.

Alkaline Battery Adapter

An alkaline battery adapter is supplied with each instrument. The adapter (part number 059-3052-000) accepts four AA alkaline batteries (use only Duracell MN1500).

Do not mix old and new batteries or different type batteries.

Troubleshooting

Problem	Possible Reasons & Solutions	
Cannot turn on power after charging the battery	**Reasons:**	Discharged battery. Defective battery.
	Solutions:	Charge or replace battery.
Lost password	**Solutions:**	Call Technical Support at +1 408-752-0723 or toll-free at +1 888-723-4800
Reading abnormally High	**Reasons:**	Dirty filter. Dirty sensor module. Excessive moisture and water condensation. Incorrect calibration.
	Solutions:	Replace filter. Blow-dry the sensor module. Calibrate the unit.
Reading abnormally Low	**Reasons:**	Dirty filter. Dirty sensor module. Weak or dirty lamp. Incorrect calibration.
	Solutions:	Replace filter. Remove Calibration Adapter. Calibrate the unit. Check for air leakage.
Buzzer Inoperative	**Reasons:**	Bad buzzer.
	Solutions:	Check that buzzer is not turned off. Call authorized service center.

Inlet flow too low	**Reasons:**	Pump diaphragm damaged or has debris. Flow path leaks.
	Solutions:	Check flow path for leaks; sensor module O-ring, tube connectors, Teflon tube compression fitting. Call Technical Support at +1 408-752-0723 or toll-free at +1 888-723-4800
"Lamp" message during operation	**Reasons:**	Lamp drive circuit. Weak or defective PID lamp, defective.
	Solutions:	Turn the unit off and back on. Replace UV lamp

RAE Systems by Honeywell
World Headquarters
3775 N. First St.
San Jose, CA 95134-1708 USA
Phone: 408.952.8200
Toll-Free: 888.723.4800
Fax: 408.952.8480

E-mail (sales support): raesales@raesystems.com
E-mail (technical support): tech@raesystems.com
Web Site: www.raesystems.com

RAE Systems Europe

Kristinehøj 23A, Boulevard 69, DK-2770 Kastrup • Denmark
Tel: +45.8652.5155 • Fax: +45.8652.5177

RAE Systems (Hong Kong) Ltd.

Units 1516-18, 15/F, Delta House, 3 On Yiu Street
Shatin, N.T. Hong Kong
Web: www.raesystems.cn • Email: asiasales@raesystems.com
Phone: +852.2669.0828

RAE Systems Middle East

LOB 7, Ground Floor, Office 19, Jebel Ali Free Zone
Dubai, United Arab Emirates
Email: mesales@raesystems.com • Phone: +971.4.887.5562

Rev. D
April 2014
P/N 059-4020-000

CSA INTERNATIONAL

Certificate of Compliance

Certificate: 1865837 **Master Contract:** 217005

Project: 2218210 **Date Issued:** 2010/01/14

Issued to: **RAE Systems, Inc.**

3775 North First St
San Jose, CA 95134
USA
Attention: James Pan

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

C US

Rich Masek

Issued by: Rich Masek

PRODUCTS

CLASS 4828 82 - SIGNAL APPLIANCES-Toxic Gas Detection Instruments - For Hazardous Locations. Certified to U.S. Standards

CLASS 4828 02 - SIGNAL APPLIANCES - Toxic Gas Detection Instruments - For Hazardous Locations

Class I; Division 1; Group A, B, C, D; T4

- MiniRAE 3000, Model PGM 7320, Portable Handheld VOC Monitor
- ppbRAE 3000, Model PGM 7340, Portable Handheld VOC Monitor
- MiniRAE Lite, Model PGM 7350, Portable Handheld VOC Monitor
- UltraRAE 3000, Model PGM 7360, Portable Handheld VOC Monitor

All monitors rated 6 Vdc. Ambient –20 °C to +50 °C, Intrinsically safe when powered by battery pack 059-3052-000 using either Duracell MN1500 or Energizer E91 alkaline batteries, powered by rechargeable Li-Ion battery pack 059-3051-000 or powered by rechargeable NiMH battery pack 059-3054-000.

APPLICABLE REQUIREMENTS

Certificate: 1865837 **Master Contract:** 217005

Project: 2218210 **Date Issued:** 2010/01/14

C22.2 No. 0-M91 - General Requirements – Canadian Electrical Code, Part II

C22.2 No. 142-M1987 - Process Control Equipment

C22.2 No. 157-92 - Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations

ANSI/UL 913:2004 - Intrinsically Safe Apparatus

ANSI/UL 916:1998 - Energy Management Equipment

MARKINGS

The following markings are required.

- Submittor's identification
- Model designation or equivalent
- Complete electrical rating (List of acceptable batteries)
- Applicable hazardous locations designation - Class I; Division 1; Groups A, B, C and D;
- Temperature Code – T4
- Serial Number or date code
- CSA Monogram with c/us indicator as shown on the Certificate of Compliance.
- WARNING: DO NOT CHANGE OR CHARGE BATTERIES IN A HAZARDOUS LOCATION.
- WARNING: - DO NOT MIX OLD/NEW OR DIFFERENT TYPE BATTERIES.
- WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY. (May be in User Manual)

Battery Pack Markings

- • Submittor's identification
  - Battery Pack part number
  - Voltage
  - WARNING to not replace or charge battery pack in a hazardous location

Multi Water Quality Checker
U-50 Series

Instruction Manual

CODE:GZ0000144342C

Preface

This manual describes the operation of the Multi Water Quality Checker, U-50 Series.
Be sure to read this manual before using the product to ensure proper and safe operation of the instrument. Also safely store the manual so it is readily available whenever necessary.

Product specifications and appearance, as well as the contents of this manual are subject to change without notice.

■ Warranty and Responsibility

HORIBA warrants that the Product shall be free from defects in material and workmanship and agrees to repair or replace free of charge, at HORIBA's option, any malfunctioned or damaged Product attributable to HORIBA's responsibility for a period of one (1) year from the delivery unless otherwise agreed with a written agreement. In any one of the following cases, none of the warranties set forth herein shall be extended;

- Any malfunction or damage attributable to improper operation
- Any malfunction attributable to repair or modification by any person not authorized by HORIBA
- Any malfunction or damage attributable to the use in an environment not specified in this manual
- Any malfunction or damage attributable to violation of the instructions in this manual or operations in the manner not specified in this manual
- Any malfunction or damage attributable to any cause or causes beyond the reasonable control of HORIBA such as natural disasters
- Any deterioration in appearance attributable to corrosion, rust, and so on
- Replacement of consumables

HORIBA SHALL NOT BE LIABLE FOR ANY DAMAGES RESULTING FROM ANY MALFUNCTIONS OF THE PRODUCT, ANY ERASURE OF DATA, OR ANY OTHER USES OF THE PRODUCT.

■ Trademarks

Generally, company names and brand names are either registered trademarks or trademarks of the respective companies.

Conformable Directive

This equipment conforms to the following directives and standards:

Directives:	the EMC Directive 2004/108/EC
Standards:	[the EMC Directive] EN61326-1:2006 Class B, Portable test and measurement equipment

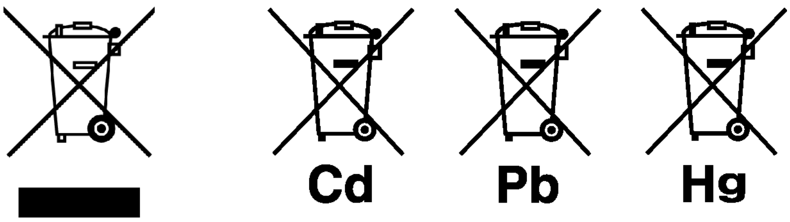
Information on Disposal of Electrical and Electronic Equipment and Disposal of Batteries and Accumulators

The crossed out wheeled bin symbol with underbar shown on the product or accompanying documents indicates the product requires appropriate treatment, collection and recycle for waste electrical and electronic equipment (WEEE) under the Directive 2002/96/EC, and/or waste batteries and accumulators under the Directive 2006/66/EC in the European Union.

The symbol might be put with one of the chemical symbols below. In this case, it satisfies the requirements of the Directive 2006/66/EC for the object chemical.

This product should not be disposed of as unsorted household waste.
Your correct disposal of WEEE, waste batteries and accumulators will contribute to reducing wasteful consumption of natural resources, and protecting human health and the environment from potential negative effects caused by hazardous substance in products.

Contact your supplier for information on applicable disposal methods.



FCC Rules

Any changes or modifications not expressly approved by the party responsible for compliance shall void the user's authority to operate the equipment.

WARNING

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

For your safety

Warning messages are described in the following manner. Read the messages and follow the instructions carefully.

● Meaning of warning messages

⚠ DANGER	This indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.
⚠ WARNING	This indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	This indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. Without safety alert indication of hazardous situation which, if not avoided, could result in property damage.

● Symbols

Description of what should be done, or what should be followed

Description of what should never be done, or what is prohibited

Safety Precautions

This section provides precautions to enable you to use the product safely and correctly and to prevent injury and damage. The terms of DANGER, WARNING, and CAUTION indicate the degree of imminency and hazardous situation. Read the precautions carefully as it contains important safety messages.

⚠ WARNING
Do not disassemble or modify the meter. May cause overheating or fire, resulting in accidents.

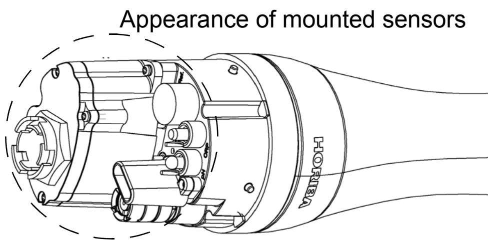
⚠ CAUTION
The pH and ORP sensors are made of glass. Handle them carefully to avoid breakage.
Do not ingest the DO, pH or ORP standard solutions. If it comes into contact with the eyes, rinse thoroughly with water. If swallowed, consult a physician.
Keep away from water when using USB communication. Improper use may result in fire or damage.

Points of concern

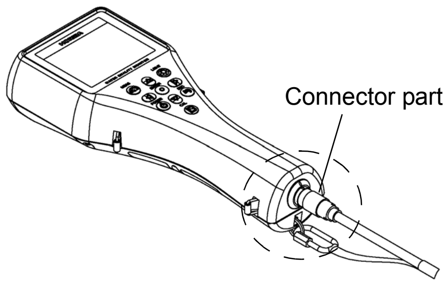
Use of the equipment in a manner not specified by the manufacturer may impair the protection provided by the equipment. It may also reduce equipment performance.

● Sensor probe

- Do not immerse the sensor probe in seawater or other samples with high salinity. Doing so may erode metallic parts. After use, promptly wash the sensor probe thoroughly in water.
- Do not immerse the sensor probe in alcohol, organic solvent, strong acid, strong alkaline, and other similar solutions.
- Do not subject to strong shocks.
- Do not perform measurement in environments of magnetic fields. Measurement errors may result.
- The sensor probe is no longer waterproof when the sensors are not mounted.

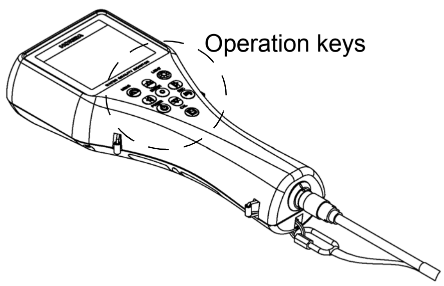


- Does not support measurement of samples containing fluorine.
- To disconnect the sensor cable or interface cable, pull them out with holding the connector part. Do not pull the cable part; it may cause breakage.



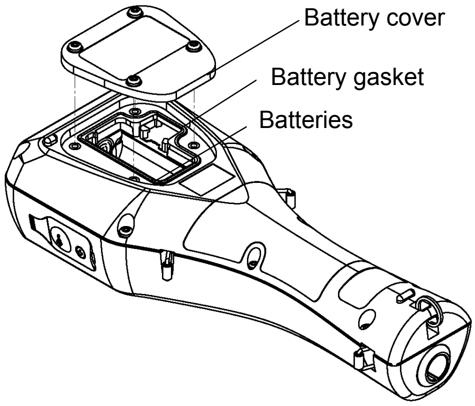
● Control unit

- Do not subject to strong shocks.
- The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.



- The control unit is no longer waterproof when the USB cable is connected.
- When operating the control unit only, protect the connector with the connector cap provided.

- Remove the batteries when not using the control unit for an extended period of time. Battery fluid leakage may cause equipment failure.
- Do not wipe the control unit with organic solvents or powder polish. The surface may deteriorate or its printing may disappear. If the display becomes dirty, wipe the dirt off with a soft cloth soaked in neutral detergent.
- Do not turn the power OFF or disconnect the cable during calibration or setting. Memory data may be erased.
- To perform measurement, connect the sensor probe cable before turning the power ON.
- Do not remove the battery gasket or twist it.
- When opening the battery case, make sure that no foreign matter is attached to the battery gasket.
- Do not use any unspecified batteries; it may cause breakage.



● Measurement

- Do not pull the cable when lowering the sensor probe into the sample during measurement. Lower the sensor probe into the sample on a chain or string.
- Before lowering the sensor probe into the sample, do not connect the hook on the unit to a human body.
- The correct values are not displayed if the sensor is not mounted when the measurement display is activated.
- Perform DO measurement with no air bubbles in the internal solution.
- Do not reuse a membrane cap of DO sensor.
- Use the spanner for DO sensor provided to attach or remove the DO sensor.
- Avoid both U-53 and U-53G turbidity measurement in air, since the rubber wiper will quickly become damaged.
- Avoid turbidity measurement in direct sunlight, since the readout may be affected.

● Calibration

During atmosphere calibration for the DO electrode with DO salinity compensation set to automatic, values are compensated based on electrical conductivity, but calibration is performed normally.

Location of use and storage

- Storage temperature: –10°C to 60°C
- Relative humidity: Under 80% and free from condensation

Store the meter in locations void of dust, strong vibrations, direct sunlight, corrosive gases, near air conditioners or windy areas.

Disposal of the product

When disposing of the product, follow the related laws and/or regulations of your country for disposal of the product.

Description in this manual

Note

This interprets the necessary points for correct operation and notifies the important points for handling the unit.

Reference

This indicates where to refer for information.

Tip

This indicates reference information.

Contents

1 About this Unit

The U-50 Series Multi Water Quality Checker features an integrated control unit and sensors. It is capable of making a maximum of eleven simultaneous measurements for various parameters, and is perfect for use in the field. The U-50 Series is designed with on-site ease-of-use in mind, provides a wide variety of functions, and can be used for water quality measurements and inspections of river water, groundwater, and waste water.

2 Device Information

2.1 Measurement parameters

Parameters	Model				
	U-51	U-52	U-52G	U-53	U-53G
pH (pH)	✓	✓	✓	✓	✓
pH (mV)	✓	✓	✓	✓	✓
Oxidation reduction potential (ORP)	✓	✓	✓	✓	✓
Dissolved oxygen (DO)	✓	✓	✓	✓	✓
Electrical conductivity (COND)	✓	✓	✓	✓	✓
Salinity (SAL) [expressed as electrical conductivity]	✓	✓	✓	✓	✓
Total dissolved solids (TDS) [expressed as electrical conductivity]	✓	✓	✓	✓	✓
Seawater specific gravity (SG) [expressed as electrical conductivity]	✓	✓	✓	✓	✓
Water temperature (TEMP)	✓	✓	✓	✓	✓
Turbidity (TURB) [LED transmission/front 30° scattering method]	–	✓	✓	–	–
Turbidity (TURB) [tungsten lamp 90° transmission/scattering method] with wiper	–	–	–	✓	✓
Water depth (DEP)	–	–	✓	✓	✓
GPS	–	–	✓	–	✓

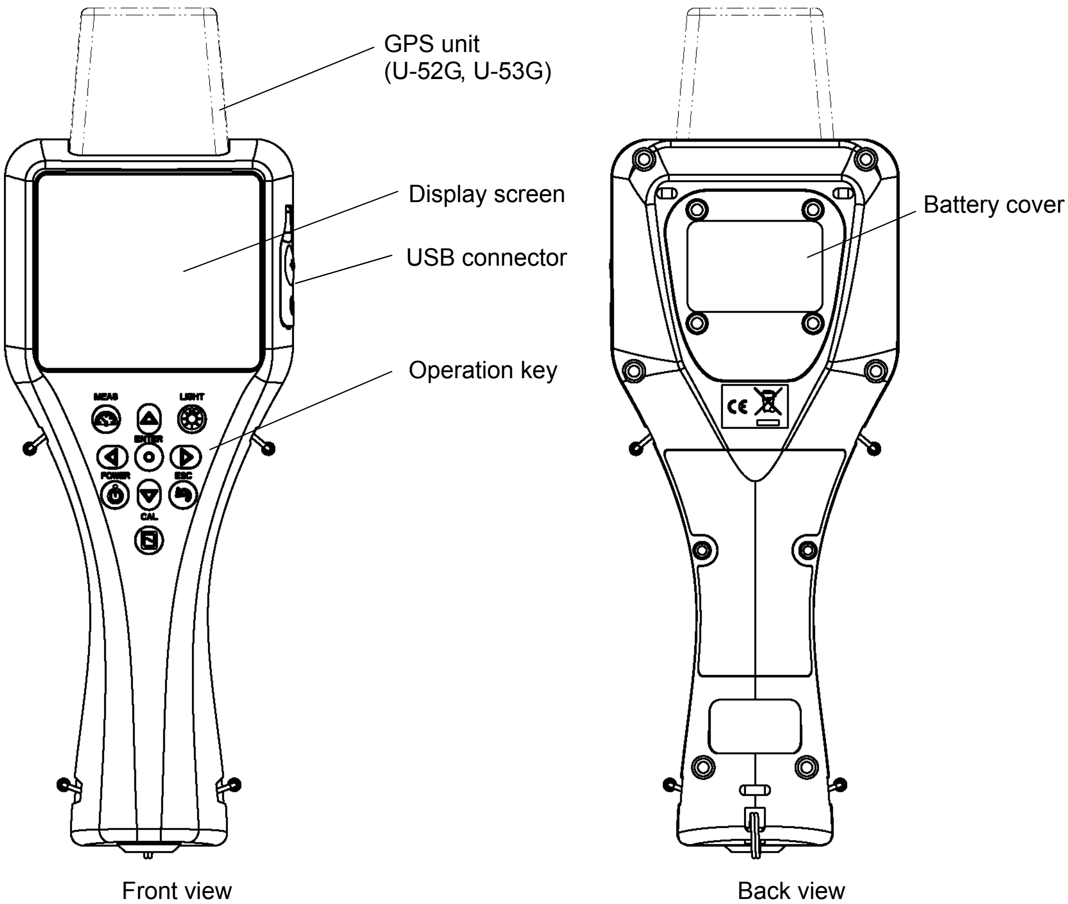
"✓" indicates a measurable parameter.

2.2 Packing list

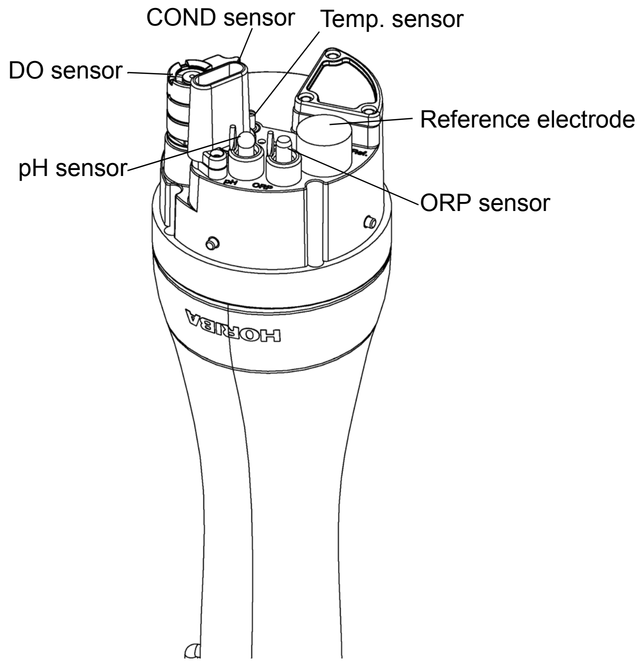
Parts Name	Quantity	Note
Control unit	1	
Sensor probe	1	
pH sensor (#7112)	1	
ORP sensor (#7313)	1	
Reference electrode (#7210)	1	
DO sensor (#7543)	1	
Turbidity sensor (#7800)	1	With U-52/U-52G only. Attached to the sensor probe.
Turbidity sensor (#7801)	1	With U-53/U-53G only. Attached to the sensor probe.
pH 4 standard solution (#100-4)	1	500 mL
pH reference internal solution (#330)	1	250 mL
DO sensor internal solution set (#306)	1	Internal solution (50 mL), Sandpaper (#8000, #600), Syringe
DO Membrane spare parts set	1	
Spanner for DO sensor	1	
Cleaning brush	1	
calibration cup	1	transparent calibration cup, black calibration cup
Back pack	1	
Strap	1	
Alkaline batteries	4	LR14
Silicon grease	1	
Instruction manual	1	

2.3 Parts name and functions

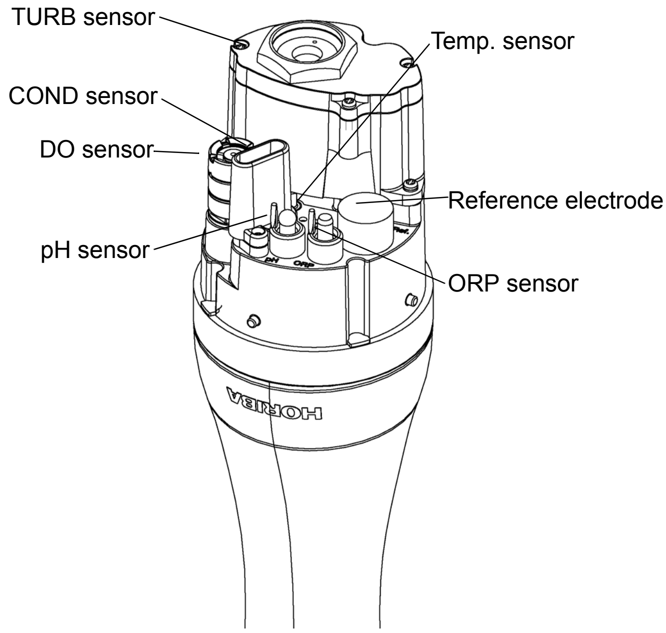
● Display



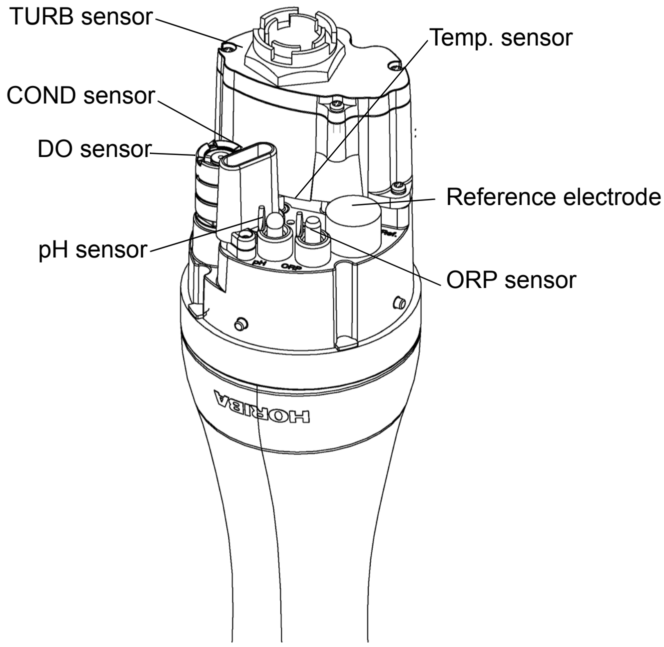
● Sensor probe (U-51)



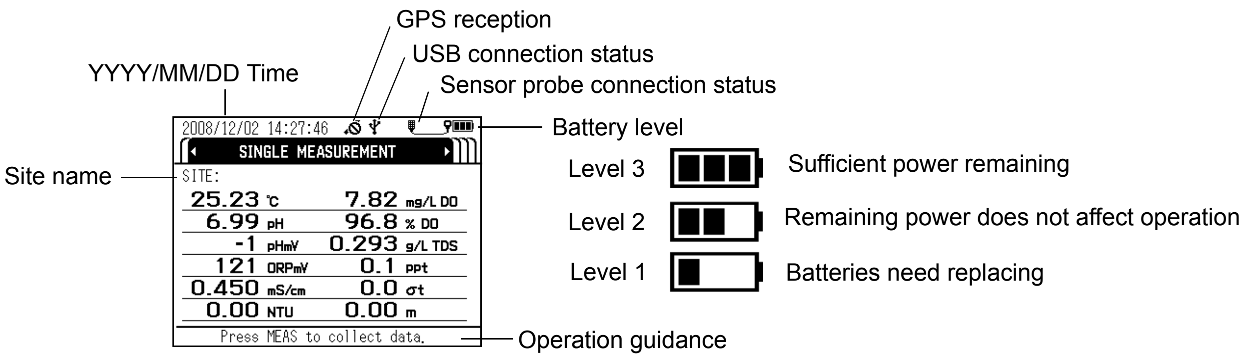
Sensor probe (U-52)



Sensor probe (U-53)



Display screen



● Operation key

	Key name	description
	POWER key	Turns the system's power ON/OFF. The initial screen appears immediately after turning the power ON. Press and hold down the POWER key for about 3 seconds to turn the power ON and OFF.
	MEAS key	When pressed in the measurement screen, used to set the measurement values of all the measurement parameters. Measurement values flash until the data stabilizes. When pressed in the setting, calibration or data operation screen, returns to the measurement screen.
	ENTER key	Used to execute functions, set entered values or store data in memory.
	CAL key	Switches to the calibration screen.
	ESC key	Returns to the immediately preceding operation.
	LIGHT key	Turns the backlight ON/OFF. ● Using the backlight shortens battery life. ● The backlight does not light for about 3 seconds after power ON. ● When the sensor probe is connected while the display's backlight is lit, the backlight goes out for about 3 seconds.
	Left key	Moves the cursor to the left.
	Right key	Moves the cursor to the right.
	Up key	Moves the cursor up.
	Down key	Moves the cursor down.

2.4 Setting menu items

Menu	Items	Reference
Measurement	Single measurement Interval measurement	" 3.2.1 Setting measurement methods " (page 18)
Site	Select site Create new site Delete site	" 3.2.2 Setting sites " (page 20)
Unit for report	TEMP (temperature) TURB (turbidity) DO (dissolved oxygen) COND (electrical conductivity) SG (seawater specific gravity) Depth (water depth) SALT (salinity)	" 3.2.3 Unit for report " (page 23)
Sensor selection	TEMP (temperature) pH pH mV ORP COND (electrical conductivity) TURB (turbidity) DO (dissolved oxygen) TDS (total dissolved solids) SALT (salinity) SG (seawater specific gravity) DEPTH (water depth)	" 3.2.4 Sensor selection " (page 25)
Compensation	DO salinity compensation DO atmospheric pressure compensation Electrical conductivity temperature coefficient TDS	" 3.2.5 Compensation " (page 26)
System	Language Version Date/time Auto power OFF Display contrast Initialize GPS locate* GPS locating accuracy*	" 3.2.6 System settings " (page 32) *Only on models with a GPS unit.

2.5 Calibration menu items

Menu	Items	Reference
Auto calibration	pH COND (electrical conductivity) TURB (turbidity) DO (dissolved oxygen) DEPTH (water depth)	" 3.3.1 Auto calibration " (page 39)
Manual calibration	TEMP (temperature) pH ORP COND (electrical conductivity) TURB (turbidity) DO (dissolved oxygen) DEPTH (water depth)	" 3.3.2 Manual calibration " (page 42)

2.6 Data operation menu items

Menu	Items	Reference
Data operation	View data Delete data Check data memory Calibration record GPS information*	" 3.5 Data operations " (page 64) *Only on models with a GPS unit.

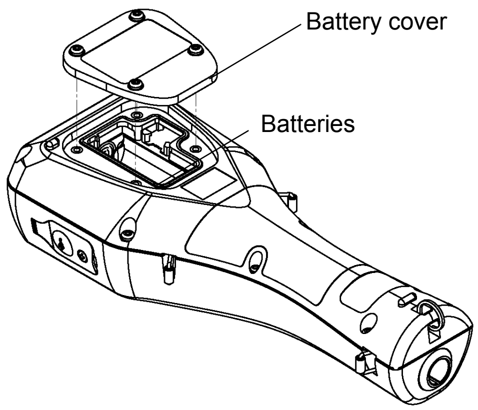
3 Basic Operation

3.1 System setup

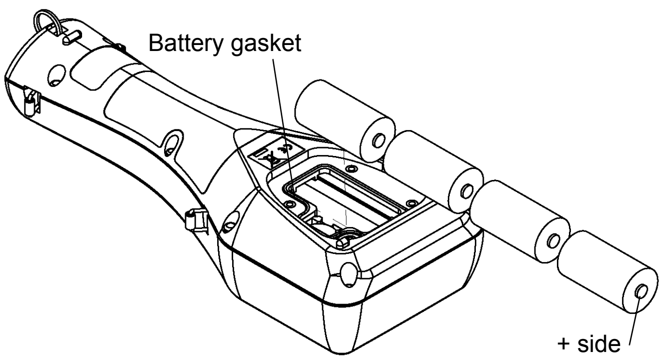
3.1.1 Inserting and replacing the batteries

The control unit is shipped without batteries. Follow the steps below to insert the batteries when using the system for the first time or replacing old batteries.

1. **Loosen the 4 screws on the battery cover by using No. 2 Phillips head screwdriver and remove the cover.**



2. **If replacing the batteries, discard the old batteries.**
3. **Insert new batteries in the control unit.**
   Check that the battery gasket is not dirty or twisted.



4. **Replace the battery cover and fasten it with the 4 screws.**
   Tighten the screws to less than 0.5 N·m.

Note

- **Data and settings will not be lost when the batteries are replaced.**
- **If dirty or twisted, the battery gasket will fail to keep the batteries dry. Check its condition before closing the cover.**
- **To ensure long service life, replacing the battery gasket periodically (once a year) is recommended.**

Precautions when using dry cell batteries

- **Batteries to use: LR14 alkaline dry cell batteries (C-size dry cell batteries) or rechargeable nickel-metal hydride dry cell batteries (C-size)**
  Do not use manganese batteries.
- **Dry cell batteries used incorrectly may leak or burst. Always observe the following**
  - Orient the batteries correctly (positive and negative ends in correct positions).
  - Do not combine new and used batteries, or batteries of different types.
  - Remove the batteries when not using the system for a prolonged period.
  - If batteries leak, have the system inspected at your nearest Horiba service station.

● Battery life

- The battery life for continuous operation when using C-size alkaline dry cell batteries is about 70 hours.
- Using the backlight consumes a proportionate amount of battery power, shortening battery life.
- Searching position information using the GPS unit consumes a proportionate amount of battery power, shortening battery life.
- Nickel-metal hydride secondary batteries can be used, but the battery life is not guaranteed since it will vary according to usage (number of times data is saved, number of charges and amount of each charge). In general, secondary batteries have one-half to one-third the life of C-size alkaline batteries.
- The 70-hour battery life figure applies to a control unit operating temperature of 20°C or more. The battery characteristics shorten the battery life at operating temperatures lower than 20°C, so check the remaining battery level, and replace the batteries before it reaches Level 1.
- The batteries packed with the system at the time of shipment are for checking operation. Their life is not guaranteed.
- The 70-hour battery life figure is the amount of operating time the batteries can provide until the system stops operating. The system may fail during operation if the remaining battery level is low, so it is a good idea to check the remaining battery level and replace the batteries with new ones well before the batteries run out completely.

U-51/52

Battery life: 70 hours (backlight off)

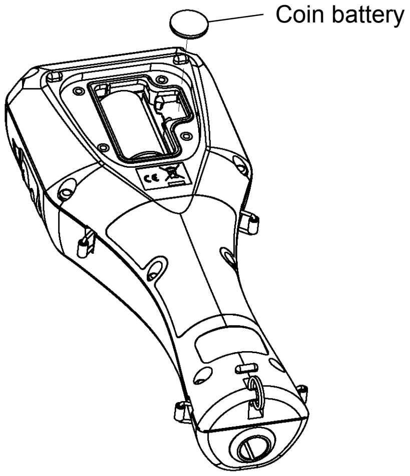
U-53

Battery life: 500 measurements (backlight off)

- Since U-53 is designed for turbidity measurement with wiper, its battery life is estimated in terms of the number of turbidity measurement sequences performed.
- Battery power is also consumed by measurement operations other than turbidity measurement.
- The battery life when turbidity measurement is not performed is about 70 hours.

3.1.2 Replacing the coin battery

- Coin battery to use: CR-2032
- The coin battery is only for the clock. It will provide problem-free operation for three years, but when using the clock continuously, it should be replaced every two years as a precaution.
- When replacing the coin battery for the clock, leave the control unit ON. If the coin battery is replaced when the control unit is turned OFF, the clock will be reset to the default settings.



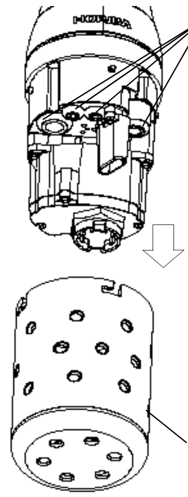
3.1.3 Attaching sensors

Note

- **When attaching or replacing a sensor, wipe any moisture off the sensor probe and sensor.**
- **Be sure to keep water out of sensor connectors. If moisture comes in contact with a sensor connector, blow-dry it with dry air.**
- **The sensor probe is not waterproof when the sensor is not mounted.**
- **Take care not to tighten the sensor too much.**

Attaching the pH sensor

1. **Remove the sensor guard.**

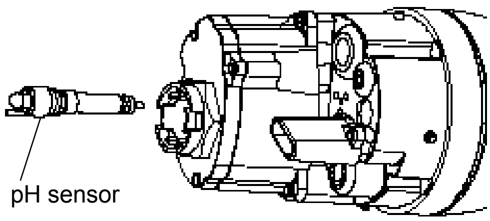


2. **Remove the sensor plug.**
3. **Coat the pH sensor O-ring with a thin layer of silicon grease (part No. 3014017718).**

Note

Be sure no grease from the O-ring gets on the sensor connector. If the sensor connector gets grease on it, wipe it off with a soft cloth soaked in alcohol.

4. **Make sure there is no moisture on the sensor probe's sensor connector (marked "pH").**
5. **Fasten the pH sensor securely by hand.**



6. **Clean the sensor with an alcohol-soaked cloth.**

- **Attaching the ORP sensor**

1. **Remove the sensor guard.**

2. **Remove the sensor plug.**

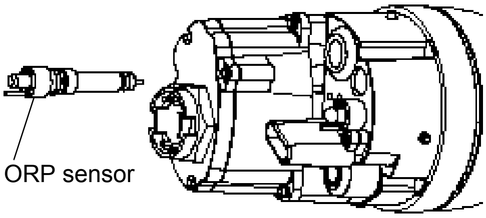
3. **Coat the ORP sensor O-ring with a thin layer of grease (part No. 3014017718).**

Note

Be sure no grease from the O-ring gets on the sensor connector. If the sensor connector gets grease on it, wipe it off with a soft cloth soaked in alcohol.

4. **Make sure there is no moisture on the sensor probe's sensor connector (marked "ORP").**

5. **Fasten the ORP sensor securely by hand.**



6. **Clean the sensor with an alcohol-soaked cloth.**

- **Attaching the reference electrode**

1. **Remove the sensor guard.**

2. **Remove the sensor plug.**

3. **Coat the reference electrode O-ring with a thin layer of grease (part No. 3014017718).**

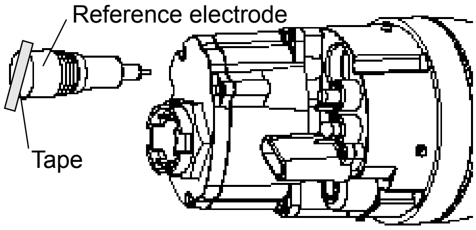
Note

Be sure no grease from the O-ring gets on the sensor connector. If the sensor connector gets grease on it, wipe it off with a soft cloth soaked in alcohol.

4. **Make sure there is no moisture on the sensor probe's sensor connector (marked "REF").**

5. **Fasten the reference electrode securely by hand.**

6. **Remove the tape from the liquid junction part of the reference electrode.**



Attaching the dissolved oxygen (DO) sensor

1. **Remove the membrane cap mounted on the DO sensor beforehand, and replace it with the new membrane cap provided. Replace the internal solution with fresh solution. The main component of the internal solution is potassium chloride (KCl), so the old solution can be disposed of down a sink or other drain.**

Reference

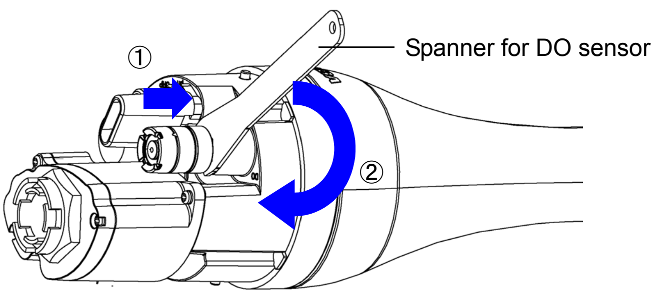
" 4.5 Replacing the membrane cap " (page 87)

2. **Screw in the DO sensor to attach it, allowing the internal solution to overflow slightly.**
3. **Use a soft cloth to wipe off the internal solution that overflowed onto the DO sensor.**
4. **Remove the sensor guard.**
5. **Remove the sensor plug.**
6. **Coat the DO sensor O-ring with a thin layer of grease (part No. 3014017718).**

Note

Be sure no grease from the O-ring gets on the sensor connector. If the sensor connector gets grease on it, wipe it off with a soft cloth soaked in alcohol.

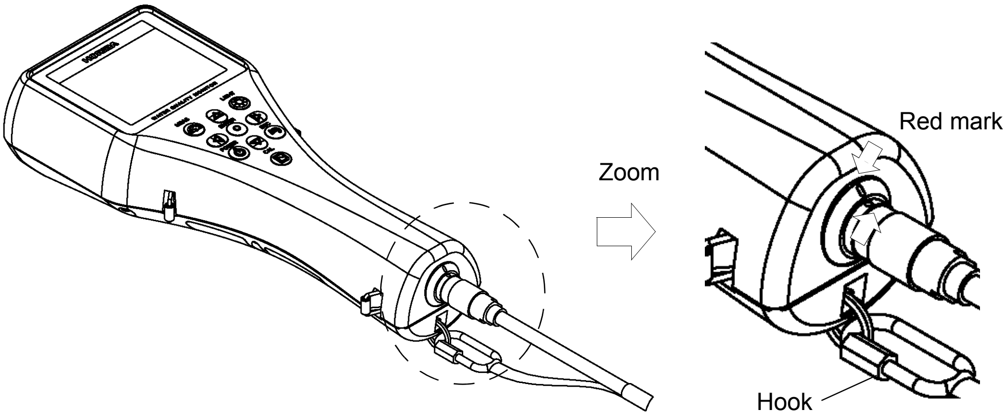
7. **Make sure there is no moisture on the sensor probe's sensor connector (marked "DO").**
8. **Fasten the DO sensor securely using the spanner for DO sensor.**
   - Hold the DO sensor with the provided spanner for DO sensor and push the sensor down. (Step 1 in figure below)
   - Screw the DO sensor in place. (Step 2 in figure below)



3.1.4 Connecting the control unit and sensor probe

Note

Connect the control unit with its power OFF.

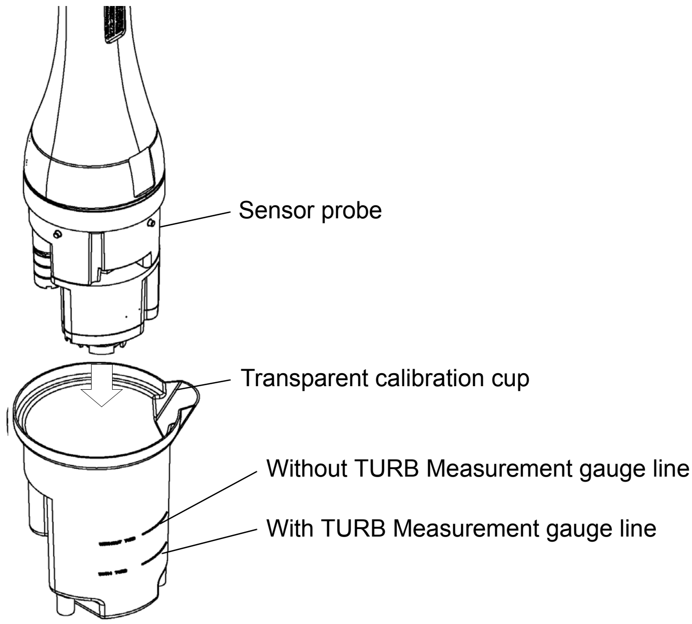


1. **Align the red mark on the connector, and press the connector in until you hear it click.**
2. **Connect the cable's hook to the display.**

3.1.5 Conditioning

Carry out the steps below when using the unit for the first time or when the system has not been used for 3 months or longer.

1. **Fill the transparent calibration cup to the line with pH 4 standard solution.**
   The transparent calibration cup has With TURB Measurement and Without TURB Measurement gauge lines.
2. **Insert the sensor probe in the transparent calibration cup.**



Note

Check that all sensors are attached.

3. **Press and hold down the control unit’s POWER key for about 3 seconds to turn the power ON. Leave the unit for at least 20 minutes to condition the sensors.**

Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

Tip

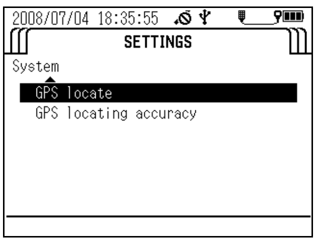
- **The procedure for immersing the sensor probe in the pH standard solution is the same as that described in “ 3.3.1 Auto calibration ” (page 39).**
  Auto calibration can be performed using the same pH 4 standard solution that was used in the conditioning procedure.
- **Immersing the sensor in the standard solution is generally required for sensor conditioning, but a voltage supply is required for DO sensor conditioning. Turning ON the power of the control unit is necessary during sensor conditioning.**

3.1.6 GPS (U-52G, U-53G)

The GPS position measurement precision is proportional to the GPS position measurement time. When the position measurement precision increases, the position measurement time also increases. See " ● GPS locating accuracy" (page 17) for how to set the position measurement precision. See " ● GPS locate" (page 15) below for how to check acquired GPS data.

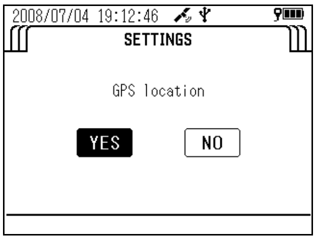
● GPS locate

1. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
2. **Press the down (▽) key to move the cursor to "System", then press the ENTER key.**
3. **Press the down (▽) key to move the cursor to "GPS locate", then press the ENTER key.**



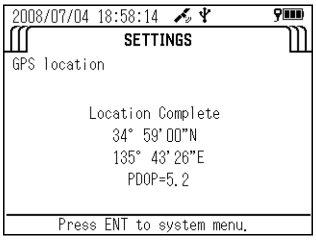
4. **The message "Press ENT key to start position measurement." appears. Press the ENTER key.**

5. **The message "Execute GPS position measurement?" appears. Move the cursor to "YES", then press the ENTER key.**

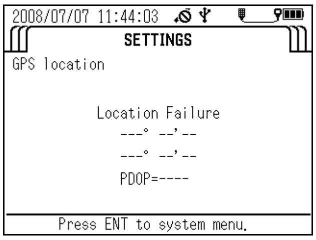


6. **The message "Warming up. Please wait." appears. Wait until the system has finished warming up (about 10 seconds).**

- Position measurement starts automatically when warmup has finished. Position measurement is performed up to 10 times.
- The GPS location complete screen appears after successful position measurement.

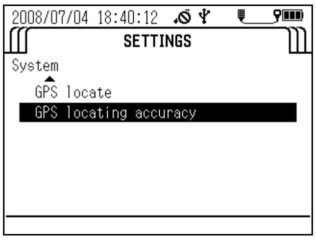


- The GPS location failure screen appears after position measurement has failed. Redo the measurement in a location free from obstacles, or wait for the meteorological conditions to improve before redoing the measurement.

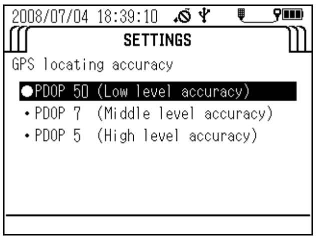


● GPS locating accuracy

1. Press the right (▷) key to switch the display to the "SETTINGS" screen.
2. Press the down (▽) key to move the cursor to "System", then press the ENTER key.
3. Press the down (▽) key to move the cursor to "GPS locating accuracy", then press the ENTER key.



4. The screen below appears. Move the cursor to the locating accuracy, then press the ENTER key. The black circle (●) indicates the currently set precision.



3.2 Settings

3.2.1 Setting measurement methods

This section describes how to set the measurement method.

● Measurement methods

● U-51/U-52

Single measurement	Pressing the MEAS key acquires the 5-second average for the selected measurement parameter.
Interval measurement	Pressing the MEAS key acquires and saves the 5-second average for the selected measurement parameter in the set interval. The measurement interval can be set to any value between 10 seconds and 24 hours.

● U-53

The U-53 turbidity sensor uses a tungsten lamp. The lamp lights for about 10 seconds, and the average measurement value acquired during this interval is displayed.

Single measurement	Pressing the MEAS key acquires the 5-second average for the selected measurement parameter after wiper operation. The 10-second average is acquired when measuring turbidity.
Interval measurement	Pressing the MEAS key acquires and saves the 5-second average for the selected measurement parameter in the set interval. The 10-second average is acquired when measuring turbidity. The measurement interval can be set to any value between 10 seconds (final check of this value required; 30 seconds may be better for U-52) and 24 hour.

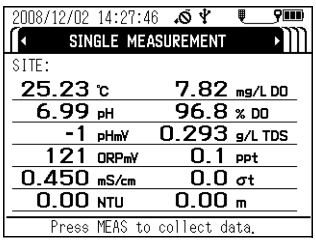
Reference

“ 3.4 Measurement ” (page 61)

● Operation method

1. **Press and hold down the control unit’s POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.

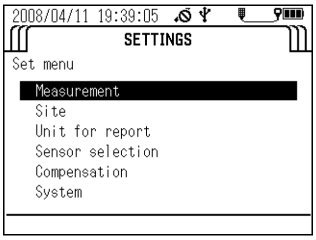


Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

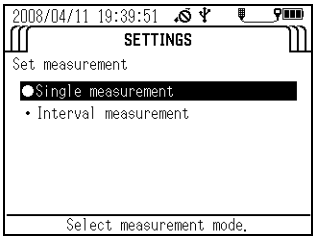
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

3. Press the down (▽) key to move the cursor to "Measurement", then press the ENTER key.



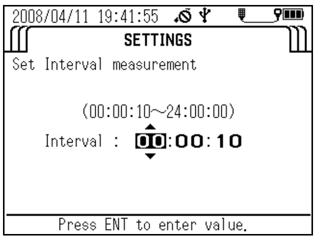
4. Press the down (▽) key to move the cursor to the desired measurement mode. Press the ENTER key to save the setting.

The black circle (●) indicates the currently selected measurement mode.



5. If you selected "Interval measurement", the display switches to the screen used to set the measurement interval. Press the up (△) and down (▽) keys to set the measurement interval.

The measurement interval can be set to any value between 10 seconds and 24 hours in the case of the U-51 and U-52, or between 30 seconds and 24 hours in the case of the U-53.



3.2.2 Setting sites

The site function allows position data to be connected to corresponding measurement data. Sites have the following specifications and features:

Site names: Text data consisting of up to 20 one-byte alphanumeric characters, spaces, etc.
Site names can be used for control unit searches and as labels for computer processing.
Site names allow measurement data to be saved with a name corresponding to the actual location where it was measured.

You can use site information as a search key when viewing data uploaded by a PC or data saved in the control unit (see " 3.5 Data operations " (page 64)).

● Selecting sites

You can select previously created sites. The black circle (●) indicates the name of the currently selected site. No sites are created at new purchasing or after initialization. Select a site after first creating one from the "Create new site" menu.

● Creating new sites

You can create and save new sites. Up to 20 site names can be registered.

● Deleting sites

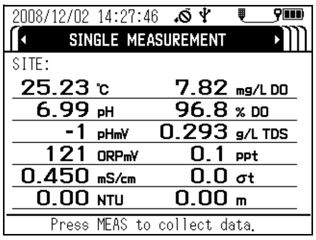
You can select a previously created site and delete it.

● Operation methods

● Selecting a site

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.

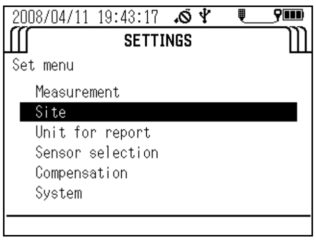


Note

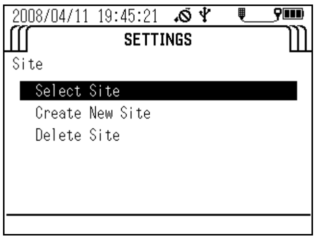
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

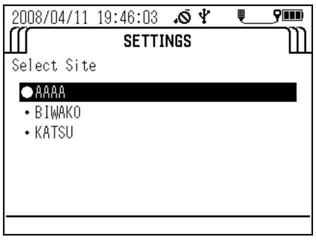
3. **Press the down (▽) key to move the cursor to "Site", then press the ENTER key.**



4. **Press the down (▽) key to move the cursor to "Select Site", then press the ENTER key to display the names of the currently saved sites.**



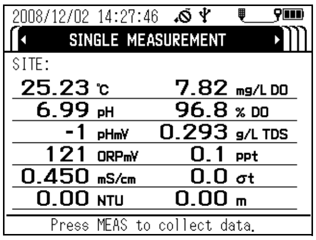
The black circle (●) indicates the currently selected site.



● **Creating a new site**

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.

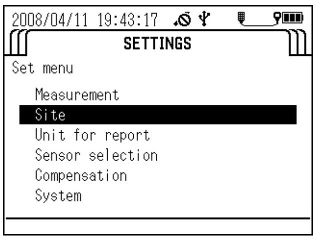


Note

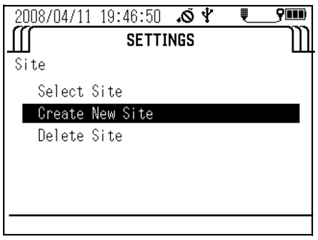
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

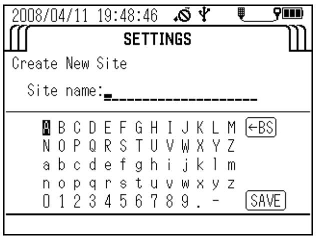
3. **Press the down (▽) key to move the cursor to "Site", then press the ENTER key.**



4. **Press the down (▽) key to move the cursor to "Create New Site", then press the ENTER key.**
   Enter the desired site name (up to 20 alphanumeric non-Asian width characters).

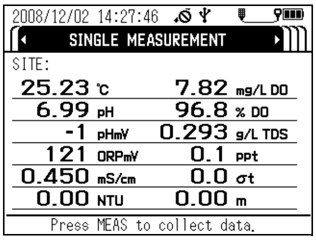


5. **Press the up (△), down (▽), right (▷), and left (◁) keys to move the cursor to each letter or number to use in the name, then press the ENTER key to confirm the entered characters. To delete incorrectly entered characters, move the cursor to "BS" and press the ENTER key to start deleting from the last character. When you have finished entering the name, save it by moving the cursor to "SAVE" and pressing the ENTER key.**



● Deleting a site

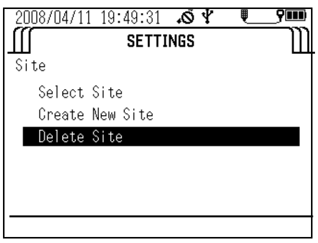
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

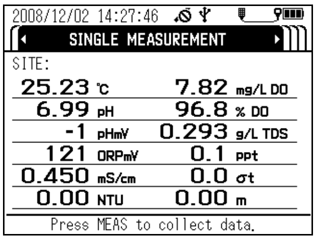
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**



3. **Press the down (▽) key to move the cursor to "Site", then press the ENTER key.**

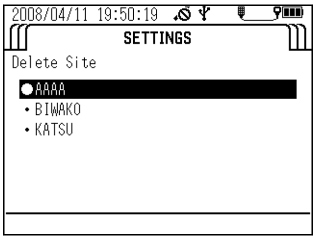
4. **Press the down (▽) key to move the cursor to "Delete Site", then press the ENTER key.**

   A list of the currently saved sites appears. The black circle (●) indicates the currently selected site.



5. **Press the down (▽) key to move the cursor to the site to delete, then press the ENTER key to delete it.**

   The currently selected site can be deleted after a different site has been selected from the site selection menu or after all unselected sites have been deleted. The same site name cannot be registered more than once.



3.2.3 Unit for report

Note

Units can only be selected when the sensor probe is connected.

Follow the steps below to set the measurement units of measurement parameters. No units are displayed if a measurement parameter has not been selected in the measurement parameter selection screen (see “ 3.2.4 Sensor selection ” (page 25)).

1. **Press and hold down the control unit’s POWER key for about 3 seconds to turn the power ON.**

   The "MEASUREMENT" screen appears after about 10 seconds.

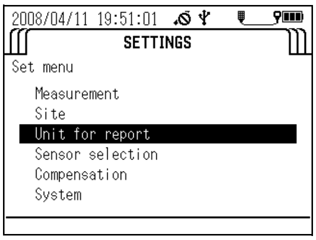
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

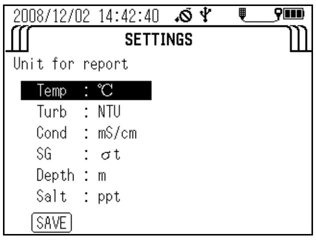
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

3. **Press the down (▽) key to move the cursor to "Unit for report", then press the ENTER key.**

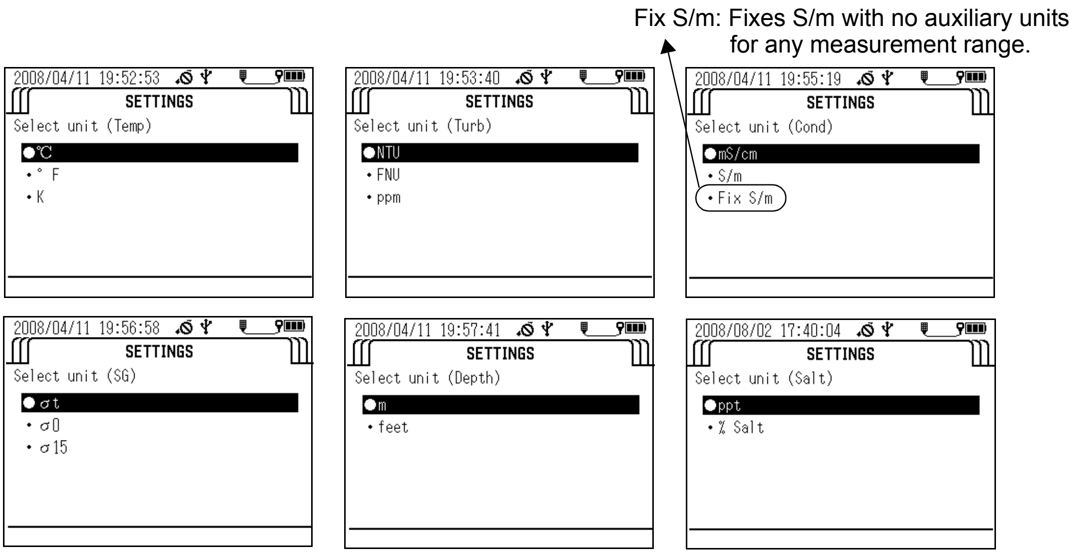
   A list of the currently selected measurement parameters and their units appears. Note that measurement parameters not selected (in the measurement parameter selection screen) are not displayed.



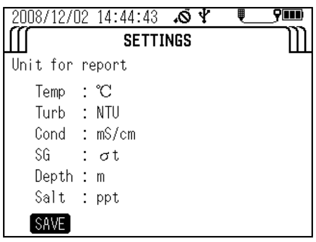
4. **Press the up (△) and down (▽) keys to move the cursor to the item to change, then press the ENTER key.**



5. **A list of the units that can be selected appears. The black circle (●) indicates the currently selected unit. Press the up (△) and down (▽) keys to move the cursor to the desired unit, then press the ENTER key.**



6. **To save the changes, press the up (△) and down (▽) keys to move the cursor to SAVE, then press the ENTER key. If you do not want to save the changes, press the ESC key.**



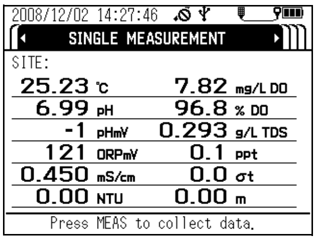
3.2.4 Sensor selection

Note

Measurement parameters can only be selected when the sensor probe is connected.

You can set between 1 and 11 measurement parameters to display in the control unit screen. Follow the steps below to select the desired measurement parameters.

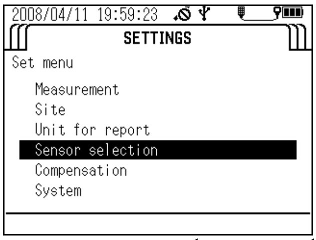
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



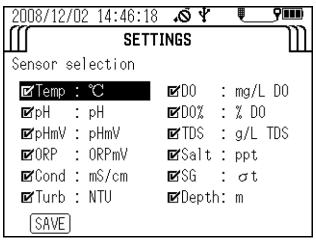
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
3. **Press the down (▽) key to move the cursor to "Sensor selection", then press the ENTER key.**
   A list of the measurement parameters that can be set and the currently set units are displayed.



4. **Move the cursor to each measurement parameter to change, then press the ENTER key.**
   A check in the check box of a measurement parameter indicates it will be displayed.
5. **To save the changes, press the up (△), down (▽), left (◁) and right (▷) keys to move the cursor to SAVE, then press the ENTER key. If you don't want to save the changes, press the ESC key.**



Note

Available measurement parameters differ according to product specifications.

3.2.5 Compensation

Note

Compensation settings can only be made when the sensor probe is connected.

U-50 series have following functions of compensation.

- Salinity compensation and atmospheric pressure compensation for dissolved oxygen (DO)
- Temperature compensation for conductivity (COND)
- Setting total dissolved solid (TDS) coefficient for TDS

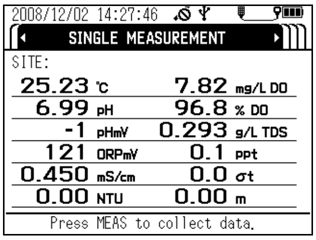
Salinity compensation (DO)

The dissolved oxygen (DO) value is presented higher than actual value if salinity compensation is not added, because the increase of salinity gives higher DO value. To obtain correct value salinity compensation is needed. The following modes are available for calculation of salinity compensation.

AUTO: Salinity compensation is performed automatically with salinity converted from conductivity.

Value input: Press the up (△) and down (▽) keys to enter a setting value when the salinity is known.

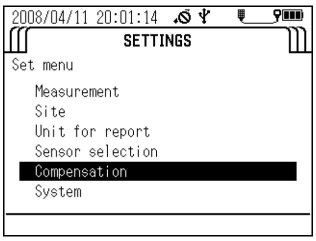
1. **Press and hold down the control unit’s POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



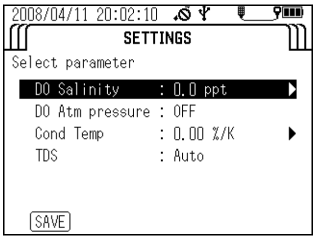
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

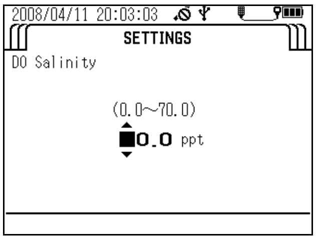
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
3. **Press the down (▽) key to move the cursor to "Compensation", then press the ENTER key.**



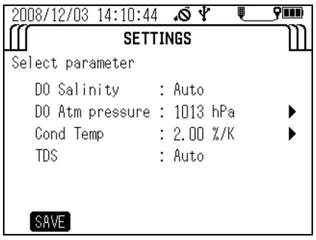
4. **Press the down (▽) key to move the cursor to "DO Salinity", then press the ENTER key to toggle the setting between "Auto" and "Input mode".**
   Default: Auto



5. **If you selected "Input mode", press the right (▷) key to display the compensation value input screen. Press the up (△) and down (▽) keys to enter the desired value, then press the ENTER key to set it.**

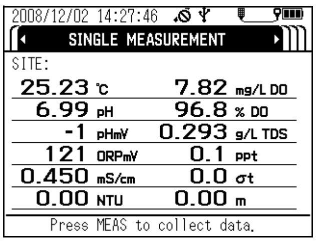


6. **To save the change, press the up (△) and down (▽) keys to move the cursor to SAVE, then press the ENTER key. If you don't want to save the change, press the ESC key.**



- **Atmospheric pressure compensation (DO)**
  Differences in the atmospheric pressure of the measurement location influence the Dissolved Oxygen (DO) measurement. By setting (input) the actual atmospheric pressure of the measurement location into the control unit, it is possible to standardize the measured Dissolved Oxygen (DO) value to a value at the standard atmospheric pressure (1013 hPa).

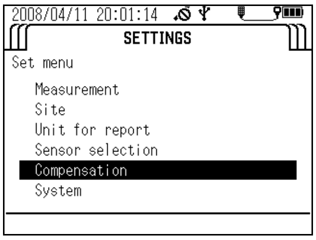
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



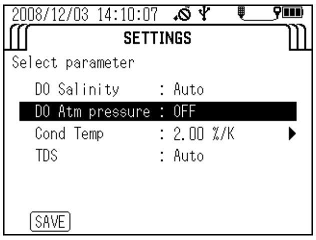
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

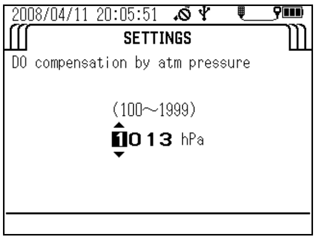
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
3. **Press the down (▽) key to move the cursor to "Compensation", then press the ENTER key.**



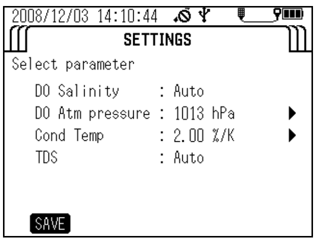
4. **Press the down (▽) key to move the cursor to "Cond Temp", then press the ENTER key to toggle the setting between "OFF" and "Input mode".**
   Default: OFF



5. **If you selected "Input mode", press the right (▷) key to display the compensation value input screen. Press the up (△) and down (▽) keys to enter the desired value, then press the ENTER key to set it.**



6. **To save the change, press the up (△) and down (▽) keys to move the cursor to SAVE, then press the ENTER key. If you don't want to save the change, press the ESC key.**

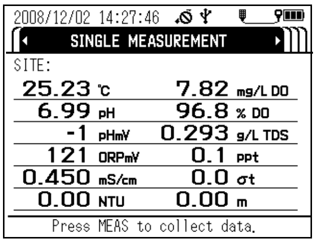


- **Temperature compensation for conductivity (COND)**

Sample conductivity (COND) varies with temperature, and this control unit uses a temperature compensation coefficient to automatically standardize the conductivity (COND) at 25°C. The initial setting coefficient is 2%/K, which is the generally used.

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.

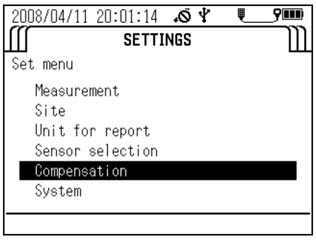


Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

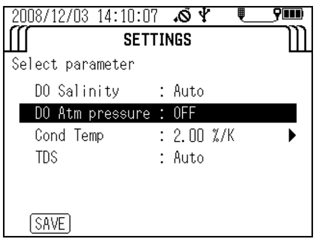
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

3. **Press the down (▽) key to move the cursor to "Compensation", then press the ENTER key.**

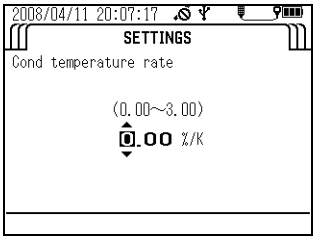


4. **Press the down (▽) key to move the cursor to "Cond Temp", then press the ENTER key to toggle the setting between "OFF" and "Input mode".**

Default: 2.00%/K

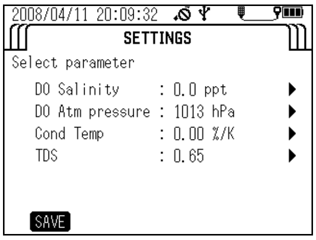


5. **If you selected "Input mode", press the right (▷) key to display the compensation value input screen. Press the up (△) and down (▽) keys to enter the desired value, then press the ENTER key to set it.**



6. **To save the change, press the up (△) and down (▽) keys to move the cursor to SAVE, then press the ENTER key.**

If you don't want to save the change, press the ESC key.

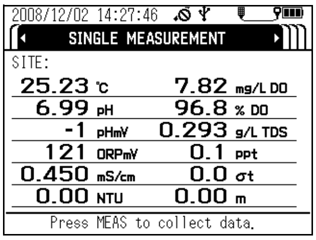


Setting a total dissolved solid (TDS) coefficient

The total dissolved solid amount (TDS) is a converted value obtained by multiplying the conductivity (COND) by a known coefficient. The coefficient initially set for the control unit is based on a conversion for KCl and $CaCO_3$ solutions and it depends on the conductivity (COND) value as shown below.

Conductivity (COND) (S/m)	Conversion coefficient
< 0.05	0.65
0.05 to 0.5	0.64
0.5 to 1	0.63
1 to 3	0.62
3 to 5	0.61
> 5	0.60

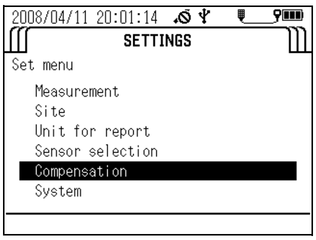
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



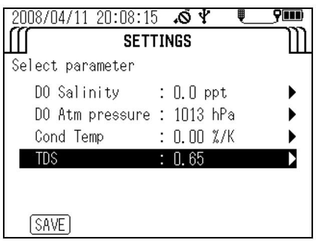
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

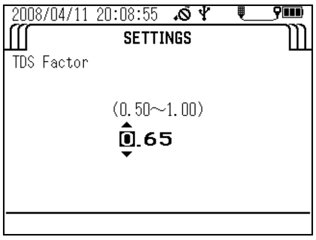
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
3. **Press the down (▽) key to move the cursor to "Compensation", then press the ENTER key.**



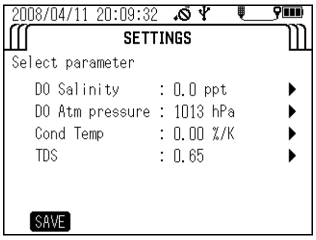
4. **Press the down (▽) key to move the cursor to "TDS", then press the ENTER key to toggle the setting between "AUTO" and "Input mode".**
   Default: Auto



5. **If you selected "Input mode", press the right (▷) key to display the compensation value input screen. Press the up (△) and down (▽) keys to enter the desired value, then press the ENTER key to set it.**



6. **To save the change, press the up (△) and down (▽) keys to move the cursor to SAVE, then press the ENTER key. If you don't want to save the change, press the ESC key.**



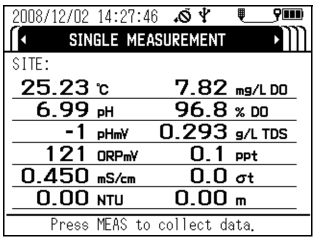
3.2.6 System settings

The system settings let you change the display language, check the system software version, set the date/time, set the auto power OFF time, set the display contrast, and initialize the settings.

● Display language

Follow the steps below to select either English or Japanese as the display language.

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.

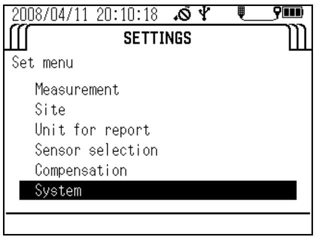


Note

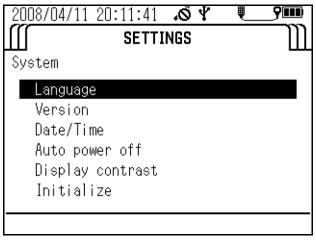
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

3. **Press the down (▽) key to move the cursor to "System", then press the ENTER key.**

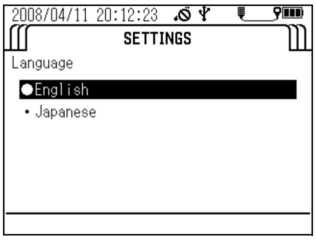


4. **Press the down (▽) key to move the cursor to "Language", then press the ENTER key.**



5. **A list of the supported display languages appears. Press the up (△) and down (▽) keys to move the cursor to the desired language, then press the ENTER key.**

The black circle (●) indicates the currently selected display language.



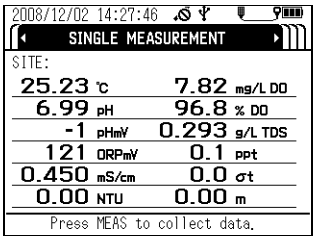
● Version

Follow the steps below to display the program No. and version of the control unit and sensor probe software.

The program No. and version of the sensor probe software will not be displayed if the sensor probe is not connected.

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.

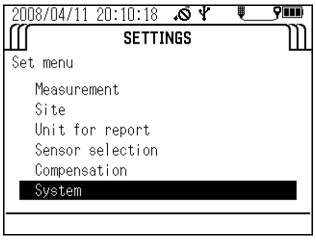


Note

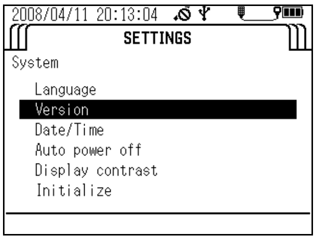
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

3. Press the down (▽) key to move the cursor to "System", then press the ENTER key.



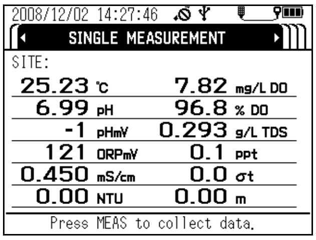
4. Press the down (▽) key to move the cursor to "Version", then press the ENTER key.
The program No. of the control unit and sensor probe software appears.



● Setting the date/time

Follow the steps below to set the date and time.

1. Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.
The "MEASUREMENT" screen appears after about 10 seconds.

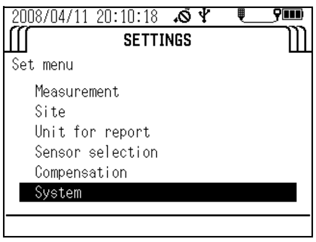


Note

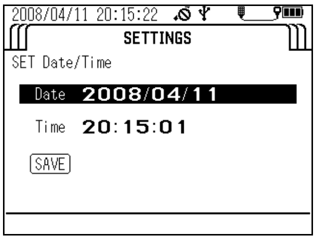
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. Press the right (▷) key to switch the display to the "SETTINGS" screen.

3. Press the down (▽) key to move the cursor to "System", then press the ENTER key.

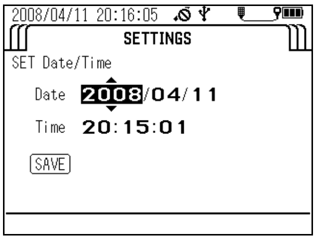


4. **Press the down (▽) key to move the cursor to "Date/time", then press the ENTER key.**

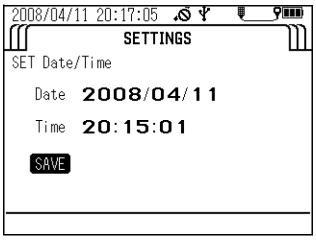


5. **Move the cursor to the date, then press the ENTER key.**

6. **Press the right (▷) key to move the cursor to the year, month, day, hour, minute and second, and press the up (△) and down (▽) keys to enter each value.**



7. **When finished entering settings, press the ENTER key to move the cursor to SAVE, then press the ENTER key again to save the settings.**

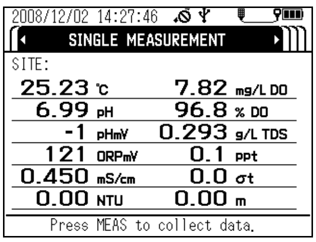


● **Setting the auto power OFF time**

Follow the steps below to set the time for the auto power OFF function (which turns the power OFF automatically when no operation is performed for the preset amount of time).

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

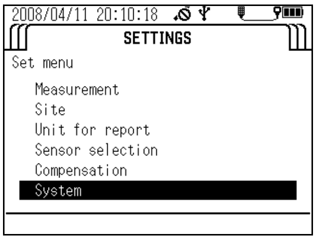
The "MEASUREMENT" screen appears after about 10 seconds.



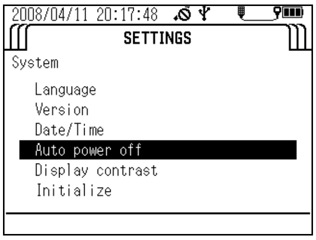
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

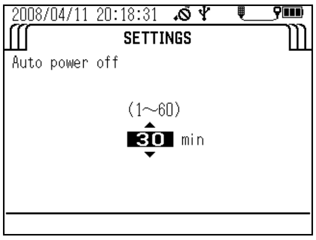
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
3. **Press the down (▽) key to move the cursor to "System", then press the ENTER key.**



4. **Press the down (▽) key to move the cursor to "Auto power off", then press the ENTER key.**



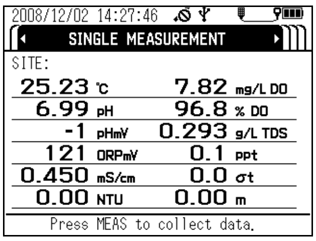
5. **Press the up (△) and down (▽) keys to select the desired time setting, then press the ENTER key.**
   You can select OFF, or settings of 1, 2, 5, 10, 20, 30 or 60 minutes.
   Default: 30 minutes



● Display contrast

Follow the steps below to adjust the display's contrast.

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.

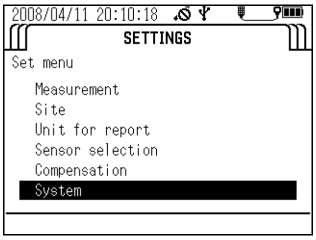


Note

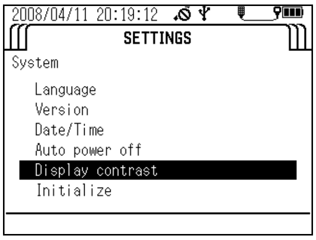
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

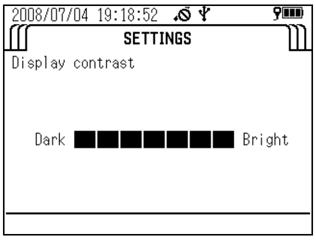
3. **Press the down (▽) key to move the cursor to "System", then press the ENTER key.**



4. **Press the down (▽) key to move the cursor to "Display contrast", then press the ENTER key.**



5. **Press the left (◁) and right (▷) keys to adjust the contrast.**
Adjustment can be made in 26 steps.

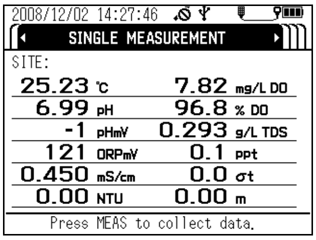


6. **Press the ENTER key.**

● Initialization

Follow the steps below to restore all the settings except date/time to their factory defaults. Factory default calibration data for the electrical conductivity and turbidity sensors will also be deleted at the same time.

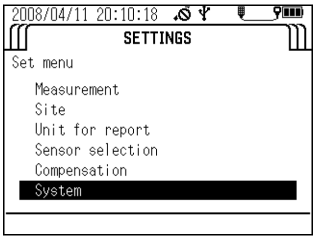
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
The "MEASUREMENT" screen appears after about 10 seconds.



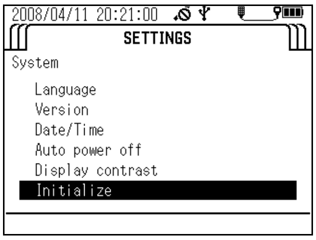
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

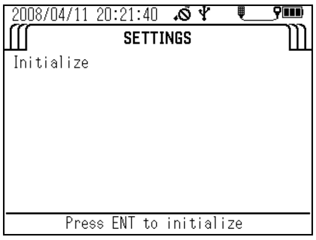
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
3. **Press the down (▽) key to move the cursor to "System", then press the ENTER key.**



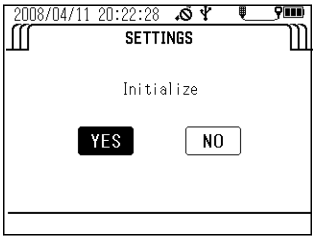
4. **Press the down (▽) key to move the cursor to "Initialize", then press the ENTER key.**



5. **Press the ENTER key again.**



6. **A confirmation message appears asking whether to execute initialization. Press the left (◁) key to move the cursor to YES, then press the ENTER key.**
   The message "Initialize Complete" appears to indicate the process has finished.



3.3 Calibration

To obtain correct measurement values, the sensors need to be calibrated using standard solution before measurement. You can select simultaneous auto calibration of the pH, COND and TURB sensors in pH4 standard solution and DO and DEP sensors simultaneously in air, or manual calibration of individual measurement parameters. You can check the result of the previous calibration using the procedure on “ 3.5.4 Checking the calibration record ” (page 70).

Note

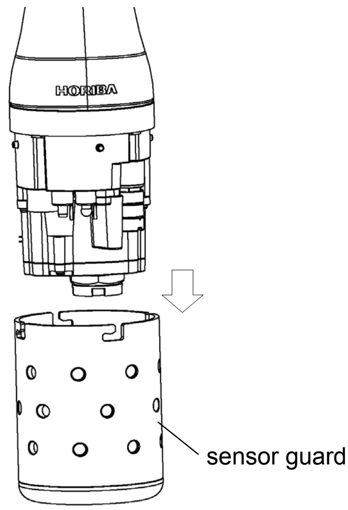
- **Wait at least 20 minutes after turning the system power ON before calibrating the DO sensor.**
- **Make the DO and COND compensation settings before calibration since these settings are applied during calibration.**
- **You can select only the desired parameters for calibration and calibrate just those parameters (see “ 3.2.4 Sensor selection ” (page 25)).**
- **Use about 200 mL of standard solution in the calibration cup.**
- **Calibration data is stored in the sensor probe.**

3.3.1 Auto calibration

Tip

- **The following parameters are calibrated (at 25°C):**
  pH: Set to 4.01 (zero-point calibration); the span is adjusted to the factory default value.
  COND: 0.449 S/m (4.49 mS/cm, span calibration); the zero point is adjusted to the factory default value.
  TURB: 0 NTU (zero-point calibration); the span is adjusted to the factory default value.
  DO: 8.92 mg/L (span calibration); the zero point is adjusted to the factory default value.
  DEP: 0 m (zero-point calibration); the zero point is adjusted to the factory default value.
- **If the air temperature changes, the readout value may not be stable. Ensure that the ambient air temperature is the same temperature as the calibration solution, because the internal probe temperature sensor and external temperature sensor (in the calibration solution) are used for the auto calibration. Allow the probe and standard solution to equilibrate for 1 hour if a thermometer is not available to verify that these temperatures are the same.**
- **Do not hold the probe while performing the auto calibration. Body temperature may elevate the internal temperature sensor measurement creating DO calibration error.**

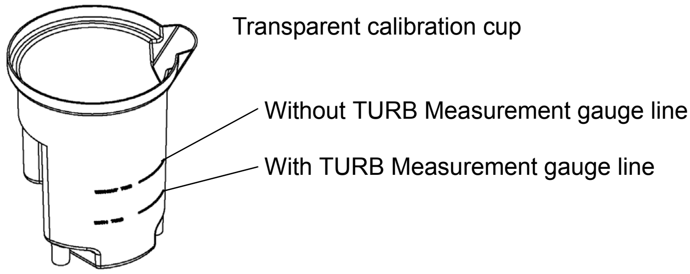
1. **Remove the sensor guard and wash the sensor probe 2 or 3 times with deionized water.**



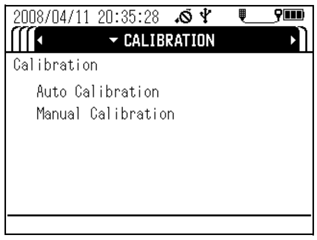
2. **Remove the transparent calibration cup.**

3. **Fill the transparent calibration cup to the line with pH 4 standard solution.**

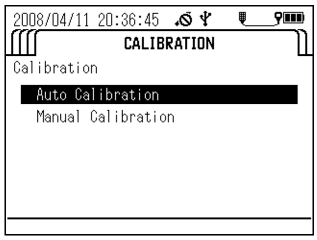
The transparent calibration cup has With TURB Measurement and Without TURB Measurement gauge lines.



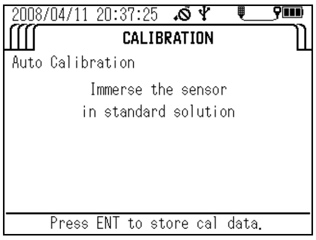
4. **Press the control unit's CAL key to set the calibration mode.**

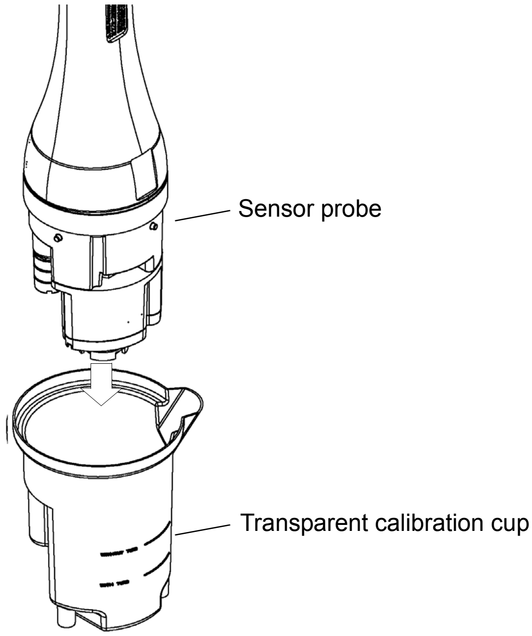


5. **Press the down (▽) key to move the cursor to "Auto Calibration", then press the ENTER key.**

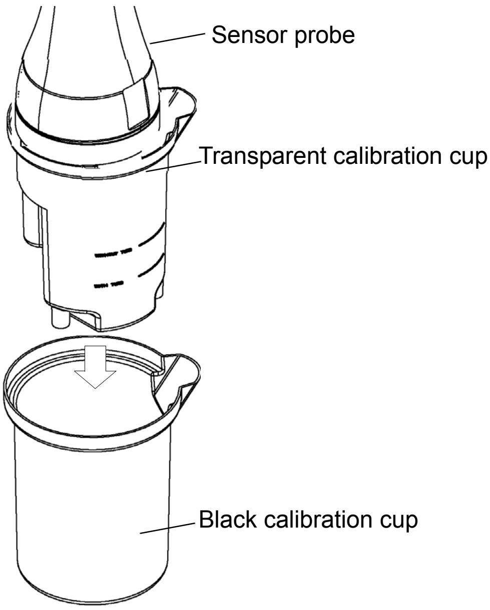


6. **Immerse the sensor probe in the transparent calibration cup.**
Check that the pH sensor, ORP sensor, reference electrode, COND sensor, TURB sensor and temperature sensor are submerged in the pH 4 standard solution and check that there are no air bubbles on the sensor.





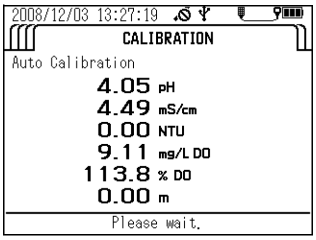
7. **With the sensor probe still in the transparent calibration cup, place the transparent calibration cup into the black calibration cup.**



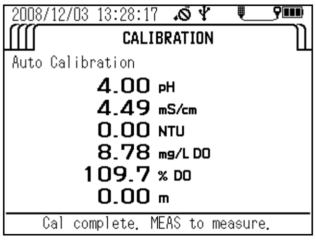
8. **When all the sensor values have stabilized, press the ENTER key to start calibration.**

Note

Do not remove the sensor probe from the calibration solution. U-53 turbidity data will display "----" until the calibration is completed.



Calibration is finished when the message "Cal complete. MEAS to measure." appears. Press the MEAS key to set the measurement screen, then start measurement.



If a calibration error occurs, start calibration after first resolving the issue according to the instructions in " 4.6 Troubleshooting " (page 89).

3.3.2 Manual calibration

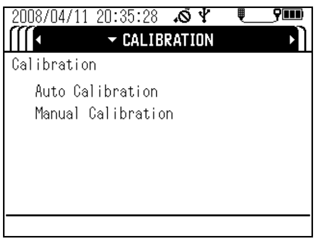
The procedures below describe how to calibrate each sensor individually.

Note

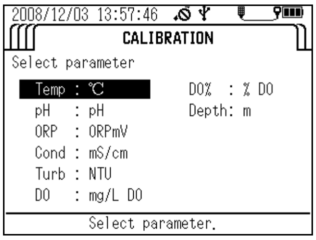
The displayed units are the units set by selecting "Unit for report" in the "SETTINGS" screen.

● Temperature (TEMP) calibration

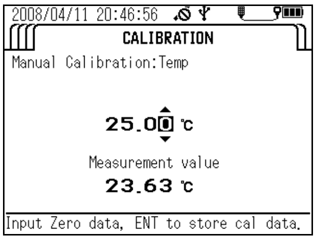
1. **Fill a bucket or similar container with water of a known temperature, and insert the sensor probe in it.**
   Wait 5 minutes before starting calibration to allow the sensor probe temperature to stabilize.
2. **Press the control unit's CAL key to set the calibration mode.**
3. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



4. **In the parameter selection screen, move the cursor to “Temp”, then press the ENTER key.**



5. **Press the up (△) and down (▽) keys to set the calibration value - the temperature of the water containing the submerged sensor probe.**



6. **Check that “Measurement value” has stabilized, then press the ENTER key to start calibration.**
Calibration is finished when the message “Cal complete. CNT to measure.” appears.

● pH calibration

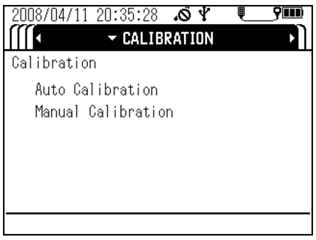
Note

You can select one calibration point (zero-point calibration) or two calibration points (zero-point calibration and span calibration). Carry out two calibration procedures to ensure good measurement precision throughout all measurement ranges.

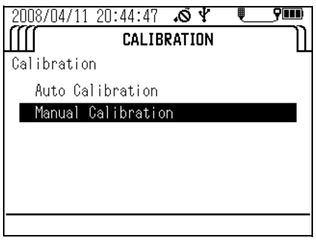
1. **Calibrate the zero point. Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with pH 7 standard solution.**

2. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

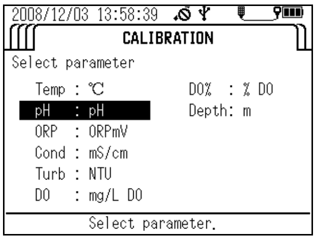
3. **Press the control unit’s CAL key to set the calibration mode.**



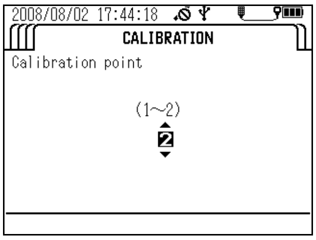
4. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



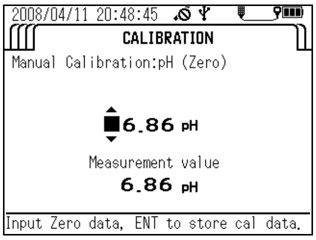
5. **In the parameter selection screen, move the cursor to "pH", then press the ENTER key.**



6. **Set the number of calibration points, then press the ENTER key.**



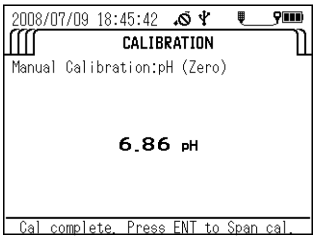
7. **Press the up (△) and down (▽) keys to set the pH value of the pH 7 standard solution containing the submerged sensor probe at the measurement temperature**



Temp. (°C)	pH 4 standard solution Phthalate	pH 7 standard solution Neutral phosphate	pH 9 standard solution Borate
0	4.01	6.98	9.46
5	4.01	6.95	9.39
10	4.00	6.92	9.33
15	4.00	6.90	9.27
20	4.00	6.88	9.22
25	4.01	6.86	9.18
30	4.01	6.85	9.14
35	4.02	6.84	9.10
40	4.03	6.84	9.07
45	4.04	6.84	9.04

8. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

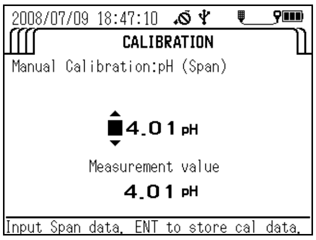
9. **Press the ENTER key to start the span calibration procedure when the message "Cal complete. Press ENT to Span cal." appears.**



10. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with pH 4 or pH 9 standard solution.**

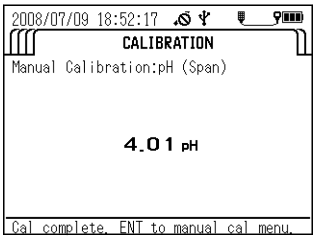
11. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

12. **Press the up (△) and down (▽) keys to set the pH value of the pH 4 or pH 9 standard solution containing the submerged sensor probe at the measurement temperature.**



13. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

14. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter**

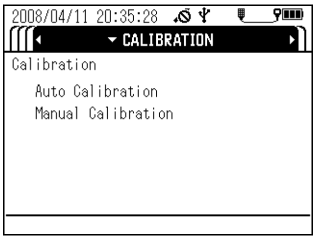


● ORP calibration

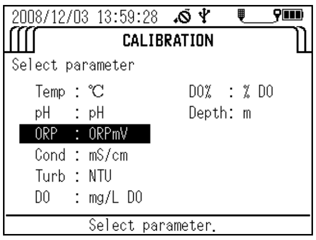
Note

- **If the prepared ORP standard solution is left in open air for one hour or more, the solution may be transformed. For this reason ORP standard solution cannot be stored.**
  Calibrate within one hour of preparing the solution.
- **When measuring sample with low concentrations of oxidants and reductants after conducting an operational check using a standard substance, the measured values may not stabilize or the results of measurement might not be repeatable. If this is the case, start the measurement after immersing the sensors in the sample water sufficiently.**
- **Note that when measuring the ORP of solution with extremely low concentrations of oxidants and reductants, such as tap water, well water, or water treated with purifying equipment, there may be less responsiveness, repeatability, and stability, in general.**
- **When alkaline ion water is left for 5 minutes, its ORP undergoes changes significantly. Always measure alkaline ion water promptly.**

1. **Fill a clean beaker with one bag of ORP standard powder No. 160-22 or No. 160-51. Add 250 mL of deionized water and agitate the solution thoroughly (there will be some excess quinhydrone (a black powder) that floats on the surface when agitating the solution). Fill the transparent calibration cup to the reference line with this standard solution.**
2. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**
3. **Press the control unit's CAL key to set the calibration mode.**
4. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



5. **In the parameter selection screen, move the cursor to ORP, then press the ENTER key.**



6. **Press the up (△) and down (▽) keys to set the mV value of the ORP standard solution containing the submerged sensor probe at the measurement temperature.**

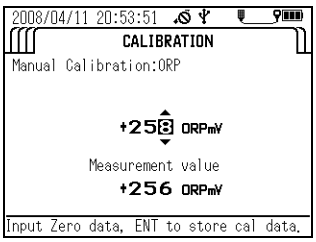


Table 1 Indicated value of ORP standard solution at various temperatures (mV)

Temperature	160-22	16051
5	+274	+112
10	+271	+107
15	+267	+101
20	+263	+95
25	+258	+89
30	+254	+83
35	+249	+76
40	+244	+69

7. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**
8. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**

● Conductivity (COND) calibration

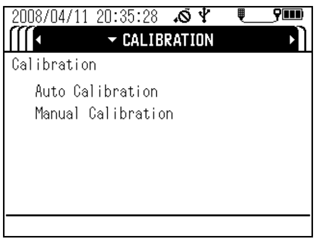
Note

- **To support a wide range of sample concentrations, electrical conductivity is divided into three measurement ranges: 0.0 mS/m to 99.9 mS/m, 0.090 S/m to 0.999 S/m, and 0.9 S/m to 9.99 S/m.**
- **When manually calibrating conductivity, you can select two calibration points (one zero-point calibration point and a span calibration point for one of the three measurement ranges) or four calibration points (one zero-point calibration point and span calibration points for all three measurement ranges). Carry out the four calibration points to ensure good measurement precision throughout all measurement ranges.**
- **Make the compensation setting before calibration since this setting is applied during calibration. (Refer to “ 6.5.3 Temperature coefficient ” (page 104)).**

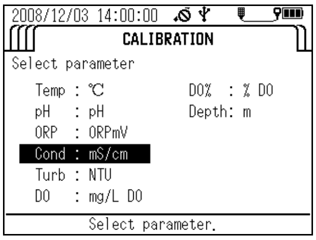
1. **Prepare the standard solution. Dry Potassium chloride (KCl) powder (high-grade commercially available) at 105°C for two hours, and leave it to cool in a desiccator.**
2. **Consult the following table and weigh potassium chloride (KCl), then prepare three standard potassium chloride (KCl) solutions following the procedure below.**

Potassium chloride (KCl) standard solution	Conductivity (COND) value	Potassium chloride (KCl) mass (g) at solution temperature of 25 °C	Calibration range
0.005 mol/L	71.8 mS/m (0.718 mS/cm)	0.373	0.0 mS/m to 99.9 mS/m (0.00 mS/cm to 0.999 mS/cm)
0.050 mol/L	0.667 S/m (6.67 mS/cm)	3.73	0.090 S/m to 0.999 S/m (1.00 mS/cm to 9.99 mS/cm)
0.500 mol/L	5.87 S/m (58.7 mS/cm)	37.2	0.9 S/m to 9.99 S/m (10.0 mS/cm to 99.9 mS/cm)

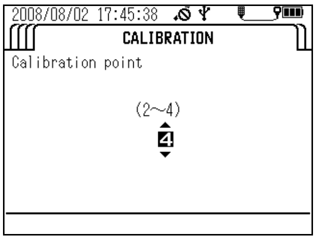
3. **Dissolve the weighed Potassium Chloride (KCl) in deionized water.**
4. **Put the dissolved Potassium Chloride (KCl) into a 1 L measuring flask, and fill to the 1 L mark with deionized water.**
5. **Calibrate the zero point. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then remove all moisture from the sensor probe (it will be calibrated in air).**
6. **Press the control unit’s CAL key to set the calibration mode.**
7. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



8. **In the parameter selection screen, move the cursor to “Cond”, then press the ENTER key.**



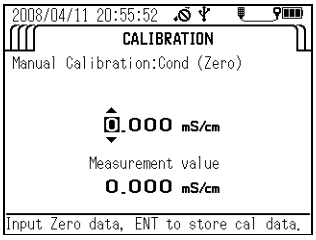
9. **Set the number of calibration points, then press the ENTER key.**



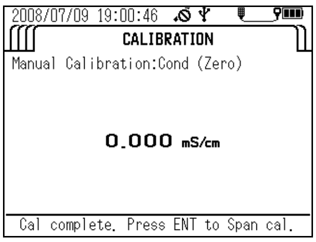
The instructions below assume that four calibration points have been set.

10. **Press the up (△) and down (▽) keys to set the "Cond" value to 0.0 mS/m (0.000 mS/cm).**

11. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**



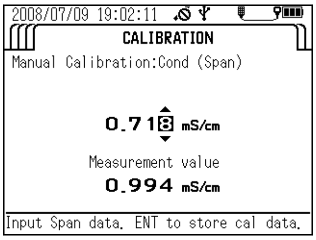
12. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the first span calibration procedure.**



13. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 71.8 mS/m (0.718 mS/cm) standard solution.**

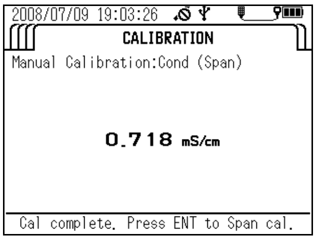
14. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

15. **Press the up (△) and down (▽) keys to set the "Cond" value to 71.8 mS/m (0.718 mS/cm).**
Calibration range = 0 mS/m to 99.9 mS/m (0 mS/cm to 0.999 mS/cm)



16. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

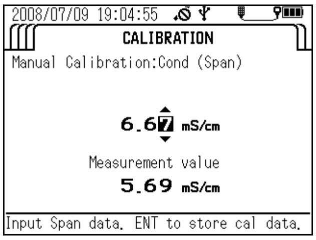
17. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the next span calibration procedure.**



18. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 0.667 S/m (6.67 mS/cm) standard solution.**

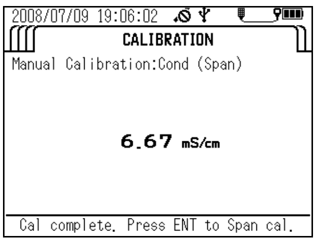
19. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

20. **Press the up (△) and down (▽) keys to set the "Cond" value to 0.667 S/m (6.67 mS/cm).**
Calibration range = 0.100 S/m to 0.999 S/m (1.00 mS/cm to 9.99 mS/cm)



21. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

22. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the next span calibration procedure.**

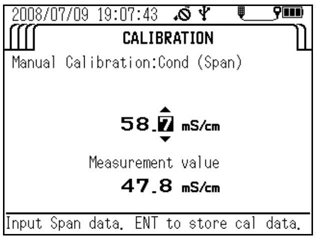


23. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 5.87 S/m (58.7 mS/cm) standard solution.**

24. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

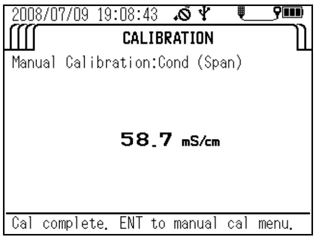
25. **Press the up (△) and down (▽) keys to set the "Cond" value to 5.87 S/m (58.7 mS/cm).**

Calibration range = 1.00 S/m to 10.00 S/m(10.0 mS/cm to 100.0 mS/cm)



26. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

27. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**



● Turbidity (TURB) calibration

Note

- **To support a wide range of sample concentrations, turbidity is divided into three measurement ranges: 0.0 to 9.9 NTU, 10 to 100 NTU, and over 100 NTU.**
- **When manually calibrating turbidity, you can select two calibration procedures (one zero-point calibration procedure and a span calibration procedure for one of the three measurement ranges), three calibration procedures (one zero-point calibration procedure and a span calibration procedure for two of the three measurement ranges) or four calibration procedures (one zero-point calibration procedure and span calibration procedures for all three measurement ranges). Carry out the four calibration procedures to ensure good measurement precision throughout all measurement ranges.**
- **Always use the calibration cup provided. Using other containers can create effects from ambient light that cause incorrect calibration.**

● Preparing the standard solutions

1. **Weigh out 5.0 g of hydrazine sulfate (commercial special grade or above), and dissolve it in 400 mL of deionized water. Dissolve 50 g of hexamethylene tetramine (commercial special grade or above) in 400 mL of deionized water in anther flask.**
2. **Mix the two solutions and add deionized water until the total solution volume is 1000 mL, and mix well. Store this solution at a temperature of 25°C ±3°C for 48 hours.**
   The turbidity value (TURB) of this solution is equivalent to 4000 NTU.
3. **Dilute 4000 NTU-solution 5 times (use a pipette to measure 50 mL of the 4000 NTU solution and pour it into a 250 mL measuring flask, and fill up to 250 mL meniscus)**
   The turbidity value (TURB) of this solution is equivalent to 800 NTU.
4. **Dilute 800 NTU solution 10 times (use a pipette to measure 25 mL of the 800 NTU solution and pour it into a 250 mL measuring flask, and fill up to 250 mL meniscus)**
   The turbidity value (TURB) of this solution is equivalent to 80 NTU.
5. **Dilute 80 NTU solution 10 times (use a pipette to measure 25 mL of the 80 NTU solution and pour it into a 250 mL measuring flask, and fill up to 250 mL meniscus)**
   The turbidity value (TURB) of this solution is equivalent to 8 NTU.

Note

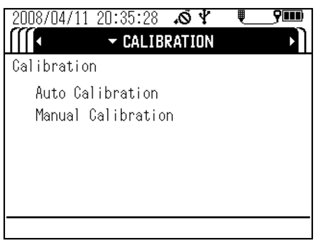
Instead of the standard solutions above, you can use other standard solutions of known concentration measured with other standard instruments.

● U-52, U-53 turbidity calibration

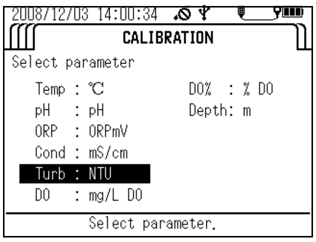
Set the number of calibration points.

You can set between 2 and 4 points.

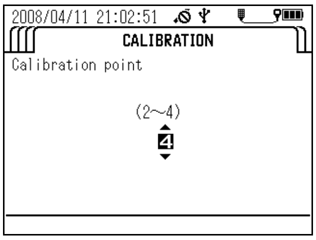
1. **Press the control unit's CAL key to set the calibration mode.**
2. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



3. **In the parameter selection screen, move the cursor to "Turb", then press the ENTER key.**



4. **Press the up (△) and down (▽) keys to set the number of calibration points, then press the ENTER key.**

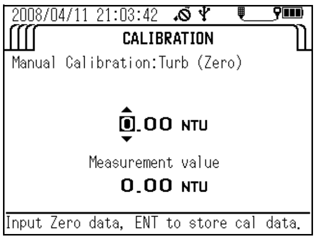


The instructions below assume that four calibration points have been set.

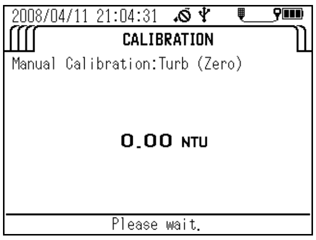
5. **Calibrate the zero point. Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with deionized water.**

6. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

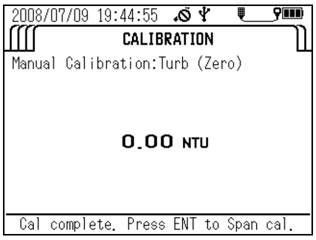
7. **Press the up (△) and down (▽) keys to set the "Turb" value to 0.0 NTU.**



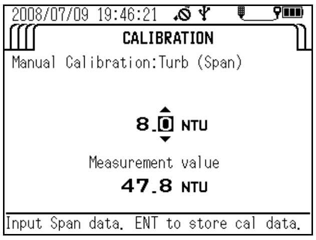
8. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**



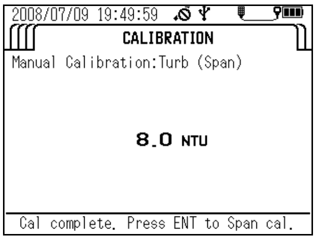
9. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the first span calibration procedure.**



10. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 8 NTU standard solution, or a standard solution of known concentration between 0.1 and 10 NTU.**
11. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**
12. **Press the up (△) and down (▽) keys to set the "TURB" value to 8 NTU, or to the known concentration of the standard solution between 0.1 and 10 NTU. (Input range = 0 NTU to 9.9 NTU (U-51) or 0 NTU to 9.99 NTU (U-52))**

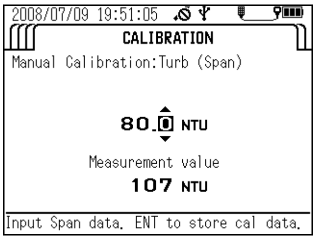


13. **Check that "Current measurement value" has stabilized, then press the ENTER key to start calibration.**
14. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the next span calibration procedure.**

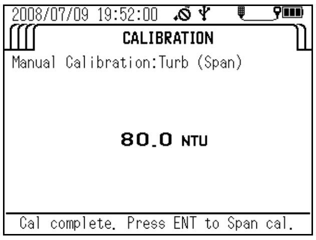


15. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 80 NTU standard solution, or a standard solution of known concentration between 10 and 100 NTU.**
16. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

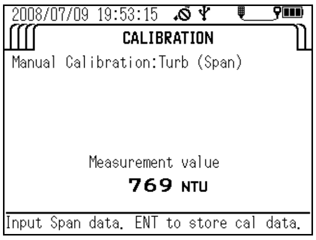
17. **Press the up (△) and down (▽) keys to set the "Turb" value to 80 NTU, or to the known concentration of the standard solution between 10 and 100 NTU. (Input range = 10.0 NTU to 99.9 NTU)**



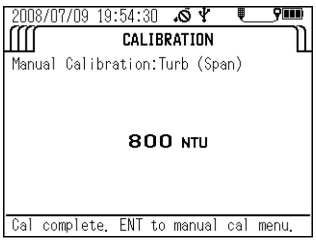
18. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**
19. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the next span calibration procedure.**



20. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 800 NTU standard solution, or a standard solution of known concentration 100 NTU above.**
21. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**
22. **Press the up (△) and down (▽) keys to set the "TURB" value to 800 NTU, or to the known concentration of the standard solution 100 NTU above.**
    (Input range = 100 NTU to 800 NTU (U-51), 100 NTU to 1000 NTU (U-52))



23. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**
24. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**



● Dissolved oxygen (DO) calibration

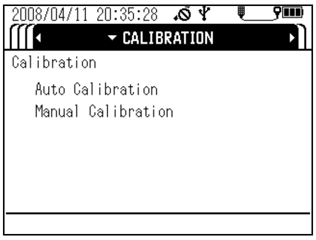
Note

- **You can select one calibration procedure (span calibration) or two calibration procedures (zero-point calibration and span calibration). Carry out the two calibration procedures to ensure good measurement precision throughout all measurement ranges.**
- **It is necessary to prepare new solution before calibration of the Dissolved Oxygen (DO) sensor.**
- **The calibration cup (included) cannot be used to manually calibrate the DO sensor. Use a suitable bottle in which the DO sensor and the temperature sensor can be immersed.**
- **Wait at least 20 minutes after turning the system power ON before calibrating the DO sensor.**
- **Make the compensation setting before calibration since the setting is applied during calibration.**
- **The DO sensor is affected by flow. When performing span calibration with saturated dissolved oxygen water, move the cable slowly up and down (move the sensor probe at a rate of roughly 20 to 30 cm a second) or agitate the saturated dissolved oxygen water.**

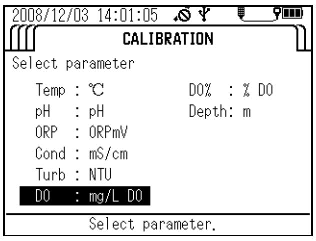
1. **Prepare the standard solution.**
- Add about 50 g of sodium sulfite to 1000 mL of water (either deionized water or tap water) and stir the mixture to dissolve the sodium sulfite in it.
- Pour 1 to 2 liters of water into a suitable flask (either deionized water or tap water). Using a air pump, feed air into the water and aerate the solution until oxygen is saturated.

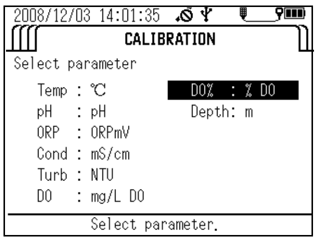
2. **First, calibrate the zero point. Press the control unit's CAL key to set the calibration mode.**

3. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**

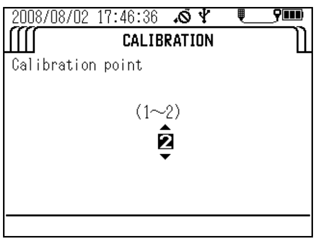


4. **In the parameter selection screen, move the cursor to DO or DO%, then press the ENTER key.**





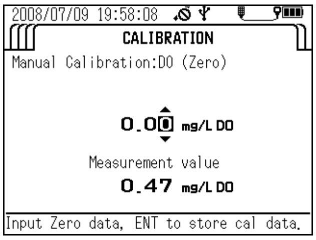
5. **Set the number of calibration procedures, then press the ENTER key.**

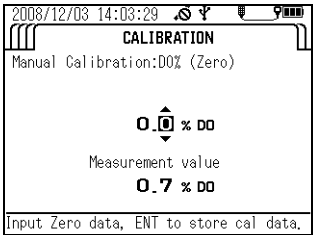


The instructions below assume that two calibration points have been set.

6. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the bottle.**

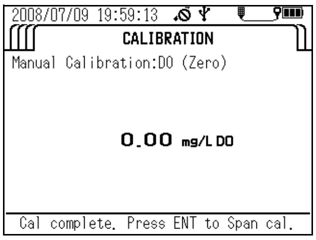
7. **Press the up (△) and down (▽) keys to set the DO value to 0.00 mg/L or 0.0%.**

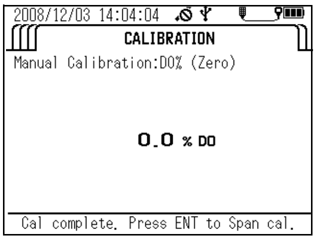




8. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

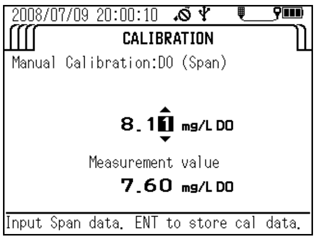
9. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the span calibration procedure.**

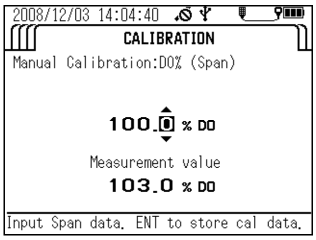




10. **Wash the sensor probe 2 or 3 times with deionized water to remove any dirt, then submerge the sensor probe in the container filled with the span solution.**

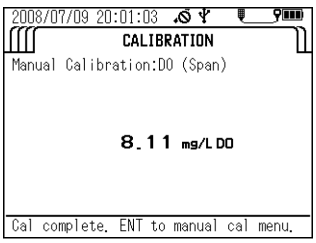
11. **Press the up (△) and down (▽) keys to set the DO value to the saturated dissolved oxygen value (mg/L) of the water at that temperature or the dissolved oxygen saturation ratio.**

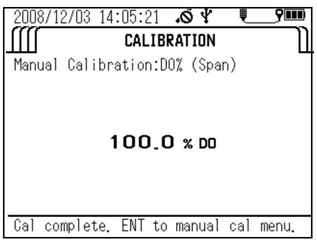




12. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

13. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**





Amounts of saturated dissolved oxygen in water at various temperatures (salinity=0.0%)

JIS K0101

Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
0	14.16						
1	13.77	11	10.67	21	8.68	31	7.42
2	13.40	12	10.43	22	8.53	32	7.32
3	13.04	13	10.20	23	8.39	33	7.22
4	12.70	14	9.97	24	8.25	34	7.13
5	12.37	15	9.76	25	8.11	35	7.04
6	12.06	16	9.56	26	7.99	36	6.94
7	11.75	17	9.37	27	7.87	37	6.86
8	11.47	18	9.18	28	7.75	38	6.76
9	11.19	19	9.01	29	7.64	39	6.68
10	10.92	20	8.84	30	7.53	40	6.59

ISO5814

Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
0	14.62				
1	14.22	11	11.03	21	8.91
2	13.83	12	10.78	22	8.74
3	13.46	13	10.54	23	8.58
4	13.11	14	10.31	24	8.42
5	12.77	15	10.08	25	8.26
6	12.45	16	9.87	26	8.11
7	12.14	17	9.66	27	7.97
8	11.84	18	9.47	28	7.83
9	11.56	19	9.28	29	7.69
10	11.29	20	9.09	30	7.56

● Span setting values for calibration in air

The software should display these values when auto calibration is performed.
Use this table to input values for manual span calibrations in air.

Tip

The DO measurement value of "air-saturated water" and air are different.
Due to the pressure difference against the membrane in air versus the membrane in water, the measurement value in air is about 10% higher than the value of air-saturated water on average.

Amounts of saturated dissolved oxygen in air at various temperatures

Following tables are applicable only to the air calibration of the U-50 DO sensor. Do not use them for other purpose.

Air calibration value in adopting evaluation based on JIS K0101

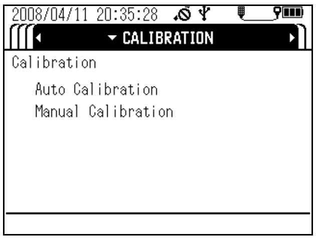
Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)
0	15.58						
1	15.15	11	11.74	21	9.55	31	8.16
2	14.74	12	11.47	22	9.38	32	8.05
3	14.34	13	11.22	23	9.23	33	7.94
4	13.97	14	10.97	24	9.08	34	7.84
5	13.61	15	10.74	25	8.92	35	7.74
6	13.27	16	10.52	26	8.79	36	7.63
7	12.93	17	10.31	27	8.66	37	7.55
8	12.62	18	10.10	28	8.53	38	7.44
9	12.31	19	9.91	29	8.40	39	7.35
10	12.01	20	9.72	30	8.28	40	7.25

Air calibration value in adopting evaluation based on ISO5814

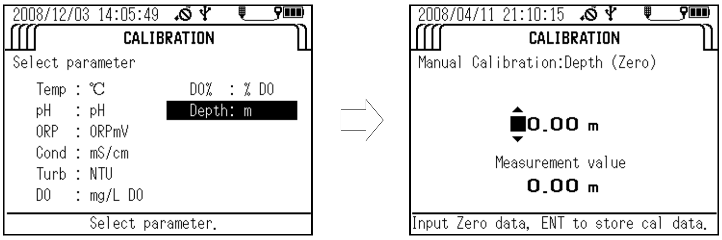
Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
0	16.08				
1	15.64	11	12.13	21	9.80
2	15.21	12	11.86	22	9.61
3	14.81	13	11.59	23	9.44
4	14.42	14	11.34	24	9.26
5	14.05	15	11.09	25	9.09
6	13.70	16	10.86	26	8.92
7	13.35	17	10.63	27	8.77
8	13.02	18	10.42	28	8.61
9	12.72	19	10.21	29	8.46
10	12.42	20	10.00	30	8.32

● Water depth (DEPTH) calibration

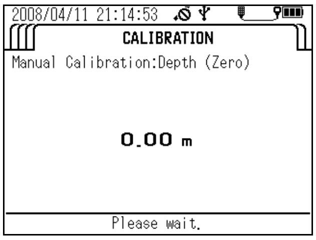
1. **Calibrate the zero point. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then remove all moisture from the sensor probe (it will be calibrated in air).**
2. **Press the control unit's CAL key to set the calibration mode.**
3. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



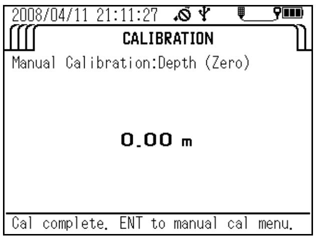
4. **In the parameter selection screen, move the cursor to "Depth", then press the ENTER key.**



5. **Press the up (△) and down (▽) keys to set the "Depth" value to 0.00 m.**
6. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**



7. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**



3.4 Measurement

You can perform measurement by either of the methods below.

- Storing data in memory manually with reference to the measurement value (single measurement)
- Having data stored in memory automatically and continuously
  U-51/U-52: Interval measurement (minimum memory interval of 10 seconds)
  U-53: Interval measurement (minimum memory interval of 30 seconds)

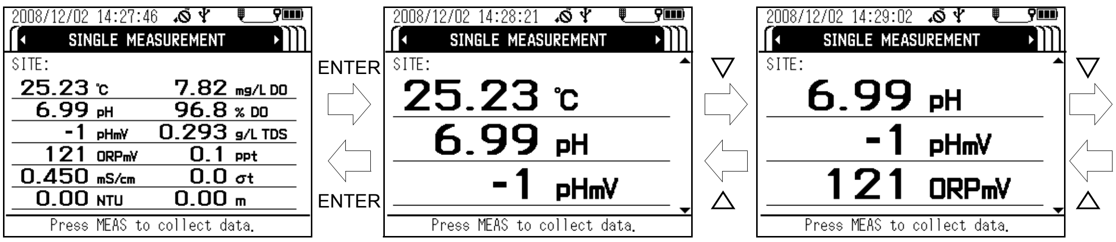
Select the measurement method that meets your requirements.

Note

- **Lower sensor probe slowly when submerging them in samples.**
- **Sensors may break if sensor probe are dropped from a height of 1 meter or more.**
- **Do not submerge sensor probe in water depths of over 30 meters. Sensor probe are only resistant to water pressure of up to 30 meters.**
- **After turning the power ON, check that the DO readout value has stabilized before starting measurement (takes around 20 minutes).**

Tip

- **When on the measurement screen, pressing the ENTER key enlarges the display and shows three measured values at a time.**
- **Pressing the up (△) and down (▽) keys scrolls through the measured values one item at a time.**
- **Pressing the ENTER key again reverts to the normal measurement screen display.**



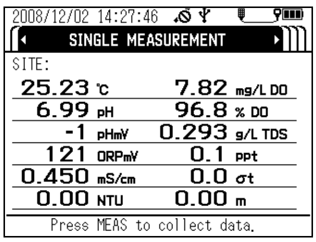
Measurement screen Normal Enlarged

3.4.1 Storing data in memory manually

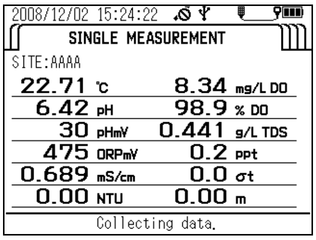
Follow the steps below to manually store data in memory while referring to the measurement value to check the readout value is stable.

● **U-51/U-52**

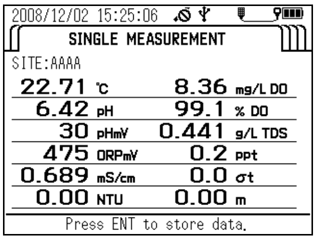
1. **Check that each sensor and sensor guard is mounted.**
2. **Check that "SINGLE MEASUREMENT" has been selected in the measurement screen.**

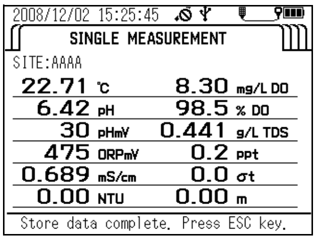


3. **Submerge the sensor probe in the sample, gently shaking them in the sample to remove any air bubbles from the sensors.**
   If the sample is non-flowing, move the cable slowly up and down (move the sensor probe at a rate of roughly 20 to 30 cm a second) to ensure that fresh sample is continuously supplied to the DO sensor.
4. **When the measurement values are stable, press the MEAS key to acquire the 5-second average.**



5. **Press the ENTER key to save the held measurement values, or press the ESC key to cancel the operation.**



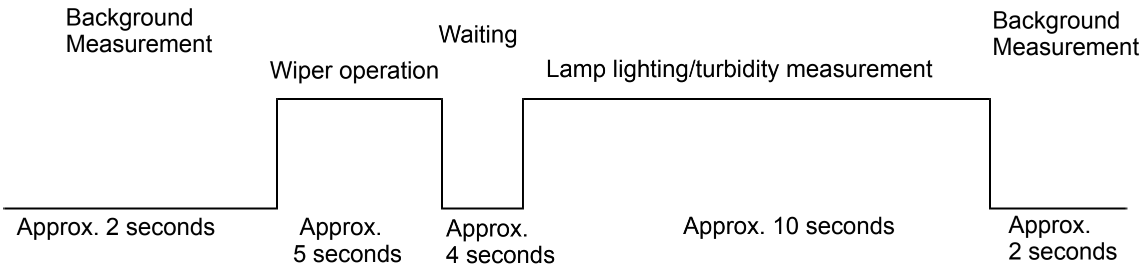


● U-53

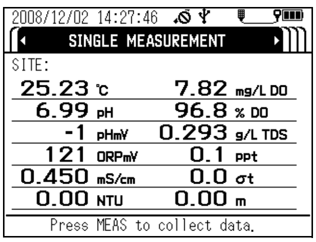
Note

Do not perform turbidity measurement in air as it may damage the wiper.

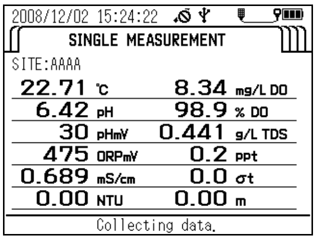
U-53 turbidity measurement follows the sequence below. The measurement values are held after each sequence.



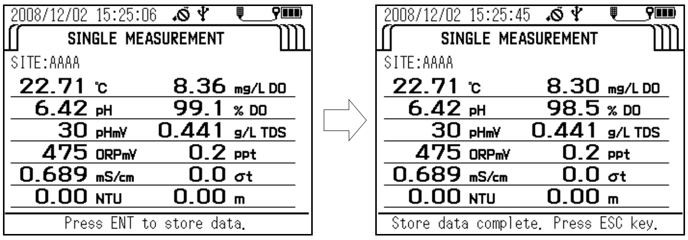
1. **Check that each sensor and sensor guard is mounted.**
2. **Check that "SINGLE MEASUREMENT" has been selected in the measurement screen.**



3. **Submerge the sensor probe in the sample, gently shaking them in the sample to remove any air bubbles from the sensors.**
   If the sample is non-flowing, move the cable slowly up and down (move the sensor probe at a rate of roughly 20 to 30 cm a second) to ensure that fresh sample is continuously supplied to the DO sensor.
4. **When the non-turbidity meter measurement values are stable, press the MEAS key to start the sequence above.**



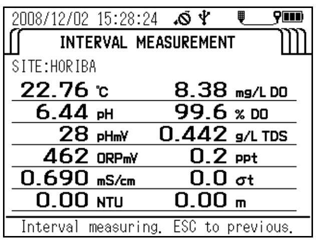
5. **When the sequence has finished, hold the measurement values. Press the ENTER key to store the held measurement values, or press the ESC key to cancel the operation.**



3.4.2 Automatic, continuous measurement

● **Interval measurement**

1. **Select the "Interval measurement" measurement setting (see " 3.2.1 Setting measurement methods " (page 18)).**
2. **Press the up (△) and down (▽) keys to set the interval value to the desired value (U-51/U-52: minimum interval: 10 seconds, U-53: minimum interval: 30 seconds), then press the ENTER key.**
   The measurement screen appears automatically, and the system becomes ready for measurement.
3. **Check that each sensor and sensor guard is mounted.**
4. **Submerge the sensor probe in the sample, gently shaking them in the sample to remove any air bubbles from the sensors.**
   If the sample is non-flowing, move the cable slowly up and down (move the sensor probe at a rate of roughly 20 to 30 cm a second) to ensure that fresh sample is continuously supplied to the DO sensor.
5. **Press the ENTER key to start measurement.**



3.5 Data operations

Use the procedures below to retrieve data stored in memory, delete all the data, check the remaining data memory capacity, and check the calibration record.

3.5.1 Displaying data

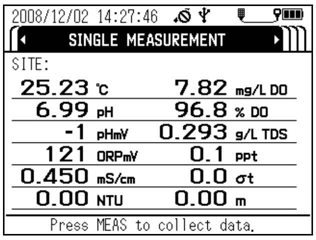
For maximum efficiency, there are 3 methods of displaying data.

- Displaying the data for a specified site
- Displaying the data for a specified date/time
- Displaying all the data

Use the method that best suits your requirements.

● **Displaying the data for a specified site**

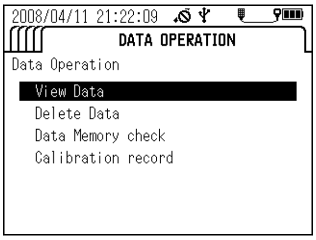
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



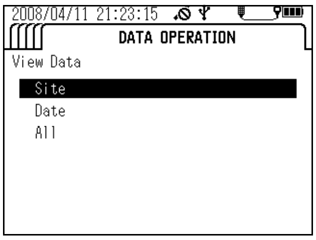
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key 3 times to display the "DATA OPERATION" screen.**
3. **Press the down (▽) key to move the cursor to "View Data", then press the ENTER key.**

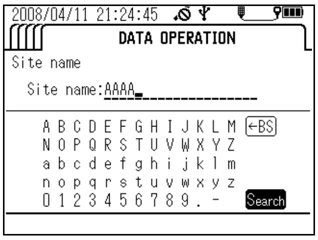


4. **Move the cursor to "Site", then press the ENTER key.**



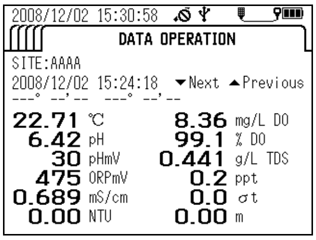
5. **Press the up (△), down (▽), left (◁) and right (▷) keys to enter the site to retrieve.**

6. **Move the cursor to "Search", then press the ENTER key.**



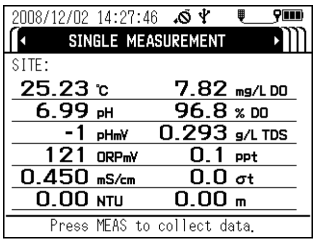
All site names that begin with the entered text are displayed.
The most recently measured data for the entered site is displayed.

7. **Press the up (△) and down (▽) keys to display earlier data.**



● Displaying the data for a specified date/time

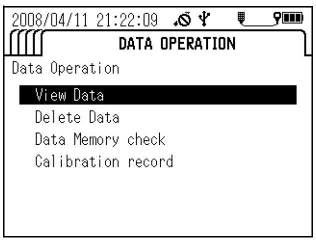
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



Note

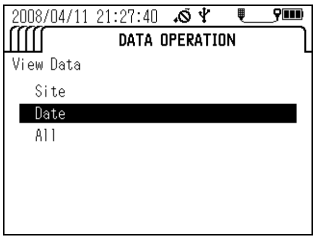
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key 3 times to display the "DATA OPERATION" screen.**
3. **Press the down (▽) key to move the cursor to "View Data", then press the ENTER key.**



4. **Move the cursor to "Date", then press the ENTER key.**

5. **With the cursor on the Date, press the ENTER key.**



6. **Press the up (△), down (▽), left (◁) and right (▷) keys to enter the desired date/time, then press the ENTER key to apply the setting.**

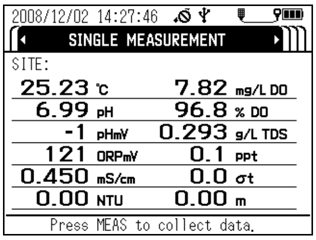
7. **The cursor moves to "Search". Press the ENTER key to start the search.**

8. **Press the up (△) and down (▽) keys to display earlier data.**

● Displaying all the data

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.

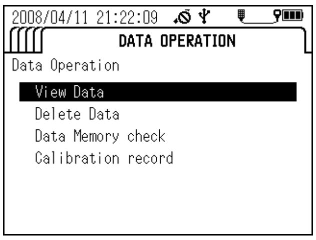


Note

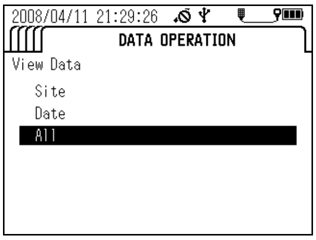
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key 3 times to display the "DATA OPERATION" screen.**

3. **Press the down (▽) key to move the cursor to "View Data", then press the ENTER key.**



4. **Move the cursor to "All", then press the ENTER key.**
The most recently measured data is displayed.

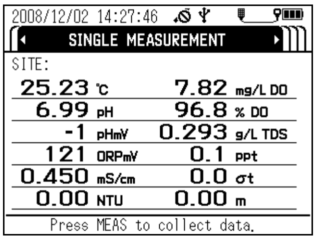


5. **Press the up (△) and down (▽) keys to display earlier data.**

3.5.2 Deleting data

Follow the steps below to delete all the data stored in memory.

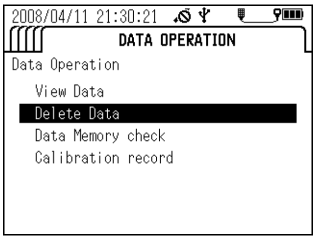
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



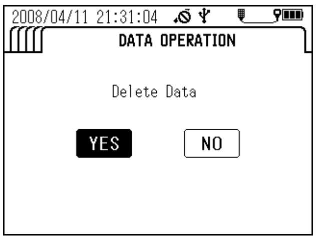
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key 3 times to display the "DATA OPERATION" screen.**
3. **Press the down (▽) key to move the cursor to "Delete Data", then press the ENTER key.**



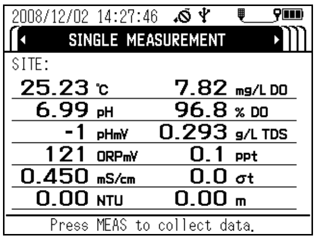
4. **Press the left (◁) key to move the cursor to YES, then press the ENTER key.**
   All the data has been deleted when the indicator appears along with the message "No data exists".



3.5.3 Checking the data memory

You can check the used data capacity and the remaining data capacity.

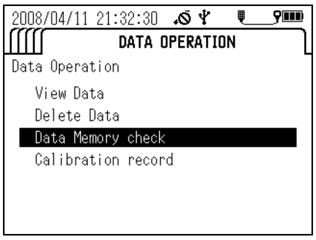
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



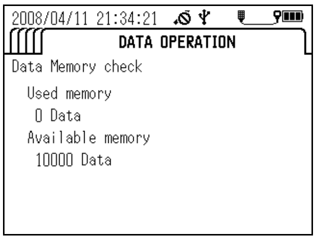
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key 3 times to display the "DATA OPERATION" screen.**
3. **Press the down (▽) key to move the cursor to "Data Memory Check", then press the ENTER key.**



The amount of memory in use and amount of available memory are displayed.

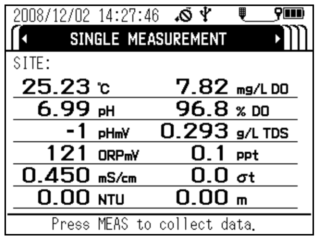


3.5.4 Checking the calibration record

Follow the steps below to check the latest calibration history.

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.



Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key 3 times to display the "DATA OPERATION" screen.**

3. **Press the down (▽) key to move the cursor to "Calibration record", then press the ENTER key.**

The latest calibration record is displayed.

3.5.5 GPS data operations

The menu for GPS data operations appears on the display to which the GPS unit is mounted.

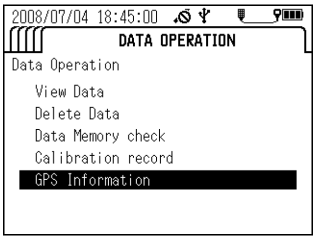
● GPS information

Follow the steps below to display acquired GPS information.

Note

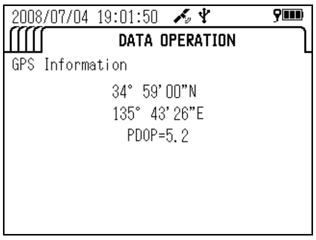
Turning the power OFF erases the GPS information.

1. **Press the right (▷) key to switch the display to the "DATA OPERATION" screen.**
2. **the down (▽) key to move the cursor to "GPS Information", then press the ENTER key.**

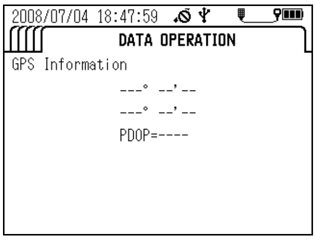


The last GPS information acquired is displayed.

● When received data exists

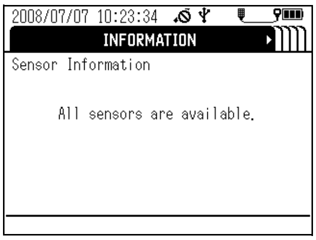


● When no received data exists

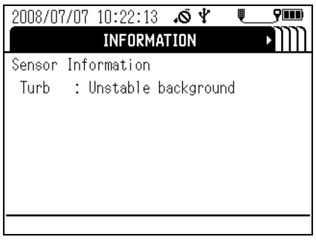


3.6 Sensor information

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.
2. **Press the left (◁) key once to display the "INFORMATION" screen.**
   The "Sensor Information" screen displays the sensor probe's status.
   - When the sensor probe is normal, the display below appears.



   - When there is a sensor probe problem, individual measurement parameters generate messages such as the one shown below. Follow the troubleshooting information to remove the problem before continuing to operate the system.

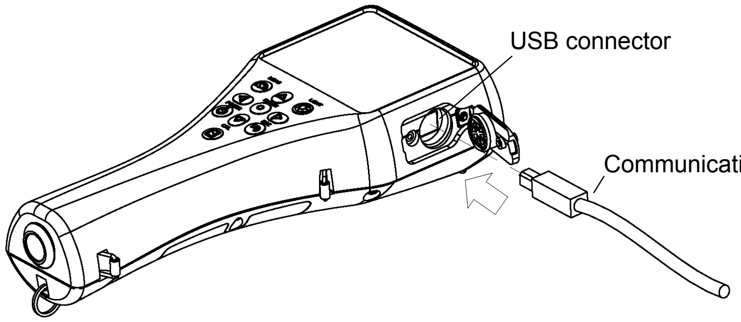


3.7 USB communication

The separately-sold, dedicated PC connection cable comes with data collection software. This software allows data to be downloaded from the control unit in CSV format.

This section contains instructions for communication commands used for USB communication.

● Connecting the cable



Dedicated cable

Part name: Communication cable (with data collection software)

Part no.: 3200174823

● Cautions when using USB communication

Take care to observe the following when using USB communication.

- Use the dedicated cable (with data collection software) or a commercially-available USB cable (A-B type) to connect to a PC.
- Be sure to match the transmission format on the control unit and the computer.
  The control unit uses the following transmission format:

Baud rate:	19200 bps
Number of stop bits:	1 bit
Data bit length:	8 bits
Parity:	None
Flow control:	None

Tip

If the transmission formats do not match, a communication error occurs and USB communication will not function normally. After changing the transmission format, restart the control unit and the computer.

- If received data is not sent back or an error occurs after a data request has been sent, adjust the program configuration so that it allows a little waiting time before a data request is sent again. This will enable more stable communication.
- The unit does not use DCD, CTS, or DSR signals. Take care of this when creating programs.

3.7.1 Communication settings

Baud rate:	19200 bps
Number of stop bits:	1 bit
Data bit length:	8 bits
Parity:	None
Flow control:	None

3.7.2 Commands

● Instant data requests

● Request command format

#	RD	@	XX	[CR]	[LF]
1	2	3	4		

1 Header		1 character
2 Command		2 characters
3 Delimiter character		1 character
4 Frame check sequence (FCS)		2 characters

The two ASCII-code characters created by converting the 8 bits of data created by successively combining the value of each character from # through @ in an exclusive OR (XOR) operation with the value of the next character.

Example: #RD@

(1)	0	XOR	35	(ASCII code of # symbol)	⇒	35
(2)	35	XOR	82	(ASCII code of R)	⇒	113
(3)	113	XOR	68	(ASCII code of D)	⇒	53
(4)	53	XOR	64	(ASCII code of @ symbol)	⇒	117 (decimal)
						↓
						75 (hex)
						↓
						Sets "75".

Example: 35 XOR 82 operation

35 in binary	⇒	0	0	1	0	0	0	1	1	
82 in binary	⇒	0	1	0	1	0	0	1	0	
XOR result		0	1	1	1	0	0	0	1	⇒ 113 (decimal)

Note: Set "XX" if you do not want to test for communication frame errors with FCS.

● Response format

#	RD	AAAAAAAAAAAAAAAAAAAA	X	X	XXXX	XX	X	X	XXXXX	X
1	2	3	4	5	6	7	8	9	10	11

XX	X	X	XXXXX	X	XX	X	X	XXXXX	X	XX	X	X	XXXXX	X
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
XX	X	X	XXXXX	X	XX	X	X	XXXXX	X	XX	X	X	XXXXX	X
27	28	29	30	31	32	33	34	35	36	37	38	39	40	41

XX	X	X	XXXXX	X	XX	X	X	XXXXX	X	XX	X	X	XXXXX	X
42	43	44	45	46	47	48	49	50	51	52	53	54	55	56

XX	X	X	XXXXX	X	XX	X	X	XXXXX	X	XX	X	X	XXXXX	X
57	58	59	60	61	62	63	64	65	66	67	68	69	70	71

XX	XX	XX	XX	XX	XX	XX	XX	XX	X	X	XXX	XX	XX	X	X	@	XX	[CR]	[LF]
72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89		

1	Header		1 character
2	Command		2 characters
3	Site name	Upper- and lowercase letters, numbers, periods (.) hyphens (-) and spaces ( )	20 characters
4	Probe status	(3) Status code	1 character
5	Probe error	(4) Status error code	1 character
6	Unused		4 characters
7	Parameter 1 code	(1) Parameter code	2 characters
8	Parameter 1 status	(5) Parameter status code	1 character
9	Parameter 1 error	(6) Parameter error code	1 character
10	Parameter 1 data	5 characters including decimal point, right-justified with blanks filled	5 characters
11	Parameter 1 unit	(2) Unit code	1 character
12	Parameter 2 code	(1) Parameter code	2 characters
13	Parameter 2 status	(5) Parameter status code	1 character
14	Parameter 2 error	(6) Parameter error code	1 character
15	Parameter 2 data	5 characters including decimal point, right-justified with blanks filled	5 characters
16	Parameter 2 unit	(2) Unit code	1 character
17	Parameter 3 code	(1) Parameter code	2 characters
18	Parameter 3 status	(5) Parameter status code	1 character
19	Parameter 3 error	(6) Parameter error code	1 character
20	Parameter 3 data	5 characters including decimal point, right-justified with blanks filled	5 characters
21	Parameter 3 unit	(2) Unit code	1 character
22	Parameter 4 code	(1) Parameter code	2 characters
23	Parameter 4 status	(5) Parameter status code	1 character
24	Parameter 4 error	(6) Parameter error code	1 character
25	Parameter 4 data	5 characters including decimal point, right-justified with blanks filled	5 characters
26	Parameter 4 unit	(2) Unit code	1 character
27	Parameter 5 code	(1) Parameter code	2 characters
28	Parameter 5 status	(5) Parameter status code	1 character
29	Parameter 5 error	(6) Parameter error code	1 character
30	Parameter 5 data	5 characters including decimal point, right-justified with blanks filled	5 characters
31	Parameter 5 unit	(2) Unit code	1 character
32	Parameter 6 code	(1) Parameter code	2 characters
33	Parameter 6 status	(5) Parameter status code	1 character
34	Parameter 6 error	(6) Parameter error code	1 character

35	Parameter 6 data	5 characters including decimal point, right-justified with blanks filled	5 characters
36	Parameter 6 unit	(2) Unit code	1 character
37	Parameter 7 code	(1) Parameter code	2 characters
38	Parameter 7 status	(5) Parameter status code	1 character
39	Parameter 7 error	(6) Parameter error code	1 character
40	Parameter 7 data	5 characters including decimal point, right-justified with blanks filled	5 characters
41	Parameter 7 unit	(2) Unit code	1 character
42	Parameter 8 code	(1) Parameter code	2 characters
43	Parameter 8 status	(5) Parameter status code	1 character
44	Parameter 8 error	(6) Parameter error code	1 character
45	Parameter 8 data	5 characters including decimal point, right-justified with blanks filled	5 characters
46	Parameter 8 unit	(2) Unit code	1 character
47	Parameter 9 code	(1) Parameter code	2 characters
48	Parameter 9 status	(5) Parameter status code	1 character
49	Parameter 9 error	(6) Parameter error code	1 character
50	Parameter 9 data	5 characters including decimal point, right-justified with blanks filled	5 characters
51	Parameter 9 unit	(2) Unit code	1 character
52	Parameter 10 code	(1) Parameter code	2 characters
53	Parameter 10 status	(5) Parameter status code	1 character
54	Parameter 10 error	(6) Parameter error code	1 character
55	Parameter 10 data	5 characters including decimal point, right-justified with blanks filled	5 characters
56	Parameter 10 unit	(2) Unit code	1 character
57	Parameter 11 code	(1) Parameter code	2 characters
58	Parameter 11 status	(5) Parameter status code	1 character
59	Parameter 11 error	(6) Parameter error code	1 character
60	Parameter 11 data	5 characters including decimal point, right-justified with blanks filled	5 characters
61	Parameter 11 unit	(2) Unit code	1 character
62	Parameter 12 code	(1) Parameter code	2 characters
63	Parameter 12 status	(5) Parameter status code	1 character
64	Parameter 12 error	(6) Parameter error code	1 character
65	Parameter 12 data	5 characters including decimal point, right-justified with blanks filled	5 characters
66	Parameter 12 unit	(2) Unit code (6) Parameter error code	1 character
67	Parameter 13 code	(1) Parameter code	2 characters
68	Parameter 13 status	(5) Parameter status code	1 character
69	Parameter 13 error	(6) Parameter error code	1 character
70	Parameter 13 data	5 characters including decimal point, right-justified with blanks filled	5 characters
71	Parameter 13 unit	(2) Unit code	1 character
72	Year	00 to 99	2 characters

73	Month	01 to 12	2 characters
74	Day	01 to 31	2 characters
75	Hour	00 to 23	2 characters
76	Minute	00 to 59	2 characters
77	Second	00 to 59	2 characters
78	Longitude (degrees)	00 to 90 or "--" (no GPS data)	2 characters
79	Longitude (minutes)	00 to 59 or "--" (no GPS data)	2 characters
80	Longitude (seconds)	00 to 59 or "--" (no GPS data)	2 characters
81	Unused	1 character	1 character
82	North latitude/South latitude	N: North; S: South	1 character
83	Latitude (degrees)	000 to 180 or "---" (no GPS data)	3 characters
84	Latitude (minutes)	00 to 59 or "--" (no GPS data)	2 characters
85	Latitude (seconds)	00 to 59 or "--" (no GPS data)	2 characters
86	Unused		1 character
87	East longitude/West longitude	E: East; W: West	1 character
88	Delimiter character		1 character
89	Frame check sequence (FCS)		2 characters

● Memory data requests

● Request command format

#	RM	X	X	AAAAAAAAAAAAAAAAAAAA	XX	XX	XX	@	XX	[CR]	[LF]
1	2	3	4	5	6	7	8	9	10		

1	Header		1 character
2	Command		2 characters
3	Data specification*1	0: Start search; 1: Next data item; 2: Previous data item; 3: Request same data again	1 character
4	Search method specification	0: All data; 1: Site search; 2: Date search	1 character
5	Search site*2	Upper- and lowercase letters, numbers, periods (.) hyphens (-) and spaces ( )	20 characters
6	Search year*3	00 to 99	2 characters
7	Search month*3	01 to 12	2 characters
8	Search day*3	01 to 31	2 characters
9	Delimiter character		1 character
10	Frame check sequence (FCS)		2 characters

*1: When sending the RM command, first send 0 [Start search], then 1 [Next data item], 2 [Previous data item] or 3 [Request same data again].

*2: [Search site] is only needed when [Site search] is specified as the search method. If another search method is specified, fill this field with spaces.

*3: [Search year], [Search month] and [Search day] are only needed when [Date search] is specified as the search method. If another search method is specified, fill this field with spaces.

● **Response format**

(when data exists)

#	RM	AAAAAAAAAAAAAAAAAAAA	XX	X	X	XXXXX	X										
1	2	3	4	5	6	7	8										
XX	X	X	XXXXX	X	XX	X	X	XXXXX	X	XX	X	X	XXXXX	X			
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23			
XX	X	X	XXXXX	X	XX	X	X	XXXXX	X	XX	X	X	XXXXX	X			
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38			
XX	X	X	XXXXX	X	XX	X	X	XXXXX	X	XX	X	X	XXXXX	X			
39	40	41	42	43	44	45	46	47	48	49	50	51	52	53			
XX	X	X	XXXXX	X	XX	X	X	XXXXX	X	XX	X	X	XXXXX	X			
54	55	56	57	58	59	60	61	62	63	64	65	66	67	68			
XX	XX	XX	XX	XX	XX	XX	XX	XX	X	X	XXX	XX	XX	X	X	@	XX	[CR] [LF]
69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	

1	Header		1 character
2	Command		2 characters
3	Site name	Upper- and lowercase letters, numbers, periods (.) hyphens (-) and spaces ( )	20 characters
4	Parameter 1 code	(1) Parameter code	2 characters
5	Parameter 1 selection	0: No selection; 1: Selection made	1 character
6	Parameter 1 error	(6) Parameter error code	1 character
7	Parameter 1 data	5 characters including decimal point, right-justified with blanks filled	5 characters
8	Parameter 1 unit	(2) Unit code	1 character
9	Parameter 2 code	(1) Parameter code	2 characters
10	Parameter 2 selection	0: No selection; 1: Selection made	1 character
11	Parameter 2 error	(6) Parameter error code	1 character
12	Parameter 2 data	5 characters including decimal point, right-justified with blanks filled	5 characters
13	Parameter 2 unit	(2) Unit code	1 character
14	Parameter 3 code	(1) Parameter code	2 characters
15	Parameter 3 selection	0: No selection; 1: Selection made	1 character
16	Parameter 3 error	(6) Parameter error code	1 character
17	Parameter 3 data	5 characters including decimal point, right-justified with blanks filled	5 characters
18	Parameter 3 unit	(2) Unit code	1 character
19	Parameter 4 code	(1) Parameter code	2 characters
20	Parameter 4 selection	0: No selection; 1: Selection made	1 character

21	Parameter 4 error	(6) Parameter error code	1 character
22	Parameter 4 data	5 characters including decimal point, right-justified with blanks filled	5 characters
23	Parameter 4 unit	(2) Unit code	1 character
24	Parameter 5 code	(1) Parameter code	2 characters
25	Parameter 5 selection	0: No selection; 1: Selection made	1 character
26	Parameter 5 error	(6) Parameter error code	1 character
27	Parameter 5 data	5 characters including decimal point, right-justified with blanks filled	5 characters
28	Parameter 5 unit	(2) Unit code	1 character
29	Parameter 6 code	(1) Parameter code	2 characters
30	Parameter 6 selection	0: No selection; 1: Selection made	1 character
31	Parameter 6 error	(6) Parameter error code	1 character
32	Parameter 6 data	5 characters including decimal point, right-justified with blanks filled	5 characters
33	Parameter 6 unit	(2) Unit code	1 character
34	Parameter 7 code	(1) Parameter code	2 characters
35	Parameter 7 selection	0: No selection; 1: Selection made	1 character
36	Parameter 7 error	(6) Parameter error code	1 character
37	Parameter 7 data	5 characters including decimal point, right-justified with blanks filled	5 characters
38	Parameter 7 unit	(2) Unit code	1 character
39	Parameter 8 code	(1) Parameter code	2 characters
40	Parameter 8 selection	0: No selection; 1: Selection made	1 character
41	Parameter 8 error	(6) Parameter error code	1 character
42	Parameter 8 data	5 characters including decimal point, right-justified with blanks filled	5 characters
43	Parameter 8 unit	(2) Unit code	1 character
44	Parameter 9 code	(1) Parameter code	2 characters
45	Parameter 9 selection	0: No selection; 1: Selection made	1 character
46	Parameter 9 error	(6) Parameter error code	1 character
47	Parameter 9 data	5 characters including decimal point, right-justified with blanks filled	5 characters
48	Parameter 9 unit	(2) Unit code	1 character
49	Parameter 10 code	(1) Parameter code	2 characters
50	Parameter 10 selection	0: No selection; 1: Selection made	1 character
51	Parameter 10 error	(6) Parameter error code	1 character
52	Parameter 10 data	5 characters including decimal point, right-justified with blanks filled	5 characters
53	Parameter 10 unit	(2) Unit code	1 character
54	Parameter 11 code	(1) Parameter code	2 characters
55	Parameter 11 selection	0: No selection; 1: Selection made	1 character
56	Parameter 11 error	(6) Parameter error code	1 character
57	Parameter 11 data	5 characters including decimal point, right-justified with blanks filled	5 characters
58	Parameter 11 unit	(2) Unit code	1 character
59	Parameter 12 code	(1) Parameter code	2 characters

60	Parameter 12 selection	0: No selection; 1: Selection made	1 character
61	Parameter 12 error	(6) Parameter error code	1 character
62	Parameter 12 data	5 characters including decimal point, right-justified with blanks filled	5 characters
63	Parameter 12 unit	(2) Unit code	1 character
64	Parameter 13 code	(1) Parameter code	2 characters
65	Parameter 13 selection	0: No selection; 1: Selection made	1 character
66	Parameter 13 error	(6) Parameter error code	1 character
67	Parameter 13 data	5 characters including decimal point, right-justified with blanks filled	5 characters
68	Parameter 13 unit	(2) Unit code	1 character
69	Year	00 to 99	2 characters
70	Month	01 to 12	2 characters
71	Day	01 to 31	2 characters
72	Hour	00 to 23	2 characters
73	Minute	00 to 59	2 characters
74	Second	00 to 5	2 characters
75	Longitude (degrees)	00 to 90 or "--" (no GPS data)	2 characters
76	Longitude (minutes)	00 to 59 or "--" (no GPS data)	2 characters
77	Longitude (seconds)	00 to 59 or "--" (no GPS data)	2 characters
78	Unused		1 character
79	North latitude/South latitude	N: North; S: South	1 character
80	Latitude (degrees)	000 to 180 or "---" (no GPS data)	3 characters
81	Latitude (minutes)	00 to 59 or "--" (no GPS data)	2 characters
82	Latitude (seconds)	00 to 59 or "--" (no GPS data)	2 characters
83	Unused		1 character
84	East longitude/West longitude	E: East; W: West	1 character
85	Delimiter character		1 character
86	Frame check sequence (FCS)		2 characters

When no data exists, or memory is at capacity)

#	RM	@	XX	[CR]	[LF]
1	2	3	4		

1	Header	1 character
2	Command	2 characters
3	Delimiter character\	1 character
4	Frame check sequence (FCS)	2 characters

Memory data count request

Request command format

#	RN	@	XX	[CR]	[LF]
1	2	3	4		

1	Header	1 character
2	Command	2 characters
3	Delimiter character\	1 character
4	Frame check sequence (FCS)	2 characters

Response format

#	RN	XXXXX	@	XX	[CR]	[LF]
1	2	3	4	5		

1	Header		1 character
2	Command		2 characters
3	Total data count	0 to 10000	5 characters
4	Delimiter character\		1 character
5	Frame check sequence (FCS)		2 characters

Command parse failure response

#	??	X	XX	X	@	XX	[CR]	[LF]
1	2	3	4	5	6	7		

1	Header	1 character
2	Command	2 characters
3	Command parse failure reason*4	1 character
4	Received command*5	2 characters
5	(3) Status code for probe status*5	1 character
6	Delimiter character	1 character
7	Frame check sequence (FCS)	2 characters

*4: List of command parse failure reasons

1: Frame length error
2: FCS mismatch
3: Undefined command
4: Data error
5: Data out of range
6: No "@" delimiter character
7: No "#" header character
8: No [Carriage return] + [Line feed] footer
9: Cannot accept command in this timing.

*5: Only set for command parse failure reason 9, [Cannot accept command in this timing]. Otherwise this field is filled with spaces.

4 Maintenance

Tip

HORIBA recommends regular manufacturer maintenance checks in order to ensure a long product life.

4.1 Routine care

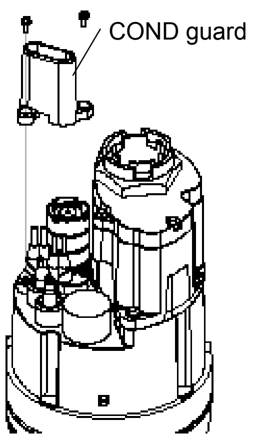
After measurement

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power OFF.**

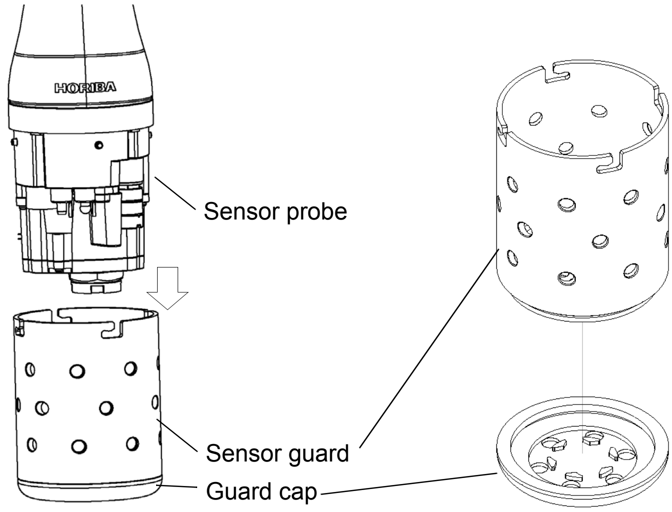
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Remove the sensor guard, and clean the sensor with tap water.**
3. **Clean the turbidity sensor with the cleaning brush provided.**
4. **Remove the two screws securing the COND guard, and the COND guard itself, and use a test tube brush to gently remove any dirt from the electrical conductivity electrode.**



5. **Wipe off any dirt with a soft cloth. If parts are very dirty, clean them with neutral detergent, then rinse them. If parts are contaminated by oil, wipe it off with a soft cloth soaked in alcohol.**
6. **Put the COND guard back in place.**
7. **Remove the sensor guard's guard cap, wash off any dirt with tap water, then put the guard cap back in place.**



4.2 Every 2 months maintenance

● Dissolved oxygen (DO) sensor

Note

- **The DO sensor's internal solution is potassium chloride (KCl). Although KCl is harmless, protective equipment such as gloves and goggles should be worn when working with it.**
- **Internal solution can be disposed of down a sink.**

- Replace the membrane cap.
- Polish the gold and silver electrodes when replacing the membrane cap.
  The gold electrode does not need to be polished if it is not dirty.

- **Silver electrode**

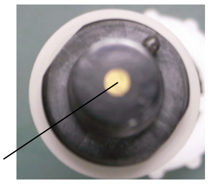
  Polish a silver electrode part with sandpaper (#500) and then wash metal electrode parts with water.

Silver electrode

- **Gold electrode**

  Polish a gold electrode part with sandpaper (#8000) and then wash metal electrode parts with water.

Gold electrode



Replace a membrane cap after clean metal electrodes parts.
Refer to “ 4.5 Replacing the membrane cap ” (page 87).

Reference electrode

Note

- **The pH reference internal solution is potassium chloride (KCl). Although KCl is harmless, protective equipment such as gloves and goggles should be worn when working with it.**
- **Internal solution can be disposed of down a sink.**

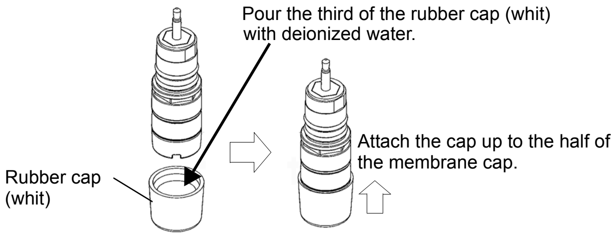
1. **Remove the rubber liquid junction plug from the reference electrode and dispose of the internal solution.**
2. **To prevent air entering, fill the reference electrode to the brim with its internal solution (No. 330).**
3. **Put the rubber liquid junction plug back in place.**

   If the rubber liquid junction plug is dirty, replace the liquid junctions (set of two; No. 9037005100). The reference electrode's internal solution will spill when replacing the liquid junctions. Rinse parts with tap water and dry them with a soft cloth.

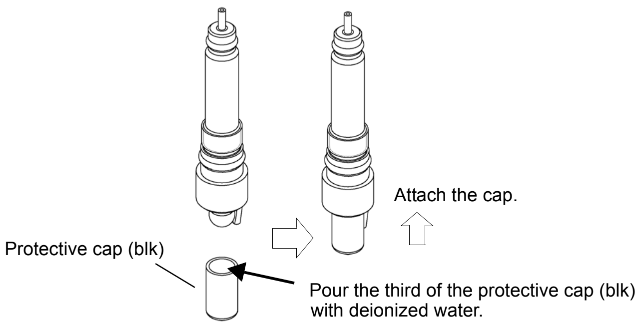
4.3 Storage

● Short-term (under 2 months) storage

- Before storing the DO sensor, pour the third of the rubber cap (whit) provided with deionized water and cover the DO sensor with them.



- Before storing the pH sensor, pour the third of the protective cap (blk) provided with deionized water and cover the pH sensor with them.



Note

Before measuerment, remove the rubber cap (whit) and the protective cap (blk).

● Long-term (2 months or more) storage

- Remove a membrane cap from DO sensor, and wash the gold electrode and silver electrode parts with water. Wipe off the moisture before storing DO sensor in the pack.
- Prevent internal solution seeping out of the reference chip by taping over the point of seepage with electrical tape.
- Before storing the system, remove the control unit's batteries to prevent battery leakage.

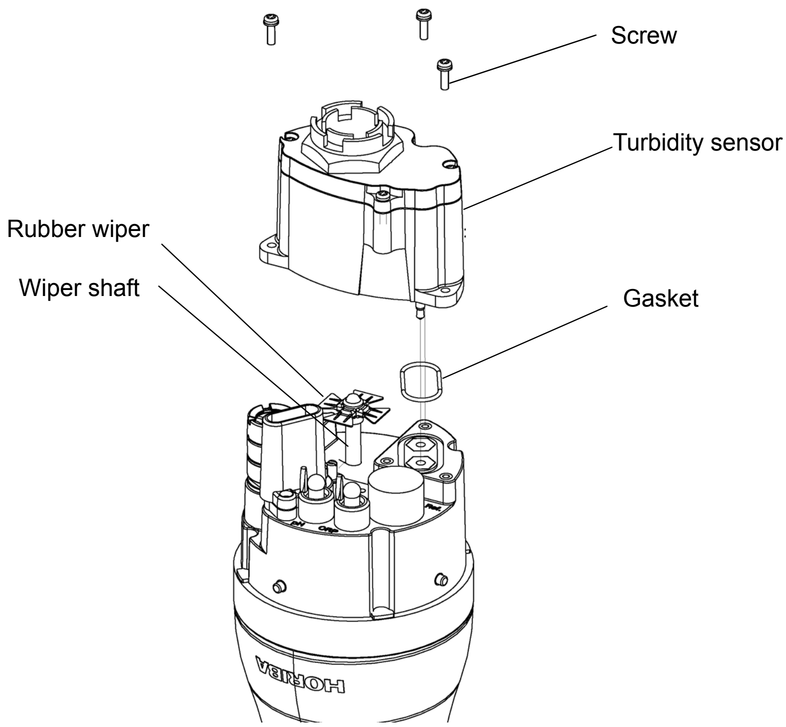
4.4 Replacing the turbidity sensor

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power OFF.**

Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Remove the sensor guard, and clean the sensor probe with tap water.**
3. **Use dry air to blow away and dry off any moisture.**
4. **Remove the three screws holding the turbidity sensor by using No. 2 Phillips head screwdriver.**
5. **Pull out the turbidity sensor horizontally.**
6. **Remove the rubber wiper and gasket, and use a soft cloth to wipe off any dirt from the wiper shaft and turbidity sensor attachment. If parts are very dirty, use a soft cloth soaked in neutral detergent or alcohol.**
7. **Replace the rubber wiper and gasket with new ones. Coat the gasket with a thin layer of grease (No. 3014017718).**
8. **Attach the new turbidity sensor and fasten it in place with the three screws.**
9. **Perform four-point calibration before using the sensor.**



4.5 Replacing the membrane cap

● Replacement procedure

1. Prepare the DO sensor.

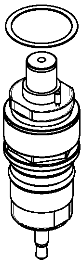
- Take a DO sensor out of pack (newly purchasing).
- Remove a DO sensor from the sensor probe (after use).

Newly purchasing

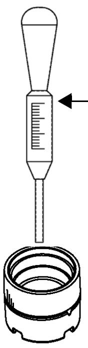
Undo a DO sensor from the sensor probe

- Twist a membrane cap from DO sensor.
- Wash the gold electrode and silver electrode parts with water.

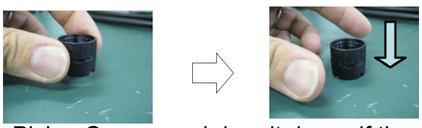
2. Replace the silicone gasket with a new one.



3. Pour internal solution into a membrane cap with a dropper.

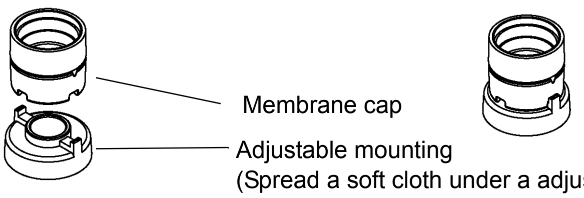


- Check air bubbles in a membrane cap.

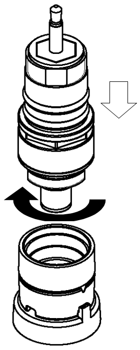


Pick a Cap up and drop it down, if there is air bubbles in internal solution of it.

4. Set up a membrane cap on a adjustable mounting.



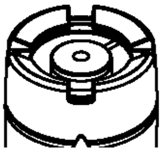
5. Attach a membrane cap to DO sensor



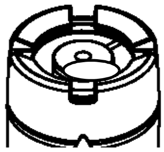
Twist a DO sensor
with holding a membrane cap tight.

6. Check for membrane surface

Check air bubbles in a membrane cap.



Good: Limited air bubbles



NG: Air bubbles of more than 5 mm in diameter

- NG → Replace a membrane cap again.
- Check that span calibration can be performed.

If the membrane cap is not attached correctly, sensitivity may be lost or response speed may decrease.

4.6 Troubleshooting

Note

If the sensor probe is removed while the control unit is indicating an error, errors cannot be canceled by using the ESC key. Either reconnect the sensor probe or restart the control unit.

4.6.1 Error displays

Error	Cause	Solution
Probe ADC error	Internal IC failure	Contact your nearest sales outlet to have the sensor probe repaired.
Probe EEPROM error/Factory	Internal IC failure	Turn the power OFF, then restart the system. If the error persists, initialize the system from the "System" menu. If the error still persists, contact your nearest sales outlet to have the sensor probe repaired.
Probe EEPROM error/User	Internal IC failure	Turn the power OFF, then restart the system. If the error persists, initialize the system from the "System" menu. If the error still persists, contact your nearest sales outlet to have the sensor probe repaired.
Turbidity sensor light source error	Turbidity sensor light source failure	Turn the power OFF, wipe off any water droplets on the probe, then remove the turbidity sensor. Check there are no water droplets around the turbidity sensor connector, then mount the sensor again. If the error persists, replace the turbidity sensor.
Turbidity sensor wiper motor error	The turbidity sensor wiper is not operating.	Press the ESC key. Check there are no obstacles near the wiper, then perform the measurement again. If the error persists, the motor will need to be replaced. Contact your nearest sales outlet to have the sensor probe repaired.
Probe capacitor error	Low battery voltage or internal IC failure	Turn the power OFF. Replace the display's batteries. If the error persists, contact your nearest sales outlet to have the sensor probe repaired.
Probe EEPROM error	Internal IC failure	Press the ESC key, then redo the operation. If the error persists, turn the power OFF, then restart the system (the current data will not be saved). If the error still persists, contact your nearest sales outlet to have the display repaired.
Probe board error	Probe board failure	Turn the power OFF. Contact your nearest sales outlet to have the sensor probe repaired.

Error	Cause	Solution
Zero-point calibration error	pH sensor 1. The pH standard solution is contaminated. 2. The pH-responsive membrane is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The pH-responsive membrane is torn.	pH sensor 1. Replace the standard solution with new solution. 2. Clean the pH-responsive membrane. 3. Refil the reference electrode's internal solution. 4. Replace the sensor.
	COND sensor 1. There is moisture on the sensor. 2. The sensor is dirty. 3. The COND sensor is broken.	COND sensor 1. Blow-dry the moisture off the sensor. 2. Clean the sensor. 3. Contact your nearest sales outlet.
	TURB sensor 1. There are air bubbles on the cell. 2. The cell window is dirty. 3. The sensor is being affected by ambient light. 4. The solution is dirty. 5. The TURB sensor has failed.	TURB sensor 1. Shake the sensor probe vigorously. 2. Clean the cell window. 3. Calibrate using the calibration cup provided. 4. Replace the solution with new solution. 5. Replace the TURB sensor.
	DO sensor 1. There are air bubbles in the internal solution. 2. The DO sensor has failed.	DO sensor 1. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 2. Replace the DO sensor.
	Water depth sensor 1. The water depth sensor is dirty. 2. The water depth sensor has failed.	Water depth sensor 1. Clean the water depth sensor. 2. Contact your nearest sales outlet.

Error	Cause	Solution
Span calibration error	pH sensor 1. The pH standard solution is contaminated. 2. The pH-responsive membrane is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The pH-responsive membrane is torn.	pH sensor 1. Replace the standard solution with new solution. 2. Clean the pH-responsive membrane. 3. Refil the reference electrode's internal solution. 4. Replace the sensor.
	ORP sensor 1. The ORP standard solution is contaminated. 2. The ORP electrode is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The ORP electrode has failed.	ORP sensor 1. Replace the standard solution with new solution. 2. Clean the ORP electrode. 3. Refil the reference electrode's internal solution. 4. Replace the ORP electrode.
	COND sensor 1. The calibration solution is not correct. 2. The sensor is dirty. 3. The COND sensor has failed.	COND sensor 1. Use the correct calibration solution for calibration. 2. Clean the sensor. 3. Contact your nearest sales outlet.
	TURB sensor 1. There are air bubbles on the cell. 2. The cell window is dirty. 3. The sensor is being affected by ambient light. 4. The solution is dirty. 5. The TURB sensor has failed.	TURB sensor 1. Shake the sensor probe vigorously. 2. Clean the cell window. 3. Calibrate using the calibration cup provided. 4. Replace the solution with new solution. 5. Replace the TURB sensor.
	DO sensor 1. The diaphragm is torn. 2. There are air bubbles in the internal solution. 3. The DO sensor has failed.	DO sensor 1. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 2. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 3. Replace the DO sensor.
	Temperature sensor The temperature sensor has failed.	Temperature sensor Contact your nearest sales outlet.
Calibration stability error	The calibration value of an individual parameter is not stable. 1. The sensor is dirty. 2. The sensor has not adjusted to the standard solution. 3. The temperature was unstable during calibration.	1. Clean the sensor. 2. Fill the transparent calibration cup with pH 4 standard solution, and wait for at least 20 minutes of conditioning before starting calibration. 3. Start calibration after the temperature has stabilized.
Turbidity calibration error	Error in turbidity measurement sequence	Turbidity calibration failed. Redo calibration after removing the displayed error.
Wet check	The cable connector is submerged.	Turn the power OFF and disconnect the cable connector. Wipe or blow-dry off all the water droplets on the probe. If the error persists, contact your nearest sales outlet to have the display and sensor probe repaired.
Power voltage error	The display's power board has failed.	This error could also be caused by poor cable contact. Turn the power OFF and disconnect the cable connector. Reconnect the connector and turn the power ON. If the error persists, contact your nearest sales outlet to have the display and sensor probe repaired.
Turbidity lamp power voltage error	The remaining battery level is low.	Turn the power OFF and replace the display's batteries with new ones.

<table>
<tr><th>Error</th><th>Cause</th><th>Solution</th></tr>
<tr><td>Display RTC error</td><td>The time display is incorrect.</td><td>Replace the coin battery.</td></tr>
<tr><td>Display FROM error</td><td>Internal IC failure</td><td>Contact your nearest sales outlet to have the control unit repaired.</td></tr>
<tr><td>Display EEPROM error</td><td>Internal IC failure</td><td>Contact your nearest sales outlet to have the control unit repaired.</td></tr>
<tr><td>Display save error</td><td>Insufficient memory space</td><td>Move data from the display, use the data operations screen to delete data, then redo the measurement.</td></tr>
<tr><td>Measurement sequence error</td><td>● When the measurement item is turbidity
1. The battery power is low.
2. The wiper is not operating normally.
3. The light source lamp is not lit.
● If items other than turbidity are also displayed
4. Board failure</td><td>1. Replace the batteries with new ones.
2. Check there are no obstacles near the wiper, then redo the measurement. If the error persists, the motor will need to be replaced. Contact your nearest sales outlet to have the sensor probe repaired.
3. Wipe off any water droplets on the probe, then remove the turbidity sensor. Check there are no water droplets around the turbidity sensor connector, then mount the sensor again. If the error persists, replace the turbidity sensor.
4. Contact your nearest sales outlet to have the sensor probe repaired.</td></tr>
<tr><td>Out of measurement range</td><td>The attempted measurement is outside the measurement range supported for that item.</td><td>The system must be used within its supported measurement ranges.</td></tr>
<tr><td rowspan="5">Last zero-point calibration invalid</td><td>pH sensor
1. The pH standard solution is contaminated.
2. The pH-responsive membrane is dirty.
3. The concentration of the reference electrode's internal solution has changed.
4. The pH-responsive membrane is torn.</td><td>pH sensor
1. Replace the standard solution with new solution.
2. Clean the pH-responsive membrane.
3. Refil the reference electrode's internal solution.
4. Replace the sensor.</td></tr>
<tr><td>COND sensor
1. There is moisture on the sensor.
2. The sensor is dirty.
3. The COND sensor has failed.</td><td>COND sensor
1. Blow-dry the moisture off the sensor.
2. Clean the sensor.
3. Contact your nearest sales outlet.</td></tr>
<tr><td>TURB sensor
1. There are air bubbles on the cell.
2. The cell window is dirty.
3. The sensor is being affected by ambient light.
4. The solution is dirty.
5. The TURB sensor has failed.</td><td>TURB sensor
1. Shake the sensor probe vigorously.
2. Clean the cell window.
3. Calibrate using the calibration cup provided.
4. Replace the solution with new solution.
5. Replace the TURB sensor.</td></tr>
<tr><td>DO sensor
1. There are air bubbles in the internal solution.
2. The DO sensor has failed.</td><td>DO sensor
1. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution.
2. Replace the DO sensor.</td></tr>
<tr><td>Water depth sensor
1. The water depth sensor is dirty.
2. The water depth sensor has failed.</td><td>Water depth sensor
1. Clean the water depth sensor.
2. Contact your nearest sales outlet.</td></tr>
<tr><td>Out of measurement range</td><td rowspan="2">[See above.]</td><td rowspan="2">[See above.]</td></tr>
<tr><td>Last zero-point calibration invalid</td></tr>
</table>

Error	Cause	Solution
Last span calibration invalid	pH sensor 1. The pH standard solution is contaminated. 2. The pH-responsive membrane is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The pH-responsive membrane is torn.	pH sensor 1. Replace the standard solution with new solution. 2. Clean the pH-responsive membrane. 3. Refil the reference electrode's internal solution. 4. Replace the sensor.
	ORP sensor 1. The ORP standard solution is contaminated. 2. The ORP electrode is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The ORP sensor glass is broken.	ORP sensor 1. Replace the standard solution with new solution. 2. Clean the ORP electrode. 3. Refil the reference electrode's internal solution. 4. Replace the sensor.
	COND sensor 1. The calibration solution is not correct. 2. The sensor is dirty. 3. The COND sensor has failed.	COND sensor 1. Use the correct calibration solution for calibration. 2. Clean the sensor. 3. Contact your nearest sales outlet.
	TURB sensor 1. There are air bubbles on the cell. 2. The cell window is dirty. 3. The sensor is being affected by ambient light. 4. The solution is dirty. 5. The TURB sensor has failed.	TURB sensor 1. Shake the sensor probe vigorously. 2. Clean the cell window. 3. Calibrate using the calibration cup provided. 4. Replace the solution with new solution. 5. Replace the TURB sensor.
	DO sensor 1. The diaphragm is torn. 2. There are air bubbles in the internal solution. 3. The DO sensor has failed.	DO sensor 1. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 2. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 3. Replace the DO sensor.
	Temperature sensor ● The temperature sensor has failed.	Temperature sensor ● Contact your nearest sales outlet.
Out of measurement range	[See above.]	[See above.]
Last zero-point calibration invalid		
Last span calibration invalid	The calibration value of an individual parameter is not stable. 1. The sensor is dirty. 2. The sensor has not adjusted to the standard solution. 3. The temperature was unstable during calibration.	1. Clean the sensors. 2. Fill the transparent calibration cup with pH 4 standard solution, and wait for at least 20 minutes of conditioning before starting calibration. 3. Start calibration after the temperature has stabilized.
Out of measurement range	[See above.]	[See above.]
Last zero-point calibration invalid		
Calibration value is factory default value.	Internal IC failure	Turn the power OFF, then restart the system. If the error persists, initialize the system from the "System" menu. If the error still persists, contact your nearest sales outlet to have the sensor probe repaired.

Error	Cause	Solution
Sample is unstable.	1. The concentration of the sample is unstable. 2. External light disturbance has affected the sensor. 3. Water has entered the turbidity sensor's connector.	1. Use a stirrer to agitate the sample during measurement. 2. Perform measurement away from direct sunlight. 3. Turn the power OFF, wipe off any water droplets on the probe, then remove the turbidity sensor. Check there are no water droplets around the turbidity sensor connector, then mount the sensor again. If the error persists, replace the turbidity sensor.

4.6.2 Error displays in sensor information

Error display	Cause	Solution
Measurement sequence error	Measurement sequence error	Turn the power OFF, then restart the system. If the error persists, have the probe repaired.
Out of measurement range	The measurement value is outside the measurement range.	Samples for measurement must be within the measurement range.
Last calibration invalid	The last calibration failed.	Redo calibration.
Calibration invalid	The calibration value is the factory default value.	Redo calibration.
Background unstable	The U-53 turbidity sensor is exposed to direct light.	Mount the guard cap and sensor guard and perform measurement away from direct sunlight.
	The turbidity value changed rapidly during measurement.	Measure a sample that has stable turbidity.

5 Specifications

<table>
<tr><th colspan="2" rowspan="2">Specification</th><th rowspan="2">Basic value</th><th colspan="5">Model</th></tr>
<tr><th>U-51</th><th>U-52</th><th>U-52G</th><th>U-53</th><th>U-53G</th></tr>
<tr><td rowspan="9">Sensor probe</td><td>Measurement temperature range</td><td>−10°C to 55°C</td><td rowspan="6">✓</td><td rowspan="6">✓</td><td rowspan="6">✓</td><td rowspan="6">✓</td><td rowspan="6">✓</td></tr>
<tr><td>Maximum sensor outer diameter</td><td>Approx. 96 mm</td></tr>
<tr><td>Sensor length</td><td>Approx. 340 mm</td></tr>
<tr><td>Cable length</td><td>2 m (standard)
10 m/30 m (options)</td></tr>
<tr><td>Mass</td><td>Approx. 1800 g</td></tr>
<tr><td>Auto calibration function</td><td>Uses pH 4 standard solution.</td></tr>
<tr><td>Measurement depth</td><td>30 m max.</td><td rowspan="3">✓</td><td rowspan="3">✓</td><td rowspan="3">✓</td><td rowspan="3">✓</td><td rowspan="3">✓</td></tr>
<tr><td>Wet-part materials[*3]</td><td>PPS, glass, SUS316L, SUS304, FKM, PEEK, Q, titanium, FEP membrane, POM</td></tr>
<tr><td>Waterproofing standard</td><td>IP-68</td></tr>
<tr><td rowspan="12">Control unit</td><td rowspan="2">Outer dimensions (W × D × H)</td><td>115 × 66 × 283 mm</td><td>✓</td><td>✓</td><td>—</td><td>✓</td><td>—</td></tr>
<tr><td>115 × 66 × 335 mm</td><td>—</td><td>—</td><td>✓</td><td>—</td><td>✓</td></tr>
<tr><td>Mass</td><td>Approx. 800 g</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>LCD</td><td>320 × 240 mm graphic LCD (monochrome) with backlight</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Memory data items</td><td>10000</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Communication interface</td><td>USB peripheral</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Batteries</td><td>C-size dry cells (×4)</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Waterproofing standard</td><td>IP-67</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>GPS unit</td><td>● Reception method (12 channel parallel)
● Measurement precision [With PDOP (high precision): 30 m or less (2 drms)]</td><td>—</td><td>—</td><td>✓</td><td>—</td><td>✓</td></tr>
<tr><td>Estimated battery life[*1]</td><td>—</td><td colspan="3">70 hours (no backlight)</td><td colspan="2">500 measurements (no backlight)</td></tr>
<tr><td>Storage temperature range</td><td>−10°C to 60°C</td><td rowspan="2">✓</td><td rowspan="2">✓</td><td rowspan="2">✓</td><td rowspan="2">✓</td><td rowspan="2">✓</td></tr>
<tr><td>Ambient temperature range</td><td>−5°C to 45°C</td></tr>
</table>

Specification		Basic value	Model				
			U-51	U-52	U-52G	U-53	U-53G
pH measurement Two calibration	Measurement method	Glass electrode method	✓	✓	✓	✓	✓
	Range	pH 0 to 14					
	Resolution	0.01 pH					
	Precision*2	±0.1 pH					
Dissolved oxygen measurement ● Salinity conversion (0 to 70 PPT, automatic) ● Automatic temperature compensation	Measurement method	Polarographic method	✓	✓	✓	✓	✓
	Film thickness	25 μm					
	Range	0 mg/L to 50.0 mg/L					
	Resolution	0.01 mg/L					
	Precision*2	0 mg/L to 20 mg/L: ±0.2 mg/L 20 mg/L to 50 mg/L: ±0.5 mg/L					
Electrical conductivity measurement ● Auto range ● Automatic temperature conversion (25°C)	Measurement method	Four-AC-electrode method	✓	✓	✓	✓	✓
	Range	0 S/m to 10 S/m (0 mS/cm to 100 mS/cm)					
	Resolution	0.000 mS/cm to 0.999 mS/cm: 0.001 1.00 mS/cm to 9.99 mS/cm: 0.01 10.0 mS/cm to 99.9 mS/cm: 0.1 0.0 mS/m to 99.9 mS/m: 0.1 0.100 S/m to 0.999 S/m: 0.001 1.00 S/m to 9.99 S/m: 0.01					
	Precision*2	1% of full-scale (midpoint of two calibration points)					
Salinity measurement	Measurement method	Electrical conductivity conversion	✓	✓	✓	✓	✓
	Range	0 PPT to 70 PPT (parts per thousand)					
	Resolution	0.1 PPT					
	Precision	±3 PPT					
TDS (total dissolved solid) measurement ● Conversion coefficient setting	Measurement method	Electrical conductivity conversion	✓	✓	✓	✓	✓
	Range	0 g/L to 100 g/L					
	Resolution	0.1% of full-scale					
	Repeatability	±2 g/L					
	Precision	±5 g/L					
Seawater specific gravity measurement ● σt, σ0, σ15 display	Measurement method	Electrical conductivity conversion	✓	✓	✓	✓	✓
	Range	0 σt to 50 σt					
	Resolution	0.1 σt					
	Precision	±5 σt					

Specification		Basic value	Model U-51	U-52	U-52G	U-53	U-53G
Temperature measurement	Measurement method	Platinum temperature sensor	✓	✓	✓	✓	✓
	Range	−10°C to 55°C					
	Resolution	0.01°C					
	Sensor	Platinum temperature sensor, JIS Class B (0.3 + 0.005 |t|)					
Turbidity measurement	Measurement method		—	LED forward 30° transmission/ scattering method		Tungsten lamp 90° transmission scattering method	
	Range			0 NTU to 800 NTU		0 NTU to 1000 NTU	
	Resolution			0.1 NTU		0.01 NTU	
	Precision*2			±5%of readout or ±1 NTU, whichever is larger		● ±0.5NTU (for 0 NTU to 10 NTU measurement range) ● 3% of readout or 1 NTU, whichever is larger (for 10 NTU to 1000 NTU measurement range)	
	Turbidity sensor wiper			—		✓	
Water depth measurement	Measurement method	Pressure method	—	—	✓	✓	✓
	Range	0 m to 30 m					
	Resolution	0.05 m					
	Precision*2	±0.3 m					
ORP (oxidation reduction potential) measurement	Measurement method	Platinum electrode method	✓	✓	✓	✓	✓
	Range	−2000 ～ +2000 mV					
	Resolution	1 mV					
	Precision*2	±15 mV					

*1: Battery life is estimated under following conditions.
- Continuous operation
- Using batteries: C-size alkaline dry cells
- Ambient temperature of the control unit: 20°C or more
- Backlight off

*2: The precision is defined by measuring the standard solution in the following cases.
- Turbidity and conductivity: after four point calibration
- pH and DO: after two point calibration
- Water depth and ORP: after one point calibration

*3: Metallic parts are made of stainless steel. Immersing in seawater may erode metallic parts.

6 Reference

6.1 Consumable parts

● Sensor

Name	Model	No.	Description
pH sensor	#7112	3014057312	Standard type pH sensor
pH sensor ToupH	#7113	3200170923	Tough glass type pH sensor
ORP sensor	#7313	3200170920	
DO sensor	#7543	3200170924	
Reference electrode	#7210	3200043582	
R bush unit	—	3200043587	Reference electrode liquid junction
TURB cell U-52	#7800	3200172803	For U-52/U-52G
TURB cell U-53	#7801	3200172800	For U-53/U-53G
Membrane cap	—	3200170194	For DO sensor

● Standard solution and inner solution

Name	Model	No.	Description
pH 4 (For automatic calibration) 500 mL	#100-4	3200043638	Standard solution for auto calibration. Also used for manual pH span calibration.
pH 4 (For automatic calibration) 4 L	#140-4	3200174430	
pH 7 500 mL	#100-7	3200043637	Standard solution for pH zero-point calibration.
pH 9 500 mL	#100-9	3200043636	Standard solution for pH manual span calibration.
Powder for ORP standard solution 10 packs	#160-51	3200043618	For ORP calibration.
Powder for ORP standard solution 10 packs	#160-22	3200043617	
Inner solution for DO sensor, 50 mL	#306	3200170938	Internal solution for DO sensor.
Internal solution for pH, 250 mL	#330	3200043641	Supplementary internal solution for pH reference electrode.

Others

Name	Model	No.	Description
Silicone grease	—	3014017718	Silicone grease for coating sensor O-ring.
Sponge brush unit	—	3200169531	Brush for cleaning sensor probe.
O-ring set for reference electrode	—	3200169376	O-rings for reference electrode.
O-ring set for DO sensor	—	3200169426	O-rings for DO sensor.
Rubber cap set for sensor guard	—	3200169428	Rubber caps used between sensor guard and sensor probe.
O-ring set for pH and ORP sensor	—	3200169520	O-rings for pH and ORP sensors.
Wiper unit	—	3200169789	Rubber wiper for U-53/U-53G turbidity sensors.
Protective cap (blk) for pH sensor	—	3200175019	Cap attached to tip of pH sensor for sensor probe storage.
Rubber cap (whit) for DO sensor	—	3200175020	Cap attached to tip of DO sensor for sensor probe storage.

6.2 Options sold separately

Name	Model	No.	Description
Bag	U-5030	3200174772	Storage bag for sensor probes and flow cell. Can be carried in one hand.
Flow cell assy	—	3200156570	Used when collecting measurement samples by pump.
Probe guard	—	3200167002	Used for taking measurements in locations where there is a current or where there is a thick layer of sludge.
Communication cable	—	3200174823	A PC connection cable. Comes with data collection software.

6.3 pH measurement

6.3.1 Principle of pH measurement

U-50 series use the glass electrode method for pH measurements. The glass electrode method measures a potential difference between the glass film for pH and the reference electrode. For more information, refer to “JIS Z 8802 pH measurement method”.

6.3.2 Temperature compensation

The electromotive force generated by the glass electrode changes depending on the temperature of the solution.

Temperature compensation is used to compensate for the change in electromotive force caused by temperature.

This function does not compensate the change in pH caused by the temperature of the solution. When pH is to be measured, the temperature of the solution must be recorded along with that pH value, even if a pH meter has automatic temperature compensation function. If the solution temperature is not recorded, the results of the pH measurement may be meaningless.

6.3.3 Standard solutions

When measuring pH, the pH meter must be calibrated using standard solution. There are five kinds of standard solutions specified in “JIS Z 8802 pH measurement”. For normal measurement, two of standard solutions with pH of 4, 7, and 9 are sufficient to accurately calibrate the meter.

For standard solutions, refer to “JIS Z 8802 pH measurement”.

pH 4 standard solution: (Phthalate)	0.05 mol/L potassium hydrogen phthalate aqueous solution
pH 7 standard solutio: (Neutral phosphate)	0.025 mol/L potassium dihydrogenphosphate, 0.025 mol/L disodium hydrogenphosphate aqueous solution
pH 9 standard solution: (Borate)	0.01 mol/L sodium tetraborate aqueous solution

Table 2 pH values of pH standard solutions at various temperatures settings

Temp. (℃)	pH 4 standard solution Phthalate	pH 7 standard solution Neutral phosphate	pH 9 standard solution Borate
0	4.01	6.98	9.46
5	4.01	6.95	9.39
10	4.00	6.92	9.33
15	4.00	6.90	9.27
20	4.00	6.88	9.22
25	4.01	6.86	9.18
30	4.01	6.85	9.14
35	4.02	6.84	9.10
40	4.03	6.84	9.07
45	4.04	6.84	9.04

6.4 DO measurement

6.4.1 Principle of DO measurement

Dissolved oxygen (DO) refers to the amount of oxygen that is contained in water.

The concentration of dissolved oxygen is generally given as mg/L or as a percentage value (the dissolved oxygen saturation ratio).

Dissolved oxygen is essential for maintaining the self-purifying ability of rivers and seas and also for fish to live. The concentration of dissolved oxygen acts as an indicator of water quality. It is often measured when processing waste water and managing water quality. Fig. 1 provides an overview of the principles behind dissolved oxygen sensor measurement.

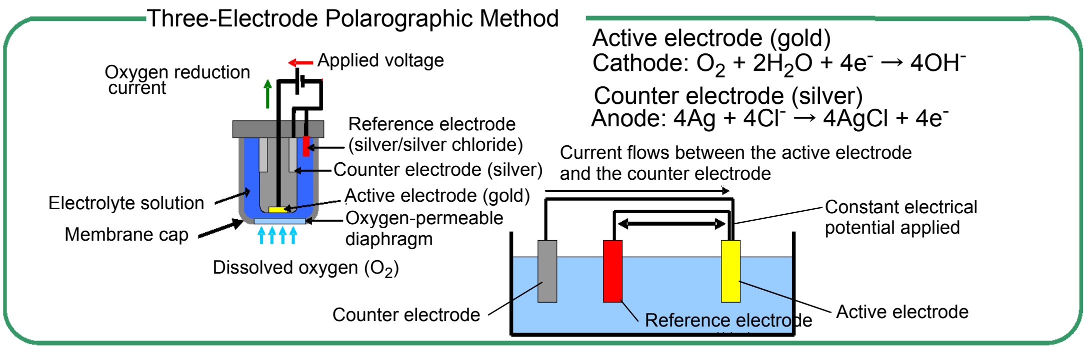


Fig. 1 Overview of principles behind dissolved oxygen sensor

The polarographic oxygen sensor is an enclosed sensor wherein voltage is applied to a cathode made of a precious metal (such as gold or platinum) and an anode also made of a precious metal (such as silver) via an external circuit, and a cap with an oxygen permeable diaphragm (membrane) is filled with electrolyte solution. As indicated in Fig. 1, the concentration of dissolved oxygen can be measured by measuring the current proportional to the amount of reduced oxygen when oxygen that has dispersed through the oxygen permeable diaphragm produces a reductive reaction on the surface of the active electrode (gold). The method of measuring dissolved oxygen based on the above principle is called the Membrane Electrode Method. Compared to the Chemical Analysis Method, which requires complicated pre-processing to alleviate the effect of reduced materials and oxidizing materials, this method allows dissolved oxygen to be measured very easily. It is also easy to remove undesired buildup from the silver electrode by polishing and cleaning if an insulator forms on it due to oxidation, making the method reusable.

6.4.2 Salinity calibration

When the solution and air come into contact and form an equilibrium (i.e. saturation), the relationship between the concentration of dissolved oxygen in the solution, C, [mol/L], and the partial pressure of oxygen in the air, Ps, [MPa/(mg/L)], can be represented by the following formula:

$C = Ps/H$

Where H [MPa/(mg/L)] is the Henry constant, a value that changes according to the composition of the solution. As H typically becomes larger as the salinity of the water increases, C becomes smaller.

The DO sensor detects the partial pressure of oxygen (Ps) in the above formula. Accordingly, if the DO sensor is immersed in deionized water saturated with air, or in an aqueous solution containing salt, the output current does not change, resulting in an erroneous measurement. For example, when salt is added to a sample, the amount of oxygen that can be dissolved in the solution decreases, but because the partial pressure of oxygen does not change, the value displayed by the control unit stays the same regardless of salt content. This concept is indicated in graph form below. (Fig. 2)

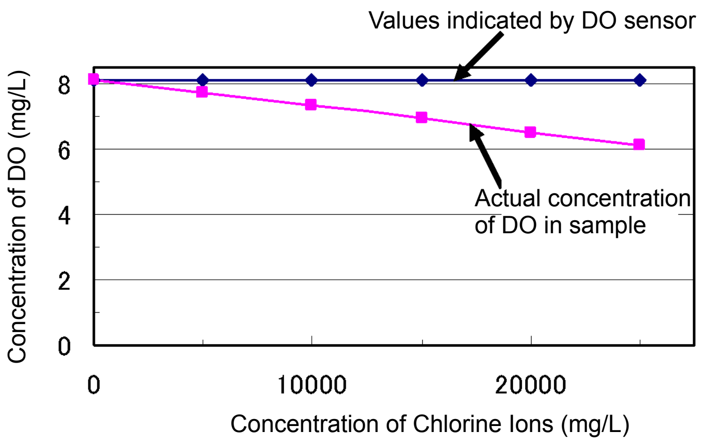


Fig. 2 Relationship between chlorine ion concentration and dissolved oxygen concentration

In samples with a high salt concentration, the solubility of oxygen is lower, but as the partial pressure of oxygen does not change, the value actually indicated on the control unit is higher than the actual value. In order to obtain a measurement of the concentration of dissolved oxygen in an aqueous solution that contains salt, it is therefore necessary to first perform salinity compensation. Conventionally, dissolved oxygen sensors have performed salinity compensation by inputting the salinity of the sample. This is fine as long as the salinity is already known. However, in most cases salinity is unknown, so even if dissolved oxygen sensors contained a salinity compensation function, it was of no practical use.

The U-50 Series can calculate and measure salinity in samples from electrical conductivity values, and can thus be used to automatically compensate for salinity.

6.5 Conductivity (COND) measurement

6.5.1 Four-AC-electrode method

Conductivity is an index of the flow of electrical current in a substance.

Salts dissolved in water are separated into cations and anions. Such solution is called electrolytic solution.

Electrolytic solution has the property of allowing the flow of current according to Ohm's law. This property is referred

to as ionic conductivity, since current flow is caused by ion movement in electrolytic solution.

Metals, on the other hand, allow the flow of current by means of electrons. This property is called electronic conductivity,

which is distinguished from ionic conductivity.

A cube with 1 m on each side, as shown in Fig. 3, is used to demonstrate an electrolytic solution. Two electrode plates are placed on opposite sides, and the cube is filled with solution. If the resistance between these two electrode plates is represented by r(Ω), the conductivity of the solution L($S \cdot m^{-1}$) is represented as L=1/r. S stands for Siemens, a unit of measurement of conductance.

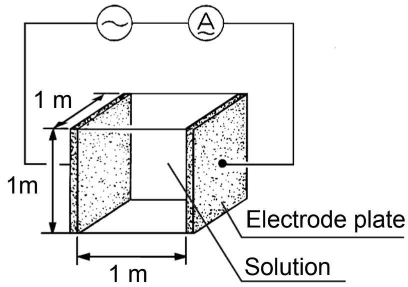


Fig. 3 Definition of conductivity

The most general method for measuring conductivity is based on the above principle, and is called the 2-electrode method.

In the 2-electrode method the influence of polarization cannot be ignored for solutions with high conductivity and conductivity cannot be measure accurately. In addition, contamination on the surface of the electrode increases apparent resistance, resulting in inaccurate measurement of conductivity.

The U-50 series has adopted the 4-electrode method to overcome these disadvantages of the the 2-electrode method.

As shown in Fig. 4, the U-50 series uses two voltage-detecting electrodes and two voltage-applying electrodes, for a total of four electrodes. The voltage-detecting electrodes are for detecting AC voltage, and the voltage-applying electrodes are for applying AC voltage.

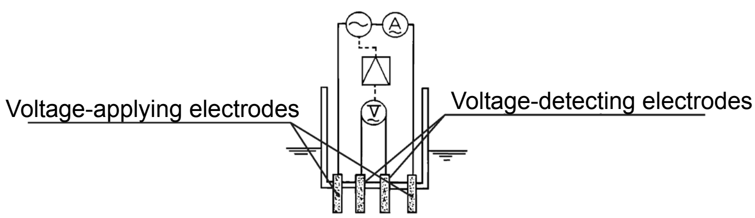


Fig. 4 Principle of the 4-electrode method

Let us assume that the current, I(A), flows in a sample of conductivity L – under automatic control of the voltage-applying electrodes – so that the voltage at the voltage-detecting-electrodes, E(V), remains constant at all times.

Then, the resistance of the sample, R(Ω), across the voltage-detecting electrodes is represented as R=E/I. The resistance, R, of the sample is inversely proportional to its conductivity, L. Accordingly, a measurement of current, Is,

of a standard solution of known conductivity, Ls, enables calculation of conductivity of a sample according to the formula L = Ls (I/Is) from the ratio L : Ls = I : Is.

Even in the 4-electrode method, polarization occurs, since AC current flows in the voltage-applying electrodes. The voltage-detecting electrodes are, however, free from the effects of polarization, since they are separated from the voltage-applying electrodes, and furthermore, current flow is negligible. Therefore, the 4-electrode method is an excellent method to enable measurement of conductivity covering a very high range.

6.5.2 SI units

New measurement units, called SI units, have been in use from 1996. Accordingly, the U-50 series also uses SI units. The following conversion table is provided for people who use the conventional kind of conductivity meter.

Note that along with the change in unit systems, the measurement values and cell counts have also changed.

	Former units	→	SI unit
Measurement value	0.1 mS/cm 1 mS/cm 100 mS/cm	→ → →	0.01 S/m 0.1 S/m 10 S/m

6.5.3 Temperature coefficient

In general, the conductivity of a solution varies largely with its temperature.

The conductivity of a solution depends on the ionic conductivity, described earlier. As the temperature rises, conductivity becomes higher since the movement of the ions becomes more active.

The temperature coefficient shows the change in % of conductivity per °C, with a certain temperature taken as the reference temperature. This is expressed in units of %/°C. The temperature coefficient assumes the premise that the conductivity of a sample changes linearly according to temperature.

Strictly speaking, with actual samples, however, conductivity changes along a curve. Furthermore, the cuve varies with the type of sample. In the ranges of smaller temperature changes, however, samples are said to have the temperature coefficient of 2%/°C (at reference temperature 25°C); this holds for most samples, except in certain special cases.

(The temperature coefficients for various types of solutions are listed on the next page.)

The U-50 series uses an automatic temperature conversion function to calculate conductivity at 25°C at a temperature

coefficient of 2 %/°C based on the measured value of the temperature. Results are displayed on the readout.

The U-50 series's temperature conversion function is based on the following formula.

$L_{25} = L_t / \{ 1 + K (t - 25) \}$

L_{25} : Conductivity of solution converted to 25°C

t : Temperature of solution at time of measurement (°C)

L_t : Conductivity of solution at t (°C)

K : Temperature coefficient (%/°C)

● Conductivity and temperature coefficient for various solutions

Conductivity and related temperature coefficients of representative substances (at 25°C) are shown in the table below.

Substance	Temp. (ºC)	Conc. (wt%)	Cond. (S/m)	Temp.coef. (%/°C)	Substance	Temp. (ºC)	Conc. (wt%)	Cond. (S/m)	Temp.coef. (%/°C)
NaOH	15	5	19.69	2.01	NaCl	18	5	6.72	2.17
		10	31.24	2.17			10	12.11	2.14
		15	34.63	2.49			15	16.42	2.12
		20	32.70	2.99			20	19.57	2.16
		30	20.22	4.50			25	21.35	2.27
		40	11.64	6.48	Na_2SO_4	18	5	4.09	2.36
KOH	15	25.2	54.03	2.09			10	6.87	2.49
		29.4	54.34	2.21			15	8.86	2.56
		33.6	52.21	2.36	Na_2CO_3	18	5	4.56	2.52
		42	42.12	2.83			10	7.05	2.71
NH_3	15	0.1	0.0251	2.46			15	8.36	2.94
		1.6	0.0867	2.38	KCl	18	5	6.90	2.01
		4.01	0.1095	2.50			10	13.59	1.88
		8.03	0.1038	2.62			15	20.20	1.79
		16.15	0.0632	3.01			20	26.77	1.68
HF	18	1.5	1.98	7.20			21	28.10	1.66
		4.8	5.93	6.66	KBr	15	5	4.65	2.06
		24.5	28.32	5.83			10	9.28	1.94
HCl	18	5	39.48	1.58			20	19.07	1.77
		10	63.02	1.56	KCN	15	3.25	5.07	2.07
		20	76.15	1.54			6.5	10.26	1.93
		30	66.20	1.52			—	—	—
H_2S0_4	18	5	20.85	1.21	NH_4Cl	18	5	9.18	1.98
		10	39.15	1.28			10	17.76	1.86
		20	65.27	1.45			15	25.86	1.71
		40	68.00	1.78			20	33.65	1.61
		50	54.05	1.93			25	40.25	1.54
		60	37.26	2.13	NH_4NO_3	15	5	5.90	2.03
		80	11.05	3.49			10	11.17	1.94
		100.14	1.87	0.30			30	28.41	1.68
		—	—	—			50	36.22	1.56
HNO_3	18	6.2	31.23	1.47	$CuSO_4$	18	2.5	10.90	2.13
		12.4	54.18	1.42			5	18.90	2.16
		31	78.19	1.39			10	32.00	2.18
		49.6	63.41	1.57			15	42.10	2.31
		62	49.64	1.57	CH_3COOH	18	10	15.26	1.69
H_3PO_4	15	10	5.66	1.04			15	16.19	1.74
		20	11.29	1.14			20	16.05	1.79
		40	20.70	1.50			30	14.01	1.86
		45	20.87	1.61			40	10.81	1.96
		50	20.73	1.74			60	4.56	2.06

6.6 Salinity (SAL) conversion

The U-50 series is designed to calculate salinity as well as the other parameters.

Note that the “salinity” here is the salinity of sea water. There is a constant relation between conductivity and salinity at certain temperatures.

Therefore, if data on the conductivity and temperature are available, the corresponding salinity can be known. In other words, the salinity measurement of the U-50 series is based on the principle of calculating the salt content, making use of the measured values of conductivity and temperature.

Note therefore, that measured results of all substances whose conductivity is detected are displayed as salinity. For example, the measured result is displayed as NaCl concentration, even if in fact the sample component is, hydrochloric acid (HCl).

6.7 TDS conversion

TDS is short for Total Dissolved Solids and means the total dissolved solid amount.

The conductivity of a solution is affected by the amount of salinity, minerals, and dissolved gases. That is, conductivity is an index that shows the total amount of all substances in the solution. Of these substances, TDS indicates only the amount of dissolved solids.

TDS can be used for a comparison of the state of substances composed of a single component such as NaCl. However, the use of TDS for the comparison of solutions of different types causes serious errors.

Conductivity and TDS are expressed by the following formulas.

Conductivity in SI units (S/m) .... TDS(g/L) = L (S/m) $\times$ K $\times$ 10

TDS(g/L) = L (mS/m) $\times$ K $\div$ 100

Conductivity in the old units (mS/cm) .... TDS(g/L) = L (mS/cm)$\times$ K

K = TDS coefficient

Initial settings use the values listed in the table (Page 80) that generally uses TDS coefficients.

For accurate TDS comparisons, find the TDS coefficient from measured conductivity values. Then set the value thus obtained and make measurements.

6.8 σt conversion

- **Specific gravity of seawater**

The density and specific gravity of seawater are equal numerically and generally are not distinguished strictly. Since seawater density ρ is between 1.000 and 1.031, 1 is subtracted from ρ and σ is obtained by multiplying the value by 1000.

The resultant value is used as the specific gravity of seawater.

$\sigma = (\rho - 1) \times 1000$

The density of seawater ρ is expressed by function of temperature, hydraulic pressure, and salinity. The density of seawater under the atmospheric pressure is expressed as σ_t. The density of seawater under the atmospheric pressure is determined by temperature and salinity.

The U-50 Series models make salinity measurement through temperature measurements and conductivity conversion and find σ_t through calculations.

In Japan σ_{15} at 15°C is called a standard specific gravity and widely used while in foreign countries σ_0 at 0°C is employed. σ_{15} and σ_0 are determined by the function of salinity.

In ocean surveys, in particular, these values σ_t, σ_{15}, and σ_0 are more widely used than conductivity and salinity and, in the U-50 Series models, newly added as measurement components.

6.9 Turbidity (TURB) measurement

6.9.1 Principle of turbidity measurement

U-52 and U-53 sensors measure turbidity using the Transmitting and Scattering Method shown in Fig. 5. U-52 sensors use a pulse light LED (infra-red emitting diode) as a light source, and detect scattered light from a 30° angle off center. U-53 sensors use a tungsten lamp as a light source and detect scattered light from a 90° angle. Both models display turbidity as a ratio of scattered light to transmitted light to reduce the affect of the color of the sample. The U-53 method conforms to EPA Method 180.1, and employs wipers to reduce the affect of air bubbles.

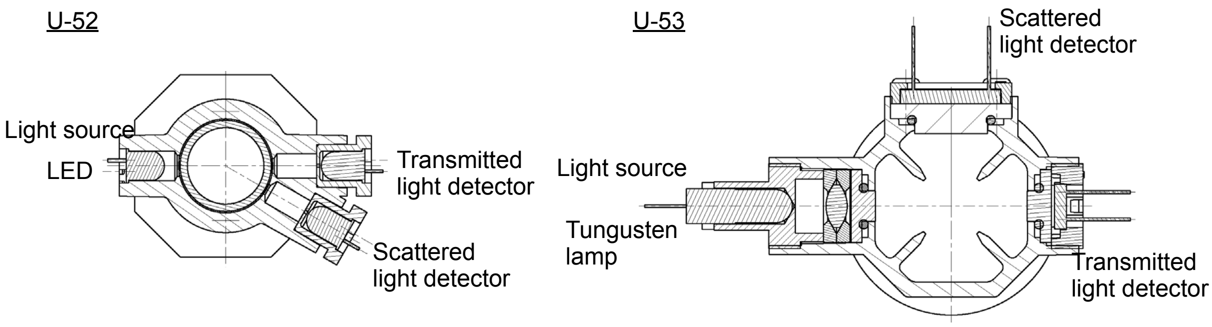


Fig. 5 Turbidity cell

6.9.2 Standard solution

U-50 series can perform calibration using formazin (NTU) or kaolin standard solutions as a turbidity standard solution. However, units for the solution used for calibration should be displayed in measurements. Do not use more than 400 mg/L of kaolin standard solution because it increases precipitation speed, resulting in measurement error.

6.10 Depth (DEPTH) measurement

6.10.1 Principle of depth measurement

For the W-22XD and W-23XD models, depth measurement can be made through use of a pressure gauge. The principle of the depth measurement uses the relation between depth and pressure.

Although the measurement with the depth sensor is affected by atmospheric pressure, the depth sensor, however, makes zero-point adjustments through the automatic calibration before measurements.

6.10.2 Influence of temperature and calibration

The depth sensor depends greatly on temperature. For a wide difference between the temperature at which the sensor has been automatically calibrated and the temperature of the measurement sample, the sensor can make depth measurements with a higher accuracy by the following method:

1. **Immerse the depth sensor of the sensor probe in the sample.**
2. **Keep the sensor immersed in the sample for about 30 minutes until the temperatures of the sensor and the sample are the same.**
3. **Then make the zero calibration of the sensor manually.**

6.11 Oxidation reduction potential (ORP) measurement

6.11.1 Principle of ORP measurement

ORP is an abbreviation for oxidation-reduction potential. ORP is the energy level (potential) determined according to the state of equilibrium between the oxidants (M^{Z+}) and reductants $M^{(Z-N)+}$ that coexist within a solution.

$$M^{Z+} + ne^{-} \Leftrightarrow M^{(Z-N)+} \qquad \cdots (1)$$

If only the solution, forming the ORP measuring system shown in Fig. 6. The difference of potential between two electrodes is generally expressed by the following equation.

$$E = E_0 - \frac{RT}{nF} \ln \frac{a_{M^{(z-n)+}}}{a_{M^{z+}}} \qquad \cdots (2)$$

E: Electric potential E_0 : Constant R: Gas constant T : Absolute temperature
n: Electron count F : Faraday constant a : Activity

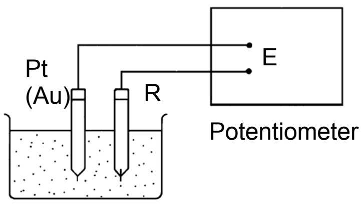


Fig. 6 Measuring mV

For example, for a solution in which trivalent iron ions coexist with bivalent iron ions, equations 1 and 2 would be as follows.

$$Fe^{3+} + e^{-} \Leftrightarrow Fe^{2+} \qquad \cdots (1)$$

$$E = E_0 - \frac{RT}{F} \ln \frac{a_{Fe^{2+}}}{a_{Fe^{3+}}} \qquad \cdots (2)$$

When only one type of state of equilibrium uniquely by equation (Fe^{3+}) and the reductant (Fe^{2+}) (using the equation $a_{Fe^{2+}}/ a_{Fe^{3+}}$). Actually, however many kinds of states of equilibrium exist simultaneously between various kinds of ions, in most solutions. This means that under actual circumstances, ORP cannot be expressed using the simple equation shown above and that the physical and chemical significance with respect to the solution is not very clear.

In this respect, the value of ORP must be understood to be only one indicator of the property of a solution. The measurement of ORP is widely used, however, as an important index in the analysis of solutions (potentiometric titration) and in the waste water treatment.

6.11.2 Standard electrode (reference electrode) types and ORP

The ORP is obtained comparing with corresponding reference electrode employed.

If different kinds of reference electrodes are used for measurement, the ORP value of the same solution may appear to be different. HORIBA's reference electrode uses Ag/AgCl with 3.33 mol/L KCl as inner solution. According to general technical literature, normal hydrogen electrodes (N.H.E.) are often used as the standard electrode.

The relationship between N.H.E. and the ORP that is measured using an Ag/AgCl with 3.33 mol/L KCl electrode is expressed by the following equation.

$E_{N.H.E.} = E + 206 - 0.7(t - 25)$ mV t = 0 - 60°C

$E_{N.H.E.}$: Measured ORP value using N.H.E. as the reference electrode

E: Measured ORP value using Ag/AgCl with 3.33 mol/L KCl as the reference electrode

Potential sign

Standard ORP is expressed in the following way, in literature related to electrochemistry and analytical chemistry.

A $Li^+ + e^- \rightarrow Li$

$E_0 = -3.024$ V VS N.H.E.

However, in some literature, the "+" and "-" signs are reversed.

B $Li \rightarrow Li^+ + e^-$

$E_0 = +3.024$ V VS N.H.E.

In expressions like B, above, the reaction is just reversed and there is no essential difference. But this kind of expression does invite confusion. The majority of the world, today, is consistent in its use of the signs as they are used in A, above.

For this reason, HORIBA, too, uses signs concerning ORP that are consistent with A, above.

HORIBA, Ltd.
2 Miyanohigashi, Kisshoin Minami-ku, Kyoto 601-8510 Japan
http://www.horiba.com

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image/u53_probe.tif 6
image/controller_connector.tif @ 600 dpi 6
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image/controller_battery_lid2.tif 7
image/front-view.tif 4
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image/ESC.tif 6
image/LIGHT.tif 6
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image/CUR_R.tif 6
image/CUR_U.tif 6
image/CUR_D.tif 6
image/controller_battery_lid2.tif 8
image/battery-4.tif 8
image/cr2032_x1.tif 10
image/p-guard.tif 11
image/U-50_attach_pH.tif 11
image/U-50_attach_orp.tif 12
image/U-50_attach_ref.tif 12
image/u50_do-spaner.tif 13
image/controller_connector.tif 14
image/コネクタ_mk.tif 14
image/校正カップ3.tif 14
image/設定GPS受信E1.tif 15
image/設定GPS測位E2.tif 16
image/設定GPS受信完了E1.tif 16
image/設定GPS測位失敗E1.tif 16
image/設定GPS精度E1.tif 17
image/設定GPS精度E2.bmp.tif 17
image/1.測定画面.tif 18
image/2.設定画面測定設定1.tif 19

image/1. 測定画面 .tif @ 200 dpi 64
image/80. データオペレーション画面 1.tif 64
image/81. データオペレーション画面 2.tif 64
image/82. データオペレーション画面３ .tif 65
image/81. データ画面データ表示 2.bmp.tif @ 200 dpi 65
image/1. 測定画面 .tif 65
image/80. データオペレーション画面 1.tif 65
image/84. データオペレーション画面 5.tif 66
image/1. 測定画面 .tif @ 200 dpi 66
image/80. データオペレーション画面 1.tif 66
image/86. データオペレーション画面 7.tif 67
image/1. 測定画面 .tif @ 200 dpi 68
image/87. データオペレーション画面 8.tif 68
image/88. データオペレーション画面 9.tif 68
image/1. 測定画面 .tif @ 200 dpi 69
image/90. データオペレーション 11.tif 69
image/91. データオペレーション 12.tif 69
image/1. 測定画面 .tif @ 200 dpi 70
image/ 校正履歴 CONDe.tif @ 200 dpi 70
image/ 校正履歴 DOE.tif @ 200 dpi 70
image/ 校正履歴 ORPE.tif @ 200 dpi 70
image/ 校正履歴 phE.tif @ 200 dpi 70
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image/ 校正履歴 TurbE.tif @ 200 dpi 70
image/ 校正履歴水深 E.tif @ 200 dpi 70
image/ 画暴 25_ENG.tif 70
image/ データ操作 GPS 情報 E10.tif 71
image/ データ操作 GPS 情報成功 E1.tif 71
image/ データ操作 GPS 情報 E1.tif 71
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image/ センサインフォメーション NGE.tif 72
image/usb-connector.tif @ 400 dpi 73
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image/s-guard_cap.tif 83
image/ プローブガード .tif 83
image/ 隔膜 5-s1.tif 84
image/ 隔膜 5-s2.tif 84
image/ 隔膜 5-g1.tif 84
image/ 隔膜 5-g2.tif 84
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image/隔膜キャップ取り付け1.tif 88
image/隔膜キャップジグ2.tif 88
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image/隔膜確認.tif 88
image/DO_原理_J.tif 101
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image/U-53_turb.tif 107
image/orp_原理図.tif @ 600 dpi 108

CSA INTERNATIONAL

Certificate of Compliance

Certificate:	1865837	**Master Contract:**	217005
Project:	2218210	**Date Issued:**	2010/01/14

Issued to: **RAE Systems, Inc.**

3775 North First St
San Jose, CA 95134
USA
Attention: James Pan

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

C US

Rich Masek

Issued by: Rich Masek

PRODUCTS

CLASS 4828 82 - SIGNAL APPLIANCES-Toxic Gas Detection Instruments - For Hazardous Locations. Certified to U.S. Standards

CLASS 4828 02 - SIGNAL APPLIANCES - Toxic Gas Detection Instruments - For Hazardous Locations

Class I; Division 1; Group A, B, C, D; T4

- MiniRAE 3000, Model PGM 7320, Portable Handheld VOC Monitor
- ppbRAE 3000, Model PGM 7340, Portable Handheld VOC Monitor
- MiniRAE Lite, Model PGM 7350, Portable Handheld VOC Monitor
- UltraRAE 3000, Model PGM 7360, Portable Handheld VOC Monitor

All monitors rated 6 Vdc. Ambient –20 °C to +50 °C, Intrinsically safe when powered by battery pack 059-3052-000 using either Duracell MN1500 or Energizer E91 alkaline batteries, powered by rechargeable Li-Ion battery pack 059-3051-000 or powered by rechargeable NiMH battery pack 059-3054-000.

APPLICABLE REQUIREMENTS

CSA INTERNATIONAL

Certificate: 1865837 **Master Contract:** 217005

Project: 2218210 **Date Issued:** 2010/01/14

C22.2 No. 0-M91 - General Requirements – Canadian Electrical Code, Part II

C22.2 No. 142-M1987 - Process Control Equipment

C22.2 No. 157-92 - Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations

ANSI/UL 913:2004 - Intrinsically Safe Apparatus

ANSI/UL 916:1998 - Energy Management Equipment

MARKINGS

The following markings are required.

- Submittor's identification
- Model designation or equivalent
- Complete electrical rating (List of acceptable batteries)
- Applicable hazardous locations designation - Class I; Division 1; Groups A, B, C and D;
- Temperature Code – T4
- Serial Number or date code
- CSA Monogram with c/us indicator as shown on the Certificate of Compliance.
- WARNING: DO NOT CHANGE OR CHARGE BATTERIES IN A HAZARDOUS LOCATION.
- WARNING: - DO NOT MIX OLD/NEW OR DIFFERENT TYPE BATTERIES.
- WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY. (May be in User Manual)

Battery Pack Markings

- • Submittor's identification
  - Battery Pack part number
  - Voltage
  - WARNING to not replace or charge battery pack in a hazardous location

Appendix C
Project Contact List

Project Contact List

Dynamic Earth

Christopher Zieger
Senior Principal
826 Newtown Yardley Road, Suite 201
Newtown, PA
267-6850276
czieger@dynamic-earth.com

Summer Hammouda
Project Manager
1901 Main Street
Lake Como, NJ 07719
732-280-0830
shammouda@dynamic-earth.com

New York State Department of Environmental Conservation (NYSDEC)

Emily Barry
Project Manager
NYSDEC Region 3
Division of Environmental Remediation
12 South Putt Corners Road
New Paltz, NY 12561-1620
845-633-5457
Emily.Barry@dec.ny.gov

Sub Contractors

Hawk Drilling, Inc.
221 Van Syckles Road
Hampton, New Jersey 08827
John Charles
908-323-2929
info@hawkdrilling.com

AWT Environmental Services, Inc.
32 Birch Street
Old Bridge, New Jersey 08857
Joseph Postorino
732-613-1660
jpostorino@awtenv.com

Site Owner

Thruway Plaza of Rockland Associates
Steven Yassky
106 Airport Executive Park
Nanuet, NY 10954
845-356-2400
syassky@rocklandrealty.com

Appendix D
Qualifications

Christopher J. Zieger, LSRP

Principal/Environmental Professional

Mr. Zieger has over 15 years of experience in environmental investigation, research, and document compilation, and is well versed in the historical and regulatory requirements of the ASTM E1527 and ASTM E1528 Standards for real estate transactions.

Mr. Zieger has coordinated and performed hundreds of environmental due diligence projects for developers, industrial and manufacturing companies, engineers, realtors, attorneys, national retail and restaurant chains, private concerns, and public agencies.

Experience Summary:

Mr. Zieger is a Licensed Site Remediation Professional (LSRP) in the State of New Jersey. He is experienced in the coordination and performance of environmental due diligence investigations including Phase I Environmental Site Assessments (ESAs) and Phase II Site Investigations, and State regulatory investigations including Preliminary Assessments; UST closure, soil and groundwater contamination delineation, Remedial Actions, and the regulatory permitting process.

Education:

- B.A., Environmental Studies, University of Pittsburgh, 2005

Certificates/Special Training:

- New Jersey Licensed Site Remediation Professional (LSRP No. 668065)
- NJDEP Subsurface Evaluator & UST Closure (License No. 483168)
- 40-Hour OSHA Hazardous Waste Operations Training with Annual Updates
- Geographic Information Systems (GIS) Certification

Areas of Expertise:

- Environmental Regulatory Compliance
- Phase I Environmental Site Assessments
- Preliminary Assessments
- Phase II Site Investigations
- UST Closure
- Regulatory Agency Interaction
- Environmental Document Reviews
- Data Collection and Assessment
- Permitting
- Report Generation and Proposal Compilation
- New Jersey ISRA Projects

Employment History:

Performing due diligence investigations (Phase I ESAs, Phase II Site Investigations, and Remedial Investigations for retail, commercial, industrial, and municipal properties throughout New Jersey, New York, Pennsylvania, Maryland, Virginia, Connecticut, Texas and Florida.

Conducting PA/SI, RI and RA activities at properties throughout New Jersey and Site Characterization Reports and Remedial Action Completion Reports in Pennsylvania.

Consulting with clients throughout the due diligence/remediation processes to effectively and efficiently reach their redevelopment/cleanup goals.

Supervising Geoprobe sampling programs to facilitate soil and groundwater sampling and analyses at commercial, industrial, municipal, and proposed residential sites.

Serving as a supervisor on UST removals throughout the northeast region and in Texas.
Interacting with regulatory agencies and implementing local, state, and federal regulations.
Preparing and issuing reports and proposals.

Managed closure of unregulated heating oil USTs at a proposed commercial parcel in Point Pleasant, New Jersey. Remedial activities included removal of impacted soil and groundwater, confirmatory soil sampling, and installation and sampling of groundwater monitor wells.

Conducted the installation of soil borings and monitor wells at a brownfields site in Rahway, New Jersey. Conducted vapor intrusion investigation at neighboring residential and commercial buildings. Oversaw soil blending remediation activities. Prepared remedial action/remedial investigation reports.

Conducted a vapor intrusion investigation including installation and sampling of sub-slab vapor points and indoor air samples at Rahway City Hall in Rahway, New Jersey.

- 2014 – Present – Dynamic Earth, LLC – Principal
- 2006 – 2013 – Whitestone Associates, Inc. – Environmental Scientist
- 2005 – Melick – Tully & Associates, PC – Environmental Scientist

DYNAMIC EARTH

Summer Hammouda

Environmental Professional/Project Manager

Summer Hammouda is an Environmental Project Manager with Dynamic Earth, LLC. She has experience in environmental investigation, research and document compilation, and is well versed in the historical and regulatory requirements of the ASTM E1527 and ASTM E1528 Standards for real estate transactions.

Ms. Hammouda is well versed in developing reports for submission to the NJDEP, including Preliminary Assessments, Site Investigation Reports, Remedial Investigation Reports, and Remedial Action Reports as well as more specialized Landfill Closure & Post-Closure Plans, LNAPL Interim Remedial Measures Reports, UST Closure Reporting, Vapor Intrusion Reporting, and more.

Education:

- Rutgers University, Bachelor of Science in Bioenvironmental Engineering, 2020

Certifications:

- 40-Hour Hazardous Waste Operations and Emergency Response Training (HAZWOPER)
- 8-Hour HAZWOPER Annual Refreshers

Areas of Expertise:

- New Jersey Department of Environmental Protection (NJDEP) Environmental Regulatory Compliance and Reporting
- New York State Department of Environmental Compliance (NYSDEC) Environmental Regulatory Compliance and Reporting
- Phase I Environmental Site Assessments
- Phase II Site Investigations
- UST Removal/Closure
- Landfill Closure & Post-Closure Operation, Monitoring & Reporting
- Vapor Intrusion Mitigation System Design & Implementation
- Construction Phase-Dewatering Permit Attainment & Groundwater Treatment System Design and Implementation
- Environmental Document Reviews
- Data Collection and Assessment
- Permitting
- Report Generation and Proposal Compilation
- Remediation Cost Estimating

Representative Experience:

- Consulted with clients throughout the due diligence/remediation processes to reach their redevelopment and cleanup goals effectively and efficiently.
- Performed due diligence investigations (Phase I ESAs/Phase II Site Investigations) and regulated investigations (Preliminary Assessments, Site/Remedial Investigations) for residential, commercial, and industrial properties throughout New York, New Jersey, and Virginia.
- Designed and/or oversaw the installation of remedial action systems (in-situ chemical injections, vapor intrusion mitigation systems, etc.)
- Supervised Geoprobe sampling programs to facilitate soil and groundwater sampling and analyses at commercial, industrial, and proposed residential sites.
- Managed numerous projects in New Jersey/New York in support of regulatory remediation and/or landfill closure activities.
- Managed construction-phase dewatering programs for periods extending upwards of six-months with over three million gallons of groundwater treated and discharged to municipal sewer systems.
- Developed fate & transport models for numerous sites to evaluate the extent of groundwater contaminant plumes and their impacts to potential receptors.
- Oversaw and managed monitoring well installations, geophysical contractors, and remedial excavation of contaminated soils.
- Conducted indoor air, ambient air, and soil gas sampling for various clients to determine mitigation requirements.
- Monitored and maintained sites with vapor intrusion mitigation systems installed.
- Created data submissions, alternative standard/ screening level memos, site investigation reports, remedial investigation reports, remedial action work plans, and remedial action reports for submission to the NJDEP.
- Coordinated with regulatory and local/municipal agencies to implement local, state, and federal regulations.

Employment History:

- 2024 – Present: Dynamic Earth, LLC – Project Manager
- 2021 – 2023: Dynamic Earth, LLC – Technical Professional
- 2020 – 2021: Arcadis, U.S. Inc. – Environmental Engineer I
- 2019 – 2020: Pfizer – Utilities and Facilities Engineering Data Analyst
- 2018 – 2019: Pfizer – Bioremediation Environmental Engineer for the American Cyanamid Superfund Site

As set forth under New York State Environmental Conservation Law, Section 15-1525

AWT Environmental Services Inc.

Registration # NYRD10971

is hereby registered with

the Commissioner of the State Department of Environmental Conservation

to drill or repair water wells in the State of New York only when supervised on-site by an individual who is exam certified in the respective water well activity. In accordance with the law and prior to commencement of drilling of any water well or wells, registrant shall file a preliminary notice with the Department. Registrant is required, upon completion of the drilling of any well(s), to file a completion report with the Department giving the log of the well, the size and depth thereof, the capacity of the pump or pumps attached or to be attached thereto, and such other information pertaining to the withdrawal of water and operation of completed well(s) as the Department by its rules and regulations may require. The registration number granted by this certificate must be displayed on the well drilling machinery of this registrant. All water well drilling shall be performed in accordance with standards promulgated by the Commissioner of Health as Appendix 5-B under Public Health Law. Notice is hereby given that all activities authorized by this certificate are subject to the provisions of Article 36-A of the New York State General Business Law.

Registrant: AWT Environmental Services Inc.
32 Birch St
Old Bridge, NJ 08857

Issue Date: March 07, 2024

Expiration Date: March 31, 2025

Authorized By: ________________

Carol Lamb-LaFay, Director
Division of Water

Rev 01/2023

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Water, Water Well Program
625 Broadway, Albany, New York 12233-3508
Toll Free: (877) 472-2619 I P: (518) 402-8291 I F: (518) 402-8290
www.dec.ny.gov

3/7/2024

NYRD10971
AWT Environmental Services Inc.
32 Birch St
Old Bridge, NJ 08857

Re: Water Well Contractor Program Registration

Your 2024 Water Well Contractors' registration certificate for the New York State Water Well Contractor Program is enclosed, along with an individual wallet-sized card for each certified individual and a vehicle registration sticker for each vehicle that sets up over a water well. Please refer to the diagram on the reverse side of this letter for proper sticker

As a reminder, the NYS Water Well Driller Registration Law, §15-1525 of NYS Environmental Conservation Law (ECL), requires the following:

• For drilling activities, an individual must be onsite who has passed two exams (General Drilling Exam and one additional drilling exam) to satisfy certification requirements. For pump installation and servicing activities within a well, an individual must be onsite who has passed two exams (Water Systems General Exam and one additional pump exam) to satisfy certification requirements. Individuals who engage in drilling AND pump installation or servicing must be certified for both. Registered businesses are responsible for ensuring that all water well drilling activities, including pump installation and servicing, are supervised by an exam certified individual. Certification exams are administered by the National Ground Water Association (NGWA) and are available to be taken at PSI testing locations across New York State. More information is available from PSI at 855-579-4642 or https://test-takers.psiexams.com/ngwa.

•Prior to drilling any water well, you must file a Preliminary Notice with NYSDEC. This form can be completed online or downloaded from the Water Well Program website at www.dec.ny.gov/lands/4997.html. Paper copies of this form are available at no cost from our office.

•Upon completion of the drilling of any well, you must: 1) file a Water Well Completion Report with NYSDEC and 2) provide a copy of such completion report to the water well owner. Completion reports should be provided to NYSDEC and the well owner within 30 days of completion of water well construction. This form can be downloaded from the Water Well Program website at www.dec.ny.gov/lands/4997.html. Paper copies of this form are available at no cost from our office.

NEW YORK STATE | Department of Environmental Conservation

Failure to meet these registration, certification, and reporting requirements can result in criminal fines and civil penalties, typically $1,500 per violation, pursuant to Article 71 subsections 1115, 1127 and 1131.

If you have any questions, please call our office toll free at 877-472-2619.

Sincerely,

Beth K. Guidetti
Professional Geologist 1
NYSDEC Water Well Program

Enclosures

Required Location of New York State Water Well Program Registration Sticker

One sticker per vehicle,
mounted on upper part of driver side fender,
immediately forward of front door.

For equipment not mounted on a vehicle,
place sticker on a visible area of equipment.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Water, Water Well Program
625 Broadway, Albany, New York 12233-3508
Toll Free: (877) 472-2619 | P: (518) 402-8291 | F: (518) 402-8290
www.dec.ny.gov

Registrant: AWT Environmental Services Inc. **3/7/2024**

Registration #: NYRD10971

Below is the certification status we have on file for individuals listed as certified on your latest NYS Water Well Contractor Registration Application. As a reminder, by law, a certified driller must be on site supervising drilling activities. Also by law, a certified pump installer must be on site supervising pump installation or servicing activities.

Certification ID Number	Name	Certified for Drilling*	Certified for Pump Installation*
NGW3212729	Kenneth Dannecker		
NGW4014255	Geovany Ramos		
PSI1000100	Baxter Duffy	Yes	No

If this information is not correct please provide our office a copy of proof of certification for each individual involved or contact our office at the address or numbers above for further information.

* P/C indicates this certification is partially complete

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NEW YORK STATE | Department of Environmental Conservation

2024

April 1, 2024-March 31, 2025

NEW YORK STATE
REGISTERED WATER WELL
CONTRACTOR

NYRD# 10971

NEW YORK STATE | Department of Environmental Conservation

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April 1, 2024-March 31, 2025

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REGISTERED WATER WELL
CONTRACTOR

NYRD# 10971

Pursuant to New York State
Environmental Conservation Law, Section 15-1525

AWT Environmental Services Inc.
NYRD10971

received a Certificate of Registration from the Commissioner of the NYSDEC to conduct water well contracting activities for the following period:

April 1, 2024 – March 31, 2025

Registration may be revoked for noncompliance. For current registration status, call 877-472-2619.

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

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NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

ONE CONTRACTOR, MANY SOLUTIONS...

AWT strives to be the most highly valued environmental services contractor in the region. Our broad platform of services is supported by experienced and highly trained people, powerful equipment, and the most current technologies. We are proud of our company and our ability to deliver for our customers. Let's connect and work together to achieve an optimal approach to site remediation and preserving our environment.

AWT ENVIRONMENTAL SERVICES, INC.

EXPERIENCE YOU CAN COUNT ON...

Growing and diversifying since 1982, AWT Environmental Services has become a multifaceted service provider offering customers a broader platform of integrated services than any other environmental contractor in the region. Our service capabilities are supported by a team of construction, remediation and drilling specialists who leverage their field-tested experience to help customers plan and optimize cost effective and successful approaches to site remediation and closure.

Beyond our industry knowledge, technical expertise and experience, customers value us because of who we are. Our business culture puts people and their safety first. We receive high marks for our health and safety training, certification, and record of safe performance. Customers also value our thorough estimates, scheduling flexibility, responsive follow ups and accurate documentation, but none of this happens consistently without a genuine concern for the success of your projects. **Simply put, we care.**

AWT ENVIRONMENTAL SERVICES, INC.

A TRULY UNIQUE ENVIROMENTAL CONTRACTOR...

For four decades, AWT has cultivated diverse talent, equipment and a services platform that are unequalled in the region. Customers count on us to not only deliver a wide scope of specified services but help in the development and optimization of the approach. In doing so, we often uncover efficiencies and identify challenges that may have resulted in missteps and cost overruns. We encourage you to take advantage of our technical expertise and deep experience.

Located in Central New Jersey, AWT handles projects from New England to the Mid-Atlantic region and everywhere in between.

"When we started to experience rapid growth, we knew that maintaining our culture and commitment to our employees would result in a successful and positive experience for customers. As a result, we've built and maintained many strong relationships and today have much more to offer, but to sustain that growth we dedicated ourselves to continuous improvement, increasing our value to customers, and creating growth opportunities for our employees."

Peter J. Postorino,
President of AWT Environmental Services

When you're planning your next project, consider AWT for:

- Soil excavation, capping and landfill closure
- Groundwater treatment and vapor mitigation
- In-situ injection and chemical oxidation
- Contaminated soil and clean fill management
- Storage tank removal and decontamination
- Environmental well drilling and soil borings
- Remediation systems installation, upgrades and maintenance

AWT strives to be the most highly valued regional environmental services contractor, providing the people, equipment, and technologies to manage environmental projects safely and efficiently. We proceed with the intent to continuously improve the lives of our staff, strengthen the bonds with customers and positively impact the community around us.

OUR MISSION

AWT ENVIRONMENTAL SERVICES, INC.

Learn more about AWT Environmental Services at **www.awtenv.com**, or call **800-732-7701** to speak with one of our customer representatives about your project opportunity. We'll help you optimize a winning approach and execute safely and successfully in the field.

PO Box 128, Sayreville, NJ 08871

AWT ENVIRONMENTAL SERVICES, INC.

Case Study No. 104

Enhance Reductive Dechlorination wit EVO and ZVI, via Re-Injectable Wells and Temporary Points

Location: Northern, New Jersey

Project Highlights

- Former Manufacturing Facility
- COC's:
  - PCE
  - TCE
- Site lithology consist of medium silty sands, underlain by silty clays.
- Remedial Reagent: 44um ZVI and EVO
- Treatment Program:
  - One injection event.
  - 4 injection Treatment areas
  - Amendments were injected within 2 RIPs, 2 horizontal wells and 7 temporary DPT points.
  - Total of ~5,000 gallons of ~6% EVO solution with ZVI was injected.
  - 10 Liters of DHC inoculum
  - Total duration: 4 days.
- Results pending.
- Field geochemical parameters indicative of reduction and pH supportive of DHC growth.
- Project was completed on time and on budget.

Site:

Former Manufacturing Facility, currently occupied by a commercial business located in northern New Jersey. Historical manufacturing operations have resulted in residual soil and groundwater impacts with contaminants of concern (COC) including chlorinated volatile organic compounds (CVOCs), specifically tetrachloroethene (PCE), Trichloroethene (TCE) and associated daughter products. Concentrations of PCE and TCE in soils at the source area were reported at 4,800 parts per billion (ppb) with down-gradient plume concentrations from 1,400 to 300 ppb.

Site lithology consists of medium silty sands, underlain by silty clays.

Treatment Program :

The treatment program included four (4) treatment areas throughout the Site consisting of a total of seven (7) temporary direct push technology (DPT) points, two (2) re-injectable points (RIPs) and two (2) horizontal excavation injection wells. The selected remedial amendments were 44 micron Zero Valent Iron (ZVI) and Emulsified Vegetive Oil (EVO), along with *Dehalococcoides* (DHC) bioaugmentation inoculum. AWT's scope of work included the mobilization of our direct push drill rig, injection equipment, chemicals obtainment, and chemical management. A total of ~5,100 gallons of a ~6% EVO solution along with 6 liters of DHC was injected over a 4-day injection duration. Observed injection pressures varied between 2 to 35 pound per square inch (PSI), with individual flow rates between .75 to 2 gallons per minute (GPM). Injections utilize a manifold system, injecting at 3 injection locations simulatiously, with each location utilizing a dedicated volumetric totalizer.

Challenges:

Daily coordination with tenants to limit disturbance to business operations and maintain a pathway for delivery traffic to the rear of the building. Bulk water storage due to slow water source flow.

Results:

Post treatment results are pending; however, based on groundwater field geochemical data, reductive conditions were observed along with supporting pH for microbial activity.

Case Study No. 105

Alkaline Activated Sodium Persulfate within Overburden and weather bedrock via Re-Injectable Wells

Location: West Central, New Jersey

Project Highlights

- Former Manufacturing Gas Plant
- COC's:
  - BTEX
  - PAHs
- Site lithology consist of tight silty sands underlain by dense clay.
- Remedial Reagent: Alkaline Activated Sodium Persulfate
- Treatment Program:
  - One injection event.
  - Installation of RIPs, keyed 2-3 ft into weather rock.
  - Treatment area ~1,500 Sq Ft.
  - Amendments were injected ed within 9 RIPs.
  - Total of ~10,200 gallons of ~25% sodium persulfate solution was injected (21,000 pounds of sodium persulfate and ~2,900 gallons of sodium hydroxide.
  - Total duration: 10 days.
- Results pending.
- Field geochemical parameters indicative of oxidation.
- Project was completed on time and on budget.

Site:

Former Manufacturing Gas Plant (MGP) located at a residential apartment building in west central New Jersey. Historical operations have resulted in residual groundwater impacts with contaminants of concern (COC) including Benzene, Toluene, Ethylbenzene, Xylene (BTEX) and Poly Aromatic Hydrocarbons (PAHs).

The treatment area is approximately 1,500 square feet, consisted of nine (9) re-injectable point (RIPs) previously installed by AWT via auger and air rotary drill methods.

Site lithology consists of silt and fine sands, underlain highly weathered bedrock at approximately 15 feet (ft) below ground surface (Bgs).

Treatment Program :

The selected remedial amendment was Sodium Persulfate with alkaline activation via sodium hydroxide. AWT's scope of work included the mobilization of our direct push drill rig, injection equipment, chemical procurement and management. A total of ~10,200 gallons of a ~23% concentration sodium persulfate solution was injected over a 10-day injection duration. Observed injection pressures varied between 2 to 25pound per square inch (PSI), with individual flow rates between 0.5 to 2 gallons per minute. Injections utilize a manifold system, injecting at 4 injection locations simulatiously, with each location utilizing a dedicated volumetric totalizer for dosaging. AWT implement continuous field monitoring via geochemical parameters of an adjacent ecological receptor to monitoring leaching potential.

Results:

Post treatment results are pending; however, based on groundwater field geochemical data, oxidation is ongoing via a supportive alkaline pH response and oxidation reduction potential (ORP).

Case Study No. 107

EVO and Micro-ZVI Injections within Temporary DPT Points at Commercial Strip Mall

Location: Northeastern, New Jersey

Project Highlights

- Former Dry Cleaners
- COC's:
  - PCE
- Site lithology consist of sandy silts underlain by clay and meadow mat.
- Remedial Reagent: EVO, ZVI and DHC Inoculum
- Treatment Program:
  - One injection event
  - Amendments were injected within 30 temporary DPT points, bottom up approach.
  - Treatment interval 5-20 ft bgs with 5 ft lifts
  - Utilized AWT's 7822 rig for the installation of temporary DPT locations.
  - Total of ~7,500 gallons in - -jected.
  - Total of 825 gallons of EVO with ZVI, 20 liters of DHC Inncollum, and 200 lbs of pH buffer.
  - Total duration: 13 days
- 99.6% reduction in COCs.
- Consistent downward tends with reductive geochemical parameters.
- Project was completed on time.

Site:

Former Dry Cleaners within a busy commercial strip mall located within northeastern New Jersey. Historical operations have resulted in residual soil and groundwater impacts of chlorinated volatile organic compounds (CVOCs), primarily Tetrachloroethene (PCE). Site source groundwater concentrations exceed 17,000 micrograms per liter (ug/L), with downgradient plume concentrations exceeding 250 ug/L. Site lithology consists of varying tight sandy silts with high organic demand. An additional source area was suspected within the dry cleaner's boundary; however, due to the current operations, further delineation was unfeasible and injection accessibility was only available within the known source area located at the front entrance of the cleaners and highly active parking lot, making future accessibility limited.

Treatment Program :

AWT implemented one remedial injection event over a thirteen day period. The selected remedial amendment was Terrasystems., Emulsified Vegetable Oil (EVO), Zero Valent Iron (ZVI), and Dehalococcoides (DHC) inoculum. The scope of work entailed utilization of AWT's Geoprobe 7822 track mounted drill rig, injection equipment, winter trailer, chemical procurement, and chemical management and storage. Each temporary injection point location targeted a 15 ft treatment thickness from 5 to 20 feet (ft) below ground surface (bgs), via five foot treatment intervals. Following the introduction of the designed remedial amendments per interval, bioaugmentation utilizing DHC sandwiched within anerobic chase water was performed. The design incorporated three barrier arrays, perpendicular to groundwater flow throughout the plume and interior hot spot injection points. A total of ~7,500 gallons of EVO, ZVI and diluted water were injected during the injection event. Observed injection pressures varied between 2 to 40 pound per square inch (PSI).

Challenges:

Management of dilution water in freezing conditions, managing remedial surfacing pathways, and communication/ management with commercial retail owners/ operators to limit disruption to business operations and parking lot traffic.

Results:

Based on post analytical data, 99.6% reduction in target COC's with a consistent downward destruction trends, supportive reductive geochemical parameters and microbial growth.

Case Study No. 111

EVO and ZVI Injections within Temporary DPT Points at Industrial Facility

Location: Central, New Jersey

Project Highlights

- Former Manufacturing Facility
- COC's:
  - PCE
- Site lithology consist of sandy silts and intermitted gravel.
- Groundwater depth 1-2 ft bgs
- Remedial Reagent: Tersus IronGel, EVO, TerOx and KB-1.
- First injection event, downgradient plume migration.
- Amendments were injected within 3 temporary DPT, 4 horizontal wells, and 1 injection well. -
- Treatment interval varied be tween 2.5-15 ft bgs.
- Utilized AWT's 54DT rig for the installation of 3 temporary DPT locations.
- Total of 3,850 gallons of diluted remedial amendment injected.
- 20 liters of DHC Inncollum introduced in sandwich method.
- Total duration: 3 days
- 99.1% reduction of PCE within source monitoring well over first four quarter.
- Over 90% reduction in CVOC source concentrations following the treatment event with no rebounding observed following sour quarters of gw sampling.
- Consistent downward tends with reductive geochemical parameters.
- Project was completed on time.

Site:

Former manufacturing facility located within an industrial area within western central New Jersey. Historical operations have resulted in residual soil and groundwater impacts of chlorinated volatile organic compounds (CVOCs), primarily Tetrachloroethene (PCE). Site source groundwater concentrations exceed 1,500 micrograms per liter (ug/L). Site lithology consists of sandy silts with intermitted gravels. Groundwater is shallow between 1 to 2 feet (ft) below ground surface. The remedial goal was to reduce residual source mass with the future installation of permeable reactive barriers to treat residual downgradient plume.

Treatment Program :

AWT implemented one remedial injection event over a three (3) day period. The selected remedial amendments were Tersus IronGel, EDS-ER, EDS Activator, Potassium hydroxide, TersOx Nutrients, and SiREMKB-1 Plus and KB-1 primer. The scope of work entailed the utilization of AWT's Geoprobe 54DT track mounted drill rig due to access limitations, injection equipment, chemical management and storage. Four previously installed horizontal wells beneath the building, three temporary wells, and one re-injectable well was utilized introduce amendment into the subsurface. Treatment depths varied from 2.5 to 15 ft bgs. Following the introduction of the designed remedial amendments per interval, bioaugmentation utilizing KB-1 sandwiched within anerobic chase water was performed. A total of ~3,800 gallons of EVO, ZVI and diluted water were injected during the injection event. Observed injection pressures varied between 2 to 20 pound per square inch (PSI).

Challenges:

Communication with current Site tenant to minimize impacts to tenants operations. Adaptions to water source. Management of injections within horizontal wells, which surfaced from previous subcontractor injections. Maintaining project duration and limiting injection pressures to reduce surfacing due to the abnormally shallow groundwater elevation present during the injection event.

Results:

Based on post analytical data, 99.1% reduction of PCE was observed within the source monitoring well after four sampling quarters, with increases in daughter product degradation. Overall, total COC's have been reduced by 90% with a consistent downward destruction trends, supportive reductive geochemical parameters and microbial growth.

As set forth under New York State Environmental Conservation Law, Section 15-1525

Hawk Drilling Inc.

Registration # NYRD10942

is hereby registered with

the Commissioner of the State Department of Environmental Conservation

to drill or repair water wells in the State of New York only when supervised on-site by an individual who is exam certified in the respective water well activity. In accordance with the law and prior to commencement of drilling of any water well or wells, registrant shall file a preliminary notice with the Department. Registrant is required, upon completion of the drilling of any well(s), to file a completion report with the Department giving the log of the well, the size and depth thereof, the capacity of the pump or pumps attached or to be attached thereto, and such other information pertaining to the withdrawal of water and operation of completed well(s) as the Department by its rules and regulations may require. The registration number granted by this certificate must be displayed on the well drilling machinery of this registrant. All water well drilling shall be performed in accordance with standards promulgated by the Commissioner of Health as Appendix 5-B under Public Health Law. Notice is hereby given that all activities authorized by this certificate are subject to the provisions of Article 36-A of the New York State General Business Law.

Registrant: Hawk Drilling Inc.
221 Van Syckels Road
Hampton, NJ 08827-4027

Issue Date: April 01, 2024

Expiration Date: March 31, 2025

Authorized By:

Carol Lamb-LaFay, Director
Division of Water

Rev 01/2023